MSRI
Mathematical Sciences Research Institute

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Annual Progress Report
on the
Mathematical Sciences Research Institute
2008-2009 Activities
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Mathematical Sciences Research Institute
Annual Report for 2008-2009

1. Overview of Activities

This annual report covers MSRI projects and activities that occurred during the fourth year, 2008–09, of the NSF core grant DMS #0441170.

1.1 New Developments

Singular spaces, ergodic theory, additive combinatorics, and algebraic geometry were the main research themes for the year 2009–10. It was a year rich in mathematical discoveries, as the programs' reports demonstrate, and impressive in the high number of participants. All programs had stellar researchers in residence for long periods. One of the many memorable talks was that of Terence Tao, who lectured on Szemeredi's Theorem as "the Rosetta stone between ergodic theory, combinatorics, and Fourier analysis". At the other hand of the spectrum, a graduate student from Stanford University, Dean Baskin, made progress toward a detailed microlocal description of the singular and asymptotic structure of the fundamental solution of the wave kernel on a class of Lorentzian spaces that are perturbations of the classic de Sitter spacetime. A hallmark of the algebraic geometry program was its many collaborations across levels and subdisciplines. As the organizers wrote, "The efflorescence of research was inspiring to behold, involving literally hundreds of projects." Research advancement and discoveries are described in detail in section 1.3 and in the organizers' reports, which can be found in the Appendix. Note that all program and workshop organizers are asked to write a detailed report of their projects and activites. We are please to report that our success rate in obtaining those reports was 100%.

2008–09 was a year when MSRI deepened its commitment to Summer Graduate Workshops (SGWs). During the summer of 2009, MSRI fully funded 4 SGWs and partially funded another 2. The Toric Varieties workshop organized by David Cox and Hal Schenck was such a vibrant success that it will be repeated in Italy next summer (2011). The Mathematics of Climate Change workshop was an equally successful 3-week summer school in which graduate student were given some of the tools and training they need to react creatively to this world crisis. Detailed reports from the organizers for each of these activities can be found in the appendix.

The year 2008–09 was also the year during which MSRI wrote its NSF 5-year grant renewal. While such an endeavor can be a daunting task, it was also a unique opportunity for MSRI to reflect on its mission and goals. In particular, judging by the consistent stream of overtly positive comments MSRI receives from mathematicians from around the globe, it has become clear that the research community benefits immensely from MSRI's programs and activities. While this might be evident to researchers who spend some time in residence at MSRI, it also became clear that additional data evaluating the impact of MSRI's programs would be quite useful. For this purpose, MSRI did a pilot survey of its 2004–09 postdoctoral fellows. Seventy percent (70%) of the 145 polled postdoctoral fellows responded to the survey. The detailed report can be found in the appendix. We now give a brief summary of the findings of this study.

Evaluating MSRI's Postdoctoral Fellowship Program 2004–09: The survey addressed the current occupation of the fellows, the impact of the fellowship on fellows' careers, and research outcomes based on the work fellows conducted at MSRI.

In summary, the study confirmed that the level of satisfaction among the postdoctoral fellows was very high and that their record of research productivity, measured using number of publications, number of presentations given, and the amount of funding obtained, was very impressive. For example, on average, the respondents estimated that they published 2 papers that resulted from work done at MSRI, and give an average of 5 talks based on that work. Fifty-one (46%) of the respondents reported having obtained funding after their MSRI postdoctoral experience, and the average number of publications listed on MathSciNet was 5 papers per respondent. (One should remember that some of those respondents had just finished their doctoral degree.) 55% of the respondents found post-Fellowship employment at group I institutions, including 3 of the 8 fellows (38%) whose degree came from a US non-group I institution. To assess the degree to which the postdoctoral experience aided in the development of new research, fellows were asked to what extent their experience at MSRI helped them develop new research directions. 80% of respondents answered either "significantly" or "a great deal." The most commonly cited strength of the program was the presence of leading experts for extended periods. As one respondent put it, "My experience there [MSRI] was transformative. Being in the room as 5 of the most brilliant senior mathematicians in my field argued about fundamental ideas was worth at least as much as my graduate work. In fact, it provided big picture context of the challenges of the field that would have been impossible to provide in graduate school."

Aside from the postdoctoral fellows' survey, we also analyzed and summarized 5 years of data collected on members and workshop participants that came for visits as short as one day or as long as an academic year. We now briefly describe those findings, which can be found in greater detail in the appendix at the end of this report.

5 years of data on MSRI's members and workshop participants: For the period of 2004–09, MSRI was visited by 8,607 workshops participants, 746 summer graduate workshop attendees, 1,120 research members, and 145 postdoctoral fellows, for a total of 10,473 visits. Some workshop participants and members made multiple visits, so that, of the 8,607 workshop visits, 5,743 were from distinct participants. During those 5 years, MSRI hosted 85 scientific workshops, 21 educational and outreach workshops, and 20 summer graduate workshops. MSRI was pleased to find that our efforts at increasing diversity among our research members and workshop participants bore fruit. 29% of the postdoctoral fellows were women, which, we believe, is quite a success given that the number of female graduate students at group I institutions is around 20% (AMS annual reports). 11% of the postdoctoral fellows were members of underrepresented minorities (we have not found documentation for the percentage of members of URM at group I institutions). MSRI was equally successful with regard to diversity among graduate students attending its SGWs, as 30% of the participants were female. The percentage of female research members participating in MSRI's programs was 18%, while 6% of the members were from minorities. We believe that both of these percentages can be improved with a more pro-active recruiting strategy (see the discussion of networking trees below) that we are in the process of implementing.

The average length of time that research members spent at MSRI is 2.4 months, more than half the length of a one-semester program (4 months). Some of the active research members received their Ph.D. more than 50 years ago, (Tony Springer (1951), Steve Male (1957), and Adriano Garsia (1957)), others were still graduate students. Among members with a Ph.D., the average

number of years since the time of degree was 12.5 years. There were a total of 166 program associates (graduate students) and members having just completed a Ph.D. degree, which represents 15% of the research members in residence for one month or more.

Comparable data was obtained for the 8,607 workshop participants: Among those who indicated their gender and ethnicity, 30% were female and 10% were minorities. Of the 5,285 participants coming from US institutions, 22% were from the Northeast, 17% from the South, 41% from the West, and 20% from the Midwest.

Lastly, the MSRI website averages over 30 Gigabytes per day of downloads and receives over 1,000,000 visits per month.

MSRI-UP program: The MSRI-UP is an undergraduate research program targeted towards underrepresented minorities with the goal of increasing the number of students from underrepresented groups in mathematics graduate programs. MSRI-UP includes summer research opportunities, mentoring, workshops on the graduate school application process, and follow-up support. MSRI has hosted three such summer programs. In 2009, the lead director was Dr. Herbert Medina, and the primary instructor was Professor John B. Little from College of the Holy Cross.
(See http://www.msri.org/calendar/workshops/WorkshopInfo/489/show_workshop).

Given the aim of the program, a natural way to evaluate it is to track the number of MSRI-UP students that get into graduate school. So far, it is only reasonable to check this number for 2007, as students from the 2008 and 2009 programs are still undergraduate students. Nine of the 12 students from the 2007 program are currently enrolled in graduate school in mathematics-related fields. See Chapter 5 for a full report, with more details and pictures.

Networking Experiment: Recruitment of underrepresented minorities is a perennial challenge for all the Math Institutes, and MSRI, in particular, is constantly searching for new approaches that may bring additional success. During 2007–08, MSRI started a networking tree in an effort to compile a list of names and contact information for under-represented minorities, women, or well-connected people who were researchers in fields centered on our upcoming programs. Via this tree, we have collected contact info relevant to three programs in 2008–09 and for three programs plus an extra "other" category for 2009–10.

For 2008–09, we collected 126 names of people who might be interested in the Algebraic Geometry program (122 of which were women), 42 names of people who might be interested in the Ergodic Theory and Additive Combinatorics program (25 of which were women), 33 names of people who might be interested in the Analysis on Singular Spaces program (15 of which were women).

Basically, the network tree is an iterative recruitment tool. We ask the organizers of each program to give us the names of either women or underrepresented minorities who may be interested in the program or people who might know such. Then we send the same letter to the people they supply. After about five generations, the list seems to stabilize, and we pass it back to the organizers. We now realize that the tree should be fed as soon as a program is accepted, which means 2 to 3 years ahead of time.

Public Understanding of Mathematics: MSRI is an acknowledged leader of activities for the public understanding of mathematics. While these activites are not funded by NSF funds, we briefly describe some of them here in order to give a glimpse of how MSRI reaches out to the public. These popular events include interviews with playwrights (Tom Stoppard, Arcadia; Michael Frayn, Copenhagen; David Auburn, Proof), musicians (St. Lawrence String Quartet, Merce Cunningham Dance Company, Christopher Taylor) and public personalities (Funny Numbers with Steve Martin and Robin Williams, M*A*T*H with Alan Alda). These events are distributed nationally in a unique series of videos. Among the many hosted this year, three (3) stand out.

The John Cage Legacy: Chance in Music and Mathematics. This fascinating 'happening' presented composers/musicians from the Merce Cunningham Dance Company in a concert, followed by a discussion between the musicians and the mathematician, statistician, magician, randomness expert Persi Diaconis of Stanford University. Bob Osserman, Special Projects Director at MSRI, moderated the discussion with a finesse that kept the audience captivated long after the music had stopped.

Meaning in Beethoven's `Grosse Fuge' was a memorable evening featuring the renowned St. Lawrence String Quartet and NPR's Rob Kapilow. This 90 minute program consisted of a discussion and performance of Beethoven's Grosse Fuge, Op. 133, a masterpiece from the composer's late period, described by Stravinsky as 'an absolutely contemporary piece of music that will be contemporary forever'. The St. Lawrence String Quartet, famed for the beauty and immediacy of its performances of both classical and modern quartet repertoire, is in residence at Stanford University. Rob Kapilow is well known for his popular and exciting "What Makes It Great?" series of commentaries on NPR. The Quartet and Kapilow joined forces in exploring the structure of this extraordinary piece of classical music, though it was dismissed in Beethoven's own time as 'an indecipherable, uncorrected horror'. The Simons auditorium was filled with mathematicians and music lovers who left with a sense of awe at Beethoven's genius for music.

The Math behind the Cath: The Inside Story of Stents, Pacemakers, and Other Medical Miracles. This extremely popular event was the first presentation in MSRI's new series on Mathematics + Medicine. Speakers Joseph Berglund and Robert J. Lang were joined by mathematicians David Eisenbud of UC Berkeley, and Bob Osserman. Joseph Berglund is the Principal R&D Engineer at Medtronic CardioVascular in Santa Rosa, where his current projects vary from development of next generation drug eluting stents, to designing bioabsorbable devices to identify and evaluate new therapy options for various unmet clinical needs. In his talk he gave an overview of cardiovascular medical devices and the principles behind them, as well as indications of how mathematics plays a role in their making. Robert J. Lang is recognized as one of the foremost origami artists in the world as well as a pioneer in computational origami and the development of formal design algorithms for folding. He has, during the course of work at NASA/Jet Propulsion Laboratory, Spectra Diode Laboratories, and JDS Uniphase, authored or co-authored over 80 papers and 45 patents in lasers and optoelectronics. He is a full-time artist and consultant on origami and its applications to engineering problems, but moonlights as the Editor-in-Chief of the IEEE Journal of Quantum Electronics. He is equally famous for the beauty of his origami figures, his applications of mathematics to paper folding, and of paper folding to practical

devices such as space probes and medical equipment. The event took place at the Berkeley Rep's Roda Theatre that can accommodate more than the 180 seats of MSRI's Simons auditorium. The theater was filled nearly to capacity, and the public had to be gently reminded that the speakers could not be expected to answer questions for the entire night!

1.2 Summary of Demographic Data for 2008-09

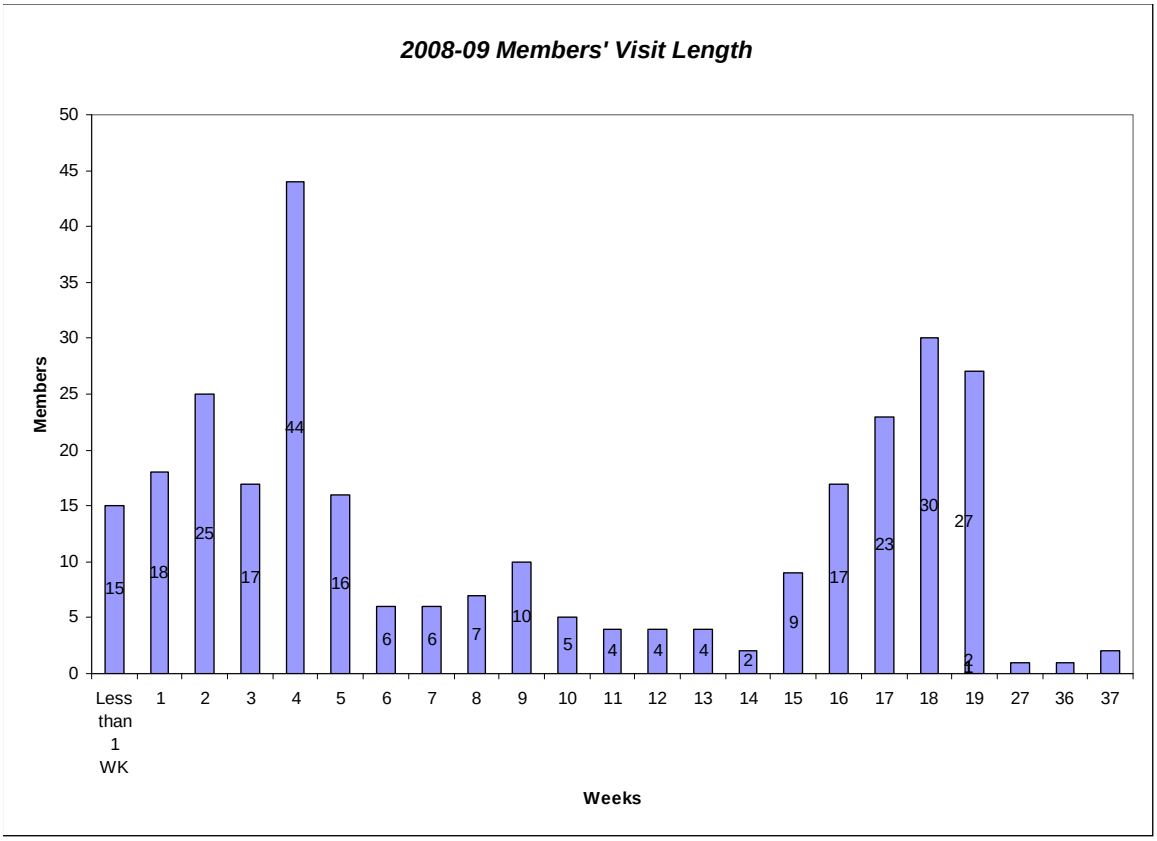
During the academic year 2008-09, MSRI hosted 34 one-semester NSF Postdoctoral Fellows, 293 program members (members that came for period of at least one month), and 1913 workshop participants.

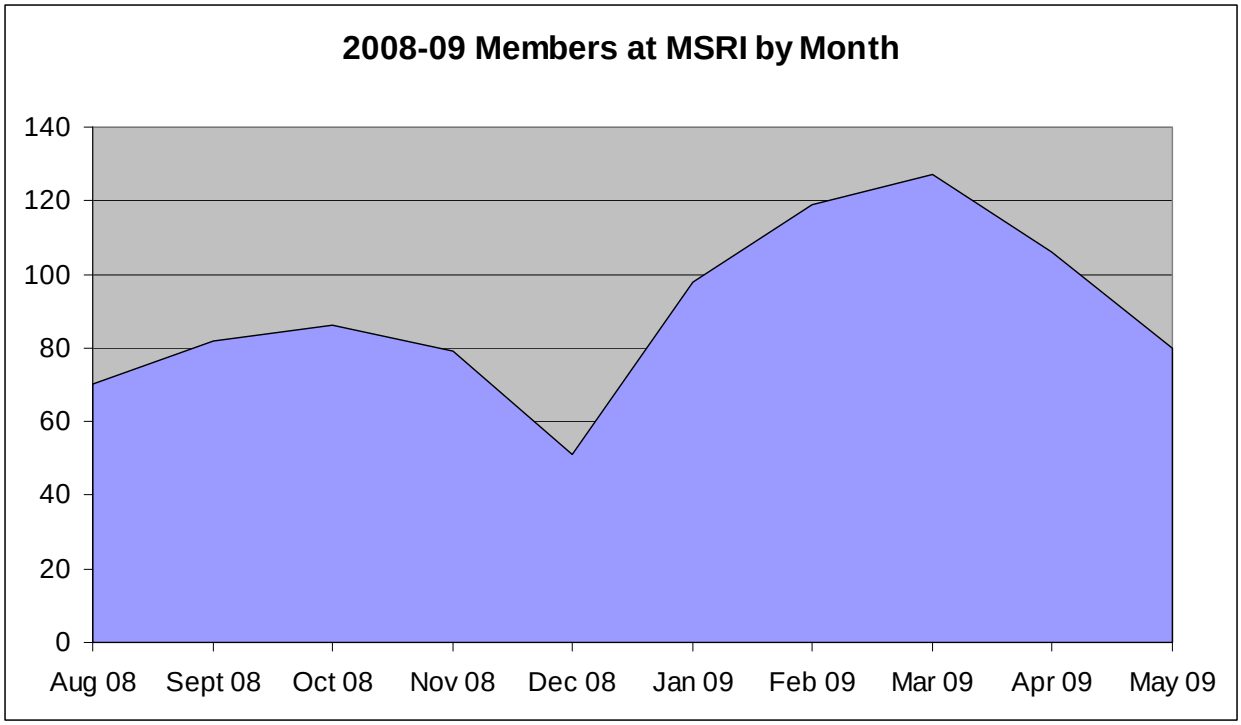
The Postdoctoral program was particularly successful and is described in detail in Chapter 2 and 3. Of the Fellows, 15% were female, 44% were US Citizens or Permanent Residents, and 68% listed a US university as their home institution. Of those institutions, 39% are located in the Northeast, 30% in the West, 22% in the Midwest, and the remaining 9% are in the South. Detailed demographic tables can be found in Chapter 3. Of the 34 postdocs 19 (56%) were from group I institutions, 11 (32%) were from foreign universities, and the rest were from US institutions belonging to group II, and M.

MSRI had a total of 293 (long-term) members. An 'average' member spent 66 days at MSRI, (half the length of a program) and the average number of members present everyday was roughly 75 (83% of our capacity), with peak attendance in October and March. Of the members, 63 (22%) were female, and 12 (8.6%) belonged to the Hispanic/Latino community. Of the members, 139 (47%) reported being US Citizen or Permanent Resident and 155 (53%) listed a US university as their home institution. Of those institutions, 23% are located in the Midwest, 32% in the West, 27% in the Northeast, and 17% in the South. Of the members, 13% were graduate students, 32% had received their Ph.D degree after 2000, 27% received theirs between 1990 and 2000, and the remaining 28% had received their Ph.D. prior to 1990. Detailed demographic data can be found in Chapter 2.

In its 2008-09 workshops, MSRI hosted 1913 separate visits (some visitors attended multiple events). We have gender data from 1885 (98.5%) participants. Of these, 617 (33%) were female. There were 134 (7%) Self-Reported under-represented minorities. Of the participants, 49% were US Citizen or Permanent Residents, and 72% of all workshop participants have their home institution in the US. The 'year of Ph.D.' distribution is somewhat different from the one for long-term members. In particular, 27% of the workshop participants were graduate students and 28% received their Ph.D. after 2000. The US regional distribution was also somewhat different: 20 % were from the Midwest, 42% from the West, 21% from the Northeast, and the remaining 16% were from the South. Data on workshop participant demographics can be found in Chapters 2 and 4.

MSRI Length of Stay Summary	
Total Member Days	19212
Total Distinct Members	293
Average # of Days per Program	128
Average # of Days per Member	65.57
Average # of Months per Member	2.2
Average # of Members per Day	75.34





1.3 Major Programs and their Associated Workshops

There were 3 major programs for the MSRI fiscal year 2008-09, and 13 workshops associated with them.

Note: In the lists of organizers of each activity, an asterisk (*) denotes lead organizer(s).

Program 1: Analysis on Singular Spaces

August 18, 2008 to December 19, 2008
Organized By: *Gilles Carron, Eugenie Hunsicker, Richard Melrose, Michael Taylor, and Jared Wunsch**

A central problem in modern mathematics is that of extending analytic constructions which are well understood in the setting of smooth compact manifolds to a broader class of spaces which are allowed to be singular. Such objects arise naturally in many geometric contexts: Singular varieties in algebraic geometry not only occur naturally as fundamental objects themselves, but even the moduli spaces of smooth varieties are naturally singular. Seemingly smooth, noncompact objects often become singular spaces upon compactification: Euclidean space can be radially compactified to a manifold with boundary, the simplest possible "singular space," while the configuration space for k-particle dynamics on R^n naturally has a compactification as an n-dimensional manifold with corners. Smooth symmetric spaces often have natural compactifications, such as the Borel-Serre compactification, that are manifolds with corners.

And objects with irregular boundaries occur frequently in mathematical physics: classical problems like the scattering of waves by a slit already involve singular geometries. Singular structures are moreover thought to play an important role in the scattering of seismic waves through the interior of the earth; the associated inverse problem is of manifest practical importance.

The study of elliptic equations on singular spaces has had fruitful interaction with topology; for instance the work of Goresky-MacPherson on intersection cohomology has pointed the way toward extending de Rham and Hodge theory to broader geometric settings. Turning to hyperbolic equations, wave propagation on incomplete spaces is complicated by diffractive effects and the subtleties of glancing rays, while on complete spaces with nice compactifications, such as Schwarzschild space, energy decay near various boundary faces is the subject of intensive current study. The subject of spectral and scattering theory on singular spaces has vast reach, spanning both number theory (modular forms) and physics (many body scattering, relativity).

All of these areas of analysis on singular space have in common the use, whether explicit or implicit, of asymptotic expansions of solutions to partial differential equations near singular strata. Calculi of pseudodifferential operators are essential tools in many problems, and a bewildering menagerie of these calculi are now known. As a result there is substantial duplication of effort, heightened by language barriers, between experts in these different subjects, and the hope that a program uniting researchers in these diverse fields will have payoffs in the transfer of mathematical "technology" from one field to another, as well as unifying disparate pseudodifferential approaches. A systematic and general theory of PDEs on stratified spaces, using iterative techniques to peel away successive strata, was a long-term goal of the program.

Workshops associated with the Analysis on Singular Spaces program:

Broader Connections: Analysis on Singular Spaces
August 28, 2008 to August 29, 2008
Organized By: *Gilles Carron, Eugenie Hunsicker*, Richard Melrose, Michael Taylor, Andras Vasy, and Jared Wunsch*

This two-day program consisted of a "crash course" in topics in PDE relevant to the Analysis on Singular Spaces main program, and in particular attempted to get graduate students, postdocs, and even advanced undergraduates ready for the Introductory Workshop the following week. The focus was topics in analysis on smooth manifolds whose generalizations to singular spaces were the focus of the main program.

Introductory Workshop on Analysis on Singular Spaces
September 2, 2008 to September 5, 2008
Organized By: *Gilles Carron, Eugenie Hunsicker, Richard Melrose*, Michael Taylor, Andras Vasy and Jared Wunsch*

This four-day program was an introduction to the main themes of the Analysis on Singular Spaces program, geared toward graduate students and postdocs. It consisted of several

minicourses, covering topics in spectral and scattering theory, index theory, and L^2-cohomology, as well as developing the technical tools needed as background.

Topology of Stratified Spaces
September 8, 2008 to September 12, 2008
Organized By: *Greg Friedman, Eugénie Hunsicker, Anatoly Libgober, and Laurentiu Maxim*

Stratified spaces occur naturally in high- and low-dimensional topology, various fields of pure mathematics, including algebraic geometry and number theory, and also in more applied fields, such as the study of configuration spaces for robot motion planning. In recent years, there has been extensive interest and success in expanding to stratified spaces the triumphs of algebraic topology in manifold theory, including the vast progress in the mid-20th century on signatures, characteristic classes, surgery theories, and the special homological properties of nonsingular analytic and algebraic varieties, such as the Kähler package. Yet such extensions from manifold theory to stratified space theory are rarely straightforward; they tend to involve the discovery and study of subtle interactions between local and global behavior. Furthermore, research in these areas turns out to have a rich interaction with the question, being addressed by the Analysis on Singular Spaces program running simultaneously at MSRI, of how to do analysis on spaces that are not locally Euclidean.

The workshop was organized into days dedicated to each of the four main themes: topology of complex varieties, signature theory on singular spaces, L^2 and intersection cohomology, and mixed Hodge theory and singularities. Each day, except Wednesday, included one introductory talk aimed at audience members from both topology and analysis of singular spaces, and three research talks. There were also room for some shorter talks by PhD students or recent graduates and for a few talks on Wednesday morning on related subjects that do not fit one of these categories.

Elliptic and Hyperbolic Equations on Singular Spaces
October 27, 2008 to October 31, 2008
Organized By: *Gilles Carron, Eugenie Hunsicker, Richard Melrose, Michael Taylor, Andras Vasy and Jared Wunsch*

This workshop focused on the study of PDEs on singular spaces and their connections with the spaces' underlying geometry. Topics were cohomology theory, index theory, and spectral geometry on the elliptic side; and wave propagation and associated inverse problems on the hyperbolic. A unifying theme was asymptotic expansions of solutions in various regimes, as for instance high frequency eigenfunction expansions, which draws techniques from hyperbolic equations into the elliptic theory.

Program Highlights

Notwithstanding the diverse interests of the participants (and indeed diverse notions of what should constitute a “singular space”), the program was well-focused and impressively coherent. Of the 6 organizers, 4 (R. Melrose, M. Taylor, A.Vasy and J. Wunsch) were present for the duration of the program, with E. Hunsicker also spending 10 weeks in residence. Richard Melrose was the UCB Chancellor’s professor for the year and gave a course in the mathematics

department (UCB) on *Smooth Operator Algebras and K-theory.* The course was very well received and attended, and seems to have sparked considerable interaction among participants at all levels of seniority.

A typical week during the semester included two regular seminars and an additional postdoc seminar which had excellent attendance from the general program. Participants enjoyed the interaction fostered by the seminar arrangements and also reported finding the simple experience of having lunch together on a regular basis to be a valuable aspect of life at MSRI. On most days, a large crowd assembled for lunch in the second-floor common room and this was a valuable venue for informal networking as well as discussion of mathematics. Participants of all levels of seniority mingled in this setting, and it may in the end have been one of the most effective mentoring tool for postdocs.

The organizers listed 12 fundamental developments that occurred during the program. Of those, a new result on inverse-scattering for obstacles in waveguides, proved by Tanya Christiansen and Michael Taylor, stands out. This work allows one to determine the shape of the obstacle, subject to some technical hypotheses, by using waves of a small range of wavelengths. Previous results of Christiansen had been confined to the two-dimensional case. Another suprising result was the extension, by Hassell and Hillairet, of Hassell's breakthoughs on the failure of quantum unique ergodicity for the Bunimovich stadium. These results show that while the motion of a billiard ball in the "stadium" (a rectangular region with semicircular ends) is rather chaotic, nonetheless there can be quantum states at high energy that are narrowly concentrated along those billiard trajectories that bounce back and forth within the rectangular part. The existence of these quantum states had been a major open problem in the burgeoning field of quantum chaos.

Five postdoctoral fellows were in residence for the duration of the programs. Each postdoctoral fellow was closely mentored and all report having greatly benefited from their experience at MSRI (see chapter 3 for a detailed description of the postdoctoral experience). Additionally, a large number of graduate students were in residence for the entire semester. Overall, the opportunity for advanced students to see the state of the field laid out for them, both in the introductory workshop and in the subsequent intense atmosphere of twice-weekly seminars, was one of the most strikingly transformative aspects of the semester.

Program 2: Ergodic Theory and Additive Combinatorics

August 18, 2008 to December 19, 2008
Organized By: *Ben Green, Bryna Kra*, Emmanuel Lesigne, Anthony Quas, Mate Wierdl*

Much recent work in ergodic theory has been motivated by interactions with combinatorics and with number theory. A particular example is Szemerédi's Theorem, which states that a set of integers with positive upper density contains arbitrarily long arithmetic progressions. The original argument was an intricate use of combinatorics; a second proof was given by Furstenberg using ergodic theory and more recently, Gowers gave a third proof based on Fourier analysis. In the last few years, methods of combinatorics, number theory, harmonic analysis, and ergodic theory have been combined to attack old problems on patterns, such as arithmetic progressions, in the prime numbers.

Furstenberg's proof uncovered the connection between combinatorial results and ergodic theory, and his ergodic theoretic proofs of combinatorial statements had unforeseen consequences within ergodic theory itself. Furstenberg and others introduced certain classes of dynamical systems and ergodic theoretic structures, and their study has become of independent interest. Moreover, the better understanding of the underlying ergodic theory has provided new combinatorial results, some of which have yet to be proven by any other method.

The recent result of Green and Tao on arbitrarily long arithmetic progressions in the set of primes immediately attracted the attention of ergodic theorists. The Green-Tao proof, similar to Furstenberg's proofs, is based on a philosophy used in ergodic theory since Riesz's proof of the Mean Ergodic Theorem: prove a structure theorem, showing that a given object can be decomposed into "structured" and "negligible" parts. However, the interest runs deeper. Finer analysis of structures in the primes has relied on "non-commutative" methods; objects similar to those in the structure theorem for multiple ergodic averages have now arisen in a combinatorial setting. These non-commutative objects have also arisen in harmonic analysis, in the context of Bourgain's result on subsequence ergodic theorems.

One aim of the proposed program was to understand the meaning of these recent results for ergodic theory. As the history of Szemerédi's Theorem shows, such an understanding benefits both ergodic theory and other fields, such as probability, combinatorics, number theory and harmonic analysis.

A difficulty facing researchers in this area is the need to be fluent in several fields of mathematics: number theory, ergodic theory, combinatorics, and harmonic analysis. A few of the leading researchers are already able to use tools from the various fields and pass from one field to another with ease. A systematic survey of the fields benefits a wider audience. This program brought together researchers in ergodic theory, harmonic analysis, number theory, and combinatorics who were interested in similar problems from very different perspectives. While the main theme of the program was ergodic theory, we highlighted the unity between ergodic theory and these other related areas.

Workshops Associated with the Ergodic Theory and Additive Combinatorics program:

Broader Connections: Ergodic Theory and Additive Combinatorics
August 21, 2008 to August 22, 2008
Organized By: *Ben Green, Bryna Kra*, Emmanuel Lesigne, Anthony Quas, Mate Wierdl*

This two day workshop featured expository talks on ergodic theory and additive combinatorics, aimed at advanced graduate students and new postdocs in these fields. An effort was made to highlight the recent interactions between the fields.

Introduction to Ergodic Theory and Additive Combinatorics
August 25, 2008 to August 29, 2008
Organized By: *Ben Green, Bryna Kra, Emmanuel Lesigne, Anthony Quas, and Mate Wierdl**

The theme of this workshop was the interplay between recurrence in ergodic theory and additive combinatorics. In addition to the now classical results on the existence of arithmetic progressions in large sets, we focused on the parallels among the ergodic theoretical, harmonic analytical and combinatorial methods. During the workshop, we planned several minicourses, including the following topics: recurrence in ergodic theory, correspondence principle, nilsystems in ergodic theory, and existence of arithmetic progressions in primes.

Discrete Rigidity Phenomena in Additive Combinatorics
November 3, 2008 to November 7, 2008
Organized By: *Ben Green, Bryna Kra, Emmanuel Lesigne, Anthony Quas*, Mate Wierdl*

We explored environments in which rigid structural information can be deduced from rather soft combinatorial hypotheses. There was a particular focus on finite and quantitative questions, although an important aspect of the workshop was to explore connections with corresponding infinite and qualitative questions in ergodic theory, where as a general rule more is known.

Topics included (but were not limited to) the following.

1. Freiman's theorem concerning the structure of sets with small doubling;
2. The Gowers Inverse Conjecture, concerning the structure of sets containing many parallelepipeds;
3. Finite versions of Ratner's theorem, concerning the structure of finite unipotent orbits in dynamical systems.

Program Highlights

As the organizers mentioned in their report (see appendix) overall the general atmosphere at MSRI was extremely fruitful. There were numerous informal and lively discussions, varied and interesting questions circulated (both in formal problem sessions and informal exchanges), and new collaborations begun. Each week there were 3 seminars, 2 “regular” ones and a postdoctoral seminar. Six (6) research professors mentored eleven (11) postdoctoral fellows, with several of them publishing or submitting papers to various journals. The several students in residence regularly attended a Berkeley student seminar on harmonic analysis and ergodic theory (directed by University of Berkeley Professor Michael Christ). In addition to the regular seminars, five (5) informal meetings were held where members presented their favorite unsolved problems. Problems ranged from classical problems that had been open for many years to new problems that had arisen while at MSRI. These late afternoon discussions were often lively and spurred numerous discussions over lunch and tea.

A notable feature of the program was the large number of questions in circulation. Amongst those posing questions, Michael Boshernitzan stands out for having a steady supply of innocent-sounding questions exploring the limits of the theory. While one or two of these were answered during the program (e.g. the paper of Boshernitzan and Glasner), the majority were taken home by participants where they no doubt continue to plague them. One question formulated in a particularly elementary way sounded so innocent that, on the day after Thanksgiving, there was a veritable maelstrom of activity with several members unsuccessfully proposing methods of

attack. The original question, alas, escaped to torment members another day (although it seems now that there is a solution to this problem).

The central idea in the recent developments (in the last 10 years) of the subject is that of Gowers norms, or equivalently on the ergodic side, the Host-Kra seminorms. At a heuristic level, this leads to a decomposition of sets and functions into structured and "random" parts. An emerging idea in recent years has been the so-called inverse conjecture for the Gowers norms, where one is seeking to express in a quantitative way in terms of correlations what it means to be have large Gowers norm. During the program a major project of Bergelson, Tao and Ziegler was completed establishing the inverse Gowers conjecture in the case of F^d_p. Their result may be informally stated as follows: If f has biased kth derivative then f correlates with a polynomial phase of degree k − 1. This leaves open the major question of the inverse conjecture of Green and Tao for Z/NZ.

Program 3: Algebraic Geometry

January 12, 2009 to May 22, 2009
Organized By: *William Fulton, Joe Harris, Brendan Hassett, János Kollár, Sándor Kovács, Robert Lazarsfeld, and Ravi Vakil**

Algebraic geometry has long been a central subject, with deep and substantial connections to almost every aspect of modern mathematics. There are numerous different approaches to the field, utilizing widely varying technical tools: Commutative algebra, complex analysis, sheaf theory, cohomological methods, and combinatorial techniques all playing important roles.

This multiplicity of techniques and interconnections creates a conundrum for the student of algebraic geometry: How can I learn all the specific tools of the trade, while at the same time developing an overall sense for what guides the subject? Even established researchers can feel powerful centrifugal forces pulling at the field, as it spawns new specialties with astonishing regularity.

This program on algebraic geometry, emphasized cross-fertilization between different areas, including classical and complex algebraic geometry, linear series techniques, moduli spaces, enumerative geometry, varieties with group actions, birational geometry, rational curves on algebraic varieties, and classification theory. The full resources of MSRI were devoted to a comprehensive discussion of these topics. The organizers hoped they conveyed the essential unity of the subject, especially to young researchers and established mathematicians in other fields who use algebraic geometry in their research.

Workshops Associated with the Algebraic Geometry program:

Connections for Women: Algebraic Geometry and Related Fields
January 22, 2009 to January 24, 2009
Organized By: *Angela Gibney, Brendan Hassett, Sándor Kovács, Diane Maclagan*, Jessica Sidman, and Ravi Vakil*

Twenty-first century algebraic geometry is a broad subject, with mathematicians on different frontiers sharing little background. This workshop consisted of colloquium-style talks introducing some of its subfields to people, particularly postdocs, working in other areas.

Classical Algebraic Geometry Today
January 26, 2009 to January 30, 2009
Organized By: *Lucia Caporaso, Brendan Hassett*, James McKernan, Mircea Mustata, Mihnea Popa*

Algebraic Geometry is one of the most diverse areas of mathematics. Due to the breadth of the subject it is often a challenge for graduate students and people from other fields to get a global view of current developments in the field. Algebraic Geometry has grown dramatically over the past century, with new subfields constantly branching off. The core of the field is now universally called Classical Algebraic Geometry, an exciting area itself full of fundamental unsolved problems and at the same time providing a theoretical foundation for the areas that have developed in recent years.

The main theme of the workshop was to explore modern approaches to problems originating in Classical Algebraic Geometry, and at the same time offered an introduction to various subfields to the younger participants in the semester-long program. Topics included:

1. Birational geometry: minimal model program, singularities of pairs, linear series, classification of surfaces of general type.
2. Moduli spaces of curves: intersection theory, cones of ample and effective divisors, limit linear series.
3. Moduli spaces of vector bundles: intersection theory on Quot schemes, Strange Duality, generalized theta divisors.
4. Abelian varieties: Schottky problem, analytic methods, Fourier-Mukai transform.
5. Rational curves on algebraic varieties: rational connectedness, behavior in families, rationality.

Macaulay II day
February 3, 2009 to February 3, 2009
Organized By: *Ravi Vakil, Gregory G. Smith, Mike Stillma**

The goal of the workshop was to help the participants use the Macaulay 2 software in their research. The first presentation focused on installation, set-up, and basic functions. Participants were encouraged to bring their laptops to this session to get assistance with the software installation. The other independent talks focused on different problems in algebraic geometry; likely topics included computing sheaf cohomology, intersection theory, and enumerative geometry. Each of these talks also demonstrated the use of Macaulay 2.

Modern Moduli Theory
February 23, 2009 to February 27, 2009
Organized By: *I. Coskun, S. Katz, A. Marian, R. Pandharipande, R. Thomas, H.H. Tseng, R. Vaki*l*

The last few years have witnessed major developments in algebraic geometry, especially in the minimal model program and derived categories. The purpose of this workshop was to explore the implications of these developments to moduli theory. The workshop convened experts specializing on the minimal model program, derived categories and moduli spaces in an informal environment to facilitate the cross-fertilization of ideas across these different fields of algebraic geometry. The four main themes were:

1. The interactions and connections between Gromov-Witten theory, Donaldson-Thomas theory and stable-pair theory.

2. Moduli of objects in derived categories and their relations to counting invariants.

3. The moduli of higher dimensional varieties.

4. New developments in Brill-Noether Theory and the minimal model program for the moduli space of curves.

Sage Days: Algebraic Geometry
March 9, 2009 to March 12, 2009
Organized By: *David Eisenbud, Daniel Erman, Dan Grayson, Mike Hansen, William Stein*, Mike Stillman*

This workshop featured numerous hands on introductory tutorials about Sage, and the interface between Sage and Macaulay2. There were discussions and talks about doing algebraic geometry with both Sage and Macaulay2, and the unique advantages of both systems. There were also talks about working with lattice polytopes and doing Lie theory in Sage. In addition to the talks and tutorials, we had numerous coding sprints.

Combinatorial, Enumerative and Toric Geometry
March 23, 2009 to March 27, 2009
Organized By: *Michel Brion, Anders Buch, Linda Chen, William Fulton, Sándor Kovács, Frank Sottile*, Harry Tamvakis, and Burt Totaro*

Algebraic geometry has long been a central subject within mathematics, enjoying deep and substantial connections to other parts of mathematics. In particular, the interplay between algebraic geometry and algebraic combinatorics has led to many important developments in these and other mathematical fields. The last fifteen years have seen an explosion of interest in algebraic varieties with rich combinatorial structures: Schubert geometry of flag varieties and their subvarieties, degeneracy loci, toric varieties, moduli spaces and Gromov-Witten theory, and varieties with group actions. Powerful tools from algebraic topology, combinatorics, commutative and computational algebra, complex and symplectic geometry, and representation theory have been developed to study such objects. In this workshop, we presented the state of the art in combinatorial, enumerative, and toric algebraic geometry. We highlighted this part of modern algebraic geometry within the context of the broader parent program at MSRI, and conveyed its scope to young researchers.

Program Highlights

By all accounts the semester was a success. Younger researchers branched out from their thesis work and most formed new collaborations, often with people outside of their area of particular expertise. This is clear in the section on postdoctoral participants. Established researchers often came to get some quiet work time, but discovered the opportunity to become acquainted with new developments in different parts of the subject. The long-term impact will of course only become clear in the long term, but the hope is that in two decades people will still talk about this program as a key formative experience in their careers. This program was a jumbo program, occuping the entire facility, and thus was not paired with another program. The organizers had planned their program remarkably well. It was inspiring to see such top researchers being so generous with their time and efforts - before, throughout, and after the program.

A hallmark of the program was its many collaborations across levels and subdisciplines. The efflorescence of research was inspiring to behold, involving literally hundreds of projects. In the program's report (see appendix) one can find a list of roughly 100 preprints produced by official members. Singling one or two out as "breakthroughs" would simply not be representative of the very high quality of these manuscripts. Rather, all are available on the arXiv. A surprising number of papers transcend narrow subdisciplines within algebraic geometry. Of course most of the benefits of the program will be realized with time as new working relationships bear fruit.

The semester started with Kickoff Presentations by the postdocs present to introduce them to the community. This consisted of 22 five-minute presentations by postdocs and a handful of advanced graduate students. Each speaker was allowed only two slides sketching the key points of his or her research program; these were distributed through the program website. The main objective was to introduce the postdocs and their work to the other members in residence. This is now a feature for every program held at MSRI. The three official workshops all had more registrants than could be accommodated in the Simons Auditorium. Overflow audiences watched lectures on screens in the Baker Boardroom. These are some of the most popular workshops ever held at MSRI. Aside from the weekly seminars, an open problem session, moderated by David Eisenbud, was held. Lists of problems posed were distributed through the program website. Eighteen postdocs were mentored by eighteen mentors, attesting to the exceptional number of research professors that were in residence for the duration of the program.

About ten graduate students were officially program associates, accompanying their advisors who were members. In addition, another 20 students participated unofficially, including students from UC Berkeley. As well as participating in regular events, they ran their own weekly seminar and regularly participated en masse in the postdoctoral seminar. The social events (including with the postdocs) were a great way for them to meet others in the community, from fellow graduate students to distinguished senior colleagues. The local graduate students from UC Berkeley were excellent hosts.

Program 4: Complementary Program 2008-09

August 18, 2008 to May 22, 2009

MSRI had a small Complementary Program comprised of two postdoctoral fellows, Chris Hillar (funded by the NSA and MSRI), and Feng Xu, 2 research members, Irwin Kra and Matilde Marcolli, and 1 graduate student, Christopher Severs.

Christopher Hillar had just completed a postdoctoral fellowship at Texas A&M University and was contemplating leaving academia. Bernd Sturmfels alerted us to the fact that Hillar was awarded a Young Investigator grant from the NSA and that given his exceptional talent it would be a loss to the mathematical community if he were to leave mathematics. We took him as a research member in the Complementary program while we administered his grant. It turned out to be one of MSRI's success stories. In Hillar's own words "…The chance to work at MSRI was life-changing and especially important given my research aspirations in mathematical neuroscience. It is challenging to work at the intersection of these two fields, and I attribute much of my ongoing success to the opportunities, encouragement, and support that MSRI has offered me." Hillar went on to obtain a joint postdoctoral fellowship with MSRI and the Redwood Center for Theoretical Neuroscience at UCB. His mentor, Dr. Bruno Olshausen, is the Redwood Center's director. The Center's goal is to develop mathematical and computational models of the underlying neurobiological mechanisms involved in perception, cognition, learning, and motor function. The scientists collaborate with experimental neuroscience labs in the design of experiments and in the analysis of neural data. It has been a rewarding experience for MSRI to see one of its members branched out so successfully.

Feng Xu was at MSRI for the academic year 2008-09 working with Director Robert Bryant, his mentor. Xu is a differential geometer whose stay at MSRI appears to have been quite prolific has he lists 3 completed papers, and was making serious progress on a fourth. One of his papers, *Pseudo-holomorphic curves in nearly Kahler CP^3,* appeared in the "Differential Geometry and Its Applications" journal. More details on his works while at MSRI can be found in the Postdoctoral Chapter of this annual report.

1.4 Scientific Activities Directed at Underrepresented Groups in Mathematics

Math Institutes Modern Mathematics Workshop
October 08, 2008 to October 09, 2008
Organized By: Ive Rubio, Herbert Medina, Kathy O'Hara, and Robert Megginson

This was the first workshop sponsored by all the US-based Math Institutes and seventh in a series sponsored by the Mathematical Sciences Research Institute on contemporary research in mathematics. Each institute will focus on their upcoming programs for the academic year 2009 – 2010.

All presentations were expository, intended for mathematical scientists and students not necessarily working in these areas, but interested in learning about new developments and the

possibility of spending some time at any of the participating math institutes. We anticipated an audience composed of graduate students, post docs, and mid career faculty.

Discussions about the institute programs included lectures which targeted a broad audience of mathematical scientists including graduate students, post docs, and mid career faculty, as well as advice about the different ways one can be involved in the upcoming programs. A panel composed of a representative from each US-based Math Institute occured on Thursday, October 9, 2008.

Promoting Diversity at the Graduate Level in Mathematics: a National Forum
October 14, 2008 to October 17, 2008
Organized By: Sylvia Bozeman* (Spelman College), Rhonda Hughes (Bryn Mawr College), Abbe Herzig (SUNY, University at Albany), Duane Cooper (Morehouse College), Ellen Kirkman(Wake Forest University), Ivelisse Rubio (University of Puerto Rico), and Olivia Scriven (Spelman College). Honorary organizers include: Dusa McDuff (SUNY Stonybrook and Barnard College), Fern Hunt (NIST), and Karen Uhlenbeck (U of Texas at Austin).

Cultivating diversity and broadening participation of historically underrepresented groups in the mathematical sciences are national goals that are identified by the National Science Foundation as "essential components of the innovation engine that drives the Nation's economy." The goal of this three-day conference was to stimulate, identify, and disseminate successful models that imporve retention of underrepresented groups in graduate programs in mathematics.

MSRI-UP 2009: Coding Theory
June 15, 2009 to July 24, 2009
Organized By: Ivelisse Rubio (University of Puerto Rico, Río Piedras), Duane Cooper* (Morehouse College), Ricardo Cortez (Tulane University), Herbert Medina (Loyola Marymount University), and Suzanne Weekes (Worcester Polytechnic Insitute).

The MSRI-UP was a comprehensive program for undergraduates that aimed at increasing the number of students from underrepresented groups in mathematics graduate programs. MSRI-UP included summer research opportunities, mentoring, workshops on the graduate school application process, and follow-up support.

1.5 Summer Graduate Workshops

1.5.1 2008 Summer Graduate Workshops

IAS/PCMI Summer Program: Analytic and Algebraic Geometry: Common Problems - Different Methods
July 06, 2008 to July 26, 2008
Location: IAS/Park City Mathematics Institute, Salt Lake City, UT
Organized By: Mircea Mustaţă (University of Michigan), Jeff McNeal (Ohio State University)

The Graduate Summer School bridged the gap between a general graduate education in mathematics and the specific preparation necessary to do research on problems of current

interest. In general, these students would have completed their first year, and in some cases, may already be working on a thesis. While a majority of the participants would be graduate students, some postdoctoral scholars and researchers were also interested in attending.

The main activity of the Graduate Summer School was a set of intensive short lectures offered by leaders in the field, designed to introduce students to exciting, current research in mathematics. These lectures did not duplicate standard courses available elsewhere. Each course consisted of lectures with problem sessions. Course assistants were available for each lecture series. The participants of the Graduate Summer School met three times each day for lectures, with one or two problem sessions scheduled each day as well.

Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas
July 07, 2008 to July 18, 2008
Location: Baker Board Room
Organized By: J.M. Landsberg* (Texas A&M), Lek-Heng Lim (UC Berkeley) and Jason Morton (UC Berkeley)

Recently the common geometry of tensors arising in questions in computational complexity, statistical learning theory, signal processing, scientific data analysis have been looked at from a unified perspective. The underlying geometry and representation theory was covered in this workshop with and eye towards problems such as the complexity of matrix multiplication, Valiant's approach to P=NP, measures of entanglement in quantum information theory, graphical models in statistical learning theory, independent component analysis and other multilinear data analytic techniques.

Climate Change - Summer Graduate Workshop
July 14, 2008 to August 01, 2008
Organized By: Christopher Jones* (UNC Chapel Hill and U Warwick, UK), Inez Fung (U.C. Berkeley), Eric Kostelich (Arizona State University), K.K. Tung (U. Washington), and Mary Lou Zeeman* (Bowdoin College), Charles D. Camp (Cal Poly, San Luis Obispo), Rachel Kuske (Univ British Columbia)

The goal of the workshop was to discern ways in which mathematics can contribute and to expose new researchers to some of the key areas that we believe will form the basis of serious mathematical considerations of climate change issues. It was part of a larger 3 week program to bring both graduate students and researchers together to jointly study ways to engage in meaningful collaborations.

Climate Change Summer School
July 14, 2008 to August 01, 2008
Organized By: Chris Jones* (UNC Chapel Hill and U Warwick, UK), Inez Fung (U.C. Berkeley), Eric Kostelich (Arizona State University), K.K. Tung (U. Washington), and Mary Lou Zeeman* (Bowdoin College), Charles D. Camp (Cal Poly, San Luis Obispo), Rachel Kuske (Univ British Columbia)

Supported by the Sea Change Foundation, this three-week summer school incorporated a workshop for graduate students as well as an advanced research workshop. The mini-program was designed to introduce students and postdocs to a set of mathematical ideas and techniques that are highly relevant to climate change research.

1.5.2 2009 Summer Graduate Workshops

Toric Varieties
June 15, 2009 to June 26, 2009
Organized By: David Cox (Amherst College) and Hal Schenck (University of Illinois)

Toric varieties are algebraic varieties defined by combinatorial data, and there is a wonderful interplay between algebra, combinatorics and geometry involved in their study. Many of the key concepts of abstract algebraic geometry (for example, constructing a variety by gluing affine pieces) have very concrete interpretations in the toric case, making toric varieties an ideal tool for introducing students to abstruse concepts.

IAS/PCMI Summer Workshop: The Arithmetic of L-functions
June 28, 2009 to July 18, 2009
Location: IAS/Park City Mathematics Institute, Salt Lake City, UT
Organized By: Cristian Popescu (UCSD), Karl Rubin (UC Irvine), Alice Silverberg (UC Irvine).
An off-site workshop partially funded by MSRI.

1.6 Other Scientific Workshops

Low Dimensional Topology
August 11, 2008 to August 15, 2008
Organized By: Elisenda Grigsby, Rob Schneiderman, Peter Teichner* and Kevin Walker

In recent years, there has been lots of exciting progress in many branches of low-dimensional topology, including Heegard Floer and Khovanov Homology, small 4-Manifolds, TQFT, knot concordance and Lefschetz fibrations. These were the main themes of this workshop whose format was three one-hour lectures every day, two in the morning and one survey lecture in the afternoon (except for Friday). This survey lecture was followed by a panel for experts, led by the afternoon speaker and some other leaders of the field. The panel discussed current developments and open problems and it extended into the late afternoon if so desired by the panelists.

Statistical and Computational Challenges in Next-Generation Sequencing
October 10, 2008
Organized By: Sandrine Dudoit*, Terry Speed, Margaret Taub

For the past decade, microarrays have been the assays of choice for high-throughput studies of gene expression. Recent improvements in the efficiency, quality, and cost of genome-wide sequencing are prompting biologists to rapidly abandon microarrays in favor of so-called next-generation sequencers, e.g., Applied Biosystems' SOLiD, Helicos BioSciences' HeliScope, Illumina's Solexa, and Roche's 454 Life Sciences sequencing systems. These high-throughput

sequencing technologies have already been applied for studying genome-wide transcription levels (mRNA-Seq), transcription factor binding sites (ChIP-Seq), chromatin structure, and DNA methylation status. While sequencing-based gene expression studies have been touted as overcoming longstanding limitations of microarray-based studies, these new biotechnologies raise similar as well as novel statistical and computational challenges. This workshop website is at: http://www.stat.berkeley.edu/~seqmtg/

Bay Area Differential Geometry Seminar
December 06, 2008

The Bay Area Differential Geometry Seminar met around 3 times each year and was a 1-day seminar on recent developments in differential geometry and global analysis, broadly interpreted. Typically, it ran from mid-morning until late afternoon, with 3-4 speakers. Box lunches were available for purchase and the final talk was followed by dinner.

International Conference on Cluster Algebras and Related Topics
December 08, 2008 to December 20, 2008
Organized By: Christof Geiss* (UNAM Ciudad Universitaria), Bernhard Keller (Université Paris Diderot - Paris 7), Idun Reiten (Nettstedskart Tilgjengelighet Norges Teknisk-Naturvitenskapelige Universite), Andrei Zelevinsky (Nostheastern University).
Location: Morelia/Mexico City

This was a combination of a conference and workshop on cluster algebras and their relations to geometry, representation theory and combinatorics. The workshop took place in Morelia (a colonial town about 250km west of Mexico-City), December 8-13, 2008 followed by the conference in Mexico-City, December 15-20. The Research in this area developed with amazing speed after the introduction of cluster algebras around 2001 by Sergey Fomin and Andrei Zelevinsky and had attracted a variety of first rate mathematicians throughout the world, for instance Alexander Goncharov, Bernhard Keller, Maxim Kontsevich, Bernard Leclerc, Idun Reiten and Claus Michael Ringel, most of them being ICM speakers. A good way to get an overview of the intense activities related to cluster algebras is Sergey Fomin's cluster algebras portal: http://www.math.lsa.umich.edu/~fomin/cluster.html

Algebraic Statistics
December 15, 2008 to December 18, 2008
Organized By: Serkan Hosten (SFSU), Lior Pachter (UCB), Bernd Sturmfels* (UCB)

Algebraic statistics is a maturing discipline focused on the applications of algebraic geometry and its computational tools in the study of statistical models. Initial results in the area were related to specific problems in categorial data analysis and experimental design, however a flurry of activity during the past several years has greatly increased the scope of the subject. Areas of interest now include graphical models, maximum likelihood estimation and Bayesian methods. Moreover, a strong connection has developed to applications in the physical and biological sciences. The field draws its tools not only from computational algebraic geometry but also from tropical, convex, and information geometry. Moreover, research in algebraic statistics has led to new directions in those fields. The workshop was a meeting point for students and leaders in the field. It presented a focused activity parallel to the 2008-2009 program on Algebraic Methods in

Systems Biology and Statistics hosted by the Statistical and Applied Mathematical Sciences Institute.

Economic Games and Mechanisms to Address Climate Change
May 04, 2009 to May 08, 2009
Organized By: Prajit Dutta (Columbia), Roy Radner (NYU), Rene Carmona (Princeton), and David Zetland (UC Berkeley).

Themes: Carbon cap-and-trade and economic consequences; Game theory and self-enforcing treaties; Economic mechanisms and incentive for greenhouse gas emission reductions.

Modern Perspectives in Applied Mathematics
May 18, 2009 to May 22, 2009
Organized By: Andrea L. Bertozzi* (University of California LosAngeles), Panagiotis Souganidis (The University of Chicago), and Eric Vanden-Eijnden (NewYorkUniversity)
Courant Institute of Mathematical Sciences, New York University, New York

Stochastic and multi-scale modeling is becoming a main driving force in many scientific and engineering disciplines, and is among the most exciting areas of scientific research. Indeed, many problems in sciences involve quantifying the behavior of complex systems with a very large number of degrees of freedom. The systems interact on a large span of scales and require to incorporate stochastic effects to account for model errors and/or disturbances from under-resolvedscales.

1.7 Educational & Outreach Activities

Mathematics Professional Development Institute (Wu Summer Institute)
July 21, 2008 to August 08, 2008
Organized By: Dr. Hung-Hsi Wu* (UC Berkeley), Kay Kirman and Hana Huang (Miraloma Elementary School, SF), and Dr. Sunil Koswatta (Harper College)

This three-week course in elementary mathematics directly addressed the mathematics needed for teaching Number Sense in K-7 classrooms. It developed whole numbers and fractions from the beginning, with an excursion into some elementary number theory about divisibility properties of whole numbers and the algorithm that yields the HCF of two numbers. Each day began with mathematics lectures by a Berkeley mathematician and concluded with small group sessions guided by MPDI graduates.

Bay Area Circle for Teachers
August 04, 2008 to August 08, 2008
Organized By: Tatiana Shubin* (San Jose State University) and Joshua Zucker (Castilleja School)

The aim of the Circle for Teachers is to equip educators with an effective problem-solving approach to teaching mathematics. This style of learning is based on the math circle environment that has proven to be successful for students around the world. The workshop immersed a group of interested middle and high school math teachers in engaging mathematics and exposed them

to a dynamic style of classroom presentation. Participants come away with a variety of resources, lesson modules, and a renewed sense of appreciation for the fascinating world of mathematics. Teachers were also eligible for continuing education credit, professional development units, or college course credits.

A major theme throughout the workshop was creatively answering the question of how to incorporate a problem-solving approach to math education into the existing curriculum. To this end, leaders supplied participants with handouts or short modules based on the material covered during their sessions. They also worked with teachers to share ideas for enlivening any math class and to develop lesson plans. Focused discussions were held regularly to determine what obstacles exist to incorporating this style of teaching into the present curriculum, what resources would be most helpful to teachers, and other related topics.

For more information about the BACT series, see the Bay Area Circle for Teachers website at http://bact.mathcircles.org.

Using Partnerships to Strengthen Elementary Mathematics Teacher Education
December 11, 2008 to December 12, 2008
Organized By: Deborah Ball* (University of Michigan), James Lewis (University of Nebraska), and William McCallum* (University of Arizona)

A core problem – perhaps the central problem – for improving elementary school mathematics is the mathematical education of elementary teachers. The historic isolation of elementary teachers' study of mathematics from their pedagogical preparation is increasingly seen to be both unnatural and ineffective. Indeed, the mathematical education of elementary teachers is inherently interdisciplinary as future teachers seek to gain the mathematical knowledge, the pedagogical knowledge and the knowledge of young students that is needed to become a successful mathematics teacher. Thus, it seems reasonable that an integrative learning approach to mathematical education of elementary teachers could yield substantial benefits.

The Mathematical Association of America Sectional Meeting
February 28, 2009
Organized By: Organized by: Dean Gooch (Santa Rosa Junior College), Tatiana Shubin* (San Jose State University), Robert L. Bryant (MSRI), Steve Chiappari and Frank Farris (Santa Clara University) and Ed Keppelmann (University of Nevada Reno)

As one of the MAAs most entertaining sections this meeting was no exception. All the presentations had plenty of rich mathematics accessible to students but equally engaging for seasoned veterans. The featured speakers were Robert Bryant (The idea of Holonomy), David Bressoud - MAA President Elect (The Story of the Alternating Sign Matrix Conjecture), Frank Farris - Editor Mathematics Magazine (A window to the 5th dimension), Kevin McCurley - Google Research (Information Modeling with Graphs), and Helene Barcelo - MSRI (Subspace Arrangements from a Combinatorial point of view). There also was a student poster session, a luncheon, and plenty of time for catching up with old friends and colleagues.

Great Circles 2009
April 16, 2009 to April 17, 2009

Organized By: Matthias Beck* (San Francisco State University), Amanda Serenevy (Executive Director of the Riverbed Community Math Center), Sam Vandervelde (St. Lawrence University), and Kathy O'Hara (MSRI)

This conference brought together experienced math circle directors and professional mathematicians along with secondary school teachers and students, with the three-fold goal of inspiring and equipping individuals to begin math circles in their communities, passing along successful math circle presentations and best practices in math circle administration, and renewing and strengthening ties among members of the existing math circle network.

Critical Issues in Mathematics Education: Teaching Undergraduates Mathematics

Funded by NSF Supplemental Grant DMS-0937701

May 11, 2009 to May 13, 2009

Organized By: William McCallum* (The University of Arizona), Deborah Loewenberg Ball* (University of Michigan), Rikki Blair (Lakeland Comminity College, Ohio), David Bressoud (Macalester College), Amy Cohen-Corwin (Rutgers University), Don Goldberg (El Camino College), Jim Lewis (University of Nebraska), Robert Megginson (University of Michigan), Bob Moses (The Algebra Project), James Donaldson (Howard University)

The sixth Critical Issues in Math Education workshop took place at MSRI May 11-13, 2009. Its title was *Teaching Undergraduates Mathematics.* Mathematicians in all collegiate institutions, from community college faculty to those who work in research-intensive doctoral institutions, share the common mission of teaching mathematics to undergraduate students, and the common problem that the transitions from high school to college and from a 2-year to a 4-year college are extremely difficult for many students. How successfully they accomplish this part of their mission has a major impact on how they are viewed by their administration and how well mathematics is supported at their institutions.

The audience for the workshop included mathematicians, mathematics educators, classroom teachers, and education researchers who are concerned with improving the teaching and learning of mathematics in our undergraduate classrooms. The workshop showcased courses, programs, and materials whose goal is to increase students' knowledge of mathematics, with an emphasis on those that show promise of being broadly replicable. This workshop addressed the major challenges of undergraduate mathematics education. Among the issues discussed at the workshop are: What research is available on how undergraduates learn; the transition from high school to college mathematics; curriculum design and assessment; and the role of research opportunities in building excitement about math. The workshop showcased examples of ideas that people implemented and documented extensively, such as Inquiry-Based Learning for Differential Equations and the Mathematical Knowledge for Teaching (Natasha Speer, Joe Wagner), Interactive Engagement in mathematics classrooms (Wade Ellis), Applied Mathematics Project and the Transition Math Project (Patrick Averbeck).

1.8 Programs Consultant List

Consultant Name(s)	Consultant Disciplinary Specialty	Consultant Employer	Activity Title
Deborah Ball	Education	University of Michigan	Educational workshops
David Bao	Differential geometry	San Francisco State University	Differential geometry seminar
Mathias Beck	Discrete geometry	San Francisco State University	Bay Area Circle for Teachers
Edward Frenkel	Langlands program	University of California, Berkeley	Future program
Inez Fung	Climate change	University of California, Berkeley	Climate Change: Summer School & Economic Games and Mechanisms to Address Climate Change
Jacob Furie	Algebraic topology	Harvard University	Future program
Philip Griffith	Algebraic geometry	Institute for Advanced Study	Future program
Joel Haas	Differential geometry	University of California, Davis	Differential geometry seminar
Chris Jones	Climate change	University of North Carolina at Chapel Hill	Climate change: Summer School
Moris Kalka	Differential geometry	Tulane University	Summer Graduate Workshops
Rob Kirby	Topology	University of California, Berkeley	Open Access Journals
William Macallum	Education	University of Arizona	Educational workshops
Rafe Mazzeo	Differential geometry	Stanford University	Differential geometry seminar
Donald McClure	Image processing	Brown University	AMS Open Access
Robert Megginson	Analysis on math	University of Michigan	MSRI - UP
Juan Meza	Computational mathematics	Lawrence Berkeley National Laboratory	MSRI - UP
Richard Montgomery	Differential geometry	University of California, Santa Cruz	Differential geometry seminar
Assaf Naor	Probability	New York University	Quantative Geometry
Douglas Nychka	Climate change	National Center for Atmospheric Research	Climate Change: Summer School & Economic Games and Mechanisms to Address Climate Change
Jim Pitman	Statistics	University of California, Berkeley	Vmath
Bjorn Poonen	Model theory	Technology	Future program
Perter Sarnak	Number theory	University of Princeton	Future program
Mark Saul	Education	Education Development Center	Great Circles 2009
Tatiana Shubin	Number theory	San Jose State University	Bay Area Circle for Teachers
Michael Singer	Differential algebra	North Carolina State University	Summer Graduate Workshops
Ted Slaman	Logic	University of California, Berkeley	Future program
Zvesda Stankova	Algebraic geometry	Mill College	Bay Area Circle for Teachers
Bernd Sturmfels	Algebraic statistics	University of California, Berkeley	Algebraic Statistics
Sam Vandervelde	Number theory	St. Lawrence University	Great Circles 2009
Cedric Villani	Optimal transport	École Normale Supérieure de Lyon	Mass Transport
Mary Lou Zeeman	Climate change	Bowdoin College	Toric Varieties
David Zetland	Climate change	University of California, Berkeley	Climate Change: Summer School
Educational Advisory Committee (EAC)			Teaching Undergraduates Mathematics
			Mathematics Teacher Education
Human Resources Advisory Committee (HRAC)			Math Institutes Modern Mathematics Workshop
			Mathematics: a National Forum
			MSRI - UP
Scientific Advisory Committee (SAC) & HRAC			Analysis on Singular Spaces
			Algebraic Geometry
			Ergodic Theory and Additive Combinatorics

2. Programs and Workshops Participation

2.1 Program Participant List

(More detailed information can be found in the email attachment)

Family Name	First Name	Home Institution Name	Position	Program
Aastrup	Johannes	Universitat Munster	Research Member	AOSS
Abramovich	Dan	Brown University	Research Professor	AG
Albin	Pierre	Massachusetts Institute of Technology	Research Member	AOSS
Aldana Dominguez	Clara	Universität Bonn	Research Member	AOSS
Alexandrova	Ivana	East Carolina University	Research Member	AOSS
Alexeev	Valery	University of Georgia	Research Professor	AG
Allahbakhshi	Mahnaz	University of Victoria	Program Associate	ET&AC
Alper	Jarod	Columbia University	Postdoc	AG
Altmann	Klaus	Freie Universität Berlin	Research Member	AG
Aluffi	Paolo	Florida State University	Research Member	AG
Anderson	David	University of Michigan	Program Associate	AG
Andreatta	Marco	Università di Trento	Research Member	AG
Araujo	Carolina	Institute of Pure and Applied Mathematics (IMPA)	Postdoc	AG
Asok	Aravind	University of California	Postdoc	AG
Austin	Tim	University of California	Program Associate	ET&AC
Bahuaud	Eric	Universite Montpellier 2 (France)	Postdoc	AOSS
Baskin	Dean	Stanford University	Program Associate	AOSS
Bauer-Catanese	Ingrid	Universitaet Bayreuth	Research Member	AG
Bayer	Arend	University of Utah	Postdoc	AG
Beauville	Arnaud	Université de Nice Sophia Antipolis	Research Professor	AG
Beheshti Zavareh	Roya	Washington University	Postdoc	AG
Behrend	Kai	University of British Columbia	Research Member	AG
Beiglböck	Mathias	Vienna University of Technology	Research Member	ET&AC
Bergelson	Vitaly	Ohio State University	Simons Visiting Professor	ET&AC
Bertram	Aaron	University of Utah	Research Member	AG
Borrelli	Giuseppe	Universidade Federal de Pernambuco	Research Member	AG
Borthwick	David	Emory University	Research Member	AOSS
Boshernitzan	Michael	Rice University	Research Professor	ET&AC
Bouclet	Jean-Marc	Université de Lille I (Sciences et Techniques de Lille Flandres Artois)	Research Member	AOSS
Brannetti	Silvia	Terza Università di Roma	Program Associate	AG
Breuillard	Emmanue	École Polytechnique	Research Member	ET&AC
Bridgeland	Tom	University of Sheffield	Research Professor	AG

Bruning	Jochen	Universität Humboldt	Research Member	AOSS
Bryan	Jim	University of British Columbia	Research Member	AG
Buch	Anders	Rutgers University	Research Member	AG
Campana	Frederic	Université de Nancy I (Henri Poincaré)	Research Professor	AG
Campbell	James	University of Memphis	Research Member	ET&AC
Caporaso	Lucia	Universita Roma TRE	Research Professor	AG
Carron	Gilles	University of Nantes	Organizer	AOSS
Casagrande	Cinzia	Università di Pavia	Guest	AG
Casalaina-Martin	Sebastian	University of Colorado	Postdoc	AG
Castravet	Ana-Maria	University of Arizona	Research Member	AG
Catanese	Fabrizio	Universität Bayreuth	Research Professor	AG
Cautis	Sabin	Rice University	Postdoc	AG
Cavalieri	Renzo	Colorado State University	Research Member	AG
Chen	Qile	Brown University	Program Associate	AG
Chen	Dawei	University of Illinois	Postdoc	AG
Chen	Linda	Swarthmore College	Research Member	AG
Christiansen	Tanya	University of Missouri, Columbia	Research Professor	AOSS
Christianson	Hans	Massachusetts Institute of Technology	Postdoc	AOSS
Chu	Qing	Universite Paris-Est Marne-La-Vallee	Program Associate	ET&AC
Coronel	Alvaro	Universidad de Chile	Program Associate	ET&AC
Corti	Alessio	Imperial College, London	Research Professor	AG
Coskun	Izzet	University of Illinois	Research Member	AG
Craw	Alastair	University of Glasgow	Research Member	AG
de Fernex	Tommaso	University of Utah	Research Member	AG
Debarre	Olivier	École Normale Supérieure	Research Professor	AG
Degeratu	Anda	Max Planck Institute for Gravitational Physics	Research Member	AOSS
Dencker	Nils	University of Lund	Research Member	AOSS
Derenthal	Ulrich	University of Zurich	Research Member	AG
Derriennic	Yves	Universite de Bretagne Occidentale	Research Member	ET&AC
Di Rocco	Sandra	K.T.H.	Research Member	AG
Doran	Brent	University of Oxford	Research Member	AG
Dryden	Emily	Bucknell University	Postdoc	AOSS
Dundon	Ariana	University of Washington	Program Associate	AG
Easton	Robert	University of Utah	Postdoc	AG
Edidin	Dan	University of Missouri, Columbia	Research Member	AG
Ein	Lawrence	University of Illinois	Research Professor	AG
Einsiedler	Manfred	Ohio State University	Research Member	ET&AC
Eisenbud	David	University of California	Research Professor	AG
Ellenberg	Jordan	University of Wisconsin	Research Member	AG
Esnault	Helene	Universität Duisburg-Essen	Research Professor	AG
Faber	Carel	Royal Institute of Technology (KTH)	Research Member	AG

Fantechi	Barbara	International School for Advanced Studies (SISSA/ISAS)	Research Professor	AG
Farkas	Gavril	Humboldt-Universität	Research Member	AG
Farsi	Carla	University of Colorado, Boulder	Research Member	AOSS
Ferenczi	Sebastien	Centre National de la Recherche Scientifique (CNRS)	Research Member	ET&AC
Finkel	Dan	University of Washington	Program Associate	AG
Fish	Alexander	Ohio State University	Postdoc	ET&AC
Foreman	Matthew	UC Irvine	Research Professor	ET&AC
Francsics	Gabor	Michigan State University	Research Member	AOSS
Frantzikinakis	Nikos	University of Memphis	Research Member	ET&AC
Freiman	Gregory	Tel Aviv University	Research Member	ET&AC
Fujino	Osamu	Kyoto University	Research Member	AG
Fulton	William	University of Michigan	Organizer	AG
Furstenberg	Hillel	Hebrew University	Research Professor	ET&AC
Gaffney	Terence	Northeastern University	Research Member	AOSS
Gamburd	Alexander	Northwestern University	Research Member	ET&AC
Gell-Redman	Jesse	Stanford University	Program Associate	AOSS
Giansiracusa	Noah	Brown University	Program Associate	AG
Gibney	Angela	University of Georgia	Research Member	AG
Gill	Nick	University of Bristol	Research Member	ET&AC
Gimperlein	Heiko	Leibniz Universitaet Hannover	Research Member	AOSS
Glasner	Moshe (Eli)	Tel Aviv University	Research Professor	ET&AC
Goettsche	Lothar	Abdus Salam International Centre for Theoretical Physics	Research Professor	AG
Gowers	Timothy	Cambridge University	Research Professor	ET&AC
Graham	William	University of Georgia	Research Member	AG
Grandjean	Vincent	University of Bath	Research Member	AOSS
Grassi	Antonella	University of Pennsylvania	Research Member	AG
Greb	Daniel	Albert-Ludwigs-Universitaet Mathematisches Institut	Postdoc	AG
Green	Ben	University of Cambridge	Organizer	ET&AC
Grieser	Daniel	Carl von Ossietzky Universitaet Oldenburg	Research Professor	AOSS
Griffiths	Phillip	Institute for Advanced Study	Research Professor	AG
Grubb	Gerd	Copenhagen University	Research Professor	AOSS
Grushevsky	Samuel	Princeton University	Research Member	AG
Guillarmou	Colin	Centre National de la Recherche Scient	Research Member	AOSS
Gyarmati	Kati	Eötvös Loránd University (ELTE)	Research Member	ET&AC
Hacking	Paul	University of Washington	Research Member	AG
Hacon	Christopher	University of Utah	Research Professor	AG
Hain	Richard	Duke University	Research Member	AG
Hall	Jack	Stanford University	Program Associate	AG
Harbater	David	University of Pennsylvania	Research Member	AG

Harris	Joseph	Harvard University	Organizer	AG
Haskins	Mark	Imperial College, London	Research Member	AOSS
Hassett	Brendan	Rice University	Organizer	AG
Heier	Gordon	University of California	Research Member	AG
Helfgott	Harald	University of Bristol	Postdoc/ RM	ET&AC
Hering	Milena	University of Utah	Research Member	AG
Hillairet	Luc	Université de Nantes	Research Member	AOSS
Hillar	Christopher	Texas A & M University	Postdoc/ RM	CP
Hoang	Le Thai	University of California	Program Associate	ET&AC
Hochman	Michael	Princeton University	Postdoc	ET&AC
Hogadi	Amit	Tata Institute of Fundamental Research	Postdoc	AG
Holm	Tara	Cornell University	Research Member	AG
Host	Bernard	Université de Marne-la-Vallée	Simons Visiting Professor	ET&AC
Hulek	Klaus	Leibniz Universität Hannover	Research Member	AG
Hunsicker	Eugenie	Lawrence University	Organizer	AOSS
Ishii	Shihoko	Tokyo Institute of Technology	Research Member	AG
Izadi	Elham	University of Georgia	Research Member	AG
Jabbusch	Kelly	Albert-Ludwigs-Universität Freiburg	Research Member	AG
Jeffres	Thalia	Wichita State University	Research Member	AOSS
Johnsen	Trygve	University of Tromso	Research Member	AG
Johnson	Jennifer	Princeton University	Research Member	AG
Johnson	Michael	Swarthmore College	Research Member	ET&AC
Kaloghiros	Anne-Sophie	University of Cambridge	Postdoc	AG
Katz	Sheldon	University of Illinois, Urbana-Champaign	Research Member	AG
Katzarkov	Ludmil	University of Miami	Research Member	AG
Katznelson	Yitzhak	Stanford University	Research Member	ET&AC
Kaufmann	Ralph	Purdue University	Research Member	AG
Kawamata	Yujiro	University of Tokyo	Research Professor	AG
Kebekus	Stefan	Albert-Ludwigs-Universität Freiburg	Research Member	AG
Kim	Bumsig	Korea Advanced Institute of Science and Technology (KAIST)	Research Member	AG
Kirson	Antonio	University of Washington	Program Associate	AG
Kollár	János	Princeton University	Organizer	AG
Kopp	Travis	University of Washington	Program Associate	AG
Kottke	Christopher	Massachusetts Institute of Technology	Program Associate	AOSS
Kovács	Sándor	University of Washington	Organizer	AG
Kra	Bryna	Northwestern University	Organizer	ET&AC
Kra	Irwin	Math for America	Research Professor	CP
Krainer	Thomas	Penn State Altoona	Research Member	AOSS
Krupchyk	Katsiaryna	University of Helsinki	Research Member	AOSS
Kurlberg	Par	Royal Institute of Technology (KTH)	Research Member	ET&AC
Langer	Adrian	University of Warsaw	Research Member	AG

Laza	Radu	University of Michigan	Postdoc	AG
Lazarsfeld	Robert	University of Michigan	Organizer	AG
Lebeau	Giles	Universite de Nice Sophia-Antipolis	Research Member	AOSS
Lee	Yongnam	Sogang University	Research Member	AG
Lee	Yuan-Pin	University of Utah	Research Member	AG
Lemanczyk	Mariusz	Nicholas Copernicus University of Torun	Simons Visiting Professor	ET&AC
Lesigne	Emmanuel	Université François Rabelais	Organizer	ET&AC
Li	Hui	University of Luxembourg	Research Member	AOSS
Lieblich	Max	Princeton University	Research Member	AG
Lind	Douglas	University of Washington	Research Member	ET&AC
Lipman	Joseph	Purdue University	Research Professor	AG
Loya	Paul	SUNY Binghamton	Research Professor	AOSS
Maass	Alejandro	University of Chile	Research Professor	ET&AC
Maclagan	Diane	University of Warwick	Research Member	AG
Magyar	Akos	University of Georgia	Research Member	ET&AC
Marcolli	Matilde	California Institute of Technology	Research Professor	CP
Marcus	Steffen	Brown University	Program Associate	AG
Marian	Alina	University of Illinois	Research Member	AG
Matthiesen	Lilian	University of Cambridge	Program Associate	ET&AC
Matusevich	Laura	Texas A&M University	Research Member	AG
Mauduit	Christian	Université d'Aix-Marseille II (Université de la Méditerranée)	Research Member	ET&AC
Maulik	Davesh	Massachusetts Institute of Technology	Research Member	AG
Mazzeo	Rafe	Stanford University	Research Member	AOSS
Mazzucato	Anna	Pennsylvania State University	Research Member	AOSS
McClendon	David	Northwestern University	Postdoc/ RM	ET&AC
McCutcheon	Randall	University of Memphis	Research Member	ET&AC
McDonald	Patrick	New College of the University of South Florida	Research Member	AOSS
McKernan	James	Massachusetts Institute of Technology	Eisenbud Professor	AG
McKinnie	Kelly	Rice University	Research Member	AG
Mella	Massimiliano	Università di Ferrara	Research Member	AG
Melo	Margarida	Terza Università di Roma	Program Associate	AG
Melrose	Richard	MIT - Massachusetts Institute of Technology	Organizer	AOSS
Mendes Lopes	Margarida	Instituto Superior Técnico	Research Member	AG
Mezzetti	Emilia	University of Trieste	Guest	AG
Miró-Roig	Rosa M.	University of Barcelona	Research Member	AG
Mori	Shigefumi	Kyoto University	Research Professor	AG
Morrison	David	University of California	Research Member	AG
Morrison	Ian	Fordham University	Research Member	AG
Mukai	Shigeru	Kyoto University	Research Professor	AG
Muller	Jorn	University of Bonn	Postdoc	AOSS

Müller	Werner	Universität Bonn	Research Professor	AOSS
Mustata	Mircea	University of Michigan	Research Member	AG
Neale	Vicky	University of Cambridge	Program Associate	ET&AC
Olsson	Martin	University of California	Research Professor	AG
Oprea	Dragos	University of California, San Diego	Postdoc	AG
Osserman	Brian	University of California	Research Member	AG
Ottaviani	Giorgio	Università di Firenze	Research Member	AG
Pandharipande	Rahul	Princeton University	Research Professor	AG
Pardini	Rita	Università di Pisa	Research Member	AG
Pareschi	Giuseppe	Universita' di Roma, Tor Vergata	Research Member	AG
Patakfalvi	Zsolt	University of Washington	Program Associate	AG
Payne	Sam	Stanford University / Clay Mathematics Institute	Research Member	AG
Perry	Peter	University of Kentucky	Research Member	AOSS
Pete	Gabor	University of Toronto	Postdoc	ET&AC
Peternell	Thomas	Universität Bayreuth	Research Member	AG
Piazza	Paolo	Università di Roma "La Sapienza"	Research Member	AOSS
Piene	Ragni	University of Oslo	Research Member	AG
Planchon	Fabrice	Université Paris 13	Research Member	AOSS
Ponge	Raphael	University of Toronto	Research Member	AOSS
Popa	Mihnea	University of Illinois	Research Member	AG
Potts	Amanda	Northwestern University	Program Associate	ET&AC
Proudfoot	Nicholas	University of Oregon	Research Member	AG
Qian	Randy	Northwestern University	Program Associate	AOSS
Quas	Anthony	University of Victoria	Organizer	ET&AC
Reid	Miles	University of Warwick	Research Professor	AG
Rochon	Frederic	University of Toronto	Postdoc	AOSS
Rojas	J. Maurice	Texas A&M University	Research Member	AG
Rosenblatt	Joseph	University of Illinois, Urbana-Champaign	Research Member	ET&AC
Ross	Julius	University of Cambridge	Research Member	AG
Ross	Kiana	University of Washington	Program Associate	AG
Rowlett	Julie	University of California	Research Member	AOSS
Roy	Emmanuel	Institut Galilée	Postdoc/ RM	ET&AC
Rydh	David	University of California	Research Member	AG
Sá Barreto	Antônio	Purdue University	Research Member	AOSS
Saez Trumper	Mariel	Pontificia Universidad Catolica de Chile	Research Member	AOSS
Sanders	Tom	Cambridge University	Postdoc	ET&AC
Sandoval	Mary	Trinity College	Research Member	AOSS
Santoro	Bianca	Duke University	Research Member	AOSS
Sawon	Justin	Colorado State University	Research Member	AG
Schmeling	Joerg	University of Lund, Sweden	Research Member	ET&AC
Schmidt	Klaus	University of Vienna	Research Professor	ET&AC
Schraudner	Michael	Universidad de Chile	Research Member	ET&AC
Schrohe	Elmar	Leibniz Universität Hannover	Research Member	AOSS
Schumacher	Georg	Philipps-Universität Marburg	Research Member	AG

Schwede	Karl	University of Michigan	Research Member	AG
Severs	Christopher	Arizona State University	Program Associate	CP
Shkredov	Ilya Dmitrievich	Moscow State University	Postdoc	ET&AC
Shmerkin	Pablo	University of Jyväskylä	Postdoc/ RM	ET&AC
Singer	Michael	University of Edinburgh	Research Member	AOSS
Sisask	Olof	University of Cambridge	Program Associate	ET&AC
Skjelnes	Roy	Royal Institute of Technology (KTH)	Research Member	AG
Smith	Gregory	Queen's University	Research Member	AG
Smorodinsky	Meir	Tel-Aviv University	Research Member	ET&AC
Smyth	David	Harvard University	Postdoc	AG
Spencer	Craig	Institute for Advanced Study	Postdoc	ET&AC
Srinivas	Vasudevan	Tata Institute of Fundamental Research	Research Member	AG
Stanhope	Elizabeth	Lewis and Clark College	Research Member	AOSS
Stefanov	Plamen	Purdue University	Research Member	AOSS
Stillman	Mike	Cornell University	Research Member	AG
Strohmaier	Alexander	Loughborough University	Research Member	AOSS
Szemeredi	Endre	Rutgers University, New Brunswick	Eisenbud Professor	ET&AC
Szendroi	Balazs	University of Oxford	Research Member	AG
Takagi	Shunsuke	Kyushu University	Research Member	AG
Talpo	Mattia	Scuola Normale Superiore	Program Associate	AG
Tamvakis	Harry	University of Maryland	Research Member	AG
Tao	Terence	University of California	Research Professor	ET&AC
Tataru	Daniel	University of California	Research Professor	AOSS
Taylor	Michael	University of North Carolina, Chapel Hill	Organizer	AOSS
Teicher	Mina	Bar-Ilan University	Research Member	AG
Tevelev	Jenia	University of Massachusetts	Research Member	AG
Thomas	Richard	Imperial College London	Research Professor	AG
Thouvenot	Jean-Paul	Université de Paris VI (Pierre et Marie Curie)	Research Member	ET&AC
Todorov	Gueorgui	Princeton University	Postdoc	AG
Tommasi	Orsola	Universität Hannover	Research Member	AG
Totaro	Burt	University of Cambridge	Research Professor	AG
Towsner	Henry	University of California	Postdoc	ET&AC
Trotman	David	University of Provence	Research Member	AOSS
Tseng	Hsian-Hua	University of Wisconsin-Madison	Postdoc	AG
Tucker	Kevin	University of Michigan	Program Associate	AG
Tziolas	Nikolaos	University of Cyprus	Research Member	AG
Ulfarsson	Henning	Brown University	Program Associate	AG
Usnich	Alexandr	Universität Zürich	Postdoc	AG
Vakil	Ravi	Stanford University	Organizer	AG
Varghese	Mathai	University of Adelaide	Research Member	AOSS
Vasy	András	Stanford University	Organizer	AOSS
Viehweg	Eckart	Universitaet Duisburg-Essen	Research Professor	AG
Vistoli	Angelo	Scuola Normale Superiore	Research Professor	AG

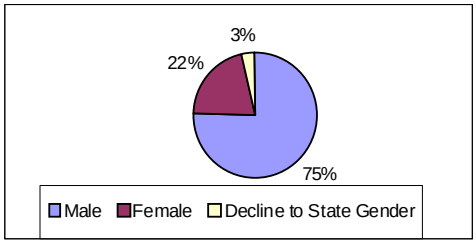
Voisin	Claire	Centre National de la Recherche Scientifique (CNRS)	Research Professor	AG
Wahl	Jonathan	University of North Carolina	Research Member	AG
Wang	Fang	Massachusetts Institute of Technology	Program Associate	AOSS
Weiss	Benjamin	Hebrew University	Simons Visiting Professor	ET&AC
Wickelgren	Kirsten	Stanford University	Program Associate	AG
Wierdl	Mate	University of Memphis	Organizer	ET&AC
Wisniewski	Jaroslaw	Uniwersytet Warszawksi	Research Member	AG
Wolf	Julia	Rutgers University	Postdoc	ET&AC
Wunsch	Jared	Northwestern University	Organizer	AOSS
Xu	Chenyang	Massachusetts Institute of Technology	Postdoc	AG
Xu	Feng	Duke University	Postdoc	CP
Ziegler	Tamar	Israel Institute of Technology	Research Member	ET&AC
Zworski	Maciej	UC Berkeley	Organizer	AOSS

2.2 Program Participant Summary

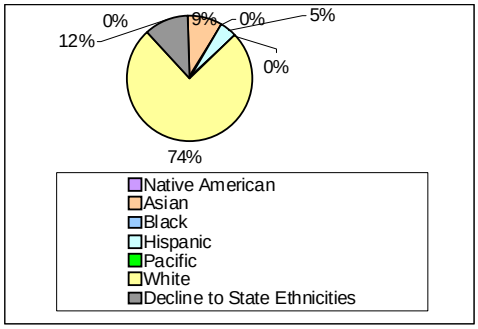
Program	# of Participants	# of Citizens & Per Res	% Citizen & Per Res	# of Female	% Female	Decline to state Gender	# of Minorities	Decline
Algebraic Geometry	161	78	48%	36	22%	8	3	15
Analysis on Singular Spaces	64	33	52%	17	27%	2	4	7
Complementary Program 08/09	5	4	80%	1	20%	0	1	1
Ergodic Theory and Additive Combinatorics	63	24	38%	9	14%	0	0	7

2.3 Program Participant Demographic Data

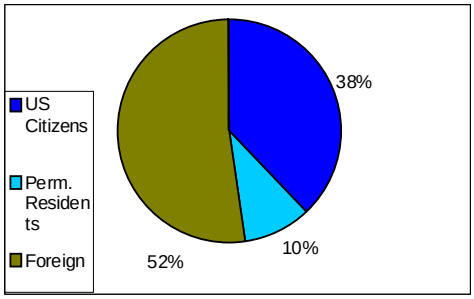
Gender	No.	% (No Decl.)*	%
No. of Distinct Participants	293		100.0%
Male	220	77.74%	75.1%
Female	63	22.26%	21.5%
Decline to State Gender	10		3.4%



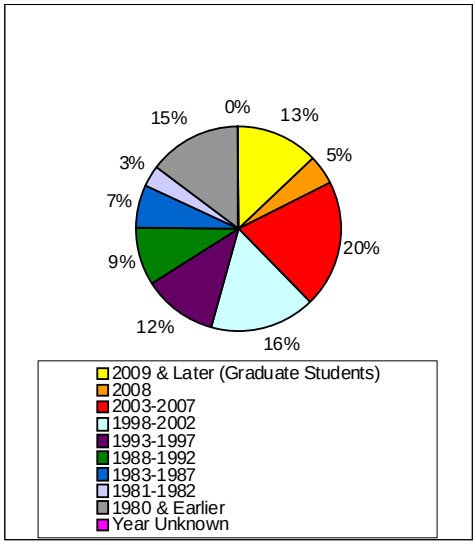
Ethnicities	No.	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	22	9.65%	7.5%
Black	0	0.00%	0.0%
Hispanic	12	5.26%	4.1%
Pacific	0	0.00%	0.0%
White	194	85.09%	66.2%
Decline to State Ethnicities	30		10.2%
Unavailable Information	35		11.9%
Total no. of Distinct Participants	293		100.0%
Minorities	12	5.26%	4.1%



Citizenships	No.		%
US Citizens & Perm. Residents	139		47.4%
Foreign	154		52.6%
Unavailable Information	0		0.0%
Total no. of Distinct Participants	293		100.0%
US Citizens	111		37.9%
Perm. Residents	28		9.6%
Home Inst. in US	155		52.90%



Year of Ph.D	No.		%
2009 & Later (Graduate Students)	38		13.0%
2008	14		4.8%
2003-2007	59		20.1%
1998-2002	48		16.4%
1993-1997	34		11.6%
1988-1992	27		9.2%
1983-1987	20		6.8%
1981-1982	10		3.4%
1980 & Earlier	43		14.7%
Year Unknown	0		0.0%
Unavailable Information	0		0.0%
Total no. of Distinct Participants	293		100.0%



**Statistic Calculation based on all participants that did not decline.*

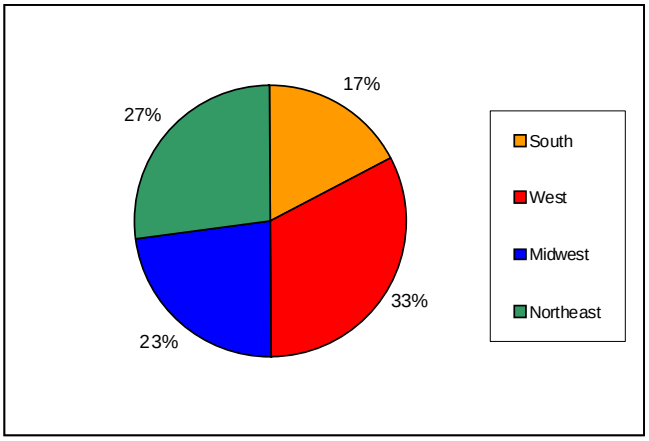
4 Programs for 2008-09

Analysis On Singular Spaces
Algerbraic Geometry
Ergodic Theory and Additive Combinatorics
Complementary Program

Home Institution Classified by States

****Regions based on US Census classification***

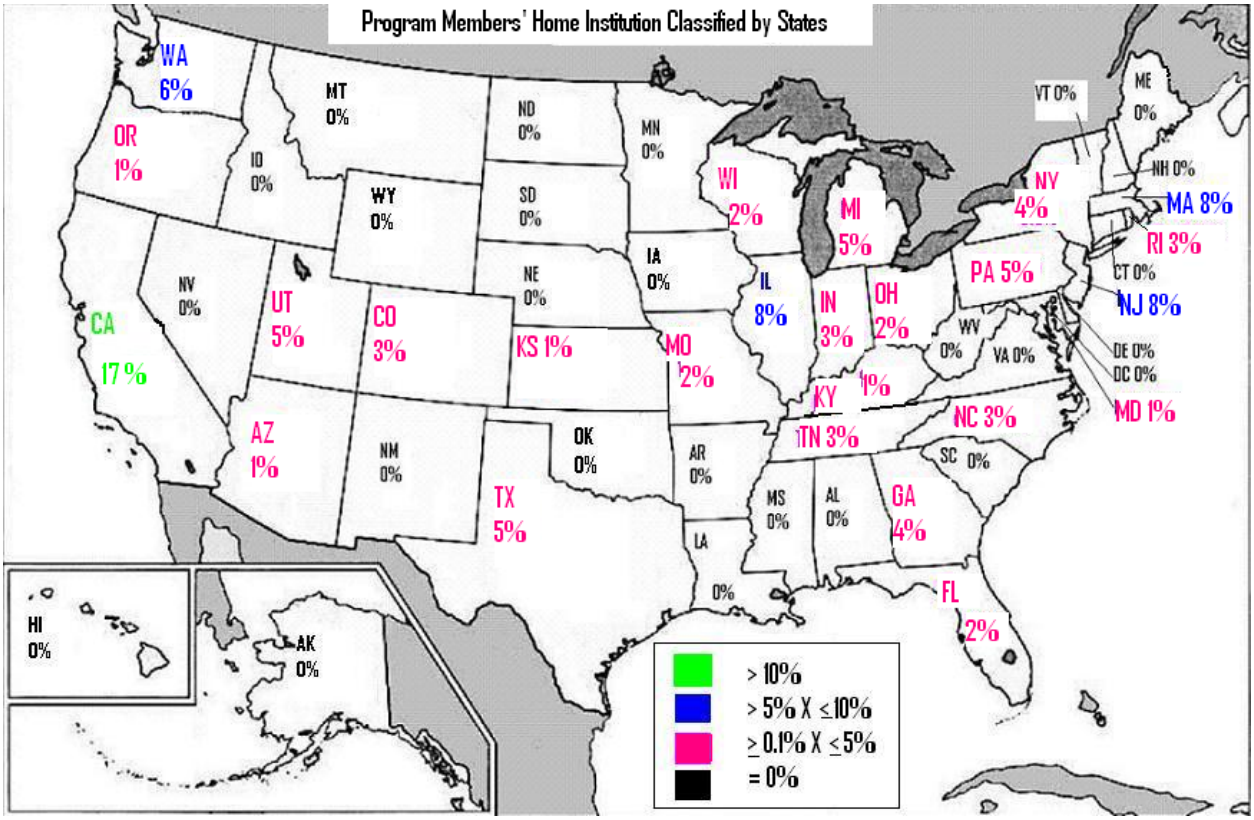
State	#	%	US Pop. (2007 Census)
South	**27**	**17.4%**	**36.6%**
AL	-	0.0%	1.5%
AR	-	0.0%	0.9%
DE	-	0.0%	0.3%
DC	-	0.0%	0.2%
FL	3	1.9%	6.1%
GA	6	3.9%	3.2%
KY	1	0.6%	1.4%
LA	-	0.0%	1.4%
MD	1	0.6%	1.9%
MS	-	0.0%	1.0%
NC	5	3.2%	3.0%
OK	-	0.0%	1.2%
SC	-	0.0%	1.5%
TN	4	2.6%	2.0%
TX	7	4.5%	7.9%
VA	-	0.0%	2.6%
WV	-	0.0%	0.6%
West	**50**	**32.3%**	**23.2%**
AK	-	0.0%	0.2%
AZ	2	1.3%	2.1%
HI	-	0.0%	0.4%
ID	-	0.0%	0.5%
MT	-	0.0%	0.3%
CA	26	16.8%	12.1%
CO	4	2.6%	1.6%
NV	-	0.0%	0.9%
NM	-	0.0%	0.7%
OR	2	1.3%	1.2%
UT	7	4.5%	0.9%
WA	9	5.8%	2.1%
WY	-	0.0%	0.2%
Midwest	**36**	**23.2%**	**22.0%**
IL	13	8.4%	4.3%
IN	5	3.2%	2.1%
IA	-	0.0%	1.0%
KS	1	0.6%	0.9%
MI	8	5.2%	3.3%
MN	-	0.0%	1.7%
MO	3	1.9%	1.9%
ND	-	0.0%	0.2%
NE	-	0.0%	0.6%
OH	3	1.9%	3.8%
SD	-	0.0%	0.3%
WI	3	1.9%	1.9%
Northeast	**42**	**27.1%**	**18.1%**
CT	-	0.0%	1.2%
ME	-	0.0%	0.4%
MA	12	7.7%	2.1%
NH	-	0.0%	0.4%
NJ	12	7.7%	2.9%
NY	6	3.9%	6.4%
PA	7	4.5%	4.1%
RI	5	3.2%	0.4%
VT	-	0.0%	0.2%
Other	-	**0.0%**	**0%**
PR	-	0.0%	0%
Other	-	0.0%	0%
Total	**155**	**100.0%**	**100.0%**

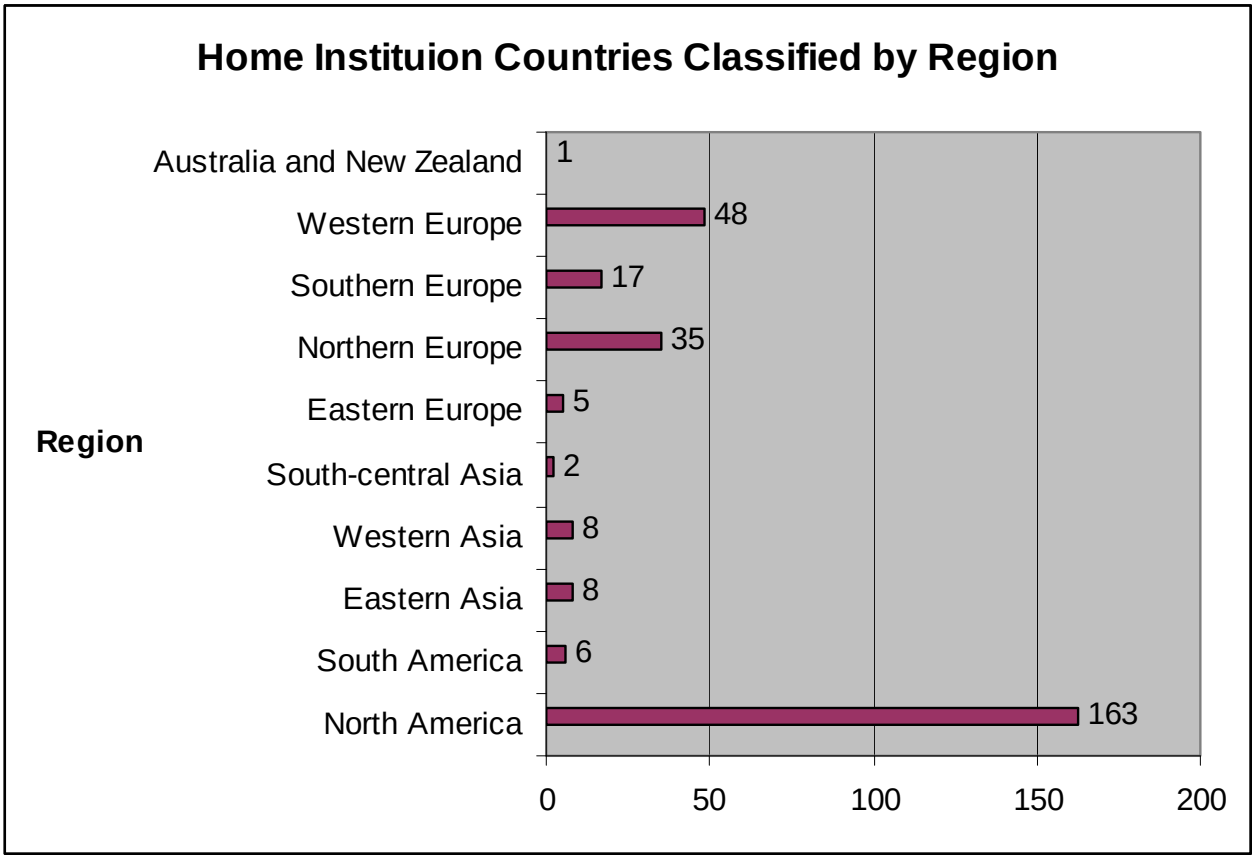


Home Institution Classified by Countries

**Regions based on United Nations' classification*

Region	Area	Country	Count of PID
Americas			**169**
	North America		163
		Canada	8
		United States	155
	South America		6
		Brazil	2
		Chile	4
Asia			**18**
	Eastern Asia		8
		Japan	6
		KOREA, REPUBLIC OF	2
	Western Asia		8
		Cyprus	1
		Israel	7
	South-central Asia		2
		India	2
Europe			**105**
	Eastern Europe		5
		Hungary	1
		Poland	3
		Russian Federation	1
	Northern Europe		35
		Denmark	1
		England	23
		Finland	2
		Ireland	1
		Norway	2
		Sweden	6
	Southern Europe		17
		Italy	15
		Portugal	1
		Spain	1
	Western Europe		48
		Austria	2
		France	21
		Germany	22
		Luxembourg	1
		Switzerland	2
Oceania			**1**
	Australia and New Zealand		1
		Australia	1
Grand Total			**293**


Program Members' Home Institution Classified by States
WA 6%
OR 1%
CA 17%
ID 0%
NV 0%
MT 0%
WY 0%
UT 5%
AZ 1%
CO 3%
NM 0%
ND 0%
SD 0%
NE 0%
KS 1%
OK 0%
TX 5%
MN 0%
IA 0%
MO 2%
AR 0%
LA 0%
WI 2%
IL 8%
MI 5%
IN 3%
OH 2%
KY 1%
TN 3%
MS 0%
AL 0%
GA 4%
FL 2%
SC 0%
NC 3%
VA 0%
WV 0%
PA 5%
NY 4%
VT 0%
ME 0%
NH 0%
MA 8%
RI 3%
CT 0%
NJ 8%
DE 0%
DC 0%
MD 1%
HI 0%
AK 0%
> 10%
> 5% X ≤ 10%
≥ 0.1% X ≤ 5%
= 0%


Home Instituion Countries Classified by Region
Region
Australia and New Zealand
Western Europe
Southern Europe
Northern Europe
Eastern Europe
South-central Asia
Western Asia
Eastern Asia
South America
North America
1
48
17
35
5
2
8
8
6
163
0
50
100
150
200

2.4 Workshop Participant List

(See e-mail attached file)

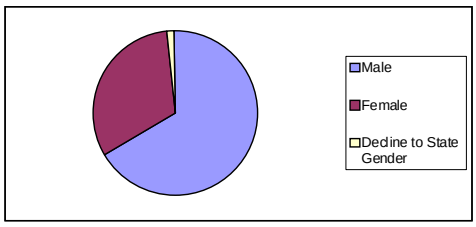
2.5 Workshop Participant Summary

Name of Activity	No. of Participants	No. of Citizens & Permanent Residents	% of Citizens & Permanent Residents	No. of Female	No. of Decline to state Gender	% of Female (includes decline)	No. of Minorities	No. of Decline to state Ethnicity	% of Minorities (includes decline)	US Home Institution	% of US Home Institution
21 Scientific Workshops											
Algebraic Statistics	64	25	39%	15	1	23.4%	5	3	7.8%	42	66%
Broader Connections: Analysis on Singular Spaces	36	15	42%	12		33.3%	1	2	2.8%	26	72%
Broader Connections: Ergodic Theory and Additive Combinatorics	53	19	36%	17		32.1%	0	3	0.0%	27	51%
Classical Algebraic Geometry Today	166	67	40%	45	5	27.1%	7	13	4.2%	103	62%
CMI/MSRI Workshop: Modular Forms and Arithmetic	74	26	35%	12	1	16.2%	3	7	4.1%	56	76%
Combinatorial, Enumerative and Toric Geometry	175	74	42%	40	3	22.9%	11	14	6.3%	124	71%
Connections for Women: Algebraic Geometry and Related Fields	82	52	63%	56	1	68.3%	6	2	7.3%	65	79%
Discrete Rigidity Phenomena in Additive Combinatorics	64	17	27%	13		20.3%	4	5	6.3%	31	48%
Economic Games and Mechanisms to Address Climate Change	56	31	55%	9	1	16.1%	0	9	0.0%	49	88%
Elliptic and Hyperbolic Equations on Singular Spaces	72	34	47%	16	2	22.2%	4	7	5.6%	46	64%
International Conference on Cluster Algebras and Related Topics	15	4	27%	4		26.7%	1	2	6.7%	14	93%
Introduction to Ergodic Theory and Additive Combinatorics	60	24	40%	16		26.7%	0	8	0.0%	33	55%
Introductory Workshop on Analysis on Singular Spaces	52	20	38%	12		23.1%	1	4	1.9%	38	73%
Low Dimensional Topology	155	97	63%	30	3	19.4%	7	10	4.5%	112	72%
Macaulay 2 day	12	4	33%	3		25.0%	0	1	0.0%	6	50%
Mathematical Genomics	63	21	33%	19	2	30.2%	1	4	1.6%	58	92%
Modern Moduli Theory	156	55	35%	27	8	17.3%	2	17	1.3%	92	59%
Modern Perspectives in Applied Mathematics	16	4	25%	4		25.0%	0	3	0.0%	13	81%
Sage Days: Algebraic Geometry	33	16	48%	9		27.3%	4		12.1%	16	48%
Topology of Stratified Spaces	45	20	44%	3		6.7%	1	7	2.2%	29	64%
Western Algebraic Geometry Seminar	19	7	37%	3		15.8%	0	1	0.0%	13	68%
21 Scientific Workshops Total	**1468**	**632**	**43%**	**365**	**27**	**25%**	**58**	**122**	**4%**	**993**	**68%**
6 Outreach & Diversity Workshops											
Bay Area Circle for Teachers	29	16	55%	13		44.8%	0		0.0%	11	38%
Great Circles 2009	97	75	77%	51	1	52.6%	5	4	5.2%	91	94%
Math Institutes Modern Mathematics Workshop	49	22	45%	24		49.0%	11	1	22.4%	31	63%
Promoting Diversity at the Graduate Level in Mathematics: a National Forum	111	79	71%	68		61.3%	37	3	33.3%	108	97%
Teaching Undergraduates Mathematics	98	75	77%	52		53.1%	13	5	13.3%	89	91%
Using Partnerships to Strengthen Elementary Mathematics Teacher Education	61	37	61%	44		72.1%	10	2	16.4%	60	98%
6 Outreach & Diversity Workshops Total	**445**	**304**	**68%**	**252**	**1**	**57%**	**76**	**15**	**17%**	**390**	**88%**
All 27 Workshops Total	**1913**	**936**	**49%**	**617**	**28**	**32%**	**134**	**137**	**7%**	**1383**	**72%**

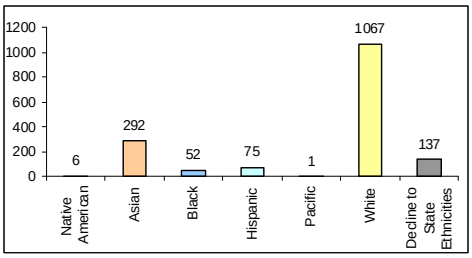
2.6 Workshop Participant Demographic Data

All Workshops Demographic Summary 2008-2009

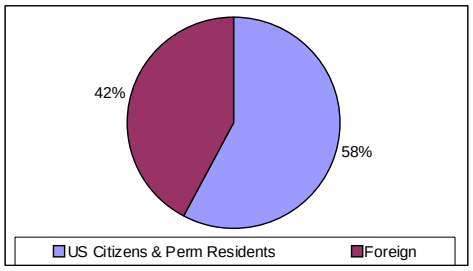
Gender	No.	% (No Decl.)*	%
No. of Participants	1913	100.00%	100.0%
Male	1268	67.27%	66.3%
Female	617	32.73%	32.3%
Decline to State Gender	28		1.5%



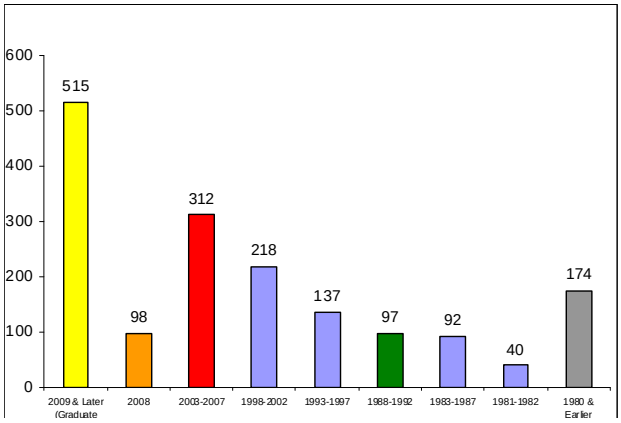
Ethnicities	No.	% (No Decl.)*	%
Native American	6	0.40%	0.3%
Asian	292	19.56%	15.3%
Black	52	3.48%	2.7%
Hispanic	75	5.02%	3.9%
Pacific	1	0.07%	0.1%
White	1067	71.47%	55.8%
Decline to State Ethnicities	137		7.2%
Unavailable Information	283		14.8%
Total no. of Participants	1913	100.00%	100.0%
Minorities	134	8.98%	7.0%



Citizenships	No.	% No Unavai)	%
US Citizens & Perm Residents	936	57.74%	48.9%
Foreign	685	42.26%	35.8%
Unavailable Information	292		15.3%
Total no. of Participants	1913	100.00%	100.0%
US Citizens	845		44.2%
Perm. Residents	91		4.8%
Home Inst. in US	1383		72.29%



Year of Ph.D	No.	% (No Unknown)	%
2009 & Later (Graduate Students)	515	30.60%	26.9%
2008	98	5.82%	5.1%
2003-2007	312	18.54%	16.3%
1998-2002	218	12.95%	11.4%
1993-1997	137	8.14%	7.2%
1988-1992	97	5.76%	5.1%
1983-1987	92	5.47%	4.8%
1981-1982	40	2.38%	2.1%
1980 & Earlier	174	10.34%	9.1%
Year Unknown	230		12.0%
Unavailable Info.	0		0.0%
Total	1913	100.00%	100.0%



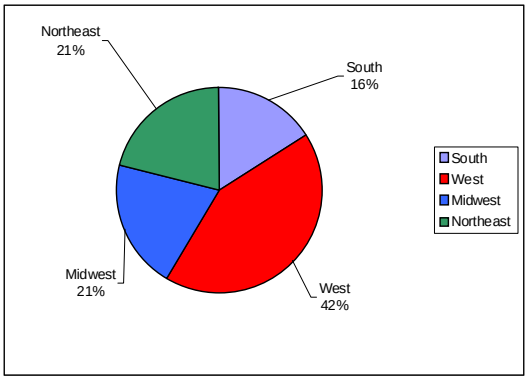
27 Workshops for 2008 - 2009

Algebraic Statistics
Bay Area Circle for Teachers
Broader Connections: Analysis on Singular Spaces
Broader Connections: Ergodic Theory and Additive Combinatorics
Classical Algebraic Geometry Today
CMI/MSRI Workshop: Modular Forms and Arithmetic
Combinatorial, Enumerative and Toric Geometry
Connections for Women: Algebraic Geometry and Related Fields
Discrete Rigidity Phenomena in Additive Combinatorics
Economic Games and Mechanisms to Address Climate Change
Elliptic and Hyperbolic Equations on Singular Spaces
Great Circles 2009
International Conference on Cluster Algebras and Related Topics
Introduction to Ergodic Theory and Additive Combinatorics
Introductory Workshop on Analysis on Singular Spaces
Low Dimensional Topology
Macaulay 2 day
Math Institutes Modern Mathematics Workshop
Mathematical Genomics
Modern Moduli Theory
Modern Perspectives in Applied Mathematics
Promoting Diversity at the Graduate Level in Mathematics: a National Forum
Sage Days: Algebraic Geometry
Teaching Undergraduates Mathematics
Topology of Stratified Spaces
Using Partnerships to Strengthen Elementary Mathematics Teacher Education
Western Algebraic Geometry Seminar

Home Institution Classified by States

****Regions based on US Census classification***

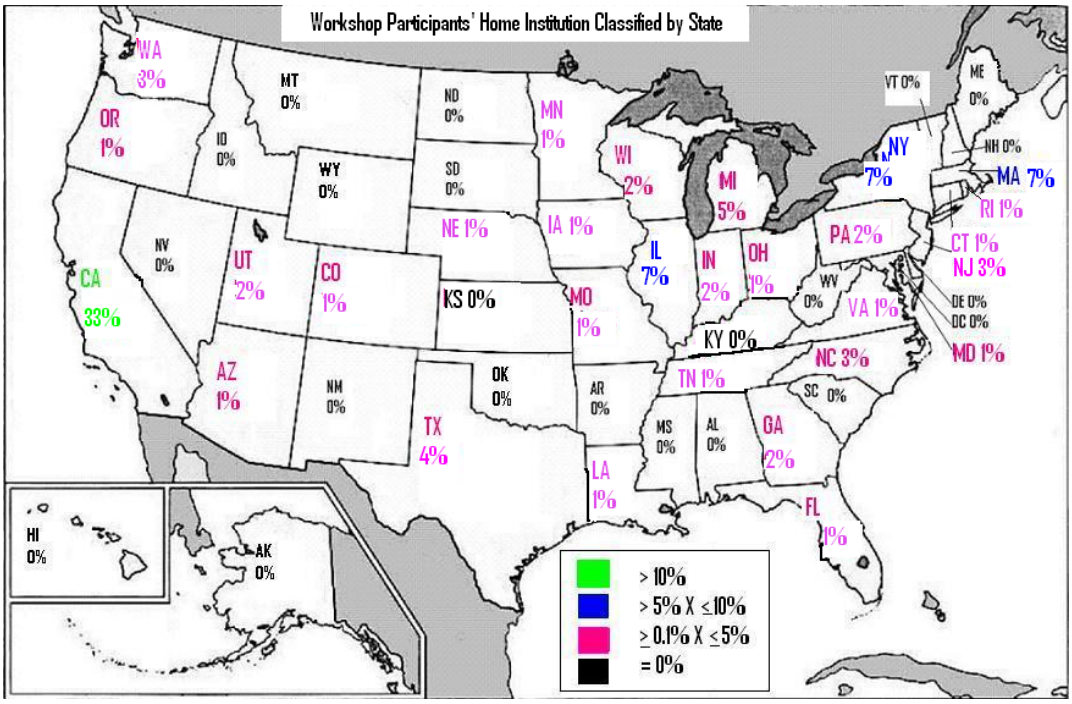
State	#	%	US Pop. (2007 Census)
South	**223**	**16.1%**	**36.6%**
AL	-	0.0%	1.5%
AR	-	0.0%	0.9%
DE	-	0.0%	0.3%
DC	6	0.4%	0.2%
FL	20	1.4%	6.1%
GA	31	2.2%	3.2%
KY	-	0.0%	1.4%
LA	19	1.4%	1.4%
MD	14	1.0%	1.9%
MS	3	0.2%	1.0%
NC	40	2.9%	3.0%
OK	1	0.1%	1.2%
SC	2	0.1%	1.5%
TN	11	0.8%	2.0%
TX	57	4.1%	7.9%
VA	18	1.3%	2.6%
WV	1	0.1%	0.6%
West	**584**	**42.2%**	**23.2%**
AK	-	0.0%	0.2%
AZ	20	1.4%	2.1%
CA	454	32.8%	0.4%
CO	18	1.3%	0.5%
HI	1	0.1%	0.3%
ID	1	0.1%	12.1%
MT	-	0.0%	1.6%
NV	4	0.3%	0.9%
NM	5	0.4%	0.7%
OR	9	0.7%	1.2%
UT	27	2.0%	0.9%
WA	45	3.3%	2.1%
WY	-	0.0%	0.2%
Midwest	**285**	**20.6%**	**22.0%**
IL	97	7.0%	4.3%
IN	22	1.6%	2.1%
IA	11	0.8%	1.0%
KS	6	0.4%	0.9%
MI	70	5.1%	3.3%
MN	15	1.1%	1.7%
MO	17	1.2%	1.9%
ND	2	0.1%	0.2%
NE	9	0.7%	0.6%
OH	15	1.1%	3.8%
SD	-	0.0%	0.3%
WI	21	1.5%	1.9%
Northeast	**291**	**21.0%**	**18.1%**
CT	15	1.1%	1.2%
ME	4	0.3%	0.4%
MA	100	7.2%	2.1%
NH	1	0.1%	0.4%
NJ	47	3.4%	2.9%
NY	90	6.5%	6.4%
PA	24	1.7%	4.1%
RI	8	0.6%	0.4%
VT	2	0.1%	0.2%
Other	**-**	**0.0%**	**0%**
PR	-	0.0%	0%
Other	-	0.0%	0%
Total	**1,383**	**100.0%**	**100.0%**

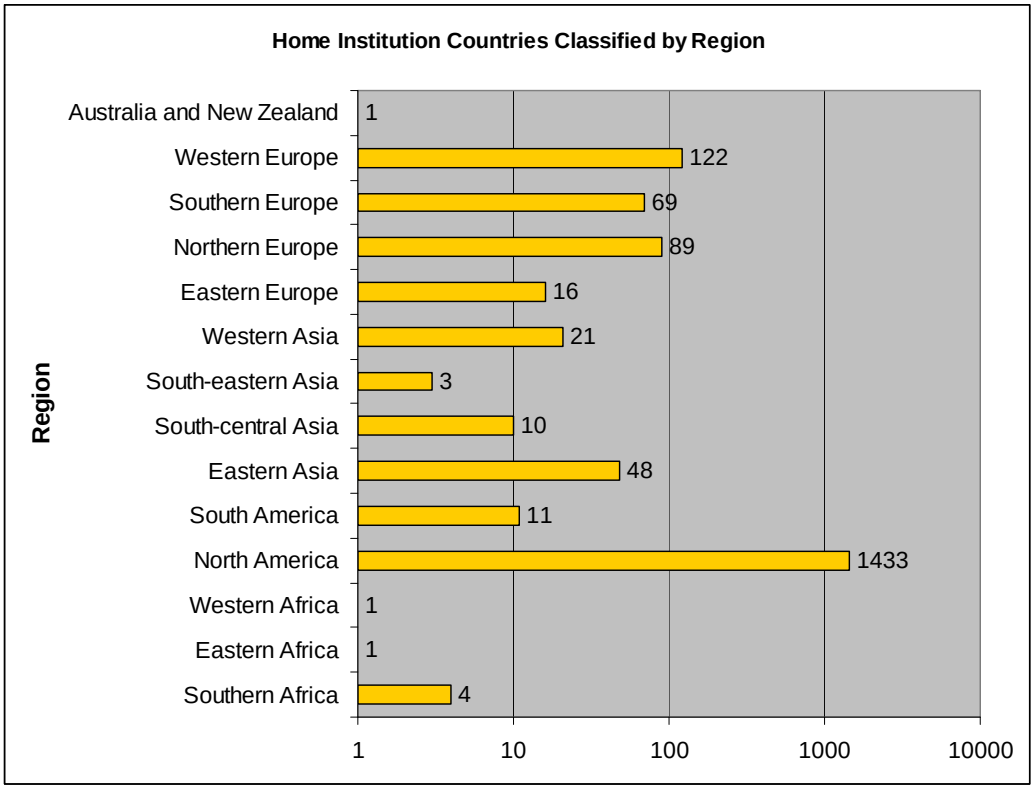


Home Institution Classified by Countries

**Regions based on United Nations' classification*

Region	Area	Country	# of Attendees
Africa			**6**
	Southern Africa		
		South Africa	4
	Eastern Africa		
		Uganda	1
	Western Africa		
		Nigeria	1
Americas			**1444**
	North America		
		Canada	50
		United States	1383
	South America		
		Argentina	2
		Brazil	5
		Chile	4
Asia			**82**
	Eastern Asia		
		China	3
		Japan	30
		Korea, Republic Of	14
		Taiwan	1
	South-central Asia		
		India	8
		Iran, Islamic Republic Of	2
	South-eastern Asia		
		Philippines	3
	Western Asia		
		Israel	14
		Turkey	7
Europe			**296**
	Eastern Europe		
		Bulgaria	1
		Belarus	1
		Czech Republic	3
		Hungary	4
		Poland	3
		Romania	4
	Northern Europe		
		Finland	2
		United Kingdom	74
		Norway	6
		Sweden	7
	Southern Europe		
		Albania	4
		Spain	16
		Italy	46
		Portugal	3
	Western Europe		
		Austria	2
		Switzerland	5
		Germany	67
		France	46
		Luxembourg	1
		Netherlands	1
Oceania			**1**
	Australia and New Zealand		
		Australia	1
Unavailable Information			84
Grand Total			**1913**


Workshop Participants' Home Institution Classified by State
WA 3%
OR 1%
CA 33%
ID 0%
NV 0%
MT 0%
WY 0%
UT 2%
AZ 1%
CO 1%
NM 0%
ND 0%
SD 0%
NE 1%
KS 0%
OK 0%
TX 4%
MN 1%
IA 1%
MO 1%
AR 0%
LA 1%
WI 2%
IL 7%
MS 0%
MI 5%
IN 2%
OH 1%
KY 0%
TN 1%
AL 0%
GA 2%
FL 1%
SC 0%
NC 3%
WV 0%
VA 1%
PA 2%
NY 7%
VT 0%
ME 0%
NH 0%
MA 7%
RI 1%
CT 1%
NJ 3%
DE 0%
DC 0%
MD 1%
HI 0%
AK 0%
> 10%
> 5% X ≤ 10%
≥ 0.1% X ≤ 5%
= 0%


Home Institution Countries Classified by Region
Region
Australia and New Zealand 1
Western Europe 122
Southern Europe 69
Northern Europe 89
Eastern Europe 16
Western Asia 21
South-eastern Asia 3
South-central Asia 10
Eastern Asia 48
South America 11
North America 1433
Western Africa 1
Eastern Africa 1
Southern Africa 4
1
10
100
1000
10000

2.7 Program Publication List

Last Name	First Name	Publication Title	Co-Authors	Status
Albin	Pierre	Pseudodifferential operators on spaces with iterated conic singularities and Hodge theory	Rafe Mazzeo, Richard Melrose	appeared
Asok	Aravind	A^1-homotopy groups, excision, and solvable quotients	Brent Doran	appeared
Bayer	Arend	Polynomial Bridgeland stability conditions and the large-volume limit		appeared
Bayer	Arend	Polynomial Bridgeland stability conditions and the large-volume limit		appeared
Chen	Dawei	Towards Mori's program for the moduli space of stable maps	Izzet Coskun, Charley Crissman	appeared
Derenthal	Ulrich	Manin's conjecture for a cubic surface with D5 singularity	T. D. Browning	appeared
Derenthal	Ulrich	Counting integral points on universal torsors		appeared
Doran	Brent	A^1-homotopy groups, excision, and solvable quotients	Aravind Asok	appeared
Einsiedler	Manfred	A joinings classificiation in positive characterisitc	Amir Mohammadi	appeared
Farsi	Carla	Orbifold fundamental group and the spectrum of the Laplacian		appeared
Kovács	Sándor	The structure of surfaces and threefolds mapping to the moduli stack	Kebekus	appeared
Kovács	Sándor	Recent advances in classification theory	Christopher Hacon	appeared
Kovács	Sándor	Moduli of canonically polarized varieties	Kollar	appeared
Melrose	Richard	Microlocal propagation near radial points and scattering for symbolic potentials of order zero	Andrew Hassell and Andr\'as Vasy	appeared
Ponge	Raphael	Logarithmic singularities of Schwartz kernels and local invariants of conformal and CR structures		appeared
Ponge	Raphael	Logarithmic singularities of Schwartz kernels and local invariants of conformal and CR structures		appeared
Ponge	Raphael	Traces on pseudodifferential operators and sums of commutators		appeared
Ponge	Raphael	Traces on pseudodifferential operators and sums of commutators		appeared
Ponge	Raphael	A microlocal approach to Fefferman's program in conformal and CR geometry		appeared
Ponge	Raphael	A microlocal approach to Fefferman's program in conformal and CR geometry		appeared
Qian	Randy	Propagation of Singularities of the Wave Equation with Inverse Square Potential		appeared
Qian	Randy	Propagation of Singuarlities on Cusp Manifolds		appeared

Rojas	J. Maurice	Sums of Squares, Randomization, and Sparse Polynomials	Osbert Bastani, Chris Hillar, and Dimitar Popov	appeared
Rojas	J. Maurice	Sums of Squares, Randomization, and Sparse Polynomials	Osbert Bastani, Chris Hillar, and Dimitar Popov	appeared
Rojas	J. Maurice	Faster Real Feasibility via Circuit Discriminants	Frederic Bihan and Casey Stella	appeared
Rojas	J. Maurice	Faster Real Feasibility via Circuit Discriminants	Frederic Bihan and Casey Stella	appeared
Sandoval	Mary	Wave Trace Invariants for G-Invariant Spectrum		appeared
Trotman	David	Equisingularity of sections, (t^r) condition, and the integral closure of modules	Terence Gaffney and Leslie Wilson	appeared
Abramovich	Dan	Stable varieties ith a twist	Brendan Hassett	distributable
Abramovich	Dan	Orbifold techniques in degeneration formulas	Barbara Fantechi	distributable
Abramovich	Dan	Relative and orbifold Gromov-Witten invariants	Charles Cadman and Jonathan Wise	distributable
Alexeev	Valery	Compactifications of moduli of Campedelli and Burniat surfaces	Rita Pardini	distributable
Alper	Jarod	On the local quotient structure of Artin stacks		distributable
Alper	Jarod	Local properties of good moduli spaces		distributable
Alper	Jarod	Stack-theoretic proof of Luna's etale slice theorem		distributable
Araujo	Carolina	Polarized minimal families of rational curves and higher Fano manifolds	Ana-Maria Castravet	distributable
Araujo	Carolina	Flat deformations of P^n		distributable
Asok	Aravind	Smooth varieties up to A^1-homotopy and algebraic h-cobordisms	Fabien Morel	distributable
Asok	Aravind	Almost vector bundles		distributable
Asok	Aravind	Birational invariants and A^1-connectedness	Fabien Morel	distributable
Bahuaud	Eric	Conformal compactification of Asymptotically locally hyperbolic metrics	Romain Gicquaud (Montpellier, France)	distributable
Baskin	Dean	A parametrix for the Klein-Gordon equation on asymptotically de Sitter spaces		distributable
Bauer-Catanese	Ingrid	Quotients of a product of curve by a finite group and their fundamental groups	F. Catanese, F. Grunewald, R. Pignatelli	distributable
Bruening	Jochen	On the spectral theory of armchair nanotubes	A. Badanin, E. Korotyaev	distributable
Bruening	Jochen	Scattering theory for the Helmholtz resonator	B. Pavlov	distributable
Bruening	Jochen	On the gluing formula for the analytic torsion	X. Ma	distributable
Bryan	Jim	BPS states of polyhedral resolutions	Gholampour	distributable
Buch	Anders	A Giambelli formula for isotropic Grassmannians	Andrew Kresch and Harry Tamvakis	distributable
Caporaso	Lucia	Torelli theorem for stable curves	Filippo Viviani	distributable

Castravet	Ana-Maria	Polarized minimal families of rational curves and higher Fano manifolds	Carolina Araujo	distributable
Catanese	Fabrizio	Quotients of products of curves, new surfaces with p_g = 0 and their fundamental groups	Ingird Bauer, Fritz Grunewald, Roberto Pignatelli	distributable
Cavalieri	Renzo	An example of CRC in two steps	Gueorgui Todorov	distributable
Coskun	Izzet	Towards Mori's program for Kontsevich moduli spaces	Dawei Chen	distributable
de Fernex	Tommaso	Shokurov's ACC conjecture for log canonical thresholds on smooth varieties	Lawrence Ein and Mircea Mustata	distributable
Degeratu	Anda	McKay Correspondence in higher dimension		distributable
Di Rocco	Sandra	Algebraic C*-actions and the inverse kinematic problem of a general 6R manipulator.	D. Eklund, A.J. Sommese, C. Wampler	distributable
Einsiedler	Manfred	Rigidity of measures invariant under semisimple groups in positive characteristic	Anish Ghosh	distributable
Fantechi	Barbara	Gromov Witten degenerate and relative invariants for orbifolds	Dan Abramovich	distributable
Farkas	Gavril	The gepmetry of the odd spin moduli space	Katharina Ludwig, Alessandro Verra	distributable
Francsics	Gabor	An explicit fundamental domain for a Picard modular group in two complex dimensions	Peter Lax	distributable
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Francsics	Gabor	An explicit fundamental domain for a Picard modular group in two complex dimensions	Peter Lax	distributable
Francsics	Gabor	Embedded eigenvalues for a class of complex hyperbolic spaces	Peter Lax	distributable
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Freiman	Gregory	Inverse Additive Number Theory XII		distributable
Gamburd	Alexander	Expanders and random wlks in SL_d(Z/p^n Z): II	Jean Bourgain	distributable
Gimperlein	Heiko	Adaptive FE-BE Coupling for Strongly Nonlinear Transmission Problems with Coulomb Friction	Matthias Maischak, Elmar Schrohe, Ernst P. Stephan	distributable
Gimperlein	Heiko	Adaptive FE-BE Coupling for Strongly Nonlinear Transmission Problems with Coulomb Friction	Matthias Maischak, Elmar Schrohe, Ernst P. Stephan	distributable

Glasner	Moshe (Eli)	A topological lens for a measure-preserving system	Lemanczyk and Benjamin Weiss	distributable
Greb	Daniel	Compact Kaehler quotients of algebraic varieties and Geometric Invariant Theory		distributable
Greb	Daniel	Rational singularities and quotients by holomorphic group actions		distributable
Grubb	Gerd	Krein resolvent formulas for elliptic boundary problems in nonsmooth domains	0	distributable
Guillarmou	Colin	Millson formula for convex co-compact manifolds	J. Park, S. Moroianu	distributable
Gyarmati	Kati	On family complexity		distributable
Hacon	Christopher	The Sarkisov Program	J. McKernan	distributable
Hassett	Brendan	Stable varieties with a twist	Dan Abramovich	distributable
Helfgott	Harald	On the behaviour of root numbers in families of elliptic curves		distributable
Holm	Tara	The Full Orbifold K-theory of Abelian Symplectic Quotients.	Rebecca Goldin, Megumi Harada, Takashi Kimura	distributable
Host	Bernard	Nilsequences and a topological structure theorem	Bryna Kra, Alejandro Maass	distributable
Kaloghiros	Anne-Sophie	A classification of terminal quartic 3-folds.		distributable
Kra	Bryna	Nilsequences and a topological structure theorem	Bernard Host, Alejandro Maass	distributable
Krainer	Thomas	Trace Expansions for Elliptic Cone Operators I	J. Gil and G. Mendoza	distributable
Lemanczyk	Mariusz	A topological lens for a measure-preserving system	E. Glasner, B. Weiss	distributable
Lemanczyk	Mariusz	Approximate transitivity property and Lebesgue spectrum	H. Abdalaoui	distributable
Lesigne	Emmanuel	Averages on annuli of Euclidean Space	Francois Havard	distributable
Li	Hui	tentative title: cohomology $\CP^2$ and $\tilde G_2(\R^{2n+1})$	Sue Tolman	distributable
Marcolli	Matilde	Modular index invariants of Mumford curves	Alan Carey and Adam Rennie (Australian National University)	distributable
Mazzeo	Rafe	A heat invariant anomaly on polygons	Julie Rowlett	distributable
Mazzucato	Anna	Vanishing viscosity limits for a class of circular pipe flows and realted singular perturbation problems	Michael Taylor	distributable
McDonald	Patrick	Heat content, moment problems and isospectral conditions		distributable
McKernan	James	The Sarkisov Program	Christopher Hacon	distributable
Melrose	Richard	Diffraction of singularities for the wave equation on manifolds with corners	Andr\'as Vasy and Jared Wunsch	distributable
Melrose	Richard	Adiabatic limit of the Chern character and Bott periodicity	Fr\'ed\'eric Rochon	distributable

Melrose	Richard	Asymptotics of solutions of the wave equation on de Sitter-Schwarzschild space	Ant\^onio S\'a Barreto and Andr\'as Vasy	distributable
Melrose	Richard	Analytic continuation and semiclassical resolvent estimates on asymptotically hyperbolic spaces	Ant\^onio S\'a Barreto and Andr\'as Vasy	distributable
Melrose	Richard	Scattering configuration spaces	Michael Singer	distributable
Morrison	Ian	New Grobner Techniques for Hilbert Stability	David Swinarski	distributable
Müller	Werner	Scattering theory and cohomology	Alexander Strohmaier	distributable
Müller	Jörn	Hodge cohomology of manifolds with fibred cusps		distributable
Olsson	Martin	Nagata compactification for algebraic spaces	Max Lieblich and Brian Conrad	distributable
Olsson	Martin	Compactifying moduli spaces for G-torsors		distributable
Ottaviani	Giorgio	On the hypersurface of Luroth quartics	E. Sernesi	distributable
Pete	Gabor	The scaling limits of dynamical and near-critical percolation and the minimal spanning tree	Christophe Garban, Oded Schramm	distributable
Planchon	Fabrice	a poor man's square function on domains	Oana Ivanovici	distributable
Reid	Miles	Anyone know these guys?	Gavin Brown	distributable
Rochon	Frederic	Some index formulae on the moduli space of stable parabolic bundles	Pierre Albin	distributable
Rochon	Frederic	The adiabatic limit of the Chern Character and Bott periodicty	Richard Melrose	distributable
Rojas	J. Maurice	Optimization and NP_R-Completeness of Certain Fewnomials	Philippe Pebay and David C. Thompson	distributable
Rojas	J. Maurice	Optimization and NP_R-Completeness of Certain Fewnomials	Philippe Pebay and David C. Thompson	distributable
Ross	Julius	Stability of Orbifolds	Richard Thomas	distributable
Ross	Julius	Bergman Kernels for Orbifolds	Richard Thomas	distributable
Roy	Emmanuel	Joining primeness and disjointness from infinitely divisible systems	Mariusz Lemanczyk, Francois Parreau	distributable
Roy	Emmanuel	ID-disjointness, factorization and filtering of stationary ID processes		distributable
Rydh	David	Noetherian approximation of algebraic spaces and stacks		distributable
Sá Barreto	Antônio	Asymptotics of Solutions of the wave equation on de Sitter-Schwarzschild Space	R. Melrose and A. Vasy	distributable
Sanders	Tom	Non-abelian Freiman theorems		distributable
Schumacher	Georg	Positivity of the relativ canonical bundle		distributable
Schwede	Karl	Divisors on globally F-regular varieties (subject to change)	Karen Smith	distributable
Singer	Michael	Scattering configuration spaces	Richard Melrose	distributable
Skjelnes	Roy	Algebraic spaces and quotients by equivalence relations of schemes		distributable

Tamvakis	Harry	A Giambelli formula for isotropic Grassmannians	Anders Buch, Andrew Kresch	distributable
Tataru	Daniel	Local energy decay for Kerr waves	M. Tohaneanu	distributable
Taylor	Michael	Pseudodifferential Operators: Four Lectures at MSRI		distributable
Tevelev	Jenia	Hypergraph Curves and Divisors on M_{0,n}	Ana-Maria Castravet	distributable
Thomas	Richard	Weighted projective embeddings and orbifold constant scalar curvature Kahler metrics	Julius Ross	distributable
Todorov	Gueorgui	An example of crepant resolution conjecture in two steps	Renzo Cavalieri	distributable
Totaro	Burt	Line bundles with partially vanishing cohomology		distributable
Trotman	David	Smooth fibering conjecture for Whitney stratified sets.	Andrew du Plessis and Claudio Murolo	distributable
Tseng	Hsian-Hua	Gromov-Witten theory of product stacks	Elena Andreini, Yunfeng Jiang	distributable
Tseng	Hsian-Hua	Gromov-Witten theory of etale gerbes, I: root gerbes	Elena Andreini, Yunfeng Jiang	distributable
Vasy	András	Asymptotics of solutions of the wave equation on de Sitter-Schwarzschild space	Richard Melrose, Antonio Sa Barreto	distributable
Weiss	Benjamin	The Isomorphism probblem in ergodic theory	M. Foreman , D. Rudloph	distributable
Weiss	Benjamin	The Isomorphism probblem in ergodic theory	M. Foreman , D. Rudloph	distributable
Wickelgren	Kirsten	Lower central series obstructions to homotopy sections of curves over a number field (Thesis)		distributable
Wlodarczyk	Jaroslaw	Combinatorial part of cohomology	Donu Arapura, Parsa Bakhtary	distributable
Wolf	Julia	Subsets of F_p^n not containing any k-term progressions	Y. Lin	distributable
Wunsch	Jared	Microlocal analysis and evolution equations		distributable
Xu	Chenyang	Products, Homotopy Limits and Applications	Amit Hogadi	distributable
Aluffi	Paolo	Limits of PGL(3)-translates of plane curves, I	Carel Faber	submitted
Aluffi	Paolo	Limits of PGL(3)-translates of plane curves, II	Carel Faber	submitted
Aluffi	Paolo	Parametric Feynman integrals and determinant hypersurfaces	Matilde Marcolli	submitted
Aluffi	Paolo	Algebra: Chapter 0		submitted
Andreatta	Marco	On the Kummer Construction	J.A. Wisniewski	submitted
Austin	Tim	Deducing the multidimensional Szemeredi Theorem from an infinitary removal lemma		submitted
Bauer-Catanese	Ingrid	The rationality of the moduli space of genus 4 curves endowed with an order three subgroup of their Jacobian	Alessandro Verra	submitted
Bayer	Arend	Quantum Cohomology of [C^N/mu_r]	Charles Cadman	submitted
Bayer	Arend	Quantum Cohomology of [C^N/mu_r]	Charles Cadman	submitted

Beheshti Zavareh	Roya	non-uniruledness results for the spaces of rational curves on hypersurfaces		submitted
Beiglböck	Mathias	Rado's Theorem in D-sets	Vitaly Bergelson, Tomasz Downarowizs, Alexander Fish	submitted
Bruening	Jochen	The signature operator on a manifold with one conical stratum	R.T. Seeley	submitted
Bruening	Jochen	Leonhard Euler in Berlin		submitted
Bryan	Jim	The quantum McKay correspondence for polyhedral singularities	Gholampour	submitted
Buch	Anders	Quantum K-theory of Grassmannians	Leonardo Mihalcea	submitted
Caporaso	Lucia	Torelli theorem for graphs and tropical curves	Filippo Viviani	submitted
Cautis	Sabin	Derived equivalences for cotangent bundles of Grassmannians via categorical sl(2) actions	J. Kamnitzer, A. Licata	submitted
Cautis	Sabin	Coherent sheaves and categorical sl(2) actions	J. Kamnitzer, A. Licata	submitted
Cautis	Sabin	Categorical geometric skew Howe duality	J. Kamnitzer, A. Licata	submitted
Cavalieri	Renzo	Tautological Pairings for moduli spaces of Curves	Stephanie Yang	submitted
Chen	Dawei	Linear series on ribbons		submitted
Christiansen	Tanya	Maximal order of growth for The resonance counting functions for generic potentials in even dimensions	Peter Hislop	submitted
Christianson	Hans	Local smoothing effects for the water-wave problem with surface tension	Vera Mikyoung Hur and Gigliola Staffilani	submitted
Chu	Qing	Convergence of multiple ergodic averages along cubes for several commuting transformations		submitted
Corti	Alessio	The Work of Hacon and McKernan		submitted
Coskun	Izzet	Stable base locus decompositions of Kontsevich moduli spaces	Dawei Chen	submitted
Coskun	Izzet	A Littlewood-Richardson rule for partial flag varieties		submitted
Dencker	Nils	On the solvability of systems of pseudodifferential operators		submitted
Derenthal	Ulrich	Manin's conjecture for a quartic del Pezzo surface with A4 singularity	T. D. Browning	submitted
Di Rocco	Sandra	Classifying polytopes via toric fibrations	A. Dickenstein and R. Piene	submitted
Dryden	Emily	Bounding the eigenvalues of the Laplace-Beltrami operator on compact submanifolds	Bruno Colbois and Ahmad El Soufi	submitted
Edidin	Dan	Logarithmic Trace and orbifold products	Tyler Jarvis, Takashi Kimura	submitted

Einsiedler	Manfred	Rigidity of measures invariant under the action of a multiplicative semigroup of rigidity of measures invariant under the action of a multiplicatie semigroup of plonomial growth on T	Alexander Fish	submitted
Faber	Carel	Limits of PGL(3)-translates of plane curves, I	Paolo Aluffi	submitted
Faber	Carel	Limits of PGL(3)-translates of plane curves, II	Paolo Aluffi	submitted
Fantechi	Barbara	Virtual Grothendieck Riemann Roch Theorems	Lothar Goettsche	submitted
Ferenczi	Sebastien	A self-dual induction for three-interval exchange transformations	L.F.C. da Rocha	submitted
Francsics	Gabor	An explicit fundamental domain for a Picard modular group in two complex dimensions	Peter Lax	submitted
Freiman	Gregory	Inverse Additive Number Theory XI		submitted
Gaffney	Terence	Equisingularity of sections, (t^r) condition, and the integral closure of modules.	Trotman, Wilson	submitted
Gaffney	Terence	The Multiplicity Polar Theorem and Isolated Singularities		submitted
Gaffney	Terence	Weak subintegral closure of ideals.	Marie A. Vitulli	submitted
Gibney	Angela	Equations	Maclagan	submitted
Gibney	Angela	Equations for $\overline{M}_{0,n}$	Diane Maclagan	submitted
Goettsche	Lothar	Riemann-Roch Theorems and elliptic genus for virtually smooth schemes	Barbara Fantechi	submitted
Graham	William	Smooth components of Springer fibers	Roger Zierau	submitted
Grieser	Daniel	Pseudodifferential operator calculus for generalized Q-rank 1 locally symmetric spaces, I	Eugenie Hunsicker	submitted
Grubb	Gerd	Distributions and Operators	0	submitted
Hall	Jack	Towards a classification of modular compactifications of the moduli space of curves	David Smyth	submitted
Hering	Milena	Multigraded regularity and the Koszul property		submitted
Hogadi	Amit	Brauer Group of Moduli Spaces of PGL(r)-Bundles over a curve	Indranil Biswas	submitted
Host	Bernard	Ergodic seminorms for commuting transformations and applications		submitted
Hulek	Klaus	Cohomology of the toroidal compactification of A_3	Orsola Tommasi	submitted
Hunsicker	Eugenie	Pseudodifferential operators on generalized Q-rank 1 locally symmetric spaces, I	Daniel Grieser	submitted
Jabbusch	Kelly	Positive sheaves of differentials coming from coarse moduli spaces	Stefan Kebekus	submitted
Jabbusch	Kelly	Families over special base manifolds and a conjecture of Campana	Stefan Kebekus	submitted
Johnson	Jennifer	How Small Can A Polynomial Be Near Infinity?	J. Koll\'ar	submitted
Kaloghiros	Anne-Sophie	The defect of Fano 3-folds		submitted

Kaufmann	Ralph	Global Stringy Orbifold Cohomology, K-theory and deRham Theory		submitted
Kebekus	Stefan	Families over special base manifolds and a conjecture of Campana	Kelly Jabbusch	submitted
Kebekus	Stefan	Positive sheaves of differentials coming from coarse moduli spaces	Kelly Jabbusch	submitted
Kebekus	Stefan	Deformations along subsheaves	Stavros Kousidis, Daniel Lohmann	submitted
Kollár	János	Log canonical singularities are Du Bois	S Kovacs	submitted
Kollár	János	How small can a polynomial be at infinity?	J Johnson	submitted
Kollár	János	Quotients by finite equivalence relations	C Raicu	submitted
Kovács	Sándor	Log canonical singularities are Du Bois	Janos Kollar	submitted
Kovács	Sándor	Boundedness of families of canonically polarized manifolds: A higher dimensional analogue of Shafarevich’s conjecture	Max Lieblich	submitted
Kovács	Sándor	Extension theorems....	Greb, Kebekus	submitted
Lemanczyk	Mariusz	Joining primeness and disjointness from infinitely divisible systems	F. Parreau, E. Roy	submitted
Lemanczyk	Mariusz	Some new cases of realization of spectral multiplicity function for ergodic transformations	A.B. Katok	submitted
Lesigne	Emmanuel	Powers of sequences and convergence of ergodic averages	Nikos Frantzikinakis, Michael Johnson, Mate Wierdl	submitted
Lesigne	Emmanuel	On the Behavior at Infinity of an On the behaviour at infinity of an integrable function		submitted
Lieblich	Max	Arithmetic aspects of moduli of vector bundles on curves		submitted
Lipman	Joseph	Reduction of derived Hochschild functors over commutative algebras and schemes.	Luchezar Avramov, Srikanth Iyengar	submitted
Lipman	Joseph	Reflexivity and rigidity for complexes. I. Commutative rings.	Luchezar Avramov, Srikanth Iyengar	submitted
Loya	Paul	Semiclassical Analysis and the Atiyah-Singer Index Theorem		submitted
Marcolli	Matilde	Cyclotomy and endomotives		submitted
Marcolli	Matilde	Parametric Feynman integrals and determinant hypersurfaces	Paolo Aluffi (Florida State University)	submitted
Marcolli	Matilde	Feynman integrals and motives		submitted
McClendon	David	An Ambrose-Kakutani theorem for countable-to-1 semiflows		submitted
Melrose	Richard	The index of projective families of elliptic operators: The decomposable case	V. Mathai and I.M. Singer	submitted
Melrose	Richard	Relative Chern character, boundaries and index formul\ae	Pierre Albin	submitted
Morrison	Ian	Stability of Elliptic Tails and 4-canonical Models	Donghoon Hyeon	submitted

Morrison	Ian	GIT Constructions of Moduli Spaces of Stable Curves and Maps		submitted
Olsson	Martin	The Picard group of M_{1,1}	William Fulton	submitted
Pete	Gabor	Scale-invariant groups	Volodymyr Nekrashevych	submitted
Pete	Gabor	Biased tug-of-war, the biased infinity Laplacian, and comparison with exponential cones	Yuval Peres, Stephanie Somersille	submitted
Quas	Anthony	Rates of divergence of nonconventional ergodic averages	Mate Wierdl	submitted
Reid	Miles	On quasismooth weighted complete intersections	Jheng-Jie Chen, Jungkai A. Chen and Meng Chen	submitted
Rosenblatt	Joseph	Distinguishing transforamtions by averaging methods		submitted
Rydh	David	Hilbert schemes and Hilbert stacks of points		submitted
Rydh	David	The space of generically etale families	Roy Skjelnes	submitted
Sá Barreto	Antônio	Inverse Problems For Einstein Manifolds	Colin Guillarmou	submitted
Saez Trumper	Mariel	Uniqueness of self-similar solutions to the network flow in a given topological class		submitted
Schwede	Karl	Centers of F-purity		submitted
Schwede	Karl	F-adjunction		submitted
Shkredov	Ilya	On monochromatic solutions of some nonlinear equations in Z/pZ		submitted
Smith	Gregory	Smooth and Irreducible Multigraded Hilbert Schemes	Diane Maclagan	submitted
Stanhope	Elizabeth	Spectral and geometric bounds on 2-orbifold diffeomorphism type	Emily Proctor	submitted
Stanhope	Elizabeth	RUI: Collaborative Research: Orbifold homotopy finiteness for isospectral sets of orbifolds with curvature bounded below	Emily Proctor	submitted
Tataru	Daniel	Trilinear restriction estimates	I. Bejenaru, S. Herr	submitted
Tataru	Daniel	L^2 wellposedness for the Zakharov system	I. Bejenaru, S. Herr, J. Holmer	submitted
Taylor	Michael	Functions of the Laplace operator on manifolds with lower Ricci and injectivity bounds		submitted
Thomas	Richard	Hilbert schemes and stable pairs: GIT and derived category wall crossings	Jacopo Stoppa	submitted
Tommasi	Orsola	Cohomology of the toroidal compactification of A_3	Klaus Hulek	submitted
Totaro	Burt	The cone conjecture for Calabi-Yau pairs in dimension two		submitted
Towsner	Henry	Epsilon Substitution and Priority Arguments		submitted
Tucker	Kevin	On the Number of Compatibly F-Split Subvarieties and Log Canonical Centers	Karl Schwede	submitted
Tziolas	Nikolaos	Smoothings of schemes with non-isolated singularities		submitted
Usnich	Alexandr	On the action of the Cremona group on non-commutative ring		submitted

Vakil	Ravi	Universal covers and fundamental groups in algebraic geometry as schemes	Kirsten Wickelgren	submitted
Vistoli	Angelo	Stacks of trigonal curves	Michele Bolognesi	submitted
Wickelgren	Kirsten	Universal covering spaces and fundamental groups in algebraic geometry as schemes	Ravi Vakil	submitted
Wisniewski	Jaroslaw	On the Kummer construction	Marco Andreatta	submitted
Wolf	Julia	A note on Elkin's improvement of Behrend's construction	B.J. Green	submitted
Wunsch	Jared	Diffraction of singularities for the wave equation on manifolds with corners	Richard Melrose, Andras Vasy	submitted
Xu	Chenyang	Weak Approximation for Low Degree del Pezzo Surfaces		submitted

3. Postdoctoral Fellows

The postdoctoral program at MSRI is central to MSRI's mission of continued excellence in mathematics research. MSRI organizes and hosts semester-long, and two-semester-long programs that, during the time of the program, become the leading edge in that field of study. MSRI's postdocs engage with fellow mathematicians from all over the world to develop their interests and contribute to the Science community. During the 2008-2009 academic year, MSRI selected 34 postdoctoral scholars with research interests in the programs that MSRI offers. 32 of those were NSF Postdoctoral Fellows, and 2 were funded the Viterbi Endowment. (MSRI received an endowment for postdoc support from the Viterbi Family Foundation that permits us to appoint two semester-long postdoctoral fellows each year).

There were many more excellent postdoc applicants than we could fund with our NSF Postdoctoral Fellowship (PD) budget line. The program organizers took additional funds from their allocated (NSF) budget to support an additional 37 participants that were within 5 years of having completed their Ph.D. Those were "Postdoc Research Members" (PD/RMs as opposed to NSF Postdoctoral Fellows) and received a per diem of $2,400 per month. While they were not monetarily compensated at the same level as the NSF Postdoctoral Fellows, they received all other privileges. That is, all Postdocs were assigned a mentor upon their arrival, they participated in a weekly Postdoc seminar, and they were a vibrant part of the research community. They also had the same logistic privileges (office, library access, bus pass, etc…)

Of the 71 Postdocs (PD+ PD/RM), 25% were female, and the 37 PD/RMs, 13 were female (35%). The numbers of US Citizen and Permanent Residents were 15 (44%) and 13 (35%), respectively. It is fair to say that all organizers were extremely satisfied with the Postdoctoral program and believed that it was by all accounts an enormous success. Looking at the Institution Placement list (below), one sees that, of the 23 NSF Postdocs who stayed in the US, 18 (78%) went on to Group I Universities, 3 went to Group II Universities, and 1 went to Group B, while the other went to the Redwood Center for Theoretical Neuroscience . Of the postdocs who were not US Citizens (or Permanent Residents), most went on to prestigious institutions, such as University of Cambridge, Zurich University, and Australian National University. **Here are additional details on the NSF Postdoctoral Fellows for each program.**

Analysis on Singular Spaces:

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Bahuaud, Eric	2007	University of Washington	I Public	Melrose, Richard	Universite Montpellier II	Foreign	Saint Mary's College	B	Postdoc
Christianson, Hans	2007	UC Berkeley	I Public	Wunsch, Jared	MIT	I Private	MIT	I Private	CLE Moore Instructor
Dryden, Emily	2004	Darthmouth College	II	Mazzeo, Rafe	Bucknell University	M	MIT	I Private	Visiting Scholar
Muller, Jorn	2008	University of Bonn	Foreign	Hunsicker, Eugenie	University of Bonn	Foreign	University of Bonn	Foreign	Assistant Professor
Rochon, Frederic	2005	MIT	I Private	Vasy, Andras	University of Toronto	Foreign	University of Toronto	Foreign	Assistant Professor

Eric Bahuaud

Eric received his Ph.D. from the University of Washington in 2007 under the supervision of John Lee. His dissertation was titled "Intrinsic Characterization of Asymptotically Hyperbolic Metrics." Bahuaud completed a paper (with Romain Gicquaud) on conformal compactification of asymptotically locally hyperbolic metrics, and began a project on the complex hyperbolic version of this problem; he interacted fruitfully with John Lee and Robin Graham on this subject during the workshop. He and Emily Dryden worked together studying Melrose's b-calculus of pseudodifferential operators under the tutelage of Paul Loya, and have embarked on a project to extend some estimates of Jeffres-Loya for the heat operator from conic manifolds to higher (edge) singularities. After his stay at MSRI, Eric Bahuaud went on to Saint Mary's College of California.

Hans Christianson

Hans received his Ph.D. from UC Berkeley in 2007 under the supervision of Maciej Zworski. His dissertation was titled "Quantum Monodromy and Non-Concentration near a Closed Semi-hyperbolic Orbit." Christianson completed a lengthy paper with Hur and Staffilani which breaks new ground in applying techniques imported from microlocal analysis to the water wave problem; the same authors began a further paper on Strichartz estimates for water waves. He began a project on random walks on manifolds with cusps jointly with Kiril Datchev (a UCB graduate student), Colin Guillarmou, Laurent Michel, and Frederic Naud. He undertook a joint project with Jeremy Marzuola on solitons for the nonlinear Schrodinger equation on hyperbolic space, as well as a project on semiclassical methods for the discrete damped wave equation. After his stay at MSRI, Hans went on to the Massachusetts Institute of Technology.

Emily Dryden

Emily received her Ph.D. from Dartmouth in 2004 under the supervision of Carolyn Gordon. Her dissertation was titled "Geometric and Spectral Properties of Compact Riemann Orbisurfaces." Dryden worked on a variety of projects, mostly centered around spectral theory of orbifolds; she undertook joint work with Eric Bahuaud, with Rafe Mazzeo, and with Patrick McDonald. She and Bahuaud spent time reading foundational material on singular spaces in an informal "reading course" and she reported that the semester enabled her to expand her research program to a wider geometric setting. After her stay at MSRI, Emily went on to Bucknell University.

Jörn Muller

Jörn received his Ph.D. from the University of Bonn in 2008. He was able to complete a paper based on his thesis, on Hodge cohomology of manifolds with fibred cusps, and began work on an L2 signature theorem. After his stay at MSRI, Jörn went on to the University of Bonn.

Frederic Rochon

Frederic received his Ph.D. from MIT in 2005 under the supervision of Richard Melrose. His dissertation was titled "Bott Periodicity for Fibred Cusp Operators." Rochon had a number of intense collaborations both underway and undertaken in the course of the semester. He completed joint papers in index theory and K-theory with Richard Melrose and with Pierre Albin, and undertook new projects with Melrose and with Albin and Clara Aldana. He reports that a casual conversation with Daniel Grieser on the subject of pushforward theorems at the beginning of the semester later led to decisive progress in his project with Albin on the index of d-bar operators acting on stable parabolic vector bundles of degree zero. After his stay at MSRI, Frederic went on to the University of Toronto.

Ergodic Theory and Additive Combinatorics:

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Fish, Alexander	2006	Hebrew University	Foreign	Lind, Doug	Ohio State University	I Public	Ohio State University	I Public	Assistant Professor
Hochman, Michael	2007	Hebrew University	Foreign	Kra, Bryna	Princeton University	I Private	Princeton University	I Private	Veblen Research Instructor
Pete, Gabor	2006	UC Berkeley	I Public	Wierdl, Mate	Microsoft Research	N/A	University of Toronto	Foreign	Coxeter Assistant Professor
Sanders, Tom	2007	University of Cambridge	Foreign	Kra, Bryna	University of Cambridge	Foreign	Institut Mittag-Leffler	Foreign	Member
Shkredov, Ilya	2005	Moscow State University	Foreign	Wierdl, Mate	Moscow State University	Foreign	Moscow State University	Foreign	Assistant Professor
Spencer, Craig	2008	University of Michigan	I Public	Green, Ben	IAS	N/A	Kansas State University	II	Assistant Professor
Towsner, Henry	2008	Carnegie Mellon University	I Private	Lesigne, Emmanuel	UCLA	I Public	UCLA	I Public	Hedrick Adjunct Assistant Professor
Wolf, Julia	2008	University of Cambridge	Foreign	Host, Bernard	Rutgers University	I Public	Rutgers University	I Public	Triennial Assistant Professor

Alexander Fish

Alexander received his Ph.D. from Hebrew University in Jerusalem in 2006 under the supervision of Harry Furstenberg. His dissertation was titled “Ramsey Properties of Subsets of N.” He was in residence for the entire semester. He worked on 2 topics: sumset phenomenon for amenable groups and measure rigidity for dilations of polynomial curves in nilmanifolds. He finished a paper joint with Michael Bjorklund on the second topic, and the paper was accepted for publication in PAMS (Proceedings of the AMS). Together with Mathias Beiglbock and Vitaly Bergelson, who both visited MSRI during the program, he wrote a preprint “Sumset phenomenon for countable amenable groups.” He also collaborated with Ilya Shkredov, another postdoc in residence. After his stay at MSRI, Alexander went on to the Ohio State University.

Michael Hochman

Michael received his Ph.D. from Hebrew University in Jerusalem in 2007 under the supervision of Benjamin Weiss. His dissertation was titled “Combinatorial Methods in Dynamical Systems.” He was in residence the entire semester. He completed work on Rohklin properties of the space of Zd actions on the Cantor set. He worked with Doug Lind, a senior member in residence, identifying the directions that can be the unique non-expansive direction for a topological Z2 action. He worked with Pablo Shmerkin on the projections of sets and measures and their dimensions, focusing on projections of products of sets and measures in R/Z that are invariant under ×2 and ×3 respectively. After his stay at MSRI, Michael went on to Princeton University.

Gabor Pete

Gabor received his Ph.D. from UC Berkeley in 2006 under the supervision of Yuval Peres. His dissertation was titled "Dependent Percolation, Critical Exponents, Anchored Isoperimetry and Random Walks." He was in residence for the entire semester. Gabor's main focus at MSRI was proving sparse Szemeredi type results: finding long arithmetic progressions in subsets of positive density inside sparse random sets. With Jozsef Balogh (UIUC), he developed an approach via a sparse hypergraph regularity lemma, but very recently, Conlon and Gowers have found a more elegant and universal method, so this project might get cancelled. With Pablo Shmerkin (MSRI) and Elchanan Mossel (UC Berkeley), Gabor is writing a paper about such questions in fractal percolation limit sets, improving recent results of Laba and Pramanik. In this setting, neither the Balogh-Pete nor the Conlon-Gowers method seems to work, so a more geometric approach is needed. G´abor is writing a paper with Amos Lapidoth (ETH Zürich) on some applications of additive combinatorics to information theory, and he is developing some ideas to prove a conjecture of Bergelson: a group is amenable if and only if any set of measurable recurrence is also of topological recurrence. Slightly related to the MSRI program, he finished a paper with Volodia Nekrashevych (Texas A&M) on scale-invariant groups, and is working on some applications of discrete Fourier analysis to statistical physics (joint with Christophe Garban (ENS Paris), Alan Hammond (NYU), Oded Schramm (Microsoft) and Jeff Steif (Chalmers)). Finally, G´abor finished a paper on using probabilistic game theory to understand a degenerate elliptic PDE, jointly with Yuval Peres (Microsoft) and Stephanie Somersille (UC Berkeley). After his stay at MSRI, Gabor went on to the University of Toronto.

Tom Sanders

Tom received his Ph.D. from the University of Cambridge in 2007 under the supervision of William Gowers. His dissertation was titled "Topics in Arithmetic Combinatorics." He was in residence for the entire semester and during this time worked in two areas. He worked on non-abelian analogs of the celebrated structural theorems of Freiman, and on improving estimates for the 'roughness' of integral valued functions on finite abelian groups. After his stay at MSRI, Tom went on to the Mittag-Leffler Institute.

Ilya Shkredov

Ilya received his Ph.D. from Moscow State University in 2005. He was in residence for the entire semester. Ilya Shkredov fruitful discussions with other MSRI members including Alexander Fish, Tom Sanders, Mathew Beiglbock, and Michael Boshernitzan. He gave an answer to a question of Mathew Beiglbock concerning some non-linear coloring problem in Z/pZ and wrote an article about that. In the near future, Ilya Shkredov and Alexander Fish will finish writing a joint paper on solution of some equations in normal sets. Also he finished his own project on dense sets without some two-dimensional configurations (more then 100 pages long paper). After his stay at MSRI, Ilya went on to Moscow State University.

Craig Spencer

Craig received his Ph.D. from the University of Michigan in 2008 under the supervision of Trevor Wooley and Donald Lewis. His dissertation was titled "Analytic Methods for Diophantine Problems." He was in residence for one month at MSRI. He will be an Assistant Professor at Kansas State University after finishing at IAS from September 2008 to July 2009. After his stay at MSRI, Craig went on to Kansas State University.

Henry Towsner

Henry received his Ph.D. from Carnegie Mellon University in 2008. He was in residence for the entire semester. During the semester at MSRI, Henry Towsner worked with Jeremy Avigad on "unwinding" the use of the Furstenberg-Zimmer structure theorem in proofs of Szemeredi's Theorem and its generalizations. A draft on the application to Szemeredi's Theorem is almost finished. He also began an investigation with Mathias Beiglb¨ock on converting proofs of combinatorial statements using ultrafilters into purely combinatorial proofs; the first result was a new proof of Hindman's Theorem. Finally, Towsner began investigating generalizations of the Furstenberg correspondence, developing a correspondence principle which preserves the Gowers uniformity norms. After his stay at MSRI, Henry went on to UCLA.

Julia Wolf

Julia received her Ph.D. from the University of Cambridge in 2008 under the supervision of William Gowers. Her dissertation was titled "Arithmetic Structure in Sets of Integers." She was in residence for the entire semester. During her time at MSRI Julia Wolf concentrated on using higher-order Fourier analysis to prove refined decomposition theorems for bounded functions in both cyclic groups and finite field geometries. This work, which was carried out in collaboration with W.T. Gowers (in residence at MSRI for two week s) led to rough drafts in both cases, with applications to counting solutions to certain systems of linear equations in these settings. She also submitted a note on Elkin's improvement of Behrend's construction with B.J. Green (in residence at MSRI for 5 weeks), and a second one on Behrend's construction for longer progressions in finite fields with Y. Lin (Stanford University). After her stay at MSRI, Julia went on to Rutgers University.

Algebraic Geometry:

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Alper, Jarod	2008	Stanford University	I Private	Vistoli, Angelo	Columbia University	I Private	Columbia University	I Private	Instructor
Araujo, Carolina	2004	Princeton University	I Private	Alexeev, Valery	IMPA	Foreign	IMPA	Foreign	Postdoc
Asok, Aravind	2006	Princeton University	I Private	Totaro, Burt	University of Washington	I Public	UCLA	I Public	Hedrick Assistant Professor
Bayer, Arend	2006	Max Planck Institut für Mathematik	Foreign	Behrend, Kai	University of Utah	I Public	University of Connecticut	II	Assistant Professor
Beheshti Zavareh, Roya	2003	MIT	I Private	Faber, Carel	Queen's University	Foreign	Washington University	I Public	Assistant Professor
Casalaina-Martin, Sebastian	2004	Columbia University	I Private	Kollar, Janos	Harvard University	I Private	University of Colorado at Boulder	II	Assistant Professor
Cautis, Sabin	2006	Harvard University	I Private	Abramovich,Dan	Rice University	I Private	Columbia University	I Private	Joseph Fels Ritt Assistant Professor
Chen, Dawei	2008	Harvard University	I Private	Vakil, Ravi	Harvard University	I Private	University of Illinois at Chicago	I Public	Research Assistant Professor
Easton, Robert	2007	Stanford University	I Private	Caporaso, Lucia	University of Utah	I Public	University of Utah	I Public	Assistant Professor
Greb, Daniel	2008	Ruhr-Universität Bochum	Foreign	Kovacs, Sandor	Mathematisches Institut der Universitaet zu Koeln	Foreign	Albert-Ludwigs-Universitaet Freiburg	Foreign	Assistant Professor
Hogadi, Amit	2007	Princeton University	I Private	Reid, Miles	Tata Institute of Fundamental Research	Foreign	Tata Institute of Fundamental Research	Foreign	Faculty Member
Kaloghiros, Anne-Sophie	2007	University of Cambridge	Foreign	Ein, Lawrence	University of Cambridge	Foreign	University of Cambridge	Foreign	Research Fellow
Laza, Radu	2006	Columbia University	I Private	Corti, Alessio	University of Michigan	I Public	Rice University	I Private	Assistant Professor
Oprea, Dragos	2005	MIT	I Private	Bryan, Jim	Stanford University	I Private	UCSD	I Public	Assistant Professor
Smyth, David	2008	Harvard University	I Private	Eisenbud, David	Harvard University	I Private	Harvard University	I Private	Junior Faculty

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Todorov, Gueorgui	2008	University of Utah	I Public	McKernan, James	University of Utah	I Public	Princeton University	I Private	Instructor
Tseng, Hsian-Hua	2005	UC Berkeley	I Public	Lee, Yuan-Pin	University of Wisconsin - Madison	I Public	Ohio State University	I Public	Assistant Professor
Usnich, Alexandr	2008	Université Pierre et Marie Curie - Paris 6	Foreign	Pandharipande, Rahul	Université Pierre et Marie Curie - Paris 6	Foreign	Zurich University	Foreign	Assistant Professor
Xu, Chenyang	2008	Princeton University	I Private	Kebekus, Stefan	MIT	I Private	MIT	I Private	C L E Moore Instructor

Jarod Alper

Jaror Alper received his Ph.D. from Stanford University in 2008 under the supervision of Ravi Vakil. His dissertation was titled "Good Moduli Spaces for Artin Stacks." At MSRI his mentor was AngeloVistoli. Jarod Alper worked on extending his thesis work on good moduli spaces in an attempt to give intrinsic constructions of moduli schemes parameterizing objects with non-finite automorphism groups. He worked on a project joint with David Smyth and Fred van der Wyck on giving moduli interpretations of log-canonical models of the moduli space of stable curves. After his stay at MSRI, Alper went on to Columbia University.

Carolina Araujo

Carolina Araujo received her Ph.D. from Princeton University in 2004 under the supervision of János Kollár. Her dissertation was titled "The Variety of Tangents to Rational Curves." At MSRI her mentor was Valery Alexeev. At MSRI she worked on a joint project with Ana-Maria Castravet about Fano manifolds with positive Chern characters. She also worked on a project concerning flat deformations of projective spaces. She gave a talk at the postdoc seminar. She also participated in a working group with other postdocs about rationally simply connected varieties. After her stay at MSRI, Carolina went on to IMPA.

Aravind Asok

Aravind Asok received his Ph.D. from Princeton University in 2004 under the supervision of Robert MacPherson. His dissertation was titled "Vector Bundles on Certain G-Varieties."
At MSRI his mentor was Burt Totaro. While at MSRI, Asok continued his collaborations with B. Doran (ETH, Zurich) and F. Morel (Ludwig-Maximallians Universitaet, Muenchen) regarding applications of techniques of homotopy theory to problems in algebraic geometry using the A1-homotopy theory developed by F. Morel and V. Voevodsky. The main accomplishment, joint with F. Morel, was a better understanding of some aspects of the Voevodsky-Rost theorem (nee Milnor conjecture) with applications to construction of unirational, non-rational varieties for which non-rationality is detected by specific "higher" cohomological obstructions. Furthermore, Asok contributed a short presentation at the MSRI Academic Sponsors day, and attended various informal seminars (e.g., the seminar on the de Jong-Starr work on rational simple connectivity) together with the various conferences. After his stay at MSRI, Aravind went on to UCLA.

Arend Bayer

Arend Bayer received his Ph.D. from Max Planck Institut für Mathematik in 2006 under the supervision of Yuri Manin. His dissertation was titled "Semisimple Quantum Cohomology, Deformations of Stability Conditions and the Derived Category." At MSRI his mentor was Kai Behrend. At the beginning of the semester, Arend Bayer gave two talks in the Post-Doc seminar that gave introductions to Bridgeland stability conditions and wall-crossing. Together with Emanuele Macri (University of Utah), he studied the space of stability conditions on the local P2. In this joint work, they determined topological properties of the space, and used it to prove a theorem on the autoequivalences of its derived category. For this project, Arend Bayer benefited directly from conversations with Richard Thomas and Hiroshi Iritani (Imperial College) at the MSRI. He started collaborations with Gueorgui Todorov (Princeton University) on stability conditions for higher-dimensional varieties, and with Renzo Cavalieri (Colorado State University) and Margarida Melo (Universit`a Roma Tre) on Hurwitz numbers, and he had many more informal discussion with other members and visitors to the MSRI. After his stay at MSRI, Arend went on to the University of Connecticut.

Roya Beheshti Zavareh

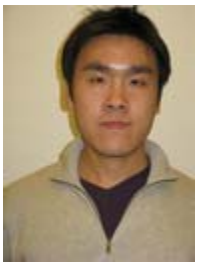
Roya Beheshit Zavareh received her Ph.D. from the Massachusetts Institute of Technology in 2003 under the supervision of A. Johan de Jong. Her dissertation was titled "Lines on Fano Hypersurfaces." At MSRI her mentor was Carel Faber. She collaborated with David Eisenbud (UC Berkeley) working on a project on the regularity of fibers of general projections. She also continued her work on birational geometry of spaces of rational curves on hypersurfaces and gave a talk in the post-doc seminar on this work. Along with a few other post-doc members, she helped running a reading group to study the new results of J. de Jong and J. Starr on rationally simply connectedness of low degree hypersurfaces. After her stay at MSRI, Roya went on to Washington University in St. Louis

Sebastian Casalaina-Martin

Sebastian Casalaina-Martin received his Ph.D. from Columbia University in 2004 under the supervision of Robert Friedman. His dissertation was titled "Singularities of the Prym Theta Divisor and Applications to Cubic Threefolds." At MSRI his mentor was Janos Kollar. In joint work with Radu Laza, he investigated the moduli space of stable genus four curves, and its relationship to both a ball quotient constructed by Kondo, as well as the discriminant locus in the moduli space of cubic threefolds. They also investigated curves with singularities of type ADE. This is work in progress and will be posted to the arxiv shortly. In another project, with Jesse Kass (Harvard University), he studied the geometry of theta divisors of integral curves. A manuscript with these results will be posted on the arxiv shortly. This project has led to work (in progress) on theta divisors of nodal, but possibly reducible curves. This is joint with Lucia Caporaso (University of Rome III), Filippo Viviani (University of Rome III), and Jesse Kass. Casalaina-Martin also gave a lecture on his work in the Algebraic Geometry Seminar at the University of British Columbia.After his stay at MSRI, Sebastian went on to the University of Colorado at Boulder.

Sabin Cautis

Sabin Cautis received his Ph.D. from Harvard University in 2006 under the supervision of Joseph Harris. His dissertation was titled "Extending Families of Curves: Monodromy and Applications." At MSRI his mentor was Dan Abramovich. He constructed equivalences between categories associated to birational varieties (more precisely, varieties related by stratified flops). He also studied examples of 2-representations in algebraic geometry and looked for a way to prove braid group relations from categorical Lie algebra actions.
He worked in part with Joel Kamnitzer from University of Toronto and Anthony Licata from Stanford University. After his stay at MSRI, Sabin went on to Columbia University.



Dawei Chen

Dawei Chen received his Ph.D. from Harvard University in 2008 under the supervision of Joseph Harris. His dissertation was titled "Covers of Elliptic Curves and the Lower bound for Slopes of Effective Divisors on the Moduli Space of Curves." At MSRI his mentor was Ravi Vakil. He finished a paper about linear series on ribbons and another one about the birational geometry of the moduli space of stable maps. The latter was done in collaboration with Izzet Coskun (UIC) and Charley Crissman (Berkeley). He also gave a talk about Mori's program on moduli spaces in the postdoc seminar. After his stay at MSRI, Dawei went on to the University of Illinois at Chicago.

Robert Easton

Robert Easton received his Ph.D. from Stanford University in 2007 under the supervision of Ravi Vakil. His dissertation was titled "S3-covers of schemes." At MSRI his mentor was Lucia Caporaso. He formed a new collaboration with fellow MSRI postdoc Jarod Alper, working on the existence of good moduli spaces. He was also chair of the postdoc seminar, and gave a short talk about covers and quotients at the MSRI Academic Sponsor Day. After his stay at MSRI, Robert went on to the University of Utah.

Daniel Greb

Daniel Greb received his Ph.D. from Ruhr-University Bochum in 2008 under the supervision of Peter Heinzner. His dissertation was titled "Projectivity of Analytic Hilbert Quotients." At MSRI his mentor was Sandor Kovacs.

Greb's work during his time at MSRI focused on two different areas: extension results for differential forms on higher-dimensional algebraic varieties and singularities of analytic Hilbert quotients.

In the first area he collaborated with S. Kebekus (Albert-Ludwigs¬Universit¨at-Freiburg), S. Kov´acs (University of Washington), and Th. Peternell (Universit¨at-Bayreuth). All three of his collaborators also visited MSRI during the Algebraic Geometry Program. Building on their previous work for low-dimensional varieties they proved the following extension result which will appear in a forthcoming preprint:

Theorem: Let X be a variety with log canonical singularities and let σ be a differential form defined on the smooth locus of X. Then, σ extends to a differential form with at worst logarithmic poles along exceptional divisors on any resolution of singularities of X.

This result, its history, and parts of its proof were discussed by Greb during a talk in the MSRI Postdoc Seminar.

In addition, Greb worked on a generalisation and refinement of classical results of Boutot on the rationality of algebraic quotient singularities to the holomorphic setup. His results about rational singularities and (analytic Hilbert) quotients by holomorphic group actions will soon appear as a preprint.

Furthermore, Greb and Kov´acs' grad student Zsolt Patakfalvi formed a reading group studying period domains and variations of Hodge structures.

Supported in part by MSRI postdoc travel money he visited the University of Washington to present his research in the Algebra and Algebraic Geometry Seminar. After his stay at MSRI, Daniel went on to the University of Freiburg.

Amit Hogadi

Amit Hogadi received his Ph.D. from Princeton University in 2007 under the supervision of Janos Kollar. His dissertation was titled "Topics in Birational Geometry." At MSRI his mentor was Miles Reid. He worked on two problems during his stay at MSRI: One was about calculation of Brauer group of moduli space (and moduli stack) of P GL(n) bundles (joint with Indranil Biswas) and the other problem (joint with Chenyang Xu, who was also a postdoc at MSRI) was on Homotopy limits and derived categories of Deligne Mumford stacks. Apart from these, he participated in a special seminar run by post-docs on Rational Simple Connectedness. After his stay at MSRI, Amit went on to the Tata Institute of Fundamental Research.

Anne-Sophie Kaloghiros

Anne-Sophie Kaloghiros received her Ph.D. from the University of Cambridge in 2007 under the supervision of Alessio Corti. Her dissertation was titled "The Topology of Terminal Quartic 3-Folds." At MSRI her mentor was Lawrence Ein. While at MSRI, she carried on her work on non-factorial terminal Gorenstein Fano 3-folds. She made the final corrections to her article "The Defect of Fano 3-folds", and she wrote a first version of the preprint "A classification of terminal quartic 3-folds and some remarks on rationality". She gave a talk in the postdoc seminar on these problems. Second, she took part to the Stacks working group and to a working group on the work of de Jong and Starr on notions of (simple) rational connectedness and the study of rational curves. Last, she worked with G. Todorov (Princeton) and C. Xu (MIT) on some (still vague) problems related to boundedness for 3-folds. After her stay at MSRI, Anne-Sophie went on to University of Cambridge.

Radu Laza

Radu Laza received his Ph.D. from Columbia University in 2006 under the supervision of Robert Friedman. His dissertation was titled "Deformations of Singularities and Variations of GIT Quotients." At MSRI his mentor was Alessio Corti. Prior to his visit at MSRI, he was a postdoc at the University of Michigan. The period that he spent at MSRI has partially overlapped with his job search. One big advantage of being at MSRI was flexibility to travel. During his period at MSRI, he gave 6 research talks: at the conference on "Arithmetic Algebraic Geometry related to moduli spaces" (Tokyo 19-23), UC Davis, U Wisconsin, Stony Brook, UNC, and the main seminar at MSRI.

At MSRI, he worked on three projects. The first project, joint with S. Casalaina-Martin, regards the birational geometry of the moduli space of genus 4 curves. This project is close to completion, and it is almost entirely a result of the research conducted at MSRI. He will talk about the results of this projects in June at the "Moduli and discrete groups conference" in Kyoto (June 8-12) and expects that a paper will be submitted by the end of the summer. The main results of the project include an explicit simultaneous semi-stable reduction for curves with ADE singularities, and an explicit and geometric resolution of the bi¬rational map between the ball quotient model for M4 constructed by ¯Kondo and Deligne-Mumford compactification M4.

A second project that he worked on is about the geometric compactification of the moduli space of polarized K3 surfaces. This is a longer term project. First, discussions with P. Hacking allowed him to expand the results from my previous paper "Triangulations of the sphere and degenerations of K3 surfaces" (on the combinatorics of degenerations of K3 surfaces). It is likely that the new results will be merged with the triangulation paper to form a joint paper with P. Hacking (to be submitted this summer). Secondly, he continued work on the geometric compactification for K3 surfaces along the lines of Koll´ar–Shepherd¬Barron–Alexeev program (of compactifying the moduli space of log general type varieties). By the end of this year, he expects complete results about a geometric compactification in the case of low degree K3 surfaces.

The third project that he worked on is about the moduli of hyperkaehler manifolds. This is related with his previous work on "Moduli of cubic fourfolds". Parts of this project are in collaboration with K. O'Grady. The semester at MSRI gave him the opportunity to discuss at length with K. O'Grady.

In conclusion, the semester at MSRI gave him the ample opportunities to discuss with his collaborators or potential collaborators (S. Casalaina-Martin, P. Hacking, K. O'Grady). He also discussed (re¬lated to his research projects) with B. Hassett, C. Voisin, S. Keel, D. Smyth, D. Hyeon, etc. Beside people directly related to his research, he had countless discussions with numerous people in the community, from senior faculty to graduate students. For instance, one result of these discussions was the decision to organize a NorthEastern regional algebraic meeting (somewhat modeled on WAGS) starting this fall. In the beginning, the core school involved will be Stony Brook (R. Laza), Amherst (J. Tevelev), and UConn

Dragos Oprea

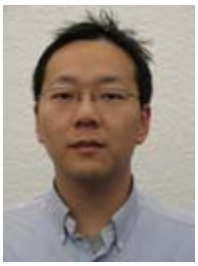
Dragos Oprea received his Ph.D. from the Massachusetts Institute of Technology in 2005 under the supervision of Gang Tian. His dissertation was titled "The Tautological Classes on the Moduli Space of Stable Maps to Flag Varieties." At MSRI his mentor was Jim Bryan. Dragos Oprea worked on two papers: "On the strange duality conjecture for elliptic K3 surfaces," written with Alina Marian (UIC), and "The moduli space of stable quotients," written with Alina Marian (UIC) and Rahul Pandharipande (Princeton). The papers can be found on the arxiv: arXiv:0902.3052, arXiv:0904.2992. He also gave a lecture entitled "The Verlinde bundles in higher genus" during the workshop Modern Moduli Theory. After his stay at MSRI, Dragos went on to UC San Diego.

David Smyth

David Smyth received his Ph.D. from Harvard University in 2008 under the supervision of Joseph Harris. His dissertation was titled "Compact Moduli of Singular Curves: A Case Study in Genus One." At MSRI his mentor was David Eisenbud. During his semester at MSRI, David Smyth collaborated with Jarod Alper (Columbia) and Fred van der Wyck (Harvard) on a project aimed at constructing certain moduli spaces of curves without using geometric invariant theory. He also gave a lecture at the Modern Moduli workshop and served on the speakers committee. After his stay at MSRI, David went on to Harvard University.

Gueorgui Todorov

Gueorgui Todorov received his Ph.D. from the University of Utah in 2008 under the supervision of Aaron Bertram. His dissertation was titled "The Gromov-Witten potential of local projective line with weights one and two and pluricanonical maps on threefolds of general type." At MSRI his mentor was James McKernan. He collaborated with Renzo Cavalieri on the Gromov-Witten potential of a partial resolution of an A2 singularity. They proved that the resulting potential matches the potential of the A2 singularity and also that of the resolution. Together with Anne-Sophie Kaloghiros and Chenyang Xu he was running a working group on birational geometry. He also collaborated and discussed various topics with Arend Bayer, Aaron Bertram, Dawei Chen, Christopher Hacon, Tommaso deFernex.After his stay at MSRI, Gueorgui went on to Princeton University.



Hsian-Hua Tseng

Hsian-Hua Tseng received his Ph.D. from UC Berkeley in 2005 under the supervision of Alexander Givental. His dissertation was titled "Quantum Riemann-Roch, Lefschetz and Serre Theorems for Orbifold Gromov-Witten Theory." At MSRI his mentor was Yuan-Pin Lee. Hsian-Hua studied Gromov-Witten theory of orbifolds while at MSRI. He calculated some genus 1 degree 0 Gromov-Witten invariants of Deligne-Mumford stacks. He collaborated with Yunfeng Jiang (University of Utah) and Elena Andreini (MPI-Bonn) on Gromov-Witten theory of product stacks and Gromov-Witten theory of root gerbes. They have written a paper with results on calculations of Gromov-Witten invariants of product stacks. He collaborated with Jeff Brown (UC Berkeley) on proving Virasoro constraints for Gromov-Witten invariants of toric bundles. He collaborated with Tom Coates (Imperial college London), Alessio Corti (Imperial college London) and Hiroshi Iritani (Imperial college London) on calculations of Gromov-Witten invariants of toric Deligne-Mumford stacks.
He also gave a lecture at the postdoc seminar on Givental's formalism in Gromov-Witten theory. After his stay at MSRI, Hsian-Hua went on to the Ohio State University.

Alexandr Usnich

Alexandr Usnich received his Ph.D. from Universite Paris VI in 2008 under the supervision of Maxim Kontsevich. His dissertation was titled "On the Cremona Group and its Subgroups." At MSRI his mentor was Rahul Pandharipande.
Alexandr Usnich worked on the Donaldson-Thomas invariants for 3 Calabi-Yau categories and on cluster mutations in non-commutative setting.After his stay at MSRI, Alexandr went on to the University of Zurich.

Chenyang Xu

Chenyang Xu received his Ph.D. from Princeton University in 2008 under the supervision of Janos Kollar. His dissertation was titled "Topics on Rationally Connected Varieties." At MSRI his mentor was Stefan Kebekus. While Chenyang was at MSRI, he finished 2 papers: one showed the weak approximation holds for some del Pezzo surfaces; the other was a joint work with Amit Hogadi, who was also in MSRI, on properties of derived categories of stacks. He gave two lectures there: one in the post-doc seminar, one in the period seminar. He also worked on some other problems, which will become papers in future. After his stay at MSRI, Chenyang Xu went on to the Massachusetts Institute of Technology.

Complementary Program 08-09:

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Hillar, Christopher	2005	UC Berkeley	I Public	N/A	Texas A&M University	II	Redwood Center for Theoretical Neuroscience	Other	N/A
Xu, Feng	2008	Duke University	I Private	N/A	Duke University	II	Australian National University	Foreign	N/A

Christopher Hillar

Christopher received his Ph.D. from Berkeley in 2005 under the supervision of Bernd Sturmfels. His dissertation was titled "Solving Polynomial Systems with Special Structure." In his time at MSRI Christopher worked on applications of compressed sensing to sparse coding with Fritz Sommer at the Redwood Institute for Theoretical Neuroscience. They have submitted their work to a NIPS conference and will be finishing up a journal article in the next month. He has also been collaborating with Lek-Heng Lim at Berkeley on the computational complexity of tensor decompositions. They should also have a paper out in the next few months. Finally, he has been working with Pentti Kanerva and Fritz Sommer on the mathematics underlying a new computational paradigm, "Hyperdimensional Computing." With it, they hope to understand and model complex systems that appear to be turing incompatible. After his stay at MSRI, Christopher went on to the Redwood Center for Theoretical Neuroscience.

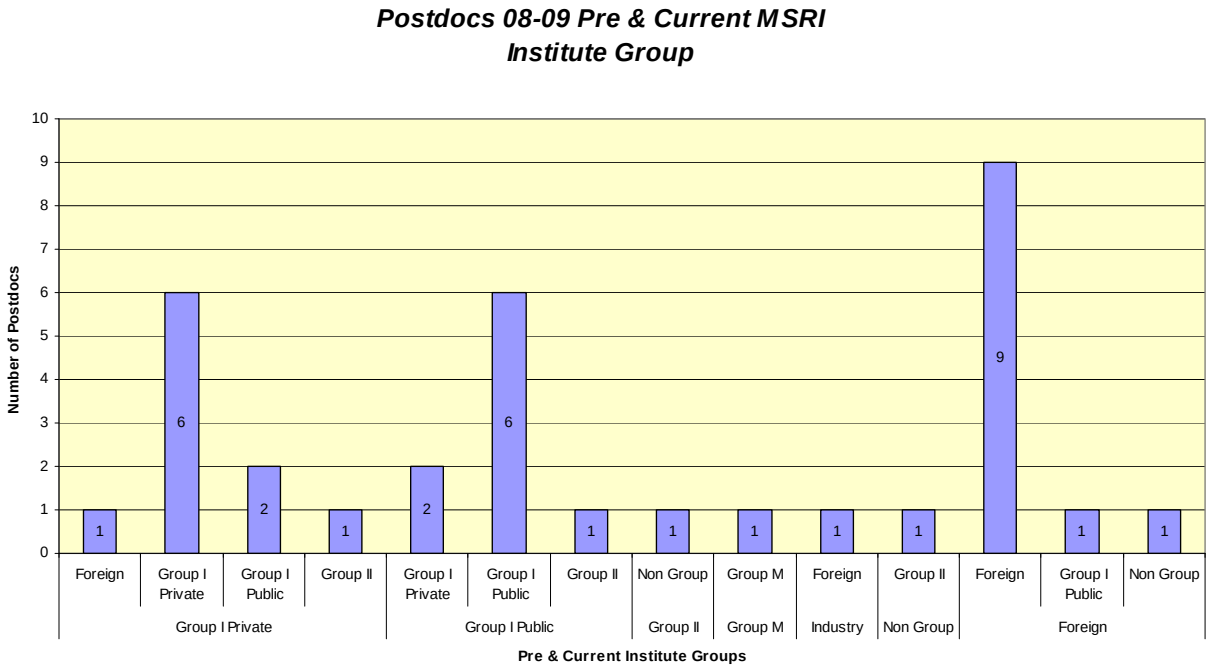
Feng Xu

Feng received his Ph.D. from Duke University in 2008 under the supervision of Robert L. Bryant. His dissertation was titled "Harmonic Morphisms with Totally Geodesic Fibers." He was in residence for the entire academic year. He worked on two topics: G_2-structures and G_2 flows, and prescribing generalized Ricci curvatures. He finished a paper joint with Robert Bryant on the first topic. He published a paper titled "Pseudo-holomorphic curves in nearly Kahler CP^3" in Differential Geometry and Its Application. He also submitted another paper to Communications in Analysis and Geometry. He has obtained some interesting results on the second topic and is writing a paper. He also visited Professor Rugang Ye at UCSB for two days and started a colabration on the first topic. After his stay at MSRI, Feng went on to the Australian National University.

3.1 Postdoctoral Fellow Placement List

Family Name	First Name	Placement Institution	Placement Department	Placement Position	MSRI Mentor	Placement State	Placement Country	Program
Alper	Jarod	Columbia University	Mathematics	Faculty/Postdoc	Angelo Vistoli	NY	US	AG
Araujo	Carolina	Instituto Nacional de Matemática Pura e Aplicada	Mathematics	Adjoint Researcher	Valery Alexeev		BZ	AG
Asok	Aravind	UCLA	Mathematics	Faculty/Postdoc	Burt Totaro	CA	US	AG
Bayer	Arend	University of Connecticut	Mathematics	Assistant Professor (Lecturer)	Kai Behrend	CT	US	AG
Beheshti Zavareh	Roya	Washington University in St. Louis	Mathematics	Faculty/Postdoc	Carel Faber	MO	US	AG
Casalaina-Martin	Sebastian	University of Colorado at Boulder	Mathematics	Faculty/Postdoc	Janos Kollar	CO	US	AG
Cautis	Sabin	Columbia University	Mathematics	G.C. Evans Instructor	Dan Abramovich	NY	US	AG
Chen	Dawei	University of Illinois at Chicago	Mathematics	Faculty/Postdoc	Ravi Vakil	IL	US	AG
Easton	Robert	University of Utah	Mathematics	Assistant Professor	Lucia Caporaso	UT	US	AG
Greb	Daniel	University of Freiburg	Mathematisches Institut	Faculty/Postdoc	Sandor Kovacs		DE	AG
Hogadi	Amit	Tata Institute of Fundamental Research	Mathematics	Postdoctoral Research Fellow	Miles Reid		IN	AG
Kaloghiros	Anne-Sophie	University of Cambridge	Mathematics	Junior Research Fellow	Lawrence Ein		UK	AG
Laza	Radu	Rice University	Mathematics	Assistant Prof. (postdoc)	Alessio Corti	TX	US	AG
Oprea	Dragos	UC San Diego	Mathematics	Faculty/Postdoc	Jim Bryan	CA	US	AG
Smyth	David	Harvard University	Mathematics	Faculty/Postdoc	David Eisenbud	MA	US	AG
Todorov	Gueorgui	Princeton University	Mathematics	Faculty/Postdoc	James McKernan	NJ	US	AG
Tseng	Hsian-Hua	Ohio State University	Mathematics	Faculty/Postdoc	Yuan-Pin Lee	OH	US	AG
Usnich	Alexandr	University of Zurich	Mathematics	Faculty/Postdoc	Rahul Pandharipande		CH	AG

Xu	Chenyang	Massachusetts Institute of Technology	Mathematics	Faculty/Postdoc	Stefan Kebekus	MA	US	AG
Bahuaud	Eric	Saint Mary's College of California	Mathematics	CNRS Postdoctoral researcher	Richard Melrose	CA	US	AOSS
Christianson	Hans	Massachusetts Institute of Technology	Mathematics	Lecturer	Jared Wunsch	MA	US	AOSS
Dryden	Emily	Bucknell University	Mathematics	Assistant Professor	Rafe Mazzeo	PA	US	AOSS
Muller	Jorn	University of Bonn	Mathematics	Faculty/Postdoc	Eugenie Hunsicker		DE	AOSS
Rochon	Frederic	University of Toronto	Mathematics	Assistant Professor	András Vasy	ON	CA	AOSS
Hillar	Christopher	Redwood Center for Theoretical Neuroscience	Mathematics	N/A	Fritz Sommer	CA	US	CP 08-09
Xu	Feng	Australian National University	Mathematics	Faculty/Postdoc	Robert Bryant		AU	CP 08-09
Fish	Alexander	Ohio State University	Mathematics	Faculty/Postdoc	Doug Lind	OH	US	ETAC
Hochman	Michael	Princeton University	Mathematics	Veblen Research Instructor	Bryna Kra	NJ	US	ETAC
Pete	Gabor	University of Toronto	Mathematics	Assistant Professor	Mate Wierdl	ON	CA	ETAC
Sanders	Tom	Mittag-Leffler Institute	Mathematics	Research Fellow	Bryna Kra		SE	ETAC
Shkredov	Ilya Dmitrievich	Moscow State University	Mathematics	N/A	Mate Wierdl		RU	ETAC
Spencer	Craig	Kansas State University	Mathematics	Faculty/Postdoc	Ben Green	KS	US	ETAC
Towsner	Henry	University of California Los Angeles	Mathematics	Assistant Adjunct Professor	Emmanuel Lesigne	CA	US	ETAC
Wolf	Julia	Rutgers University	Mathematics	Assistant Professor	Bernard Host	NJ	US	ETAC



HIGHLIGHTS:

Of the 10 postdocs who came from Group I Private Insitutions, 6 are currently at a Group I Private Institutions. The other are split among Group II Institutions and Foreign Institution.

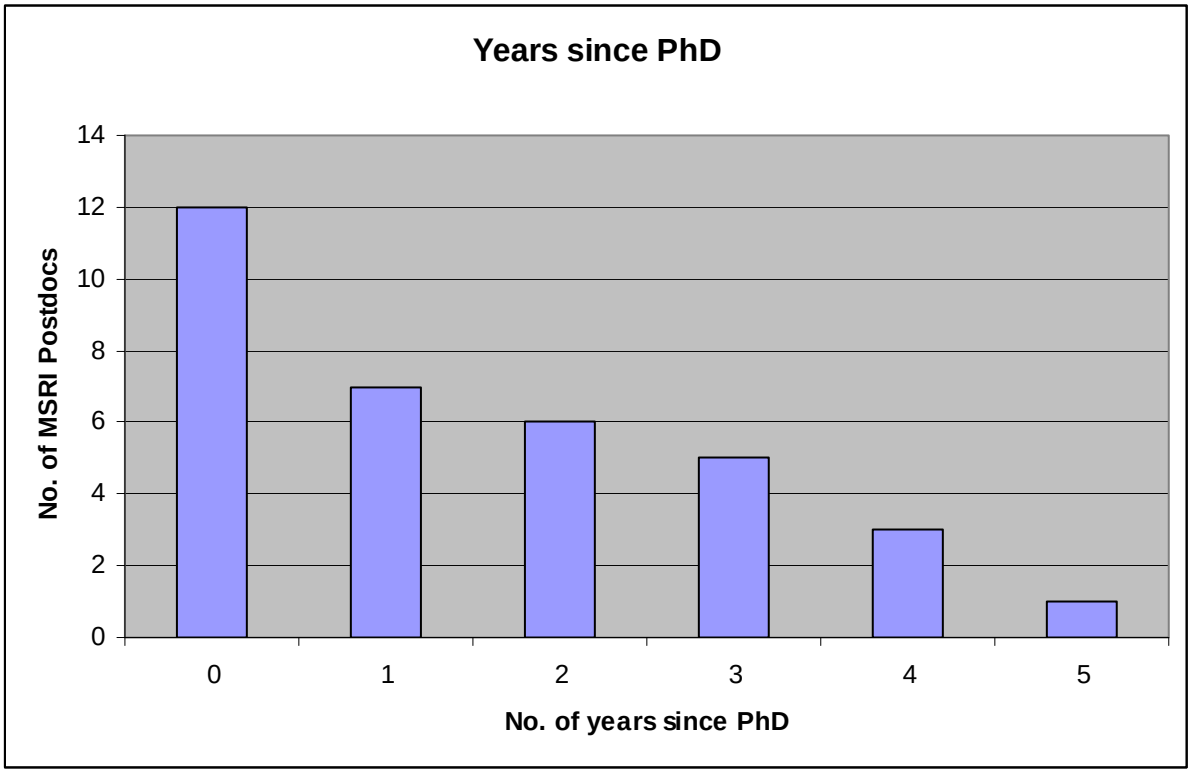
Of the 9 postdocs who came from Group I Public Institutions, 6 are currently at Group I Public Institutions, and 2 are at Group I Private Insitutions.

Of the 11 postdocs who came from Foreign Institutions, 9 returned to Foreign Institutions.

3.2 Postdoctoral Fellow Participant Summary

Name of Activity	# of PD	# of Citizens & Per Res	%	# of Female	%	# of Minorities	%	# of US Home Institution	%
Algebraic Geometry	19	8	42%	3	16%	1	5%	14	74%
Analysis on Singular Spaces	5	3	60%	1	20%	-	0%	2	40%
Complementary Program 08/09	2	1	50%	-	0%	1	50%	2	100%
Ergodic Theory and Additive Combinatorics	8	3	38%	1	13%	-	0%	5	63%
Total Number of Distinct Postdoc Fellow	34	15	44%	5	15%	2	6%	23	68%

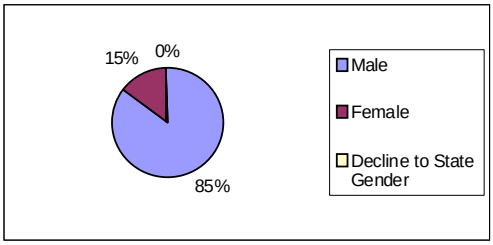
Yrs Since PhD	08-09
0	12
1	7
2	6
3	5
4	3
5	1
Total 08-09 Postdocs	34



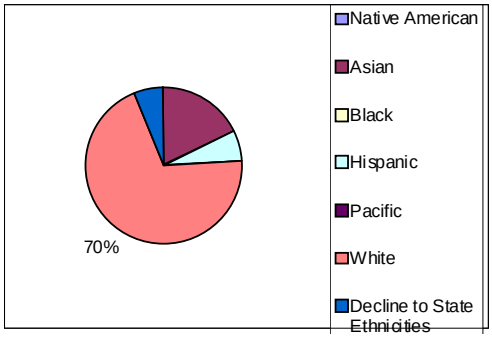
3.3 Postdoctoral Fellow Demographic Data

4 Programs Postdoctoral Fellow Summary

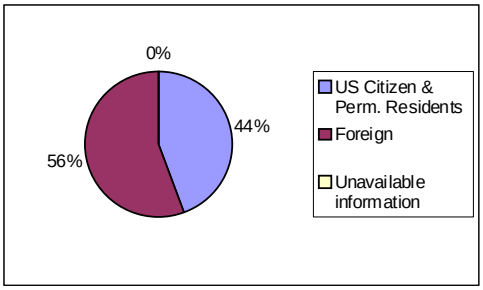
Gender	#	% (No Decl.)*	%
No. of Postdoctoral Fellows	34		100.0%
Male	29	85.29%	85.3%
Female	5	14.71%	14.7%
Decline to State Gender	0		0.0%



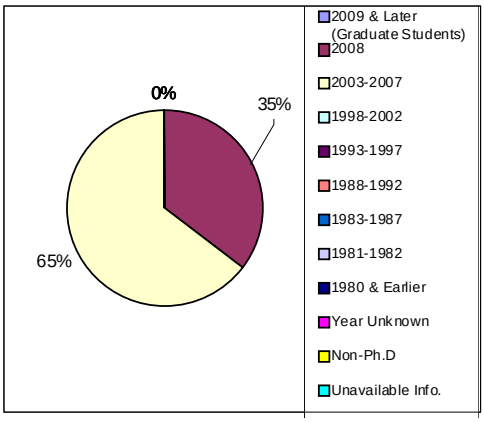
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	6	19.35%	17.6%
Black	0	0.00%	0.0%
Hispanic	2	6.45%	5.9%
Pacific	0	0.00%	0.0%
White	23	74.19%	67.6%
Decline to State Ethnicities	2		5.9%
Unavailable Information	1		2.9%
Total no. of Postdoctoral Fellows	34		100.0%
Minorities	2	6.45%	5.9%



Citizenships	#		%
US Citizen & Perm. Residents	15		44.1%
Foreign	19		55.9%
Unavailable information	0		0.0%
Total no. of Postdoctoral Fellows	34		100.0%
US Citizen	11		32.4%
Perm Residents	4		11.8%
Home Inst. in US	23		67.65%



Year of Ph.D	#		%
2009 & Later (Graduate Students)	0		0.0%
2008	12		35.3%
2003-2007	22		64.7%
1998-2002	0		0.0%
1993-1997	0		0.0%
1988-1992	0		0.0%
1983-1987	0		0.0%
1981-1982	0		0.0%
1980 & Earlier	0		0.0%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	34		100.0%

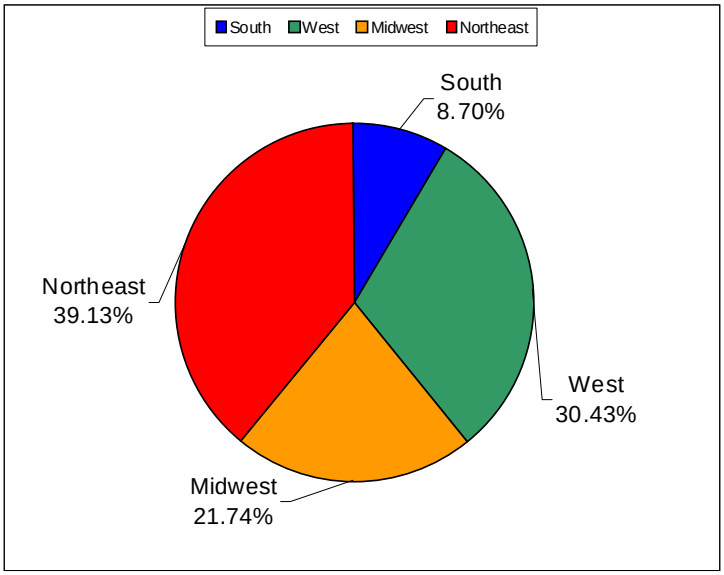


**Statistic Calculation based on all participants that did not decline.*

Home Institution Classified by States

****Regions based on US Census classification***

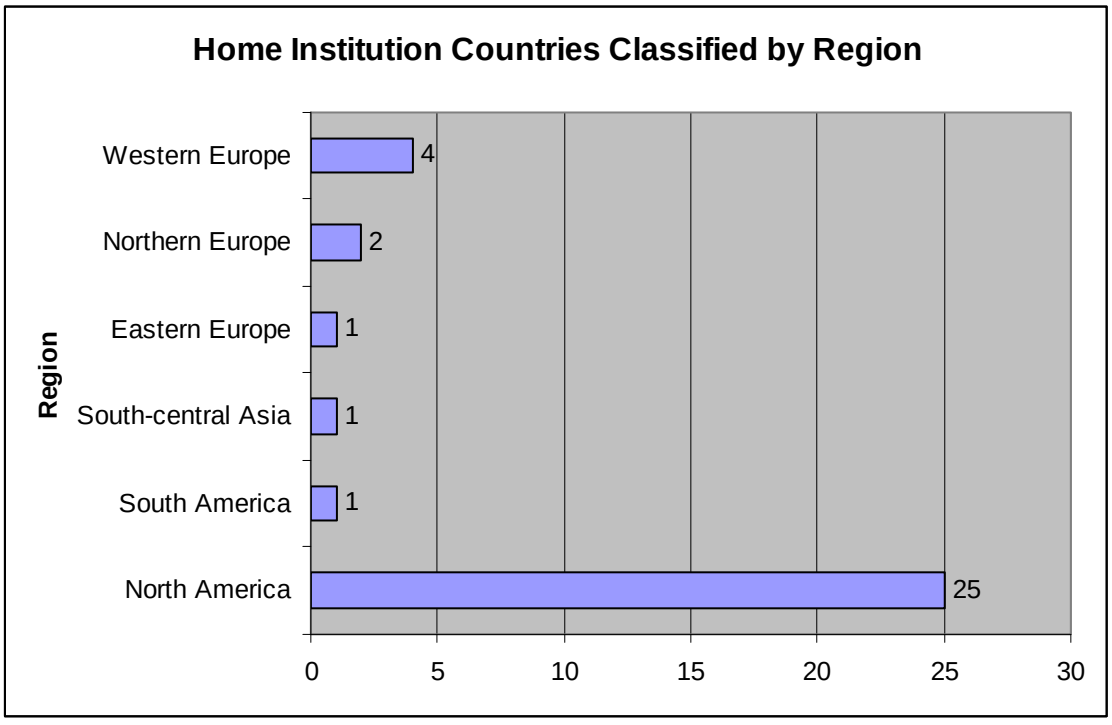
State	#	%
South	**2**	**8.7%**
AL	-	0.0%
AR	-	0.0%
DE	-	0.0%
DC	-	0.0%
FL	-	0.0%
GA	-	0.0%
KY	-	0.0%
LA	-	0.0%
MD	-	0.0%
MS	-	0.0%
NC	1	4.3%
OK	-	0.0%
SC	-	0.0%
TN	-	0.0%
TX	1	4.3%
VA	-	0.0%
WV	-	0.0%
West	**7**	**30.4%**
AK	-	0.0%
AZ	-	0.0%
CA	4	17.4%
CO	1	4.3%
HI	-	0.0%
ID	-	0.0%
MT	-	0.0%
NV	-	0.0%
NM	-	0.0%
OR	-	0.0%
UT	2	8.7%
WA	-	0.0%
WY	-	0.0%
Midwest	**5**	**21.7%**
IL	1	4.3%
IN	-	0.0%
IA	-	0.0%
KS	-	0.0%
MI	1	4.3%
MN	-	0.0%
MO	1	4.3%
ND	-	0.0%
NE	-	0.0%
OH	1	4.3%
SD	-	0.0%
WI	1	4.3%
Northeast	**9**	**39.1%**
CT	-	0.0%
ME	-	0.0%
MA	3	13.0%
NH	-	0.0%
NJ	4	17.4%
NY	1	4.3%
PA	1	4.3%
RI	-	0.0%
VT	-	0.0%
Other	-	**0.0%**
PR	-	0.0%
Other	-	0.0%
Total	**23**	100.0%



Home Institution Classified by Countries

*Regions based on United Nations' classification

Region	Area	Country	# of Attendees
Americas			**26**
	North America		25
		Canada	2
		United States	23
	South America		1
		Brazil	1
Asia			**1**
	South-central Asia		1
		India	1
Europe			**7**
	Eastern Europe		1
		Russian Federation	1
	Northern Europe		2
		United Kingdom	2
	Western Europe		4
		Switzerland	1
		Germany	2
		France	1
Grand Total			**34**



3.4 Postdoctoral Research Member List

Last Name	First Name	Placement Institution	Placement Department	Placement Position	Mentor	Placement State	Placement Country	Program
Albin	Pierre	Massachusetts Institute of Technology	Mathematics	Postdoctoral Fellow	Rafe Roys Mazzeo	MA	US	AOSS
Aldana Dominguez	Clara	Universität Bonn		graduate student	No Mentor		DE	AOSS
Alexandrova	Ivana	East Carolina University	Mathematics	Postdoctoral Fellow	No Mentor	NC	US	AOSS
Beiglböck	Mathias	Vienna University of Technology	Mathematics	Postdoctoral Fellow	Reinhard Winkler		AT	ETAC
Breuillard	Emmanue	École Polytechnique	Mathematics	associate professor	Gregory Aleksandrovic Margulis		FR	ETAC
Cavalieri	Renzo	Colorado State University	Mathematics	Faculty/Postdoc	Aaron James Bertram	CO	US	AG
Coskun	Izzet	University of Illinois	Mathematics	Faculty/Postdoc	Joseph Daniel Harris	IL	US	AG
Derenthal	Ulrich	University of Zurich	Mathematics	Postdoc	Yuri Tschinkel		CH	AG
Doran	Brent	University of Oxford	Mathematics	Faculty/Postdoc	Robert Duncan MacPherson		GB	AG
Gill	Nick	University of Bristol	Mathematics	Faculty/Postdoc	No Mentor		GB	ETAC
Guillarmou	Colin	Centre National de la Recherche Scient	Mathematics	Researcher CNRS	Laurent Guillopé		FR	AOSS
Gyarmati	Kati	Eötvös Loránd University (ELTE)	Mathematics	Postdoctoral Fellow	No Mentor		HU	ETAC
Helfgott	Harald	University of Bristol	Mathematics	Senior Lecturer	Henryk Iwaniec		GB	ETAC
Hering	Milena	University of Utah	Mathematics	Faculty/Postdoc	William Edgar Fulton	UT	US	AG
Jabbusch	Kelly	Albert-Ludwigs-Universität Freiburg	Mathematics	Faculty/Postdoc	Sándor József Kovács		DE	AG
Johnson	Michael	Swarthmore College	Mathematics	Lecturer	No Mentor	PA	US	ETAC
Krupchyk	Katsiaryna	University of Helsinki	Mathematics	Academy research fellow	No Mentor		FI	AOSS

Li	Hui	University of Luxembourg	Mathematics	Postdoc	No Mentor		LU	AOSS
Lieblich	Max	Princeton University	Mathematics	Faculty/Postdoc	A. Johan de Jong	NJ	US	AG
Marian	Alina	University of Illinois	Mathematics	Faculty/Postdoc	Shing-Tung Yau	IL	US	AG
Maulik	Davesh	Massachusetts Institute of Technology	Mathematics	Faculty/Postdoc	Rahul Pandharipande	MA	US	AG
McClendon	David	Northwestern University	Mathematics	Assistant Professor	Daniel Jay Rudolph	IL	US	ETAC
McKinnie	Kelly	Rice University	Mathematics	Faculty/Postdoc	No Mentor	TX	US	AG
Osserman	Brian	University of California	Mathematics	Assistant Professor	A. Johan de Jong	CA	US	AG
Payne	Sam	Stanford University / Clay Mathematics Institute	Mathematics	Postdoctoral Research Fellow	William Edgar Fulton	CA	US	AG
Proudfoot	Nicholas	University of Oregon	Mathematics	Faculty/Postdoc	Allen Ivar Knutson	OR	US	AG
Rowlett	Julie	University of California	Mathematics	Faculty/Postdoc	Rafe Roys Mazzeo	CA	US	AOSS
Roy	Emmanuel	Institut Galilée	Mathematics	Maître de conférences	François Louis Baccelli		FR	ETAC
Rydh	David	University of California	Mathematics	Faculty/Postdoc	No Mentor	CA	US	AG
Saez Trumper	Mariel	Pontificia Universidad Catolica de Chile	Mathematics	Assistant Professor	No Mentor	RM	CL	AOSS
Santoro	Bianca	Duke University	Mathematics	Assistant Research Professor	Gang Tian	NC	US	AOSS
Schraudner	Michael	Universidad de Chile	Mathematics	Postdoctoral	Wolfgang Krieger		CL	ETAC
Schwede	Karl	University of Michigan	Mathematics	Postdoc Assistant Professor	Sándor József Kovács	MI	US	AG
Shmerkin	Pablo	University of Jyväskylä	Mathematics	Postdoc	Boris M. Solomyak		FI	ETAC
Takagi	Shunsuke	Kyushu University	Mathematics	Research Associate Professor	No Mentor		JP	AG
Tommasi	Orsola	Universität Hannover	Mathematics	Postdoc	Joseph H. M. Steenbrink		DE	AG
Ziegler	Tamar	Technion - Israel Institute of Technology	Mathematics	Faculty	Harry Furstenberg		IL	ETAC

3.5 Postdoctoral Research Member Summary

Name of Activity	# of PD/RM	# of Citizens & Per Res	%	# of Female	%	# of Minorities	%	# of US Home Institution	%
Algebraic Geometry	17	9	53%	5	29%	-	0%	12	71%
Analysis on Singular Spaces	9	2	22%	6	67%	1	11%	4	44%
Complementary Program 08/09	-	-		-		-		-	-
Ergodic Theory and Additive Combinatorics	11	2	18%	2	18%	-	0%	2	18%
Total Number of Distinct Postdoc Fellow	37	13	35%	13	35%	1	3%	18	49%

4. Graduate Students

Most graduate students who visit MSRI had been invited to take part in one of our Summer Graduate Workshops. A much smaller number of graduate students are invited each year as "Program Associates" in our semester and year-long scientific programs. Program Associates benefit greatly from the chance to interact with a wide variety of mathematicians, gaining intense exposure to current ideas and trends in their area of specialization. Though without fundings, Program Associates benefit from most members' privileges.

4.1 Summer Graduate Workshops

Every summer MSRI organizes several summer graduate workshops (usually two weeks each), most of which are held at MSRI. Attending one of these workshops can be a very motivating and exciting experience for a student: participants have often said that it was the first experience where they felt like real mathematicians, interacting with other students and mathematicians in their field. Academic sponsored institutes as well as any US university are invited to send two students (in total) to participate in these programs, and can send a third if the group includes a woman or a member of an under-represented minority. MSRI covers the travel (up to $700 USD for foreign sponsoring institutions) and local expenses of all the students.

The procedure is as follows: MSRI's Deputy Director informs the Sponsor's Representative and the Director of Graduate Studies of the available Summer Graduate Programs for the following year. The Director of Graduate Studies submits nominations of students for particular programs. If the chosen program is already full, the institution may make additional nominations to other programs until its quota of two or three accepted participants is reached. As mentioned above from none sponsoring institutions are most welcome to apply, they need to be nominated by their department's chair of graduate studies.

The following are descriptions of the 6 Summer Graduate workshops which took place during the 2008-2009 academic year. Altogether 174 graduate students from all over the US participated in those workshops, of which 32% were female. See the table in section 4.4 for detailed demographic data.

SGW 1: IAS/PCMI Summer Program: Analytic and Algebraic Geometry: Common Problems – Different Methods

Date: July 06, 2008 to July 26, 2008
Location: IAS/Park City Mathematics Institute, Salt Lake City, UT
Organizers: Mircea Mustaţă, Jeff McNeal

The Graduate Summer School bridged the gap between a general graduate education in mathematics and the specific preparation necessary to do research on problems of current interest. In general, these students would have completed their first year, and in some cases, may already be working on a thesis. While a majority of the participants were graduate students, some postdoctoral scholars and researchers were also interested in attending.

The main activity of the Graduate Summer School was a set of intensive short lectures offered by leaders in the field, designed to introduce students to exciting, current research in mathematics. These lectures did not duplicate standard courses available elsewhere. Each course consisted of lectures with problem sessions. Course assistants were available for each lecture series. The participants of the Graduate Summer School met three times each day for lectures, with one or two problem sessions scheduled each day as well.

This workshop required a special application with a January 20, 2008 deadline. For application forms and information about the courses, please visit
http://www.admin.ias.edu/ma/current/program_gradsummer.php

SGW 2: Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas

Date: July 07, 2008 to July 18, 2008
Location: MSRI
Organizers: J.M. Landsberg*, Lek-Heng Lim, Jason Morton

Questions in computational complexity, statistical learning theory, signal processing, scientific data analysis, and other areas have recently been recast in terms of geometry and representation theory. Among them are: the complexity of matrix multiplication, Valiant's approach to P=NP, measures of entanglement in quantum information theory, matchgates in computer science, graphical models in statistical learning theory, the study of phylogenetic invariants, independent component analysis and other multilinear data analytic techniques in bioinformatics, signal processing, and spectroscopy.

The geometric perspective allows one to understand the questions in a more general mathematical context. It explains known results in terms of standard theorems in geometry and helps to advance the relevant areas.

The goals of this workshop were twofold: To introduce the relevant geometry and representation theory and to present and discuss open questions from the relevant areas that we believe could be resolved by workshop participants.

We introduced the problems that lead to varieties in spaces of tensors and cover the basic

geometry and representation theory needed to study them. By the middle of the second week we worked on open questions.

For more advanced participants, there was a follow-up research workshop at the American Institute of Mathematics (AIM) the week after the graduate workshop. Information on the research workshop is available at http://www.aimath.org/ARCC/workshops/repnsoftensors.html.

SGW 3: Climate Change – Summer Graduate Workshop

Date: July 14, 2008 to August 01, 2008
Location: MSRI
Organizers: Christopher Jone*, Inez Fung, Eric Kostelich, K.K. Tung, Mary Lou Zeeman*, Charles D. Camp, Rachel Kuske

The goal of the workshop was to discern ways in which mathematics can contribute and to expose new researchers to some of the key areas that we believe will form the basis of serious mathematical considerations of climate change issues. It was part of a larger 3 week program to bring both graduate students and researchers together to jointly study ways to engage in meaningful collaborations. See Climate Change Summer School .

Mathematical contributions are needed at two levels. Addressing climate change presents daunting challenges to the scientific community. It involves scientists with expertise varying from concrete engineering design to those formulating economic and political policies. Mathematical analysis of models plays a key coordinating role in making these models as effective as possible. Mathematicians are needed to formulate and refine models, understand their limitations and optimize the underlying computational strategies. At the same time, there is considerable basic research that needs to be done to properly ground the modeling, and resulting predictions. Mathematical input is badly needed to delineate the limits of reasonable predictability and quantify inherent uncertainties. Since the underlying models are highly nonlinear, complex evolving systems with stochastic inputs, there are considerable, and exciting basic research contributions to be made at a deep mathematical level. We emphasized this latter aspect in the summer program.

Three themes drove the workshop:

Prediction and uncertainty
Economic impact and decision-making
Incorporating and assimilating data.

Schedule 7/14 - 7/18 (PDF 132KB)

In the first half of the summer school (July 14- July 23) there were short courses in: Climate Modeling, Data Assimilation, Dynamical Systems, Stochastic Processes, Statistics, and Computation Methods which will be aimed at graduate students and postdocs. Students also worked on mentored research projects in teams.

The second half of the summer school (July 24 - Aug 1) involved brainstorming on mathematical issues in climate science. Working groups were formed to address specific issues and formulate

plans and concrete problems. This was an exciting opportunity for students to be a part of high-level efforts to grapple with difficult questions and forge research directions that promise impact on climate change research as well as interesting mathematics. Students were integrated into the work of the brainstorming workshop in several ways: they presented their projects aimed at defining a mathematical question in climate research, as starting points for further discussion; and they were assigned a senior mentor who worked with them to draft the reports of each day's activities. Meetings were then held at the end of each day for the students to meet with each other and share their insights.

SGW 4: Climate Change – Summer School

Date: July 14, 2008 to August 01, 2008
Location: MSRI
Organizers: Christopher Jones*, Inez Fung, Eric Kostelich, K.K. Tung, Mary Lou Zeeman*, Charles D. Camp, Rachel Kuske

It is now generally accepted in the scientific community that the world is undergoing a significant change in its climate. Mathematical models play a central role in ongoing climate change research. They are the basis for all specific predictions of future changes and have been critical in elucidating the underlying physical processes. This has not yet translated, however, into the involvement of mathematicians themselves in climate change research, at least not to any large degree.

This was a three-week program that incorporated a summer workshop for graduate students as well as an advanced brainstorming workshop. The program was designed to introduce students and postdocs to a set of mathematical ideas and techniques that are highly relevant to climate change research. This program was a follow-up to the Symposium on Climate Change held at MSRI in April 2007, and the Climate Program at the Joint Math Meetings in January 2008. It further aimed at fleshing out Dana MacKenzie's "Mathematics of Climate Change" resulting from the April 2007 symposium on mathematical challenges and opportunites in climate change research, whose development promises significant applications to improving our understanding of the underlying processes of climate change in all its manifestations.

The workshop was structured as follow:

First half, July 14 - July 23: Short courses in Climate Modeling, Data Assimilation, Dynamical Systems, Stochastic Processes, Statistics, and Computational Methods which aimed at graduate students and postdocs. Students worked on mentored research projects in teams. Visit the Climate Change - Summer Graduate Workshop webpage.

Second half, July 24 - Aug 1: Brainstorming workshop on mathematical challenges in climate science, including student presentations, discussions, informal presentations on generic mathematical stumbling blocks encountered in climate research; break out working groups and mentored graduate student projects. Students were integrated into the work of the brainstorming workshop in several ways: they presented their projects aimed at defining a mathematical question in climate research, as starting points for further discussion; and they were assigned a senior mentor who worked with them to draft the reports of each day's activities. Meetings were held at the end of each day for the students to meet with each other and share their insights.

This Summer School was jointly supported by MSRI and the Sea Change Foundation.

Information about the 2007 Symposiums on Global Warming can be found at the links below.
Public Symposium
Scientific Symposium

SGW 5: Toric Varieties

Date: June 15, 2009 to June 26, 2009
Location: MSRI
Organizers: David Cox, Hal Schenck

Toric varieties are algebraic varieties defined by combinatorial data, and there is a wonderful interplay between algebra, combinatorics and geometry involved in their study. Many of the key concepts of abstract algebraic geometry (for example, constructing a variety by gluing affine pieces) have very concrete interpretations in the toric case, making toric varieties an ideal tool for introducing students to abstruse concepts.

The first week covered basic material, including affine toric varieties, projective toric varieties, normal toric varieties constructed from fans, divisors, and homogeneous coordinates. We also discussed toric surfaces.The second week went deeper into the subject, covering topics such as ampleness, vanishing theorems in cohomology, the secondary fan, and geometric invariant theory.

An important feature of the workshop was that it did not assume that students had a full background in algebraic geometry. Students knew basic facts about varieties in affine and projective space, but we assumed no knowledge of schemes, sheaves, cohomology, etc.

SGW 6: IAS/PCMI Summer Workshop: The Arithmetic of L-Functions

Date: June 28, 2009 to July 18, 2009
Location: IAS/Park City Mathematics Institute, Salt Lake City, UT
Organizers: Cristian Popescu, Karl Rubin, Alice Silverberg
An off-site workshop partically funded by MSRI.

4.2 Program Associates

While most graduate students who visit MSRI have been invited to take part in one of our Summer Graduate Workshops, a smaller number of students are invited each year as "Program Associates" in our semester and year-long scientific programs. Program Associates benefit greatly from the chance to interact with a wide variety of mathematicians, gaining intense exposure to current ideas and trends in their area of specialization. While MSRI does not have the financial resources to fund the Program Associates they are closely supervised and essentially benefit from all members' privileges. They are provided with access card to the building, allowing them to use the premises at any time and days of the week. They are given a bus pass, as well as library and sports facilities access pass. Thirty two graduate students spent a

semester at MSRI during the academic year 2008-09, of those 35% were female. See the table in section 4.7 for a detailed description of the demographic data.

During the Fall 2008, the two programs, Analysis on Singular Spaces and Ergodic Theory and Additive Combinatorics, hosted numerous graduate students.

From the Analysis on Singular Spaces Program, students attended introductory workshops and twice-weekly seminars which they found as an invaluable experience. Below are some significant progresses made by several program associates in this program:

- Heiko Gimperlein made progress on a project with Schrohe on a bounded H∞ calculus for psuedofifferential operators.
- Dean Baskin made progress toward a detailed microlocal description of the singular and asymptotic structure of the fundamental solution of the wave kernel on a class of Lorentzian spaces which are perturbations of the classic de Sitter spacetime.
- Fang Wang completed her first draft of her thesis on the analog of the Dirichelet-to-Neumann operator for Poincare-Einstein metrics.
- Chris Kottke discussed his ideas concerning index theory and monopoles with several participants.
- Randy Qian made significant progress on his thesis project to understand diffraction on singularities of the wave equation by inverse-square singularities.

From the Ergodic Theory and Additive Combinatorics Program, three program associates were in residence the whole semester:

- Mahsa Allahbakhshi worked on her thesis and is currently working on measures of maximal entropy arising in symbolic factor mappings
- Qing Chu worked on generalizing known multiple convergence results for commuting transformations over cubes and with polynomial exponents. She also had fruitful discussions with Tim Austin (UCLA graduate student, also in residence for a few weeks), Bryna Kra, and Amanda Potts.
- Amanda Potts worked on generalizing the known results for flows, including showing convergence along polynomial times and giving a description of the limit.

During the Spring 2009, the Algebraic Geometry Program hosted 29 graduated students overall, some were officially program associates and some students from the University of California, Berkeley. In addition to participating in regular events, the graduate students also ran their own weekly seminar, and regularly participated en masse in the postdoctoral seminars.

4.3 Summer Graduate Workshops List

Family Name	First Name	Home Institution Name	Position	Activity Title
Bernardi	Alessandra	Universita degli studi di Milano	Graduate Student	G&RT
Boralevi	Ada	Texas A & M University	Graduate Student	G&RT
Cartwright	Dustin	University of California	Graduate Student	G&RT
Cheng	Steven	Johns Hopkins University	Graduate Student	G&RT
Diaz	Pedro	Central Michigan University	Graduate Student	G&RT
Farnell	Shawn	Colorado State University	Graduate Student	G&RT
Friedland	S.	University of Illinois	Graduate Student	G&RT
Garcia-Puente	Luis	Sam Houston State University	Faculty/Postdoc	G&RT
Garza	Ricardo	University of California, Los Angeles	Graduate Student	G&RT
Hernandez	Troy	University of Illinois Chicago	Graduate Student	G&RT
Johnson	Garrett	University of California at Santa Barbara	Graduate Student	G&RT
Kondor	Risi	University College	Faculty/Postdoc	G&RT
Lin	Min-Hsiung	North Carolina State University, Raleigh	Graduate Student	G&RT
Lin	Shaowei	University of California	Graduate Student	G&RT
Lin	Haijian	University of California	Graduate Student	G&RT
Long	John	University of California, Los Angeles	Graduate Student	G&RT
Murthy	Sandeep	University of Bristol	Graduate Student	G&RT
Oeding	Luke	Texas A & M University	Graduate Student	G&RT
Ribeiro	Jason	Northeastern University	Graduate Student	G&RT
Rushton	Brian	Brigham Young University	Graduate Student	G&RT
Russell	Jeremy	Northeastern University	Graduate Student	G&RT
Scavino	Marco	Universidad de la Republica Uruguay	Graduate Student	G&RT
Shiu	Anne	University of California	Graduate Student	G&RT
Slofstra	William	University of California, Berkeley	Graduate Student	G&RT
Smith	Elin	Massachusetts Institute of Technology	Graduate Student	G&RT
Sullivan	William	Portland State University	Graduate Student	G&RT
Womack	Andrew	Washington University	Graduate Student	G&RT
Yang	Ming	Texas A & M University	Graduate Student	G&RT
Ye	Ke	Texas A & M University	Graduate Student	G&RT
Arap	Maxim	University of Georgia	Graduate Student	IAS/PCMI
Cantillo	Jorge	Rutgers University - Newark	Graduate Student	IAS/PCMI
Choi	Jinwon	University of Illinois, Urbana-Champaign	Graduate Student	IAS/PCMI
Deng	Wei	Washington University	PhD Student	IAS/PCMI
Gharahbeigi	Sara	Washington University	Graduate Student	IAS/PCMI
Goedhart	Eve	Bryn Mawr College	Graduate Student	IAS/PCMI
Hurley	Donny	National University of Ireland, Dublin	Graduate Student	IAS/PCMI
Joshi	Janhavi	Ohio State University	Graduate Student	IAS/PCMI
Konstantinovskiy	Lev	University of Georgia	Graduate Student	IAS/PCMI
Kopp	Travis	University of Washington	Graduate Student	IAS/PCMI
Li	Si	Harvard University	Graduate Student	IAS/PCMI
Liu	Yu-Han	Ohio State University	Graduate Student	IAS/PCMI
Lozovanu	Victor	University of Michigan	Graduate Student	IAS/PCMI

Lundell	Benjamin	Cornell University	Graduate student	IAS/PCMI
Nitz	Ted	University of California, Santa Cruz	Graduate Student	IAS/PCMI
Novoseltsev	Andrey	University of Alberta	Graduate Student	IAS/PCMI
Palm	Marc	Virginia Polytechnic Institute	Graduate Student	IAS/PCMI
Parra	Manuel	University of Michigan	PhD Student	IAS/PCMI
Preygel	Anatoly	Massachusetts Institute of Technology	Graduate Student	IAS/PCMI
Quddus	Safdar	Washington University	Graduate Student	IAS/PCMI
Sengupta	Tathagata	Brandeis University	Graduate Student	IAS/PCMI
Shroff	Ravi	University of California, San Diego	Graduate Student	IAS/PCMI
Song	Ruifang	Harvard University	PhD student	IAS/PCMI
Sun	Jingzhou	Johns Hopkins University	Graduate Student	IAS/PCMI
Svishcheva	Anastasia	Emory University	Graduate Student	IAS/PCMI
Arnst	Maarten	University of Southern California	Faculty/Postdoc	CC - SS
Boghosian	Bruce	Tufts University	Graduate Student	CC - SS
Danforth	Chris	University of Vermont	Graduate Student	CC - SS
Drummond	Tony	Lawrence Berkeley National Laboratory	Staff Scientist	CC - SS
Dutta	Prajit	Columbia University	Professor	CC - SS
Engel	Chermelle	Australian Bureau of Meteorology	Senior Professional Officer Grade C	CC - SS
Ezzedine	Souheil	LLNL	Graduate Student	CC - SS
Flaschka	Hermann	University of Arizona	Professor	CC - SS
Ide	Kayo	University of California, Los Angeles	Graduate Student	CC - SS
Kalb	Virginia	NASA/GSFC	mathematician/data analyst	CC - SS
Kalnay	Eugenia	University of Maryland	Graduate Student	CC - SS
Kaper	Hans	National Science Foundation	Graduate Student	CC - SS
Kuhl	David	University of Maryland, College Park	Graduate Student	CC - SS
McGehee	Richard	University of Minnesota	Professor	CC - SS
Meza	Juan	Lawrence Berkeley National Laboratory	Department Head	CC - SS
Namachchivaya	Navaratnam	University of Illinois at Urbana-Champaign	Graduate Student	CC - SS
Parker	Wendy	Ohio University	Graduate Student	CC - SS
Phillips	Mark	UNC Asheville	Research Associate	CC - SS
Schecter	Stephen	North Carolina State University, Raleigh	Faculty/Postdoc	CC - SS
Scott	Sherry	Marquette University	Assistant Professor	CC - SS
Silber	Mary	Northwestern Universty	Professor	CC - SS
Stainforth	Dave	University of Oxford	Graduate Student	CC - SS
Traeger	Christian	University of California, Berkeley	Assistant Professor	CC - SS
Zhou	Jiansong	University of Washington	Graduate Student	CC - SS
Zhu	Jingyi	University of Utah	Associate Professor	CC - SS
Abel	Haley	Washington University	Graduate Student	CC - SGW
Ampadu	Clement	Central Michigan University	Graduate Student	CC - SGW
Balci	Nusret	Indiana University, Bloomington	Graduate Student	CC - SGW
Bamzai	Aparna	University of California, Los Angeles	Graduate Student	CC - SGW
Cheampion	Richard	University of San Francisco	Graduate Student	CC - SGW
Chen	Qingshan	Indiana University, Bloomington	Graduate Student	CC - SGW
Chen	Yan-Jiun	Cornell University	Graduate Student	CC - SGW
comboul	maud	University of Southern California	PhD student	CC - SGW
Crowell	Sean	University of Oklahoma	Graduate Student	CC - SGW

cummins	Breschine	Montana State University	Graduate Student	CC - SGW
Engel	Chermelle	Australian Bureau of Meteorology	Senior Professional Officer Grade C	CC - SGW
Ettinger	Bree	University of Georgia	Teaching Assistant	CC - SGW
Fadali	Lyla	University of California, San Diego	Graduate Student	CC - SGW
Garcia Carreras	Bernardo	University of Bath	Graduate Student	CC - SGW
Gully	Adam	University of Utah	Graduate Student	CC - SGW
Hoang	Nguyen	Kansas State University	Graduate Student	CC - SGW
Holmes	Bill	Indiana University, Bloomington	Graduate Student	CC - SGW
Iams	Sarah	Cornell University	Graduate Student	CC - SGW
Jafarov	Elchin	University of Alaska	Graduate Student	CC - SGW
Kim	Kunwoo	University of Illinois at Urbana-Champaign	Graduate Student	CC - SGW
Kjerland	Marc	University of Illinois Chicago	Graduate Student	CC - SGW
Kong	Hoitin	University of Georgia	Graduate Student	CC - SGW
Lewis	Chloe	University of California, Berkeley	Graduate student	CC - SGW
Li	King-Fai	California Institute of Technology	Graduate Student	CC - SGW
Luo	Qinghua	University of Oklahoma	Graduate Student	CC - SGW
Mathew	Supriya	Macquarie University	PhD student	CC - SGW
Ortega	Omayra	Arizona State University	Faculty/Postdoc	CC - SGW
Pantic	Sanja	University of Illinois Chicago	Graduate Student	CC - SGW
Parker	Jay	University of Illinois Chicago	Graduate Student	CC - SGW
Pearson	Yanthe	Rensselaer Polytechnic Institute	PhD student	CC - SGW
Poole	Thomas	SUNY Stony Brook	Graduate Student	CC - SGW
Stancevic	Ognjen	University of New South Wales	PhD student	CC - SGW
Sullivan	Kathryn	Cornell University	Graduate Student	CC - SGW
Swanson	Greta	Portland State University	Graduate Student	CC - SGW
Tang	Hui	Tufts University	Graduate Student	CC - SGW
Tasset	Tiffany	University of Colorado	Graduate Student	CC - SGW
Tipireddy	Ramakrishna	University of Southern California	PhD student	CC - SGW
Webb	Adrean	University of Colorado	Graduate Student	CC - SGW
Whitehead	Jared	University of Michigan, Ann Arbor	Graduate Student	CC - SGW
Widiasih	Esther	University of Minnesota, Minneapolis	Graduate Student	CC - SGW
Yu	Guowei	University of Minnesota, Minneapolis	Graduate Student	CC - SGW
Beaudry	Agnes	Northwestern University	Graduate Student	TV
Brannetti	Silvia	Terza Università di Roma	Graduate Student	TV
Cartwright	Dustin	University of California	Graduate Student	TV
Chan	Melody	University of California	Graduate Student	TV
Chowdhury	Atoshi	Stanford University	Graduate Student	TV
Chung	KiRyong	Seoul National University	Graduate Student	TV
Contois	Mark	University of Washington	Graduate Student	TV
Diemer	Colin	University of Pennsylvania	Graduate Student	TV
Dover	James	University of Oklahoma	Graduate Student	TV
Duncan	Alex	University of British Columbia	Graduate Student	TV
Dutle	Aaron	University of South Carolina	Graduate Student	TV
Erman	Daniel	University of California	Graduate Student	TV
Escobar	Laura	San Francisco State University	Graduate Student	TV
Gibbins	Aliska	Ohio State University	Graduate Student	TV
Gudmundsson	Hilmar	Reykjavik University	Graduate Student	TV
Hardarson	Marteinn	Reykjavik University	Graduate Student	TV

Hinkelmann	Franziska	Virginia Polytechnic Institute	Graduate Student	TV
Hsiao	Jen-Chieh	Purdue University	Graduate Student	TV
Kang	Ning	University of Texas, Austin	Graduate Student	TV
Kazanova	Anna	University of Massachusetts	Graduate Student	TV
Kodgis	Lisa	University of Hawaii	Graduate Student	TV
Kositwattanarerk	wittawat	Clemson University	Graduate Student	TV
Li	Zhiyuan	Rice University	Graduate Student	TV
Lin	Kuei-Nuan	Purdue University	Graduate Student	TV
Lin	Jan-Li	Indiana University, Bloomington	Graduate Student	TV
Mahmood	Fatima	Cornell University	Graduate Student	TV
Malmskog	Elizabeth	Colorado State University	Graduate Student	TV
Mathews	Bryant	University of California, Los Angeles	Graduate Student	TV
Miller	Jason	Ohio State University	Graduate Student	TV
Mondal	Pinaki	University of Toronto	Graduate student	TV
Mukhopadhyay	Swarnava	University of North Carolina	Graduate Student	TV
Novoseltsev	Andrey	University of Alberta	Graduate Student	TV
O'Keefe	Augustine	Tulane University	Graduate Student	TV
Pabiniak	Milena	Cornell University	Graduate Student	TV
Pham	Vinh An	University of Missouri	Graduate Student	TV
Ravikumar	Vijay	Rutgers University	Graduate Student	TV
Sachitano	David	California State University	Graduate Student	TV
Seceleanu	Alexandra	University of Illinois at Urbana-Champaign	Graduate Student	TV
Shao	Yijun	University of Arizona	Graduate Student	TV
Slawinski	Mike	University of California, San Diego	Graduate Student	TV
Sweet	Ross	Boston University	Graduate Student	TV
Tian	Zhiyu	SUNY	Graduate Student	TV
Trentacoste	Catherin	Clemson University	Graduate Student	TV
Wechter	Matthew	University of Illinois Chicago	Graduate Student	TV
Whitney	Josh	University of California	Graduate Student	TV
Williams	Harold	University of California	Graduate Student	TV
Xie	Yu	Purdue University	Graduate student	TV
Zhong	Changlong	University of Southern California	Graduate Student	TV
Zhu	Yi	SUNY Stony Brook	Graduate Student	TV
Ulfarsson	Henning	Brown University	Graduate Student	IAS/PCMI
Van Garrel	Micheal	California Institute of Technology	Graduate Student	IAS/PCMI
Venkatram	Kartik	Massachusetts Institute of Technology	Graduate Student	IAS/PCMI
Womack	Andrew	Washington University	Graduate Student	IAS/PCMI
Zhu	Yi	SUNY Stony Brook	Graduate Student	IAS/PCMI

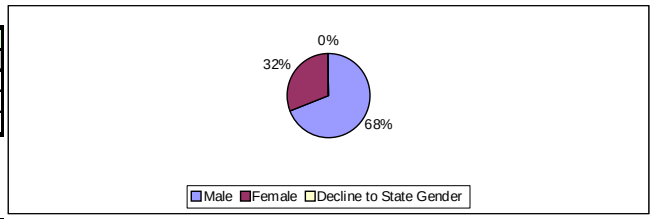
4.4 Summer Graduate Workshops Summary

Workshop	No. of Officially Registered Worksho	No. of Citizens & Permanent	% of Citizens & Permanent	No. of Female	No. of Decline to state	% of Female	No. of Minorities	No. of Decline to state Ethnicity	% of Minorities	# of US Home Institute	% of US Home Institute
Climate Change - Summer Graduate Workshop	41	18	43.9%	20	0	48.8%	4	2	10.3%	36	87.8%
Climate Change Summer School	25	13	52.0%	7	0	28.0%	2	2	8.7%	23	92.0%
Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas	29	10	34.5%	4	0	13.8%	1	0	3.4%	22	75.9%
IAS/PCMI Summer Program: Analytic and Algebraic Geometry: Common Problems - Different Methods	25	3	12.0%	5	0	20.0%	0	1	0.0%	21	84.0%
IAS/PCMI Summer Program: The Arithmetic of L-functions	5	1	20.0%	1	0	20.0%	0	0	0.0%	5	100.0%
Toric Varieties	49	23	46.9%	18	0	36.7%	0	2	0.0%	42	85.7%
Grand Total	**174**	**68**	**39.1%**	**55**	**0**	**31.6%**	**7**	**7**	**4.2%**	**149**	**85.6%**

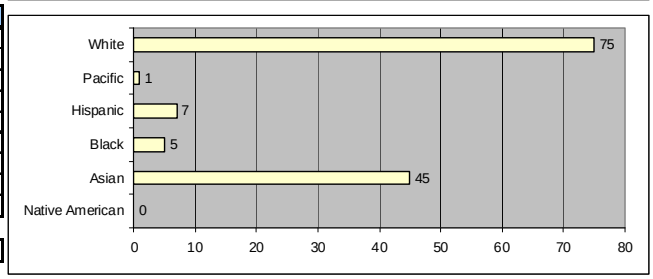
4.5 Summer Graduate Workshops Demographic Data

Summer Graduate Workshop Demographic Summary 2008-2009

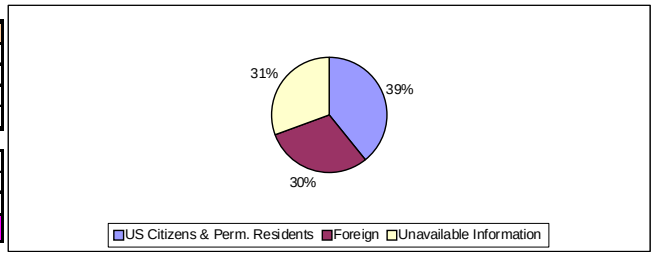
Gender	No.	% (No Decl.)*	%
Officially Registered Participants	174		
Male	119	68.39%	68.4%
Female	55	31.61%	31.6%
Decline to State Gender	0		0.0%



Ethnicities	No.	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	45	33.83%	25.9%
Black	5	3.76%	2.9%
Hispanic	7	5.26%	4.0%
Pacific	1	0.75%	0.6%
White	75	56.39%	43.1%
Decline to State Ethnicity	7		4.0%
Unavailable Information	34		19.5%
Total no. of Participants	174		100.0%
Minorities	7	5.26%	4.0%



Citizenships	No.		%
US Citizens & Perm. Residents	68		39.1%
Foreign	52		29.9%
Unavailable Information	54		31.0%
Total no. of Participants	174		100.0%
US Citizens	65		37.4%
Perm. Residents	3		1.7%
Home Inst. in US	149		85.63%

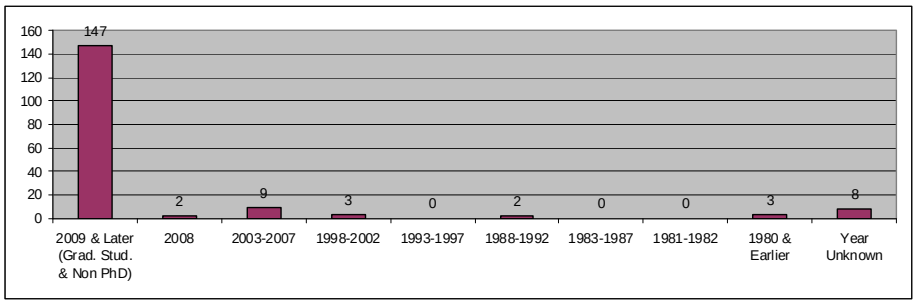


Year of Ph.D	No.		%
2009 & Later (Grad. Stud. & Non PhD)	147		84.5%
2008	2		1.1%
2003-2007	9		5.2%
1998-2002	3		1.7%
1993-1997	0		0.0%
1988-1992	2		1.1%
1983-1987	0		0.0%
1981-1982	0		0.0%
1980 & Earlier	3		1.7%
Year Unknown	8		4.6%
Unavailable Information	0		0.0%
Total	174		100.0%

SGWs for 2008-09

Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas
Climate Change - Summer Graduate Workshop
Climate Change Summer School
IAS/PCMI Summer Program: The Arithmetic of L-Function
IAS/PCMI Summer Program: Analytic and Algebraic Geometry
Toric Varieties

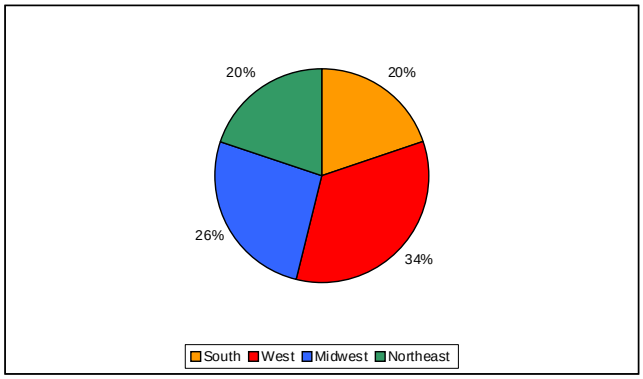
**Statistic Calculation based on all participants that did not decline.*

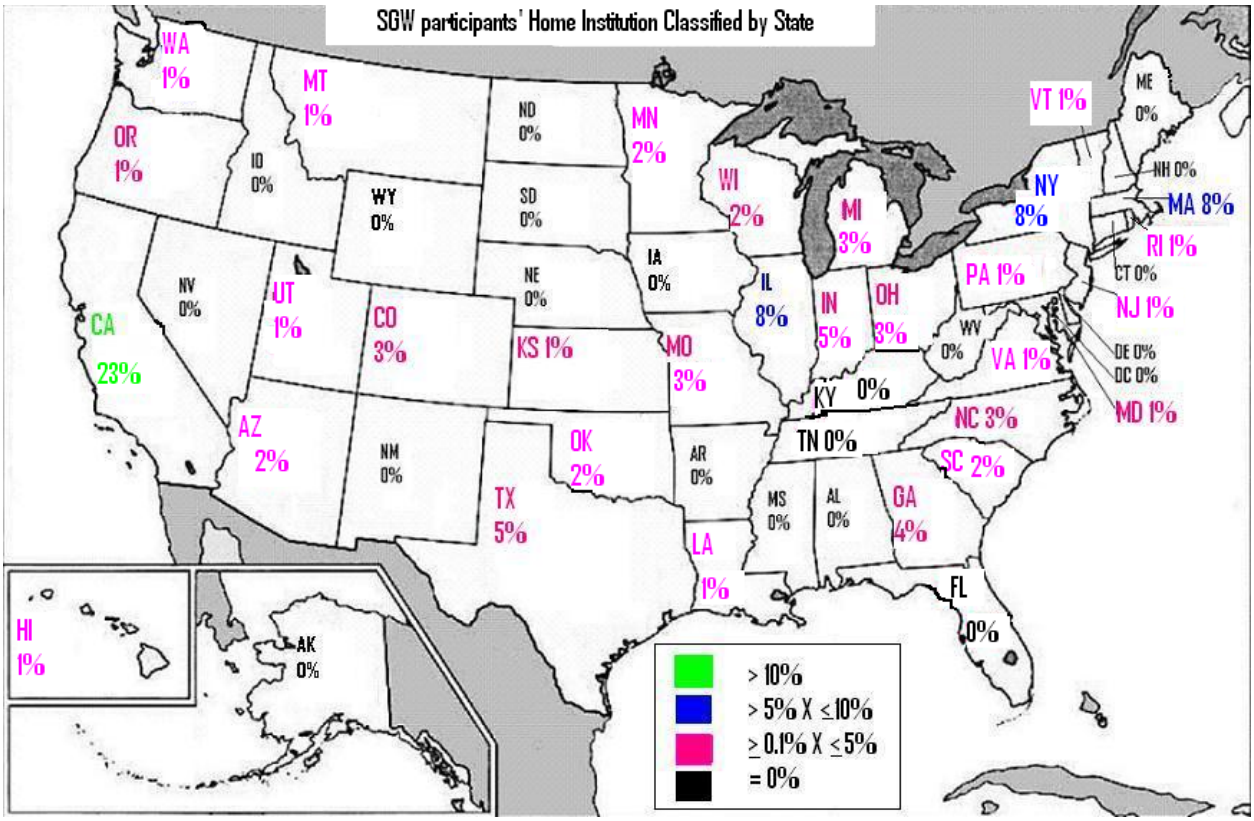


Home Institution Classified by States

****Regions based on US Census classification***

State	No.	%	US Pop. (2007 Census)
South	**30**	**20.1%**	**36.6%**
AL	-	0.0%	1.5%
AR	-	0.0%	0.9%
DE	-	0.0%	0.3%
DC	-	0.0%	0.2%
FL	-	0.0%	6.1%
GA	6	4.0%	3.2%
KY	-	0.0%	1.4%
LA	1	0.7%	1.4%
MD	4	2.7%	1.9%
MS	-	0.0%	1.0%
NC	4	2.7%	3.0%
OK	3	2.0%	1.2%
SC	3	2.0%	1.5%
TN	-	0.0%	2.0%
TX	7	4.7%	7.9%
VA	2	1.3%	2.6%
WV	-	0.0%	0.6%
West	**50**	**33.6%**	**23.2%**
AK	1	0.7%	0.2%
AZ	3	2.0%	2.1%
CA	35	23.5%	0.4%
CO	4	2.7%	0.5%
HI	1	0.7%	0.3%
ID	-	0.0%	12.1%
MT	1	0.7%	1.6%
NV	-	0.0%	0.9%
NM	-	0.0%	0.7%
OR	1	0.7%	1.2%
UT	2	1.3%	0.9%
WA	2	1.3%	2.1%
WY	-	0.0%	0.2%
Midwest	**39**	**26.2%**	**22.0%**
IL	12	8.1%	4.3%
IN	7	4.7%	2.1%
IA	-	0.0%	1.0%
KS	1	0.7%	0.9%
MI	5	3.4%	3.3%
MN	3	2.0%	1.7%
MO	5	3.4%	1.9%
ND	-	0.0%	0.2%
NE	-	0.0%	0.6%
OH	5	3.4%	3.8%
SD	-	0.0%	0.3%
WI	1	0.7%	1.9%
Northeast	**30**	**20.1%**	**18.1%**
CT	-	0.0%	1.2%
ME	-	0.0%	0.4%
MA	12	8.1%	2.1%
NH	-	0.0%	0.4%
NJ	2	1.3%	2.9%
NY	12	8.1%	6.4%
PA	2	1.3%	4.1%
RI	1	0.7%	0.4%
VT	1	0.7%	0.2%
Other	**-**	**0.0%**	**0%**
PR	-	0.0%	0%
Other	**-**	0.0%	0%
Total	**149**	**100.0%**	**100.0%**

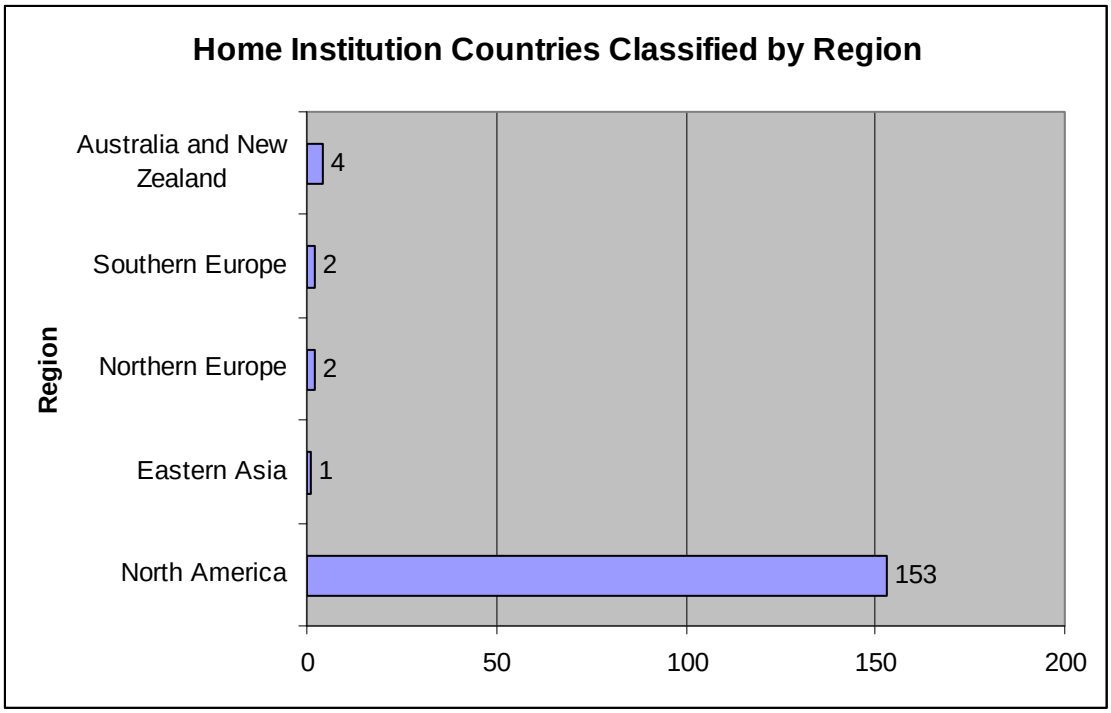




Home Institution Classified by Countries

**Regions based on United Nations' classification*

Region	Area	Country	# of Attendees
Americas			**153**
	North America		153
		Canada	4
		United States	149
Asia			**1**
	Eastern Asia		1
		Korea, Republic of	1
Europe			**4**
	Northern Europe		2
		England	2
	Southern Europe		2
		Italy	2
Oceania			**4**
	Australia and New Zealand		4
		Australia	4
Unavailable Information			12
Grand Total			**174**



4.6 Program Associates List

Family Name	First Name	Home Institute Name	Home Inst City	Inst State	Inst Country
Allahbakhshi	Mahnaz	University of Victoria	Victoria	BC	CA
Anderson	David	University of Michigan, Ann Arbor	Ann Arbor	MI	US
Austin	Tim	University of California, Los Angeles	Los Angeles	CA	US
Baskin	Dean	Stanford University	Stanford	CA	US
Brannetti	Silvia	Terza Università di Roma	Rome		IT
Chen	Qile	Brown University	Providence	RI	US
Chu	Qing	Université de Marne-la-Vallée	Champs-sur-Marne		FR
Coronel	Alvaro	Universidad de Chile	Santiago		CL
Dundon	Ariana	University of Washington	Seattle	WA	US
Finkel	Dan	University of Washington	Seattle	WA	US
Gell-Redman	Jesse	Stanford University	Stanford	CA	US
Giansiracusa	Noah	Brown University	Providence	RI	US
Hall	Jack	Stanford University	Stanford	CA	US
Hoang	Le Thai	University of California, Los Angeles	Los Angeles	CA	US
Kirson	Antonio	University of Washington	Seattle	WA	US
Kopp	Travis	University of Washington	Redmond	WA	US
Kottke	Christopher	Massachusetts Institute of Technology	Lexington	MA	US
Marcus	Steffen	Brown University	Providence	RI	US

Matthiesen	Lilian	University of Cambridge	Cambridge		GB
Melo	Margarida	Terza Università di Roma	Rome		IT
Neale	Vicky	University of Cambridge	Cambridge		GB
Patakfalvi	Zsolt	University of Washington	Redmond	WA	US
Potts	Amanda	Northwestern University	Evanston	IL	US
Qian	Randy	Northwestern University	Evanston	IL	US
Ross	Kiana	University of Washington	Redmond	WA	US
Severs	Christopher	Arizona State University	Tempe	AZ	US
Sisask	Olof	University of Cambridge	Cambridge		GB
Talpo	Mattia	Scuola Normale Superiore	Pisa		IT
Tucker	Kevin	University of Michigan, Ann Arbor	Ann Arbor	MI	US
Ulfarsson	Henning	Brown University	Providence	RI	US
Wang	Fang	Massachusetts Institute of Technology	Cambridge	MA	US
Wickelgren	Kirsten	Stanford University	Stanford	CA	US

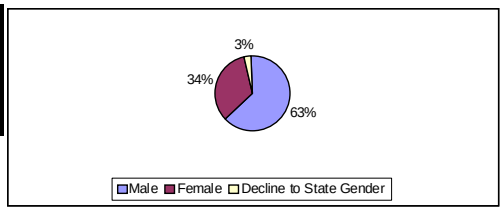
4.7 Program Associates Summary

Name of Activity	No. of Program Associates	No. of Citizens & Permanent Residents	% of Citizens & Permanent Residents	No. of Female	No. of Decline to state Gender	% of Female (includes decline)	No. of Minorities	No. of Decline to state Ethnicity	% of Minorities (includes decline)	US Home Institution	% of US Home Institution
Algebraic Geometry	17	9	53%	5	1	31%	0	1	0%	14	82%
Analysis on Singular Spaces	5	4	80%	1	0	20%	0	0	0%	5	100%
Complementary Program 08/09	1	1	100%	0	0	0%	0	0	0%	1	100%
Ergodic Theory and Additive Combinatorics	9	1	11%	5	0	56%	0	0	0%	3	33%
Total	**32**	**15**	**47%**	**11**	**1**	**35%**	**0**	**1**	**0%**	**23**	**72%**

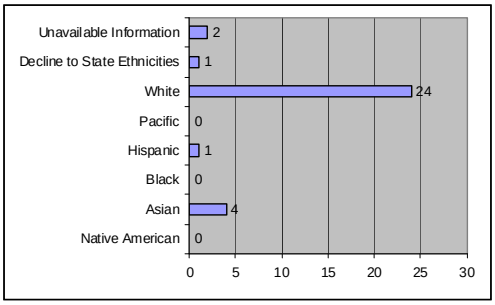
4.8 Program Associates Demographic Data

Program Associates Demographic Summary

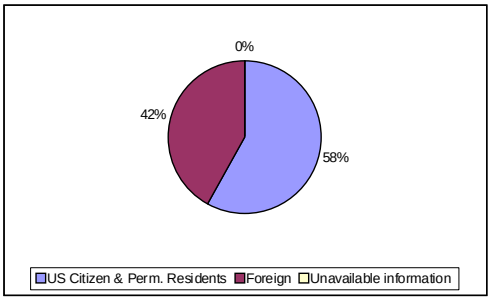
Gender	#	% (No Decl.)*	%
No. of Program Associates (GS)	32		100.0%
Male	20	64.5%	62.5%
Female	11	35.5%	34.4%
Decline to State Gender	1		3.1%



Ethnicities	#	% (No Decl.)*	%
Native American	0	0.0%	0.0%
Asian	4	13.8%	13.3%
Black	0	0.0%	0.0%
Hispanic	1	3.4%	3.3%
Pacific	0	0.0%	0.0%
White	24	82.8%	80.0%
Decline to State Ethnicities	1		3.3%
Unavailable Information	2		6.7%
Total no. of Program Associates	32		106.7%
Minorities	0	0.00%	0.0%



Citizenships	#		%
US Citizen & Perm. Residents	15		46.9%
Foreign	11		34.4%
Unavailable information	0		0.0%
Total no. of Program Associates	26		81.3%
US Citizen	15		46.9%
Perm Residents	0		0.0%
Home Inst. in US	23		71.9%

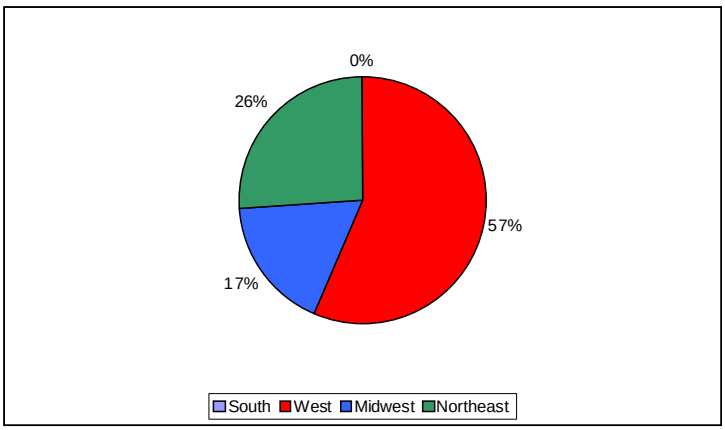


**Statistic Calculation based on all participants that did not decline.*

Home Institution Classified by States

****Regions based on US Census classification***

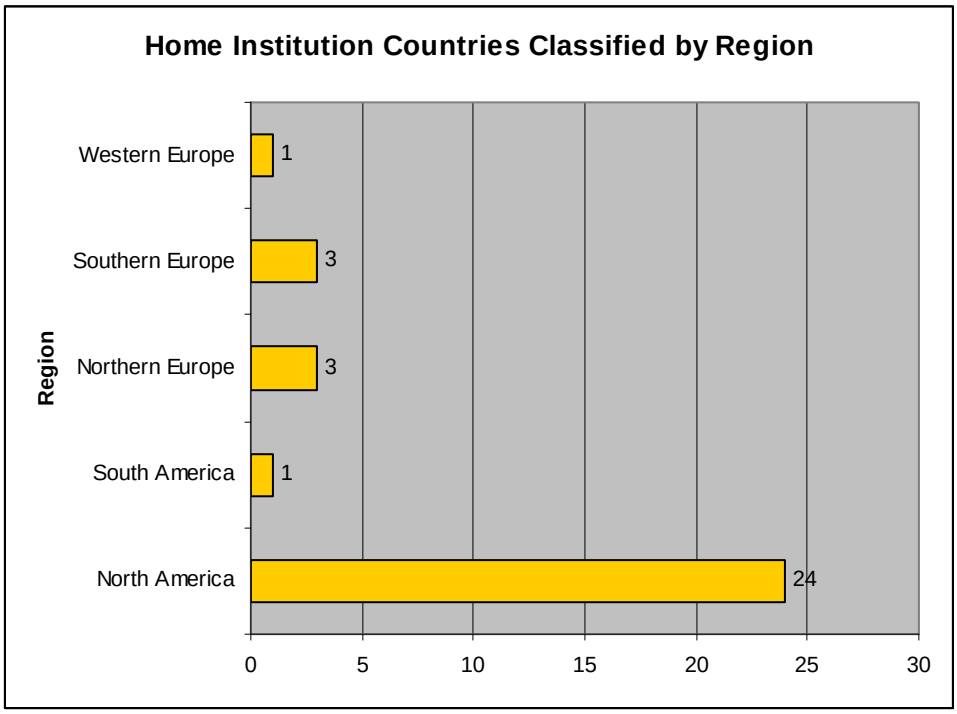
State	#	%	US Pop. (2007 Census)
South	**-**	**0.0%**	**36.6%**
AL	-	0.0%	1.5%
AR	-	0.0%	0.9%
DE	-	0.0%	0.3%
DC	-	0.0%	0.2%
FL	-	0.0%	6.1%
GA	-	0.0%	3.2%
KY	-	0.0%	1.4%
LA	-	0.0%	1.4%
MD	-	0.0%	1.9%
MS	-	0.0%	1.0%
NC	-	0.0%	3.0%
OK	-	0.0%	1.2%
SC	-	0.0%	1.5%
TN	-	0.0%	2.0%
TX	-	0.0%	7.9%
VA	-	0.0%	2.6%
WV	-	0.0%	0.6%
West	**13**	**56.5%**	**23.2%**
AK	-	0.0%	0.2%
AZ	1	4.3%	2.1%
HI	-	0.0%	0.4%
ID	-	0.0%	0.5%
MT	-	0.0%	0.3%
CA	6	26.1%	12.1%
CO	-	0.0%	1.6%
NV	-	0.0%	0.9%
NM	-	0.0%	0.7%
OR	-	0.0%	1.2%
UT	-	0.0%	0.9%
WA	6	26.1%	2.1%
WY	-	0.0%	0.2%
Midwest	**4**	**17.4%**	**22.0%**
IL	2	8.7%	4.3%
IN	-	0.0%	2.1%
IA	-	0.0%	1.0%
KS	-	0.0%	0.9%
MI	2	8.7%	3.3%
MN	-	0.0%	1.7%
MO	-	0.0%	1.9%
ND	-	0.0%	0.2%
NE	-	0.0%	0.6%
OH	-	0.0%	3.8%
SD	-	0.0%	0.3%
WI	-	0.0%	1.9%
Northeast	**6**	**26.1%**	**18.1%**
CT	-	0.0%	1.2%
ME	-	0.0%	0.4%
MA	2	8.7%	2.1%
NH	-	0.0%	0.4%
NJ	-	0.0%	2.9%
NY	-	0.0%	6.4%
PA	-	0.0%	4.1%
RI	4	17.4%	0.4%
VT	-	0.0%	0.2%
Other	**-**	**0.0%**	**0.0%**
PR	-	0.0%	0.0%
Other	**-**	0.0%	0.0%
Total	**23**	**100.0%**	**100.0%**



Home Institution Classified by Countries

**Regions based on United Nations' classification*

Region	Area	Country	# of Attendees
Americas			**25**
	North America		24
		Canada	1
		United States	23
	South America		1
		Chile	1
Europe			**7**
	Northern Europe		3
		United Kingdom	3
	Southern Europe		3
		Italy	3
	Western Europe		1
		France	1
Grand Total			**32**



4.9 Regular Workshops Graduate Student List (excluding SGWs)

(See e-mail attached file)

4.10 Regular Workshops Graduate Student Summary

Name of Activity	No. of Graduate Students	No. of Citizens & Permanent Residents	% of Citizens & Permanent Residents	No. of Female	No. of Decline to state Gender	% of Female (includes decline)	No. of Minorities	No. of Decline to state Ethnicity	% of Minorities (includes decline)	US Home Institution	% of US Home Institution
21 Scientific Workshops											
Algebraic Statistics	27	11	41%	8	1	29.6%	3	1	11.1%	20	74%
Broader Connections: Analysis on Singular Spaces	11	2	18%	1		9.1%	0	1	0.0%	7	64%
Broader Connections: Ergodic Theory and Additive Combinatorics	16	2	13%	7		43.8%	0	1	0.0%	8	50%
Classical Algebraic Geometry Today	53	18	34%	13	1	24.5%	4	3	7.5%	40	75%
CMI/MSRI Workshop: Modular Forms and	17	3	18%	5		29.4%	1	2	5.9%	10	59%
Combinatorial, Enumerative and Toric	45	21	47%	13		28.9%	3	2	6.7%	36	80%
Connections for Women: Algebraic Geometry and Related Fields	31	18	58%	19	1	61.3%	3	1	9.7%	25	81%
Discrete Rigidity Phenomena in Additive Combinatorics	13	2	15%	4		30.8%	1	1	7.7%	6	46%
Economic Games and Mechanisms to Address Climate Change	13	10	77%	1		7.7%	0	2	0.0%	12	92%
Elliptic and Hyperbolic Equations on Singular Spaces	9	5	56%	2		22.2%	0		0.0%	6	67%
International Conference on Cluster Algebras and Related Topics	9	2	22%	3		33.3%	1	1	11.1%	9	100%
Introduction to Ergodic Theory and Additive Combinatorics	19	5	26%	6		31.6%	0	3	0.0%	13	68%
Introductory Workshop on Analysis on Singular Spaces	20	6	30%	1		5.0%	0	1	0.0%	14	70%
Low Dimensional Topology	32	22	69%	7	1	21.9%	2	4	6.3%	25	78%
Macaulay 2 day	1	1	100%			0.0%	0		0.0%	1	100%
Mathematical Genomics	9	5	56%	5	1	55.6%	0	1	0.0%	9	100%
Modern Moduli Theory	52	17	33%	11	4	21.2%	1	7	1.9%	34	65%
Modern Perspectives in Applied Mathematics	5	1	20%	2		40.0%	0	2	0.0%	3	60%
Sage Days: Algebraic Geometry	12	6	50%	5		41.7%	3		25.0%	8	67%
Topology of Stratified Spaces	9	1	11%	1		11.1%	0	1	0.0%	5	56%
Western Algebraic Geometry Seminar	12	5	42%	1		8.3%	0		0.0%	10	83%
21 Scientific Workshops Total	**415**	**163**	**39%**	**115**	**9**	**28%**	**22**	**34**	**5%**	**301**	**73%**
6 Outreach & Diversity Workshops											
Bay Area Circle for Teachers	4	4	100%	2		50.0%	0		0.0%	2	50%
Great Circles 2009	33	28	85%	21	1	63.6%	1	2	3.0%	29	88%
Math Institutes Modern Mathematics Workshop	9	8	89%	4		44.4%	8	1	88.9%	9	100%
Promoting Diversity at the Graduate Level in Mathematics: a National Forum	15	12	80%	12		80.0%	6	1	40.0%	15	100%
Teaching Undergraduates Mathematics	22	16	73%	16		72.7%	3	2	13.6%	20	91%
Using Partnerships to Strengthen Elementary Mathematics Teacher Education	17	14	82%	14		82.4%	5		29.4%	16	94%
6 Outreach & Diversity Workshops Total	**100**	**82**	**82%**	**69**	**1**	**69%**	**23**	**6**	**23%**	**91**	**91%**
All 27 Workshops Total	**515**	**245**	**48%**	**184**	**10**	**36%**	**45**	**40**	**9%**	**392**	**76%**

5. Undergraduate Program

Research Topic: Coding Theory
Date: June 15, 2009 to July 24, 2009
Organizers: Ivelisse Rubio, Duane Cooper*, Ricardo Cortez, Herbert Medina, Suzanne Weekes

Overview of the summer program

The MSRI-UP summer program was designed for undergraduate students who have completed two years of university-level mathematics courses and would like to conduct research in the mathematical sciences. The academic portion of the program was led by John B. Little, Professor of Mathematics at College of the Holy Cross. Dr. Little had done research in many mathematical fields including computational algebra and coding theory and has extensive experience with directing undergraduate research. Indeed, he had worked in Research Experience for Undergraduates (REUs) in both the U.S. and Puerto Rico.

During the summer, each of the 18 student participants:

- participated in the mathematics research program under the direction of Dr. Little
- completed a research project done in collaboration with other MSRI-UP students

- gave a presentation and wrote a technical report on his/her research project
- attended a series of colloquium talks given by leading researches in their fields
- attended workshops aimed at developing skills and techniques needed for research careers in the mathematical sciences and
- learned techniques that will maximize a student's likelihood of admissions to graduate programs as well as the likelihood of winning fellowships
- received a $3000 stipend, lodging, meals and roundtrip travel to Berkeley, CA.

After the summer, each student:

- had an opportunity to attend a national mathematics or science conference where students presented their research
- was part of a network of mentors that provides continuous advice in the long term as the student makes progress in his/her studies
- was contacted regarding future research opportunities

The main objective of the MSRI-UP 2009 was to identify talented students, especially those from underrepresented groups, who are interested in mathematics and made available to them meaningful research opportunities, the necessary skills and knowledge to participate in successful collaborations, and a community of academic peers and mentors who can advise, encourage and support them through a successful graduate program.

The objective was designed to contribute significantly toward meeting the program goal of increasing the number of graduate degrees in the mathematical sciences, especially doctorates, earned by U.S. citizens and permanent residents by cultivating heretofore untapped mathematical talent within the U.S. Black, Hispanic/Latino and Native American communities.

Recently, MSRI is delighted to have learned that 2 of the students who participated in the MSRI-UP 2007 were awarded the 2010 NSF Graduate Research Fellowships. There are Talea Mayo and Gina Pomann.

Topic: Coding Theory

Prerequisite: A solid course in linear algebra and a course where a student develops skill in reading and constructing proofs.

Communication of information often takes place over noisy channels that can corrupt the messages sent over them. For reliability of communication, it is often desirable to encode the transmitted information in such a way that errors can be detected and/or corrected when they occur. Finding methods that achieve error control without introducing undue redundancy, and that admit efficient encoding and decoding, was the main goal of coding theory.

Consider a communications environment in which messages are divided into *words* or blocks of a fixed length, k, formed using a finite alphabet with q symbols. The simplest case (the one best adapted to electronic hardware) is an alphabet with two symbols, the binary digits 0, 1. Indeed, in

the codes used for the transfer of digital information within computer systems, and for storing information on compact disks, or other media and retrieving it for use at a later time, q is either 2 or a power of 2. The alphabet with exactly two symbols can be identified with the finite field, but the theory is substantially the same if the alphabet is any finite field. In order to detect and/or correct errors when they occur, some redundancy must be built into the information that is transmitted over the channel. One possible approach is to make the encoded form of a message consist of blocks or n-tuples of length $n>k$ over the same alphabet used for the message itself. Codes obtained in this way are called block codes of length n over the alphabet.

The summer started with a quick (2 week) short course giving an introduction to the theory of block codes over and other finite fields including: the Hamming distance, the parameters n,k,d of codes and some elementary bounds (Gilbert-Varshamov, Hamming, Singleton, etc.) on the parameters, linear codes, generator and parity check matrices for encoding and syndrome decoding, some important examples such as Hamming and Golay codes, cyclic codes and associated polynomial algebra, general finite fields, Reed-Solomon and BCH codes, algebraic decoding algorithms.

The basic decoding method for Reed-Solomon codes (leading up to the Berlekamp-Massey algorithm) is designed to correct up to $t=[(d-1)/2]=[(n-k)/2]$ errors in a received word. By results on the error-correcting capacity of a code in terms of its minimum distance, this restriction on the number of errors is necessary if we ask for a method that returns only one closest codeword for each received word. There has been a surge of interest in different algorithms for Reed-Solomon and other codes in recent years.

Starting with work of Sudan in the late 1990's and followed by work of Guruswami & and Sudan and Roth & Ruckstein, a significant amount of work has been devoted to methods that produce a list of all codewords within some specified distance (possibly $>t$ above) of the received word.

For the remaing 4 weeks of the workshop, the students worked on various projects. This workshop was not supported by the DMS-0441170. The funds came from the NSA and another NSF grant. The full report has been submitted with the annual report of the 2 grants.

Short Biographies of the 2009 MSRI-UP

Ivelisse M. Rubio was born and raised in Puerto Rico. She received her B.S. and M.S. in Mathematics from the University of Puerto Rico-Río Piedras and her Ph.D. in Applied Mathematics from Cornell University. In 1998 she co-founded the NSF-REU Summer Institute in Mathematics for Undergraduates (SIMU) at the UPR-Humacao. Ive is currently a Professor in the Computer Science Department at the UPR-Rio Piedras. Her research interests are finite fields and applications to error-correcting codes.

John B. Little, is a Professor of Mathematics at College of Holy Cross. His undergrad degree is from Haverford College and his Ph.D. from Yale. John has directed students in REUs several times including three times in Humacao, Puerto Rico where he and I had a chance to work together. His mathematical interests are varied and include algebraic geometry, computational methods in algebraic geometry and commutative algebra, and algebraic coding theory.

Website: http://math.holycross.edu/~little/homepage.html

Emille Davie is a Visiting Assistant Professor at the University of California, Santa Barbara. She received her undergraduate degree at Spelman College and her Ph.D. at University of Georgia. Her research interests are in braid groups, mapping class groups of surfaces and 3-manifolds. She has worked in the Enhancing Diversity in Graduate Education (EDGE) Program as a mentor. Website: http://www.math.ucsb.edu/~davie/

Ashley Wheeler is a second-year graduate student in mathematics at the University of Michigan. She received her undergraduate degree at Kansas State University. As an undergraduate, Ashley worked on a research project titled "Symplectic topology of Hamiltonian systems with one degree of freedom."

Candice Price is currently a graduate student in pure mathematics at the University of Iowa. Candice finished her undergraduate education at California State University Chico where she was an active participate in LS-AMP. She continued her education at San Francisco State University, where she received an M.A. Candice is studying topology with an emphasis in knot theory. Candice also worked as a graduate student assistant in the 2008 MSRI-UP.

Herbert A. Medina is a Professor of Mathematics at Loyola Marymount University. Undergrad at UCLA and Ph.D. at UC Berkeley. He's an analyst and has done work in Hilbert space operators (of a certain type) and some theoretical aspects of wavelets. He's also dabbled in other elementary math topics. Prof. Medina has been involved in many undergraduate summer programs including 5 summers as co-director of an REU at the University of Puerto Rico-Humacao. Website: http://myweb.lmu.edu/hmedina/

2008 MSRI-UP Participants List

Participants	Home Institution
Almodovar, Leyda	University of Puerto Rico at Mayaguez
Amaya, James	College of New Jersey
Carbonara, Alejandro	California Institute of Technology
Chancellor, Warren	Morehouse College
Cody, Eugene	Phoenix Colelge
Gaudinez, Aileen	Chapman University
Harry, April	Xavier University
Henry, Jonathon	Califoria State Polytechnic University, Pomona
Heu, Kimberly	University of Hawaii at Manoa
Le, Ellen	Pomona College
Morales, Lourdes	University of Puerto Rico at Rio Piedras
Murillo Pablo, Juan	Sonoma State University
Ortiz Camacho, Abner	University at Puerto Rico at Humacao
Outing, Cheryl	Spelman College
Parmelee, Caytlin	Nazreth Colege of Rochester
Vega, Brian	California State Polytechnic University
Vega, Rachel	Concordia College

6. Appendix – Final Reports

Program Reports
- Analysis on Singular Spaces
- Ergodic Theory and Additive Combinatorics
- Algebraic Geometry
- Complementary Program

Workshop Reports
- No. 447: CMI-MSRI Workshop: Modular Forms and Arithmetic
- No. 441: Low-Dimensional Topology
- No 438: Broader Connections Ergodic Theory and Additive Combinatorics
- No. 439: Introduction to Ergodic Theory and Additive Combinatorics
- No. 442: Broader Connections: Analysis on Singular Spaces
- No. 443: Introdctory Workshop Analysis of Singular Spaces
- No. 469: Topology of Stratified Spaces
- No. 444: Elliptic and Hyperbolic Equations on Singular Spaces
- No. 440: Discrete Rigidity Phenomena in Additive Combinatorics
- No 499: International Conference on Cluster Algebras and Related Topics
- No. 484: Algebraic Statistics
- No. 471: Connections for Women: Algebraic Geometry and Related Fields
- No. 470: Classical Algebraic Geometry Today
- No. 472: Modern Moduli
- No. 473: Combinatorial, Enumerative, and Toric Geometry
- No. 515: Economic Games and Mechanisms to Address Climate Change

Summer Graduate Workshop Reports
- Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas
- Climate Change - Summer Graduate Workshop and Summer School
- IAS/PCMI Summer Program: Analytic and Algebraic Geometry
- Toric Varieties

2004-2009 Members and Participants data
- Evaluating MSRI's Postdoctoral Fellowship Program
- Demographic Data of MSRI 5 Years Study

MSRI ANALYSIS ON SINGULAR SPACES PROGRAM
FINAL REPORT
March 2, 2009

1. Introduction

The *Analysis on singular spaces* program at MSRI ran from August 18, 2008 to December 19, 2008. The organizing committee consisted of Gilles Carron (University of Nantes), Eugenie Hunsicker (Loughborough University), Richard Melrose (Massachusetts Institute of Technology), Michael Taylor (University of North Carolina, Chapel Hill), András Vasy (Stanford), and Jared Wunsch (Northwestern University). Notwithstanding the diverse interests of the participants (and indeed diverse notions of what should constitute a "singular space"), the program was well-focused and impressively coherent.

We were fortunate to have a large number of senior participants visiting for the entire semester. Among the organizers, Richard Melrose, Michael Taylor, András Vasy, and Jared Wunsch were present for the duration, with Eugénie Hunsicker also spending ten weeks. Additionally Tanya Christiansen, Terence Gaffney, and Paul Loya spent the whole semester at MSRI, and the program had fruitful interactions with Daniel Tataru and Maciej Zworski from UCB, who both participated all semester. Werner Müller visited for ten weeks, funded by the Clay Mathematics Institute, while Daniel Grieser and Gerd Grubb each visited for a month as Simons Professor. Melrose was the UCB Chancellor's Professor for the year, and gave a course at UCB on *Smooth Operator Algebras and K-theory*.

2. Research developments

- **Fredholm theory on quasi-asymptotically locally Euclidean spaces.** Degeratu and Mazzeo made substantial progress on an extended examination of the Fredholm properties of generalized Laplacians on crepant resolutions of quotients of $\mathbb{C}^n$ by finite subgroups of $SU(n)$, and the Riemannian generalizations of these spaces. The eventual goal is to prove Atiyah-Patodi-Singer type index theorems in this setting, which has applications to the higher dimensional McKay correspondence in algebraic geometry.
- **The fundamental solution of the wave operator on asymptotically de Sitter spaces.** Baskin, a Stanford graduate student (under the direction of Mazzeo and Vasy) made progress toward a detailed microlocal description of the singular and asymptotic structure of the fundamental solution of the wave kernel on a class of

Lorentzian spaces which are perturbations of the classic de Sitter spacetime. Eventual applications will include the stability (with respect to Einstein evolution) of de Sitter itself.

- **Analytic signature on stratified spaces.** Albin, Mazzeo, Piazza, and Leichtnam made substantial progress on a manuscript which provides the definition of an analytic signature on a general class of stratified spaces satisfying the Witt condition. They proved that for any iterated edge Witt space, the signature operator acting on L^2 differential forms has maximal domain compactly included in L^2, hence has well-defined finite index. The proof is carried out both in the ordinary context and also for the higher Dirac operator, i.e. twisted by the bundle of reduced C^* algebras associated to a map of the space into $B\Gamma$ (where Γ is the fundamental group). They expect to be able to improve this to a full signature theorem, i.e. equating this analytic signature with a topological signature for this class of operators and spaces. Piazza reports that during the Topology of Stratified Spaces Workshop, he learned a "magic theorem" on Witt bordism invariants from Shmuel Weinberger and Markus Banagl that is of considerable use in giving a topological interpretation of the Witt analytic index.
- **Local index theorem.** Loya was able to use the techniques of semi-classical analysis (which he learned from Melrose's UCB lectures) to finish a pedagogically novel proof of the local index theorem for Dirac operators; the resulting proof will appear in *Advances in Applied Clifford Algebras*.
- **Vanishing viscosity limits for circular pipe flows.** Mazzucato and Taylor obtained a result showing that viscous solutions to a class of circular pipe flows converge in the vanishing-viscosity limit to the solution to the associated Euler equation, in a variety of function spaces (including certain weighted b-Sobolev spaces), fine enough to specify boundary layer behavior, including concentration of vorticity on the boundary.
- **Inverse problems for obstacles in wave guides.** Christiansen and Taylor obtained an inverse-scattering result for obstacles in a waveguide, specified by knowledge of the scattering matrix $S_{kk}(\lambda)$, for a single k (of a certain sort) and for λ in an interval. This result applies to obstacles that are rotationally symmetric around an axis parallel to the waveguide, as well as convex, connected, and real-analytic. It extends previous results known in dimension-two.
- **Eta forms and gerbes.** Melrose and Rochon showed that the 2-form part of the eta form (in the "odd" case) is the B-field for the K-theory gerbe.
- **Scattering configurations spaces.** Melrose and Singer completed an ongoing project to describe the n-fold scattering configuration

space. This space was introduced principally to describe the compactification of the moduli space of magnetic monopoles.

- **Eta invariants on convex cocompact hyperbolic manifolds.** Guillarmou (together with S. Moroianu and J. Park) nearly completed an ongoing project to define an eta invariant for Dirac and signature operator on convex cocompact hyperbolic manifolds (infinite volume) by showing the usual procedure for compact manifolds goes through thanks to an algebraic cancellation near infinity. They then define the odd type Selberg zeta function $Z(s)$ and show its meromorphic extension for the spin case and that the eta invariant on the manifold is the argument of Z(0).
- **Random walks on manifolds with finite volume cusps.** Christianson, Datchev, and Guillarmou (together with L. Michel and F. Naud) undertook a novel project describing the spectrum of a random walk operator on manifolds with finite volume cusps. The goal is to generalize the results of Lebeau-Michel to this setting and to understand the spectral change owing to vanishing injectivity radius.
- **Asymptotics of waves on De Sitter-Schwarzschild space.** Melrose, Sá Barreto, and Vasy wrote a paper and made much progress on another paper on the asymptotics of solutions of the wave equation on curved black hole space times (De Sitter-Schwarzschild space) and the closely related topic of high energy resolvent estimates for the Laplacian on asymptotically hyperbolic spaces. With three coauthors, the opportunity to work together intensively at MSRI was a major help both in actually writing the papers, and also in organizing their large scale structure.
- **Diffraction of waves on manifolds with corners.** Melrose, Vasy, and Wunsch made significant progress on an ongoing project to understand the regularity of the diffracted singularities appearing when a singularity of a solution to the wave equation strikes a corner. The opportunity for intensive collaboration was essential for the authors to overcome certain technical obstacles in the proof, including the implementation a duality argument which proves propagation of a "nonfocusing" condition dual to coisotropic regularity.

3. Organizational structure

The typical week during the semester included two regular seminars, on Tuesday and Thursday, and an additional postdoc seminar on Friday. The Tuesday/Thursday lectures were scheduled for two hours, even while the lecturers were asked to give hour-long lectures. The format thus allowed more than ample time for audience questions and interactions without causing the speaker to have to cut short the planned presentation. The postdoctoral seminar on Fridays also had excellent attendance from the general program

members and functioned as a third parallel seminar series. Richard Melrose, as UCB Chancellor's Professor, gave a course *Smooth Operator Algebras and K-theory*, which was attended by a range of "students" from Berkeley and MSRI including both traditional graduate students and tenured faculty. This course seems to have sparked considerable interaction among partipants at all levels of seniority.

Participants enjoyed the interaction fostered by the seminar arrangements and also reported finding the simple experience of having lunch together on a regular basis to be a valuable aspect of life at MSRI. On most days, a large crowd assembled for lunch in the second-floor common room and this was a valuable venue for informal networking as well as discussion of mathematics. Participants of all levels of seniority mingled in this setting, and it may in the end have been the most effective mentoring tool for postdocs.

4. Workshops and conferences

4.1. **Broader Connections Workshop.** The Broader Connections workshop associated to the semester was held August 28–29. It was organized by Eugénie Hunsicker. Approximately 30 mathematicians attended the workshop, which consisted of eight introductory talks given by mathematicians selected both for their lecturing ability and for their interest in mentoring underrepresented groups in mathematics. The lecturers were Thalia Jeffres, Tanya Christiansen, Eugénie Hunsicker and Paul Loya. In addition to the talks, there was a problem session where participants had a chance to get to know each other as they worked on problems suggested by the lecturers. There were morning, afternoon and lunch breaks on both days, when participants could network with each other and talk to more established researchers in the field. There was also a networking dinner for women. The response to the workshop was quite positive, both for its networking opportunities and for the preparation it gave for the introductory workshop.

4.2. **Introductory Workshop.** The Introductory Workshop for the Analysis on Singular Spaces semester program was held from September 2 to September 5. The workshop only lasted four days as the week was curtailed by Labor Day; in recompense, there was no half-day. The principal workshop organizers were Eugénie Hunsicker, András Vasy, and Jared Wunsch.

The scientific program consisted primarily of a linked collection of minicourses, as follows:

- Richard Melrose, *Real blow-ups*
- Michael Taylor, *Pseudodifferential operators on singular spaces*
- Maciej Zworski and Tanya Christiansen, *Spectral and scattering theory*
- Gerd Grubb, *Introduction to index theory*
- Paul Loya, *Index theory on singular spaces*
- Gilles Carron, L^2 *cohomology*

These courses were designed to give background material suitable for advanced students and postdocs (as well as more senior researchers from allied fields) to be able to take part in the main thrust of the semester's program. The mini-courses proved by and large quite well-integrated, with core material on pseudodifferential operators being covered very efficiently by Taylor in the early part of the week, and thus available to other speakers; likewise, key ideas from spectral and scattering theory were introduced quickly by Zworski and Christiansen and played recurrent roles in the other courses.

In addition to the mini-courses, three half-hour slots were allocated to short lectures on open problems, given by Jochen Brüning, Werner Müller, and Rafe Mazzeo. These problem sessions provided a lively counterpoint to the main courses, reminding the participants that notwithstanding all that is known about analysis on singular spaces, it remains a vital field, with much left unknown.

4.3. **Topical Workshop.** This workshop focused on recent advances in the field. There were seventy-three participants and the workshop was organized by the program organizers (Gilles Carron, Eugénie Hunsicker, Richard Melrose, Michael Taylor, András Vasy and Jared Wunsch) together with Pierre Albin. The speakers and their topics were:

Monday October 27, 2008

Gilles Lebeau: a novel approach to proving existence results for non-linear partial differential equations by putting a probabilistic distribution on the space of initial data.

Andrew Hassell: extending various classical results in harmonic analysis (such as the Stein-Tomas restriction theorem) to more general, closely related situations where translation-invariance is lost.

Gregory Eskin: described various inverse problems for second order hyperbolic equations and discussed the existence of black or white holes.

Steven Zelditch: an exciting new approach to establishing existence of solutions to a homogeneous Monge-Ampere equation.

Tuesday October 28, 2008

Daniel Tataru: the asymptotic behavior of solutions to the wave and Schrödinger equations on long range perturbations of Euclidean space.

Nicolas Burq: truly non-linear behavior of solutions to the non-linear Schrödinger equation.

Mark Stern: instanton solutions of the Yang-Mills functional on $\mathbb{T}^3 \times \mathbb{R}$ joining different components of the moduli space of flat connections on $\mathbb{T}^3$.

Tanya Christiansen: characterizing obstacles with a reflection symmetry inside cylindrical ends by scattering data.

Wednesday October 29, 2008

Colin Guillarmou: an explicit formula for the η invariant of an infinite

volume hyperbolic manifolds without cusps in terms of the corresponding odd Selberg zeta function.
Rafe Mazzeo: described the Teichmüller space of surfaces with a given genus and number of conic points.

Thursday October 30, 2008
Marius Mitrea: described the complete range of Sobolev, Besov, and Triebel-Lizorkin spaces on which the second derivative of Green's operator acts boundedly.
Robin Graham: looking for Einstein metrics on perturbations of $\mathbb{H}^4 \times \mathbb{S}^7$ within the class of 'edge' metrics.
Bert-Wolfgang Schulze: a calculus of corner-degenerate operators on appropriate stratified spaces.

Friday October 31, 2008
András Vasy: using high-energy estimates on the analytic continuation of the resolvent to describe asymptotics of solutions to the wave equation on de Sitter-Schwarzschild space.
Maciej Zworski: counting the number of resonances associated to a union of disjoint convex obstacles satisfying a separation condition (Ikawa's condition).
Victor Ivrii: periodicity in classical and quantum dynamics and its effect on spectral asymptotics.

Additionally, Andrew Hassell gave a colloquium at Berkeley arranged as part of this meeting, in which he spoke on his recent breakthrough showing that the "Bunimovich stadium," while classically ergodic, is not (for almost any aspect ratio) quantum unique ergodic. Some collaborations to explore the ramifications of this result and the method of its proof emerged as a consequence of the meeting.

5. Postdoctoral Fellows

One of our proposed postdoctoral fellows, Katya Krupchyk, was unable to attend the whole program owing to visa difficulties, and was therefore supported as a member rather than a postdoc and is not included below. Krupchyk reported having found the program quite valuable; she was informally mentored by Eugénie Hunsicker.

Data for the other postdocs is as follows.

Eric Bahuaud:

Prior positions: Ph.D. Washington 2007; CNRS/ANR Postdoc at Universite Montpellier 2 Sept 2007–July 2008.

Current position: Adjunct lecturer at Saint Mary's College of California.

Mentor: Melrose.

Bahuaud completed a paper (with Romain Gicquaud) on conformal compactification of asymptotically locally hyperbolic metrics, and began a project on the complex hyperbolic version of this problem; he interacted fruitfully with John Lee and Robin Graham on this subject during the workshop. He and Emily Dryden worked together studying Melrose's b-calculus of pseudodifferential operators under the tutelage of Paul Loya, and have embarked on a project to extend some estimates of Jeffres-Loya for the heat operator from conic manifolds to higher (edge) singularities.

Hans Christianson: Ph.D. Berkeley 2007; MIT Moore Instructor 2007–present.

Mentor: Wunsch

Christianson completed a lengthy paper with Hur and Staffilani which breaks new ground in applying techniques imported from microlocal analysis to the water wave problem; the same authors began a further paper on Strichartz estimates for water waves. He began a project on random walks on manifolds with cusps jointly with Kiril Datchev (a UCB graduate student), Colin Guillarmou, Laurent Michel, and Frederic Naud. He undertook a joint project with Jeremy Marzuola on solitons for the nonlinear Schrödinger equation on hyperbolic space, as well as a project on semiclassical methods for the discrete damped wave equation.

Emily Dryden: Ph.D. Dartmouth 2004;

Prior positions: Postoctoral Fellow, McGill University, 2004–2005; Centre Interfacultaire Bernoulli, EPFL (Lausanne, Switzerland), Visiting Professor, August–September 2005; Instituto Superior Tecnico (Lisbon, Portugal), Postdoctoral Fellow, 2005–6; Bucknell University, Assistant Professor, 2006–present.

Current position(s): MIT, Visiting Scholar in Pure Mathematics, January-August 2009; Bucknell University, Assistant Professor.

Dryden worked on a variety of projects, mostly centered around spectral theory of orbifolds; she undertook joint work with Eric Bahuaud, with Rafe Mazzeo, and with Patrick McDonald. She and Bahuaud spent time reading foundational material on singular spaces in an informal "reading course" and she reported that the semester enabled her to expand her research program to a wider geometric setting.

Jörn Müller

Ph.D. Bonn 2008;

Prior position: none.

Current position: University Bonn, scientific assistant.

Mentor: Hunsicker.

Müller was able to complete a paper based on his thesis, on Hodge cohomology of manifolds with fibred cusps, and began work on an L^2 signature theorem.

Frédéric Rochon Ph.D. MIT 2005;

Prior positions: Simons Instructor at Stony Brook, Assistant Professor at University of Toronto.

Current position: Assistant Professor at University of Toronto.

Mentor: Vasy.

Rochon had a number of intense collaborations both underway and undertaken in the course of the semester. He completed joint papers in index theory and K-theory with Richard Melrose and with Pierre Albin, and undertook new projects with Melrose and with Albin and Clara Aldana. He reports that a casual conversation with Daniel Grieser on the subject of pushforward theorems at the beginning of the semester later led to decisive progress in his project with Albin on the index of d-bar operators acting on stable parabolic vector bundles of degree zero.

6. Graduate Students

A number of graduate students were present for all or part of the program (mentored by their thesis advisors), and found it an invaluable experience.

Heiko Gimperlein (advisor: Schrohe) made progress on a project with Schrohe on a bounded H_∞ calculus for pseudodifferential operators, and reports having had an idea for a simpler proof of the regularity of solutions to the Hamilton-Jacobi-Bellman equations arising from a talk at UCB.

Dean Baskin (advisors: Mazzeo, Vasy) made progress toward a detailed microlocal description of the singular and asymptotic structure of the fundamental solution of the wave kernel on a class of Lorentzian spaces which are perturbations of the classic de Sitter spacetime.

Fang Wang (advisor: Melrose) benefitted from discussion with several participants in the topical workshop, and completed the first draft of (the first part of) her thesis on the analog of the Dirichlet-to-Neumann operator for Poincaré-Einstein metrics. Subsequently she started to work on geometric scattering theory in the context of Einstein's equations due to activity in this general area.

Chris Kottke (advisor: Melrose) spent only a couple of weeks at MSRI but was able to discuss his ideas concerning index theory and monopoles with several participants.

Randy Qian (advisor: Wunsch) was able to make significant progress on his thesis project to understand diffraction of singularities of the wave equation by inverse-square singularities.

Glenn Austin Ford (advisor: Wunsch) visited MSRI for both workshops, and benefitted especially from discussions and lectures on the geometry of singular spaces, and hyperbolic equations in this setting.

Overall, the opportunity for advanced students to see the state of the field laid out for them both in the introductory workshop and in the subsequent intense atmosphere of twice-weekly seminars was one of the most strikingly transformative aspects of the semester.

7. Diversity

Of the program's five postdocs, two were women (with a third woman, Krupchyk, attending as a member instead of a postdoc owing to visa issues). The program also boasted an impressive array of senior women, with Christiansen, Hunsicker, and Grubb all attending for substantial periods as research professors or organizers. All of these women gave lectures in Introductory and/or Broader Connections workshops. The program as a whole had seventeen women members, at various levels of seniority (and including five long-term members, in additions to the research professors listed above), out of approximately sixty-five total; thus it was more than 25% women.

Additionally, one of our other research professors, Paul Loya, is Native American; Loya attended for the whole semester and interacted extensively with students during his stay, in addition to delivering a number of introductory lectures in our Broader Connections and Introductory workshops (and a research seminar as well).

8. Synergistic activities

Melrose's course at UCB attracted a wide audience and served to publicize many of the activities at MSRI to a wider audience (Loya also enjoyed substantial informal interaction with students in conjunction with this class), as did the Evans lectures of Christiansen, Taylor, and Wunsch. The program had very fruitful interaction with Tataru and Zworski at UCB, as well as with their students, who derived considerable benefit from the MSRI program.

The program had considerable interaction with the Topology of Stratified Spaces Workshop held at MSRI from September 8–12. While this workshop was not formally a part of the programs's activities, it brought in many experts in the more topological aspects of singular spaces, and went a large distance to realizing the program's goal of fostering interaction between the analytic and topological communities.

9. Nuggets and breakthroughs

Tanya Christiansen and Michael Taylor proved a new result on inverse-scattering for obstacles in waveguides, following on a talk that Christiansen gave on some results in this direction. The inverse-scattering problem is that of determining an object—in this case, one in the middle of a waveguide—by bouncing waves off of it; these waves might be acoustic, seismic, or electromagnetic: to a good approximation, the theory is the same. The work of Christiansen-Taylor allows us to determine the shape of the obstacle, subject to some technical hypotheses, by using waves of a small range of wavelengths. Previous results of Christiansen had been confined to the two-dimensional case.

Frédéric Rochon reported that a casual conversation with Daniel Grieser at the beginning of the semester later led to decisive progress in his project with Pierre Albin on the index of d-bar operators acting on stable parabolic

vector bundles of degree zero. Index theory is a subject of crucial importance both in geometry and in modern mathematical physics, where it arises in connection with the study of anomalies in quantum field theory.

Andrew Hassell discussed and, in interaction with Luc Hillairet, was able to extend his recent breakthoughs on the failure of quantum unique ergodicity for the Bunimovich stadium. These results show that while the motion of a billiard ball in the "stadium" (a rectangular region with semicircular ends) is rather chaotic, nonetheless there can be quantum states at high energy that are narrowly concentrated along those billiard trajectories that bounce back and forth within the rectangular part. The existence of these quantum states had been a major open problem in the burgeoning field of quantum chaos.

Postdoctoral Fellows Summary

Pre/Post Institute Group

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Bahuaud, Eric	2007	University of Washington	I Public	Melrose, Richard	Universite Montpellier II	Foreign	Saint Mary's College	B	Postdoc
Christianson, Hans	2007	UC Berkeley	I Public	Wunsch, Jared	MIT	I Private	MIT	I Private	CLE Moore Instructor
Dryden, Emily	2004	Darthmouth College	II	Mazzeo, Rafe	Bucknell University	M	MIT	I Private	Visiting Scholar
Muller, Jorn	2008	University of Bonn	Foreign	Hunsicker, Eugenie	University of Bonn	Foreign	University of Bonn	Foreign	Assistant Professor
Rochon, Frederic	2005	MIT	I Private	Vasy, Andras	University of Toronto	Foreign	University of Toronto	Foreign	Assistant Professor

		Pre-MSRI							
		Group I Private	Group I Public	Group II	Group III	Group B	Group M	Foreign	Total
Post-MSRI	Group I Private	1					1		2
	Group I Public								-
	Group II								-
	Group III								-
	Group B							1	1
	Group M								-
	Foreign							2	2
	Total	**1**	**-**	**-**	**-**	**-**	**1**	**3**	**5**

Participant List

MSRI Program:

Analysis on Singular Spaces

August 18 to December 19, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Primary Institute	Position
Aastrup, Johannes	Universitat Munster	Post. Doc.
Albin, Pierre	Massachusetts Institute of Technology	Postdoctoral Fellow
Aldana Dominguez, Clara	Universität Bonn	Graduate Student
Alexandrova, Ivana	East Carolina University	Postdoctoral Fellow
Bahuaud, Eric	Universite Montpellier 2 (France)	CNRS Postdoctoral researcher
Baskin, Dean	Stanford University	Graduate student
Borthwick, David	Emory University	Associate Professor
Bouclet, Jean-Marc	Université de Lille I (Sciences et Techniques de Lille Flandres Artois)	Professor
Bruning, Jochen	Universität Humboldt	Professor
Carron, Gilles	University of Nantes	Professor
Christiansen, Tanya	University of Missouri, Columbia	Professor
Christianson, Hans	Massachusetts Institute of Technology	Lecturer
Davis, Benjamin	Saint Mary's College of California	Associate Professor
Degeratu, Anda	Max Planck Institute for Gravitational Physics	Junior Scientist
Dencker, Nils	University of Lund	Professor
Dryden, Emily	Bucknell University	Assistant Professor
Farsi, Carla	University of Colorado, Boulder	Professor
Francsics, Gabor	Michigan State University	Associate Professor
Gaffney, Terence	Northeastern University	Professor
Gell-Redman, Jesse	Stanford University	Graduate Student
Gimperlein, Heiko	Leibniz Universitaet Hannover	Graduate Student
Grandjean, Vincent	University of Bath	Professor
Grieser, Daniel	Carl von Ossietzky Universitaet Oldenburg	Professor
Grubb, Gerd	Copenhagen University	Professor
Guillarmou, Colin	Centre National de la Recherche Scient	Researcher CNRS
Haskins, Mark	Imperial College, London	Reader in Pure Mathematics
Hillairet, Luc	Université de Nantes	Maitre de Conferences
Hunsicker, Eugenie	Lawrence University	Assistant Professor
Jeffres, Thalia	Wichita State University	Assistant Professor
Kottke, Christopher	Massachusetts Institute of Technology	Graduate Student
Krainer, Thomas	Penn State Altoona	Asst. Professor
Krupchyk, Katsiaryna	University of Helsinki	Academy research fellow
Lebeau, Giles	Universite de Nice Sophia-Antipolis	Professor
Li, Hui	University of Luxembourg	Postdoc
Loya, Paul	SUNY Binghamton	Associate Professor
Mazzeo, Rafe	Stanford University	Professor
Mazzucato, Anna	Pennsylvania State University	Assistant Professor
McDonald, Patrick	New College of the University of South Florida	Professor
Melrose, Richard	MIT - Massachusetts Institute of Technology	Professor
Muller, Jorn	University of Bonn	Graduate Student
Müller, Werner	Universität Bonn	Professor
Perry, Peter	University of Kentucky	Professor
Piazza, Paolo	Università di Roma "La Sapienza"	Professor
Planchon, Fabrice	Université Paris 13	Professor
Ponge, Raphael	University of Toronto	Assistant Professor
Qian, Randy	Northwestern University	Graduate Student
Rochon, Frederic	University of Toronto	Assistant Professor
Rowlett, Julie	University of California	Faculty/Postdoc
Sá Barreto, Antônio	Purdue University	Professor
Saez Trumper, Mariel	Pontificia Universidad Catolica de Chile	Assistant Professor
Sandoval, Mary	Trinity College	Professor
Santoro, Bianca	Duke University	Assistant Research Professor

Saper, Les	Duke University	Professor
Schrohe, Elmar	Leibniz Universität Hannover	Professor
Singer, Michael	University of Edinburgh	Professor
Stanhope, Elizabeth	Lewis and Clark College	Faculty/Postdoc
Stefanov, Plamen	Purdue University	Professor
Strohmaier, Alexander	Loughborough University	Lecturer
Tataru, Daniel	University of California	Professor
Taylor, Michael	University of North Carolina, Chapel Hill	Professor
Trotman, David	University of Provence	Professor
Uhlmann, Gunther	University of Washington	Professor
Varghese, Mathai	University of Adelaide	Professor
Vasy, András	Stanford University	Professor
Wang, Fang	Massachusetts Institute of Technology	Graduate Student
Wunsch, Jared	Northwestern University	Associate Professor
Zworski, Maciej	University of California	Professor

Analysis on Singular Spaces

2008-2009

Program Participant Summary

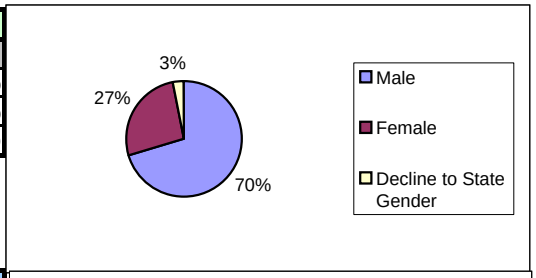
Analysis on Singular Spaces	# of Distinct Participants	%	# of Citizens & Perm. Res.	%	# of Female	%	# of Minorities	%
Postdoctoral Fellows	5	*7.8%*	3	*4.7%*	1	*1.6%*	0	*0.0%*
PD/RM	9	*14.1%*	2	*3.1%*	6	*9.4%*	1	*1.6%*
Program Associates	5	*7.8%*	3	*4.7%*	1	*1.6%*	0	*0.0%*
Research Members	32	*50.0%*	16	*25.0%*	6	*9.4%*	2	*3.1%*
Research Professor	7	*10.9%*	5	*7.8%*	2	*3.1%*	1	*1.6%*
Organizers	6	*9.4%*	4	*6.3%*	1	*1.6%*	0	*0.0%*
Total no. of Distinct Participants	**64**	***100.0%***	**33**	***52%***	**17**	***26.6%***	**4**	***6.3%***

Home Institute Grouping

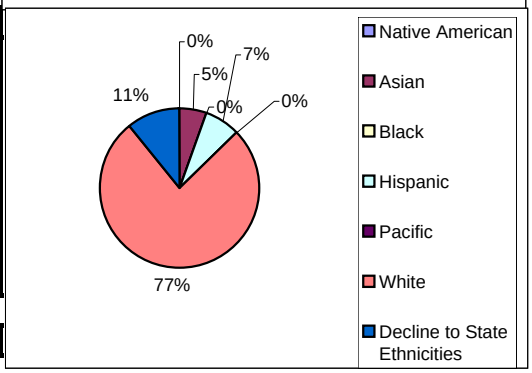
Analysis on Singular Spaces	Group I Private	Group I Public	Group II	Group III	Group B	Group M	Foreign Institute	Total
Postdoctoral Fellows	1	-	-	-	-	1	3	**5**
PD/RM	2	1	-	-	-	1	5	**9**
Program Associates	4	-	-	-	-	-	1	**5**
Research Members	2	5	2	2	4	-	17	**32**
Research Professor	-	2	2	-	-	-	3	**7**
Organizers	3	1	-	-	-	-	2	**6**
Total	**12**	**9**	**4**	**2**	**4**	**2**	**31**	**64**
%	***18.8%***	***14.1%***	***6.3%***	***3.1%***	***6.3%***	***3.1%***	***48.4%***	***100.0%***

Analysis on Singular Spaces (All Participants) Demographic Summary

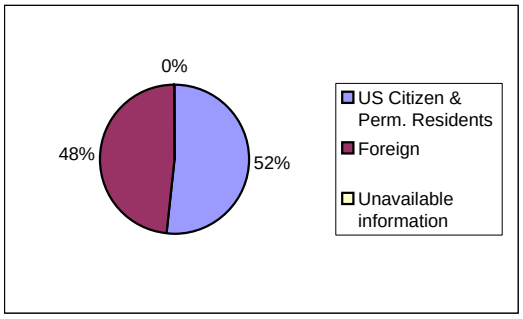
Gender	#	% (No Decl.)*	%
No. of Distinct Participants	64		
Male	45	72.58%	70.3%
Female	17	27.42%	26.6%
Decline to State Gender	2		3.1%



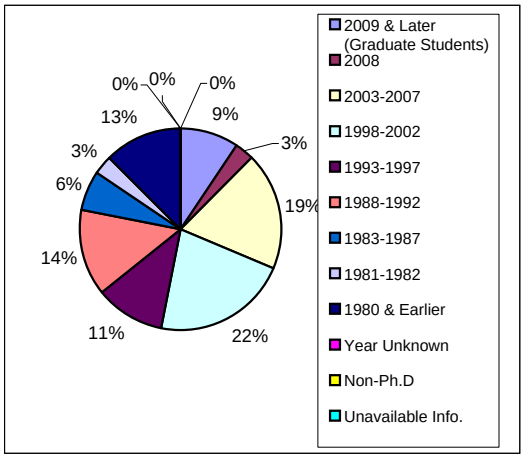
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	3	6.12%	5.5%
Black	0	0.00%	0.0%
Hispanic	4	8.16%	7.3%
Pacific	0	0.00%	0.0%
White	42	85.71%	76.4%
Decline to State Ethnicities	6		10.9%
Unavailable Information	8		
Total no. of Distinct Participants	63		
Minorities	4	8.16%	6.3%



Citizenships	#		%
US Citizen & Perm. Residents	33		51.6%
Foreign	31		48.4%
Unavailable information	0		0.0%
Total no. of Distinct Participants	64		100.0%
US Citizen	25		39.1%
Perm Residents	8		12.5%
Home Inst. in US	33		51.56%



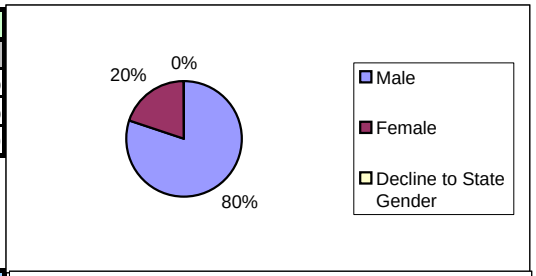
Year of Ph.D	#		%
2009 & Later (Graduate Students)	6		9.4%
2008	2		3.1%
2003-2007	12		18.8%
1998-2002	14		21.9%
1993-1997	7		10.9%
1988-1992	9		14.1%
1983-1987	4		6.3%
1981-1982	2		3.1%
1980 & Earlier	8		12.5%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	64		100.0%



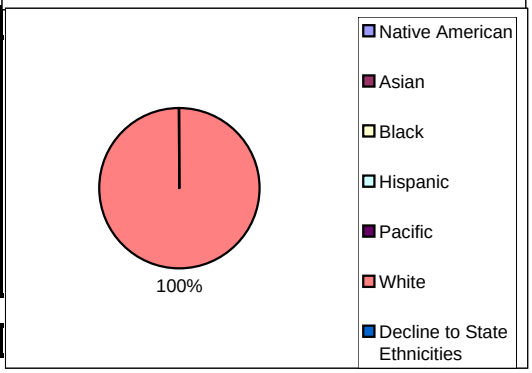
**Statistic Calculation based on all participants that did not decline.*

Analysis on Singular Spaces Postdoctoral Fellow Summary

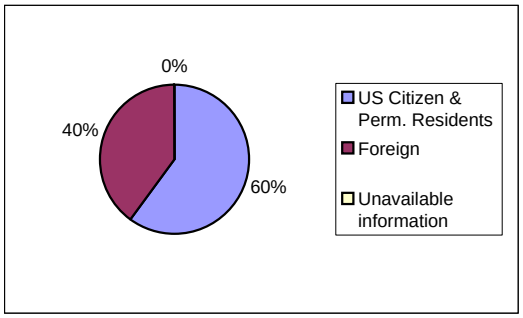
Gender	#	% (No Decl.)*	%
No. of Postdoctoral Fellows	5		
Male	4	80.00%	80.0%
Female	1	20.00%	20.0%
Decline to State Gender	0		0.0%



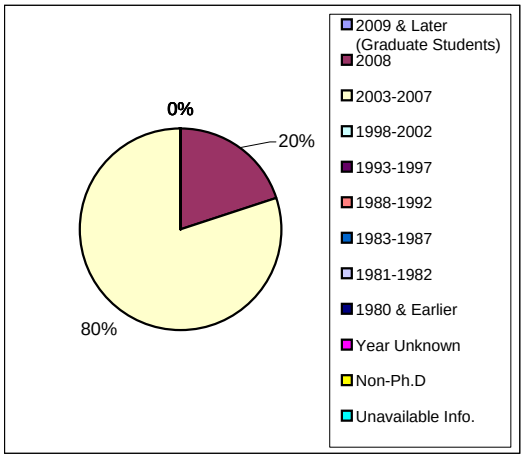
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	0	0.00%	0.0%
Black	0	0.00%	0.0%
Hispanic	0	0.00%	0.0%
Pacific	0	0.00%	0.0%
White	5	100.00%	100.0%
Decline to State Ethnicities	0		0.0%
Unavailable Information	0		0.0%
Total no. of Postdoctoral Fellows	5		100.0%
Minorities	0	0.00%	0.0%



Citizenships	#		%
US Citizen & Perm. Residents	3		60.0%
Foreign	2		40.0%
Unavailable information	0		0.0%
Total no. of Postdoctoral Fellows	5		100.0%
US Citizen	2		40.0%
Perm Residents	1		20.0%
Home Inst. in US	2		40.00%



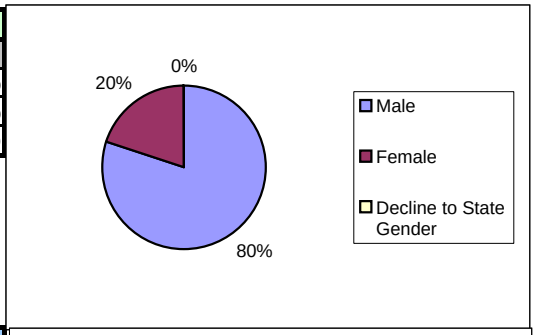
Year of Ph.D	#		%
2009 & Later (Graduate Students)	0		0.0%
2008	1		20.0%
2003-2007	4		80.0%
1998-2002	0		0.0%
1993-1997	0		0.0%
1988-1992	0		0.0%
1983-1987	0		0.0%
1981-1982	0		0.0%
1980 & Earlier	0		0.0%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	5		100.0%



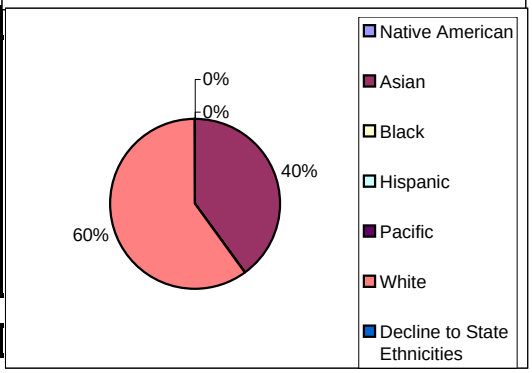
**Statistic Calculation based on all participants that did not decline.*

Analysis on Singular Spaces Program Associate (Graduate Student) Summary

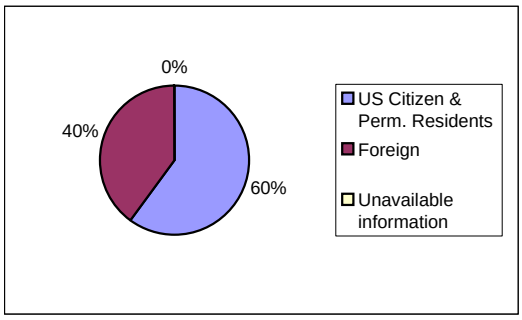
Gender	#	% (No Decl.)*	%
No. of Program Associates	5		
Male	4	80.00%	80.0%
Female	1	20.00%	20.0%
Decline to State Gender	0		0.0%



Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	2	40.00%	40.0%
Black	0	0.00%	0.0%
Hispanic	0	0.00%	0.0%
Pacific	0	0.00%	0.0%
White	3	60.00%	60.0%
Decline to State Ethnicities	0		0.0%
Unavailable Information	0		0.0%
Total no. of Program Associates	5		100.0%
Minorities	0	0.00%	0.0%



Citizenships	#		%
US Citizen & Perm. Residents	3		60.0%
Foreign	2		40.0%
Unavailable information	0		0.0%
Total no. of Program Associates	5		100.0%
US Citizen	3		60.0%
Perm Residents	0		0.0%
Home Inst. in US	4		80.00%



**Statistic Calculation based on all participants that did not decline.*

Report on the ergodic theory and additive combinatorics program

Ben Green, Bryna Kra, Emmanuel Lesigne, Anthony Quas, Mate Wierdl

MSRI Fall 2008

1 Introduction

The semester long program in ergodic theory and additive combinatorics was held at MSRI during the fall of 2008 (August 19-December 18). The semester was organized by Ben Green (University of Cambridge, England), Bryna Kra (Northwestern University), Emmanuel Lesigne (University of Tours, France), Anthony Quas (University of Victoria, Canada), Mate Wierdl (University of Memphis). Ben Green was in residence for 5 weeks during two visits, while the other organizers were in residence during the whole program.

The idea of the program was to bring together experts in both ergodic theory and additive combinatorics, to facilitate the interaction between the two fields. While the interaction between the two fields has a few decades of history, many of the recent advances in both fields (the Green-Tao proof that the primes contain arithmetic progressions, the Host-Kra proof of convergence of multiple averages), demanded new insights. Concurrent with this goal, we organized three conferences. The first two were introductory in nature, and had several minicourses with introductory talks given by experts. The third conference was a high level conference on rigidity theory, which lies at the intersection of several mathematical fields, two of them are ergodic theory and number theory. Many of the greatest "stars" of ergodic theory and additive combinatorics were in residence for all or part of the program. We also had several postdoctoral fellows during the program, and most were in residence during the whole program.

Overall, the general atmosphere at MSRI was extremely fruitful. There were numerous informal and lively discussions, varied and interesting questions circulated (both in formal problem sessions and informal exchanges), and new collaborations began. This atmosphere of scientific exchange was confirmed by numerous comments by participants. The general organization of MSRI, including the excellent library, make the Institute a great place for dynamical mathematical research.

In what follows, we report on the the postdoctoral fellows, the three conferences, the semester's regular activities (seminars, unsolved problem posing sessions), and some work of the various members while in residence.

2 Postdoctoral fellows

Fish, Alexander

Year of PhD 2006

Institution of Ph.D. Hebrew University in Jerusalem

Institution and positions after Ph.D. before MSRI The Ohio State University

Institution and position after MSRI The Ohio State University

Mentor while at MSRI Doug Lind

Ohio State. He was in residence for the entire semester. He worked on 2 topics: sumset phenomenon for amenable groups and measure rigidity for dilations of polynomial curves in nilmanifolds. He finished a paper joint with Michael Bjorklund on the second topic, and the paper was accepted for publication in PAMS (Proceedings of the AMS). Together with Mathias Beiglbock and Vitaly Bergelson, who both visited MSRI during the program, he wrote a preprint "Sumset phenomenon for countable amenable groups." He also collaborated with Ilya Shkredov, another postdoc in residence.

Hochman, Michael

Year of PhD 2007

Institution of Ph.D. Hebrew University of Jerusalem

Institution and positions after Ph.D. before MSRI Veblen Research Instructor, Princeton University

Institution and position after MSRI Veblen Research Instructor, Princeton University

Mentor while at MSRI Bryna Kra

He was in residence the entire semester. He completed work on Rohklin properties of the space of Z^d actions on the Cantor set. He worked with Doug Lind, a senior member in residence, identifying the directions that can be the unique non-expansive direction for a topological Z^2 action. He worked with Pablo Shmerkin on the projections of sets and measures and their dimensions, focusing on projections of products of sets and measures in R/Z that are invariant under $\times 2$ and $\times 3$ respectively.

McClendon, David

Year of PhD 2006

Institution of Ph.D. Univ. of Maryland

Institution and positions after Ph.D. before MSRI Lecturer, Northwestern University (Fall 2006-Spring 2007) Boas Asst. Professor, Northwestern University (Fall 2007-present)

Institution and position after MSRI Boas Asst. Professor, Northwestern University

Mentor while at MSRI Doug Lind

Northwestern University. He was in residence for the entire semester.

David McClendon worked in three areas: first, he studied Weyl complexity of polynomials and was able to extend a result of Frantzikinakis regarding the maximal Weyl complexity of a family of polynomials. Second, he attempted to characterize the families of polynomials which do not have "good lower bounds" (that is, those families that do not satisfy a Khintchine recurrence-type result). Third, he worked toward a one-sided version of the Becker-Kechris theorem, obtaining partial results.

Pete, Gabor

Year of PhD 2006

Institution of Ph.D. UC Berkeley

Institution and positions after Ph.D. before MSRI Microsoft Research, Redmond. Postdoc 2006-2008

Institution and position after MSRI University of Toronto, Coxeter Assistant Professor

Mentor while at MSRI Máté Wierdl

He was in residence for the entire semester. Gábor's main focus at MSRI was proving sparse Szemerédi type results: finding long arithmetic progressions in subsets of positive density inside sparse random sets. With József Balogh (UIUC), he developed an approach via a sparse hypergraph regularity lemma, but very recently, Conlon and Gowers have found a more elegant and universal method, so this project might get cancelled. With Pablo Shmerkin (MSRI) and Elchanan Mossel (UC Berkeley), Gábor is writing a paper about such questions in fractal percolation limit sets, improving recent results of Łaba and Pramanik. In this setting, neither the Balogh-Pete nor the Conlon-Gowers method seems to work, so a more geometric approach is needed. Gábor is writing a paper with Amos Lapidoth (ETH Zürich) on some applications of additive combinatorics to information theory, and he is developing some ideas to prove a conjecture of Bergelson: a group is amenable if and only if any set of measurable recurrence is also of topological recurrence. Slightly related to the MSRI program, he finished a paper with Volodia Nekrashevych (Texas A&M) on scale-invariant groups, and is working on some applications of discrete Fourier analysis to statistical physics (joint with Christophe Garban (ENS Paris), Alan Hammond (NYU), Oded Schramm (Microsoft) and Jeff Steif (Chalmers)). Finally, Gábor finished a paper on using probabilistic game theory to understand a degenerate elliptic PDE, jointly with Yuval Peres (Microsoft) and Stephanie Somersille (UC Berkeley).

Roy, Emmanuel

Year of PhD 2005

Institution of Ph.D. Universit Paris 6

Institution and positions after Ph.D. before MSRI ATER (Paris 6) (from September 2005 to august 2006) Matre de confrences (Paris 13) (from September 2006 to current)

Institution and position after MSRI Matre de confrences (Paris 13) (from September 2006 to current)

Mentor while at MSRI Anthony Quas

He was in residence the entire semester. He proved the existence of a Pinsker factor for an infinite measure preserving action of a countable amenable group. He also derived most of the basic ergodic properties of "max-stable" processes, generalizing existing results. This work takes the form of two articles. He also finished a paper on filtering and infinite divisibility and another paper in collaboration with M. Lemanczyk, who was in residence for a month, and F. Parreau (Université de Paris XIII) on disjointness properties.

Sanders, Tom

Year of PhD 2007

Institution of Ph.D. University of Cambridge

Institution and positions after Ph.D. before MSRI Member IAS

Institution and position after MSRI Member Institut Mittag-Leffler;

Mentor while at MSRI Bryna Kra

He was in residence for the entire semester and during this time worked in two areas. He worked on non-abelian analogs of the celebrated structural theorems of Freiman, and on improving estimates for the 'roughness' of integral valued functions on finite abelian groups.

Shkredov, Ilya Dmitrievich

Year of PhD 2005

Institution of Ph.D. Moscow State University

Institution and positions after Ph.D. before MSRI Moscow State University 2006-2007, Assistant Professor Institute for Advanced Study, Princeton 2007, postdoc Moscow State University 2008, Assistant Professor

Institution and position after MSRI Moscow State University 2009- ...., Assistant Professor

Mentor while at MSRI Mate Wierdl

He was in residence for the entire semester. Ilya Shkredov fruitful discussions with other MSRI members including Alexander Fish, Tom Sanders, Mathew Beiglbock, and Michael Boshernitzan. He gave an answer to a question of Mathew Beiglbock concerning some non-linear coloring problem in Z/pZ and wrote an article about that. In the near future, Ilya Shkredov and Alexander Fish will finish writing a joint paper on solution of some equations in normal sets. Also he finished his own project on dense sets without some two-dimensional configurations (more then 100 pages long paper).

Shmerkin, Pablo

Year of PhD 2006

Institution of Ph.D. University of Washington

Institution and positions after Ph.D. before MSRI University of Jyväskyä (Finland), postdoc September 2006-March 2008. University of Manchester (UK), research associate since April 2008.

Institution and position after MSRI University of Manchester (UK), research associate since April 2008.

Mentor while at MSRI Emmanuel Lesigne.

He was in residence for the entire semester. With M. Hochman (postdoc at MSRI), he worked on the projections of sets and measures and their dimensions, focusing on projections of products of sets and measures in R/Z that are invariant under $\times 2$ and $\times 3$ respectively. With Pete (postdoc at MSRI), he worked on the existence of arithmetic structures and analogues of Szemeredi theorem for random fractals. With J. Schmeling (member at MSRI for one month), he worked on the fractal dimensions of iterated sumsets and comparison with the discrete case. In addition, continued work with Y. Peres (Microsoft) on the convolution of self-similar measures and with B. Solomyak (University of Washington) on the con nection between multifractal formalism and beta expansions.

Towsner, Henry

Year of PhD 2008

Institution of Ph.D. Carnegie Mellon University

Institution and positions after Ph.D. before MSRI N/A

Institution and position after MSRI Hedrick Assistant Adjunct Professor

Mentor while at MSRI Emmanuel Lesigne

He was in residence for the entire semester.

During the semester at MSRI, Henry Towsner worked with Jeremy Avigad on "unwinding" the use of the Furstenberg-Zimmer structure theorem

in proofs of Szemeredi's Theorem and its generalizations. A draft on the application to Szemeredi's Theorem is almost finished. He also began an investigation with Mathias Beiglböck on converting proofs of combinatorial statements using ultrafilters into purely combinatorial proofs; the first result was a new proof of Hindman's Theorem. Finally, Towsner began investigating generalizations of the Furstenberg correspondence, developing a correspondence principle which preserves the Gowers uniformity norms.

Wolf, Julia

Year of PhD 2008

Institution of Ph.D. University of Cambridge

Institution and positions after Ph.D. before MSRI Institute for Advanced Study, Princeton (Member)

Institution and position after MSRI Rutgers The State University of New Jersey (Assistant professor, NTT)

Mentor while at MSRI Bernard Host

She was in residence for the entire semester. During her time at MSRI Julia Wolf concentrated on using higher-order Fourier analysis to prove refined decomposition theorems for bounded functions in both cyclic groups and finite field geometries. This work, which was carried out in collaboration with W.T. Gowers (in residence at MSRI for two week s) led to rough drafts in both cases, with applications to counting solutions to certain systems of linear equations in these settings. She also submitted a note on Elkin's improvement of Behrend's construction with B.J. Green (in residence at MSRI for 5 weeks), and a second one on Behrend's construction for longer progressions in finite fields with Y. Lin (Stanford University).

Spencer, Craig Valere

Year of PhD 2008

Institution of Ph.D. University of Michigan

Institution and positions after Ph.D. before MSRI N/A

Institution and position after MSRI Member, IAS Sept. 2008-July 2009;Assistant Professor, Kansas State University Aug. 2008-

Mentor while at MSRI Ben Green

He was in residence for one month.

3 Students

There were numerous students who visited during the semester. Three of them were is residence the whole time:

Mahsa Allahbakhshi Mahsa is a PhD student at the University of Victoria working under the supervision of Anthony Quas. She is working on her thesis and is currently working on measures of maximal entropy arising in symbolic factor mappings.

Qing Chu She is a student of Bernard Host, and she worked on generalizing known multiple convergence results for commuting transformations over cubes and with polynomial exponents. She also had fruitful discussions with Tim Austin (UCLA graduate student, also in residence for a few weeks), Bryna Kra, Amanda Potts.

Amanda Potts She a graduate student at Northwestern and her advisor is Bryna Kra. She worked on generalizing the known results for flows, including showing convergence along polynomial times and giving a description of the limit.

There were other students in residence for shorter periods, including:

Tim Austin He is a student of Terence Tao and was in residence for 6 weeks. He worked on various topics, including convergence results for commuting transformations, a new proof of the density Hales-Jewett Theorem, and a quantitative proof of the Furstenberg-Katznelson recurrence theorem.

Lilian Matthiesen She is student of Ben Green and worked on her thesis and attended introductory workshops.

Vicky Neale She is student of Ben Green and worked on her thesis and attended introductory workshops.

Olof Sisask He is student of Ben Green and worked on his thesis and attended introductory workshops.

Alvaro Coronel He is student of Alejandro Maass and worked on writing up his thesis while in residence.

4 Workshops

4.1 Broader Connections: Ergodic Theory and Additive Combinatorics

The Broader Connections workshop was held August 21–22 2008 to serve as a pre-introduction to the semester's program on Ergodic Theory and Additive Combinatorics. It was immediately followed by the program's first main workshop: An Introduction to Ergodic Theory and Additive Combinatorics (August 25–29 2008).

The goal of the workshop was to set the stage for the remainder of the program, introducing all participants to the basics. Since the program is aimed at

researchers coming from a number of different areas (harmonic analysis, combinatorics and ergodic theory), a key aim of the meeting was to establish a common framework for discussion. As the title of the meeting indicates ("Broader Connections" as opposed to the more traditional "Connections for Women"), the workshop was aimed broadly at graduate students and postdocs in the areas of the workshop and closely related research areas as well as more senior women faculty members in nearby research areas. As in other Connections workshops, an important aspect was providing a format that would encourage the formation of connections between researchers, especially female researchers.

The formal part of the workshop consisted of four two-lecture series given by Vitaly Bergelson of the Ohio State University, Izabella Łaba of the University of British Columbia, Akshay Venkatesh of Stanford University and Tamar Ziegler of the Technion in Haifa, Israel. Of these, Bergelson and Ziegler came from an ergodic perspective while Łaba's work is in harmonic analysis and Venkatesh works on number theory. Each lecturer gave a one-hour lecture on each of the days.

Bergelson's lectures focused on the philosophy of ergodic Ramsey theory: sufficiently rich combinatorial structures have a tendency to be "unbreakable" in the sense that if the structure is finitely partitioned, one of the pieces inherits large scale pieces of the original structure. Łaba's lectures gave a detailed introduction to the application of harmonic analysis in the subject, focusing on Roth's theorem (one of the early results in additive combinatorics, stating that every sufficiently dense subset of the integers contains three-term arithmetic progressions) and its generalizations. Venkatesh lectured on group actions on homogeneous spaces and illustrated the theory with a discussion of Pell's equation and counting of lattice structures. Ziegler's lectures were on the role of weak-mixing in non conventional ergodic averages (the ergodic tools underlying the Furstenberg proof of Szemerédi's theorem on arithmetic progressions in dense sets of integers) and the characteristic factors that govern the behavior of these averages.

Thursday afternoon, the workshop featured an informal panel discussion entitled "Three things I wish I had known". This was aimed at younger women mathematicians, and students and postdocs more generally. The format for the discussion was that the four panelists introduced themselves and shared their thoughts on things they had learned. The floor was then opened for questions. The panel was moderated by Hélène Barcelo of MSRI and the panelists were Tanya Christensen of the University of Missouri (a member of the Analysis of Singular Spaces program), Bryna Kra of Northwestern University, Malabika Pramanik of the University of British Columbia and Ayşe Şahin of DePaul University. During the discussion, there was a range of interesting questions from the floor covering issues such as collaboration with senior colleagues; broadening one's research interests; how to pick good research questions. On Thursday evening all the women participants at the conference were invited to dinner at a local Chinese restaurant, and 16 people attended.

Overall the workshop was highly successful. The lectures were very well attended with approximately 60 people present. Many people commented to

the organizers that the quality of exposition was very high.

4.2 Introduction to Ergodic Theory and Additive Combinatorics

This workshop was organized, in connection with the workshop "Broader Connections: Ergodic Theory and Additive Combinatorics" (held the previous week), as an introduction to the semester long research program of the same name. It was designed to be particularly useful to the most junior members of the workshop and semester program.

The aim of the research program "Ergodic Theory and Additive Combinatorics" is to bring together people of different areas of mathematics that have recently enjoyed substantial interaction. These areas include: Additive Combinatorics, Harmonic Analysis, and Ergodic Theory. The main focus of the workshop was mathematical questions on which these three different areas are effective, and related themes were presented from all perspectives. As was noted by many different speakers, the celebrated theorem of Szemerédi (on the existence of arbitrarily long arithmetic progressions in any positive density subset of integers) is the archetype of the richness of this confrontation-collaboration. Terence Tao spoke of Szemerédi's Theorem as "the Rosetta stone between ergodic theory, combinatorics, and Fourier analysis." Reading three different languages discussing the same problem is extremely instructive and gives insight for solving new problems.

Techniques from Harmonic Analysis, Combinatorial Number Theory, and Ergodic Theory have been successively and successfully utilized to prove Szemerédi's theorem and many of its generalizations and improvements: quantitative results; generalization to other types of progressions (such as "polynomial progressions"); sets of zero density (such as the Green-Tao theorem on long arithmetic progressions in prime numbers); higher dimensional results; study of structures other than the integers (such as graphs). Each of these topics was the subject of lectures during the workshop, at a level which allowed newcomers to the fields to understand the basics.

The workshop was built around mini-courses (unfortunately Hillel Furstenberg, who was the originator of the ergodic theory view-point in this field, was unable to attend at the last moment due to health reasons). Mini-courses were given by Bernard Host, Ben Green, and Terence Tao. They gave outstanding talks, going from carefully explained basic facts to recent results, with significant information on the proofs. Bernard Host described the appearance and role of "translations on compact quotients of nilpotent Lie groups" in this field; Ben Green gave a comprehensive and fascinating outlook on the proof of Green-Tao theorem; Terence Tao illustrated several different examples of the bridges between "finitary quantitative" and "abstract qualitative" results on existence of configurations, graph properties, and convergence theorems.

Eight more classical research talks were given by specialists of combinatorial number theory (Endre Szemerédi himself), ergodic theory (Nikos Frantzikinakis, Thierry de la Rue, Vitaly Bergelson, Tamar Ziegler and Benjamin Weiss),

Fourier analysis (Izabella Laba, Tom Sanders). Moreover, during two Problem Sessions, ten participants (including two post-docs) took the opportunity to ask open challenging questions.

The total number of registered participants was 109, from 12 different countries, including an important proportion of young mathematicians (male and female), PhD students or post-docs. Since most of the talks were really accessible, we believe that most participants benefited from their participation.

The excellent atmosphere, comfort, and organization of MSRI were of great importance in the success of this meeting. The schedule of the workshop and the building itself gave numerous opportunities for informal encounters and discussions.

We already gave a quick description of the content of mini-courses by Bernard Host, Ben Green and Terence Tao. Complementing these course, new mathematical results related to the background material were announced during the workshop. Endre Szemerédi announced the solution of an Erdös conjecture on sumsets of "not too thin" sets of integers. Nikos Frantzikinakis stated theorems of multiple recurrence along sequences produced by functions from an arbitrary Hardy field. Izabella Laba gave conditions on the fractional dimension of a set of real numbers which guarantee that this set contains an arithmetic progression of length three. Thierry de la Rue gave precise calculations of the rate of exponential growth for random Fibonacci sequences. Vitaly Bergelson presented multiple recurrence theorems for measure preserving actions of general amenable groups, and asked several challenging questions around amenable actions. Tamar Ziegler announced new results on the inverse problems for "ergodic Gowers-Host-Kra seminorms" in the context of products of finite fields actions.

4.3 MSRI Workshop on Discrete Rigidity Phenomena

Overview. The term "Discrete Rigidity Phenomena" was invented specially for this workshop, which was one of the highlights of the special semester on Ergodic Theory and Additive Combinatorics. Although many of the invited speakers were bemused (or occasionally amused) by the title, they all gave talks very much within the intended spirit of the workshop. This strongly suggests that the time was ripe for such a meeting.

What, then, are Discrete Rigidity Phenomena? Organizer Ben Green gave the opening lecture at the conference, outlining his interpretation of one aspect of this area of study. He mentioned various types of approximate objects arising in additive combinatorics, specifically approximate groups, approximate homomorphisms, and approximate polynomials. He asked a number of questions about such objects, many of which demanded that approximate objects be described more explicitly, perhaps in terms of their exact algebraic analogs or closely related structures. In the talk Green showed that some of the key questions of additive combinatorics, specifically Freiman's theorem and the inverse conjectures for the Gowers norms, may be understood within this context.

Over the course of the week the notion of a Discrete Rigidity Phenomenon, as delineated by the participants' lectures, grew considerably from this rather

focused core.

The program. The week consisted largely of lectures, with four or five on each day except Wednesday when, as is the custom at MSRI, a free afternoon was declared. Monday afternoon included an MSRI/Evans lecture by Fields Medalist Tim Gowers down the hill at Berkeley on the subject of "What is Quadratic Fourier Analysis." In this lecture Gowers discussed some of the ideas from his famous 1998 work on Szemerédi's theorem, regarded by many as the place where modern additive combinatorics was born. He proceeded to bring those ideas thoroughly up to date whilst carefully staying within the brief of this series of talks, designed for a general audience.

Back up the hill, one common theme was the interplay between ergodic theory and additive combinatorics. This was exemplified by the talks of Bernard Host, who discussed joint work with Kra and Maass on nilsequences from an analyst's viewpoint, and Terry Tao, who discussed his joint work with Green on "discrete" dynamics on nilmanifolds and its applications to prime number theory. Tamar Ziegler presented very interesting recent joint work with Trevor Wooley on finding progressions with "arithmetic" common differences in certain sets, and Hillel Furstenberg gave a talk connecting additive combinatorics with so-called piecewise Bohr sets, objects which have recently been studied on the "ergodic" side. The purer ergodic side of the subject was represented by Manfred Einsiedler's talk on issues related to Ratner's measure rigidity theorem (the name of which was the inspiration for the present workshop). Meanwhile, the interplay between dynamics and number theory was brought to the fore by Adrian Ubis' discussion of his recent joint work with Peter Sarnak on the horocycle flow at prime times.

A second major theme centered around the Gowers norms, introduced by Gowers in his work on Szemerédi's theorem and now rather central to additive combinatorics. Hamed Hatami gave a talk about some very general kinds of norms arising in graph theory which, in a certain sense, generalize Gowers's construction. Julia Wolf talked about her joint work with Tim Gowers clarifying exactly which Gowers norms are necessary to control specific types of linear expressions related to arithmetic progressions. Her talk featured a certain "decomposition" theorem in which a function is split into structured and random parts. Luca Trevisan spoke about a very similar type of result that he was able to approach using language from game theory and computer science. Ryan O'Donnell gave a highly entertaining and polished account of the importance of Gowers-type norms, and in particular the inverse questions associated with them, in theoretical computer science.

A third big theme was a discussion of approximate groups from various perspectives. Harald Helfgott presented his new result on the approximate subgroups of $\mathrm{SL}_3(\mathbb{F}_p)$, whilst Emmanuel Breuillard gave a wonderfully accessible account of his so-called Uniform Tits Alternative, a result about a certain notion of approximate subgroups in $\mathrm{GL}_n(k)$. Tom Sanders presented a very general result about approximate groups, valid in quite unstructured settings, and in particular for all solvable groups and all torsion-free groups. James Lee

gave a talk establishing quantitative information on sets with a certain precise type of polynomial growth, establishing that they have a nontrivial image inside reasonably small matrix groups over $\mathbb{C}$. Mei-Chu Chang discussed sum-product theorems and their applications to classical character sum estimates, but concluded with some intriguing speculations about approximate subgroups of $\mathrm{SL}_3(\mathbb{C})$. Alexander Gamburd described his work with Bourgain in which the aforementioned additive-combinatorial type results are applied to yield spectacular results about the existence of expanders as Cayley graphs associated to matrix groups. Elon Lindenstrauss gave some hints of his very impressive work joint with Bourgain, Furman and Mozes. In this work they prove, under quite general conditions, that if one takes a walk on the d-dimensional torus $\mathbb{T}^d$ by acting using a randomly selected integer matrix from some finite set, this walk becomes uniformly distributed with advancing time.

Lastly (and most welcome) there were a few talks by major experts which did not fit so easily into the above categories, but which amply demonstrated the power of "discrete rigidity phenomenological" modes of thinking in other areas. Avi Widgerson gave a fascinating talk on extractors in computer science and their link with additive combinatorics. Jean Bourgain discussed his amazing work with Gamburd and Sarnak locating almost primes in very strange places – orbits of linear groups. Finally, Akshay Venkatesh hinted at his tour-de-force work with Einsiedler and Margulis on quantitative versions of Ratner's theorem, and went on to discuss how more can be said in number-theoretical situations, where one may benefit from the presence of Hecke operators.

Participants. There were a total of 85 registered participants, as well as numerous other participants from the members in the semester long program at MSRI on additive combinatorics and ergodic theory. This included 8 graduate students and 11 postdoctoral fellows.

5 Organizational structure, seminars

Each week of our program, we had three seminars. The "regular" seminars were on Tuesdays and Thursdays 2-3PM, and the postdoc seminar was on Fridays, 11-12AM. The students in residence regularly attended a Berkeley student seminar on harmonic analysis and ergodic theory (directed by University of Berkeley Professor Michael Christ) on Wednesday afternoons. In addition to the seminars, we had daily tea at 3:30.

The regular seminar talks were:

Michael Boshernitzan Hardy fields in ergodic theory.

Bernard Host Ergodic seminorms for commuting transformations; a third proof of Tao's theorem.

Moshe (Eli) Glasner Stationary dynamical systems and Szemeredi's theorem for PSL(2,Z).

Christian Mauduit A q-additive property of the primes and squares.

Endre Szemeredi On sumset sums.

Terence Tao The correspondence principle and the inverse conjecture for the Gowers norm over finite fields.

Yves Derriennic Reversibility and the ergodic theorem.

Ben Green Quantitative distribution of orbits on nilmanifolds.

Harald Helfgott Escape and incidence: their role in growth in groups.

Anthony Quas Distance sets and the odd-distance graph.

Alejandro Maass Topological parallelepipeds: How do you recognize nilsequences?

Douglas Lind Mahler, Entropy, and Heisenberg.

Joerg Schmeling Mass Transference and Dyadic Diophantine Approximation.

Sebastien Ferenczi Combinatorics of Interval Exchange Transformations.

Mate Wierdl Some problems on bases for the integers.

Mariusz Lemanczyk On non-mixing for interval exchange transformations.

Emmanuel Lesigne Good and bad powers for recurrence.

Timothy Gowers Combinatorics inside sparse random sets I

Timothy Gowers Combinatorics inside sparse random sets II

Randall McCutcheon Concentration function estimates and intersective sets from matrices.

Hillel Furstenberg Logarithmic density and Ramsey theory.

Ilya Dmitrievich Shkredov On some two-dimensional configurations in dense sets.

Henry Towsner Metastability and the Mean Ergodic Theorem.

Emmanuel Lesigne Averages on annuli on a Euclidean space.

There were talks which were jointly organized by our program and UC Berkeley's math department (the MSRI-Evans Lecture Series). The talks related to this program were:

Terence Tao Szemeredi's theorem: a Rosetta stone between ergodic theory, combinatorics, and Fourier analysis.

Bryna Kra Combinatorial Ergodic Theory

Timothy Gowers Quadratic Fourier Analysis

Vitaly Bergelson Ergodic Ramsey theory: old and new results and conjectures.

Talks in the postdoc seminar:

Julia Wolf Minimal characteristic factors for linear systems

Tom Sanders Models in additive combinatorics

Emmanuel Roy Poisson suspensions and infinite ergodic theory

Michael Hochman Ergodic theorems for multiparameter actions on infinite measure spaces

Alexander Fish Rigidity of measures on the torus invariant under the action of a "large" multiplicative semigroup.

Qing Chu Convergence of multiple averages along cubes for several commuting transformations

Amanda Potts Polynomial Ergodic Averages and Flows

Mahsa Allahbakhshi Measures of Maximal Relative Entropy

In addition to these seminars, we had 5 informal meetings where members presented their favorite unsolved problems. Problems ranged from classical problems that had been open for many years to new problems that had arisen while at MSRI. These late afternoon discussions were often lively and spurred numerous discussions over lunch and tea.

6 Interaction with other programs

Over the course of the semester there was a substantial amount of interaction between the Ergodic Theory and Additive Combinatorics program and the Mathematics Department at Berkeley: Michael Christ and his students regularly attended seminars and lectures at MSRI and Christ organized a harmonic analysis student seminar which was also attended by several of the students in residence at MSRI. Patrick LaVictoire, a PhD student at UC Berkeley, had extensive discussions with Mate Wierdl about recent developments in subsequence ergodic theory, including LaVictoire's own recent work about convergence along sparse random sequences and important new work on convergence along the squares.

7 Some research topics

Doug Lind, Klaus Schmidt They worked hard on a paper involving the dynamics of actions by discrete amenable groups, especially the discrete Heisenberg group, by automorphisms of a compact abelian group. This is part of a larger program that links these topics to von Neumann algebras and to extremely interesting noncommutative phenomena that lead to some concrete results that do not seem to be provable any other way. Working together at MSRI enabled them to advance this project considerably, and they are close to having the main paper completed.

As mentioned above, Lind also had productive interactions with Michael Hochmann on a problem that originated at the MSRI Symbolic Dynamics Program from 1992, and also worked with Manfred Ensiedler during his two visits to MSRI on a project they will be completing soon.

Bernard Host, Bryna Kra, Alejandro Maass They worked on proving a structure theorem for topological dynamical systems, analogous to the structure theorem of Host and Kra for measure preserving systems. This lead to a new characterization of nilsequences, which have played an important role in recent advances both in ergodic theory and in additive combinatorics.

Bernard Host, Bryna Kra They worked on generalizing results of Furstenberg and his collaborators that Furstenberg discussed during the second workshop. They gave a characterization of certain dynamically produced subsets of the integers in terms of piecewise nil-Bohr sets, which is a generalization of the more classical Bohr set.

Hillel Furstenberg During the November workshop Furstenberg lectured on combinatorial properties of sets of integers that imply that the set is close to being "almost periodic". It was natural to expect that an analogous property would lead to nil-sequences. This was discussed with Bernard Host and Bryna Kra who have done pioneering work on nil-sequences, and the indications are that the expected result is true. Furstenberg also discussed connections between ergodic theory and fractal theory with Michael Hochman and these discussions as well as discussions with Michael Boshernitzan and Mahsa Allahbakhshi brought to light a variety of problems and were mutually beneficial.

Emmanuel Lesigne With Nikos Frantzikinakis, Michael Johnson, Mate Wierdl, he concluded the writing of an article on "sub-sequence ergodic theory". Vitaly Bergelson and Emmanuel Lesigne made progress in some research around "quantitative multiple recurrence." With Mariusz Lemanczyk, he initiated a new collaboration on spectral properties of perturbations of nil-translations. He took great profit from numerous discussions, lectures and problem sessions.

Mate Wierdl In addition to what was mentioned elsewhere, he collaborated with Kati Gyarmati (sumsets, Plnnecke's theorem, pseudo random sequences), Anthony Quas (bases of integers, finished paper on "worst sums"). He also had very enlightening discussions with Berkeley graduate student, Patrick La Victoire. Patrick presented his unexpected result on almost everywhere convergence along some random sequences in L^1, and then has been having discussions about the recent breakthrough result of Buczolich-Mauldin on the non-convergence along the squares in L^1.

Anthony Quas During his stay at MSRI he worked on relationships between various notions of strong recurrence (strong recurrence for measure-preserving transformations, strong recurrence for ergodic measure-preserving transformations, strong recurrence for sets of positive upper density, strong recurrence for sets of positive upper Banach density). A new equivalence was shown. This points to a question concerning the essential differences between ergodic and non-ergodic systems with regard to recurrence properties (discussion with E. Lesigne). He also worked with Wierdl on counting functions of sums of integer bases. With Lemanczyk and Thouvenot, Quas discussed L^1 spectral questions of dynamical systems: the AT property for Morse-type systems (a of positive simple spectrum condition) and L^1 simple spectrum of Bernoulli shifts. These discussions are continuing.

Harald Helfgott Part of his time, especially during the first third of the semester, was spent on additive matters not immediately related to combinatorics. He interacted substantially with Ben Green during his visits to MSRI; in one of their conversations, Tao gave him some pointers to the literature (papers by Vaaler) that led him to realize that an auxiliary result he was attempting to obtain had already been proven by Graham and Vaaler in 1982. The second half of the semester was spent partly on projective and additive matters. Here it was good to get some feedback both from people in additive combinatorics and in ergodic theory. The workshop in November enabled him to speak with several visitors (including his own postdoc) on matters related to growth in groups. Discussions with Lindenstrauss and Tao were especially helpful.

Michael Schraudner During his 3 week long stay, he worked on a paper (nearly finished by now) defining a class of multidimensional shifts of finite type having known topological entropies $h(X) = \log N$ for some natural number N. While in one-dimension the entropy of a shift of finite type is given as the logarithm of the Perron value of its matrix, in dimensions two and above no procedure to determine the exact value of the entropy is known (there are only approximation algorithms depending on special mixing properties), whereas the class of real numbers appearing as entropies was recently characterized by work of Hochman-Meyerovitch.

He also started to think about subshifts defined on regular trees, which I believe may be seen as an intermediate case/link between one-dimensional

and multidimensional subshifts, in which some of the undecidability problems of higher-dimensional shifts may be avoided.

He discussed mainly with Mike Hochman, but also with Doug Lind and Anthony Quas.

8 Nuggets and breakthroughs

A notable feature of the program was the large number of questions in circulation. Amongst those posing questions, Michael Boshernitzan stands out for having a steady supply of innocent-sounding questions exploring the limits of the theory.

While one or two of these were answered during the program (e.g. the paper of Boshernitzan and Glasner), the majority were taken home by participants where they will no doubt continue to plague people. One question formulated in a particularly elementary way sounded so innocent that on the day after Thanksgiving (after which a number of the participants were due to leave), there was a veritable maelstrom of activity with several members unsuccessfully proposing methods of attack. The original question, alas, escaped to torment members another day (although it seems now that there is a solution to this problem).

The central idea in the recent developments (in the last 10 years) of the subject is that of Gowers norms or equivalently on the ergodic side, the Host-Kra seminorms. At a heuristic level, these leads to a decomposition of sets and functions into structured and "random" parts. An emerging idea in recent years has been the so-called inverse conjecture for the Gowers norms, where one is seeking to express in a quantitative way in terms of correlations what it means to be have large Gowers norm. During the program, a major project of Bergelson, Tao and Ziegler was completed establishing the inverse Gowers conjecture in the case of $\mathbb{F}_p^d$. Their result may be informally stated as follows: *If f has biased kth derivative then f correlates with a polynomial phase of degree $k-1$.* This leaves open the major question of the inverse conjecture of Green and Tao for $\mathbb{Z}/N\mathbb{Z}$.

Postdoctoral Fellows Summary

Pre/Post Institute Group

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Fish, Alexander	2006	Hebrew University	Foreign	Lind, Doug	Ohio State University	I Public	Ohio State University	I Public	Assistant Professor
Hochman, Michael	2007	Hebrew University	Foreign	Kra, Bryna	Princeton University	I Private	Princeton University	I Private	Veblen Research Instructor
Pete, Gabor	2006	UC Berkeley	I Public	Wierdl, Mate	Microsoft Research	N/A	University of Toronto	Foreign	Coxeter Assistant Professor
Sanders, Tom	2007	University of Cambridge	Foreign	Kra, Bryna	University of Cambridge	Foreign	Institut Mittag-Leffler	Foreign	Member
Shkredov, Ilya	2005	Moscow State University	Foreign	Wierdl, Mate	Moscow State University	Foreign	Moscow State University	Foreign	Assistant Professor
Spencer, Craig	2008	University of Michigan	I Public	Green, Ben	IAS	N/A	Kansas State University	II	Assistant Professor
Towsner, Henry	2008	Carnegie Mellon University	I Private	Lesigne, Emmanuel	UCLA	I Public	UCLA	I Public	Hedrick Adjunct Assistant Professor
Wolf, Julia	2008	University of Cambridge	Foreign	Host, Bernard	Rutgers University	I Public	Rutgers University	I Public	Triennial Assistant Professor

		Pre-MSRI								
		Group I Private	Group I Public	Group II	Group III	Group B	Group M	Foreign	Other	Total
Post-MSRI	Group I Private	1								1
	Group I Public		3							3
	Group II								1	1
	Group III									-
	Group B									-
	Group M									-
	Foreign							2	1	3
	Other									-
	Total	**1**	**3**	**-**	**-**	**-**	**-**	**2**	**2**	**8**

Participant List

MSRI Program:

Ergodic Theory and Additive Combinatorics

August 18 to December 19, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Primary Institute	Position
Aliste, Jose	Universidad de Chile	Graduate Student
Allahbakhshi, Mahnaz	University of Victoria	PhD Student
Austin, Tim	University of California	Graduate Student
Beiglböck, Mathias	Vienna University of Technology	Postdoctoral Fellow
Bergelson, Vitaly	Ohio State University	Professor
Bilyk, Dmitriy	Georgia Institute of Technology	Assistant Professor
Boshernitzan, Michael	Rice University	Professor
Breuillard, Emmanue	École Polytechnique	Associate Professor
Campbell, James	University of Memphis	Assoc Professor
Chu, Qing	Universite Paris-Est Marne-La-Vallee	Graduate Student
Coronel, Alvaro	Universidad de Chile	Ph. D. student
Derriennic, Yves	Universite de Bretagne Occidentale	Professor
Einsiedler, Manfred	Ohio State University	Professor
Ferenczi, Sebastien	Centre National de la Recherche Scientifique (CNRS)	directeur de recherches
Fish, Alexander	Ohio State University	Faculty/Postdoc
Foreman, Matthew	UC Irvine	Professor
Frantzikinakis, Nikos	University of Memphis	Lecturer
Freiman, Gregory	Tel Aviv University	Full Professor and Professor Emeritus
Furstenberg, Hillel	Hebrew University	Professor
Gamburd, Alexander	Northwestern University	Professor
Gill, Nick	University of Bristol	Faculty/Postdoc
Glasner, Moshe (Eli)	Tel Aviv University	Professor
Gowers, Timothy	Cambridge University	Rouse Ball Professor of Mathematics
Green, Ben	University of Cambridge	Professor
Gyarmati, Kati	Eötvös Loránd University (ELTE)	Postdoctoral Fellow
Helfgott, Harald	University of Bristol	Senior Lecturer
Hoang, Le Thai	University of California	Graduate Student
Hochman, Michael	Princeton University	Veblen Research Instructor
Host, Bernard	Université de Marne-la-Vallée	Professor
Johnson, Michael	Swarthmore College	Lecturer
Katznelson, Yitzhak	Stanford University	Professor
Kra, Bryna	Northwestern University	professor
Kurlberg, Par	Royal Institute of Technology (KTH)	Associate Professor
Lemanczyk, Mariusz	Nicholas Copernicus University of Torun	Professor
Lesigne, Emmanuel	Université François Rabelais	Professor
Lind, Douglas	University of Washington	Professor
Maass, Alejandro	University of Chile	Full Professor
Magyar, Akos	University of Georgia	Associate Professor
Matthiesen, Lilian	University of Cambridge	Research Student
Mauduit, Christian	Université d'Aix-Marseille II (Université de la Méditerranée)	full professor
McClendon, David	Northwestern University	Assistant Professor
McCutcheon, Randall	University of Memphis	Professor
Neale, Vicky	University of Cambridge	PhD student
Nevo, Amos	Technion (Israel Institute of Technology)	Professor
Pete, Gabor	University of Toronto	Assistant Professor
Potts, Amanda	Northwestern University	Graduate Student
Prakash, Gyan	University de Bordeaux 1	Professor
Quas, Anthony	University of Victoria	Professor
Rosenblatt, Joseph	University of Illinois, Urbana-Champaign	Professor
Roy, Emmanuel	Institut Galilée	Maître de conférences
Sanders, Tom	Cambridge University	Research Fellow
Schmeling, Joerg	University of Lund, Sweden	Full Professor
Schmidt, Klaus	University of Vienna	Professor
Schraudner, Michael	Universidad de Chile	Postdoctoral
Shkredov, Ilya Dmitrievich	Moscow State University	N/A
Shmerkin, Pablo	University of Jyväskylä	Postdoc
Sisask, Olof	University of Cambridge	PhD student

Smorodinsky, Meir	Tel-Aviv University	Professor
Spencer, Craig	Institute for Advanced Study	graduate student
Szemeredi, Endre	Rutgers University, New Brunswick	Professor
Tao, Terence	University of California	Faculty/Postdoc
Thouvenot, Jean-Paul	Université de Paris VI (Pierre et Marie Curie)	Professor
Towsner, Henry	University of California	Assistant Adjunct Professor
Trevisan, Luca	UC Berkeley	Associate Professor
Weiss, Benjamin	Hebrew University	Professor
Wierdl, Mate	University of Memphis	Professor
Wolf, Julia	Rutgers University	Assistant Professor
Ziegler, Tamar	Technion - Israel Institute of Technology	Faculty

Ergodic Theory and Additive Combinatorics

2008-2009

Program Participant Summary

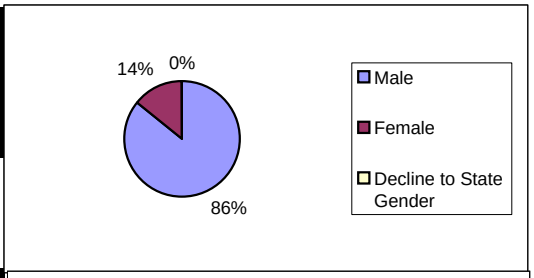
Ergodic Theory and Additive Combinatorics	# of Distinct Participants	%	# of Citizens & Perm. Res.	%	# of Female	%	# of Minorities	%
Postdoctoral Fellows	8	*12.7%*	3	*4.8%*	1	*1.6%*	0	*0.0%*
PD/RM	11	*17.5%*	2	*3.2%*	2	*3.2%*	1	*1.6%*
Program Associates	9	*14.3%*	1	*1.6%*	5	*7.9%*	1	*1.6%*
Research Members	17	*27.0%*	9	*14.3%*	0	*0.0%*	0	*0.0%*
Research Professor	13	*20.6%*	6	*9.5%*	0	*0.0%*	1	*1.6%*
Organizers	5	*7.9%*	3	*4.8%*	1	*1.6%*	0	*0.0%*
Total no. of Distinct Participants	**63**	***100.0%***	**24**	***38.1%***	**9**	***14.3%***	**3**	***4.8%***

Home Institute Grouping

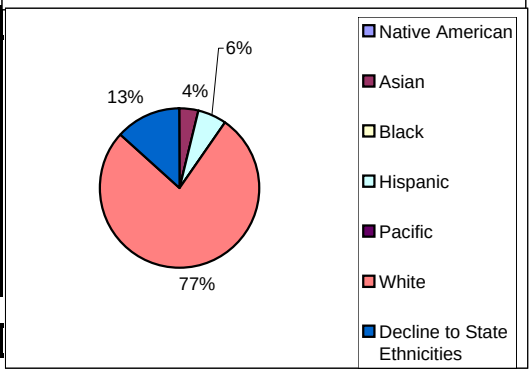
Ergodic Theory and Additive Combinatorics	Group I Private	Group I Public	Group II	Group III	Group B	Foreign	IAS	Total
Organizer	1	0	0	1	0	3	0	**5**
Postdoc	1	3	0	0	0	3	1	**8**
PD/RM	1	0	0	0	1	9	0	**11**
Program Associate	1	2	0	0	0	6	0	**9**
Research Member	2	3	1	3	0	8	0	**17**
Research Professor	1	3	1	0	0	8	0	**13**
Total	**7**	**11**	**2**	**4**	**1**	**37**	**1**	**63**
%	***11.1%***	***17.5%***	***3.2%***	***6.3%***	***1.6%***	***58.7%***	***1.6%***	***100.0%***

Ergodic Theory and Additive Combinatorics (All Participants) Demographic Summary

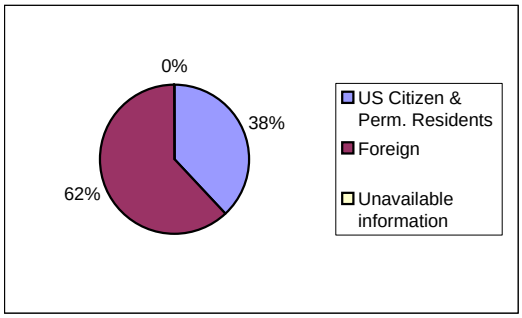
Gender	#	% (No Decl.)*	%
No. of Distinct Participants	63		100.0%
Male	54	85.71%	85.7%
Female	9	14.29%	14.3%
Decline to State Gender	0		0.0%



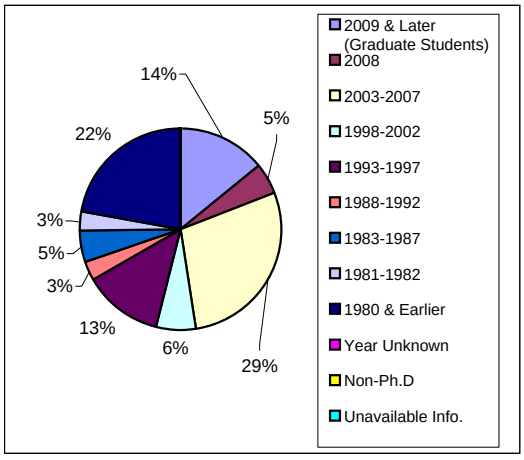
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	2	4.44%	3.2%
Black	0	0.00%	0.0%
Hispanic	3	6.67%	4.8%
Pacific	0	0.00%	0.0%
White	40	88.89%	63.5%
Decline to State Ethnicities	7		11.1%
Unavailable Information	11		17.5%
Total no. of Distinct Participants	63		100.0%
Minorities	3	6.67%	4.8%



Citizenships	#		%
US Citizen & Perm. Residents	24		38.1%
Foreign	39		61.9%
Unavailable information	0		0.0%
Total no. of Distinct Participants	63		100.0%
US Citizen	21		33.3%
Perm Residents	3		4.8%
Home Inst. in US	26		41.27%



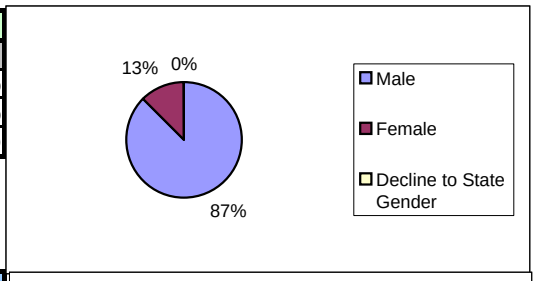
Year of Ph.D	#		%
2009 & Later (Graduate Students)	9		14.3%
2008	3		4.8%
2003-2007	18		28.6%
1998-2002	4		6.3%
1993-1997	8		12.7%
1988-1992	2		3.2%
1983-1987	3		4.8%
1981-1982	2		3.2%
1980 & Earlier	14		22.2%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	63		100.0%



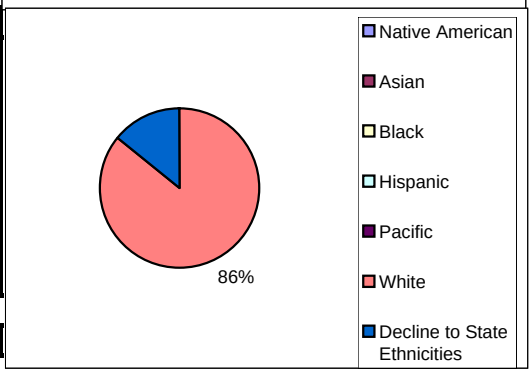
**Statistic Calculation based on all participants that did not decline.*

Ergodic Theory and Additive Combinatorics Postdoctoral Fellow Summary

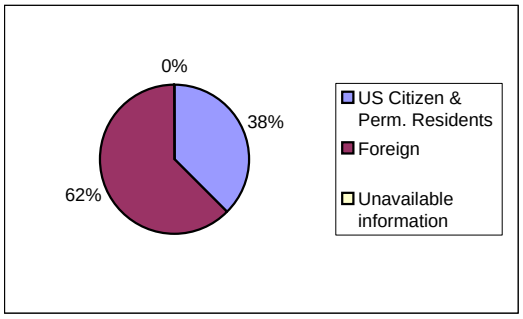
Gender	#	% (No Decl.)*	%
No. of Postdoctoral Fellows	8		
Male	7	87.50%	87.5%
Female	1	12.50%	12.5%
Decline to State Gender	0		0.0%



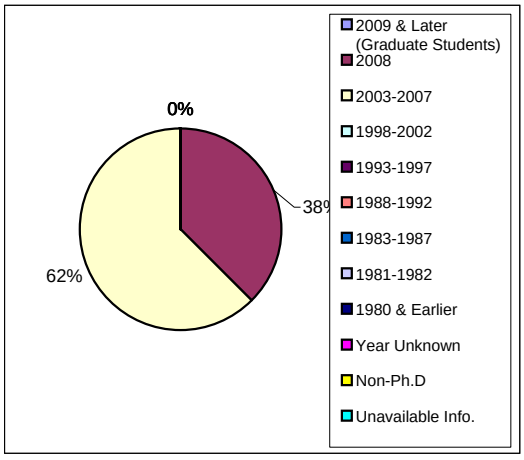
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	0	0.00%	0.0%
Black	0	0.00%	0.0%
Hispanic	0	0.00%	0.0%
Pacific	0	0.00%	0.0%
White	6	100.00%	85.7%
Decline to State Ethnicities	1		14.3%
Unavailable Information	1		14.3%
Total no. of Postdoctoral Fellows	8		114.3%
Minorities	0	0.00%	0.0%



Citizenships	#		%
US Citizen & Perm. Residents	3		37.5%
Foreign	5		62.5%
Unavailable information	0		0.0%
Total no. of Postdoctoral Fellows	8		100.0%
US Citizen	3		37.5%
Perm Residents	0		0.0%
Home Inst. in US	5		62.50%



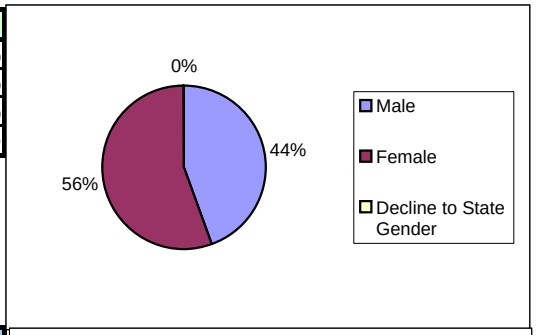
Year of Ph.D	#		%
2009 & Later (Graduate Students)	0		0.0%
2008	3		37.5%
2003-2007	5		62.5%
1998-2002	0		0.0%
1993-1997	0		0.0%
1988-1992	0		0.0%
1983-1987	0		0.0%
1981-1982	0		0.0%
1980 & Earlier	0		0.0%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	8		100.0%



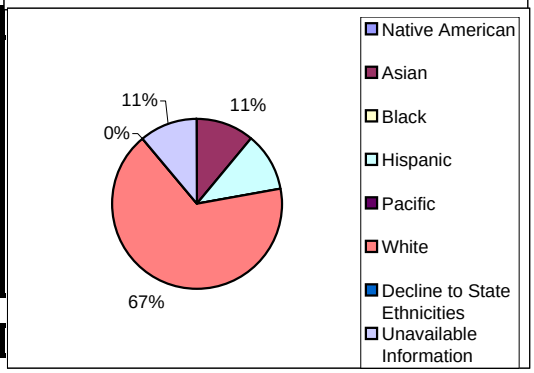
**Statistic Calculation based on all participants that did not decline.*

Ergodic Theory and Additive Combinatorics Program Associate (Graduate Student) Summary

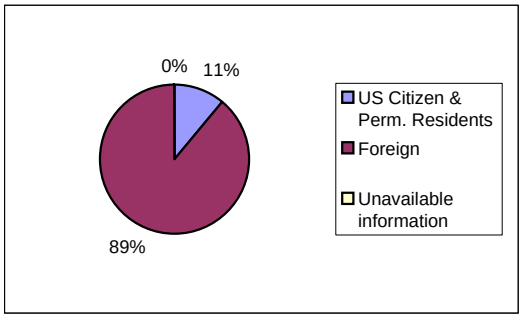
Gender	#	% (No Decl.)*	%
No. of Program Associates (GS)	9		100.0%
Male	4	44.44%	44.4%
Female	5	55.56%	55.6%
Decline to State Gender	0		0.0%



Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	1	12.50%	12.5%
Black	0	0.00%	0.0%
Hispanic	1	12.50%	12.5%
Pacific	0	0.00%	0.0%
White	6	75.00%	75.0%
Decline to State Ethnicities	0		0.0%
Unavailable Information	1		12.5%
Total no. of Program Associates	9		112.5%
Minorities	1	12.50%	11.1%



Citizenships	#		%
US Citizen & Perm. Residents	1		11.1%
Foreign	8		88.9%
Unavailable information	0		0.0%
Total no. of Program Associates	9		100.0%
US Citizen	1		11.1%
Perm Residents	0		0.0%
Home Inst. in US	3		33.33%



**Statistic Calculation based on all participants that did not decline.*

MSRI Spring 2009 Program: Algebraic Geometry Final Program Report

Brendan Hassett, Sándor Kovács, and Ravi Vakil
Program organizing committee co-chairs

June 30, 2009.

Contents

1 Introduction

Algebraic geometry has long been a central subject in mathematics, with deep and substantial connections to almost every aspect of the field. There are numerous different approaches to algebraic geometry, utilizing widely varying technical tools. Commutative algebra, complex analysis, sheaf theory, cohomological methods, and combinatorial techniques all play important roles. Powerful centrifugal forces pull at the field, as it spawns new specialties with astonishing regularity. New students of algebraic geometry tend to be specialized, and unfamiliar with other perspectives. Established researchers tend to see a narrow band of the subject at research conferences in their area. But dramatic new developments consistently involve broader themes, and connections between different parts of the subjects. Recent breakthroughs in higher-dimensional algebraic geometry, and in those parts of algebraic geometry connected with physics, are only two of a large number of examples.

From January to May 2009, MSRI hosted a semester-long program in algebraic geometry. The goal of this program was to bring together this diverse field. The size of MSRI gives a unique opportunity to collect a large number of researchers from throughout the field, at different stages of their careers, for an extended period of time. Programs at other research institutes gave an excuse to narrow the scope somewhat: the program concentrated on those portions of algebraic geometry that were particularly algebraic and geometric. Areas emphasized less (despite their continuing importance to the field) were: analytic methods; pure commutative algebra; arithmetic geometry; and tropical geometry. Despite this restriction in scope, one main challenge of the program was to avoid overwhelming the participants. A second challenge was the size of the program: at the start, we deliberately chose a small number of influential researchers to lay out our vision for the program. As a result, we were deluged with talented researchers interested in attending. Due to financial constraints, we were able to fund only a small portion of those interested, and even these at quite a low level. Many people not offered funding asked to come anyway, often for long periods of time. So we had to work to manage expectations, and also to try to build a welcoming intellectual community, which included those not officially part of the program. Another major challenge was the developing a cohesive community, and to avoid the program fragmenting into a number of independent parallel programs. The choice of seminars was designed with this in mind; this is discussed below.

By all accounts, the semester was a success. Younger researchers branched out from their thesis work, and most formed new collaborations, often with people

outside of their area of particular expertise. This will be clear in the discussion of the postdoctoral participants below. Established researchers often came to get some quiet work time, but discovered the opportunity to become acquainted with new developments in different parts of the subject. The long-term impact will of course only become clear in the long term, but we hope that in two decades, people still talk about this program as a key formative experience in their careers.

The semester was organized by William Fulton (Michigan), Joe Harris (Harvard), Brendan Hassett (Rice), János Kollár (Princeton), Sándor Kovács (Washington), Rob Lazarsfeld (Michigan), and Ravi Vakil (Stanford).

The web "portal" for the entire program is:

`http://main.msri2009.org/`

Supporting information may be found there. A list of participants may be found at:

`http://participants.msri2009.org/`

This list of 164 people does not include a good number who informally dropped by the program, or who attended some of the many workshops. A sampling of the preprints produced by participants during the period of the program is given in §2.

We would like to single out Hélène Barcelos and Jackie Blue for special thanks. Barcelos took over as Deputy Director shortly before the start of our program, and had an immediate impact. Our program posed a number of challenges for the staff: we had far more people (officially and unofficially) than other programs, while the staff had the same number of hours in a day. Throughout, Barcelos' primary concern was the success of the research program, and she was happy to think hard about how to make things work, when it would have been easier to just say "no". Blue's work with finding housing for participants is legendary, but we wanted to point out that this program had many more participants than usual, with less funding per participant, in a particularly grim economic climate, and we heard not one negative comment from any members about their housing experience.

2 Research developments

A hallmark of the program was its many collaborations across levels and subdisciplines. The efflorescence of research was inspiring to behold, involving literally hundreds of projects. The following is a list of roughly 100 preprints produced

by official members during the first-half of 2009. All are available on the arXiv. A surprising number of papers transcend narrow subdisciplines within algebraic geometry. Of course, most of the benefits of the program will be realized after the conclusion of the program, as new working relationships bear fruit.

Non-Defectivity of Grassmannians of planes (Abo, Ottaviani, Peterson)

Stable varieties with a twist (Abramovich, Hassett)

Explicit compactifications of moduli spaces of Campedelli and Burniat surfaces (Alexeev, Pardini)

Local properties of good moduli spaces (Alper)

On the local quotient structure of Artin stacks (Alper)

Deforming Stanley-Reisner schemes (Altmann, Christopherson)

Parametric Feynman integrals and determinant hypersurfaces (Aluffi, Marcolli)

Gromov-Witten theory of product stacks (Andreini, Jiang, Tseng)

The combinatorial part of the cohomology of a singular variety (Arapura, Bakhtary, Włodarczyk)

Reider's Theorem and Thaddeus Pairs Revisited (Arcara, Bertram)

$\mathbb{A}^1$-homotopy groups, excision, and solvable quotients (Asok, Doran)

Reflexivity and rigidity for complexes. I. Commutative rings (Avramov, Iyengar, Lipman)

Reduction of derived Hochschild functors over commutative algebras and schemes (Avramov, Iyengar, Lipman, Nayak)

On the Brauer group of Enriques surfaces (Beauville)

Non-uniruledness results for the space of rational curves in hypersurfaces (Behesti)

Bidding chess (Bhat, Payne)

Faster Real Feasibility via Circuit Discriminants (Bihan, Rojas, Stella)

Brauer Group of Moduli Spaces of PGL(r)-Bundles over a curve (Biswas, Hogadi)

Discreteness and rationality of F-jumping numbers on singular varieties (Blickle, Schwede, Takagi, Zhang)

Stacks of trigonal curves (Bolognesi, Vistoli)

Pro-p groups and towers of rational homology spheres (Boston, Ellenberg)

Some 4-point Hurwitz numbers in positive characteristic (Bouw, Osserman)

Goresky-MacPherson duality and deformations of Koszul algebras (Braden, Licata, Phan, Proudfoot, Webster)

BPS invariants for resolutions of polyhedral singularities (Bryan, Gholampour)

The Monodromy Conjecture for hyperplane arrangements (Budur, Mustaţă, Teitler)

Quotients resolubles ou nilpotents des groupes de Kaehler orbifoldes (Campana)

Torelli theorem for stable curves (Caporaso, Viviani)

Torelli theorem for graphs and tropical curves (Caporaso, Viviani)

Categorical geometric skew Howe duality (Cautis, Kamnitzer, Licata)

Coherent sheaves and categorical sl(2) actions (Cautis, Kamnitzer, Licata)

Derived equivalences for cotangent bundles of Grassmannians via categorical sl(2) actions (Cautis, Kamnitzer, Licata)

An example of crepant resolution conjecture in two steps (Cavalieri, Todorov)

Tautological pairings on moduli spaces of curves (Cavalieri, Yang)

Linear series on ribbons (Chen)

Stable Base Locus Decompositions of Kontsevich Moduli Spaces (Chen, Coskun)

Towards Mori's program for the moduli space of stable maps (Chen, Coskun, Crissman)

Strong rational connectedness of toric varieties (Chen, Shokurov)

The local lifting problem for actions of finite groups on curves (Chinberg, Guralnick, Harbater)

Hyperplane sections of abelian surfaces (Colombo, Frediani, Pareschi)

Stability and Unobstructedness of Syzygy Bundles (Costa, Marques, Miro-Roig)

Hyper-Kähler fourfolds and Grassmann geometry (Debarre, Voisin)

Shokurov's ACC Conjecture for log canonical thresholds on smooth varieties (de Fernex, Ein, Mustaţă)

Deformations of canonical pairs and Fano varieties (de Fernex, Hacon)

The Milnor fibre of the Pfaffian and the Hilbert scheme of four points on three-space (Dimca, Szendrői)

Logarithmic trace and orbifold products (Edidin, Jarvis, Kimura)

Cohomology of Coherent Sheaves and Series of Supernatural Bundles (Eisenbud, Schreyer)

The Kakeya set and maximal conjectures for algebraic varieties over finite fields (Ellenberg, Oberlin, Tao)

Two small remarks on Nori fundamental group scheme (Esnault, Hai)

Abelian birational sections in characteristic 0 (Esnault, Wittenberg)

Linear Shafarevich Conjecture (Eyssidieux, Katzarkov, Pantev, Ramachandran)

Remarks on hard Lefschetz conjectures on Chow groups (Fu)

Non-vanishing theorem for log canonical pairs (Fujino)

Rational singularities and quotients by holomorphic group actions (Greb)

1-rational singularities and quotients by reductive groups (Greb)

The tropical vertex (Gross, Pandharipande, Siebert)

The Sarkisov program (Hacon, McKernan)

Patching subfields of division algebras (Harbater, Hartmann, Krashen)

Products, Homotopy Limits and Applications (Hogadi, Xu)

The relations among invariants of points on the projective line (Howard, Millson, Snowden, Vakil)

Families over special base manifolds and a conjecture of Campana (Jabbusch, Kebekus)

Positive sheaves of differentials coming from coarse moduli spaces (Jabbusch, Kebekus)

Deformations along subsheaves (Kebekus, Kousidis, Lohmann)

Enriques diagrams, infinitely near points, and Hilbert schemes (Kleiman, Piene, Tyomkin)

Compatibly Frobenius split subschemes are rigid (Knutson)

Frobenius splitting and Möbius inversion (Knutson)

Positroid varieties I: juggling and geometry (Knutson, Lam, Speyer)

Log canonical singularities are Du Bois (Kollár, Kovács)

Fano Varieties with Large Degree Endomorphisms (Kollár, Xu)

A note on restriction theorems for semistable sheaves (Langer)

On the S-fundamental group scheme (Langer)

Triangulations of the sphere and degenerations of K3 surfaces (Laza)

A short course on multiplier ideals (Lazarsfeld)

Complex structure on the rational blowdown of sections in E(4) (Lee)

Arithmetic aspects of moduli of sheaves on curves (Lieblich)

On the strange duality conjecture for elliptic K3 surfaces (Marian, Oprea)

The moduli space of stable quotients (Marian, Oprea, Pandharipande)

Equivalent birational embeddings I and II: divisors (Mella, Polastri)

Severi type inequalities for irregular surfaces with ample canonical class (Mendes Lopes, Pardini)

The quantum differential equation of the Hilbert scheme of points in the plane (Okounkov, Pandharipande)

On the hypersurface of Lüroth quartics (Ottaviani, Sernesi)

The kappa ring of the moduli of curves of compact type: I and II (Pandharipande)

Optimization and NP_R-Completeness of Certain Fewnomials (Pebay, Rojas, Thompson)

Refined Asymptotics for Sparse Sums of Squares (Rojas, Sethuraman)

Fibrations on four-folds with trivial canonical bundles (Sawon)

A Simple Characterization of Du Bois Singularities (Schwede)

F-adjunction (Schwede)

Test ideals in non-Q-Gorenstein rings (Schwede)

Globally F-regular and log Fano varieties (Schwede, Smith)

On the number of compatibly Frobenius split subvarieties, prime F-ideals, and log canonical centers (Schwede, Tucker)

Towards a classification of modular compactifications of the moduli space of curves (Smyth)

Hilbert schemes and stable pairs: GIT and derived category wall crossings (Stoppa, Thomas)

The cone conjecture for Calabi-Yau pairs in dimension two (Totaro)

Universal covering spaces and fundamental groups in algebraic geometry as schemes (Vakil, Wickelgren)

Rigidity of Mori cone for Fano manifolds (Wiśniewski)

Weak Approximation for Low Degree del Pezzo Surfaces (Xu)

3 Organizational structure

Our main goal was to provide a large number and variety of events, each anchored in a particular part of algebraic geometry, but better connected to other parts of the field than a typical research conference. This had two aspects: ongoing seminars throughout the semester, and special events. Against this, we had to balance the danger of having too much going on.

We enlisted a number of people to help.

The Speakers Committee (Stefan Kebekus chair, Dan Abramovich, David Eisenbud, David Smyth) oversaw the seminars, ensuring breadth and diversity of speakers. The success of the program owes a great deal to their efforts.

David Smyth sent a weekly mailing to the participants, advertising coming events.

Martin Olsson was the "postdoctoral czar", and kept individual track of how the postdocs were doing. He organized the mentoring, and oversaw the postdoctoral seminar.

Rob Easton ran the postdoctoral seminar, in consultation with the large postdoctoral community.

Daniel Erman and Kevin Tucker ran the graduate student seminar.

The chairs of the full program were actively involved in all aspects of organization, and were for example involved in all discussions of the above committees.

Many senior participants took it upon themselves to help. Miles Reid in particular was a very positive influence.

4 Seminars, workshops and conferences

The events of the semester are listed at:

`http://past.msri2009.org/`

Regular events. A "typical week" consisted of the following events.
Monday
4:10-5:00 MSRI/Evans lecture at Berkeley (roughly every two weeks), followed by pizza/beer
Tuesday
2:00-3:00 Basic Notions (often related to the main seminar or the colloquium)
4:00-5:00 Main Seminar
Wednesday
1:30-3:00 Emphasis period seminar (several seminars over several weeks, loosely tied to an adjacent conference)
4:00-5:00 Graduate student seminar (followed by socializing, often at Raleigh's on Telegraph Ave.)
Thursday
Two regular self-organized seminars, on log geometry and on stacks, often took place on Thursday afternoons. Both topics are transdisciplinary notions that recently have spread throughout much of algebraic geometry.
Friday
12:00-1:00 Postdoc seminar (followed by pizza)

2:00-3:00 Algebraic Geometry Colloquium
Weekends
Organized recreational activities (e.g. hikes, basketball).

Workshops and conferences. We held an unusual number of conferences and workshops associated with the semester. All were intended to focus on one particular aspect of the subject, but to make connections to the rest of the field. Speakers were particularly asked to speak to people not normally at conferences they attend. Links for further information on all of these events are available at the MSRI algebraic geometry portal page:

`http://main.msri2009.org`

- Deformation theory and moduli (July 23-August 03, 2007, organized by Max Lieblich, Martin Olsson, Brian Osserman, and Ravi Vakil), a summer school for graduate students and postdocs. This workshop was particularly successful; MSRI had to greatly expand it due to overwhelming interest. Detailed notes and videos remain publicly available.

- We started the semester with Kickoff Presentations (January 14-16 — the year is 2009 unless otherwise noted) by the postdocs present, to introduce them to the community. Their slides remain publicly available.

- Warm-up lectures: Sam Payne and Phil Griffiths gave warm-up lectures in two topics (Toric Geometry, Hodge Theory, January 20-21)

- The first "official" conference was: *Connections for Women: Algebraic geometry and related fields* (January 22-24, organized by Angela Gibney, Brendan Hassett, Sándor Kovács, Diane Maclagan, Jessica Sidman, and Ravi Vakil)

- The introductory workshop was on the topic of *Classical algebraic geometry today* (January 26-30, Lucia Caporaso, Brendan Hassett, James McKernan, Mircea Mustaţă co-chair, Mihnea Popa co-chair)

- There was a Macaulay 2 Workshop (February 3, Greg Smith and Mike Stillman), helping many algebraic geometers become comfortable with using Macaulay 2 in their research.

- The third major workshop was on *Modern moduli theory* (February 23-27, Izzet Coskun chair, Sheldon Katz, Alina Marian, Rahul Pandharipande, Richard Thomas, Hsian-Hua Tseng, Ravi Vakil)
- The program hosted the 14th *SAGE days* (March 9-12, William Stein).
- On March 13, an open problem session was held for the postdocs.
- The final official workshop was on *Combinatorial, enumerative and toric geometry* (March 23-27, Michel Brion, Anders Buch, Linda Chen chair, William Fulton, Frank Sottile, Harry Tamvakis, Burt Totaro)
- The program hosted the twice-annual *Western Algebraic Geometry Seminar* (WAGS, April 25-26, Aravind Asok, Martin Olsson, Jonathan Wise)
- The semester concluded with a series of *Closing Lectures* (May 18-22, Rob Lazarsfeld)

The three official workshops all had more registrants than could be accomodated in the Simons Auditorium. Overflow audiences watched lectures on screens in the Baker Boardroom. These are some of the most popular workshops ever held at MSRI. We thank the staff for the lengths they went to, to make these supersized conferences a success.

5 Postdoctoral program

The postdoctoral participants may have benefited more than any other participants. The program organizers designated Martin Olsson (Berkeley) as the coordinator of the postdoctoral program. Olsson, in consultation with the program co-chairs, matched senior faculty mentors with postdocs. With the help of Deputy Director Barcelo, we communicated our expectations of the guidance mentors should offer postdocs:

- A discussion at the beginning of the semester on the problem(s) the postdoc is working on.
- An "open problems" session with all postdocs and senior members in residence.
- How to choose what to work on.

- Introductions to senior researchers in the postdoc's area.
- How to give a good talk.
- How to write a paper well.
- Discussion about publications (e.g. how quickly to publish a thesis; choosing and dealing with journals; feedback on drafts).
- Discussion on NSF grant proposal writing; feedback on proposal drafts.
- Career discussions, including comments on CV writing, how to prepare for an interview, two-body issues; etc.
- Sharing of views on how to address the various aspects of an academic career (proportion of research/teaching/service at various stage of ones career; etc.).

A number of activities were targeted toward postdocs. The first week of the program, David Eisenbud (Berkeley, and the previous Director of MSRI), János Kollár (Princeton), and the program co-chairs organized a series of 'Kickoff presentations'. This consisted of 22 ten-minute presentations by postdocs and a handful of advanced graduate students. Each speaker prepared precisely two slides sketching the key points of his or her research program; these were distributed through the program website. The main objective was to introduce the postdocs and their work to the other members in residence.

There was the weekly postdoc seminar, organized by Robert Easton, a postdoc at the University of Utah. The format was a series of introductory talks, combining exposition with real-world calculations. The intention was an informal seminar aimed at teaching postdocs how to do real work with various tools/theories, not formal lectures aimed at experts.

We held an open-problem session, moderated by David Eisenbud. Postdocs and their mentors were all strongly encouraged to attend. (The grad students also turned out in force.) Lists of problems posed were distributed through the program website. Finally, there were numerous informal seminars on diverse topics, e.g., the Log Geometry working group led by Dan Abramovich (Brown) and the Stacks working group led by Laura Matusevich.

The Postdocs: Background, research accomplishments, and placement

Jarod Alper received his Ph.D. from Stanford University in 2008 under the supervision of Ravi Vakil. His dissertation was titled "Good Moduli Spaces for Artin Stacks." At MSRI his mentor was Angelo Vistoli.

Jarod Alper worked on extending his thesis work on good moduli spaces in an attempt to give intrinsic constructions of moduli schemes parameterizing objects with non-finite automorphism groups. He worked on a project joint with David Smyth and Fred van der Wyck on giving moduli interpretations of log-canonical models of the moduli space of stable curves.

After his stay at MSRI, Jarod Alper went on to continue his NSF postdoctoral fellowship in the mathematics department at Columbia University.

Carolina Araujo received her Ph.D. from Princeton University in 2004 under the supervision of János Kollár. Her dissertation was titled "The Variety of Tangents to Rational Curves." At MSRI her mentor was Valery Alexeev.

At MSRI she worked on a joint project with Ana-Maria Castravet about Fano manifolds with positive Chern characters. She also worked on a project concerning flat deformations of projective spaces. She gave a talk at the postdoc seminar. She also participated in a working group with other postdocs about rationally simply connected varieties.

After her stay at MSRI, Carolina went to the Instituto Nacional de Matemática Pura E Aplicada, IMPA, Brazil.

Aravind Asok received his Ph.D. from Princeton University in 2004 under the supervision of Robert MacPherson. His dissertation was titled "Vector Bundles on Certain G-Varieties." At MSRI his mentor was Burt Totaro.

While at MSRI, Asok continued his collaborations with B. Doran (ETH, Zurich) and F. Morel (Ludwig-Maximallians Universitaet, Muenchen) regarding applications of techniques of homotopy theory to problems in algebraic geometry using the $\mathbb{A}^1$-homotopy theory developed by F. Morel and V. Voevodsky. The main accomplishment, joint with F. Morel, was a better understanding of some aspects of the Voevodsky-Rost theorem (née Milnor conjecture) with applications to construction of unirational, non-rational varieties for which non-rationality is detected by specific "higher" cohomological obstructions. Furthermore, Asok contributed a short presentation at the MSRI Academic Sponsors day, and attended various informal seminars (e.g., the seminar on the de Jong-Starr work on rational simple connectivity) together with the various conferences.

After his stay at MSRI, Aravind took a position as a tenure-track assistant professor at the Department of Mathematics, University of Southern California

Arend Bayer received his Ph.D. from Max Planck Institut für Mathematik in

2006 under the supervision of Yuri Manin. His dissertation was titled "Semisimple Quantum Cohomology, Deformations of Stability Conditions and the Derived Category." At MSRI his mentor was Kai Behrend.

At the beginning of the semester, Arend Bayer gave two talks in the Post-Doc seminar that gave introductions to Bridgeland stability conditions and wall-crossing. Together with Emanuele Macri (University of Utah), he studied the space of stability conditions on the local $\mathbb{P}^2$. In this joint work, they determined topological properties of the space, and used it to prove a theorem on the autoequivalences of its derived category. For this project, Arend Bayer benefited directly from conversations with Richard Thomas and Hiroshi Iritani (Imperial College) at MSRI. He started collaborations with Gueorgui Todorov (Princeton University) on stability conditions for higher-dimensional varieties, and with Renzo Cavalieri (Colorado State University) and Margarida Melo (Università Roma Tre) on Hurwitz numbers, and he had many more informal discussion with other members and visitors to the MSRI.

After his stay at MSRI, Arend went to the University of Connecticut department of mathematics as a tenure-track assistant professor.

Roya Beheshti Zavareh received her Ph.D. from the Massachusetts Institute of Technology in 2003 under the supervision of A. Johan de Jong. Her dissertation was titled "Lines on Fano Hypersurfaces." At MSRI her mentor was Carel Faber.

She collaborated with David Eisenbud (UC Berkeley) working on a project on the regularity of fibers of general projections. She also continued her work on birational geometry of spaces of rational curves on hypersurfaces and gave a talk in the post-doc seminar on this work. Along with a few other post-doc members, she helped running a reading group to study the new results of J. de Jong and J. Starr on rationally simply connectedness of low degree hypersurfaces.

After her stay at MSRI, Roya went to Washington University in St. Louis, where she is a tenure-track assistant professor of mathematics.

Sebastian Casalaina-Martin received his Ph.D. from Columbia University in 2004 under the supervision of Robert Friedman. His dissertation was titled "Singularities of the Prym Theta Divisor and Applications to Cubic Threefolds." At MSRI his mentor was János Kollár.

In joint work with Radu Laza, he investigated the moduli space of stable genus four curves, and its relationship to both a ball quotient constructed by Kondo, as well as the discriminant locus in the moduli space of cubic threefolds. They also investigated curves with singularities of type ADE. This is work in progress and will be posted to the arxiv shortly.

In another project, with Jesse Kass (Harvard University), he studied the geom-

etry of theta divisors of integral curves. A manuscript with these results will be posted on the arxiv shortly.

This project has led to work (in progress) on theta divisors of nodal, but possibly reducible curves. This is joint with Lucia Caporaso (University of Rome III), Filippo Viviani (University of Rome III), and Jesse Kass.

Casalaina-Martin also gave a lecture on his work in the Algebraic Geometry Seminar at the University of British Columbia.

After his stay at MSRI, Sebastian went to the University of Colorado at Boulder department of mathematics as a tenure-track assistant professor.

Sabin Cautis received his Ph.D. from Harvard University in 2006 under the supervision of Joseph Harris. His dissertation was titled "Extending Families of Curves: Monodromy and Applications." At MSRI his mentor was Dan Abramovich.

He constructed equivalences between categories associated to birational varieties (more precisely, varieties related by stratified flops). He also studied examples of 2-representations in algebraic geometry and looked for a way to prove braid group relations from categorical Lie algebra actions.

He worked in part with Joel Kamnitzer from University of Toronto and Anthony Licata from Stanford University.

After his stay at MSRI, he went on to be a Ritt Assistant Professor in the Mathematics Department at Columbia University.

Dawei Chen received his Ph.D. from Harvard University in 2008 under the supervision of Joseph Harris. His dissertation was titled "Covers of Elliptic Curves and the Lower bound for Slopes of Effective Divisors on the Moduli Space of Curves." At MSRI his mentor was Ravi Vakil.

He finished a paper about linear series on ribbons and another one about the birational geometry of the moduli space of stable maps. The latter was done in collaboration with Izzet Coskun (UIC) and Charley Crissman (Berkeley). He also gave a talk about Mori's program on moduli spaces in the postdoc seminar.

After his stay at MSRI, Dawei went to the Department of Mathematics, Statistics, and Computer Science University of Illinois at Chicago as a research assistant professor.

Robert Easton received his Ph.D. from Stanford University in 2007 under the supervision of Ravi Vakil. His dissertation was titled "S_3-covers of schemes." At MSRI his mentor was Lucia Caporaso.

He formed a new collaboration with fellow MSRI postdoc Jarod Alper, working on the existence of good moduli spaces. He was also chair of the postdoc seminar, and gave a short talk about covers and quotients at the MSRI Academic Sponsor Day.

After his stay at MSRI, he resumed his postdoc position as an assistant professor in the Department of Mathematics at the University of Utah.

Daniel Greb received his Ph.D. from Ruhr-University Bochum in 2008 under the supervision of Peter Heinzner. His dissertation was titled "Projectivity of Analytic Hilbert Quotients." At MSRI his mentor was Sándor Kovács.

Greb's work during his time at MSRI focused on two different areas: extension results for differential forms on higher-dimensional algebraic varieties and singularities of analytic Hilbert quotients.

In the first area he collaborated with S. Kebekus (Albert-Ludwigs-Universität-Freiburg), S. Kovács (University of Washington), and Th. Peternell (Universität-Bayreuth). All three of his collaborators also visited MSRI during the Algebraic Geometry Program. Building on their previous work for low-dimensional varieties they proved the following extension result which will appear in a forthcoming preprint:

Theorem: Let X be a variety with log canonical singularities and let σ be a differential form defined on the smooth locus of X. Then, σ extends to a differential form with at worst logarithmic poles along exceptional divisors on any resolution of singularities of X.

This result, its history, and parts of its proof were discussed by Greb during a talk in the MSRI Postdoc Seminar.

In addition, Greb worked on a generalisation and refinement of classical results of Boutot on the rationality of algebraic quotient singularities to the holomorphic setup. His results about rational singularities and (analytic Hilbert) quotients by holomorphic group actions will soon appear as a preprint.

Furthermore, Greb and Kovács' grad student Zsolt Patakfalvi formed a reading group studying period domains and variations of Hodge structures.

Supported in part by MSRI postdoc travel money he visited the University of Washington to present his research in the Algebra and Algebraic Geometry Seminar.

After his stay at MSRI, Daniel returned to his position as Akademischer Rat (Assistant Professor) at Mathematisches Institut, Albert-Ludwigs-Universität-Freiburg, Germany.

Amit Hogadi received his Ph.D. from Princeton University in 2007 under the supervision of János Kollár. His dissertation was titled "Topics in Birational Geometry." At MSRI his mentor was Miles Reid.

He worked on two problems during his stay at MSRI: One was about calculation of Brauer group of moduli space (and moduli stack) of $PGL(n)$ bundles (joint with Indranil Biswas) and the other problem (joint with Chenyang Xu, who

was also a postdoc at MSRI) was on Homotopy limits and derived categories of Deligne Mumford stacks. Apart from these, he participated in a special seminar run by post-docs on Rational Simple Connectedness.

After his stay at MSRI, Amit returned to the School of Maths, Tata Institute of Fundamental Research (TIFR), Mumbai, India.

Anne-Sophie Kaloghiros received her Ph.D. from the University of Cambridge in 2007 under the supervision of Alessio Corti. Her dissertation was titled "The Topology of Terminal Quartic 3-Folds." At MSRI her mentor was Lawrence Ein.

While at MSRI, she carried on her work on non-factorial terminal Gorenstein Fano 3-folds. She made the final corrections to her article "The Defect of Fano 3-folds", and she wrote a first version of the preprint "A classification of terminal quartic 3-folds and some remarks on rationality". She gave a talk in the postdoc seminar on these problems. Second, she took part to the Stacks working group and to a working group on the work of de Jong and Starr on notions of (simple) rational connectedness and the study of rational curves. Last, she worked with G. Todorov (Princeton) and C. Xu (MIT) on some (still vague) problems related to boundedness for 3-folds.

After MSRI, Anne-Sophie returned to her Junior Research Fellowship at Trinity Hall and DPMMS, University of Cambridge.

Radu Laza received his Ph.D. from Columbia University in 2006 under the supervision of Robert Friedman. His dissertation was titled "Deformations of Singularities and Variations of GIT Quotients." At MSRI his mentor was Alessio Corti.

Prior to his visit at MSRI, he was a postdoc at the University of Michigan. The period that he spent at MSRI partially overlapped with his job search. One big advantage of being at MSRI was flexibility to travel. During his period at MSRI, he gave 6 research talks: at the conference on "Arithmetic Algebraic Geometry related to moduli spaces" (Tokyo), UC Davis, U Wisconsin, Stony Brook, UNC, and the main seminar at MSRI.

At MSRI, he worked on three projects. The first project, joint with S. Casalaina-Martin, regards the birational geometry of the moduli space of genus 4 curves. This project is close to completion, and it is almost entirely a result of the research conducted at MSRI. He will talk about the results of this projects in June at the "Moduli and discrete groups conference" in Kyoto (June 8-12) and expects that a paper will be submitted by the end of the summer. The main results of the project include an explicit simultaneous semi-stable reduction for curves with ADE singularities, and an explicit and geometric resolution of the birational map between

the ball quotient model for M_4 constructed by Kondo and the Deligne-Mumford compactification $\overline{M}_4$.

A second project that he worked on is about the geometric compactification of the moduli space of polarized K3 surfaces. This is a longer term project. First, discussions with P. Hacking allowed him to expand the results from his previous paper "Triangulations of the sphere and degenerations of K3 surfaces" (on the combinatorics of degenerations of K3 surfaces). It is likely that the new results will be merged with the triangulation paper to form a joint paper with P. Hacking (to be submitted this summer). Secondly, he continued work on the geometric compactification for K3 surfaces along the lines of Kollár–Shepherd-Barron–Alexeev program (of compactifying the moduli space of log general type varieties). By the end of this year, he expects complete results about a geometric compactification in the case of low degree K3 surfaces.

The third project that he worked on is about the moduli of hyperkaehler manifolds. This is related with his previous work on "Moduli of cubic fourfolds". Parts of this project are in collaboration with K. O'Grady. The semester at MSRI gave him the opportunity to discuss at length with K. O'Grady.

In conclusion, the semester at MSRI gave him the ample opportunities to discuss with his collaborators or potential collaborators (S. Casalaina-Martin, P. Hacking, K. O'Grady). He also discussed (related to his research projects) with B. Hassett, C. Voisin, S. Keel, D. Smyth, D. Hyeon, etc. Beside people directly related to his research, he had countless discussions with numerous people in the community, from senior faculty to graduate students. For instance, one result of these discussions was the decision to organize a Northeastern regional algebraic geometry meeting (somewhat modeled on WAGS) starting this fall. In the beginning, the core schools involved will be Stony Brook (R. Laza), Amherst (J. Tevelev), and UConn (A. Bayer).

After his stay at MSRI, Radu will start as a tenure-track assistant professor at the mathematics department of the State University of New York at Stony Brook.

Dragos Oprea received his Ph.D. from the Massachusetts Institute of Technology in 2005 under the supervision of Gang Tian. His dissertation was titled "The Tautological Classes on the Moduli Space of Stable Maps to Flag Varieties." At MSRI his mentor was Jim Bryan.

Dragos Oprea worked on two papers: "On the strange duality conjecture for elliptic K3 surfaces," written with Alina Marian (UIC), and "The moduli space of stable quotients," written with Alina Marian (UIC) and Rahul Pandharipande (Princeton). The papers can be found on the arxiv: arXiv:0902.3052, arXiv:0904.2992. He also gave a lecture entitled "The Verlinde bundles in higher

genus" during the workshop Modern Moduli Theory.

After his stay at MSRI, Dragos went to the Department of Mathematics at UC San Diego as a tenure-track assistant professor.

David Smyth received his Ph.D. from Harvard University in 2008 under the supervision of Joseph Harris. His dissertation was titled "Projectivity of analytic Hilbert quotients." At MSRI his mentor was David Eisenbud.

During his semester at MSRI, David Smyth collaborated with Jarod Alper (Columbia) and Fred van der Wyck (Harvard) on a project aimed at constructing certain moduli spaces of curves without using geometric invariant theory. He also gave a lecture at the Modern Moduli workshop and served on the speakers committee.

After his stay at MSRI, David went on to be a Junior Fellow at Harvard.

Gueorgui Todorov received his Ph.D. from the University of Utah in 2008 under the supervision of Aaron Bertram. His dissertation was titled "The Gromov-Witten potential of local projective line with weights one and two and pluricanonical maps on threefolds of general type." At MSRI his mentor was James McKernan.

He collaborated with Renzo Cavalieri on the Gromov-Witten potential of a partial resolution of an A_2 singularity. They proved that the resulting potential matches the potential of the A_2 singularity and also that of the resolution. Together with Anne-Sophie Kaloghiros and Chenyang Xu he was running a working group on birational geometry. He also collaborated and discussed various topics with Arend Bayer, Aaron Bertram, Dawei Chen, Christopher Hacon, Tommaso deFernex.

After his stay at MSRI, Gueorgui went to be an Instructor at the mathematics department at Princeton University.

Hsian-Hua Tseng received his Ph.D. from UC Berkeley in 2005 under the supervision of Alexander Givental. His dissertation was titled "Quantum Riemann-Roch, Lefschetz and Serre Theorems for Orbifold Gromov-Witten Theory." At MSRI his mentor was Yuan-Pin Lee.

Hsian-Hua studied Gromov-Witten theory of orbifolds while at MSRI. He calculated some genus 1 degree 0 Gromov-Witten invariants of Deligne-Mumford stacks. He collaborated with Yunfeng Jiang (University of Utah) and Elena Andreini (MPI-Bonn) on Gromov-Witten theory of product stacks and Gromov-Witten theory of root gerbes. They have written a paper with results on calculations of Gromov-Witten invariants of product stacks. He collaborated with Jeff Brown (UC Berkeley) on proving Virasoro constraints for Gromov-Witten invariants of toric bundles. He collaborated with Tom Coates (Imperial College

London), Alessio Corti (Imperial College London) and Hiroshi Iritani (Imperial College London) on calculations of Gromov-Witten invariants of toric Deligne-Mumford stacks.

He also gave a lecture at the postdoc seminar on Givental's formalism in Gromov-Witten theory.

After his stay at MSRI, Hsian-Hua went on to be a tenure-track assistant professor at department of mathematics, Ohio State University.

Alexandr Usnich received his Ph.D. from Universite Paris VI in 2008 under the supervision of Maxim Kontsevich. His dissertation was titled "On the Cremona Group and its Subgroups." At MSRI his mentor was Rahul Pandharipande.

Alexandr Usnich worked on the Donaldson-Thomas invariants for 3 Calabi-Yau categories and on cluster mutations in non-commutative setting.

After his stay at MSRI, Alexandr went to the Institut für Mathematik, Zurich University

Chenyang Xu received his Ph.D. from Princeton University in 2008 under the supervision of János Kollár. His dissertation was titled "Topics on Rationally Connected Varieties." At MSRI his mentor was Stefan Kebekus.

While Chenyang was at MSRI, he finished 2 papers: one showed the weak approximation holds for some del Pezzo surfaces; the other was a joint work with Amit Hogadi, who was also in MSRI, on properties of derived categories of stacks. He gave two lectures there: one in the post-doc seminar, one in the Emphasis seminar. He also worked on some other problems, which will become papers in the future.

After his stay at MSRI, Chenyang went on to be C.L.E Moore instructor at the mathematics department of MIT.

Other postdocs.

In addition to the official MSRI postdocs, there were a number of participants (official and unofficial) still in the postdoctoral stage of their careers. We did our best to treat them on the same footing as the official MSRI postdocs. In some cases, these people are based outside the US and supported by their governments. Others were supported by their home departments. These 'unofficial' postdocs were also assigned mentors by the organizers:

Ulrich Derenthal received his Ph.D. from Georg-August-Universität Göttingen in 2006 under the supervision of Yuri Tschinkel. His dissertation was titled "Geometry of Universal Torsors". At MSRI his mentor was Brendan Hassett. After his stay at MSRI, Ulrich took a position as a Juniorprofessor at the Mathematisches Institut, Universität Freiburg (Germany)

Milena Hering received her Ph.D. from the University of Michigan in 2006

under the supervision of William Fulton. Her dissertation was titled "Syzygies of toric varieties". At MSRI her mentor was Michael Stillman. After her stay at MSRI, Milena was a postdoctoral assistant professor at the Department of Mathematics at the University of Utah.

David Rydh received his Ph.D. from the Kungliga Tekniska Högskolan in Stockholm in 2008 under the supervision of Dan Laksov. His dissertation was titled "Families of cycles and the Chow scheme". At MSRI his mentor was Martin Olsson. After his stay at MSRI, David was a postdoc at the Department of Mathematics at the University of California at Berkeley.

6 Graduate students

A number of graduate students took part in the program. About ten graduate students were officially program associates, accompanying their advisors who were members. In addition, a number of students participated unofficially, including students from Berkeley. (Our mailing list includes 29 students overall.) As well as participating in regular events, they ran their own weekly seminar, and regularly participated en masse in the postdoctoral seminar. The social events (including with the postdocs) were a great way for them to meet others in the community, from fellow graduate students to distinguished senior colleagues. The local graduate students from Berkeley were excellent hosts.

7 Diversity

In recommending participants, the committee was very conscious of issues of diversity. At this point, many of the younger leaders in the field are women, and the percentage of algebraic geometers who are women has been rising quickly, albeit from a very low number. A glance at our list of participants will show that we had a good percentage of women, including at the most senior levels (Research Professors, named professorships), and women had a significant presence on all committees, including as chairs. Indeed, the representation of women in our program significantly exceeds the percentage of US doctorates in algebraic geometry awarded to women. (In a recent informal study, we found 8-9 % of these going to women.)

On the other hand, the participation of underrepresented groups such as African-Americans and US-born Hispanics in algebraic geometry remains low, and the

pipeline into the field is insufficiently developed. The organizers worked to recruit participants from these groups. In advance of the special semester, Brendan Hassett gave a series of lectures at the annual meeting of SACNAS (Society for the Advancement of Chicano and Native American scientists) as part of our recruitment effort.

8 Synergistic activities

A number of synergistic activities took place during the semester. Connections to computational methods were encouraged through two events (on the programs Macaulay II and SAGE). Bernd Sturmfels' course on Tropical Geometry connected this program to the subsequent one on tropical geometry. Immediately after the end of the semester, a conference was held at Berkeley on representation theory, geometry, and combinatorics (organized by Martin Olsson and Ishai Dan-Cohen), and there was a great deal of activity between the two groups at that time. Many participants took part in a Math Circles meeting during the semester (and many volunteered their own children). The holding of WAGS (the Western Algebraic Geometry Seminar) at MSRI encouraged new synergistic interactions. Participants took part in a mathematically-themed event by *Playground*, a workshop of playwrights in the Bay Area.

9 A Nugget

The following nugget is based on Jim Bryan's excellent article in the *Emissary*.

Algebraic geometry is one of the oldest subjects in mathematics, and yet it is arguably at its most vibrant today. The subject is continually being invigorated by its active connections with topology, complex geometry, representation theory, number theory, commutative algebra, combinatorics, and modern high energy physics. Indeed, the participants of the 2009 MSRI jumbo program in algebraic geometry have a vast range of interests and many of the researchers have gravitated to algebraic geometry from other fields.

At the core of algebraic geometry are varieties, spaces defined by polynomial equations. For example, the solution set of a single equation in two variables defines a curve in the plane. If the coefficients of the polynomial are taken to be in the complex numbers, we get a Riemann surface, which can be visualized as the surface of a doughtnut with g holes. It was realized early on that rather than

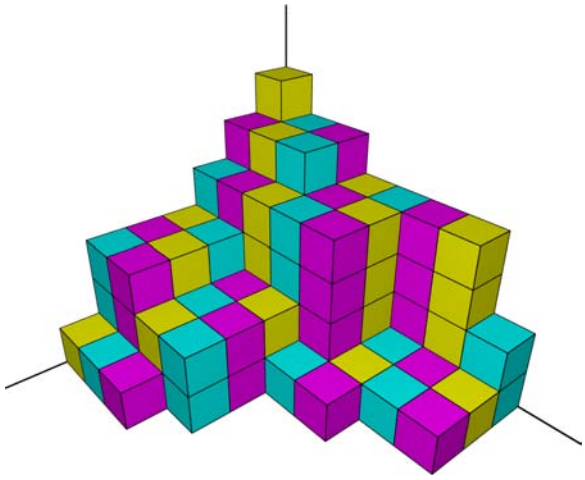


Figure 1: *3D partitions* are piles of boxes stacked stably in the corner of a room. These objects are of central importance in recent developments in algebraic geometry, notably in Donaldson-Thomas theory

studying varieties one at a time, one should consider how they vary in families, or *moduli*. In the nineteenth century, Bernhard Riemann studied curves in moduli and discovered that curves of genus g are parameterized by a $3g-3$ dimensional moduli space. Moduli spaces in general, and the moduli space of curves in particular, now occupy a central place in modern algebraic geometry.

The modern point of view in algebraic geometry differs considerably from that of its inception. A significant paradigm shift occurred in the 1960's led by the work of Serre, Grothendieck, Deligne and Mumford. New and powerful theoretical tools were developed in those days to study how varieties behave in families. We are perhaps in the midst of a further paradigm shift, where these abstract tools are applied to concrete questions from across matheamtics.

Moduli spaces also occur in string theory and in quantum field theory where they often have an algebro-geometric interpretation. Some of the most exciting recent advances in the theory of moduli have been fueled by these interactions. Examples include *Donaldson-Thomas invariants*, which despite their intricate definition can sometimes be computed by concrete, combinatorial means:

Postdoctoral Fellows Summary

Pre/Post Institute Group

Name	*PhD Year*	*Degree Institute*	*AMS Group*	*MSRI - Mentor*	*Pre - MSRI*	*AMS Group*	*Placement Institute*	*AMS Group*	*Position*
Alper, Jarod	2008	Stanford University	I Private	Vistoli, Angelo	Columbia University	I Private	Columbia University	I Private	Instructor
Araujo, Carolina	2004	Princeton University	I Private	Alexeev, Valery	IMPA	Foreign	IMPA	Foreign	Postdoc
Asok, Aravind	2006	Princeton University	I Private	Totaro, Burt	University of Washington	I Public	UCLA	I Public	Hedrick Assistant Professor
Bayer, Arend	2006	Max Planck Institut für Mathematik	Foreign	Behrend, Kai	University of Utah	I Public	University of Connecticut	II	Assistant Professor
Beheshti Zavareh, Roya	2003	MIT	I Private	Faber, Carel	Queen's University	Foreign	Washington University	I Public	Assistant Professor
Casalaina-Martin, Sebastian	2004	Columbia University	I Private	Kollar, Janos	Harvard University	I Private	University of Colorado at Boulder	II	Assistant Professor
Cautis, Sabin	2006	Harvard University	I Private	Abramovich,Dan	Rice University	I Private	Columbia University	I Private	Joseph Fels Ritt Assistant Professor
Chen, Dawei	2008	Harvard University	I Private	Vakil, Ravi	Harvard University	I Private	University of Illinois at Chicago	I Public	Research Assistant Professor
Easton, Robert	2007	Stanford University	I Private	Caporaso, Lucia	University of Utah	I Public	University of Utah	I Public	Assistant Professor
Greb, Daniel	2008	Ruhr-Universität Bochum	Foreign	Kovacs, Sandor	Mathematisches Institut der Universitaet zu Koeln	Foreign	Albert-Ludwigs-Universitaet Freiburg	Foreign	Assistant Professor
Hogadi, Amit	2007	Princeton University	I Private	Reid, Miles	Tata Institute of Fundamental Research	Foreign	Tata Institute of Fundamental Research	Foreign	Faculty Member
Kaloghiros, Anne-Sophie	2007	University of Cambridge	Foreign	Ein, Lawrence	University of Cambridge	Foreign	University of Cambridge	Foreign	Research Fellow
Laza, Radu	2006	Columbia University	I Private	Corti, Alessio	University of Michigan	I Public	Rice University	I Private	Assistant Professor
Oprea, Dragos	2005	MIT	I Private	Bryan, Jim	Stanford University	I Private	UCSD	I Public	Assistant Professor
Smyth, David	2008	Harvard University	I Private	Eisenbud, David	Harvard University	I Private	Harvard University	I Private	Junior Faculty

Todorov, Gueorgui	2008	University of Utah	I Public	McKernan, James	University of Utah	I Public	Princeton University	I Private	Instructor
Tseng, Hsian-Hua	2005	UC Berkeley	I Public	Lee, Yuan-Pin	University of Wisconsin - Madison	I Public	Ohio State University	I Public	Assistant Professor
Usnich, Alexandr	2008	Université Pierre et Marie Curie - Paris 6	Foreign	Pandharipande, Rahul	Université Pierre et Marie Curie - Paris 6	Foreign	Zurich University	Foreign	Assistant Professor
Xu, Chenyang	2008	Princeton University	I Private	Kebekus, Stefan	MIT	I Private	MIT	I Private	C L E Moore Instructor

		Pre-MSRI							
		Group I Private	Group I Public	Group II	Group III	Group B	Group M	Foreign	Total
Post-MSRI	Group I Private	4	2						6
	Group I Public	2	3					1	6
	Group II	1	1						2
	Group III								-
	Group B								-
	Group M								-
	Foreign							5	5
	Total	**7**	**6**	**-**	**-**	**-**	**-**	**6**	**19**

Participant List

MSRI Program:

Algebraic Geometry

January 1 to May 22, 2009

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Primary Institute	Position
Abramovich, Dan	Brown University	Professor
Alexeev, Valery	University of Georgia	David C. Barrow Professor
Alper, Jarod	Columbia University	Faculty/Postdoc
Altmann, Klaus	Freie Universität Berlin	Professor
Aluffi, Paolo	Florida State University	Professor
Anderson, David	University of Michigan	Graduate Student
Andreatta, Marco	Università di Trento	Participant
Araujo, Carolina	Institute of Pure and Applied Mathematics (IMPA)	Adjoint Researcher
Asok, Aravind	University of California	Faculty/Postdoc
Bauer-Catanese, Ingrid	Universitaet Bayreuth	Professor
Bayer, Arend	University of Utah	Assistant Professor (Lecturer)
Beauville, Arnaud	Université de Nice Sophia Antipolis	Faculty/Postdoc
Beheshti Zavareh, Roya	Washington University	Faculty/Postdoc
Behrend, Kai	University of British Columbia	Professor
Bertram, Aaron	University of Utah	Professor and Chair
Borrelli, Giuseppe	Universidade Federal de Pernambuco	Professor
Brannetti, Silvia	Terza Università di Roma	Graduate Student
Bridgeland, Tom	University of Sheffield	Faculty/Postdoc
Bryan, Jim	University of British Columbia	Faculty/Postdoc
Buch, Anders	Rutgers University	Faculty/Postdoc
Campana, Frederic	Université de Nancy I (Henri Poincaré)	professor
Caporaso, Lucia	Universita Roma TRE	Faculty/Postdoc
Casagrande, Cinzia	Università di Pavia	Faculty/Postdoc
Casalaina-Martin, Sebastia	University of Colorado	Faculty/Postdoc
Castravet, Ana-Maria	University of Arizona	Faculty/Postdoc
Catanese, Fabrizio	Universität Bayreuth	Professor
Cautis, Sabin	Rice University	G.C. Evans Instructor
Cavalieri, Renzo	Colorado State University	Faculty/Postdoc
Chen, Qile	Brown University	Graduate Student
Chen, Dawei	University of Illinois	Faculty/Postdoc
Chen, Linda	Swarthmore College	Faculty/Postdoc
Corti, Alessio	Imperial College, London	Professor
Coskun, Izzet	University of Illinois	Faculty/Postdoc
Costa, Laura	University of Barcelona	Faculty/Postdoc
Craw, Alastair	University of Glasgow	Faculty/Postdoc
de Fernex, Tommaso	University of Utah	Assistant Professor
Debarre, Olivier	École Normale Supérieure	Faculty/Postdoc
Derenthal, Ulrich	University of Zurich	Postdoc
Di Rocco, Sandra	K.T.H.	associate professor
Doran, Brent	University of Oxford	Faculty/Postdoc
Dundon, Ariana	University of Washington	Graduate Student
Easton, Robert	University of Utah	Assistant Professor
Edidin, Dan	University of Missouri, Columbia	Associate Professor
Ein, Lawrence	University of Illinois	Professor
Eisenbud, David	University of California	Professor
Ellenberg, Jordan	University of Wisconsin	Assistant Professor
Esnault, Helene	Universität Duisburg-Essen	Faculty/Postdoc
Faber, Eleonore	Universität Wien	Graduate Student
Faber, Carel	Royal Institute of Technology (KTH)	Full Professor
Fantechi, Barbara	International School for Advanced Studies (SISSA/ISAS)	Faculty/Postdoc
Farkas, Gavril	Humboldt-Universität	Professor
Finkel, Dan	University of Washington	Graduate Student
Fu, Baohua	Academy of Mathematics and Systems Science	Participant
Fujino, Osamu	Kyoto University	Faculty/Postdoc
Fulton, William	University of Michigan	Professor
Giansiracusa, Noah	Brown University	Graduate Student
Gibney, Angela	University of Georgia	Faculty/Postdoc
Goettsche, Lothar	Abdus Salam International Centre for Theoretical Physics	Faculty/Postdoc
Graber, Thomas	California Institute of Technology	Associate Professor
Graham, William	University of Georgia	Professor
Grassi, Antonella	University of Pennsylvania	Professor
Greb, Daniel	Albert-Ludwigs-Universitaet Mathematisches Institut	Faculty/Postdoc

Griffiths, Phillip	Institute for Advanced Study	Professor
Grushevsky, Samuel	Princeton University	Faculty/Postdoc
Hacking, Paul	University of Washington	Faculty/Postdoc
Hacon, Christopher	University of Utah	Faculty/Postdoc
Hain, Richard	Duke University	Faculty/Postdoc
Hall, Jack	Stanford University	Graduate Student
Harbater, David	University of Pennsylvania	Christopher H. Browne Distinguished Professor
Harris, Joseph	Harvard University	Professor
Hassett, Brendan	Rice University	Faculty/Postdoc
Heier, Gordon	University of California	Faculty/Postdoc
Hering, Milena	University of Utah	Faculty/Postdoc
Hogadi, Amit	Tata Institute of Fundamental Research	Participant
Holm, Tara	Cornell University	Faculty/Postdoc
Hulek, Klaus	Leibniz Universität Hannover	Professor
Hwang, Jun-Muk	Korea Institute for Advanced Study (KIAS)	Faculty/Postdoc
Ishii, Shihoko	Tokyo Institute of Technology	Professor
Izadi, Elham	University of Georgia	Faculty/Postdoc
Jabbusch, Kelly	Albert-Ludwigs-Universität Freiburg	Faculty/Postdoc
Johnsen, Trygve	University of Tromso	Faculty/Postdoc
Johnson, Jennifer	Princeton University	Senior Lecturer
Kaloghiros, Anne-Sophie	University of Cambridge	Junior Research Fellow
Katz, Sheldon	University of Illinois, Urbana-Champaign	Professor and Chair
Katzarkov, Ludmil	University of Miami	Professor
Kaufmann, Ralph	Purdue University	Associate Professor
Kawamata, Yujiro	University of Tokyo	Faculty/Postdoc
Kebekus, Stefan	Albert-Ludwigs-Universität Freiburg	Faculty/Postdoc
Kim, Bumsig	Korea Advanced Institute of Science and Technology (KAIST)	Professor
Kirson, Antonio	University of Washington	Graduate Student
Knutson, Allen	University of California, San Diego	Professor
Kollár, János	Princeton University	Professor
Kopp, Travis	University of Washington	Graduate Student
Kovács, Sándor	University of Washington	Professor
Kresch, Andrew	Universität Zürich	Professor
Langer, Adrian	University of Warsaw	Associate Professor
Laza, Radu	University of Michigan	Assistant Prof. (postdoc)
Lazarsfeld, Robert	University of Michigan	Faculty/Postdoc
Lee, Yongnam	Sogang University	Associate Professor
Lee, Yuan-Pin	University of Utah	Faculty/Postdoc
Lieblich, Max	Princeton University	Faculty/Postdoc
Lipman, Joseph	Purdue University	Professor
Maclagan, Diane	University of Warwick	Faculty/Postdoc
Marcus, Steffen	Brown University	Graduate Student
Marian, Alina	University of Illinois	Faculty/Postdoc
Matusevich, Laura	Texas A&M University	Assistant Professor
Maulik, Davesh	Massachusetts Institute of Technology	Faculty/Postdoc
McKernan, James	Massachusetts Institute of Technology	Faculty/Postdoc
McKinnie, Kelly	Rice University	Faculty/Postdoc
Mella, Massimiliano	Università di Ferrara	Faculty/Postdoc
Melo, Margarida	Terza Università di Roma	Graduate Student
Mendes Lopes, Margarida	Instituto Superior Técnico	Faculty/Postdoc
Mezzetti, Emilia	University of Trieste	Full professor
Miró-Roig, Rosa M.	University of Barcelona	Full Professor
Miyaoka, Yoichi	Kyoto University	Participant
Mori, Shigefumi	Kyoto University	Professor
Morrison, David	University of California	Faculty/Postdoc
Morrison, Ian	Fordham University	Faculty/Postdoc
Mukai, Shigeru	Kyoto University	Faculty/Postdoc
Mustata, Mircea	University of Michigan	Faculty/Postdoc
Nevins, Thomas	University of Illinois at Urbana-Champaign	Faculty/Postdoc
O'Grady, Kieran	Sapienza Universita' di Roma	Full professor
Olsson, Martin	University of California	Faculty
Oprea, Dragos	University of California, San Diego	Faculty/Postdoc
Osserman, Brian	University of California	Assistant Professor
Ottaviani, Giorgio	Università di Firenze	Professor
Pandharipande, Rahul	Princeton University	Faculty/Postdoc
Pardini, Rita	Università di Pisa	Faculty/Postdoc
Pareschi, Giuseppe	Universita' di Roma, Tor Vergata	Full Professor
Patakfalvi, Zsolt	University of Washington	Graduate Student
Payne, Sam	Stanford University / Clay Mathematics Institute	Postdoctoral Research Fellow
Peternell, Thomas	Universität Bayreuth	Professor

Piene, Ragni	University of Oslo	Faculty/Postdoc
Popa, Mihnea	University of Illinois	Faculty/Postdoc
Proudfoot, Nicholas	University of Oregon	Faculty/Postdoc
Reid, Miles	University of Warwick	Professor
Rojas, J. Maurice	Texas A&M University	Professor
Ross, Julius	University of Cambridge	Faculty/Postdoc
Ross, Kiana	University of Washington	Graduate Student
Roth, Michael	Queen's University	Participant
Rydh, David	University of California	Faculty/Postdoc
Sawon, Justin	Colorado State University	Assistant Professor
Schoen, Chad	Duke University	Professor
Schumacher, Georg	Philipps-Universität Marburg	Fachbereich Mathematik
Schwede, Karl	University of Michigan	Postdoc Assistant Professor
Shokurov, Vyacheslav	Johns Hopkins University	Professor
Skjelnes, Roy	Royal Institute of Technology (KTH)	Assistant Professor
Smith, Karen	MIT - Massachusetts Institute of Technology	Participant
Smith, Gregory	Queen's University	Faculty/Postdoc
Smyth, David	Harvard University	Faculty/Postdoc
Srinivas, Vasudevan	Tata Institute of Fundamental Research	Faculty/Postdoc
Stillman, Mike	Cornell University	Director of Graduate Studies in Mathematics
Szendroi, Balazs	University of Oxford	Lecturer
Takagi, Shunsuke	Kyushu University	Research Associate Professor
Talpo, Mattia	Scuola Normale Superiore	Undergraduate Student
Tamvakis, Harry	University of Maryland	Participant
Teicher, Mina	Bar-Ilan University	Faculty/Postdoc
Tevelev, Jenia	University of Massachusetts	Faculty/Postdoc
Thomas, Richard	Imperial College London	Faculty Postdoc
Todorov, Gueorgui	Princeton University	Faculty/Postdoc
Tommasi, Orsola	Universität Hannover	Postdoc
Totaro, Burt	University of Cambridge	Lowndean Professor of Astronomy and Geometry
Tseng, Hsian-Hua	University of Wisconsin-Madison	Faculty/Postdoc
Tucker, Kevin	University of Michigan	Graduate Student
Tziolas, Nikolaos	University of Cyprus	Assistant Professor
Ulfarsson, Henning	Brown University	Graduate Student
Usnich, Alexandr	Universität Zürich	Faculty/Postdoc
Vakil, Ravi	Stanford University	Assistant Professor
Viehweg, Eckart	Universitaet Duisburg-Essen	Professor
Vistoli, Angelo	Scuola Normale Superiore	Professor
Voisin, Claire	Centre National de la Recherche Scientifique (CNRS)	Faculty/Postdoc
Wahl, Jonathan	University of North Carolina	Faculty/Postdoc
Westera, Dennis	University Wien	Graduate Student
Wickelgren, Kirsten	Stanford University	Graduate Student
Wisniewski, Jaroslaw	Uniwersytet Warszawksi	Professor
Xu, Chenyang	Massachusetts Institute of Technology	Faculty/Postdoc

Algebraic Geometry

2008-2009

Program Participant Summary

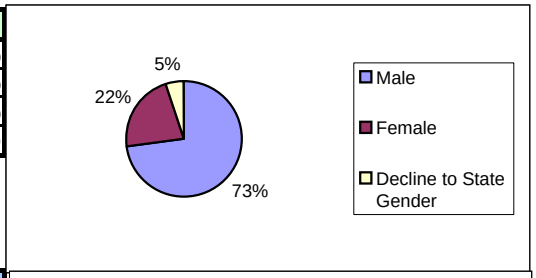
Algebraic Geometry	# of Distinct Participants	%	# of Citizens & Perm. Res.	%	# of Female	%	# of Minorities	%
Postdoctoral Fellows	19	*11.8%*	8	*5.0%*	3	*1.9%*	0	*0.0%*
PD/RM	17	*10.6%*	9	*5.6%*	5	*3.1%*	0	*0.0%*
Program Associates	17	*10.6%*	9	*5.6%*	5	*3.1%*	1	*0.6%*
Research Members	70	*43.5%*	34	*21.1%*	17	*10.6%*	3	*1.9%*
Research Professor	28	*17.4%*	10	*6.2%*	3	*1.9%*	0	*0.0%*
Organizers	7	*4.3%*	7	*4.3%*	0	*0.0%*	0	*0.0%*
Guests	3	*1.9%*	1	*0.6%*	3	*1.9%*	0	*0.0%*
Total no. of Distinct Participants	**161**	***100.0%***	**78**	***48.4%***	**36**	***22.4%***	**4**	***2.5%***

Home Institute Grouping

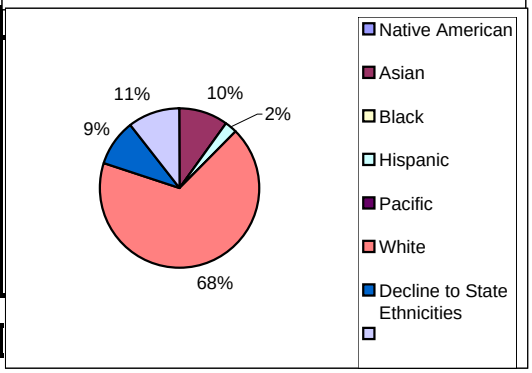
Algebraic Geometry	Group I Private	Group I Public	Group II	Group B	IAS	Foreign	Total
Guest	1					2	**3**
Organizer	4	3					**7**
PD/RM	4	4	2	1		6	**17**
Postdoc	5	7	1	1		5	**19**
Program Associate	6	8				3	**17**
Research Member	7	14	12	2		35	**70**
RP	2	5	1		1	19	**28**
Total	**29**	**41**	**16**	**4**	**1**	**70**	**161**
%	***18.0%***	***25.5%***	***9.9%***	***2.5%***	***0.6%***	***43.5%***	***100.0%***

Algebraic Geometry (All Participants) Demographic Summary

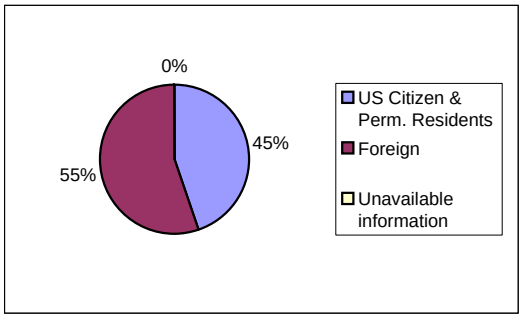
Gender	#	% (No Decl.)*	%
No. of Distinct Participants	161		100.0%
Male	117	76.47%	72.7%
Female	36	23.53%	22.4%
Decline to State Gender	8		5.0%



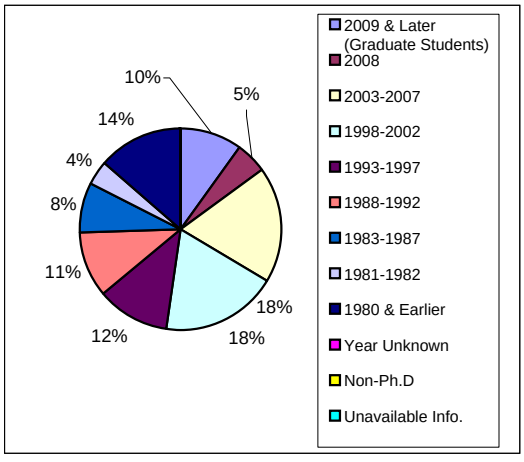
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	16	12.40%	9.9%
Black	0	0.00%	0.0%
Hispanic	4	3.10%	2.5%
Pacific	0	0.00%	0.0%
White	109	84.50%	67.7%
Decline to State Ethnicities	15		9.3%
Unavailable Information	17		10.6%
Total no. of Distinct Participants	161		100.0%
Minorities	4	3.10%	2.5%



Citizenships	#		%
US Citizen & Perm. Residents	78		48.4%
Foreign	96		59.6%
Unavailable information	0		0.0%
Total no. of Distinct Participants	174		108.1%
US Citizen	62		38.5%
Perm Residents	16		9.9%
Home Inst. in US	91		56.52%



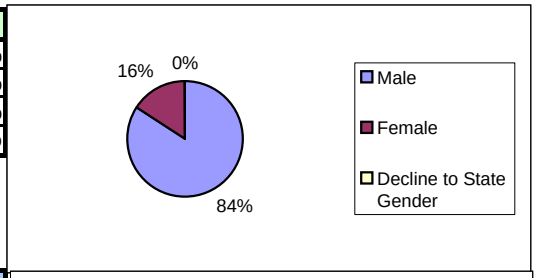
Year of Ph.D	#		%
2009 & Later (Grauate Students)	16		9.9%
2008	8		5.0%
2003-2007	30		18.6%
1998-2002	30		18.6%
1993-1997	19		11.8%
1988-1992	17		10.6%
1983-1987	13		8.1%
1981-1982	6		3.7%
1980 & Earlier	22		13.7%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	161		100.0%



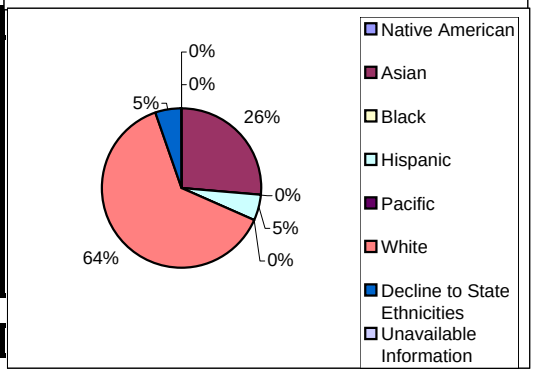
**Statistic Calculation based on all participants that did not decline.*

Algebraic Geometry Postdoctoral Fellow Summary

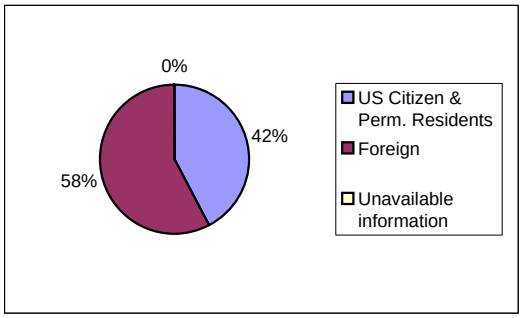
Gender	#	% (No Decl.)*	%
No. of Postdoctoral Fellows	19		100.0%
Male	16	84.21%	84.2%
Female	3	15.79%	15.8%
Decline to State Gender	0		0.0%



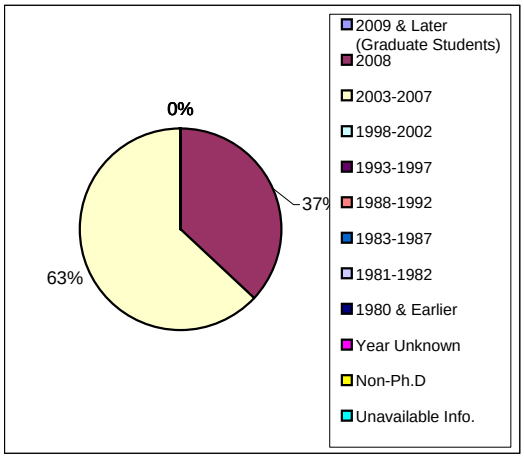
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	5	27.78%	26.3%
Black	0	0.00%	0.0%
Hispanic	1	5.56%	5.3%
Pacific	0	0.00%	0.0%
White	12	66.67%	63.2%
Decline to State Ethnicities	1		5.3%
Unavailable Information	0		0.0%
Total no. of Postdoctoral Fellows	19		100.0%
Minorities	1	5.56%	5.3%



Citizenships	#		%
US Citizen & Perm. Residents	8		42.1%
Foreign	11		57.9%
Unavailable information	0		0.0%
Total no. of Postdoctoral Fellows	19		100.0%
US Citizen	5		26.3%
Perm Residents	3		15.8%
Home Inst. in US	14		73.68%



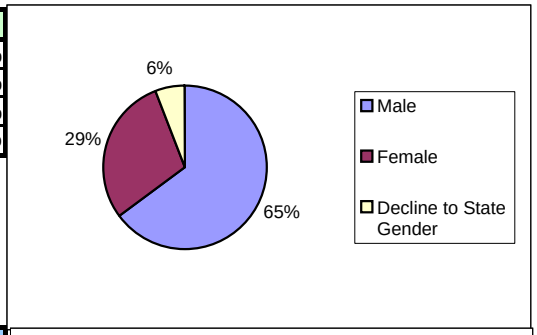
Year of Ph.D	#		%
2009 & Later (Graduate Students)	0		0.0%
2008	7		36.8%
2003-2007	12		63.2%
1998-2002	0		0.0%
1993-1997	0		0.0%
1988-1992	0		0.0%
1983-1987	0		0.0%
1981-1982	0		0.0%
1980 & Earlier	0		0.0%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	19		100.0%



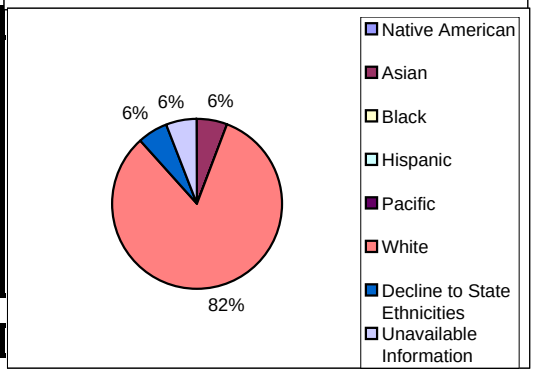
**Statistic Calculation based on all participants that did not decline.*

Algebraic Geometry Program Associate (Graduate Student) Summary

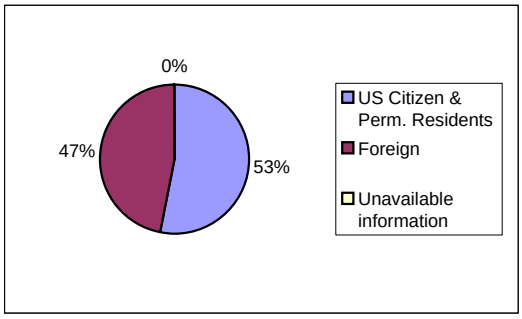
Gender	#	% (No Decl.)*	%
No. of Program Associates (GS)	17		100.0%
Male	11	68.75%	64.7%
Female	5	31.25%	29.4%
Decline to State Gender	1		5.9%



Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	1	6.67%	6.3%
Black	0	0.00%	0.0%
Hispanic	0	0.00%	0.0%
Pacific	0	0.00%	0.0%
White	14	93.33%	87.5%
Decline to State Ethnicities	1		6.3%
Unavailable Information	1		6.3%
Total no. of Program Associates	17		106.3%
Minorities	0	0.00%	0.0%



Citizenships	#		%
US Citizen & Perm. Residents	9		52.9%
Foreign	8		47.1%
Unavailable information	0		0.0%
Total no. of Program Associates	17		100.0%
US Citizen	9		52.9%
Perm Residents	0		0.0%
Home Inst. in US	14		82.35%



**Statistic Calculation based on all participants that did not decline.*

Complementary Program 2008-09

August 18, 2008 to May 22, 2009

MSRI had a small Complementary Program comprised of two postdoctoral fellows, Chris Hillar (funded by the NSA and MSRI), and Feng Xu , 2 research members, Irwin Kra and Matilde Marcolli, and 1 graduate student, Christopher Severs.

Christopher Hillar had just completed a postdoctoral fellowship at Texas A&M University and was contemplating leaving academia. Bernd Sturmfels alerted us to the fact that Hillar was awarded a Young Investigator grant from the NSA and that given his exceptional talent it would be a loss to the mathematical community if he were to leave mathematics. We took him as a research member in the Complementary program while we administered his grant. It turned out to be one of MSRI's best success stories. In Hillar's own words "…The chance to work at MSRI was life-changing and especially important given my research aspirations in mathematical neuroscience. It is challenging to work at the intersection of these two fields, and I attribute much of my ongoing success to the opportunities, encouragement, and support that MSRI has offered me." Hillar went on to obtain a joint postdoctoral fellowship with MSRI and the Redwood Center for Theoretical Neuroscience at UCB. His mentor, Dr. Bruno Olshausen, is the Redwood Center's director. The Center's goal is to develop mathematical and computational models of the underlying neurobiological mechanisms involved in perception, cognition, learning, and motor function. The scientists collaborate with experimental neuroscience labs in the design of experiments and in the analysis of neural data. It has been a rewarding experience for MSRI to see one of its members branched out so successfully.

Feng Xu was at MSRI for the academic year 2008-09 working with Director Robert Bryant, his mentor. Xu is a differential geometer whose stay at MSRI appears to have been quite prolific has he lists 3 completed papers, and was making serious progress on a fourth. One of his papers, *Pseudo-holomorphic curves in nearly Kahler CP^3*, appeared in the "Differential Geometry and Its Applications" journal. More details on his works while at MSRI can be found in the Postdoctoral Chapter of this annual report.

Postdoctoral Fellow

Complementary Program 2008-09

Christopher Hillar

Christopher received his Ph.D. from Berkeley in 2005 under the supervision of Bernd Sturmfels. His dissertation was titled "Solving Polynomial Systems with Special Structure." In his time at MSRI Christopher worked on applications of compressed sensing to sparse coding with Fritz Sommer at the Redwood Institute for Theoretical Neuroscience. They have submitted their work to a NIPS conference and will be finishing up a journal article in the next month. He has also been collaborating with Lek-Heng Lim at Berkeley on the computational complexity of tensor decompositions. They should also have a paper out in the next few months. Finally, he has been working with Pentti Kanerva and Fritz Sommer on the mathematics underlying a new computational paradigm, "Hyperdimensional Computing." With it, they hope to understand and model complex systems that appear to be turing incompatible. After his stay at MSRI, Christopher went on to the Redwood Center for Theoretical Neuroscience.

Feng Xu

Feng received his Ph.D. from Duke University in 2008 under the supervision of Robert L. Bryant. His dissertation was titled "Harmonic Morphisms with Totally Geodesic Fibers." He was in residence for the entire academic year. He worked on two topics: G_2-structures and G_2 flows, and prescribing generalized Ricci curvatures. He finished a paper joint with Robert Bryant on the first topic. He published a paper titled "Pseudo-holomorphic curves in nearly Kahler CP^3" in Differential Geometry and Its Application. He also submitted another paper to Communications in Analysis and Geometry. He has obtained some interesting results on the second topic and is writing a paper. He also visited Professor Rugang Ye at UCSB for two days and started a colabration on the first topic. After his stay at MSRI, Feng went on to the Australian National University.

Participant List

MSRI Program:

Complementary Program 08/09

August 18, 2008 to May 22, 2009

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Primary Institute	Position
Hillar, Christopher	Texas A & M University	NSF Postdoctoral Fellow
Kra, Irwin	Math for America	Executive Director
Marcolli, Matilde	California Institute of Technology	Faculty/Postdoc
Severs, Christopher	Arizona State University	Graduate Student
Xu, Feng	Duke University	Graduate Student

Complementary Program 2008-09

2008-2009

Program Participant Summary

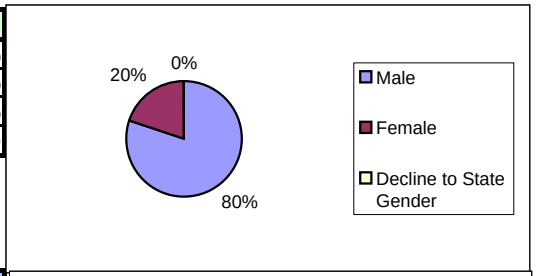
Comlementary Program 08-09	# of Distinct Participants	%	# of Citizens & Perm. Res.	%	# of Female	%	# of Minorities	%
Postdoctoral Fellows	2	*40.0%*	1	*20.0%*	0	*0.0%*	1	*20.0%*
Program Associates	1	*20.0%*	1	*20.0%*	0	*0.0%*	0	*0.0%*
Research Members	0	*0.0%*	0	*0.0%*	0	*0.0%*	0	*0.0%*
Research Professor	2	*40.0%*	2	*40.0%*	1	*20.0%*	0	*0.0%*
Total no. of Distinct Participants	**5**	***100.0%***	**4**	***80.0%***	**1**	***20.0%***	**1**	***20.0%***

Home Institute Grouping

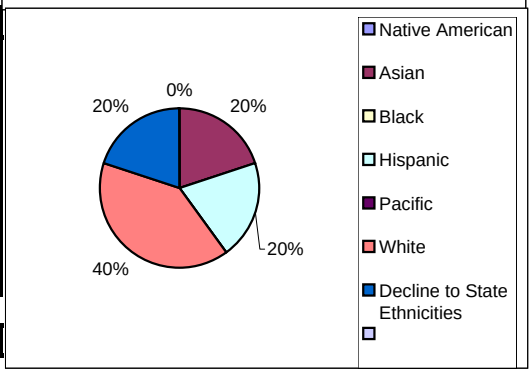
Complementary Program 08-09	I Private	I Public	II	Other	Total
Postdoc	1		1		**2**
Program Associate			1		**1**
Research Member					**-**
Research Professor	1	1			**2**
Total	**2**	**1**	**2**	**-**	**5**
%	***40.0%***	***20.0%***	***40.0%***	***0.0%***	***100.0%***

Complementary Program 2008-09 (All Participants) Demographic Summary

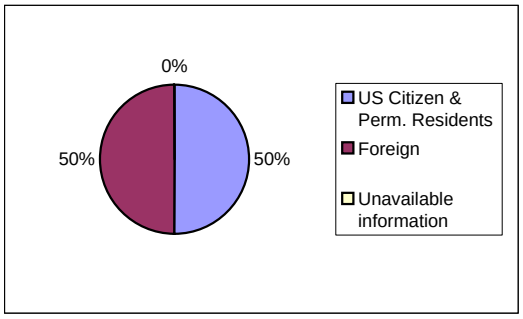
Gender	#	% (No Decl.)*	%
No. of Distinct Participants	5		100.0%
Male	4	80.00%	80.0%
Female	1	20.00%	20.0%
Decline to State Gender	0		0.0%



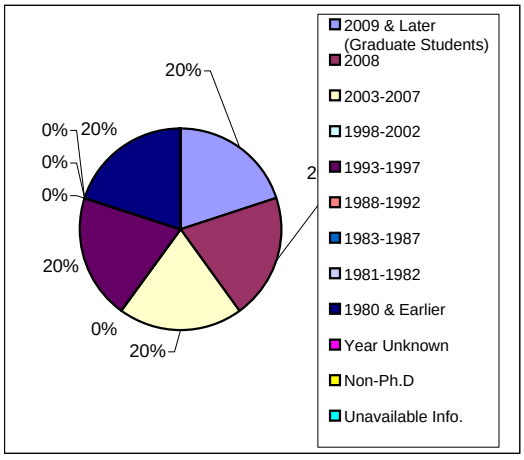
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	1	25.00%	20.0%
Black	0	0.00%	0.0%
Hispanic	1	25.00%	20.0%
Pacific	0	0.00%	0.0%
White	2	50.00%	40.0%
Decline to State Ethnicities	1		20.0%
Unavailable Information	0		0.0%
Total no. of Distinct Participants	5		100.0%
Minorities	1	25.00%	20.0%



Citizenships	#		%
US Citizen & Perm. Residents	4		80.0%
Foreign	4		80.0%
Unavailable information	0		0.0%
Total no. of Distinct Participants	8		160.0%
US Citizen	3		60.0%
Perm Residents	1		20.0%
Home Inst. in US	5		100.00%



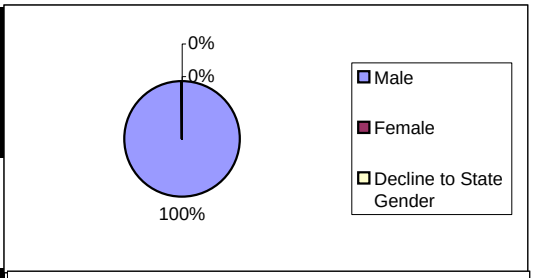
Year of Ph.D	#		%
2009 & Later (Graduate Students)	1		20.0%
2008	1		20.0%
2003-2007	1		20.0%
1998-2002	0		0.0%
1993-1997	1		20.0%
1988-1992	0		0.0%
1983-1987	0		0.0%
1981-1982	0		0.0%
1980 & Earlier	1		20.0%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	5		100.0%



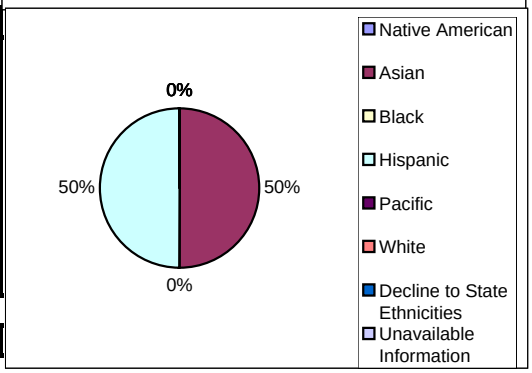
**Statistic Calculation based on all participants that did not decline.*

Complementary Program 2008-09 Postdoctoral Fellow Summary

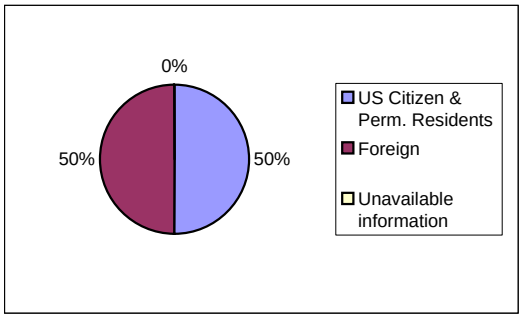
Gender	#	% (No Decl.)*	%
No. of Postdoctoral Fellows	2		100.0%
Male	2	100.00%	100.0%
Female	0	0.00%	0.0%
Decline to State Gender	0		0.0%



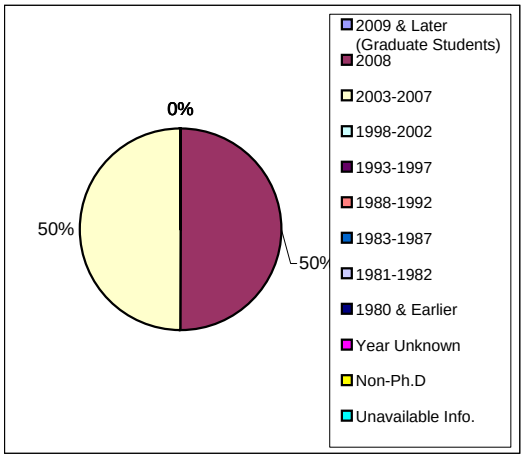
Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	1	50.00%	50.0%
Black	0	0.00%	0.0%
Hispanic	1	50.00%	50.0%
Pacific	0	0.00%	0.0%
White	0	0.00%	0.0%
Decline to State Ethnicities	0		0.0%
Unavailable Information	0		0.0%
Total no. of Postdoctoral Fellows	2		100.0%
Minorities	1	50.00%	50.0%



Citizenships	#		%
US Citizen & Perm. Residents	1		50.0%
Foreign	1		50.0%
Unavailable information	0		0.0%
Total no. of Postdoctoral Fellows	2		100.0%
US Citizen	1		50.0%
Perm Residents	0		0.0%
Home Inst. in US	2		100.00%



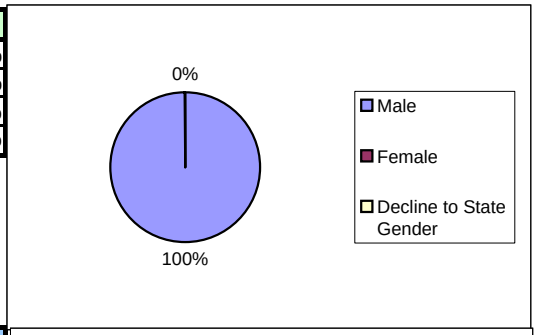
Year of Ph.D	#		%
2009 & Later (Graduate Students)	0		0.0%
2008	1		50.0%
2003-2007	1		50.0%
1998-2002	0		0.0%
1993-1997	0		0.0%
1988-1992	0		0.0%
1983-1987	0		0.0%
1981-1982	0		0.0%
1980 & Earlier	0		0.0%
Year Unknown	0		0.0%
Non-Ph.D	0		0.0%
Unavailable Info.	0		0.0%
Total	2		100.0%



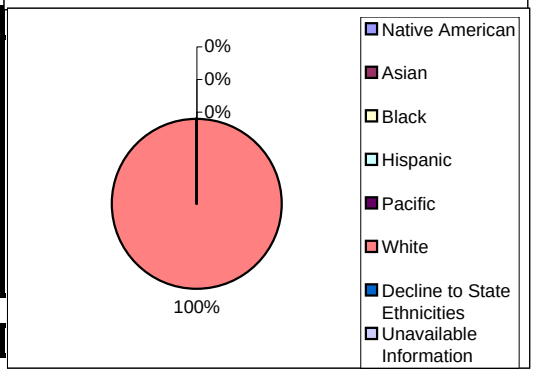
**Statistic Calculation based on all participants that did not decline.*

Complementary Program 2008 -09 Program Associate (Graduate Student) Summary

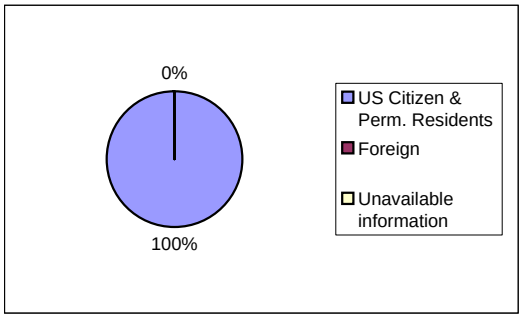
Gender	#	% (No Decl.)*	%
No. of Program Associates (GS)	1		100.0%
Male	1	100.00%	100.0%
Female	0	0.00%	0.0%
Decline to State Gender	0		0.0%



Ethnicities	#	% (No Decl.)*	%
Native American	0	0.00%	0.0%
Asian	0	0.00%	0.0%
Black	0	0.00%	0.0%
Hispanic	0	0.00%	0.0%
Pacific	0	0.00%	0.0%
White	1	100.00%	100.0%
Decline to State Ethnicities	0		0.0%
Unavailable Information	0		0.0%
Total no. of Program Associates	1		100.0%
Minorities	0	0.00%	0.0%



Citizenships	#		%
US Citizen & Perm. Residents	1		100.0%
Foreign	0		0.0%
Unavailable information	0		0.0%
Total no. of Program Associates	1		100.0%
US Citizen	1		100.0%
Perm Residents	0		0.0%
Home Inst. in US	1		100.00%



**Statistic Calculation based on all participants that did not decline.*

REPORT ON THE CONFERENCE “MODULAR FORMS AND ARITHMETIC”

FRANK CALEGARI, SAMIT DASGUPTA, BJORN POONEN, AND RICHARD TAYLOR

This is a report on the conference “Modular forms in arithmetic” held June 28 to July 2, 2008 at the University of California, Berkeley and the Mathematical Sciences Research Institute. The conference consisted of 17 lectures by international experts in arithmetic geometry, with a focus on aspects connected with automorphic forms and Galois representations.

It opened with a pair of colloquium-style lectures, which, as intended, attracted not only the conference participants but also a broader audience from around the San Francisco Bay Area. First, Barry Mazur spoke on Ribet’s construction of abelian extensions via the Galois representations attached to modular forms, and how its modern interpretation in terms of *familie*s of Galois representations connects to current research. Second, Kevin Buzzard gave a very general lecture on the role of modularity of elliptic curves in the proof of Fermat’s last theorem, and explained the larger picture to which this conjecturally belongs.

These two lectures placed many of the later lectures in context. For instance, Mazur’s lecture set the stage for Samit Dasgupta’s lecture on the weak Gross-Stark conjecture and Jo¨el Bella¨ıche’s lecture on extensions of p-adic Galois representations.

Other lectures covered current research on the geometry of Shimura varieties (Mark Kisin on the $\mathbb{F}_p$-points, Elena Mantovan on integral models of compactifications), the insufficiency of known cohomological obstructions for explaining non-existence of rational points on varieties (Bjorn Poonen), Rebolledo’s use of supersingular elliptic curves to prove some results towards uniform bounds for non-surjectivity of Galois representations associated to elliptic curves over $\mathbb{Q}$ (Lo¨ıc Merel), some partial results towards a function field Lang-Trotter conjecture (Nicholas Katz), the rigid p-adic geometry of modular curves (Robert Coleman), a conjectural strengthening of the Jacquet-Langlands correspondence that sees torsion (Frank Calegari), torsion points on abelian varieties (Matthew Baker), a new functor from representations to (φ, Γ)-modules (Marie-France Vign´eras), the interplay between ramification subgroups and finite subgroups of complex Lie groups arising in the local Langlands correspondence (Benedict Gross), and speculations on Kolyvagin’s old ideas that give (perhaps overly optimisitic) hope for a proof of the Birch

and Swinnerton-Dyer conjecture for elliptic curves over Q with analytic rank greater than 1 (William Stein). Two of the speakers, David Helm and Matthew Emerton discovered as a result of the

conference that they were working on the same problem, extending the mod ℓ local Lang-lands correspondence to representations over an Artinian ring instead of just a field. Because the collaboration between Helm and Emerton is a striking concrete example of the success of the conference, we asked Helm to write a short but detailed summary of their work. He writes:

> Both Matthew Emerton's research and my own centered on the question of making the local Langlands correspondence for $GL(2)$ work in families. That is, given a p-adic family of two-dimensional representations of the Galois group of a local field F, we sought a natural way of associating a p-adic family of admissible representations of $GL_2(F)$, in a way that induced the classical local Langlands correspondence on points of the two families.
>
> Neither of us managed to achieve this goal independently, but Emerton was able to show that given a family ρ of Galois representations, there was at most one family π of admissible representations satisfying a short list of properties that one would expect if π and ρ were related by local Langlands. He was not able to show that such a π always existed, however. Meanwhile, I had independently taken a more constructive approach, via deformation theory. My approach was able to associate a π to every ρ, but my construction was very *ad hoc*, and I was unable to find a convincing way of showing that the π I constructed was the "right" one.
>
> Emerton and I only became aware of each other's work when the conference abstracts were posted; we soon found that our work dovetailed perfectly — his result uniquely characterised the families π I constructed, and my construction proved his conjecture that a π satisfying his properties always existed.

Finally, we note that the extended breaks between lectures gave ample opportunities for interaction between participants. Several junior participants commented to us afterwards that they appreciated the opportunity to meet

and discuss mathematics with the leaders in the field. For instance, one student mentioned that, through talking to Barry Mazur during the breaks at the conference, she learned an idea that would let her circumvent a mathematical obstacle she was facing in the writing of her dissertation.

Workshop Summary for CMI/MSRI Workshop: Modular Forms and Arithmetic

Held: June 28 to July 2, 2008

The Mathematical Sciencs Research Institute

Participant Information
134 participants

Gender (n = 134 participants)		
Male	78.36%	105
Female	21.64%	29
Declined to state	0.00%	0

Ethnicity (n = 91 participants)		
White	37.31%	50
Asian	14.93%	20
Hispanic	2.99%	4
Pacific Islander	0.00%	0
Black	1.49%	2
Native American	0.00%	0
Declined to state	11.19%	15

CMI/MSRI Workshop: Modular Forms and Arithmetic

Invited Speakers

Bellaiche, Joel	Columbia University
Buzzard, Kevin	Imperial College, London
Mazur, Barry	Harvard University
Gross, Benedict H.	Harvard University
Stein, William Arthur	University of Washington
Coleman, Robert	UC Berkeley
Katz, Nicholas	Princeton University
Mantovan, Elena	California Institute of Technology
Baker, Matthew Howard	Georgia Tech
Kisin, Mark	University of Chicago
Helm, David	University of Texas
Urban, Eric	Columbia University
de Jong, Johan	Columbia University
Lenstra, Hendrik W.	Universiteit Leiden
Merel, Loic	Institut de Mathématiques de Jussieu
Vigneras, Marie-France	Université de Paris 7
Emerton, Matthew James	Northwestern University

CMI/MSRI Workshop: Modular Forms and Arithmetic Schedule		
Saturday June 28, 2008		
08:30AM - 09:00AM	Coffee and Registration at UCB North Gate Hall	
09:00AM - 09:10AM	Introduction	
09:10AM - 10:10AM	Barry Mazur	Construction of abelian extensions following Ken Ribet
10:10AM - 10:30AM	Morning Break	
10:30AM - 11:30AM	Kevin Buzzard	Ken Ribet and Fermat's Last Theorem
11:30AM - 02:00PM	Lunch	
02:00PM - 03:00PM	Nicholas Katz	Lang-Trotter revisited, and lower bounds for Frobenius traces
03:00PM - 04:00PM	Afternoon Tea	
04:00PM - 05:00PM	Mark Kisin	Shimura varieties mod p
Sunday June 29, 2008		
08:30AM - 09:00AM	Coffee	
09:00AM - 10:00AM	Marie-France Vigneras	A functor from smooth O_L-torsion representations to (φ, Γ)-modules
10:00AM - 10:30AM	Morning Break	
10:30AM - 11:30AM	David Helm	On l-adic families of admissible representations of $GL_2(Q_p)$
11:30AM - 02:00PM	Lunch	
02:00PM - 03:00PM	William Stein	Kolyvagin's Approach to the Birch and Swinnerton-Dyer Conjecture
03:00PM - 04:00PM	Afternoon Tea	
04:00PM - 05:00PM	Benedict Gross	Ramification theory and nite subgroups of Lie groups
Monday June 30, 2008		
09:00AM - 10:00AM	Matthew Emerton	Level lowering for p-adic modular forms
10:00AM - 10:30AM	Morning Break	
10:30AM - 11:30AM	Bjorn Poonen	Cohomological obstructions to rational points
Tuesday July 1, 2008		
09:00AM - 10:00AM	Frank Calegari	Towards a Torsion Jacquet-Langlands Correspondence for GL(2)
10:00AM - 10:30AM	Morning Break	
10:30AM - 11:30AM	Samit Dasgupta	Ribet's converse to Herbrand and the weak Gross-Stark conjecture
11:30AM - 02:00PM	Lunch	
02:00PM - 03:00PM	Joel Bellaiche	Non trivial extensions of p-adic Galois representations that are trivial at p
03:00PM - 04:00PM	Afternoon Tea	
04:00PM - 05:00PM	Loic Merel	Modular symbols for global fields
07:00PM - 09:00PM	Banquet honoring Ken Ribet on his 60th Birthday (UCB Faculty club)	

Wednesday July 2, 2008		
09:00AM - 10:00AM	Robert Coleman	Wide Open Spaces
10:00AM - 10:30AM	Morning Break	
10:30AM - 11:30AM	Elena Mantovan	Integral models for toroidal compactications of Shimura varieties
11:30AM - 02:00PM	Lunch	
02:00PM - 03:00PM	Matthew Baker	Torsion points on abelian varieties
03:00PM - 04:00PM	Afternoon Tea	

Currently Available Videos

- **Barry Mazur** , Construction of abelian extensions following Ken Ribet *June 28,2008, 09:10 AM to 10:10 AM*
- **Kevin Buzzard** , Ken Ribet and Fermat's Last Theorem *June 28,2008, 10:30 AM to 11:30 AM*
- **Nicholas Katz** , Lang-Trotter revisited, and lower bounds for Frobenius traces *June 28,2008, 02:00 PM to 03:00 PM*
- **Mark Kisin** , Shimura varieties mod p *June 28,2008, 04:00 PM to 05:00 PM*
- **Marie-France Vigneras** , A functor from smooth OL-torsion representations to (φ, Γ)-modules *June 29,2008, 09:00 AM to 10:00 AM*
- **David Helm** , On l-adic families of admissible representations of GL2(Qp) *June 29,2008, 10:30 AM to 11:30 AM*
- **William Stein** , Kolyvagin's Approach to the Birch and Swinnerton-Dyer Conjecture *June 29,2008, 02:00 PM to 03:00 PM*
- **Benedict Gross** , Ramification theory and finite subgroups of Lie groups *June 29,2008, 04:00 PM to 05:00 PM*
- **Matthew Emerton** , Level Lowering of p-adic Modular Forms *June 30,2008, 09:00 AM to 10:00 AM*
- **Bjorn Poonen** , Cohomological Obstructions to Rational Points. *June 30,2008, 10:30 AM to 11:30 AM*
- **Frank Calegari** , Towards a Torsion Jacquet_Langlands Correspondence for GL(2) *July 1,2008, 09:00 AM to 10:00 AM*
- **Samit Dasgupta** , Ribet's Converse to Herbrand and the Weak Gross-Stark Conjecture. *July 1,2008, 10:30 AM to 11:30 AM*
- **Joel Bellaiche** , Non Trival Extensions of p-adic Galois Representations that are Trival at p. *July 1,2008, 02:00 PM to 03:00 PM*
- **Loic Merel** , Modular Symbols for Global Fields *July 1,2008, 04:00 PM to 05:00 PM*
- **Robert Coleman** , Wide Open Spaces *July 2,2008, 09:00 AM to 10:00 AM*
- **Elena Mantovan** , Integral Models for Toroidal Compactications of Shimura Varieties. *July 2,2008, 10:30 AM to 11:30 AM*
- **Matthew Baker** , Torsion Points on Abelian Varieties *July 2,2008, 02:00 PM to 03:00 PM*

Participant List

MSRI Workshop:

CMI/MSRI Workshop: Modular Forms and Arithmetic

June 28 to July 2, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Achter, Jeffrey D.	Participant	Colorado State University
Adibhatla, Rajender	Invited Participant/ CLAY	University of Sheffield
Agarwal, Mahesh Kumar	Invited Participant	McMaster University
Agashe, Amod Sadanand	Invited Participant	Florida State University
Agboola, Adebisi	Participant	UC Santa Barbara
Allotta, Jeff	Invited Participant	Northwestern University
Arnold, Trevor	Participant	University of Washington
Baker, Matthew Howard	Speaker/ CLAY	Georgia Tech
Bakhova, Maiia Jurevna	Participant	Louisiana State University
Baran, Burcu	Participant	Universita' di Roma
Bellaiche, Joel	Speaker/ CLAY	Columbia University
Brown, Jim	Invited Participant/ CLAY	California Institute of Technology
Brumer, Armand	Participant	Fordham University
Buhler, Joe P.	Participant	CCR
Busuioc, Cecilia	Invited Participant/ CLAY	Boston University
Buzzard, Kevin	Speaker/ CLAY	Imperial College
Calegari, Frank	Organizer/ CLAY	Northwestern University
Cardon, David A.	Participant	Brigham Young University
Cheng, Yuan-You	Participant	Wakeforest University
Choi, Suh Hyun	Invited Participant/ CLAY	Harvard University
chung, min i	Participant	not available
Citro, Craig Louis	Participant	UCLA
Coleman, Robert	Speaker/ CLAY	UC Berkeley
Conrad, Brian David	Invited Participant	Stanford University
Dasgupta, Samit	Organizer/ CLAY	Harvard University
de Jong, Johan	Speaker/ CLAY	Columbia University
Dembele, Lassina	Invited Participant	University of Duisburg-Essen
Dewar, Michael Patrick	Invited Participant/ CLAY	University of Illinois at Urbana-Champaign
Dieulefait, Luis Victor	Invited Participant	Harvard University
El-Guindy, Ahmad	Participant	Texas A&M University
Elkin, Arsen	Participant	Colorado State University
Ellenberg, Jordan	Participant	University of Wisconsin
Ellwood, David A.	Organizer	Boston University
Emerton, Matthew James	Speaker/ Clay	Northwestern University
Eriksson, Dennis	Participant	Tokyo University
Fité, Francesc	Invited Participant/ CLAY	Universitat Politècnica de Catalunya
Freeman, David	Participant	UC Berkeley
Fried, Michael D.	Invited Participant	UC Irvine
Fuchs, Elena D	Invited Participant/ CLAY	Princeton University
Garton, Derek William	Invited Participant/ CLAY	University of Wisconsin
Ghitza, Alexandru Edgar	Participant	Colby College
Greicius, Aaron	Participant	UC Berkeley
Gross, Benedict H.	Speaker/ CLAY	Harvard University
Gruendken, Linda Meike	Invited Participant	University of Pennsylvania
Guitart, Xavier	Invited Participant/ CLAY	Universitat Politècnica de Catalunya
Hagedorn, Tom	Participant	The College of New Jersey
Harby, John	Participant	not available
Hartshorne, Robert	Participant	UC Berkeley
Helm, David	Speaker/ CLAY	University of Texas
Ishikawa, Muriel Y.	Participant	not available
Jetchev, Dimitar	Participant	UC Berkeley
Jones, Nathan C	Participant	CRM, Universite de Montreal
Katz, Nicholas	Speaker/ CLAY	Princeton University
Kedlaya, Kiran Sridhara	Participant	Massachusetts Institute of Technology
Kharel, Savan	Participant	Indiana University

Kim, Byungchan	Invited Participant/ CLAY	University of Illinois at Urbana-Champaign
Kisin, Mark	Speaker/ CLAY	University of Chicago
Kramer, Ken	Participant	Queens College (CUNY)
Lan, Kai-Wen	Invited Participant	Harvard University
Lang, William E.	Participant	Brigham Young University
Lario, Joan-Carles	Participant	Universitat Politècnica de Catalunya
Lenstra, Hendrik W.	Speaker/ CLAY	Universiteit Leiden
Li, Wen-Ch'ing Winnie	Participant	Penn State University
Ling, Jie	Invited Participant	University of Wisconsin - Madison
Liu, Tong	Invited Participant/ CLAY	University of Pennsylvania
Long Hoelscher, Jing	Participant	University of Arizona
Long, Ling	Participant	Iowa State University
Luu, Martin	Invited Participant/ CLAY	Princeton University
Lyo, Grace	Invited Participant	Massachusetts Institute of Technology
Lyons, Christopher	Invited Participant	California Institute of Technology
Mantilla, Guillermo Arturo	Participant	University of Wisconsin - Madison
Mantovan, Elena	Speaker/ CLAY	California Institute of Technology
Mayer, Hartwig	Invited Participant	Humboldt University of Berlin
Mazur, Barry	Speaker/ CLAY	Harvard University
McCallum, William Gordon	Participant	University of Arizona
McMurdy, Ken	Participant	Ramapo College of New Jersey
Merel, Loic	Speaker/ CLAY	Institut de mathematiques de Jussieu
Mohamed, Moustafa Ibrahim Moustafa	Participant	University of Warwick
Molina Blanco, Santiago	Invited Participant	Universitat Politecnica de Catalunya
Nicole, Marc-Hubert	Invited Participant	Institut de mathematiques de Jussieu
Niziol, Wieslawa	Participant	University of Utah
Olsson, Martin	Participant	UC Berkeley
Omar, Sami	Participant	University of Tunis
Ono, Ken	Participant	University of Wisconsin
Ozman, Ekin	Invited Participant	University of Wisconsin
Pakingan, Bryan	Participant	UC Berkeley
Papaioannou, Athanasios	Invited Participant	University of Chicago
Park, Jae-Young	Participant	UC Berkeley
Paulin, Alexander	Participant	Imperial College
Poonen, Bjorn	Organizer	UC Berkeley
Prasad, Dipendra	Invited Participant	Tata Institute of Fundamental Research
Raygoza, Isabela	Participant	not available
Reeder, Mark	Participant	Boston College
Ribet, Kenneth A.	Participant	UC Berkeley
Robert, Francesc Creixell	Participant	Universitat Politecnica de Catalunya
Satriano, Matt	Participant	Stanford University
Schein, Michael M.	Invited Participant	Hebrew University of Jerusalem
Schoof, Rene'	Participant	Universita' di Roma
Schuett, Matthias	Invited Participant	Harvard University
Sengun, Mehmet Haluk	Invited Participant	University of Wisconsin
Seo, Soogil	Participant	Yonsei university
Shahriyari, Leili	Participant	Johns Hopkins University
Shin, Sug Woo	Invited Participant	Harvard University
Silverberg, Alice	Invited Participant	UC Irvine
Spencer, Mark	Participant	Springer
Stein, William Arthur	Speaker/ CLAY	University of Washington
Sun, Shenghao	Participant	UC Berkeley
Takloo-Bighash, Ramin	Invited Participant	UIC
Tan, Fucheng	Invited Participant	Massachusetts Institute of Technology
Tate, John	Participant	University of Texas
Taylor, Richard Lawrence	Organizer	Harvard University
Tornaría, Gonzalo	Participant	Facultad de Ciencias
Trifkovic, Mak	Participant	University of Victoria
Tsaknias, Panagiotis	Participant	University of Sheffield
Turkelli, Seyfi	Invited Participant	University of Wisconsin
Upton, Margaret	Participant	Texas A&M University

Urban, Eric	Speaker/ CLAY	Columbia University
Van Luijk, Ronald Martinus	Invited Participant	Warwick University
Van Order, Jeanine Marie	Invited Participant	University of Cambridge
Varilly, Anthony	Participant	UC Berkeley
Vega, Maria Valentina	Invited Participant	Texas A&M University
Vigneras, Marie-France	Speaker/ CLAY	Université de Paris 7 (Diderot)
Vincent, Christelle	Invited Participant	University of Wisconsin
Voight, John Michael	Invited Participant	University of Vermont
Walji, Nahid	Participant	California Institute of Technology
Weigandt, James Emmanuel	Participant	Purdue University
Weinert, Andreas Victor	Invited Participant	University of Edinburgh
Weinstein, Jared	Invited Participant	UCLA
Wong Kew, Rich	Participant	Presidential Postdoctoral Fellows and Research Scientists
Wood, Victoria Y. H.	Participant	UC Berkeley
Yazdani, Soroosh	Invited Participant	McMaster University
Yoo, Hwajong	Participant	UC Berkeley
Zhu, Hui June	Participant	State University of New York (SUNY) at Buffalo

REPORT FOR MSRI WORKSHOP ON “LOW-DIMENSIONAL TOPOLOGY”

ORGANIZERS: ELISENDA GRIGSBY, ROB SCHNEIDERMAN,
PETER TEICHNER AND KEVIN WALKER

In recent years, low-dimensional topology and geometry has experienced a tremendous new impetus, owing in part to new-found interactions with a broad array of other mathematical areas. These recent developments have shed light on classical topics in low-dimensional topology, including 3-manifold topology, 4-manifold topology, and knot theory. Our workshop at MSRI focused on some of these developments, with special emphasis on following 3 interlocking themes:

- 4-dimensional manifolds
- Lefschetz fibrations
- Heegaard Floer Homology

The current vitality of low-dimensional topology was reflected in the enthusiastic turnout for this workshop, with about 200 registered participants, from institutions in 15 countries.

Each morning two lectures were given on the most exciting current research, whereas the afternoon lectures were given in a survey style, followed by panel discussions. These discussions on more focused topics were a successful attempt to let graduate students eavesdrop on a conversation among leading experts on topics that are not yet fully understood.

Some highlights of the results presented include: Cliff Taubes on Seiberg-Witten equations and dynamics of vector fields on 3-manifolds; Mike Freedman’s proposed construction of quantum characteristic classes; work of Vidussi and Friedl relating twisted Alexander polynomials, fibered 3-manifolds, and the Thurston norm; Anna Beliakova’s extension of Witten-Reshetikhin-Turaev invariants to rational homology 3-spheres; applications of sutured Floer homology to the uniqueness question for Seifert surfaces by Andras Juhasz; Slava Krushkal’s update on topological surgery in dimension 4; Cochran, Harvey, and Leidy’s refined applications of higher order Blanchfield duality to the n-solvable filtration of the classical knot concordance group; and several different approaches to the big picture via catagorification given by Sergei Gukov, Dror Bar-Natan, Ko Honda, and Mikhail Khovanov.

The topics of the afternoon discussion panels, mirroring the most important developments in each area were as follows.

The first panel, led by Ron Stern, and including Ron Fintushel, Anar Akhmedov, Inanc Baykur, and Jongil Park, focused on “small” 4-manifolds. One fundamental challenge in 4-manifold topology is to find exotic smooth structures on simply-connected 4-manifolds, including the last remaining open case of the Poincar´e

conjecture. The first major breakthrough on this problem in recent years was due to Donaldson who, in the mid-eighties, showed that there are exotic smooth structures on the simply-connected 4-manifold $X = CP^2 \# 9\overline{CP}^2$. The second Betti number

of X is still quite large (10), and it is an important challenge to find exotic structures on 4-manifolds with smaller second Betti number. The case where $b2 = 0$ is the smooth 4-dimensional Poincar´e conjecture, the last remaining case of the generalized Poincar´e conjecture and perhaps the most famous open problem in low-dimensional topology. By the end of the 80's, Donaldson's result was improved to $b2 = 9$ but, despite dizzying progress in gauge theory and keen interest in the question, $b2 = 9$ remained the best result until 2004, when the result was improved to $b2 = 8$, then 7, and then 6. Very recently there have been claims laid to simply-connected examples with $b2 = 5$, 4 and 3, as well as exotic structures on a non-simply-connected homology $S^2 \times S^2$ ($b2 = 2$).

A broken Lefschetz fibration is a map from a smooth 4-manifold to S^2 whose only singularities are complex Morse singularities and indefinite fold singularities along circles. Such structures provide a new and promising viewpoint on the study of smooth oriented 4-manifolds. The survey talk of Denis Auroux presented recent existence results, wrinkled fibrations, and the conjectured relations between 3-and 4-manifold invariants and the Lagrangian matching invariants of Tim Perutz. Current avenues of research along these lines was elaborated upon during the panel discussion, which also included David Gay, Yanki Lekili, and Inanc Baykur.

Heegaard Floer homology is an invariant for knots, 3-manifolds, and 4-manifolds which was constructed with the aim of understanding smooth 4-manifold invariants. With the help of 4-dimensional techniques, it is shown that the resulting knot invariant (knot Floer homology) detects the genus of knots in 3-space, as well as the property of a knot of being fibered. It also gives new proofs of the Milnor conjecture (on the minimal genus of surfaces in the 4-ball bounding torus knots) and Donaldson's famous results concerning exotic structures on 4-manifolds. Although the original definition of Heegaard Floer homology in in terms of counts of certain holomorphic disks, we've known for the past year that there are combinatorial descriptions of many aspects of the theory, as well as new connections with contact topology of the 3-sphere.

Peter Ozsvath's afternoon survey talk on Heegaard Floer homology was followed by a series of "elevator statements" (short summararies of current work) given by active researchers in the field:

Andras Stipsicz, Renyi Institute, Budapest, "HF Contact invariant and applications"

Thomas Mark, University of Virginia, "Computing HF 4-manifold invariants"

Robert Lipshitz, Columbia University, "HF for 3-manifolds with parameterized boundary"

Matthew Hedden, MIT, "Applications of HF to Knot concordance questions"

Elisenda Grigsby/Stephan Wehrli, Columbia University, "Relationship to Khovanov homology"

Joan Licata, Stanford University, "HF link homology and the Thurston norm"

There was also a panel on the history of low dimensional topology, including Mike Freedman, Bob Edwards, and Ron Stern, lead by the afternoon speaker (and birthday boy) Rob Kirby, whose talk described the origins and development of the calculus of framed links, which has continued to play a workhorse role in many

3-and 4-dimensional constructions. This panel turned out to provide a valuable service to young researchers in the form of well-informed advice, and perspective on the varieties of mathematical experience.

Workshop Summary for Low Dimensional Topology

Held: August 11 to August 15, 2008

The Mathematical Sciencs Research Institute

Participant Information
209 participants

Gender (n = 209 participants)		
Male	79.43%	166
Female	20.10%	42
Declined to state	0.48%	1

Ethnicity (n = 186 participants)		
White	61.72%	129
Asian	13.88%	29
Hispanic	3.35%	7
Pacific Islander	0.96%	2
Black	1.91%	4
Native American	0.48%	1
Declined to state	6.70%	14

Low Dimensional Topology

Invited Speakers

Auroux, Denis	Massachusetts Institute of Technology
Bar-Natan, Dror	University of Toronto
Beliakova, Anna	University of Zurich
Freedman, Michael H	Microsoft
Gukov, Sergei	UC Santa Barbara
Honda, Ko	University of Southern California
Juhasz, Andras	Princeton University
Khovanov, Mikhail	Columbia University
Krushkal, Slava	University of Virginia
Leidy, Constance	Wesleyan University
Ozsvath, Peter Steven	Columbia University
Stern, Ronald J.	UC Berkeley
Szabo, Zoltan I.	Princeton University
Taubes, Clifford	Harvard University

Low Dimensional Topology Schedule		
Monday August 11, 2008		
09:30AM - 10:30AM	Michael Freedman	Towards quantum characteristic classes
11:00AM - 12:00PM	Stefano Vidussi	Twisted Alexander polynomials and fibrations of 3-manifolds
01:30PM - 02:30PM	Ronald Stern	4-manifolds, big and small
02:30PM - 03:00PM	Small 4-Manifold Panel	
04:30PM - 09:00PM	Picnic at Codornices Park	
Tuesday August 12, 2008		
09:30AM - 10:30AM	Sergei Gukov	Knot Homologies via Instanton Counting
11:00AM - 12:00PM	Dror Bar-Natan	Projectivization, W-Knots, Kashiwara-Vergne and Alekseev-Torossian
01:30PM - 02:30PM	Denis Auroux	Broken Lefschetz fibrations on smooth 4-manifolds
02:30PM - 03:00PM	Lefschetz Fibration Panel	
06:00PM - 10:00PM	Pizza, Beer, Poker and Music in 1015 Evans	
Wednesday August 13, 2008		
09:30AM - 10:30AM	Ko Honda	Contact structures, Heegaard Floer homology and triangulated categories
11:00AM - 12:00PM	Anna Beliakova	Unified Witten-Reshetikhin-Turaev invariants of rational homology 3-spheres
01:30PM - 02:30PM	Robion Kirby	The origin of the calculus (not Newton's)
02:30PM - 03:00PM	History Panel	
08:00PM - 10:00PM	Rob Schneiderman	Anna's Jazz Island in Berkeley
Thursday August 14, 2008		
09:30AM - 10:30AM	Mikhail Khovanov	Categorification of quantum groups
11:00AM - 12:00PM	Andras Juhasz	Sutured Floer homology and Seifert surfaces
01:30PM - 02:30PM	Peter Ozsvath	Heegaard Floer homology
02:30PM - 03:00PM	Heegaard Floer Panel	
06:30PM - 10:30PM	Banquet at International House	
Friday August 15, 2008		
09:00AM - 10:00AM	Slava Krushkal	4-manifolds and the A-B slice problem
10:15AM - 11:15AM	Constance Leidy	Knot Concordance and Higher-Order Blanchfield Duality
11:30AM - 12:30PM	Clifford Taubes	The Seiberg-Witten equations and dynamics of vector fields in dimension 3

Currently Available Videos

- **Michael Freedman** , Towards Quantum Characteristic Classes *August 11,2008, 09:30 AM to 10:30 AM*
- **Stefano Vidussi** , Twisted Alexander Polynomials and Fibrations of 3-manifolds *August 11,2008, 11:00 AM to 12:00 PM*
- **Ronald Stern** , 4-manifolds, Big and Small *August 11,2008, 01:30 PM to 02:30 PM*
- **Sergei Gukov** , Knot Homologies via Instanton Counting *August 12,2008, 09:30 AM to 10:40 AM*
- **Dror Bar-Natan** , Projectivization, W-Knots, Kashiwara-Vergne and Alekseev-Torossian *August 12,2008, 11:00 AM to 12:00 PM*
- **Denis Auroux** , Broken Lefschetz fibrations on smooth 4-manifolds *August 12,2008, 01:30 PM to 02:30 PM*
- **Ko Honda** , Contact structures, Heegaard Floer homology and triangulated categories *August 13,2008, 09:30 AM to 10:30 AM*
- **Anna Beliakova** , Unified Witten-Reshetikhin-Turaev invariants of rational homology 3-spheres *August 13,2008, 11:00 AM to 12:00 PM*
- **Robion Kirby** , The origin of the calculus (not Newton's) *August 13,2008, 01:30 PM to 02:30 PM*
- **Mikhail Khovanov** , Categorification of quantum groups *August 14,2008, 09:30 AM to 10:30 AM*
- **Andras Juhasz** , Sutured Floer homology and Seifert surfaces *August 14,2008, 11:00 AM to 12:00 PM*
- **Peter Ozsvath** , Heegaard Floer homology *August 14,2008, 01:30 PM to 02:30 PM*
- **Slava Krushkal** , 4-manifolds and the A-B slice problem *August 15,2008, 09:00 AM to 10:00 AM*
- **Constance Leidy** , Knot Concordance and Higher-Order Blanchfield Duality *August 15,2008, 10:15 AM to 11:15 AM*
- **Clifford Taubes** , The Seiberg-Witten equations and dynamics of vector fields in dimension 3 *August 15,2008, 11:30 AM to 12:30 PM*

Participant List

MSRI Workshop:

Low Dimensional Topology

August 11 to August 15, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Adeboye, Ilesanmi	Participant	University of Southern California
Agol, Ian	Participant	UC Berkeley
Akhmedov, Anar	Participant	Georgia Tech
Armond, Cody	Invited Participant	Louisiana State University
Atkinson, Christopher	Participant	University of Illinois at Chicago
Auroux, Denis	Speaker	Massachusetts Institute of Technology
Baker, Kenneth Lee	Participant	University of Miami
Baldwin, John	Invited Participant	Princeton University
Bar-Natan, Dror	Speaker	University of Toronto
Barrera, Carlos	Participant	UC Davis
Bauer, Stefan	Participant	Universität Bielefeld
Baykur, Refik Inanc	Participant	Columbia University
Beliakova, Anna	Speaker	University of Zurich
Berke, Allison	Participant	Berkeley/UCSF Joint Graduate Group in Bioengineering
Bigelow, Stephen	Participant	UC Santa Barbara
Biyogmam, Guy Roger	Invited Participant	New Mexico State University
Bloom, Jonathan	Invited Participant	Columbia University
Boden, Hans U.	Participant	McMaster University
Bodenham, Dean	Invited Participant	University of Cape Town
Boerner, Jeffrey	Invited Participant	University of Iowa
Bowden, Jonathan	Invited Participant	Ludwig-Maximilians-University
Bragazzi, Nicola Luigi	Invited Participant	University of Genoa
Brown, Tova	Participant	Massachusetts Institute of Technology
Buck, Dorothy	Participant	Imperial College London
Burke, John R	Invited Participant	Wesleyan University
Cai, Xuanting	Invited Participant	Louisiana State University
Celik Onaran, Sinem	Invited Participant	Middle East Technical University
Cha, Jae Choon	Participant	POSTECH
Cho, Hyunjoo	Invited Participant	University of Rochester
Clark, David Allan	Invited Participant	UC San Diego
Cochran, Tim	Participant	Rice University
Cohen, Moshe	Invited Participant	Louisiana State University
Conant, James	Participant	UC San Diego
Cornwell, Christopher	Invited Participant	Michigan State University
Dasbach, Oliver	Participant	Louisiana State University
Davie, Emille Kennae	Note Taker	UC Santa Barbara
Deng, Wei	Invited Participant	Washington University in St. Louis
Doria, Celso Melchiades	Participant	Michigan State University
Dreyer, Renaud	Participant	Apple Inc.
Dunfield, Nathan M	Participant	University of Illinois
Early, Nicholas Joseph	Invited Participant	Louisiana State University
Edmonds, Allan	Participant	Indiana University
Edwards, Robert	Participant	UCLA
Elliott, Andrew	Invited Participant	Rice University
Etgu, Tolga	Participant	Koc University
Etienne, Gallais	Invited Participant	Laboratoire de Mathématiques Jean Leray
Etnyre, John	Participant	Georgia Institute of Technology
Fel'shtyn, Alexander	Participant	University of Szczecin and Boise State University
Fintushel, Ronald A.	Participant	Michigan State University
Freedman, Michael H	Speaker	Microsoft
Friedl, Stefan	Invited Participant	university of Warwick
Frohman, Charles	Participant	University of Iowa
Fuller, Terry	Participant	California State University, Northridge
Gay, David Thomas	Participant	University of Cape Town

Ghiggini, Paolo	Participant	California Technical Institute
Gilmer, Patrick Meriwether	Participant	Louisiana State University
Gilmore, Allison	Invited Participant	Columbia University
Gordon, Cameron M.	Participant	University of Texas at Austin
Gospodinov, Georgi Donev	Participant	Olin College of Engineering
Grigsby, Eli	Organizer	Columbia University
Gukov, Sergei	Speaker	UC Santa Barbara
Guntel, Brandy	Invited Participant	University of Texas at Austin
Habegger, Nathan	Participant	Université de Nantes
Hambleton, Ian	Participant	McMaster University
Harvey, Shelly	Participant	Rice University
Hass, Joel	Participant	UC Davis
Haydys, Andriy	Participant	Universitaet Bielefeld
Hays, Chris	Invited Participant	Michigan State University
Heck, Prudence	Invited Participant	Indiana University
Hedden, Matthew Edward	Participant	Massachusetts Institute of Technology
Hempel, John P.	Participant	Rice University
Henrich, Allison	Invited Participant	Dartmouth College
Herald, Christopher	Participant	University of Nevada, Reno
Honda, Ko	Speaker	University of Southern California
Horn, Peter D	Invited Participant	Rice University
Huan, Zhen	Participant	Indiana University
Hutchings, Michael L.	Participant	UC Berkeley
Jabuka, Stanislav	Participant	University of Nevada, Reno
Johnson, Jesse	Participant	Yale University
Jubin, Benoit	Participant	UC Berkeley
Juhasz, Andras	Speaker	Princeton University
Kaestner, Aaron	Invited Participant	University of Illinois at Chicago
Kalfagianni, Efstratia	Participant	Michigan State University
Kalman, Tamas	Participant	University of Tokyo
Kania-Bartoszynska, Joanna	Participant	National Science Foundation
Kapovich, Michael	Participant	UC Berkeley
Kawamuro, Keiko	Participant	Rice University
Kearney, Mary Katherine	Invited Participant	Indiana University
Kerckhoff, Steven	Participant	Stanford University
Khovanov, Mikhail	Speaker	Columbia University
Kim, Hee Jung	Participant	Louisiana State University
Kim, Se-Goo	Participant	Kyung Hee University
Kim, Taehee	Participant	Konkuk University
Kirby, Robion C.	Participant	UC Berkeley
Kitayama, Takahiro	Invited Participant	the University of Tokyo
Knapp, Adam	Invited Participant	Michigan State University
Kojima, Sadayoshi	Participant	Tokyo Institute of Technology
Kotschick, Dieter	Participant	LMU University of Munich
Krasner, Daniel	Invited Participant	Columbia University
Kruglov, Volodymyr Volodymyrovich	Participant	Institute for low temperature physics
Krushkal, Slava	Speaker	University of Virginia
Kuno, Yusuke	Invited Participant	University of Tokyo
Kuperberg, Greg	Participant	UC Davis
Kutluhan, Cagatay	Invited Participant	University of Michigan
LaFountain, Doug	Invited Participant	SUNY Buffalo
Lawson, Terry Curtis	Participant	Tulane University
Leidy, Constance	Speaker	Wesleyan University
Lekili, Yanki	Invited Participant	Massachusetts Institute of Technology
Levine, Adam Simon	Invited Participant	Columbia University
Licata, Joan Elizabeth	Participant	Stanford University
Lipshitz, Robert	Participant	Columbia University
Liu, Yi	Participant	UC Berkeley
Livingston, Charles	Participant	Indiana University
Lowrance, Adam	Invited Participant	Louisiana State University
Macasieb, Melissa L	Participant	University of British Columbia

Maher, Joseph M	Participant	Oklahoma State University
Maksymenko, Sergey Ivanovich	Participant	Institute of Mathematics of NAS of Ukraine
Manjarrez-Gutierrez, Fabiola	Invited Participant	UC Davis
Manolescu, Ciprian	Participant	UC Berkeley
Mark, Thomas	Participant	University of Virginia
Martinez-Pedroza, Eduardo	Participant	University of Oklahoma
Matic, Gordana	Participant	University of Georgia
Mattman, Thomas	Participant	California State University Chico
McCarty, Ben	Invited Participant	Louisiana State University
McDougall, Adam Corey	Invited Participant	University of Iowa
McGibbon, Jason	Invited Participant	University of Massachusetts Amherst
Medetogullari, Elif	Invited Participant	Columbia University
Meier, Fabian	Invited Participant	Universität Bielefeld
Melvin, Paul M.	Participant	Bryn Mawr College
Meyers, Anna Lynn	Invited Participant	University of Iowa
Modami, Babak	Invited Participant	Yale University
Molle, Heather Michelle	Invited Participant	University of Iowa
Moore, Marion	Invited Participant	UC Davis
Morrison, Scott	Participant	UC Santa Barbara
Moss, Jason Edward	Invited Participant	Florida State University
Naik, Swatee	Participant	University of Nevada, Reno
Nakamura, Kei	Invited Participant	UC Davis
Neumann, Walter	Participant	Columbia University
Ng, Lenny	Participant	Duke University
Nogueira, João Miguel	Invited Participant	University of Texas at Austin
Obi, Chibueze Nonso	Participant	Gambian Mathematics Society
O'Donnol, Danielle	Invited Participant	Rice University
Ouyang, Chung-Hsing	Participant	California State University, East Bay
Ozbagci, Burak	Participant	Koc University
Ozsvath, Peter Steven	Speaker	Columbia University
Park, B. Doug	Participant	University of Waterloo
Park, Jongil	Participant	Seoul National University
Pelayo, Alvaro	Participant	UC Berkeley
PERIANAN, THANGAVELU	Participant	Aditanar College
Perutz, Tim	Participant	Columbia University
Peters, Thomas David	Invited Participant	Columbia University
Petersen, Kathleen L	Participant	Queen's University
Petit, Jerome	Participant	Tokyo Institute of Technology
Petkova, Tsvetelina	Invited Participant	Columbia University
Pfeiffer, Hendryk	Participant	The University of British Columbia
Radosevich, Mark	Invited Participant	Brandeis University
Rathbun, Matthew	Invited Participant	UC Davis
Rezazadegan, Reza	Invited Participant	Rutgers University
Roberts, Justin	Participant	UC San Diego
Roberts, Lawrence Pierce	Participant	Michigan State University
Ruberman, Daniel	Participant	Brandeis University
Russell, Heather Michelle	Invited Participant	University of Iowa
Saito, Toshio	Participant	Nara Women's University
Sazdanovic, Radmila Tomislav	Invited Participant	The George Washington University
Scharlemann, Martin G.	Participant	UC Berkeley
Schleimer, Saul	Participant	University of Warwick
Schneiderman, Rob	Organizer	Max Planck Institute for Mathematics
Schultens, Jennifer	Participant	UC Davis
Seidel, Paul Alfred	Participant	Massachusetts Institute of Technology
Shirokova, Nadya	Participant	Stanford University
Sibley, Ben	Invited Participant	University of Maryland College Park
Spiska, Stefan	Participant	Universität Bielefeld
Stern, Ronald J.	Speaker	UC Berkeley
Stipsicz, András I.	Participant	Renyi Institute of Mathematics
Suarez Serrato, Pablo	Participant	LMU University of Munich
Sunukjian, Nathan Sarkis	Invited Participant	Michigan State University

Symington, Margaret Fife	Participant	Mercer University
Szabo, Zoltan I.	Speaker	Princeton University
Tange, Motoo	Participant	Kyoto University
Taubes, Clifford	Speaker	Harvard University
Teichner, Peter	Organizer	UC Berkeley
Thurston, Dylan	Participant	Barnard College
Todd, Robert G.	Participant	University of Nebraska Omaha
Torres, Rafael	Invited Participant	Max Planck Institute for Mathematics
Tosun, Bulent	Invited Participant	Middle East Technical University
Upadhyay, Ashish Kumar	Participant	Birla Institute of Technology and Science, Pilani
Usher, Michael J	Participant	University of Georgia
Van Cott, Cornelia Anna	Participant	Indiana University
Van Horn-Morris, Jeremy	Participant	Universite du Quebec a Montreal
Vertesi, Vera	Invited Participant	Alfred Renyi Institute of Mathematics
Vidussi, Stefano	Invited Participant	Kansas State University
Walker, Kevin M	Organizer	Microsoft
Wallace, Steven D.	Invited Participant	Louisiana State University
Wang, Jiajun	Participant	California Technical Institute
Watson, Liam Thomas	Invited Participant	Univertsité du Québec à Montréal
Wehrli, Stephan Martin	Participant	Université de Paris VII (Denis Diderot)
Williams, Jonathan	Invited Participant	University of Texas-Austin
Williams, Michael John	Participant	UC Santa Barbara
Wong Kew, Rich	Participant	Presidential Postdoctoral Fellows and Research Scientists
Wong, Helen	Participant	Bowdoin College
Wu, Enxin	Invited Participant	University of Western Ontario
Yamada, Yuichi	Participant	University of Tokyo
Yilmaz, Elif	Invited Participant	Columbia University
Yun, Ki-Heon	Participant	Sungshin Women's University
Zarev, Rumen	Invited Participant	Columbia University
Zentner, Raphael	Participant	Universitaet Bielefeld
Zhang, Gengyu	Invited Participant	Tokyo Institute of Technology
Zhou, Junjie	Participant	UC Berkeley

Broader Connections Ergodic Theory and Additive Combinatorics
Held at the MSRI, August 21- 29, 2008

Organized By: Ben Green (University of Cambridge), Bryna Kra (Northwestern University), Emmanuel Lesigne (University of Tours), Anthony Quas (University of Victoria), Mate Wierdl (University of Memphis)

The Broader Connections workshop was held August 21–22 2008 to serve as a pre-introduction to the semester's program on Ergodic Theory and Additive Combinatorics. It was immediately followed by the program's first main workshop: An Introduction to Ergodic Theory and Additive Combinatorics (August 25–29 2008).

The goal of the workshop was to set the stage for the remainder of the program, introducing all participants to the basics. Since the program is aimed at researchers coming from a number of different areas (harmonic analysis, combinatorics and ergodic theory), a key aim of the meeting was to establish a common framework for discussion. As the title of the meeting indicates ("Broader Connections" as opposed to the more traditional "Connections for Women"), the workshop was aimed broadly at graduate students and postdocs in the areas of the workshop and closely related research areas as well as more senior women faculty members in nearby research areas. As in other Connections workshops, an important aspect was providing a format that would encourage the formation of connections between researchers, especially female researchers.

The formal part of the workshop consisted of four two-lecture series given by Vitaly Bergelson of the Ohio State University, Izabella aba of the University of British Columbia, Akshay Venkatesh of Stanford University and Tamar Ziegler of the Technion in Haifa, Israel. Of these, Bergelson and Ziegler were coming from an ergodic perspective while aba's work is in harmonic analysis and Venkatesh works on number theory. Each lecturer gave a one-hour lecture on each of the days.

Bergelson's lectures focused on the philosophy of ergodic Ramsey theory: sufficiently rich combinatorial structures have a tendency to be "unbreakable" in the sense that if the structure is finitely partitioned, one of the pieces inherits large scale pieces of the original structure. aba's lectures gave a detailed introduction to the application of harmonic analysis in the subject, focusing on Roth's theorem (one of the early results in additive combinatorics, stating that every sufficiently dense subset of the integers contains three-term arithmetic progressions) and its generalizations. Venkatesh lectured on group actions on homogeneous spaces and illustrated the theory with a discussion of Pell's equation and counting of lattice structures. Ziegler's lectures were on the role of weak-mixing in nonconventional ergodic averages (the ergodic tools underlying the Furstenberg proof of Szemerédi's theorem on arithmetic progressions in dense sets of integers) and the characteristic factors that govern the behavior of these averages.

On the Thursday afternoon, the workshop featured an informal panel discussion entitled "Three things I wish I had known". This was aimed at younger women mathematicians, and students and postdocs more generally. The format for the discussion was that the four panelists introduced themselves and shared their thoughts on things they had learned. The floor was then opened for questions. The panel was moderated by Hélène Barcelo of MSRI and the panelists were Tanya Christensen of the University of Missouri (a member of the Analysis of Singular Spaces program), Bryna Kra of Northwestern University, Malabika Pramanik of the University of British Columbia and Ayşe Şahin of DePaul University. During the discussion, there was a range of interesting questions from the floor covering issues such as collaboration with senior colleagues; broadening one's research interests; how to pick good research questions. On Thursday evening all the women participants at the conference were invited to dinner at a local Chinese restaurant, and 16 people attended.

Overall the workshop was highly successful. The lectures were very well attended with approximately 60(?) people present. Many people commented to the organizers that the quality of exposition was very high.

Workshop Summary for Broader Connections: Ergodic Theory and Additive Combinatorics

Held: August 21 to August 22, 2008

The Mathematical Sciencs Research Institute

Participant Information
81 participants

Gender (n = 81 participants)		
Male	71.60%	58
Female	28.40%	23
Declined to state	0.00%	0

Ethnicity (n = 66 participants)		
White	46.91%	38
Asian	20.99%	17
Hispanic	1.23%	1
Pacific Islander	1.23%	1
Black	0.00%	0
Native American	1.23%	1
Declined to state	9.88%	8

Broader Connections: Ergodic Theory and Additive Combinatorics

Invited Speakers

Bergelson, Vitaly	The Ohio State University
Laba, Izabella	University of British Columbia
Venkatesh, Akshay	New York University, Courant Institute
Ziegler, Tamar D	Technion

Broader Connections: Ergodic Theory and Additive Combinatorics Schedule

Thursday August 21, 2008

0AM - 10:30AM	Vitaly Bergelson	An Introduction to Ideas and Methods of Ergodic Ramsey Theory
10:30AM - 11:00AM	Coffee/Tea	
11:00AM - 12:00PM	Izabella Laba	Harmonic Analysis and Additive Combinatorics
12:00PM - 02:00PM	Lunch	
02:00PM - 03:00PM	Tamar Ziegler	An introduction to characteristic factors in ergodic theory
03:00PM - 03:30PM	Coffee/Tea	
03:30PM - 04:30PM	Akshay Venkatesh	An introduction to homogeneous dynamics
04:30PM - 05:30PM	Panel discussion: Three things I wish I had known	

Friday August 22, 2008

09:30AM - 10:30AM	Vitaly Bergelson	An Introduction to Ideas and Methods of Ergodic Ramsey Theory
10:30AM - 11:00AM	Coffee/Tea	
11:00AM - 12:00PM	Izabella Laba	Harmonic Analysis and Additive Combinatorics
12:00PM - 02:00PM	Lunch	
02:00PM - 03:00PM	Tamar Ziegler	An introduction to characteristic factors in ergodic theory
03:00PM - 04:00PM	Coffee/Tea	
0PM - 05:00PM	Akshay Venkatesh	An introduction to homogeneous dynamics

Currently Available Videos

- **Vitaly Bergelson** , An Introduction to Ideas and Methods of Ergodic Ramsey Theory *August 21,2008, 09:30 AM to 10:30 AM*
- **Izabella Laba** , Harmonic Analysis and Additive Combinatorics *August 21,2008, 11:00 AM to 12:00 PM*
- **Tamar Ziegler** , An introduction to characteristic factors in ergodic theory *August 21,2008, 02:00 PM to 03:00 PM*
- **Akshay Venkatesh** , An introduction to homogeneous dynamics *August 21,2008, 03:30 PM to 04:30 PM*
- **Vitaly Bergelson** , An Introduction to Ideas and Methods of Ergodic Ramsey Theory *August 22,2008, 09:30 AM to 10:30 AM*
- **Izabella Laba** , Harmonic Analysis and Additive Combinatorics *August 22,2008, 11:00 AM to 12:00 PM*
- **Tamar Ziegler** , An introduction to characteristic factors in ergodic theory *August 22,2008, 02:00 PM to 03:00 PM*
- **Akshay Venkatesh** , An introduction to homogeneous dynamics *August 22,2008, 03:30 PM to 04:30 PM*

Participant List

MSRI Workshop:

Broader Connections: Ergodic Theory and Additive Combinatorics

August 21 to August 22, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Ahmadi Dastjerdi, Dawood	Participant	University of Guilan
Allahbakhshi, Mahnaz	Invited Participant	University of Victoria
Beiglböck, Mathias	Participant	Technische Universität Wien
Bergelson, Vitaly	Speaker	Ohio State University
Borenstein, Evan Scot	Participant	Georgia Tech
Breuillard, Emmanue F.	Invited Participant	Ecole Polytechnique
Campbell, James T.	Participant	University of Memphis
Chan, Siu On	Participant	UC Berkeley
Chen, Kuo-Chang	Participant	National Tsing Hua University
Cheng, Yuan-You	Participant	Wakeforest University
Chu, Qing	Invited Participant	Universite Paris-Est Marne-La-Vallee
cook, brian	Participant	University of Georgia
Eisner, Tanja	Participant	University of Tuebingen, Germany
El Houcein, El Abdalaoui	Participant	LMRS, Univ. Rouen
Feldman, Jacob	Participant	UC Berkeley
Foreman, Matthew	Participant	UC Irvine
Green, Ben Joseph	Organizer	University of Cambridge
Hayes, Benjamin Richard	Participant	University of Washington
Hochman, Michael Zvi	Participant	Princeton University
Holtz, Olga	Participant	UC Berkeley
Homma, Kosuke	Participant	University of Texas at Austin
Hosseini, Maryam	Participant	University of Guilan
Hough, Robert	Participant	Stanford University
Hulgan, Jonathan Darren	Participant	University of Memphis
Ismael, BACHY	Participant	Cornell Univeristy
Jean-Francois, BERTAZZON	Participant	IML
Jones, Nathan C	Participant	Universite de Montreal
Kim, Meh-Lit	Participant	not available
Kleinman, Aaron	Participant	UC Berkeley
Kra, Bryna	Organizer	Northwestern University
kukshrestha, manjusha s	Participant	Anand agricultural university
Laba, Izabella	Speaker	University of British Columbia
LaVictoire, Patrick	Participant	UC Berkeley
Le, Thai Hoang	Invited Participant	UCLA
Lesigne, Emmanuel	Organizer	Université François Rabelais
Levin, Alexander	Participant	Massachusetts Institute of Technology
Li, Tianhong	Invited Participant	Chinese Academy of Sciences
Lim, Seonhee	Invited Participant	Cornell Univeristy
Long, Eoin Patrick	Participant	Cambridge University
Lovett, Shachar	Invited Participant	Wiezmann Institute
Lyall, Neil	Participant	University of Georgia
Mathe, Andras	Participant	Eotvos University
Matthiesen, Lilian	Invited Participant	University of Cambridge
McClendon, David Matthew	Participant	Northwestern University
Neale, Vicky	Invited Participant	University of Cambridge
Nedev, Zhivko	Participant	University of Victoria
Oh, Hee	Participant	California Institute of Technology
Pete, Gabor	Participant	University of Toronto
Potgieter, Paul	Participant	not available
Potts, Amanda	Notetaker	Northwestern University
Pramanik, Malabika	Invited Participant	University of British Columbia
Prasad, Vidhu S.	Participant	University of Massachusetts Lowell
Prendiville, Sean	Invited Participant	University of Bristol
Quas, Anthony	Organizer	University of Victoria

Ralston, David	Invited Participant	Rice University
Reimann, Jan	Participant	UC Berkeley
Reyes, Edgar	Participant	Southeastern Louisiana University
Rypdal, Martin Wibe	Participant	University of Tromsoe
Sahin, Ayse Arzu	Invited Participant	DePaul University
Senger, Steven Michael	Participant	University of Missouri
Shparlinski, Igor	Participant	Macquarie University
Simsek, Sevim	Participant	Isik University
Skau, Christian Fredrik	Participant	Norwegian University of Science & Technology(NTNU)
Smorodinsky, Meir	Participant	Tel-Aviv University
So, Wasin	Participant	San Jose State University
Son, Younghwan	Participant	Ohio State University
Spencer, Craig Valere	Participant	Institute for Advanced Study
Stovall, Betsy	Participant	UC Berkeley
Towsner, Henry Piers	Participant	Carnegie Mellon University
Venkatesh, Akshay	Speaker	New York University
Vishe, Pankaj Hemant	Participant	New York University
Wallwater, Aya	Invited Participant	Technion
Wang, Shouhong	Participant	Indiana University
Wang, Zhiren	Participant	Princeton University
Wierdl, Mate	Organizer	University of Memphis
Wong Kew, Rich	Participant	Presidential Postdoctoral Fellows and Research Scientists
Yamazaki, Kazuo	Participant	Stanford University
Zheng, Bowei	Participant	UC Berkeley
Ziegler, Tamar D	Speaker	Technion
Zywina, David	Participant	UC Berkeley

Introduction to Ergodic Theory and Additive Combinatorics
Held at the MSRI, August 21- 29, 2008

Organized By: Ben Green (University of Cambridge), Bryna Kra (Northwestern University), Emmanuel Lesigne (University of Tours), Anthony Quas (University of Victoria), Mate Wierdl (University of Memphis)

This workshop was organized, in connection with the workshop "Broader Connections: Ergodic Theory and Additive Combinatorics" (held the previous week), as an introduction to the semester long research program of the same name. It was designed to be particularly useful to the most junior members of the workshop and semester program.

The aim of the research program "Ergodic Theory and Additive Combinatorics" is to bring together people of different areas of mathematics that have recently enjoyed substantial interaction. These areas include: Additive Combinatorics, Harmonic Analysis, and Ergodic Theory. The main focus of the workshop was mathematical questions on which these three different areas are effective, and related themes were presented from all perspectives. As was noted by many different speakers, the celebrated theorem of Szemerédi (on the existence of arbitrarily long arithmetic progressions in any positive density subset of integers) is the archetype of the richness of this confrontation-collaboration. Terence Tao speaks of Szemerédi's Theorem as "the Rosetta stone between ergodic theory, combinatorics, and Fourier analysis". Reading three different languages discussing the same problem is extremely instructive and gives insight for solving new problems.

Techniques from Harmonic Analysis, Combinatorial Number Theory, and Ergodic Theory have been successively and successfully utilized to prove Szemerédi's theorem and many of its generalizations and improvements: quantitative results; generalization to other types of progressions (such as "polynomial progressions"); sets of zero density (such as the Green-Tao theorem on long arithmetic progressions in prime numbers); higher dimensional results; study of structures other than the integers (such as graphs). Each of these topics was the subject of lectures during the workshop, at a level which allowed newcomers to the fields to understand the basics.

The workshop was built around four mini-courses (unfortunately Hillel Furstenberg, who was the originator of the ergodic theory view-point in this field, was unable to attend due to health reasons). Mini-courses were given by Bernard Host, Ben Green, and Terence Tao. They gave outstanding talks, going from carefully explained basic facts to recent results, with significant information on the proofs. Bernard Host described the appearance and role of "translations on compact quotients of nilpotent Lie groups" in this field; Ben Green gave a comprehensive and fascinating outlook on the proof of Green-Tao theorem; Terence Tao illustrated several different examples of the bridges between "finitary quantitative" and "abstract qualitative" results on existence of configurations, graph properties, and convergence theorems.

Eight more classical research talks were given by specialists of combinatorial number theory (Endre Szemerédi himself), ergodic theory (Nikos Frantzikinakis, Thierry de la Rue, Vitaly Bergelson, Tamar Ziegler and Benjamin Weiss), Fourier analysis (Izabella Laba, Tom Sanders). Moreover, during two Problem Sessions, ten participants (including two post-docs) took the opportunity to ask open challenging questions.

The total number of registered participants was 109, from 12 different countries, including an important proportion of young mathematicians (male and female), PhD students or post-docs. Since most of the talks were really accessible, we believe that most participants benefited from their participation.

The excellent atmosphere, comfort, and organization of MSRI were of great importance in the success of this meeting. The schedule of the workshop and the building itself gave numerous opportunities for informal encounters and discussions.

———————————————- SOME MORE DETAILS ON THE CONTENT.

The schedule of the workshop and the abstracts of the talks are accessible on line http://www.msri.org/calendar/workshops/WorkshopInfo/439/show_workshop

Video tapes of the talks were made by the MSRI staff and should be accessible.

We already gave a quick description of the content of mini-courses by Bernard Host, Ben Green and Terence Tao. Complementing these course, new mathematical results related to the background material were announced during the workshop. Endre Szemerédi announced the solution of an Erdös conjecture on sumsets of "not too thin" sets of integers. Nikos Frantzikinakis stated theorems of multiple recurrence along sequences produced by functions from an arbitrary Hardy field. Izabella Laba gave conditions on the fractional dimension of a set of real numbers which guarantee that this set contains an arithmetic progression of length three. Thierry de la Rue gave precise calculations of the rate of exponential growth for random Fibonacci sequences. Vitaly Bergelson presented multiple recurrence theorems for measure preserving actions of general amenable groups, and asked several challenging questions around amenable actions. Tamar Ziegler announced new results on the inverse problems for "ergodic Gowers-Host-Kra seminorms" in the context of products of finite fields actions.

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FUNDING GUIDELINES : The budget accorded to the workshop allowed us to support 25 participants with per diem support, and a travel support for one speaker. The complete funding information is includ

Workshop Summary for Introduction to Ergodic Theory and Additive Combinatorics

Held: August 25 to August 29, 2008

The Mathematical Sciencs Research Institute

Participant Information
112 participants

Gender (n = 112 participants)		
Male	78.57%	88
Female	21.43%	24
Declined to state	0.00%	0

Ethnicity (n = 90 participants)		
White	43.75%	49
Asian	22.32%	25
Hispanic	1.79%	2
Pacific Islander	0.89%	1
Black	0.00%	0
Native American	0.89%	1
Declined to state	10.71%	12

Introduction to Ergodic Theory and Additive Combinatorics

Invited Speakers

Bergelson, Vitaly	The Ohio State University
de la Rue, Thierry	LMR
Frantzikinakis, Nikos	University of Memphis
Furstenberg, Hillel	Hebrew University
Host, Bernard	Université de Marne-la-Vallée
Laba, Izabella	University of British Columbia
Tao, Terence	UC Berkeley
Weiss, Benjamin	Hebrew University
Ziegler, Tamar D	Technion

Introduction to Ergodic Theory and Additive Combinatorics Schedule		
Monday August 25, 2008		
09:00AM - 09:30AM	coffee and registration	
09:30AM - 10:30AM	Bernard Host	Nilmanifolds in ergodic theory, I
10:30AM - 11:10AM	morning break	
11:10AM - 12:00PM	Endre Szemeredi	On the sumsets of infinite sequences
12:00PM - 02:00PM	lunch	
02:00PM - 03:00PM	Bernard Host	Nilmanifolds in ergodic theory, II
03:00PM - 04:10PM	afternoon tea	
04:10PM - 05:00PM	Nikos Frantzikinakis	Szemeredi's theorem and Hardy fields
Tuesday August 26, 2008		
09:30AM - 10:30AM	Vitaly Bergelson	An Introduction to Diophantine Dynamics
10:30AM - 11:00AM	morning break	
11:00AM - 12:00PM	Bernard Host	Nilmanifolds in ergodic theory, III
12:00PM - 02:00PM	lunch	
02:00PM - 02:50PM	Izabella Laba	Arithmetic progressions in sets of fractional dimension
03:00PM - 04:10PM	afternoon tea	
04:10PM - 05:00PM	Thierry de la Rue	Random Fibonacci sequences
Wednesday August 27, 2008		
09:30AM - 10:30AM	Ben Green	Progressions in primes, I
10:30AM - 11:00AM	morning break	
11:00AM - 12:00PM	Vitaly Bergelson	Ergodic Ramsey theory and amenable groups
Thursday August 28, 2008		
09:30AM - 10:30AM	Terence Tao	Correspondence principle and finitary ergodic theory, I
10:30AM - 11:00AM	morning break	
11:00AM - 12:00PM	Ben Green	Progressions in primes, II
12:00PM - 02:00PM	lunch	
02:00PM - 03:00PM	Terence Tao	Correspondence principle and finitary ergodic theory, II
03:00PM - 03:30PM	afternoon tea	
03:30PM - 04:00PM	Problem session	
04:10PM - 05:00PM	Tom Sanders	Roth's theorem in additive combinatorics
Friday August 29, 2008		
09:30AM - 10:30AM	Ben Green	Progressions in primes, III
10:30AM - 11:00AM	morning break	
11:00AM - 12:00PM	Terence Tao	Correspondence principle and finitary ergodic theory, III

12:00PM - 02:00PM	lunch	
02:00PM - 02:50PM	Tamar Ziegler	An inverse theorem for the uniformity seminorms associated with the action of \F_p^\infty.
02:50PM - 03:30PM	afternoon tea	
03:30PM - 04:00PM	Problem session	
04:10PM - 05:00PM	Benjamin Weiss	Connections between Ramsey theory for trees and Markov processes

Currently Available Videos

- **Bernard Host** , Nilmanifolds in ergodic theory, I *August 25,2008, 09:30 AM to 10:30 AM*
- **Endre Szemeredi** , On the sumsets of infinite sequences *August 25,2008, 11:10 AM to 12:00 PM*
- **Bernard Host** , Nilmanifolds in ergodic theory, II *August 25,2008, 02:00 PM to 03:00 PM*
- **Nikos Frantzikinakis** , Szemeredi's theorem and Hardy fields *August 25,2008, 04:10 PM to 05:00 PM*
- **Vitaly Bergelson** , An Introduction to Diophantine Dynamics *August 26,2008, 09:30 AM to 10:30 AM*
- **Bernard Host** , Nilmanifolds in ergodic theory, III *August 26,2008, 11:00 AM to 12:00 PM*
- **Izabella Laba** , Arithmetic progressions in sets of fractional dimension *August 26,2008, 02:00 PM to 02:50 PM*
- **Thierry de la Rue** , Random Fibonacci sequences *August 26,2008, 04:10 PM to 05:00 PM*
- **Ben Green** , Progressions in primes, I *August 27,2008, 09:30 AM to 10:30 AM*
- **Vitaly Bergelson** , Ergodic Ramsey theory and amenable groups *August 27,2008, 11:00 AM to 12:00 PM*
- **Terence Tao** , Correspondence principle and finitary ergodic theory, I *August 28,2008, 09:30 AM to 10:30 AM*
- **Ben Green** , Progressions in primes, II *August 28,2008, 11:00 AM to 12:00 PM*
- **Terence Tao** , Correspondence principle and finitary ergodic theory, II *August 28,2008, 02:00 PM to 03:00 PM*
- **Tom Sanders** , Roth's theorem in additive combinatorics *August 28,2008, 04:10 PM to 05:00 PM*
- **Ben Green** , Progressions in primes, III *August 29,2008, 09:30 AM to 10:30 AM*
- **Terence Tao** , Correspondence principle and finitary ergodic theory, III *August 29,2008, 11:00 AM to 12:00 PM*
- **Tamar Ziegler** , An inverse theorem for the uniformity seminorms associated with the action of \F_p^\infty. *August 29,2008, 02:00 PM to 02:50 PM*
- **Benjamin Weiss** , Connections between Ramsey theory for trees and Markov processes *August 29,2008, 04:10 PM to 05:00 PM*

Participant List

MSRI Workshop:

Introduction to Ergodic Theory and Additive Combinatorics

August 25 to August 29, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Ahmadi Dastjerdi, Dawood	Participant	University of Guilan
Allahbakhshi, Mahnaz	Invited Participant	University of Victoria
AlQudah, Mohammad A	Participant	Central Michigan University
Auslander, Joseph	Participant	University of Maryland
Babson, Eric	Participant	UC Berkeley
Batson, Joshua	Participant	Yale
Beiglböck, Mathias	Participant	Technische Universität Wien
Bergelson, Vitaly	Speaker	Ohio State University
Boshernitzan, Michael	Participant	Rice University
Breuillard, Emmanue F.	Participant	Ecole Polytechnique
Campbell, James T.	Participant	University of Memphis
Carron, Gilles	Organizer	University of Nantes
Chaika, Jonathan Michael	Participant	Rice University
Chan, Siu Man	Participant	UC Berkeley
Chan, Siu On	Participant	UC Berkeley
Chandee, Vorrapan	Participant	Stanford University
Chen, Kuo-Chang	Participant	National Tsing Hua University
Cheng, Yuan-You	Participant	Wakeforest University
Chu, Qing	Invited Participant	Universite Paris-Est Marne-La-Vallee
Das, Tushar	Participant	University of North Texas
de la Rue, Thierry	Speaker	LMR
De, Anindya	Participant	UC Berkeley
Eisner, Tatjana	Participant	Eberhard-Karls-Universität Tübingen
El Houcein, El Abdalaoui	Invited Participant	University of Rouen
Ferenczi, Sebastien Simon	Participant	CNRS
Foreman, Matthew	Participant	UC Irvine
Frantzikinakis, Nikos	Speaker	University of Memphis
Franze, Craig	Participant	not available
Furstenberg, Hillel	Speaker	Israel Academy of Sciences and Humanities
Green, Ben Joseph	Organizer	University of Cambridge
Hayes, Benjamin Richard	Participant	University of Washington
Helfgott, Harald Andres	Participant	University of Montreal
Hochman, Michael Zvi	Participant	Princeton University
Homma, Kosuke	Participant	University of Texas at Austin
Hosseini, Maryam	Participant	University of Guilan
Host, Bernard	Speaker	Université de Marne-la-Vallée
Hough, Robert	Participant	Stanford University
Hulgan, Jonathan Darren	Participant	University of Memphis
Ismael, BACHY	Invited Participant	Cornell Univeristy
Jones, Nathan C	Invited Participant	University of Montreal
Kanduru, Srinivasa Raghava	Participant	Annamalai university
Kleinman, Aaron	Participant	UC Berkeley
Kra, Bryna	Organizer	Northwestern University
Laba, Izabella	Speaker	University of British Columbia
LaVictoire, Patrick	Participant	UC Berkeley
Le, Thai Hoang	Invited Participant	UCLA
Lesigne, Emmanuel	Organizer	Université François Rabelais
Li, Tianhong	Invited Participant	Chinese Academy of Sciences
Li, Xiannan	Participant	Stanford University
Lim, Seonhee	Invited Participant	Cornell Univeristy
Long, Eoin Patrick	Participant	Cambridge University
Lovett, Shachar	Invited Participant	Weizmann Institute of Science
Lyall, Neil	Participant	University of Georgia
Maldonado, Juan Pablo	Participant	UMSNH

Mathe, Andras	Participant	Eotvos University
Matthiesen, Lilian	Invited Participant	University of Cambridge
McClendon, David Matthew	Participant	Northwestern University
Miller, Gay	Participant	University of Illinois
Moore, Calvin C.	Participant	UC Berkeley
Nathanson, Melvyn B.	Participant	Lehman College (CUNY)
Neale, Vicky	Invited Participant	University of Cambridge
Nedev, Zhivko	Participant	University of Victoria
Nguyen, Hoi Huu	Invited Participant	Rutgers University
Oh, Hee	Participant	California Institute of Technology
olmez, oktay	Participant	Iowa State University
Omar, Sami	Participant	University of Tunis
Parrish, Andrew	Participant	University of Memphis
Pollington, Andrew	Participant	National Science Foundation
Potgieter, Paul	Participant	University of South Africa
Potts, Amanda	Notetaker	Northwestern University
Pramanik, Malabika	Invited Participant	University of Britiish Columbia
Prasad, Vidhu S.	Participant	University of Massachusetts Lowell
Prendiville, Sean	Invited Participant	University of Bristol
Quas, Anthony	Organizer	University of Victoria
Quddus, Safdar	Participant	Washington University
Ralston, David	Invited Participant	Rice University
Rosenblatt, Joseph M	Participant	National Science Foundation
Rubinstein-Salzedo, Simon	Participant	Stanford University
Sahin, Ayse Arzu	Invited Participant	DePaul University
Sanders, Tom	Participant	Cambridge University
Senger, Steven Michael	Participant	University of Missouri
Shahriyari, Leili	Participant	Johns Hopkins University
Shea, Stephen M.	Participant	Wesleyan University
Shen, Jian	Participant	Texas State University
Shkredov, Ilya Dmitrievich	Participant	Moscow State University
Silva, Cesar	Invited Participant	Williams College
Simsek, Sevim	Invited Participant	Isik University
Skau, Christian Fredrik	Invited Participant	Norwegian University of Science & Technology(NTNU)
So, Wasin	Participant	San Jose State University
Son, Younghwan	Participant	Ohio State University
Spencer, Craig Valere	Participant	University of Michigan
Stovall, Betsy	Participant	UC Berkeley
subedi, deepak	Participant	NEHU
Szemeredi, Endre	Speaker/ Member	Rutgers University
Tao, Terence	Speaker	UC Berkeley
Tonchev, Vladimir Dimitrov	Participant	Michigan Technological University
Towsner, Henry Piers	Participant	Carnegie Mellon University
Trevisan, Luca	Participant	UC Berkeley
Tulsiani, Madhur	Participant	UC Berkeley
Vishe, Pankaj Hemant	Invited Participant	New York University
Vurgun, Demet	Participant	Bogazici University
Wallwater, Aya	Invited Participant	Technion
Wang, Shouhong	Participant	Indiana University
Wang, Zhiren	Participant	Princeton University
Weiss, Benjamin	Speaker	Hebrew University
Wierdl, Mate	Organizer	University of Memphis
Yamazaki, Kazuo	Participant	Stanford University
Yu, Gang	Invited Participant	Kent State University
Zheng, Bowei	Participant	UC Berkeley
Ziegler, Tamar D	Speaker	Technion
Zuckerman, David	Participant	University of Texas at Austin

Broader Connections: Analysis on Singular Spaces

Held At MSRI, August 28, 2008 to August 29, 2008

Organized By: Gilles Carron, Eugenie Hunsicker, Richard Melrose, Michael Taylor, Andras Vasy, and Jared Wunsch

The Broader Connections workshop for the program Analysis of Singular Spaces was held on August 28-29. The Introductory workshop for the program was held the following week, September 2-5. The co-organizers were Jared Wunsch, András Vasy and Eugénie Hunsicker. The Broader Connections workshop was aimed at students and and at mathematicians who come from areas of mathematics somewhat outside the main program, and it had three main goals. The first was to provide an overview of the area in a way that emphasized motivations and intuition. The second goal was to prepare participants for the introductory workshop the following week by providing an overview of the main questions and techniques from analysis of singular spaces. The third motivation was to give students, women and younger members a chance to network ahead of the introductory workshop and program.

Approximately 30 mathematicians registered for the workshop, and approximately that many attended. Participants came from a wide range of backgrounds, including master's and PhD students, post docs and full faculty members. Participants attended from all over the US and Europe, with an even greater diversity of national origins. For a majority of participants (14/20 who responded to the survey), this was their first visit to MSRI.

The scientific part of the workshop consisted of eight talks over two days. These were organized into three two-lecture short courses: "Topics in PDE," "The Atiyah-Singer Index Theorem," and "An Introduction to Scattering Theory" and two additional talks, "An Introduction to Pseudodifferential Operators" and "An Introduction to the Hodge Theorem." Lecturers were chosen both for their exceptional expository abilities and as representatives of groups that are often underrepresented in mathematics–three lecturers, Thalia Jeffres, Tanya Christiansen and Eugénie Hunsicker are women and the fourth lecturer, Paul Loya, has native American heritage. The lecturers collaborated ahead of time to create a series of lectures that built on and reinforced each other, and would be interesting and useful for mathematicians from a range of backgrounds. Additionally, the speakers coordinated with speakers from the Introductory workshop to ensure a good transition. The level of presentation in all talks was outstanding. Some comments were: "It was useful for me to see these topics presented together in a way that demonstrated their interconnectednesss," "In graduate school, it is often easy to get lost in the theory. The explicit examples the lecturers used were very helpful for building intuition about where it comes from," "The presenters made a real effort to make the material accessible, and succeeded for the most part. This provided an excellent opportunity to learn about topics outside my area of specialization." All participants cited the desire to broaden

and/or deepen their knowledge in the area as a reason for attending the workshop, and found this aspect of the workshop generally successful.

The speakers believe that the best way to become familiar with new and difficult material is to work with it, and for this reason, each lecturer provided a short set of exercises for participants. There was time in the schedule on both afternoons for participants to work on these exercises and to ask the lecturers questions. This worked very well, and aside from giving participants a chance to solidify the content of the lectures, it also gave them a chance to get to know each other as they worked in small groups. Some participants also used this opportunity to discuss how the material in the lectures related to what they had been studying recently, and to ask the speakers questions about that. One student commented that in graduate school, one often gets so involved in theory that one does not do many calculations, and that the calculational questions were very helpful for understanding the material.

Each day there was a lunch break and both a morning and afternoon tea break, which gave participants a chance to get to know each other and also other program members who were not attending the BC workshop. On Thursday evening, we had a women's networking dinner at a local restaurant attended by women at various stages of their careers. Amongst a wide variety of other topics, we discussed having children and taking/negotiating maternity leave and careers at a variety of institutions, from research universities to liberal arts colleges, and overseas universities. Most participants cited networking as an important reason for attending the workshop, and found this aspect of the workshop satisfactory. One participant said she identified a potential future collaborator. Another participant commented that it was useful to be able to talk to experts, but even more useful to have a chance to talk to peers just a bit more advanced in the field.

Of the participants who responded to this part of the survey, 11 had received direct invitations, 5 had heard of the workshop through word of mouth, 6 had seen the workshop on the MSRI webpage, and one had seen a poster. This is indicative of the effort the organizers put into directly identifying potential participants, and informally advertising the workshop through word of mouth. Recruitment did suffer through lack of timely advertising: for instance, the advertisement in the AWM newsletter did not appear until after the funding deadline had already passed and most funding had already been committed. Moreover, a problem with the online application system resulted in at least seven applications being misplaced just before the funding decisions were to be made. These applications only came to the attention of the organizers when they were contacted directly by baffled applicants waiting in vain for a response. We thus fear that additional applications may have been lost altogether. We have discussed the issues facing MSRI's advertising protocols and web interface with the new Deputy Director, who assures us that both will be updated.

As recruitment was done primarily by the organizers, the participants in the workshop were mostly mathematicians with some prior knowledge of the subject. The area of analysis on singular spaces is, however, sufficiently well-developed and broad (ranging

from topology to hard analysis) that even participants well-versed in some areas of emphasis found novelty in lectures on others. Of the participants who responded to the survey, 13/20 thus found the introduction to the area "very useful" and all but one of the remainder found it "moderately useful." The networking aspects of the program were even more favorably received, with 18/20 finding the networking "very useful" with the rest finding it "moderately useful". Finally, 15/20 respondents found the workshop a "very useful" preparation for the introductory workshop, with the rest finding it "moderately useful." We thus judge the workshop to have successfully achieved all three of its goals.

Workshop Summary for Broader Connections: Analysis on Singular Spaces

Held: August 28 to August 29, 2008

The Mathematical Sciencs Research Institute

Participant Information
41 participants

Gender (n = 41 participants)		
Male	63.41%	26
Female	36.59%	15
Declined to state	0.00%	0

Ethnicity (n = 29 participants)		
White	43.90%	18
Asian	19.51%	8
Hispanic	4.88%	2
Pacific Islander	0.00%	0
Black	0.00%	0
Native American	0.00%	0
Declined to state	2.44%	1

Broader Connections: Analysis on Singular Spaces

Invited Speakers

Christiansen, Tanya Julie	University of Missouri, Columbia
Hunsicker, Eugenie	Loughborough University
Jeffres, Thalia David	Wichita State
Loya, Paul	SUNY Binghamton

Broader Connections: Analysis on Singular Spaces Schedule

Thursday August 28, 2008

09:00AM - 10:00AM	Thalia Jeffres	Differential operators
10:00AM - 10:30AM	Tea	
10:30AM - 11:30AM	Thalia Jeffres	Differential Operators
11:30AM - 12:30PM	Eugenie Hunsicker	Introduction to pseudodifferential operators
12:30PM - 02:00PM	Lunch	
02:00PM - 03:00PM	Paul Loya	Index theory I
03:00PM - 03:30PM	Tea	
04:10PM - 05:10PM	UCB Colloqium (Evans Hall)	
06:30PM - 08:00PM	Dinner, Great China restaurant	

Friday August 29, 2008

09:00AM - 10:00AM	Paul Loya	Index Theory II
10:00AM - 10:30AM	Tea	
10:30AM - 12:30PM	Tanya Christiansen	Scattering theory
12:30PM - 02:00PM	Lunch	
02:00PM - 03:00PM	Problem Session/Q and A	
03:00PM - 03:30PM	Tea	
03:30PM - 04:30PM	Eugenie Hunsicker	Hodge theory

Currently Available Videos

- **Thalia Jeffres** , Differential operators *August 28,2008, 09:00 AM to 10:00 AM*
- **Thalia Jeffres** , Differential operators *August 28,2008, 10:30 AM to 11:30 AM*
- **Eugenie Hunsicker** , Introduction to pseudodifferential operators *August 28,2008, 11:30 AM to 12:30 PM*
- **Paul Loya** , Index theory I *August 28,2008, 02:00 PM to 03:00 PM*
- **Paul Loya** , Index theory II *August 29,2008, 09:00 AM to 10:00 AM*
- **Tanya Christiansen** , Scattering theory *August 29,2008, 10:30 AM to 12:30 PM*
- **Eugenie Hunsicker** , Hodge theory *August 29,2008, 03:30 PM to 04:30 PM*

Participant List

MSRI Workshop:

Broader Connections: Analysis on Singular Spaces

August 28 to August 29, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Aldana Dominguez, Clara Lucia	Invited Participant	Universität Bonn
Altalli, Rajaa	Participant	Northeastern University
Azimian, Amin	Invited Participant	Islamic Azad University,South Tehran
Bahuaud, Eric C	Participant	University of Washington
Baskin, Dean	Participant	Stanford University
Carron, Gilles	Organizer	University of Nantes
Christiansen, Tanya Julie	Participant	University of Missouri, Columbia
Christianson, Hans P	Participant	Massachusetts Institute of Technology
Djordjevic, Jasmina	Participant	not available
Dryden, Emily B.	Participant	Bucknell University
Eswarathasan, Suresh	Invited Participant	University of Rochester
Ford, Austin	Invited Participant	Northwestern University
Fritzsch, Karsten	Invited Participant	Universität Oldenburg
Huang, Xiaoling	Invited Participant	UC Santa Barbara
Hunsicker, Eugenie	Organizer	Loughborough University
Jeffres, Thalia David	Participant	Wichita State
Lebedeva, Nina	Invited Participant	University of Muenster
Li, Jinghao	Invited Participant	Binghamton University
Lodha, Yash	Participant	SUNY-Binghamton
Lotay, Jason	Participant	University College Oxford
Loya, Paul	Participant	SUNY Binghamton
Melrose, Richard Burt	Organizer	Massachusetts Institute of Technology
Minemyer, Barry Francis	Participant	SUNY Binghamton
Pham, Ha Ngoc	Participant	Stanford University
Pokorny, Florian Till	Invited Participant	University of Edinburgh
Rezazadegan, Reza	Invited Participant	Rutgers University
Rochon, Frederic	Participant	University of Toronto
Roidos, Nikolaos	Invited Participant	Loughborough University
Sandoval, Mary R.	Participant	Trinity College
Sher, David Alexander	Participant	Stanford University
Stanhope, Elizabeth	Participant	Lewis & Clark
Stewart, Deedee	Invited Participant	Wichita State
Taylor, Michael	Organizer	University of North Carolina, Chapel Hill
Uski, Ville	Invited Participant	Loughborough University
VanValkenburgh, Michael	Invited Participant	University of California
Vasy, András	Organizer	Stanford University
Wang, Fang	Invited Participant	Massachusetts Institute of Technology
Weilandt, Martin	Invited Participant	Humboldt-Universitaet zu Berlin
Wunsch, Jared	Organizer	Northwestern University
Xu, Feng	Notetaker	Duke University
Zhou, Ting	Invited Participant	Unversity of Washington

FINAL REPORT: INTRODUCTORY WORKSHOP ANALYSIS OF SINGULAR SPACES PROGRAM, FALL 2008

The Introductory Workshop for the Analysis on Singular Spaces semester program was held at MSRI, from Sept. 2 to Sept. 5. The workshop only lasted four days as the week was curtailed by Labor Day; in recompense, there was no half-day, and the daily schedule was slightly longer than might otherwise have been considered ideal. The principal workshop organizers were Eug´enie Hunsicker, Andr´as Vasy, and Jared Wunsch.

The scientific program consisted primarily of a linked collection of minicourses, as follows:

Richard Melrose, *Real blow-ups*

Michael Taylor, *Pseudodifferential operators on singular spaces*

Maciej Zworski and Tanya Christiansen, *Spectral and scattering theory*

Gerd Grubb, *Introduction to index theory*

Paul Loya, *Index theory on singular spaces*

Gilles Carron, L^2 *cohomology*

These courses were designed to give background material suitable for advanced students and postdocs (as well as more senior researchers from allied fields) to be able to take part in the main thrust of the semester's program. The mini-courses proved by and large quite well-integrated, with core material on pseudodifferential operators being covered very efficiently by Taylor in the early part of the week, and thus available to other speakers; likewise, key ideas from spectral and scattering theory were introduced quickly by Zworski and Christiansen and played recurrent roles in the other courses.

In addition to the mini-courses, three half-hour slots were allocated to short lectures on open problems, given by Jochen Br¨uning, Werner M¨uller, and Rafe Mazzeo. These lectures were organized at the last minute to fill in slots that had been left open at the discretion of the organizers; initially they had been intended for last-minute short presentations on background material that the lecturers were assuming and the students felt they lacked. The speakers turned out to have such a firm grasp of appropriate level and pace, however, that such

remedial classes did not seem warranted. (This was borne out in

conversations with individual participants; additionally, the input of all participants was solicited in deciding what to do with these lecture slots.) Instead, these problem sessions provided a lively counterpoint to the main courses, reminding the participants that notwithstanding all that is known about analysis on singular spaces, it remains a vital field, with much left unknown.

The program was preceded by a “Broader Connections” workshop that was intended to give underprepared participants or those from remote fields of mathematics a chance to fill in fundamental background material. The Broader Connections program, organized by Eug´enie Hunsicker, featured more elementary lectures, and assigned homework problems designed to help the students learn through concrete exercises. Two lecturers, Loya and Christiansen, taught in both programs.

73 participants registered for the workshop, of whom 14 were female. Only five participants responded to the survey, which was conducted online. (The organizers have suggested that MSRI find a way to administer the survey so as to boost reponse rates.) Of these five respondents, two were new to MSRI. All said that the workshop had been very useful. Four of the five had heard about the workshop by word of mouth; there had been very little print-or web-based advertising for the workshop, and attendance probably did suffer as a result. Anecdotal evidence gathered by the organizers suggests that the students who participated felt that the program exposed them to many facets of a diverse field. In the ordinary course of a mathematical education, one might learn one or two of these areas, but the more synoptic point of view of the workshop was both unusual and successful.

Workshop Summary for Introductory Workshop on Analysis on Singular Spaces

Held: September 2 to September 5, 2008

The Mathematical Sciencs Research Institute

Participant Information
69 participants

Gender (n = 69 participants)		
Male	79.71%	55
Female	20.29%	14
Declined to state	0.00%	0

Ethnicity (n = 46 participants)		
White	42.03%	29
Asian	17.39%	12
Hispanic	2.90%	2
Pacific Islander	0.00%	0
Black	0.00%	0
Native American	0.00%	0
Declined to state	4.35%	3

Introductory Workshop on Analysis on Singular Spaces

Invited Speakers

Bruning, Jochen	Humboldt-Universitaet zu Berlin
Carron, Gilles	University of Nantes
Christiansen, Tanya Julie	University of Missouri, Columbia
Grubb, Gerd	Københavns Universitet
Loya, Paul	SUNY Binghamton
Melrose, Richard Burt	Massachusetts Institute of Technology
Taylor, Michael	University of North Carolina, Chapel Hill
Zworski, Maciej	UC Berkeley

Introductory Workshop on Analysis on Singular Spaces Schedule		
Tuesday September 2, 2008		
09:00AM - 10:00AM	Michael Taylor	Pseudodifferential Operators on Singular Spaces I
10:00AM - 10:30AM	Coffee, Tea in the Atrium	
10:30AM - 11:00AM	Discussion	
11:00AM - 12:00PM	Richard Melrose	Real Blow-ups I
12:00PM - 01:30PM	Lunch	
01:30PM - 02:30PM	Maciej Zworski	Spectral and Scattering Theory I
02:30PM - 03:30PM	Michael Taylor	Pseudodifferential Operators on Singular Spaces II
03:30PM - 04:00PM	Coffee, Tea in the Atrium	
04:00PM - 05:00PM	Gerd Grubb	Introduction to Index Theory
05:00PM - 06:00PM	Evening reception	
Wednesday September 3, 2008		
09:00AM - 10:00AM	Michael Taylor	Pseudodifferential Operators on Singular Spaces III
10:00AM - 10:30AM	Coffee, tea in the Atrium	
10:30AM - 11:00AM	Jochen Bruning	Open problems
11:00AM - 12:00PM	Richard Melrose	Real Blow-ups II
12:00PM - 01:30PM	Lunch	
01:30PM - 02:30PM	Tanya Christiansen	Spectral and Scattering theory, II
02:30PM - 03:30PM	Gilles Carron	Cohomology, I
03:30PM - 04:00PM	Coffee, Tea in the Atrium	
04:00PM - 05:00PM	Gerd Grubb	Intro to Index Theory, II
Thursday September 4, 2008		
09:00AM - 10:00AM	Michael Taylor	Pseudodifferential Operators on Singular Spaces
10:00AM - 10:30AM	Coffee, Tea in the Atrium	
10:30AM - 11:00AM	Open problems (Werner Mueller)	
11:00AM - 12:00PM	Richard Melrose	Real Blowups, III
12:00PM - 01:30PM	Lunch	
01:30PM - 02:30PM	Gilles Carron	Cohomology, II
02:30PM - 03:30PM	Gerd Grubb	Intro to Index Theory, III
03:30PM - 04:00PM	Coffee, Tea in the Atrium	
04:10PM - 05:10PM	Lecture/Colloquium at Evans Hall	
Friday September 5, 2008		
09:00AM - 10:00AM	Maciej Zworski	Spectral and Scattering theory, III
10:00AM - 10:30AM	Coffee, Tea in the Atrium	
10:30AM - 11:00AM	Open problems (Rafe Mazzeo)	
11:00AM - 12:00PM	Paul Loya	Index Theory on Singular Spaces, I
12:00PM - 01:30PM	Lunch	

01:30PM - 02:30PM	Tanya Christiansen	Spectral and Scattering theory, IV
02:30PM - 03:30AM	Gilles Carron	Cohomology, III
03:30PM - 04:00PM	Coffee, Tea in the Atrium	
04:00PM - 05:00PM	Paul Loya	Index Theory on Singular Spaces, II

Currently Available Videos

- **Michael Taylor** , Pseudodifferential Operators on Singular Spaces I *September 2,2008, 09:00 AM to 10:00 AM*
- **Richard Melrose** , Real Blow-ups I *September 2,2008, 11:00 AM to 12:00 PM*
- **Maciej Zworski** , Spectral and Scattering Theory I *September 2,2008, 01:30 PM to 02:30 PM*
- **Michael Taylor** , Pseudodifferential Operators on Singular Spaces II *September 2,2008, 02:30 PM to 03:30 PM*
- **Gerd Grubb** , Introduction to Index Theory *September 2,2008, 04:00 PM to 05:00 PM*
- **Michael Taylor** , Pseudodifferential Operators on Singular Spaces III *September 3,2008, 09:00 AM to 10:00 AM*
- **Richard Melrose** , Real Blow-ups II *September 3,2008, 11:00 AM to 12:00 PM*
- **Tanya Christiansen** , Spectral and Scattering theory, II *September 3,2008, 01:30 PM to 02:30 PM*
- **Gilles Carron** , Cohomology, I *September 3,2008, 02:30 PM to 03:30 PM*
- **Gerd Grubb** , Introduction to Index Theory II *September 3,2008, 04:00 PM to 05:00 PM*
- **Michael Taylor** , Pseudodifferential Operators on Singular Spaces *September 4,2008, 09:00 AM to 10:00 AM*
- **Richard Melrose** , Real Blow-ups III *September 4,2008, 11:00 AM to 12:00 PM*
- **Gilles Carron** , Cohomology, II *September 4,2008, 01:30 PM to 02:30 PM*
- **Gerd Grubb** , Introduction to Index Theory III *September 4,2008, 02:30 PM to 03:30 PM*
- **Maciej Zworski** , Spectral and Scattering theory, III *September 5,2008, 09:00 AM to 10:00 AM*
- **Paul Loya** , Index Theory on Singular Spaces, I *September 5,2008, 11:00 AM to 12:00 PM*
- **Tanya Christiansen** , Spectral and Scattering theory, IV *September 5,2008, 01:30 PM to 02:30 PM*
- **Gilles Carron** , Cohomology, III *September 5,2008, 02:30 PM to 03:30 PM*
- **Paul Loya** , Index Theory on Singular Spaces, II *September 5,2008, 04:00 PM to 05:00 PM*

Participant List

MSRI Workshop:

Introductory Workshop on Analysis on Singular Spaces

September 2 to September 5, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Aldana Dominguez, Clara Lucia	Invited Participant	University Bonn
Altalli, Rajaa	Participant	Northeastern University
Azimian, Amin	Invited Participant	Islamic Azad University
Babson, Eric	Participant	UC Berkeley
Bahuaud, Eric C	Participant	University of Washington
Baskin, Dean	Participant	Stanford University
Bruning, Jochen	Participant	Humboldt-Universitaet zu Berlin
Carron, Gilles	Organizer	University of Nantes
Christ, Michael	Participant	UC Berkeley
Christiansen, Tanya Julie	Participant	University of Missouri, Columbia
Datcher, Kiril	Participant	UC Berkeley
Der, Ricky	Invited Participant	University of Pennsylvania
Diaz, Rafael	Participant	Universidad Politecnica de las Fuerzas Armadas
Dryden, Emily B.	Participant	Bucknell University
Eswarathasan, Suresh	Invited Participant	University of Rochester
Ettinger, Boris	Participant	UC Berkeley
Feng, Renjie	Invited Participant	John Hopkins University
Ferreira, Carla Maria	Participant	University of Minho
Ford, Austin	Invited Participant	Northwestern University
Fowler, Jim A.	Participant	University of Chicago
Francsics, Gabor	Participant	Michigan State University
Fritzsch, Karsten	Invited Participant	Universität Oldenburg
Gaffney, Terence J	Participant	Northeastern University
Gell-Redman, Jesse David	Participant	Stanford University
Ghosh, Subhroshekhar	Participant	UC Berkeley
Gimperlein, Heiko	Participant	Leibniz Universität Hannover
Grandjean, Vincent Jean Henri	Participant	University of Bath
Grubb, Gerd	Participant	Københavns Universitet
Holman, Sean	Invited Participant	University of Washington
Huang, Xiaoling	Invited Participant	UC Santa Barbara
Hunsicker, Eugenie	Organizer	Loughborough University
Jeffres, Thalia David	Participant	Wichita State University
Kantor, Joshua Matthew	Invited Participant	University of Washington
Li, Hui	Participant	University of Luxembourg
Li, Jinghao	Participant	Binghamton University
Liu, Hongyu	Invited Participant	University of Washington
Loya, Paul	Participant	SUNY Binghamton
Melrose, Richard Burt	Organizer	Massachusetts Institute of Technology
Nartey, Samuel	Participant	University of Cambridge
Parsons, Todd Lawrence	Invited Participant	University of Pennsylvania
Pham, Ha Ngoc	Participant	Stanford University
Piazza, Paolo	Participant	Università di Roma "La Sapienza"
Pokorny, Florian Till	Invited Participant	University of Edinburgh
Qian, Randy Zhigang	Invited Participant	Northwestern University
Rezazadegan, Reza	Invited Participant	Rutgers University
Rochon, Frederic	Participant	University of Toronto
Roidos, Nikolaos	Invited Participant	Loughborough University
Royer, Julien	Invited Participant	Université de Nantes
Sandoval, Mary R.	Participant	Trinity College
Sher, David Alexander	Participant	Stanford University
Singer, Michael A.	Participant	University of Edinburgh
Stewart, Deedee	Invited Participant	Wichita State University
Sverdlov, Roman Markovich	Participant	University of Michigan
Taylor, Michael	Organizer	University of North Carolina, Chapel Hill

Thomann, Laurent	Invited Participant	Université de Nantes, laboratoire J. Lerray
Tohaneanu, Mihai Horia	Participant	UC Berkeley
Trotman, David J.A.	Participant	l'Université de la Méditerranée
Uski, Ville	Invited Participant	Loughborough University
VanValkenburgh, Michael	Invited Participant	UC Berkeley
Vasy, András	Organizer	Stanford University
Vertman, Boris	Participant	University Bonn
Wang, Fang	Invited Participant	Northwestern University
Weilandt, Martin	Invited Participant	Humboldt-Universitaet zu Berlin
Wunsch, Jared	Organizer	Northwestern University
Xu, Feng	Notetaker	Duke University
Yamazaki, Kazuo	Participant	Stanford University
Zhou, Ting	Invited Participant	Unversity of Washington
Zoghi, Masrour	Invited Participant	University of Toronto
Zworski, Maciej	Participant	UC Berkeley

Final Report:
Workshop on Topology of Stratified Spaces
Fall 2008

The MSRI workshop “Topology of Stratified Spaces” was held on September 8-12. This was the week following the Introductory workshop for the Analysis of Singular Spaces program and was chosen to promote interaction between the topology workshop and the analysis program. The co-organizers were Greg Friedman, Eug´enie Hunsicker, Anatoly Libgober and Laurentiu Maxim. The Topology of Stratified Spaces workshop was aimed at mathematicians from four areas within topology of stratified spaces, as well as at mathematicians from the program on Analysis of Singular Spaces with interests in relations to topology. The workshop had four main goals. The first was to provide introductions to each of the research areas represented at the workshop, the second was to present current research together with current questions in each field, the third was to promote networking among mathematicians from these related areas, and the final was to produce a proceedings volume that would serve as a good introduction to various topics in the topology of stratified spaces and include suggestions for research problems.

Approximately fifty mathematicians registered online for the workshop, and about that number attended, mostly the same as those who registered. Participants included mathematicians at various stages of their careers from graduate students to senior researchers, and also from many places, including all over the US, Germany, France, UK, Luxembourg, Canada and Japan. For many participants, especially younger ones, this was their first visit to MSRI. At least 12 of the participants had primary ties to the Analysis of Singular Spaces program. As funding was limited, the organizers decided to provide only per diem local expenses in an effort to fund as many participants as possible. Priority was given to younger mathematicians and mathematicians who did not have grants. Twenty participants received at least partial funding for the workshop.

The scientific part of the workshop consisted of talks over four and a half days (with Wednesday afternoon free) and a final open problem session. These were organized into four basic areas: L^2-cohomology and Hodge and signature theorems, topology of complex algebraic varieties, topological signature theory on singular spaces, and mixed Hodge theory and singularities. The various topics corresponded roughly to the days of the conference and each started with an introductory lecture. Speakers were chosen for their prominence in

their areas and for their expository abilities, with additional half hour spots reserved for talks by students and recent graduates. The level of presentation was generally excellent. Speakers made a point of putting their work in the context of previous work and main problems of their subdisciplines which made their talks accessible to those from different subdisciplines. There was quite active discussion during question periods as well as during daily lunch breaks and both a morning and afternoon tea breaks, On Tuesday evening there was a reception for the workshop. All of these informal times were also chances for participants from the workshop to meet and talk to members from the analysis program.

The workshop generated many new connections, including:

M. Kerr and G. Pearlstein have begun a collaboration and plan to write a paper on normal functions for the proceedings volume.

S. Weinberger and J. Schuerman both report a useful discussion about the relationship between Schuerman's work with Yokura on the motivic integration perspective on characteristic classes of singular varieties and the work of Weinberger, Friedman, Banagl and Maxim on surgery and L-class theory. A collaboration has come out of this between Schuerman and Maxim.

E. Hunsicker had useful discussions about perverse signatures with M. Banagl and G. Friedman. She and Friedman have begun a collaboration to extend her work on these from the analytic to the topological setting.

S. Weinberger and P. Piazza had useful discussions about finding common ground in the study of higher signature for manifolds with boundary from the analytic and topological viewpoints. Piazza learned from Weinberger something that will significantly extend the scope of his current project with Mazzeo and Albin from the Analysis of Singular Spaces program.

L. Saper had useful conversations with mathematicians from both analytic and topological backgrounds, including G. Pearlstein, E. Hunsicker, P. Piazza, C. McCrory and S. Weinberger. Hunsicker believes some of his techniques from Hodge theorems on locally symmetric spaces may have bearing on Hodge theorems for monopole moduli spaces. S. Weinberger was interested to learn about L. Saper's astonishing result about globally self-dual sheaves that are not locally self-dual, but get their global self-duality as a result of vanishing theorems a la Vogan-Zuckerman.

C. McCrory reported several useful interactions. He learned from G. Friedman about his work refining work from McCrory's thesis on stratified general position. He was reminded by David Trotman about the usefulness of bi-Lipschitz homeomorphisms and about work by Trotman's student Vallette related to McCrory's work and he learned from Trotman that one of the problems he had suggested for the session appears to have been solved by Kuiper. Trotman also made an interesting conjecture about the

weight filtration McCrory discussed in his lecture (see the problem list). McCrory also learned from B. Williams about a serious mistake in Daniel Biss' 2003 Annals paper on the MacPhersonian (a combinatorial model of the Grassmannian), which he had not heard about before.

On the whole, the workshop was considered very stimulating by participants. It succeeded extremely well in its goals of increasing networking and collaboration among mathematicians from related, but often mutually isolated

areas of topology and analysis of stratified spaces, as is evidenced by the number of new collaborations and useful conversations reported. The organizers are all staying on as editors for the proposed proceedings volume, which will be published through the MSRI book series. There are already committments from five speakers as well as the four introductory speakers to contribute to the volume, which will also include an expanded list of research problems that were proposed in the problem session. It promises to be a useful reference for future work in the field.

Workshop Summary for Topology of Stratified Spaces

Held: September 8 to September 12, 2008

The Mathematical Sciencs Research Institute

Participant Information
54 participants

Gender (n = 54 participants)		
Male	92.59%	50
Female	7.41%	4
Declined to state	0.00%	0

Ethnicity (n = 39 participants)		
White	48.15%	26
Asian	5.56%	3
Hispanic	0.00%	0
Pacific Islander	0.00%	0
Black	0.00%	0
Native American	0.00%	0
Declined to state	18.52%	10

Topology of Stratified Spaces

Invited Speakers

Cappell, Sylvain E.	New York University, Courant Institute
Carron, Gilles	University of Nantes
Katzarkov, Ludmil	UC Irvine
Mazzeo, Rafe	Stanford University
McCrory, Clinton Graydon	University of Georgia
Saper, Les	Duke University
Weinberger, Shmuel	University of Chicago
Yokura, Shoji	Kagoshima University

Topology of Stratified Spaces Schedule		
Monday September 8, 2008		
09:00AM - 10:00AM	Xianzhe Dai	An introduction to L^2 cohomology
10:00AM - 10:30AM	Coffee, Tea in the Atrium	
10:30AM - 11:30AM	Gilles Carron	L2 cohomology of QALE space
11:30AM - 01:15PM	Lunch	
01:15PM - 02:15PM	Les Saper	Cohomology of compactifications of locally symmetric spaces
02:30PM - 03:30PM	Paolo Piazza	The signature operator on Witt spaces (joint work with Pierre Albin, Eric Leichtnam and Rafe Mazzeo)
03:30PM - 04:00PM	Coffee, Tea in the Atrium	
04:00PM - 05:30PM	Evans lecture	
Tuesday September 9, 2008		
09:00AM - 10:00AM	Markus Banagl	"The Signature of Singular Spaces and its Refinements to Generalized Homology Theories."
10:00AM - 10:30AM	Coffee, tea in the Atrium	
10:30AM - 11:30AM	Sylvain Cappell	Replacement of fixed points of group actions
11:30AM - 01:15PM	Lunch	
01:15PM - 02:15PM	Shmuel Weinberger	Stratified Surgery and Functoriality
02:30PM - 03:30PM	Clinton McCrory	The weight filtration for real algebraic varieties
03:30PM - 04:00PM	coffee, Tea in the Atrium	
04:00PM - 04:30PM	Jim Fowler	Lattices with torsion and rational homology manifolds
04:30PM - 05:00PM	Filipp Levikov	The (intersection) homology groups of a fibre bundle over a sphere
05:00PM - 08:00AM	Welcome Reception	
Wednesday September 10, 2008		
09:00AM - 10:00AM	Anatoly Libgober	Elliptic genus of singular varieties.
10:00AM - 10:30AM	Coffee, Tea in Atrium	
10:30AM - 11:00AM	Daniel Matei	Cohomology of complements to algebraic plane curves
11:00AM - 11:30AM	Lee McEwan	Monodromy of curves and quasi-ordinary surfaces
11:30AM - 12:00PM	Mikhail Mazin	Leray-type Operators for Stratified Spaces and the Parshin's Reciprocity Law for Residues
Thursday September 11, 2008		
09:00AM - 10:00AM	Robert Waelder	Singular Elliptic Genus of Normal Surfaces
10:00AM - 10:30AM	Coffee, Tea in the Atrium	
10:30AM - 11:30AM	Sandor Kovacs	Singularities in the Minimal Model Program
11:30AM - 01:15PM	Lunch	

01:15PM - 02:15PM	Shoji Yokura	Motivic Characteristic classes of singulare varieties
02:30PM - 03:30PM	Mark de Cataldo	the perverse filtration and the Lefschetz Hyperplane Theorem
03:30PM - 04:00PM	Cofee, tea in the Atrium	
04:00PM - 05:30PM	Berkeley Colloquium	
Friday September 12, 2008		
09:00AM - 10:00AM	Ludmil Katzarkov	Hodge Structures and Homological Mirror Symmetry
10:00AM - 10:30AM	Coffee, Tea in the Atrium	
10:30AM - 11:30AM	Gregory Pearlstein	Singularities of Normal Functions
11:30AM - 01:15PM	Lunch	
01:15PM - 02:15PM	Joerg Schuermann	Characteristic classes of mixed Hodge modules
02:30PM - 03:30PM	Matt Kerr	Hodge theory of Calabi-Yau fibrations
03:30PM - 04:00PM	Coffee, tea in the Atrium	
04:00PM - 05:00PM	Eugenie Hunsicker	Problem Session

Currently Available Videos

- **Xianzhe Dai** , An introduction to L^2 cohomology *September 8,2008, 09:00 AM to 10:00 AM*
- **Gilles Carron** , L2 cohomology of QALE space *September 8,2008, 10:30 AM to 11:30 AM*
- **Les Saper** , Cohomology of compactifications of locally symmetric spaces *September 8,2008, 01:15 PM to 02:15 PM*
- **Paolo Piazza** , The signature operator on Witt spaces (joint work with Pierre Albin, Eric Leichtnam and Rafe Mazzeo) *September 8,2008, 02:30 PM to 03:30 PM*
- **Markus Banagl** , The Signature of Singular Spaces and its Refinements to Generalized Homology Theories. *September 9,2008, 09:00 AM to 10:00 AM*
- **Sylvain Cappell** , Replacement of fixed points of group actions *September 9,2008, 10:30 AM to 11:30 AM*
- **Shmuel Weinberger** , Stratified Surgery and Functoriality *September 9,2008, 01:15 PM to 02:15 PM*
- **Clinton McCrory** , The weight filtration for real algebraic varieties *September 9,2008, 02:30 PM to 03:30 PM*
- **Jim Fowler** , Lattices with torsion and rational homology manifolds *September 9,2008, 04:00 PM to 04:30 PM*
- **Filipp Levikov** , The (intersection) homology groups of a fibre bundle over a sphere *September 9,2008, 04:30 PM to 05:00 PM*
- **Anatoly Libgober** , Elliptic genus of singular varieties *September 10,2008, 09:00 AM to 10:00 AM*

- **Daniel Matei** , Cohomology of complements to algebraic plane curves *September 10,2008, 10:30 AM to 11:00 AM*
- **Lee McEwan** , Monodromy of curves and quasi-ordinary surfaces *September 10,2008, 11:00 AM to 11:30 AM*
- **Mikhail Mazin** , Leray-type Operators for Stratified Spaces and the Parshin's Reciprocity Law for Residues *September 10,2008, 11:30 AM to 12:00 PM*
- **Robert Waelder** , Singular Elliptic Genus of Normal Surfaces *September 11,2008, 09:00 AM to 10:00 AM*
- **Sandor Kovacs** , Singularities in the Minimal Model Program *September 11,2008, 10:30 AM to 11:30 AM*
- **Shoji Yokura** , Motivic Characteristic classes of singulare varieties *September 11,2008, 01:15 PM to 02:15 PM*
- **Mark de Cataldo** , The perverse filtration and the Lefschetz Hyperplane Theorem *September 11,2008, 02:30 PM to 03:30 PM*
- **Ludmil Katzarkov** , Hodge Structures and Homological Mirror Symmetry *September 12,2008, 09:00 AM to 10:00 AM*
- **Gregory Pearlstein** , Singularities of Normal Functions *September 12,2008, 10:30 AM to 11:30 AM*
- **Joerg Schuermann** , Characteristic classes of mixed Hodge modules *September 12,2008, 01:15 PM to 02:15 PM*
- **Matt Kerr** , Hodge theory of Calabi-Yau fibrations *September 12,2008, 02:30 PM to 03:30 PM*

Participant List

MSRI Workshop:

Topology of Stratified Spaces

September 8 to September 12, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Avramidi, Grigori I	Invited Participant	University of Chicago
Bahuaud, Eric C	Participant	University of Washington
Banagl, Markus	Invited Participant	University of Heidelberg
Bhandari, Ganesh Raj	Participant	Tribhuvan University
Caibar, Mirel	Participant	The Ohio State University
Cappell, Sylvain E.	Speaker	New York University, Courant Institute
Carron, Gilles	Speaker	University of Nantes
Dai, Xianzhe	Invited Participant	UC Santa Barbara
de Cataldo, Mark Andrea	Invited Participant	Stony Brook University
Diaz, Rafael	Participant	Universidad Politecnica de las Fuerzas Armadas
Dryden, Emily B.	Participant	Bucknell University
Edidin, Dan	Participant	University of Missouri, Columbia
Fischer, Aron	Invited Participant	not available
Fowler, Jim A.	Participant	University of Chicago
Francsics, Gabor	Participant	Michigan State University
Friedman, Greg	Organizer	Texas Christian University
Gaffney, Terence J	Participant	Northeastern University
Gaisendrees, Florian J	Participant	University of Heidelberg
Ganter, Nora	Participant	Brooks Coop
Gasparovic, Ellen	Participant	University of North Carolina at Chapel Hill
Gimperlein, Heiko	Participant	Universität Hannover
Grandjean, Vincent Jean Henri	Member	University of Bath
Hunsicker, Eugenie	Organizer	Loughborough University
Iqbal, Sohail	Participant	University of Warwick
Katzarkov, Ludmil	Speaker	UC Irvine
Kennedy, Gary	Participant	Ohio State University
Kerr, Matt	Invited Participant	Durham University
Kovacs, Sandor J.	Invited Participant	University of Washington
Levikov, Filipp	Invited Participant	University of Heidelberg
Libgober, Anatoly S.	Organizer	University of Illinois
Matei, Daniel	Invited Participant	Institute of Mathematics of the Romanian Academy
Maxim, Laurentiu George	Organizer	University of Illinois at Chicago
Mazin, Mikhail	Invited Participant	University of Toronto
Mazzeo, Rafe	Speaker	Stanford University
McCrory, Clinton Graydon	Speaker	University of Georgia
McEwan, Lee J.	Participant	The Ohio State University
Pearlstein, Gregory James	Invited Participant	Michigan State University
Piazza, Paolo	Participant	Università di Roma "La Sapienza"
Pike, Brian	Participant	University of North Carolina at Chapel Hill
Rochon, Frederic	Participant	University of Toronto
Saper, Les	Speaker	Duke University
Schaedler, Konstantin	Invited Participant	University of Heidelberg
Schuermann, Joerg	Invited Participant	Muenster
Scott, Richard Allan	Participant	Santa Clara University
Straser, Oliver	Invited Participant	University of heidelberg
Tang, Xiang	Participant	Washington University
Trotman, David J.A.	Participant	Universite aix Marseille
Waelder, Robert	Invited Participant	University of Illinois at Chicago
Weinberger, Shmuel	Speaker	University of Chicago
Williams, Edward Bruce	Invited Participant	University of Notre Dame
Wunsch, Jared	Member	Northwestern University
Yamazaki, Kazuo	Participant	Stanford University
Yokura, Shoji -	Speaker	Kagoshima University
Yuzvinsky, Sergey	Invited Participant	University of Oregon

Workshop Summary for Elliptic and Hyperbolic Equations on Singular Spaces

Held: October 27 to October 31, 2008

The Mathematical Sciencs Research Institute

Participant Information
87 participants

Gender (n = 87 participants)		
Male	78.16%	68
Female	19.54%	17
Declined to state	2.30%	2

Ethnicity (n = 76 participants)		
White	59.77%	52
Asian	9.20%	8
Hispanic	8.05%	7
Pacific Islander	1.15%	1
Black	0.00%	0
Native American	1.15%	1
Declined to state	8.05%	7

Elliptic and Hyperbolic Equations on Singular Spaces

Invited Speakers

Bunke, Ulrich	Georg-August-Universität
Burq, Nicolas	Université de Paris 11 (Sud)
Hassell, Andrew W.	Australian National University
Mitrea, Marius	University of Missouri, Columbia
Rodnianski, Igor	Princeton University
Saper, Les	Duke University
Schulze, Bert-Wolfgang	Universitat Potsdam
Stern, Mark	Duke University
Tataru, Daniel I.	UC Berkeley
Zworski, Maciej	UC Berkeley
Christiansen, Tanya Julie	University of Missouri, Columbia
Guillarmou, Colin	Centre National de la Recherche Scient
Lebeau, Giles	École Polytechnique
Mazzeo, Rafe	Stanford University
Ivrii, Victor	University of Toronto
Zelditch, Steven	Johns Hopkins University

Elliptic and Hyperbolic Equations on Singular Spaces Schedule		
Monday October 27, 2008		
09:30AM - 10:30AM	Giles Lebeau	a probabilistic view point
10:30AM - 11:00AM	Coffee, Tea in the Atrium	
11:00AM - 12:00PM	Andrew Hassell	Restriction theorems on asymptotically conic manifolds
12:00PM - 02:00PM	Lunch	
02:00PM - 03:00PM	Gregory Eskin	Inverse hyperbolic problems and optical(acoustic)black holes.
03:00PM - 03:30PM	Coffee, tea in the atrium	
03:30PM - 04:30PM	Steven Zelditch	The Cauchy problem for the homogeneous Monge Ampere geodesic equation
Tuesday October 28, 2008		
09:30AM - 10:30AM	Daniel Tataru	Global parametrices and decay for wave and Schroedinger evolutions on asymptotically flat backgrounds
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Nicolas Burq	"The resonant Hermite-Schr\"odinger equation on the sphere"
12:00PM - 02:00PM	LUNCH	
02:00PM - 03:00PM	Mark Stern	Minimal Energy Yang-Mills connections and interpolating instantons.
03:00PM - 03:30PM	Coffee, tea in the atrium	
03:30PM - 04:30PM	Tanya Christiansen	"The scattering matrix, sojourn times, and an inverse problem for planar waveguide
04:45PM - 06:00PM	Reception in the atrium	
Wednesday October 29, 2008		
09:30AM - 10:30AM	Colin Guillarmou	Millson formula for infinite volume case, and the odd zeta Selberg function.
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Rafe Mazzeo	``Flexibility of singular Einstein metrics"
Thursday October 30, 2008		
09:30AM - 10:30AM	Marius Mitrea	Boundary Problems for the Laplacian in Convex Domains
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Robin Graham	11 dimensional supergravity and asymptotically hyperbolic scattering
12:00PM - 02:00PM	LUNCH	
02:00PM - 03:00PM	Bert-Wolfgang Schulze	"The Iterative Structure of Corner Operators"
03:00PM - 03:30PM	Coffee, Tea in the atrium	

Friday October 31, 2008		
09:30AM - 10:30AM	András Vasy	"Wave propagation and high energy resolvent estimates for De Sitter - Schwarzchild space
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Maciej Zworski	Quantization on fractal trapped sets in scattering by convex obstacles
12:00PM - 01:00PM	Victor Ivrii	Dynamics and Spectral Asymptotics

Currently Available Videos

- **Giles Lebeau** , A Probabilistic Viewpoint *October 27,2008, 09:30 AM to 10:30 AM*
- **Andrew Hassell** , Restriction theorems on asymptotically conic manifolds *October 27,2008, 11:00 AM to 12:00 PM*
- **Gregory Eskin** , Inverse hyperbolic problems and optical(acoustic)black holes. *October 27,2008, 02:00 PM to 03:00 PM*
- **Steven Zelditch** , The Cauchy problem for the homogeneous Monge Ampere geodesic equation *October 27,2008, 03:30 PM to 04:30 PM*
- **Daniel Tataru** , Global parametrices and decay for wave and Schroedinger evolutions on asymptotically flat backgrounds *October 28,2008, 09:30 AM to 10:30 AM*
- **Nicolas Burq** , "The resonant Hermite-Schr\"odinger equation on the sphere" *October 28,2008, 11:00 AM to 12:00 PM*
- **Mark Stern** , Minimal Energy Yang-Mills connections and interpolating instantons. *October 28,2008, 02:00 PM to 03:00 PM*
- **Tanya Christiansen** , "The scattering matrix, sojourn times, and an inverse problem for planar waveguide *October 28,2008, 03:30 PM to 04:30 PM*
- **Colin Guillarmou** , Millson formula for infinite volume case, and the odd zeta Selberg function. *October 29,2008, 09:30 AM to 10:30 AM*
- **Rafe Mazzeo** , ``Flexibility of singular Einstein metrics" *October 29,2008, 11:00 AM to 12:00 PM*
- **Marius Mitrea** , Boundary Problems for the Laplacian in Convex Domains *October 30,2008, 09:30 AM to 10:30 AM*
- **Robin Graham** , 11 dimensional supergravity and asymptotically hyperbolic scattering *October 30,2008, 11:00 AM to 12:00 PM*
- **Bert-Wolfgang Schulze** , "The Iterative Structure of Corner Operators" *October 30,2008, 02:00 PM to 03:00 PM*
- **András Vasy** , "Wave propagation and high energy resolvent estimates for De Sitter - Schwarzchild space *October 31,2008, 09:30 AM to 10:30 AM*
- **Maciej Zworski** , Quantization on fractal trapped sets in scattering by convex obstacles *October 31,2008, 11:00 AM to 12:00 PM*
- **Victor Ivrii** , Dynamics and Spectral Asymptotics *October 31,2008, 12:00 PM to 01:00 PM*

Participant List

MSRI Workshop:

Elliptic and Hyperbolic Equations on Singular Spaces

October 27 to October 31, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Albin, Pierre	Organizer	Massachusetts Institute of Technology
Aldana Dominguez, Clara Lucia	Participant	Universität Bielefeld
Bahuaud, Eric C	Participant	University of Washington
Baskin, Dean	Participant	Stanford University
Blair, Matthew David	Participant	University of New Mexico
Bouclet, Jean-Marc	Member	Université de Lille I
Brezina, Jan	Participant	Czech Academy of Sciences
Bunke, Ulrich	Speaker	Universität Regensburg
Burq, Nicolas	Speaker	Université de Paris 11 (Sud)
Carron, Gilles	Organizer	University of Nantes
Christiansen, Tanya Julie	Speaker	University of Missouri, Columbia
Dryden, Emily B.	Participant	Bucknell University
Eskin, Gregory	Invited Participant	UCLA
Felea, Raluca	Invited Participant	Rochester Institute of Technology
Filippakis, Michael E	Participant	National Technical University of Athens
Fogwell, Thomas	Participant	Weiss Associates
Ford, Austin	Invited Participant	Northwestern University
Francsics, Gabor	Participant	Michigan State University
Galstyan, Anahit Ann	Participant	University of Texas Pan American
Gimperlein, Heiko	Participant	Universität Hannover
Gornet, Ruth	Invited Participant	University of Texas at Arlington
Graham, Robin	Invited Participant	University of Washington
Grandjean, Vincent Jean Henri	Participant	University of Bath
Guillarmou, Colin	Speaker	Centre National de la Recherche Scientifique
hall, Michael	Participant	UCLA
Hassell, Andrew W.	Speaker	Australian National University
Hengesbach, Conrad	Member	UC Berkeley
Hillairet, Luc	Participant	Universite de Nantes
Hilsum, Michel	Participant	Centre National de la Recherche Scientifique
Hitrik, Michael	Participant	UC Berkeley
Hunsicker, Eugenie	Participant	Loughborough University
Ivanovici, Oana Danela	Invited Participant	Paris Sud University
Ivrii, Victor	Speaker	University of Toronto
Jasiczak, Michal J	Participant	Adam Mickiewicz University
Karmarkar, Sharada	Participant	Applied Geometries, LLC
Kottke, Christopher	Invited Participant	Massachusetts Institute of Technology
Krainer, Thomas	Participant	Pennsylvania State University
Krupchyk, Katsiaryna	Participant	University of Helsinki
Lebeau, Giles	Speaker	École Polytechnique
Lee, Jeonghun	Participant	University of Minnesota
Lee, John M.	Participant	University of Washington
Liu, Baoping	Participant	UC Berkeley
Loya, Paul	Participant	SUNY Binghamton
Marazzi, Leonardo	Invited Participant	Purdue University
Masamune, Jun	Invited Participant	Worcester Polytechnic Institute
Mazzeo, Rafe	Speaker	Stanford University
Mazzucato, Anna Laura	Participant	Pennsylvania State University
McDonald, Patrick T.	Participant	New College of Florida
Melrose, Richard Burt	Organizer	Massachusetts Institute of Technology
Mitrea, Marius	Speaker	University of Missouri, Columbia
Muller, Jorn	Participant	Universität Bielefeld
Nistor, Victor	Participant	Pennsylvania State University
Planchon, Fabrice	Participant	Université Paris 13
Ponge, Raphael S.	Participant	University of Toronto

Qian, Randy Zhigang	Participant	Northwestern University
Rochon, Frederic	Participant	University of Toronto
Rochon, Frederic	Participant	University of Toronto
Rodnianski, Igor	Speaker	Princeton University
Rowlett, Julie Marie	Notetaker	UC Berkeley
Saez Trumper, Mariel Ines	Participant	Pontificia Universidad Catolica de Chile
Sandoval, Mary R.	Participant	Trinity College
Santoro, Bianca	Participant	Duke University
Saper, Les	Speaker	Duke University
Schulze, Bert-Wolfgang	Speaker	universitat potsdam
Sene, Abdoulaye	Participant	Cheikh Anta DIOP University
Singer, Michael A.	Participant	University of Edinburgh
Stanhope, Elizabeth	Participant	Lewis & Clark University
Stefanov, Plamen	Participant	Purdue University
Steinhauer, Dustin	Participant	UC Berkeley
Stern, Mark	Speaker	Duke University
Stern, Mark	Participant	Duke University
Tataru, Daniel I.	Speaker	UC Berkeley
Taylor, Michael	Organizer	University of North Carolina, Chapel Hill
Trotman, David J.A.	Participant	Universite aix Marseille
Uhlmann, Gunther	Participant	University of Washington
VanValkenburgh, Michael	Participant	UC Berkeley
Vasy, András	Organizer	Stanford University
Vertman, Boris	Invited Participant	University Bonn
Viola, Joseph	Participant	UC Berkeley
Voight, John Michael	Invited Participant	University of Vermont
Wang, Fang	Invited Participant	Massachusetts Institute of Technology
Witt, Ingo	Invited Participant	University of Goettingen
Wrii, Victor	Participant	not available
Wunsch, Jared	Organizer	Northwestern University
Xu, Feng	Participant	Duke University
Zelditch, Steven	Speaker	Johns Hopkins University
Zworski, Maciej	Speaker	UC Berkeley

MSRI Workshop on Discrete Rigidity Phenomena
November 3rd-7th 2008

Organized by Bryna Kra and Ben Green (chief organizers) with Maté Wierdl, Anthony Quas and Emmanuel Lesigne.

Overview. The term "Discrete Rigidity Phenomena" was invented specially for this workshop, which was one of the highlights of the special semester on Ergodic Theory and Additive Combinatorics. Although many of the invited speakers were bemused (or occasionally amused) by the title, they all gave talks very much within the intended spirit of the workshop. This strongly suggests that the time was ripe for such a meeting.

What, then, are Discrete Rigidity Phenomena? Organizer Ben Green gave the opening lecture at the conference, outlining his interpretation of one aspect of this area of study. He mentioned various types of approximate objects arising in additive combinatorics, specifically approximate groups, approximate homomorphisms, and approximate polynomials. He asked a number of questions about such objects, many of which demanded that approximate objects be described more explicitly, perhaps in terms of their exact algebraic analogs or closely related structures. In the talk Green showed that some of the key questions of additive combinatorics, specifically Freiman's theorem and the inverse conjectures for the Gowers norms, may be understood within this context.

Over the course of the week the notion of a Discrete Rigidity Phenomenon, as delineated by the participants' lectures, grew considerably from this rather focussed core.

The program. The week consisted largely of lectures, with four or five on each day except Wednesday when, as is the custom at MSRI, a free afternoon was declared. Monday afternoon included an MSRI/Evans lecture by Fields Medalist Tim Gowers down the hill at Berkeley on the subject of "What is Quadratic Fourier Analysis." In this lecture Gowers discussed some of the ideas from his famous 1998 work on Szemerédi's theorem, regarded by many as the place where modern additive combinatorics was born. He proceeded to bring those ideas thoroughly up to date whilst carefully staying within the brief of this series of talks, designed for a general audience.

Back up the hill, one common theme was the interplay between ergodic theory and additive combinatorics. This was exemplified by the talks of Bernard Host, who discussed joint work with Kra and Maass on nilsequences from an analyst's viewpoint, and Terry Tao, who discussed his joint work with Green on "discrete" dynamics on nilmanifolds and its applications to prime number theory. Tamar Ziegler presented very interesting recent joint work with Trevor Wooley on finding progressions with "arithmetic" common differences in certain sets, and Hillel Furstenberg gave a talk connecting additive combinatorics with so-called piecewise Bohr sets, objects which have recently been studied on the "ergodic" side. The purer ergodic side of the subject was represented by Manfred Einsiedler's talk on issues related to Ratner's measure rigidity theorem (the name of which was the inspiration for the present workshop). Meanwhile, the interplay between dynamics and number theory was brought to the fore by Adrian Ubis' discussion of his recent joint work with Peter Sarnak on the horocycle flow at prime times.

A second major theme centered around the Gowers norms, introduced by Gowers in his work on Szemerédi's theorem and now rather central to additive combinatorics. Hamed Hatami gave a talk about some very general kinds of norms arising in graph

theory which, in a certain sense, generalize Gowers's construction. Julia Wolf talked about her joint work with Tim Gowers clarifying exactly which Gowers norms are necessary to control specific types of linear expressions related to arithmetic progressions. Her talk featured a certain "decomposition" theorem in which a function is split into structured and random parts. Luca Trevisan spoke about a very similar type of result that he was able to approach using language from game theory and computer science. Ryan O'Donnell gave a highly entertaining and polished account of the importance of Gowers-type norms, and in particular the inverse questions associated with them, in theoretical computer science.

A third big theme was a discussion of approximate groups from various perspectives. Harald Helfgott presented his new result on the approximate subgroups of $\mathrm{SL}_3(F_p)$, whilst Emmanuel Breuillard gave a wonderfully accessible account of his so-called Uniform Tits Alternative, a result about a certain notion of approximate subgroups in $\mathrm{GL}_n(k)$. Tom Sanders presented a very general result about approximate groups, valid in quite unstructured settings, and in particular for all solvable groups and all torsion-free groups. James Lee gave a talk establishing quantitative information on sets with a certain precise type of polynomial growth, establishing that they have a nontrivial image inside reasonably small matrix groups over C. Mei-Chu Chang discussed sum-product theorems and their applications to classical character sum estimates, but concluded with some intriguing speculations about approximate subgroups of $\mathrm{SL}_3(C)$. Alexander Gamburd described his work with Bourgain in which the aforementioned additive-combinatorial type results are applied to yield spectacular results about the existence of expanders as Cayley graphs associated to matrix groups. Elon Lindenstrauss gave some hints of his very impressive work joint with Bourgain, Furman and Mozes. In this work they prove, under quite general conditions, that if one takes a walk on the d-dimensional torus T^d by acting using a randomly selected integer matrix from some finite set, this walk becomes uniformly distributed with advancing time.

Lastly (and most welcome) there were a few talks by major experts which did not fit so easily into the above categories, but which amply demonstrated the power of "discrete rigidity phenomenological" modes of thinking in other areas. Avi Widgerson gave a fascinating talk on extractors in computer science and their link with additive combinatorics. Jean Bourgain discussed his amazing work with Gamburd and Sarnak locating almost primes in very strange places – orbits of linear groups. Finally, Akshay Venkatesh hinted at his tour-de-force work with Einsiedler and Margulis on quantitative versions of Ratner's theorem, and went on to discuss how more can be said in number-theoretical situations, where one may benefit from the presence of Hecke operators.

Participants. There were a total of 85 registered participants, as well as numerous other participants from the members in the semester long program at MSRI on additive combinatorics and ergodic theory. This included 23 graduate students.

Funding. The conference was funded by grants from the National Security Agency and from the National Science Foundation.

Workshop Summary for Discrete Rigidity Phenomena in Additive Combinatorics

Held: November 3 to November 7, 2008

The Mathematical Sciencs Research Institute

Participant Information
87 participants

Gender (n = 87 participants)		
Male	80.46%	70
Female	19.54%	17
Declined to state	0.00%	0

Ethnicity (n = 78 participants)		
White	52.87%	46
Asian	19.54%	17
Hispanic	6.90%	6
Pacific Islander	0.00%	0
Black	2.30%	2
Native American	0.00%	0
Declined to state	8.05%	7

Discrete Rigidity Phenomena in Additive Combinatorics

Invited Speakers

Bourgain, Jean	Institute for Advanced Study
Breuillard, Emmanue F.	Ecole Polytechnique
Chang, Mei-Chu	UC Riverside
Einsiedler, Manfred Leopold	The Ohio State University
Frantzikinakis, Nikos	University of Memphis
Furstenberg, Hillel	Hebrew University
Gamburd, Alexander	Northwestern University
Gowers, Timothy	Cambridge University
Helfgott, Harald Andres	University of Montreal
Host, Bernard	Université de Marne-la-Vallée
Lee, James	University of Washington
Lindenstrauss, Elon Bruno	Hebrew University
O'Donnell, Ryan William	Microsoft Corp.
Sanders, Tom	Cambridge University
Sarnak, Peter C.	Princeton University
Tao, Terence	UC Berkeley
Trevisan, Luca	UC Berkeley
Ubis, Adrian	not available
Venkatesh, Akshay	New York University, Courant Institute
Wigderson, Avi	Hebrew University
Wolf, Julia	Institute for Advanced Study
Ziegler, Tamar D	Technion

Discrete Rigidity Phenomena in Additive Combinatorics Schedule		
Monday November 3, 2008		
09:00AM - 09:45AM	Ben Green	Discrete Rigidity Phenomena
10:15AM - 11:00AM	Alexander Gamburd	Uniform spectral gap bounds
11:15AM - 12:00PM	Bernard Host	How does one recognize a nilsequence?
02:15PM - 03:00PM	Mei-Chu Chang	Sum-Product and Character Sums in finite fields
04:00PM - 05:00PM	MSRI/Evans Lecture by Timothy Gowers	
Tuesday November 4, 2008		
10:00AM - 10:45AM	Emmanue Breuillard	A strong Tits Alternative and Arithmetic Heights
11:15AM - 12:00PM	Harald Helfgott	Growth in SL3
01:45PM - 02:30PM	Avi Wigderson	Randomness Extractors
02:35PM - 03:20PM	Tom Sanders	Freiman-type theorems in nonabelian groups
03:45PM - 04:30PM	Tamar Ziegler	Multiple recurrence along the shifted primes
Wednesday November 5, 2008		
09:00AM - 09:45AM	Manfred Einsiedler	Rigidity of unipotent joinings in positive characteristic.
10:15AM - 11:00AM	Ryan O'Donnell	Inverse Theorems and Inapproximability
11:15AM - 12:00PM	Elon Lindenstrauss	On stationary measures and random walks on tori.
12:00PM - 06:00PM	No talks this afternoon	
Thursday November 6, 2008		
10:00AM - 10:45AM	James Lee	Eigenvalue multiplicity and growth of groups
11:15AM - 12:00PM	Adrian Ubis	The horocycle flow and primes
01:45PM - 02:30PM	Jean Bourgain	Extension of Selberg's theorem and sieving in
02:35PM - 03:20PM	Akshay Venkatesh	Uniform distribution and Hecke Operators
04:00PM - 04:45PM	Hillel Furstenberg	Additive Combinatorics and Piecewise Bohr Subsets of N
Friday November 7, 2008		
10:00AM - 10:45AM	Julia Wolf	Decompositions into polynomial phase functions
11:15AM - 12:00PM	Luca Trevisan	A "Boosting" proof of the weak regularity lemma
01:45PM - 02:30PM	Hamed Hatami	Graph norms and Sidorenko's conjecture
02:35PM - 03:20PM	Terence Tao	Distribution of Orbits on NIlmanifolds

Currently Available Videos

- **Ben Green** , Discrete Rigidity Phenomena *November 3,2008, 09:00 AM to 09:45 AM*
- **Alexander Gamburd** , Uniform spectral gap bounds *November 3,2008, 10:15 AM to 11:00 AM*

- **Bernard Host** , How does one recognize a nilsequence? *November 3,2008, 11:15 AM to 12:00 PM*
- **Mei-Chu Chang** , Sum-Product and Character Sums in finite fields *November 3,2008, 02:15 PM to 03:00 PM*
- **Emmanue Breuillard** , A strong Tits Alternative and Arithmetic Heights *November 4,2008, 10:00 AM to 10:45 AM*
- **Harald Helfgott** , Growth in SL3 *November 4,2008, 11:15 AM to 12:00 PM*
- **Avi Wigderson** , Randomness Extractors *November 4,2008, 01:45 PM to 02:30 PM*
- **Tom Sanders** , Freiman-type theorems in nonabelian groups *November 4,2008, 02:35 PM to 03:20 PM*
- **Tamar Ziegler** , Multiple recurrence along the shifted primes *November 4,2008, 03:45 PM to 04:30 PM*
- **Manfred Einsiedler** , Rigidity of unipotent joinings in positive characteristic *November 5,2008, 09:00 AM to 09:45 AM*
- **Ryan O'Donnell** , Inverse Theorems and Inapproximability *November 5,2008, 10:15 AM to 11:00 AM*
- **Elon Lindenstrauss** , On stationary measures and random walks on tori. *November 5,2008, 11:15 AM to 12:00 PM*
- **James Lee** , Eigenvalue multiplicity and growth of groups *November 6,2008, 10:00 AM to 10:45 AM*
- **Adrian Ubis** , The horocycle flow and primes *November 6,2008, 11:15 AM to 12:00 PM*
- **Jean Bourgain** , Extension of Selberg's theorem and sieving in *November 6,2008, 01:45 PM to 02:30 PM*
- **Akshay Venkatesh** , Uniform distribution and Hecke Operators *November 6,2008, 02:35 PM to 03:20 PM*
- **Hillel Furstenberg** , Additive Combinatorics and Piecewise Bohr Subsets of N *November 6,2008, 04:00 PM to 04:45 PM*
- **Julia Wolf** , Decompositions into polynomial phase functions *November 7,2008, 10:00 AM to 10:45 AM*
- **Luca Trevisan** , A Boosting proof of the weak regularity lemma *November 7,2008, 11:15 AM to 12:00 PM*
- **Hamed Hatami** , Graph norms and Sidorenko's conjecture *November 7,2008, 01:45 PM to 02:30 PM*
- **Terence Tao** , Distribution of Orbits on NIlmanifolds *November 7,2008, 02:35 PM to 03:20 PM*

Participant List

MSRI Workshop:

Discrete Rigidity Phenomena in Additive Combinatorics

November 3 to November 7, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institue
Allahbakhshi, Mahnaz	Invited Participant	University of Victoria
Atingabunor, George Amoah	Participant	Khomanani Business College
Austin, Tim	Invited Participant	UC Berkeley
Beame, Paul	Participant	University of Washington
Bourgain, Jean	Speaker	Institute for Advanced Study
Breuillard, Emmanue F.	Speaker	Ecole Polytechnique
Bukh, Boris	Invited Participant	Princeton University
Bystron, Jakub	Participant	Karlovy (Charles) University
Campbell, James T.	Participant	University of Memphis
Chan, Siu Man	Participant	UC Berkeley
Chan, Siu On	Participant	UC Berkeley
Chang, Mei-Chu	Speaker	UC Riverside
Chism, Lyrial Marie	Participant	University of Mississippi
Chu, Qing	Invited Participant	Universite Paris-Est Marne-La-Vallee
Coronel, Alvaro	Invited Participant	Universidad de Chile
Cruz Morales, John Alexander	Participant	Universidad Nacional de Colombia
De, Anindya	Participant	UC Berkeley
Einsiedler, Manfred Leopold	Speaker	Ohio State University
Eisner, Tatjana	Invited Participant	Eberhard-Karls-Universität Tübingen
Ferenczi, Sebastien Simon	Participant	National Council for Scientific Research
Frantzikinakis, Nikos	Speaker	University of Memphis
Furstenberg, Hillel	Speaker	The Hebrew University of Jerusalem
Gamburd, Alexander	Speaker	Northwestern University
Gill, Nick	Participant	University of Cambridge
Gowers, Timothy	Speaker	University of Cambridge
Green, Ben Joseph	Organizer	University of Cambridge
Hatami, Hamed	Invited Participant	University of Toronto
Helfgott, Harald Andres	Speaker	University of Montreal
Hochman, Michael Zvi	Participant	Princeton University
Host, Bernard	Speaker	Université de Marne-la-Vallée
Jean-Francois, Bertazzon	Participant	Universite aix Marseille
Jones, Nathan C	Invited Participant	Universite de Montreal
Kaufman, Tali	Invited Participant	Massachusetts Institute of Technology
Kra, Bryna	Organizer	Northwestern University
Kurlberg, Par Martin	Participant	Royal Institute of Technology
Le, Anh Vinh	Invited Participant	Harvard University
Le, Thai Hoang	Invited Participant	UCLA
Lee, Jaewoo	Invited Participant	City University of New York (CUNY)
Lee, James	Speaker	University of Washington
Lesigne, Emmanuel	Organizer	Université François Rabelais
Lind, Douglas	Participant	University of Washington
Lindenstrauss, Elon Bruno	Speaker	Hebrew University
Lu, Guangshi	Participant	Stanford University
Maass, Alejandro Eduardo	Participant	University of Chile
Matthiesen, Lilian	Invited Participant	University of Cambridge
McClendon, David Matthew	Participant	Northwestern University
McCutcheon, Randall G	Participant	University of Memphis
Nedev, Zhivko	Participant	University of Victoria
Nguyen, Hoi Huu	Invited Participant	Rutgers University
O'Donnell, Ryan	Participant	Carnegie-Mellon University
O'Donnell, Ryan William	Speaker	Microsoft Corp.
Oliveira e Silva, Diogo	Participant	UC Berkeley
Omar, Sami	Participant	University of Tunis
Packer, Judy	Participant	University of Colorado

Pete, Gabor	Participant	University of Toronto
Pitassi, Toniann	Participant	University of Toronto
Potgieter, Paul	Participant	University of South Africa
Potts, Amanda	Invited Participant	Northwestern University
Pramanik, Malabika	Invited Participant	Univ of Britiish Columbia
Prendiville, Sean	Invited Participant	University of Bristol
Quas, Anthony	Organizer	University of Victoria
Roy, Emmanuel	Participant	Institut Galilée
Sanders, Tom	Speaker	University of Cambridge
Sarnak, Peter C.	Speaker	Princeton University
Schraudner, Michael Heinrich	Participant	University of Chile
Shkredov, Ilya Dmitrievich	Participant	Moscow State University
Shmerkin, Pablo S	Participant	University of Jyväskylä
Sisask, Olof	Invited Participant	University of Cambridge
So, Wasin	Participant	San Jose State University
Solomyak, Boris	Invited Participant	University of Washington
Solymosi, Jozsef	Invited Participant	University of British Columbia
subedi, deepak	Participant	North-Eastern Hill University
Tao, Terence	Speaker	UC Berkeley
Towsner, Henry Piers	Participant	Carnegie Mellon University
Trevisan, Luca	Speaker	UC Berkeley
Tulsiani, Madhur	Participant	UC Berkeley
Ubis, Adrian	Speaker	not available
Venkatesh, Akshay	Speaker	New York University, Courant Institute
Wang, Yonghui	Participant	Stanford University
Wang, Zhiren	Invited Participant	Princeton University
Wierdl, Mate	Organizer	University of Memphis
Wigderson, Avi	Speaker	Hebrew University
Wolf, Julia	Speaker	Institute for Advanced Study
Xu, Zhe	Participant	Northwestern University
Yekhanin, Sergey	Invited Participant	Microsoft Corp.
Zelenyuk, Yuliya	Participant	University of the Witwatersrand
Ziegler, Tamar D	Speaker	Technion

Workshop Summary for International Conference on Cluster Algebras and Related Topics

Held: December 8 to December 20, 2008

The Mathematical Sciencs Research Institute

Participant Information
17 participants

Gender (n = 17 participants)		
Male	76.47%	13
Female	23.53%	4
Declined to state	0.00%	0

Ethnicity (n = 15 participants)		
White	35.29%	6
Asian	29.41%	5
Hispanic	5.88%	1
Pacific Islander	0.00%	0
Black	5.88%	1
Native American	0.00%	0
Declined to state	11.76%	2

Participant List

MSRI Workshop:

International Conference on Cluster Algebras and Related Topics

December 8 to December 20, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Appel, Andrea	Invited Participant	Northeastern University
Salvatore, Stella	Invited Participant	Northeastern University
Carrol, Andrew	Invited Participant	Northeastern University
Labardini, Daniel	Invited Participant	Northeastern University
Lam, Thomas	Invited Participant	Harvard
Fei, Jarui	Invited Participant	Ann Arbor
Gautam, Sachin	Invited Participant	Northeastern University
Musiker, Gregg	Invited Participant	Massachusetts Institute of Technology
Pylyavskyy, Pavlo	Invited Participant	Ann Arbor
Serrano, Luis	Invited Participant	Ann Arbor
Speyer, David	Invited Participant	Massachusetts Institute of Technology
Sutar, Kavita	Invited Participant	Northeastern University
Talaska, Kelli	Invited Participant	Ann Arbor
Thind, Jaimal	Invited Participant	SUNY Stony Brook
Tran, Tao	Invited Participant	Northeastern University
Williams, Lauren	Invited Participant	Harvard

Algebraic Statistics

Final Report for the MSRI workshop, December 15-18, 2008

Organizers: Serkan Hoşten, Lior Pachter and Bernd Sturmfels

Algebraic statistics is a maturing discipline focused on the applications of algebraic geometry and its computational tools in the study of statistical models. Initial results in the area were related to specific problems in categorial data analysis and experimental design, however a flurry of activity during the past several years has greatly increased the scope of the subject. Areas of interest now include graphical models, maximum likelihood estimation and Bayesian methods. Moreover, a strong connection has developed to applications in the physical and biological sciences. The field draws its tools not only from computational algebraic geometry but also from tropical, convex, and information geometry. Moreover, research in algebraic statistics has led to new directions in those fields. The highly successful workshop provided a unique focal point for students, postdocs and leaders in the field.

There was a total number of 77 registered participants, most of which were either graduate students or young mathematicians or statisticians, within three years of their PhD. There was a strong contingent of Berkeley students, since Bernd Sturmfels had just finished teaching a one-semester introductory course on Algebraic Statistics down the hill. Particular attention was paid to creating synergy with – and complementarity to – the one-year program 2008-09 on *Algebraic methods in Statistics and Systems Biology* at SAMSI.

The four-day workshop had a total number of 23 talks. Nine of them were one-hour talks, delivered in the mornings by senior researchers, while the other 14 talks lasted 40 minutes, and all the latter speakers were either postdocs or graduate students. The series of morning talks started with Milan Studenỳ who gave an overview on conditional independence structures and recent research with Raymond Hemmecke on polyhedral methods. Aleksandra Slavkovich presented the use of Markov bases as a tool for statistical problems in disclosure limitation and privacy, important area of societal concern. Applications to the life sciences were in the foreground in the presen-

tations by Marta Casanellas, who spoke on recent advances on phylogenetic invariants, and Ruriko Yoshida, who laid out a geometrical framework for addressing problems about cophylogenies in evolutionary biology. Her lively presentation energized the graduate students, as it included the offer of a cash prize of $10,000$ Yen for the solution to a relevant mathematics question.

The connection between algebraic statistics and information geometry was highlighted in the presentations by Nihat Ay, who introduced the natural geometry of exponential families, and Giovanni Pistone, who demonstrated the use of Gröbner basis techniques for inference in information geometry. Particular highlights of the conference were the lectures by two senior statisticians from Japan. Akimichi Takemura persuasively showed how the representation theory of finite groups can be applied to determine the invariance of hierarchical models and thus facilitate the computation of their Markov bases. Sumio Watanabe spoke about the real log-canonical threshold of a parametrized statistical model. His fascinating work demonstrates the practical use of resolution of singularities in the asymptotic evaluation of marginal likelihood integrals in Bayesian statistics. Last but not least, Seth Sullivant surveyed recent advances on finiteness theorems in algebraic statistics, with particular emphasis on his breakthrough with Chris Hillar on finite generation of symmetric ideals in polynomial rings with countably many unknowns.

The 14 talks by students and postdocs were all extremely well-presented, and they demonstrated an amazing range of high-level research in algebraic statistics and related fields of inquiry. The presenters and their topics were:

Risi Kondor: Non-commutative harmonic analysis in machine learning
Sonja Petrovic: Markov basis for p1 random graph models
Villo Csiszar: Hierarchical models for random permutations
Lek-Heng Lim: Algebraic models for higher-order correlations
Piotr Zwiernik: Semialgebraic description of conditional independ. models
Luke Oeding: Towards the salmon conjecture
Serguei Norine: Markov bases of binary graph models
Alexander Schoenhuth: Equations for hidden Markov and related models
Shaowei Lin: Asymptotic approximation of marginal likelihood integrals
Han Xiao: Finiteness of small factor analysis models
Daniel Bates: Exactness in numerical algebraic computations
Philipp Rostalski: Moment matrices and real root finding
Ahmad Yasamin: The Wishart distribution over a Lorentz cone
Caroline Uhler: Commuting birth-and-death processes

MSRI Mathematical Sciences Research Institute

Algebraic Statistics

December 15, 2008 to December 18, 2008

Schedule

Monday December 15, 2008		
9:15AM - 9:30AM	Welcome From MSRI Director, Robert Bryant	
09:30AM - 10:30AM	Milan Studeny	Conditional independence structures and polyhedra
10:30AM - 11:00AM	coffee, tea in the atrium	
11:00AM - 12:00PM	Aleksandra Slavkovich	Algebraic Statistics and Disclosure Limitation Problems
12:00PM - 1:30AM	Lunch	
1:30PM - 2:10PM	Risi Kondor	Non-commutative harmonic analysis in machine learning
2:20PM - 3:00PM	Sonja Petrovic	Markov basis for p1 random graph models
3:00PM - 3:30PM	Coffe, tea in the atrium	
3:30PM - 4:10PM	Villo Csiszar	Hierarchical models for random permutations
4:20PM - 5:00PM	Lek-Heng Lim	Algebraic models for higher-order correlations
Tuesday December 16, 2008		
9:30AM - 10:30AM	Akimichi takemura	Perturbation method for determining group of invariance of hierarchical models
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Marta Casanellas	Phylogenetic invariants
12:00PM - 1:30PM	Lunch	
1:30PM - 2:10PM	Piotr Zwiernik	Semi-algebraic description of conditional independence tree models for binary data
2:20PM - 3:00PM	Luke Oeding	Towards the salmon conjecture
3:00PM - 3:30PM	Coffee, tea in the atrium	
3:30PM - 4:10PM	Serguei Norine	Markov bases of binary graph models
4:20PM - 5:00PM	Alexander Schoenhuth	Equations for hidden Markov and related models
5:00PM - 7:00PM	Reception in the atrium	

Wednesday December 17, 2008		
9:30AM - 10:30AM	Nihat Ay	On the natural geometry of exponential families
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Sumio Watanabe	Algebraic Geometrical Method in Singular Statistical Estimation
12:00PM - 1:30PM	Lunch	
1:30PM - 2:10PM	Shaowei Lin	Asymptotic Approximation of Marginal Likelihood Integrals
2:20PM - 3:00PM	Han Xiao	Finiteness of small factor analysis models
3:00PM - 3:30PM	Coffe, tea in the atrium	
3:30PM - 4:10PM	Daniel Bates	Exactness in numerical algebraic computations
4:20PM - 5:00PM	Philipp Rostalski	Moment matrices and real root finding
6:00PM - 8:00PM	Dinner TBD	
Thursday December 18, 2008		
9:30AM - 10:30AM	Ruriko Yoshida	First steps toward the geometry of cophylogeny
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Giovanni Pistone	Algebraic statistics in non-parametric information geometry"
12:00PM - 1:30PM	Lunch	
1:30PM - 2:10PM	Ahmad Yasamin	Hypothesis Testing For The Wishart Distributions Over A Lorentz Cone
2:20PM - 3:00PM	Caroline Uhler	Commuting birth-and-death processes
3:00PM - 3:30PM	Coffee, tea in the atrium	
3:30PM - 4:30PM	Seth Sullivant	Finiteness theorems in algebraic statistics

Current Available Videos

- **Milan Studeny** , Conditional independence structures and polyhedra *December 15,2008, 09:30 AM to 10:30 AM*
- **Aleksandra Slavkovich** , Algebraic Statistics and Disclosure Limitation Problems *December 15,2008, 11:00 AM to 12:00 PM*
- **Risi Kondor** , Non-commutative harmonic analysis in machine learning *December 15,2008, 01:30 PM to 02:10 PM*
- **Sonja Petrovic** , Markov basis for p1 random graph models *December 15,2008, 02:20 PM to 03:00 PM*
- **Villo Csiszar** , Hierarchical models for random permutations *December 15,2008, 03:30 PM to 04:10 PM*
- **Lek-Heng Lim** , Algebraic models for higher-order correlations *December 15,2008, 04:20 PM to 05:00 PM*
- **Akimichi takemura** , Perturbation method for determining group of invariance of hierarchical models *December 16,2008, 09:30 AM to 10:30 AM*
- **Marta Casanellas** , Phylogenetic invariants *December 16,2008, 11:00 AM to 12:00 PM*
- **Piotr Zwiernik** , Semi-algebraic description of conditional independence tree models for binary data *December 16,2008, 01:30 PM to 02:10 PM*
- **Luke Oeding** , Towards the salmon conjecture *December 16,2008, 02:20 PM to 03:00 PM*
- **Serguei Norine** , Markov bases of binary graph models *December 16,2008, 03:30 PM to 04:10 PM*
- **Alexander Schoenhuth** , "Equations for hidden Markov and related models" *December 16,2008, 04:20 PM to 05:00 PM*
- **Nihat Ay** , On the natural geometry of exponential families *December 17,2008, 09:30 AM to 10:30 AM*

- **Sumio Watanabe** , Algebraic Geometrical Method in Singular Statistical Estimation *December 17,2008, 11:00 AM to 12:00 PM*
- **Shaowei Lin** , Asymptotic Approximation of Marginal Likelihood Integrals *December 17,2008, 01:30 PM to 02:10 PM*
- **Han Xiao** , Finiteness of small factor analysis models *December 17,2008, 02:20 PM to 03:00 PM*
- **Daniel Bates** , Exactness in numerical algebraic computations *December 17,2008, 03:30 PM to 04:10 PM*
- **Philipp Rostalski** , Moment matrices and real root finding *December 17,2008, 04:20 PM to 05:00 PM*
- **Ruriko Yoshida** , First steps toward the geometry of cophylogeny *December 18,2008, 09:30 AM to 10:30 AM*
- **Giovanni Pistone** , Algebraic statistics in non-parametric information geometry" *December 18,2008, 11:00 AM to 12:00 PM*
- **Ahmad Yasamin** , Hypothesis Testing For The Wishart Distributions Over A Lorentz Cone *December 18,2008, 01:30 PM to 02:10 PM*
- **Caroline Uhler** , Commuting birth-and-death processes *December 18,2008, 02:20 PM to 03:00 PM*
- **Seth Sullivant** , Finiteness theorems in algebraic statistics *December 18,2008, 03:30 PM to 04:30 PM*

Speaker List

MSRI Workshop

Algebraic Statistics

December 15, 2008 to December 18, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Ay, Nihat	Speaker	Max Planck Institute for Colloids and Interfaces
Casanellas, Marta	Speaker	Universitat Politecnica de Catalunya
Csiszar, Villo	Speaker	Eötvös Loránd University (ELTE)
Hower, Valerie Marie	Speaker	Georgia Institute of Technology
Kondor, Risi	Speaker	University College
Petrovic, Sonja	Speaker	University of Illinois
Pistone, Giovanni	Speaker	Politecnico Di Torino
Slavkovich, Aleksandra	Speaker	Pennsylvania State University
Studeny, Milan	Speaker	Institute of information theory and Automation
Sullivant, Seth Michael	Speaker	UCB - University of California, Berkeley
takemura, Akimichi	Speaker	The University of Tokyo
Uhler, Caroline	Speaker	University of California
Watanabe, Sumio	Speaker	Tokyo Institute of Technology
Yoshida, Ruriko	Speaker	University of Kentucky
Zwiernik, Piotr	Speaker	University of Warwick

Participant List

MSRI Workshop

Algebraic Statistics

December 15, 2008 to December 18, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Amini, Omid	Participant	Institut Max-Planck MPII, Allemagne & Université McGill
Arcak, Murat	Participant	University of California
Ay, Nihat	Speaker	Max Planck Institute for Colloids and Interfaces
Bates, Daniel J	Participant	Colorado State University
Beck, Matthias	Participant	San Francisco State University
Bi, Shuchau	Participant	University of California
Birkner, René	Participant	Freie Universität Berlin, Institut für Mathematik
Canepa, Bogdan	Participant	University of Bucharest
Canepa, Elena Cristina	Participant	Carnegie-Mellon University
Capobianco, Enrico	Participant	Center for Research and Development in Sardinia, Bioinformatics Laboratory, Science and Technology Park
Cartwright, Dustin	Participant	Department of Mathematics
Casanellas, Marta	Speaker	Universitat Politecnica de Catalunya
Chan, Melody	Participant	University of California
Coleman, Deidra Andrea	Participant/Notetaker	North Carolina State University
Csiszar, Villo	Speaker	Eötvös Loránd University (ELTE)
Cueto, Maria Angelica	Notetaker	University of California
Di, Yanming	Participant	University of Washington
Eisenbud, David	Participant	UC Berkeley Math Faculty
Engström, Alexander	Participant	Royal Institute of Technology (KTH)
Fernández-Sánchez, Jesús	Participant	Polytechnical University of Cataluña (Barcelona)
Fink, Alex	Participant	UC Berkeley
Friedrich, Thomas	Particpant	Freie Universität Berlin
Gupta, Shuva	Participant	Florida State University
Haase, Christian Alexander	Participant	Math Dept, FU Berlin
Hara, Hisayuki	Participant	University of Tokyo
Harris, Kelley	Participant	Harvard University
Haws, David	Participant	University of California
Hemmecke, Raymond	Participant	TU Darmstadt
Hillar, Christopher Jacques	Participant	Texas A & M University
Hodge, Terrell L.	Participant	Western Michigan University
Hosten, Serkan	Organizer	San Francisco State University
Hower, Valerie Marie	Speaker	Georgia Institute of Technology
Karmarkar, Sharada	Participant	Applied Geometries, LLC
Kim, Edward	Participant	Department of Mathematics, UC Davis
Koeppe, Matthias	Participant	University of California
Kondor, Risi	Speaker	University College
Kornilov, Petr	Participant	N/A
Korsan, Bob	Participant	Decisions, Decisions!
Lee, Tong	Participant	Hunter College, CUNY
Leykin, Anton	Participant	University of Illinois

Li, Qunhua	Participant	University of California
Lim, Lek-Heng	Participant	University of California, Berkeley
Lin, Shaowei	Participant	University of California
Malagò, Luigi	Participant	Politecnico di Milano
Matsen, Frederick	Participant	University of California
Merberg, Adam	Participant	University of California
Miranda, Eric Douglas	Participant	San Francisco State University
Morton, Jason	Participant	Stanford University
Norine, Serguei	Participant	Princeton University
Oeding, Luke	Participant	Texas A & M University
Ovchinnikov, Sergei	Participant	San Francisco State University
Pachter, Lior	Organizer	UCB - University of California, Berkeley
Pardue, Keith	Participant	Department of Defense
Petrovic, Sonja	Speaker	University of Illinois
Pistone, Giovanni	Speaker	Politecnico Di Torino
Rau, Johannes	Participant	Technische Universitaet Kaiserslautern
Reyhani, Nima	Participant	University of California
Rostalski, Philipp	Participant	Automatic Control Laboratory
Sagnol, Guillaume	Participant	Centre de Mathématiques Appliquées de l'école Polytechnique
Schoenhuth, Alexander	Participant	Simon Fraser University
Seceleanu, Alexandra	Participant	University of Illinois at Urbana-Champaign
Sei, Tomonari	Participant	University of Tokyo
Shiu, Anne J.	Participant	University of California
Slavkovich, Aleksandra	Speaker	Pennsylvania State University
Studeny, Milan	Speaker	Institute of information theory and Automation
Sturmfels, Bernd	Organizer	UCB - University of California, Berkeley
Sullivant, Seth Michael	Speaker	UCB - University of California, Berkeley
takemura, Akimichi	Speaker	The University of Tokyo
Tannor, David	Participant	Western Michigan University
Uhler, Caroline	Speaker	University of California
Vinzant, Cynthia	Participant	University of California
Watanabe, Sumio	Speaker	Tokyo Institute of Technology
Xiao, Han	Participant	The University of Chicago
Yamazaki, Kazuo	Participant	Stanford University
Yarahmadian, Shantia	Participant	Indiana Molecular Biology Institute
Yasamin, Ahmad Saeid	Participant	University of North Carolina
Yoshida, Ruriko	Speaker	University of Kentucky
Yu, Josephine T.	Participant	Massachusetts Institute of Technology
Zheng, Wenjing	Participant	University of California
Zuk, Or	Participant	Massachusetts Institute of Technology
Zwiernik, Piotr	Speaker	University of Warwick

Workshop Summary for Algebraic Statistics

Held: December 15 to December 18, 2008

The Mathematical Sciencs Research Institute

Participant Information
82 participants

Gender (n = 82 participants)		
Male	74.39%	61
Female	24.39%	20
Declined to state	1.22%	1

Ethnicity (n = 81 participants)		
White	62.20%	51
Asian	23.17%	19
Hispanic	4.88%	4
Pacific Islander	0.00%	0
Black	2.44%	2
Native American	0.00%	0
Declined to state	6.10%	5

REPORT FOR THE WORKSHOP ON *CONNECTIONS FOR WOMEN: ALGEBRAIC GEOMETRY AND RELATED FIELDS*

ANGELA GIBNEY, BRENDAN HASSETT, SÁNDOR KOVÁCS, DIANE MACLAGAN, JESSICA SIDMAN AND RAVI VAKIL

Twenty-first century algebraic geometry is a broad subject, with mathematicians on different frontiers sharing little background. In addition there is a lot of exciting work happening at the interfaces of algebraic geometry with neighboring fields. This workshop was aimed to extend the "Connections" theme to connecting mathematicians, particularly graduate students and postdocs from differing areas and from neighboring fields, to each other.

The workshop ran for three days, from Thursday to Saturday. Taking the nontraditional measure of extending the workshop into the weekend allowed broader participation, especially from those at colleges with higher teaching loads. When we asked for a show of hands, over 27 (out of approximately 70) people indicated that this was indeed helpful in allowing their attendence.

The workshop consisted of six hour-long plenary talks given by established mathematicians, four half-hour talks by postdocs, a panel discussion on professional development issues, and a poster session.

Lucia Caporaso, from Rome III, opened the conference with a modern update of the classical Torelli theorem and its interpretation for curves and abelian varieties. Tara Holm, from Cornell, gave an introduction of symplectic techniques in algebraic geometry. For the final talk of the day, conference participants attended the UC Berkeley Colloquium which was given by Karen Smith, from the University of Michigan. Sara Billey, from the University of Washington, gave the opening talk of the second day of the workshop, giving an introduction to affine Grassmannians. The second and third talks were half hour presentations by postdocs Sonja Petrović, from UIC, and Rebecca Lehman, from Bar Ilan/and Tulane. Petrović talked about Graver bases of varieties of minimal degree and Lehman talked about branch curves of singular surfaces. The last hour talk was given by Linda Chen, from Swarthmore College, who gave an introduction to enumerative geometry, Gromov-Witten theory, and orbifolds. On the last day of the workshop, hour long talks were given by Rachel Pries, from Colorado

State University and Rekha Thomas, from the University of Washington. Pries spoke about the boundary of the moduli space of curves and arithmetic applications. Thomas gave an introduction to problems in convex algebraic geometry. Amanda Knecht, from the University of Michigan gave a half-hour talk on weak approximation for degree 2 del Pezzo surfaces. The final half-hour talk was given by Kelly McKinnie, from Rice University, who gave an introduction to indecomposable classes in the Brauer group of $\mathbb{Q}_p(t)$.

For the panel discussion, we wanted to give the participants an opportunity to have useful group discussions about issues related to academic life of concern to them. We set up a panel in the morning of the first day with the hope that the discussions started there would continue throughout the workshop. We asked panelists to give very brief self-introductions highlighting experiences that they thought might be of interest to the audience. We did not set a formal topic because we did not want to presuppose that we knew what participants wanted to hear. The focus of participants' questions was overwhelmingly directed towards searching for temporary and permanent academic positions.

We selected a panel of people representing a wide range of experiences including serving on hiring committees, writing grants, getting tenure, teaching at a liberal arts college, applying for jobs, serving as the editor of a journal, and having children. The panel consisted of Jessica Sidman (Mount Holyoke College), Susan Sierra (University of Washington), Elham Izadi (University of Georgia), and Karen Smith (University of Michigan).

We encouraged participants to put additional questions in writing as the workshop progressed. We had a time slot for these questions on Saturday afternoon. We fielded questions regarding the journal submission process, collaborators, getting letters of recommendation, knowing when to graduate, publication patterns, and job searches.

These aspects of the conference were clearly appreciated by the participants. One graduate student participant wrote afterwards "The conference was very different from many I've attended. It had a unique focus on not only math, but how to be a mathematician, which I've never encountered before. For those of us just starting in the profession that's very useful, and it's something I have not gotten from other sources."

On Friday afternoon there was a very successful poster session accompanied by a reception in which the participants (whose names, titles and abstracts are listed in Section 1) discussed their work with both workshop participants and visitors to MSRI. The posters were displayed in the atrium for the remainder of the conference.

We wanted our funding decisions to be consistent and transparent. We devised the following criteria: We gave $396 per diem + $250 for travel for people who presented posters as we felt that their commitment to participate at this higher level should be recognized. We allotted $396 per diem for postdocs who were not giving posters. We gave $198 per diem for graduate students beyond their first year who were not giving posters. Postdocs received more than graduate students in this system because we felt graduate students might have extra funding resources available to them through their advisors.

1. Poster participants, titles and abstracts

Sami Assaf, Massachusetts Institute of Technology
Cores, quotients and the affine Grassmannian

We describe how the combinatorics of core partitions can be used to describe the homology classes of the affine Grassmannian, and we make connections with the related combinatorics of quotients of partitions. This is based on joint work with Sara Billey.

Silvia Brannetti, Terza Universitá di Roma
A combinatorial approach to Alexander-Hirschowitz's theorem based on toric degenerations

We present an alternative proof of Alexander-Hirschowitz's Theorem in dimension 3 using degenerations of toric varieties.

Susan Cooper, University of Nebraska
Hilbert Functions of Fat Points

Certain data about a finite set of distinct, reduced points in projective space can be obtained from its Hilbert function. It is well known what these Hilbert functions look like, and it is natural to try to generalize this characterization to non-reduced schemes. In particular, we consider a fat point scheme determined by a set of distinct points (called the support) and non-negative integers (called the multiplicities)

In general, it is not yet known what the Hilbert functions are for fat points with fixed multiplicities as the support points vary. However, if the points are in projective 2-space and the number of support points is 8 or less, we can write down all of the possible Hilbert functions for any given set of multiplicities (due to Guardo-Harbourne and Geramita-Harbourne-Migliore). We will focus on what can be said, in projective 2-space, given information about what collinearities occur among the

support points. Using this information we obtain upper and lower bounds for the Hilbert function of the fat point scheme.

Moreover, we give a simple criterion for when the bounds coincide yielding a precise calculation of the Hilbert function in this case. This is joint work with B. Harbourne and Z. Teitler.

Milena Hering, University of Utah

Some topics in toric Geometry and the Hilbert scheme of points in the plane

I will present some results about equations and syzygies of toric varieties, in particular a class of toric varieties arising as a toric degeneration of the moduli space of weighted points on the projective line; positivity properties of toric vector bundles; the graph of zero- and one-dimensional torus orbits of the Hilbert scheme of points in the plane.

Val Hower, Georgia Tech

Comparing the topology of real and complex toric varieties

By definition, a real algebraic variety X is maximal if the sum of the $\mathbb{Z}/2\mathbb{Z}$ Betti numbers of the real points $X(\mathbb{R})$ is equal to the sum of the $\mathbb{Z}/2\mathbb{Z}$ Betti numbers of the complex points $X(\mathbb{C})$. In 2004 Bihan, Franz, McCrory, and van Hamel conjectured that every toric variety is maximal. Their conjecture was based in part on the numerous examples of maximal toric varieties (including all nonsingular projective toric varieties). After giving some examples of the Betti numbers for real and complex toric varieties, we establish the maximality of a large class of singular toric varieties using polyhedral duality and the language of cosheaves on fans. In addition, we give some counterexamples to the conjecture.

DongSeon Hwang, Korea Advanced Institute of Science and Technology

The maximum number of singular points on rational homology projective planes

A normal projective complex surface is called a rational homology projective plane if it has the same Betti numbers with the complex projective plane $\mathbb{CP}^2$.It is known that a rational homology projective plane with quotient singularities has at most 5 singular points. So far all known examples have at most 4 singular points. Recently, Belousov

proved that every log del Pezzo surface of Picard number one has at most 4 singular points. In this poster, after a brief introduction to rational homology projective planes with quotient singularities, we will present a sketch of a proof of the following theorem: every rational homology projective plane S with quotient singularities such that K_S is nef has at most 4 singular points except one case. The exceptional case comes from Enriques surfaces with a configuration of 9 smooth rational curves whose Dynkin diagram is of type $3A_1 \oplus 2A_3$. This is a joint work with JongHae Keum.

Enka Lakuriqi, University of Utah
Mirror Symmetry for Enriques Surfaces

Mirror symmetry is a duality between type II string theories. Mathematically, it can be translated as a duality between Calabi-Yau varieties. As the duality is natural, it carries over symmetries and one could thus naturally ask what the mirror of Enriques surfaces are. In this poster, I will present some recent work on how to find mirrors of Enriques surfaces using the Hori-Vafa ansatz and more general methods.

Sonja Mapes, Columbia University
LCM lattices and cellular resolutions of monomial ideals

The minimal free resolution of a monomial ideal can be expressed entirely in terms of the LCM lattice of the ideal. It has also been shown that given a finite atomic lattice L one can construct certain monomial ideals M whose LCM lattice is L. I explore the relationship between LCM lattices whose associated monomial ideals have similar resolutions.

Margarida Melo, Terza Universit di Roma
Compactified Picard stacks over the moduli space of stable curves with marked points

Let $\mathcal{P}ic_{d,g,n}$ be the stack parametrizing degree d line bundles over smooth curves of genus g with n marked points. We will explain how to give a construction of smooth and irreducible algebraic stacks yielding a modular compactification of $\mathcal{P}ic_{d,g,n}$ over the moduli stack of n-pointed stable curves, $\overline{\mathcal{M}}_{g,n}$. By this we mean an algebraic stack with a proper (or at least universally closed) map onto $\overline{\mathcal{M}}_{g,n}$, containing $\mathcal{P}ic_{d,g,n}$ as a dense open substack.

These stacks parametrize what we will call balanced line bundles over n-pointed quasistable curves, generalizing L. Caporaso's compactification of the universal degree d Picard variety over $\overline{\mathcal{M}}_g^0$. In fact, for $n = 0$, we just give a stack theoretical description of Caporaso's compactification and then, following the lines of Knudsen's construction of $\overline{\mathcal{M}}_{g,n}$, we go on by induction on the number of points.

Elizabeth Sell, Millersville University

Universal abelian covers for surface singularities $\{z^n = f(x, y)\}$

The splice quotients are an interesting class of normal surface singularities with rational homology sphere links, defined by W. Neumann and J. Wahl. The universal abelian cover of a splice quotient is a complete intersection surface singularity of a certain type. If Γ is a tree of rational curves that satisfies certain combinatorial conditions, then there exist splice quotients with resolution graph Γ. Suppose the equation $z^n = f(x, y)$ defines a surface $X_{f,n}$ with an isolated singularity at the origin in $\mathbb{C}^3$. For f irreducible, we completely characterize, in terms of n and a variant of the Puiseux pairs of f, those $X_{f,n}$ for which the resolution graph satisfies the combinatorial conditions that are necessary for splice quotients.

Susan Sierra, University of Washington

The geometry of birationally commutative surfaces

Given a projective surface X over a field k and an automorphism σ of X, as well as other data, one may construct a number of families of graded rings, which are known as *birationally commutative (projective) surfaces*. Because these rings are all subrings of the skew polynomial ring $k(X)[z; \sigma]$, they are noncommutative. The geometry of the underlying data controls the algebraic properties of the various rings, but these connections are often quite unexpected, and the geometric properties that one must consider are rather subtle. We explore some of these connections, and show how they lead to a classification of all birationally commutative surfaces. We also mention recent joint results with Bell and Rogalski that relate dynamics on complex surfaces to noncommutative algebra.

Kaisa Taipale, University of Minnesota Twin Cities
The Abelian/Nonabelian Correspondence

The abelian/nonabelian correspondence suggests a relationship between the Gromov-Witten theory of Grassmannians $G(k, n)$ and the twisted Gromov-Witten theory of products of projective space $(\mathbb{P}^{n-1})^k$. My poster introduces Gromov-Witten invariants, outlines the geometric meaning of the conjectured correspondence, and presents results for the special case $k = 2$.

Chelsea Walton, University of Michigan
Point Parameter Rings

We introduce the point parameter ring B, a generalized twisted homogeneous coordinate ring associated to a degenerate analogue of the three-dimensional Sklyanin algebra. The surprising geometry of these algebras yields a result similar to one of Artin-Tate-van den Bergh, namely that B is generated in degree one and thus is a factor of the corresponding degenerate Sklyanin algebra.

Kirsten Wickelgren, Stanford University
Universal Covering Spaces and Fundamental Groups in Algebraic Geometry as Schemes

This poster is on joint work with Ravi Vakil. In topology, the notions of the fundamental group and the universal cover are closely intertwined. In algebraic geometry, the traditional development of the etalé fundamental group is somewhat different, reflecting a perceived lack of a good universal cover. However, we show that usual notions from topology carry over directly to the algebraic and arithmetic setting without change, leading to a fundamental group family which is a scheme.

Josephine Yu, Massachusetts Institute of Technology
Tropical approach to the "Implicitization Challenge"

The tropicalization of a subvariety of a torus is a polyhedral fan which carries some information about the original variety. If the original variety is a hypersurface, then the Newton polytope of the defining equation can be recovered from the tropical hypersurface. Tropical

methods may give us some invariants of unknown varieties. As an example, we give a partial solution to the "Implicitization Challenge" in the book *Lectures on Algebraic Statistics* by Drton, Sturmfels, and Sullivant. We compute some vertices of the Newton polytope of a hypersurface in $\mathbb{P}^{15}$ which arise from a graphical statistical model with four observed and two hidden binary variables.

This is based on joint work with Angelica Cueto.

Cornelia Yuen, SUNY Potsdam

A minimal reduction of Ferrers ideals

In their study on the content of the product of two polynomials, A. Corso, V. Vasconcelos and R. Villarreal found a minimal reduction of a particular class of Ferrers ideals. Inspired by their work and the work of A. Corso and U. Nagel, we find a minimal reduction of an arbitrary Ferrers ideal using a different approach. We will give an introduction to Ferrers ideals and minimal reductions, explain the motivating result, and present our generalization. This is joint work with Sonja Petrović.

Connections for Women: Algebraic Geometry and Related Fields Schedule		
Thursday January 22, 2009		
09:00AM - 09:15AM	Opening Remarks	
09:15AM - 10:15AM	Lucia Caporaso	From curves to abelian varieties:updating the classical Torelli theorem
10:15AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Panel Discussion	
12:00PM - 02:00PM	Lunch	
02:00PM - 03:00PM	Tara Holm	Symplectic techniques in algebraic geometry
03:00PM - 04:00PM	Coffee, tea in the atrium	
04:00PM - 05:00PM	Smith (UC Berkeley Colloquium)	
Friday January 23, 2009		
09:15AM - 10:15AM	Sara Billey	An introduction to Affine Grassmannians
10:00AM - 10:30AM	Coffe, tea in the atrium	
10:30AM - 11:00AM	Sonja Petrovic	Graver bases of varieties of minimal degree
11:00AM - 11:30AM	Break	
11:30AM - 12:00PM	Rebecca Lehman	Branch Curves of Singular Surfaces
12:00PM - 02:00PM	Lunch	
02:00PM - 03:00PM	Linda Chen	Enumerative geometry, Gromov-Witten theory, and orbifolds.
03:00PM - 05:00PM	Poster Session	
03:00PM - 03:30PM	Coffee Tea in the atrium	
06:00PM - 08:00PM	Group Dinner	
Saturday January 24, 2009		
09:15AM - 10:15AM	Rachel Pries	Boundary of the moduli space of curves and arithmetic applications
10:15AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Rekha Thomas	Convex Algebraic Geometry
12:00PM - 02:00PM	Lunch	
02:00PM - 02:30PM	Amanda Knecht	Weak Approximation for Degree 2 del Pezzo Surfaces
02:30PM - 03:00PM	Break	
03:00PM - 03:30PM	Kelly McKinnie	Indecomposable classes in the Brauer group of Q_p(t)
03:30PM - 04:00PM	Coffe, tea in the atrium	
04:00PM - 05:00PM	Panel/Group discussion	

Connections for Women:
Algebraic Geometry and Related Fields
Invited Speakers

Billey, Sara	University of Washington
Caporaso, Lucia	University of Rome III
Chen, Linda	Swarthmore
Holm, Tara	Cornell
Knecht, Amanda	University of Michigan
Lehman, Rebecca	Tulane University
McKinnie, Kelly	Rice University
Petrovic, Sonja	University of Illinois at Chicago
Pries, Rachel	Colorado State
Smith, Karen	University of Michigin
Thomas, Rekha	University of Washington

Participant List

MSRI Workshop:

Connections for Women: Algebraic Geometry and Related Fields

January 22 to January 24, 2009

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	PrimInst
Abramovich, Dan	Participant	Brown University
Agarwala, Susama	Participant	Johns Hopkins University
Araujo, Carolina B.	Participant	IMPA
Assaf, Sami H	Participant	Massachusetts Institute of Technology
Babson, Eric	Participant	University of California
Bayer, Arend	Participant	University of Utah
Berkesch, Christine M.	Participant	Purdue University
Billey, Sara C.	Speaker	University of Washington
Bobkova, Irina	Participant	Northwestern University
Boocher, Adam	Participant	University of California
Brannetti, Silvia	Participant	Terza Università di Roma
Brown, Morgan	Participant	University of California
Buczynska, Weronika Julia	Participant	Texas A & M University
Caporaso, Lucia	Speaker	Universita Roma TRE
Cartwright, Dustin Alexander	Participant	University of California
Casanellas, Marta	Participant	Universitat Politecnica de Catalunya
Castravet, Ana-Maria	Participant	University of Arizona
Chamberlain, Erin Eleen	Participant	Brigham Young University
Chan, Melody	Participant	University of California
Chen, Linda	Speaker	Swarthmore College
Chowdhury, Atoshi	Participant	Stanford University
Cooper, Susan Marie	Participant	University of Nebraska
Cooper, Yaim	Participant	Princeton University
Crissman, Charley	Participant	University of California
Cueto, Maria Angelica	Participant	University of California
Docampo Alvarez, Roi	Participant	University of Illinois
Dundon, Ariana	Participant	University of Washington
Dyachkova Trnkova, Maria	Participant	Palacky University (UP)
edwige, Maléka	Participant	Université Cheikh Anta Diop de Dakar (UCAD)
Erman, Daniel Max	Participant	University of California
Gibney, Angela C	Organizer	University of Georgia
Goldstein, Ellen	Participant	Tufts University
Greb, Daniel	Participant	Mathematisches Institut der Universitaet zu Koeln
Gujarathi, Pritam Rajendralal	Participant	North Maharashtra University, Jalgaon
Harada, Megumi	Participant	McMaster University
Hassett, Brendan Edward	Organizer	Rice University
Hering, Milena	Participant	University of Connecticut
Hernandez, Daniel Jesus	Participant	University of Michigan
Ho, Wei	Participant	Princeton University
Holm, Tara Suzanne	Speaker	Cornell University
Hower, Valerie Marie	Participant	Georgia Institute of Technology
Huang, Yuhao	Participant	University of California
Hwang, DongSeon	Participant	Korea Advanced Institute of Science and Technology (KAIST)
Im, Mee Seong	Participant	University of Illinois Urbana-Champaign
Iqbal, Sohail	Participant	University of Warwick
Joshi, Janhavi	Participant	Ohio State University
Kaloghiros, Anne-Sophie	Participant	University of Cambridge
Karaali, Gizem	Participant	Pomona College
Kim, Jin-Hong	Participant	KAIST
Knecht, Amanda	Speaker	University of Michigan
Kovacs, Sandor J.	Organizer	University of Washington
Lakuriqi, Enkeleida K	Participant	Univeristy of Utah, Department of Mathematics
Lee, Hwayoung	Participant	University of California, Riverside
Lee, Yongnam	Participant	Sogang University

Lehman, Rebecca	Speaker	Bar-Ilan University
Li, Shuijing	Participant	Rice University
Luengo, Ignacio M	Participant	Universidad Complutense de Madrid
Maclagan, Diane	Organizer	Warwick University
Malaspina, Francesco	Participant	Politecnico di Torino
Manolache, Cristina	Participant	SISSA/ISAS
Mapes, Sonja	Participant	Columbia University
Margulies, Susan	Participant	Rice University
Mathewkutty, Habel K.	Participant	Habel Math
Matusevich, Laura Felicia	Participant	Texas A&M University
McKinnie, Kelly L	Speaker	Rice University
Melo, Ana Margarida	Participant	Terza Università di Roma
Mendes Lopes, Margarida M.N.S.R.M	Participant	Instituto Superior Tecnico, Universidade Tecnica de Lisboa
Mezzetti, Emilia	Participant	University of Trieste
Morrison, Ian	Participant	Fordham University
O'Keefe, Augustine	Participant	Tulane University
Omar, Saad Omar	Participant	planet transit
Osserman, Brian David	Participant	University of California, Davis
Ottaviani, Giorgio	Participant	Università di Firenze
Pardini, Rita	Participant	Università di Pisa
Petrovic, Sonja	Speaker	University of Illinois
Pisolkar, Supriya Arvind	Participant	Harish-Chandra Research Institute
Pons Llopis, Juan Francisco	Participant	University of Barcelona
Popa, Mihnea	Participant	University of Illinois
Prager, Amy Beth	Participant	Hunter College, CUNY
Pries, Rachel Justine	Speaker	Colorado State University
Rahmati, Mohammad Reza	Participant	IPM
Rizzardo, Alice	Participant	Columbia University
Ross, Kiana	Participant	University of Washington
Ruiz, Amanda	Participant	Binghamton University (SUNY)
Rydh, David	Participant	Royal institute of technology
Schwede, Karl Earl	Participant	University of Michigan
Seceleanu, Alexandra	Participant	University of Illinois at Urbana-Champaign
Sell, Elizabeth	Participant	Millersville University
shabbir, dr khurram	Participant	GU University lahore
Shahriyari, Leili	Participant	Johns Hopkins University
Sheshmani, Artan	Participant	University of Illinois at Urbana-Champaign
Shiu, Anne J.	Participant	University of California
Sidman, Jessica Soon-Hae	Organizer	University of Massachusetts, Amherst
Sierra, Susan J.	Participant	University of Washington
Smith, Gregory G.	Participant	Queen's University
Smith, Karen E.	Speaker	MIT
Stiller, Peter F.	Participant	Texas A&M University
Stillman, Mike	Participant	Cornell University
Taipale, Kaisa	Participant	University of Minnesota Twin Cities
Talaska, Kelli	Participant	University of Michigan
Tarizadeh, Abolfazl	Participant	IASBS
Thomas, Rekha Rachel	Speaker	University of Washington
Torogh, R S	Participant	University of Poona
Vakil, Ravi	Organizer	Stanford University
Vazirani, Monica Joy	Participant	University of California
Vinzant, Cynthia	Participant	University of California
Viray, Bianca	Participant	University of California
Walton, Chelsea	Participant	University of Michigan
Wickelgren, Kirsten	Participant	Stanford University
Williams, Lauren	Participant	Harvard University
Witt, Emily Elspeth	Participant	University of Michigan
Wood, Melanie Matchett	Participant	Princeton University
Wulcan, Elizabeth	Participant	University of Michigan
Xie, Yu	Participant	Purdue University
Xu, Fei	Participant	Rice University

Yang, Stephanie	Participant	Royal Institute of Technology (KTH)
Yu, Josephine T.	Participant	MIT
Yuen, Cornelia	Participant	SUNY Potsdam, Dept of Math

Connections for Women: Algebraic Geometry and Related Fields

Held: January 22 to January 24, 2009

The Mathematical Sciences Research Institute

Officially Registered Participant Information
118 participants

Gender (n = 118 participants)		
Male	29.66%	35
Female	70.34%	83
Declined to state	0.00%	0

*Ethnicity (n = 118 participants)		
White	50.39%	64
Asian	23.62%	30
Hispanic	3.94%	5
Pacific Islander	0.00%	0
Black	0.79%	1
Native American	0.00%	0
Declined to state	21.26%	27

**Some participants selected more than one ethnicity*

REPORT ON THE MSRI WORKSHOP "CLASSICAL ALGEBRAIC GEOMETRY TODAY" JANUARY 26–30, 2009

Organizers

- Lucia Caporaso (University of Rome III)
- Brendan Hassett (Rice University)
- James M^{c}Kernan (MIT)
- Mircea Mustaţă (University of Michigan)
- Mihnea Popa (University of Illinois at Chicago)

1. Scientific description

Algebraic Geometry is one of the most diverse fields of research in mathematics. It has had an incredible evolution over the past century, with new subfields constantly branching off. For this reason, the core of the field is now universally called Classical Algebraic Geometry, an exciting area itself full of fundamental unsolved problems and at the same time providing a theoretical foundation for new areas that have developed in recent years.

Due to the breadth of the subject it is often a challenge for graduate students and people from other fields to get a global view on current developments in Algebraic Geometry. The main theme of the workshop was to explore modern approaches to problems originating in Classical Algebraic Geometry, and at the same time offer an introduction to various subfields to the younger participants in the semester-long program. Many of the talks had a large didactic component, as the speakers were encouraged to provide ample background and motivation for their results. A large part of the audience consisted in graduate students and postdoctoral fellows.

The workshop was intended to reflect this diversity of Algebraic Geometry and its most fascinating recent developments. As such, it covered a wide range of topics, such as birational geometry, geometry of curves and surfaces, abelian varieties, rational curves on algebraic varieties, moduli spaces, derived categories, and enumerative geometry. A number of talks were surveys describing entire areas of research, introducing the participants to a wide array of techniques that are visibly becoming essential in dealing with the fundamental problems still unsolved.

One of the remarkable features of the workshop was the interaction with the *Connections for Women* workshop, hosted by MSRI the week immediately

before the *Classical Algebraic Geometry Today* workshop. This highlighted the research accomplishments of young women in Algebraic Geometry. Our committee coordinated offers of financial support with the organizing committee of the Connections workshop, hence many participants at their meeting received funding and stayed on for ours. In addition, one of the main guidelines in making funding decision was to offer support to participants in earlier stages of their careers, with little access to personal or institutional grants, while encouraging more senior participants to use such grants for their expenses whenever possible. As a result, women and young mathematicians were more heavily represented at our workshop than at typical conferences in Algebraic Geometry, thus contributing to an excitingly diverse week.

Overall, the worskhop seems to have established new MSRI records in participation, proof of the enormous popularity of the field, and of its influence on neighboring areas. Many of the speakers discussed important open problems in their respective areas of interest. These are bound to be among the main engines driving the development of the field in the next few years. We received wonderful input at the end, especially from younger participants who most commonly called the lectures "extremely inspiring".

2. Highlights of presentations

The workshop started with the talk of Joe Harris (Harvard) on the interpolation problem. It gave a nice overview of open questions of a classical flavor, having to do with the geometry of sets of points in projective spaces, that so far have defied modern tools. The second lecture, of Yuri Tschinkel (NYU), presented a surprising connection between classical and modern Algebraic Geometry. It described the use of the axiomatic framework for projective geometry in questions in birational and non-abelian geometry.

Several talks dealt with the geometry of abelian varieties. Sam Grushevsky (Princeton) gave a beautiful survey of results on the Schottky problem, from several points of view, including the recent solution of the Trisecant Conjecture due to Krichever. The talk of Giuseppe Pareschi (Rome II) presented applications of derived categories techniques (more precisely, of the Fourier-Mukai transform) to the study of abelian varieties, and more generally, of irregular varieties. Applications included an extension to arbitrary dimension of a classical inequality for surfaces due to Castelnuovo-de Franchis. Martin Olsson (Berkeley) gave a nice introduction to log geometry, explaining how this can be used to single out the main component in the compactification of the moduli space of abelian varieties.

Another topic that was emphasized was birational geometry. Christopher Hacon (Utah) gave a talk on deformations of canonical pairs and Fano varieties. It described how birational geometry varies in smooth families of Fano varieties, building on the recent advances in the Minimal Model Program, due to Birkar,

Cascini, Hacon and M^{c}Kernan. Burt Totaro (Cambridge) talked about the nef cone of Calabi-Yau pairs of dimension two. Using the action of the automorphism group of such a pair on the hyperbolic plane, he explained the proof of a conjecture of Kawamata and Morrison in this context. Rob Lazarsfeld (Michigan) gave the MSRI Evans talk (held on the UC Berkeley campus). This attracted a large crowd, both from the workshop and from the Berkeley math department. The talk described the state-of-the-art on various positivity notions for subvarieties of codimension one, a topic that has attracted a huge amount of interest in recent years. The case of higher codimension is much more difficult, and the speaker described some interesting and promising open questions in this direction. Jun-Muk Hwang (KIAS) gave the concluding talk of the workshop. He discussed the variety of minimal rational tangents on a Fano Variety, in particular whether one can recover birationally the Fano variety from the local information given by the variety of minimal rational tangents.

There were three talks on transcendental aspects in the study of algebraic varieties. Olivier Debarre (ENS) gave a survey on periods and moduli, presenting the Hodge-theoretic approach to the study of certain moduli spaces via the period map, and describing Torelli-type results on when this map is injective or an immersion. Mark de Cataldo (Stony Brook) gave an introduction to some deep results in the topology of algebraic varieties, and applied them in a very concrete setting. More precisely, he used the Decomposition Theorem, in its precise form for the Hitchin fibration featured in recent work of Ngô Bao Châu on the Fundamental Lemma, to study the Hodge theory of certain moduli spaces. The talk of Kieran O'Grady (Rome I) presented recent progress towards an analogue of the Torelli theorem for holomorphic symplectic fourfolds.

The rest of the talks treated various other topics of current interest. Rita Pardini (Pisa) gave a nice survey of old and recent results on the geography of irregular surfaces, concentrating on inequalities satisfied by the numerical invariants of such surfaces, and on the construction of interesting surfaces with prescribed invariants. János Kollár (Princeton) discussed a fundamental question: how to reconstruct an algebraic variety from its normalization, or more generally, how to construct the quotient by a finite equivalence relation? This is a basic issue, with important applications to constructing compactifications of moduli spaces. The talk of Richard Thomas (Imperial College) gave an overview of several approaches to defining invariants counting curves on Calabi-Yau threefolds, presenting recent progress towards relating these theories. Daniel Huybrechts (Bonn) talked about derived categories and Chow groups of K3 surfaces. It is an important problem to understand the group of autoequivalences of the derived category of such a surface, and the talk dealt with the action of this group on the cohomology and on the Chow group of the surface. Alina Marian (UIC) presented some new connections between algebraic geometry and representation theory, via constructions of interesting Lie algebra actions on the cohomology of hyperquot schemes. David Eisenbud (Berkeley) talked about recent results and

open problems on syzygies of algebraic varieties. In particular, he described the solution of the Boij-Söderberg Conjectures, describing the cone of all possible Betti diagrams of Cohen-Macaulay modules.

MSRI Mathematical Sciences Research Institute

Classical Algebraic Geometry Today

January 26, 2009 to January 30, 2009

Schedule

Monday January 26, 2009		
9:15AM - 9:30AM	MSRI Welcome	
9:30AM - 10:30AM	Speaker #1	The Interpolation Problem
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Speaker #2	Applications of projective geometry to birational geometry
12:00PM - 2:00PM	Lunch	
2:00PM - 3:00PM	Speaker #3	The geography of irregular surfaces.
3:00PM	Coffee, Tea in the atrium	
4:00PM - 5:00PM	Speaker #4	Positivity Properties of Divisors and Higher Codimension Cycles
Tuesday January 27, 2009		
9:30AM - 10:30AM	Speaker #5	Deformations of canonical pairs and Fano varieties
10:30AM - 11:00AM	Coffe, tea in the atrium	
11:00AM - 12:00PM	Speaker #6	Quotients by finite equivalence relations
12:00PM - 2:00PM	Lunch	
2:00PM - 3:00PM	Speaker #7	"Periods and Moduli"
3:00PM	Coffee, tea in the atrium	
4:00PM - 5:00PM	Speaker #8	The Hodge theory of character varieties
5:00PM - 6:00PM	Reception in the atrium	
Wednesday January 28, 2009		
09:30AM - 10:30AM	Speaker #9	Counting curves in 3-folds
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Speaker #10	Derived cateories and Chow groups of K3 surfaces
Thursday January 29, 2009		
9:30AM - 10:30AM	Speaker #11	The Schottky problem
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Speaker #12	Refined generic vanishing
12:00PM - 2:00PM	Lunch	
2:00PM - 3:00PM	Speaker #13	Main components of moduli spaces and log geometry.
3:00PM	Coffee, tea in the atrium	
4:00PM - 5:00PM	Speaker #14	Algebraic surfaces and hyperbolic geometry
Friday January 30, 2009		
9:30AM - 10:30AM	Speaker #15	Lie algebra actions on the cohomology of hyperquot schemes.
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Speaker #16	Four-dimensional analogues of K3 surfaces.
12:00PM - 2:00PM	Lunch	
2:00PM - 3:00PM	Speaker #17	Syzygies and Geometry
3:00PM	Coffee, Tea in the atrium	
4:00PM - 5:00PM	Speaker #18	Equivalence problem for minimal rational curves

Classical Algebraic Geometry Today

Invited Speakers

Andrea de Cataldo, Mark	SUNY, Stony Brook
Debarre, Olivier	University of Strasbourg
Eisenbud, David	UC Berkeley
Grushevsky, Samuel	Princeton University
Hacon, Christopher	University of Utah
Harris, Joe	Harvard University
Huybrechts, Daniel	University of Bonn
Hwang, Jun-Muk	KIAS, Seoul
Lazarsfeld, Robert	Univeristy of Michigan
Kollar, Jason	Princeton University
Marian, Alina	University of Illinois, Chicago
O'Grady, Kieran	University of Rome I
Olsson, Martin	UC Berkeley
Pardini, Rita	University of Pisa
Pareschi, Giuseppe	University of Rome II
Thomas, Richard	Imperial College, London
Totaro, Burt	Cambridge University
Tschinkel, Yuri	New York University

Participant List

MSRI Workshop:

Classical Algebraic Geometry Today

January 26 to January 30, 2009

at Mathematical Sciences Research Institute, Berkeley California

Name	Institution
Agarwala, Susama	Johns Hopkins University
Anderson, David E	University of California, Berkeley
Antieau, David Benjamin	University of Illinois
Arap, Maxim	University of Georgia
Assaf, Sami H	Massachusetts Institute of Technology
Bakker, Benjamin Thomas	Princeton University
Barja, Miguel Ángel	Universitat Politècnica de Catalunya
Berkesch, Christine M.	Purdue University
Bhatt, Bhargav	Princeton University
Blickle, Manuel	Univ Duisburg-Essen, Standort Essen
Bobkova, Irina	Northwestern University
Boralevi, Ada	Texas A & M University
Brannetti, Silvia	Terza Università di Roma
Brown, Morgan	University of California, Berkeley
Buczynski, Jaroslaw Artur	Texas A & M University
Budur, Nero	Univ. of Notre Dame
Caporaso, Lucia	Universita Roma TRE
Casanellas, Marta	Universitat Politecnica de Catalunya
Castravet, Ana-Maria	University of Arizona
Castro, Alex	UCSC
Chaudhuri, Chitrabhanu	Northwestern University, Mathematics Department
Cheltsov, Ivan	University of Edinburgh
Chen, Yifei	Johns Hopkins University
Chiecchio, Alberto	University of Washington
Choe, Insong	Konkuk University
Choi, Jinwon	Not Available
Choi, Sung Rak	University of California
Chou, Chih-Chi	Not Available
Colombo, Elisabetta	Università di Milano
Cooper, Yaim	Princeton University
Coskun, Izzet	University of Illinois
Costa, Laura	UB
Cueto, Maria Angelica	University of California
Davis, Christopher James	MIT
de Cataldo, Mark Andrea	SUNY Brook University
de Fernex, Tommaso	University of Utah
Debarre, Olivier	Ecole Normale Superieure
DeLand, Matthew	Columbia University
Docampo Alvarez, Roi	University of Illinois
Dries, Bart van den	Utrecht University
Dundon, Ariana	University of Washington
Eckl, Thomas	University of Liverpool
Ein, Lawrence M. H.	University of Illinois, Chicago
Eisenbud, David	University of California, Berkeley
Erman, Daniel Max	University of California
Fedorchuk, Maksym	Columbia University
Frediani, Paola	Università di Pavia
Fuji, Hiroyuki	Nagoya University
Furukawa, Katsuhisa	Department of Mathematics, School of Fundamental Science and Engineering, Waseda University,
Geraschenko, Anton	University of California, Berkeley
Gharahbeigi, Sara	Washington University
Ginensky, Adam	Not Available

Gongopadhyay, Krishnendu	Tata Institute of Fundamental Research
Gonzalez, Jose Luis	University of Michigan
Gorla, Elisa Alda	Universität Zürich
Greb, Daniel	Albert-Ludwigs Universitaet
Grieve, Nathan M	Queen's University
Grushevsky, Samuel	Princeton University
Hacon, Christopher D	University of Utah
Harris, Joseph D.	Harvard University
Hassett, Brendan Edward	Rice University
Hering, Milena	University of Connecticut
Hernandez, Daniel Jesus	University of Michigan
Ho, Wei	Princeton University
Hogadi, Amit Pratap	Tata Institute of Fundamental Research
Huang, Jonathan	University of Maryland
Huybrechts, Daniel	University of Bonn
Hwang, DongSeon	Korea Advanced Institute of Science and Technology (KAIST)
Hwang, Jun-Muk	Korea Institute for Advanced Study (KIAS)
Hyun, Yoonsuk	Massachusetts Institute of Technology
Ikeda, Atsushi	Osaka University
Im, Mee Seong	University of Illinois Urbana-Champaign
Izadi, Elham	University of Georgia
Jensen, David H	University of Texas
Jiang, Xiaodong	University of Utah
Jow, Shin-Yao	University of Michigan
Kaloghiros, Anne-Sophie	University of Cambridge
Kang, Ning	Not Available
Keel, Sean	University of Texas
Kelly, Sean James	University of Maryland
Kim, Jin-Hong	KAIST
Kirson, Antonio	University of Washington
Kissounko, Veniamine	University of Toronto
Kitadai, Yukinori	Hiroshima University
Knecht, Amanda	University of Michigan
Kollár, János	Princeton University
Kopp, Travis J	University of Washington
Kotov, Vladimir	Northwestern University
Lahoz, Marti	Universitat Politecnica de Catalunya
Lai, Mijia	Not Available
LAI, CHING-JUI	University of Utah
Lazarsfeld, Robert K.	University of Michigan
Lazic, Vladimir	University of Cambridge
Le, Anh Vinh	Harvard University
Lee, Yongnam	Sogang University
Lee, Hwayoung	University of California
Lehman, Rebecca	Bar-Ilan University
Lehmann, Brian	Massachusetts Institute of Technology
Li, Shuijing	Rice University
Libgober, Anatoly S.	University of Illinois
Lo, Jason	Stanford University
Logvinenko, Timothy	University of Liverpool
Lombardi, Luigi	University of Illinois
Maguire, Stephen Joseph	University of Illinois at Urbana-Champaign
Malaspina, Francesco	Politecnico di Torino
Mapes, Sonja	Columbia University
Marchisotto, Elena Anne	CSUN
Marcus, Steffen	Brown University
Marian, Alina	Yale University
Markman, Eyal	University of Massachusetts
Martens, Johan Andre	University of Toronto
Matusevich, Laura Felicia	Harvard University

McKernan, James	MIT
McKinnie, Kelly L	Rice University
Melo, Margarida	Terza Università di Roma
Mendes Lopes, Margarida M.N.S.R.M	Instituto Superior Tecnico, Universidade tecnica de Lisboa
Mezzetti, Emilia	University of Trieste
Mishra, Chayan Kumar	Avadh University
Moeller, Martin	Max-Planck-Institut fuer Mathematik
Mojiri, Ahmad	Texas A&M University - Texarkana
Morrison, Ian	Fordham University
Mulase, Motohico	UC Davis
Mustata, Mircea	University of Michigan
Naranjo, Juan Carlos	Universitat de Barcelona
Nasu, Hirokazu	Tokyo Denki University
Neves, Jorge	University of Coimbra
Niu, Wenbo	University of Illinois
Nunez, Luis Cristobal	Wesleyan University
Nyström, David Witt	Matematiska vet., Chalmers University of Technology
O'Grady, Kieran G.	Harvard University
O'Grady, Kieran Gregory	Università di Roma ``La Sapienza''
O'Keefe, Augustine	Tulane University
Oblomkov, Alexei A	607 Fine Hall
Ohashi, Hisanori	Kyoto University
Okada, Takuzo	Kyoto University
Olsson, Martin	University of California
Ookawa, Shinnosuke	University of Tokyo
Osserman, Brian David	MIT
Ottaviani, Giorgio	Universita di Firenze
Pardini, Rita	Università di Pisa
Pareschi, Giuseppe	Universita di Roma
Patakfalvi, Zsolt	University of Washington
Petrovic, Sonja	University of Illinois
Pham, Tuan Dang Anh	University of California
Pignatelli, Roberto	Università di Trento
Pisolkar, Supriya Arvind	Harish-Chandra Research Institute
Pons Llopis, Juan Francisco	University of Barcelona
Popa, Mihnea	University of Illinois
Pugin, Thibaut	Columbia University
Quallbrunn, Federico	University of Buenos Aires
Quddus, Safdar	Washington University
ran, ziv	UC Riverside
Ranestad, Kristian	University of Oslo
Reid, Miles	University of Warwick
Rezazadegan, Reza	Rutgers University
Rizzardo, Alice	Columbia University
Ross, Joe	Columbia University
Ruiz, Amanda	Binghamton University (SUNY)
Rydh, David	University of California, Berkeley
Salihu, Armend	Sudan University for Science & Technology
Scala, Luca	University of Chicago
Schappacher, Norbert	Université de Strasbourg
Schwede, Karl Earl	University of Michigan
SHEN, MINGMIN	Columbia University
Sheshmani, Artan	University of Illinois at Urabna Champaign
Singh, Vijaykumar Haribansh	Claude Shannon Institute
Smith, James T	San Francisco State University
Smith, Roy Campbell	University of Georgia
Smith, Gregory G.	Columbia University
Srinivas, Vasudevan	Tata Institute of Fundamental Research
Stapledon, Alan Michael	University of Michigan
Starr, Jason Michael	SUNY

Stiller, Peter F.	Texas A&M University
Szendroi, Balazs	University of Oxford
Tanimoto, Sho	New York University
Tarasca, Nicola	Humboldt-Universität
Tarizadeh, Abolfazl	IASBS
Teixidor, Montserrat	Tufts University
Testa, Damiano	University of Oxford
Thomas, Richard Paul Winsley	Imperial College London
To, Jinhyung	University of Illinois at Urbana-Champaign
Totaro, Burt	University of Chicago
Treisman, Zachary David	University of British Columbia
Tschinkel, Yuri	New York University
Tucker, Kevin Francis	University of Michigan
Ulfarsson, Henning Arnor	Brown University
Urbinati, Stefano	University of Utah
Urzua, Giancarlo	University of Michigan
Varilly, Anthony	University of California
Venkatram, Kartik	Massachusetts Institute of Technology
Viray, Bianca	University of California
Walton, Chelsea	University of Michigan
Werner, Caryn	Allegheny College
Wood, Melanie Matchett	Princeton University
Xu, Chenyang	Princeton University
Xu, Fei	Rice University
Yang, Stephanie	Royal Institute of Technology (KTH)
Yoshioka, Kota	Kobe
Yu, Josephine T.	MIT
Zhan, Cheng	University of Houston
Zhang, Ziyu	Stanford University

Classical Algebraic Geometry Today
Held: January 26 to January 30, 2009
The Mathematical Sciences Research Institute

Officially Registered Participant Information
226 participants

Gender (n = 193 participants)		
Male	70.98%	137
Female	26.42%	51
Declined to state	2.59%	5

Ethnicity (n = 221 participants)		
White	54.75%	121
Asian	26.70%	59
Hispanic	4.52%	10
Pacific Islander	0.00%	0
Black	0.90%	2
Native American	0.45%	1
Declined to state	12.67%	28

Appendix 3a. Sample workshop Survey

Introductory Workshop

Did the various topics within the workshop integrate into a coherent picture?

- ☐ Agree
- ☐ Somewhat agree
- ☒ Disagree

Was your background adequate to access a reasonable portion of the material?

- ☐ Agree
- ☐ Somewhat agree
- ☐ Disagree

Did the workshop increase your interest in the subject?

- ☐ Yes
- ☐ No

Was there adequate time between lectures for discussion?

- ☐ Not Satisfactory
- ☐ Satisfactory
- ☐ Above satisfactory

Were the speakers generally clear and well organized in their presentation?

- ☐ Not satisfactory
- ☐ Satisfactory
- ☐ Very satisfactory

Please explain

Was the workshop worth your time and effort?

- ☐ Yes
- ☐ No

Please explain

Your overall experience at MSRI

	1	2	3	4	5	
Not satisfactory	☐	☐	☐	☐	☐	Above satisfactory

The assistance provided by the MSRI staff

	1	2	3	4	5	
Not satisfactory	☐	☐	☐	☐	☐	Above satisfactory

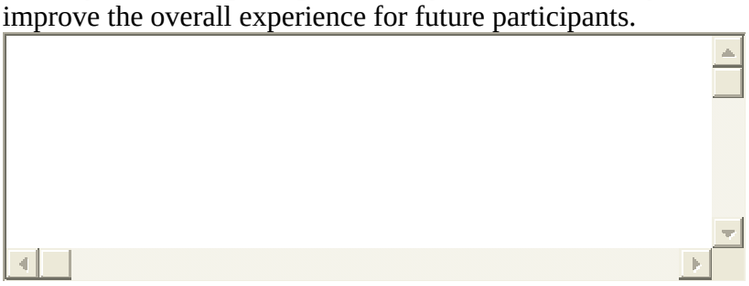
The overall atmosphere of MSRI

	1	2	3	4	5	
Not satisfactory	☐	☐	☐	☐	☐	Above satisfactory

The physical surroundings

	1	2	3	4	5	
Not satisfactory	☐	☐	☐	☐	☐	Above satisfactory

Thank you for completing this survey. We welcome any additional comments or suggestions you may have to improve the overall experience for future participants.



REPORT ON THE MODERN MODULI WORKSHOP FEBRUARY 23-27

Organizers

- Izzet Coskun (University of Illinois at Chicago), chair
- Sheldon Katz (University of Illinois at Urbana-Champagne)
- Alina Marian (University of Illinois at Chicago)
- Rahul Pandharipande (Princeton University)
- Ravi Vakil (Stanford University)
- Richard Thomas (Imperial College, London)
- Hsian-Hua Tseng (University of Wisconsin-Madison)

1. Scientific Program

The last few years have witnessed very exciting developments in algebraic geometry, for example, in the minimal model program (MMP) and the area of derived categories. The purpose of this workshop was to give researchers working in moduli theory a global view of recent developments and to explore the implications of these developments to moduli theory.

The workshop convened graduate students, young researchers and leading experts specializing on the minimal model program, derived categories and moduli spaces in an informal environment to facilitate the flow of ideas across these different fields of algebraic geometry. Our main goals were to foster collaborations among experts working in very different branches of algebraic geometry, to encourage further exploration of the new developments for moduli theory and to inform the young participants about the new developments, open problems and new directions in the field. The workshop received wide-spread interest and became one of the largest workshops in moduli theory ever organized. There were over two hundred participants, many of whom were graduate students, young researchers and women.

The four main themes of the workshop were:

(1) New developments in Brill-Noether Theory and the minimal model program for the moduli space of curves.
(2) The interactions and connections between Gromov-Witten theory, Donaldson-Thomas theory and stable-pair theory.
(3) Moduli of objects in derived categories and their relations to counting invariants.

(4) The moduli of higher dimensional varieties.

Each day of the workshop was devoted to one of these themes. The workshop lasted five days from Monday morning February 23 to Friday evening February 27, with 17 participants delivering one hour lectures. Wednesday afternoon was designated as a free afternoon to encourage discussions and collaborations among the participants. On the remaining days, the schedule included four talks per day (except Monday), with substantial periods of time devoted to discussions and informal working groups.

Given the large number of participants, it was not possible to fully fund everyone. We aimed to offer as much money as possible to every eligible applicant who needed funding in order to be able to attend the workshop. The amount of funding for a participant depended on three factors: the type of funding requested by the participant (travel, lodging or both), the proximity of the participant's home-institution and the participant's likelihood of finding other sources of support. For example, we decided to fund postdoctoral fellows at a slightly higher rate than graduate students believing that graduate students can obtain support from their institutions. Participants from California or nearby states were offered a small travel allowance, participants from other parts of North America were offered a larger travel allowance and participants coming from Europe and Asia were offered the largest travel allowance.

The workshop was a great success in achieving its goals. Several of the participants, such as Rahul Pandharipande and James McKernan, gave widely accessible talks that surveyed recent developments in the field. A young participant characterized the talks as "inspiring" and "informative". Several participants reported that the workshop was a great opportunity for them to start new projects.

2. Highlights of the presentations

Monday was devoted to recent developments in classical questions about moduli theory. Rahul Pandharipande (Princeton University) delivered a lecture entitled "The top Chern class of the Hodge bundle," where he discussed three enumerative problems for the top Chern class of the Hodge bundle. These problems are closely related to the Faber-Pandharipande conjecture on the tautological ring of curves of compact type and the recent developments in the Gromov-Witten Theory of K3 surfaces and relative Gromov-Witten theory. His subject beautifully linked many of widely different moduli spaces of interest to the

workshop, such as the moduli spaces of curves, abelian varieties, stable maps, stable pairs, and maps to $\mathbb{P}^1$ (Hurwitz spaces). Brendan Hassett (Rice University) in his talk "Rational curves on K3 surfaces and their higher-dimensional analogs" discussed new methods for proving that a projective K3 surface has infinitely many irreducible rational curves using deformation and characteristic p techniques. David Smyth (Harvard University) in his lecture "Modular compactifications of the moduli space of curves" described how to give new modular compactifications of the moduli spaces of pointed smooth curves by allowing singularities other than nodes. These new modular compactifications are closely related to spaces that arise while running the Minimal Model Program for the moduli space of curves.

Tuesday was devoted to recent developments in Gromov-Witten Theory and invariants counting objects in derived categories. The strong theme running through all four talks was the phenomenon of wall crossing – when a change in parameters leads to a change in invariants in an interesting and calculable way. Mark Gross (UC San Diego) spoke about "The tropical vertex", an elementary algebraic gadget originally appearing in work of Kontsevich-Soibelman. He explained how it encodes counts of tropical curves in $(\mathbb{C}^*)^2$, or actual curves and Gromov-Witten invariants of toric surface compactifications. Tom Bridgeland (Sheffield) then talked on "Hall algebras and curve-counting", explaining how the wall crossing theories of Joyce and Kontsevich-Soibelman can be used to prove the conjectural equivalence of the Donaldson-Thomas and Pandharipande-Thomas curve counting invariants on a Calabi-Yau 3-fold. The lecture of Yukinobu Toda (Oxford) on "Stability conditions and Donaldson-Thomas type invariants" used similar techniques, and his new notion of a weak stability condition, to relate the curve counting invariants on birational (and even noncommutative) Calabi-Yau manifolds. Finally Dominic Joyce (Oxford) explained how to strengthen his wall crossing theory to incorporate the Behrend function and so the virtual class into his invariants, thus vastly generalising the Donaldson-Thomas invariants.

On Wednesday, Barbara Fantechi (SISSA) spoke about "The inertia stack of $M_{g,n}$", with a view toward extending the (partly conjectural) structure of the tautological ring of $M_{g,n}$. She discussed work in progress on the cohomology of the inertia stack of $M_{g,n}$, in particular classifying the connected components of the inertia stack in all genera. She also described the related Chen-Ruan cohomology of $M_{g,n}$ for low values of the genus, as an algebra over the ordinary cohomology of

$M_{g,n}$. Yuan-Pin Lee (University of Utah) subsequently talked on "K-equivalence in Gromov-Witten theory", addressing the functoriality of Gromov-Witten theory under ordinary and Mukai flops of the target variety. He explained that Gromov-Witten theory is invariant (up to an analytic continuation) under Mukai flops as well as *simple* ordinary flops.

In Thursday's talks a variety of topics were discussed. Dragos Oprea (UC San Diego) spoke about "The Verlinde bundles in higher genus", which was about how to express the Verlinde bundle in terms of some naturally defined vector bundles on the Jacobian of a smooth curve. The results he discussed suggest an approach to understanding strange duality statements for curves and perhaps higher dimensional geometry. Davesh Maulik (Clay Mathematics Institute and MIT) spoke about "Gromov-Witten theory of K3 surfaces". He discussed the famous Yau-Zaslow formula relating enumeration of rational curves on K3 surfaces to modular forms. He reviewed several previous approaches to the Yau-Zaslow formula for counting rational curves in primitive classes, and he discussed recent joint work with A. Klemm, R. Pandharipande, and E. Scheidegger proving the full Yau-Zaslow formula for non-primitive classes. He also briefly discussed some recent results (joint work with R. Pandharipande and R. Thomas) on modularity of higher genus Gromov-Witten invariants of K3 surfaces. The talk of Carel Faber (KTH) consisted of two parts, the common theme of which is the cohomology of moduli spaces of curves. In the first part he discussed conjectures and results on the structure of tautological rings of the moduli space $M_{g,n}$ of pointed curves and its variants, such as $M^{rt}_{g,n}$, $M^{ct}_{g,n}$, and $\overline{M}_{g,n}$. In particular he explained some relations among these conjectures. In the second part he discussed recent work with G. van der Geer and J. Bergström concerning the Σ_n-equivariant Euler characteristics of $\overline{M}_{g,n}$ for $g = 2, 3$. As an addition to the workshop we also had a special seminar given by Bumsig Kim (KIAS). He explained a new way to compactify the spaces of maps from smooth curves to projective varieties. His construction allows the target variety to degenerate when the domain curve becomes nodal. The target variety is allowed to degenerate in a way identical to the one that occured in the Fulton-MacPherson configuration spaces. The main result is a compactification which still admits a perfect obstruction theory that can be used to define a virtual fundamental class and Gromov-Witten type invariants. Two versions of such compactifications were discussed in the talk (one due to B. Kim-A. Kresch-Y. Oh and the other due to

B. Kim). In genus 1 he explained that one of his compactifications provides a desingularization of the main component of the moduli space of stable maps to projective spaces. He concluded with several interesting conjectures relating the invariants defined using his compactifications and standard Gromov-Witten invariants.

Friday was devoted to the moduli spaces of higher dimensional varieties. János Kollár (Princeton University) spoke about the relationship between log canonical (LC) and Du Bois singularities. The main result was that semi LC implies Du Bois. As a consequence, he proved that the Cohen-Macaulay condition was open and closed in the moduli space of surfaces of general type. The talk reflected joint work with S. Kovács. James McKernan (MIT) gave a very nice survey of the current state of the minimal model program. The goal of the program is to replace a variety with a birational model where either the canonical divisor is nef or there is a fibration whose fibers which are Fano varieties. The process has a number of contractions and flips. The remaining step is to prove that there is no infinite sequence of flips. McKernan gave an overview of some of the results and conjectural approaches to proving that flips terminate. Valery Alexeev (University of Georgia) spoke about explicit compactifications of the moduli spaces of Campedelli and Burniat surfaces. These are the first interesting examples where the entire (compact) moduli spaces can be fully described. The method involves studying compact parameter spaces of configurations of lines in the plane. The talk reflected joint work with R. Pardini. Eckardt Viehweg (Essen) spoke about Kobayashi geodesics in the moduli space of abelian varieties A_g. These are algebraic curves that are totally geodesic submanifolds for the Kobayashi metric. Viehweg showed that Kobayashi geodesics can be characterized as those curves whose logarithmic tangent bundle splits as a subbundle of the logarithmic tangent bundle of A_g. Both Shimura curves and Teichmueller curves are examples of Kobayashi geodesics, but there are other examples. Viehweg showed that non-compact Kobayashi geodesics always map to the locus of real multiplication and that the $\mathbb{Q}$-irreducibility of the induced variation of Hodge structures implies that they are defined over a number field. The talk reflected joint work with M. Moeller.

MSRI Mathematical Sciences Research Institute

Modern Moduli Theory

February 23, 2009 to February 27, 2009

Schedule

Monday, February 23, 2009		
9:30AM - 10:30AM	Rahul Pandharipande	The top Chern class of the Hodge bundle.
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Brendan Hassett	Rational curves on K3 surfaces and their higher-dimensional analogs
12:00PM - 2:00PM	Lunch	
2:00PM - 3:00PM	David Smyth	Modular compactifications of the moduli space of curves
Tuesday February 24, 2009		
09:30AM - 10:30AM	Mark Gross	The tropical vertex
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Tom Bridgeland	Hall algebras and curve-counting
12:00PM - 1:30PM	Lunch	
1:30PM - 2:30PM	Yukinobu Toda	Stability conditions and Donaldson-Thomas type invariants
2:30PM - 3:00PM	Coffee, tea in the atrium	
3:00PM - 4:00PM	Dominic Joyce	A theory of generalized Donaldson-Thomas invariants
4:00PM - 5:00PM	Reception in the atrium	

Wednesday February 25, 2009		
9:30AM - 10:30AM	Barbara Fantechi	TBD
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Yuan-Pin Lee	K-equivalence in Gromov--Witten theory

Thursday February 26, 2009		
09:30AM - 10:30AM	Dragos Oprea	The Verlinde bundles in higher genus
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Davesh Maulik	Gromov-Witten theory on K3 surfaces
12:00PM - 2:00PM	Lunch	
2:00PM - 3:00PM	Carel Faber	A remark on a conjecture of Hain and Looijenga
Friday February 27, 2009		
9:30AM - 10:30AM	János Kollár	Log canonical implies Du Bois
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	James McKernan	Termination of flips
12:00PM - 2:00PM	Lunch	
2:00PM - 3:00PM	Valery Alexeev	Explicit compactifications of moduli spaces of Campedelli and Burniat surfaces
3:00PM - 4:00PM	Coffee, tea in the atrium	
4:00PM - 5:00PM	Eckart Viehweg	Kobayashi geodesics in A_g

Currently Available Videos

- **Rahul Pandharipande** , The top Chern class of the Hodge bundle. *February 23,2009, 09:30 AM to 10:30 AM*
- **Brendan Hassett** , Rational curves on K3 surfaces and their higher-dimensional analogs *February 23,2009, 11:00 AM to 12:00 PM*
- **David Smyth** , Modular compactifications of the moduli space of curves *February 23,2009, 02:00 PM to 03:00 PM*
- **Mark Gross** , "The tropical vertex" *February 24,2009, 09:30 AM to 10:30 AM*
- **Tom Bridgeland** , Hall algebras and curve-counting *February 24,2009, 11:00 AM to 12:00 PM*
- **Yukinobu Toda** , Stability conditions and Donaldson-Thomas type invariants *February 24,2009, 01:30 PM to 02:30 PM*
- **Dominic Joyce** , A theory of generalized Donaldson-Thomas invariants *February 24,2009, 03:00 PM to 04:00 PM*
- **Barbara Fantechi** , "Intertia stack of M_{g,n}" *February 25,2009, 09:30 AM to 10:30 AM*
- **Yuan-Pin Lee** , K-equivalence in Gromov--Witten theory *February 25,2009, 11:00 AM to 12:00 PM*
- **Dragos Oprea** , The Verlinde bundles in higher genus *February 26,2009, 09:30 AM to 10:30 AM*
- **Davesh Maulik** , "Gromov-Witten theory on K3 surfaces *February 26,2009, 11:00 AM to 12:00 PM*
- **Carel Faber** , A remark on a conjecture of Hain and Looijenga *February 26,2009, 02:00 PM to 03:00 PM*
- **János Kollár** , Log canonical implies Du Bois *February 27,2009, 09:30 AM to 10:30 AM*
- **James McKernan** , Termination of flips *February 27,2009, 11:00 AM to 12:00 PM*
- **Valery Alexeev** , Explicit compactifications of moduli spaces of Campedelli and Burniat surfaces *February 27,2009, 02:00 PM to 03:00 PM*
- **Eckart Viehweg** , Kobayashi geodesics in A_g *February 27,2009, 04:00 PM to 05:00 PM*

Speaker List

MSRI Workshop:

Modern Moduli Theory

February 23 to February 27, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institue
Dragos Oprea	Speaker	University of Claifornia, San Diego
Carel Faber	Speaker	Royal Institute of Technology (KTH)
Valery Alexeev	Speaker	University of Georgia
Brendan Edward Hassett	Speaker	Rice
Yuan-Pin Lee	Speaker	University of Utah
David Ishii Smyth	Speaker	Harvard University
Barbara Fantechi	Speaker	Sissa
James McKernan	Speaker	MIT
Dominic David Joyce	Speaker	University of Oxford
Yukinobu Toda	Speaker	University of Tokyo
Eckart Viehweg	Speaker	Universitaet Duisburg-Essen
Tom Andrew Bridgeland	Speaker	University of Sheffield
Joseph D. Harris	Speaker	Harvard University
János Kollár	Speaker	Princeton University
Davesh Maulik	Speaker	Massachusetts Institute of Technology
Andrew Critch	Speaker	University of California
Mark W. Gross	Speaker	University of California, San Diego

Participant List

MSRI Workshop:

Modern Moduli Theory

February 23 to February 27, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Abramovich, Dan	Participant	University of Utah
Addington, Nicolas	Participant	University of Wisconsin
Alexeev, Valery	Participant	consevatoire national des arts et métiers
Alvarez-Consul, Luis	Participant	California Institute of Technology
Araujo, Carolina B.	Participant	Max-Planck-Institute for Mathematics
Bakker, Benjamin Thomas	Participant	Institut Mittag-Leffler
Baranovsky, Vladimir	Participant	UC Davis
Bauer-Catanese, Ingrid Claudia	Organizer	University of Illinois
Bayer, Arend	Organizer	University of Connecticut
Beheshti Zavareh, Roya	Organizer	University of Illinois
Behrend, Kai	Organizer	Princeton University
Beil, Charles	Organizer	Imperial College London
Bernardara, Marcello	Organizer	University of Wisconsin
Bertram, Aaron	Organizer	Stanford University
Bohm, Janko	Participant	SISSA
Boocher, Adam	Participant	Kyoto university
Borrelli, Giuseppe	Participant	American University
Bradlow, Steven	Participant	Univ. of Notre Dame
Brannetti, Silvia	Participant	University of Georgia
Brav, Christopher Ira	Participant	University of California
Bridgeland, Tom Andrew	Participant	University of Trieste
Brown, Morgan	Participant	University of California
Budur, Nero	Participant	University of Michigan
Casagrande, Cinzia	Participant	SUNY
Casalaina-Martin, Sebastian	Participant	proline soccer academy
Castravet, Ana-Maria	Participant	Universita' degli Studi di Milano
Catanese, Fabrizio Marcello Enrico	Participant	Department of Mathematics, Imperial College London
Cautis, Sabin	Participant	University of Utah
Chang, Hua-Liang	Participant	Tyler Foster
Cheung, Rex	Participant	Harvard University
Choi, Jinwon	speaker/member	University of Illinois
Ciocan-Fontanine, Ionut	Speaker/Member	Royal Institute of Technology (KTH)
Cooper, Yaim	Speaker	University of Georgia
Coskun, Izzet	Speaker/member	University of Illinois
cotignoli, giulio	Speaker/Member	University of Utah
Cotterill, Ethan Guy	Speaker	Harvard University
Craw, Alastair	Participant	University of Liverpool
Critch, Andrew	Speaker/Member	University of California
Cueto, Maria Angelica	speaker/member	University of California
Dalakov, Peter	Speaker	University of Oxford
Davison, Nicholas David James	Speaker	University of Tokyo
de Fernex, Tommaso	speaker/member	University of Utah
Debarre, Olivier	Speaker/Member	University of Sheffield
Derenthal, Ulrich	Speaker/Member	University of Zurich
Docampo Alvarez, Roi	Speaker/member	Princeton University
Donovan, Will	Speaker/Member	Massachusetts Institute of Technology
Dundon, Ariana	Participant	SISSA/ISAS
Ein, Lawrence M. H.	Participant	Princeton University
Elezi, Artur	Participant	SEYTUNSCOM RESOURCES
Erman, Daniel Max	Participant	Rheinische Friedrich-Wilhelms-Universität Bonn

Esnault, Helene I	Participant	International School for Advanced Studies (SISSA/ISAS), Trieste
Esteves, Eduardo de Sequeira	Participant	University of Utah
Faber, Carel	Participant	SUNY
Faenzi, Daniele	Participant	University of Salamanca
Fantechi, Barbara	Participant	Sissa
Farajzadeh Tehrani, Mohammad	Participant	Princeton University
Farkas, Gavril	Participant	Math Dept
Fedorchuk, Maksym	Participant	Albert-Ludwigs-Universitaet Mathematisches Institut
Finkel, Dan	Participant	University of Arizona
Foster, Tyler Stephen	Participant	Rheinische Friedrich-Wilhelms-Universität Bonn
Frantzen, Kristina	Participant	Ruhr-Universität Bochum
Fuji, Hiroyuki	Participant	University of Bonn, Germany
Fulghesu, Damiano	Participant	Scuola Normale Superiore
Fusi, Davide	Participant	Terza Università di Roma
Geraschenko, Anton	Participant	Stanford University
Gholampour, Amin	Participant	Princeton University
Giansiracusa, Noah	Participant	Department of Mathematics
Greb, Daniel	Participant	Humboldt University of Berlin
Gross, Mark W.	Participant	University of Salamanca
Grushevsky, Samuel	Participant	University of Missouri
Grzegorczyk, Ivona	Participant	Terza Università di Roma
Guerra, Stefano	Participant	Rheinische Friedrich-Wilhelms-Universität Bonn
Hacking, Paul Anthony	Participant	University of Illinois at Urbana-Champaign
Hadian-Jazi, Majid	Participant	Università di Pavia
Hain, Richard Martin	Participant	Tokyo Institute of Technology
Hall, Jack K	Participant	Terza Università di Roma
Harris, Joseph D.	Participant	Columbia University
Hartmann, Heinrich	Participant	Stanford University
Hartshorne, Robin	Participant	University of California
Hassett, Brendan Edward	Participant	University of Salamanca
Helminck, Aloysius Gerardus	Participant	North Carolina State University
Hering, Milena	Participant	University of Washington
Hernandez-Ruiperez, Daniel	Participant	Department of Mathematics, Duke University
Ho, Wei	Participant	Princeton University
Hogadi, Amit Pratap	Participant	Politecnico di Milano
Hoskins, Vicky	Participant	Oxford
Huang, Yuhao	Participant	University of California
Hyeon, Donghoon	Participant	University of Illinois
Hyun, Yoonsuk	Participant	Massachusetts Institute of Technology
Im, Mee Seong	Participant	University of Utah
Iritani, Hiroshi	Participant	Princeton University
Jiang, Yunfeng	Participant	University of Illinois
Johnson, Paul	Participant	University of Texas
Joyce, Dominic David	Participant	University of British Columbia
Kaloghiros, Anne-Sophie	Participant	Kyungpook National University
Kamnitzer, Joel	Participant	American Institute of Mathematics
Kang, Ning	Participant	University Of Texas, Austin
Karp, Dagan Joshua	Participant	Imperial College London
Kass, Jesse	Participant	University of Massachusetts
kasule, yasin buwembo	Participant	IMPA
Katz, Sheldon	Participant	University of Oxford
Kebekus, Stefan	Participant	University of Wisconsin
Kelly, Tyler	Participant	N/A
Kim, Hoil	Participant	Kyungpook National University
Kimura, Takashi	Participant	University of Salamanca
Kollár, János	Participant	International School for Advanced Studies (SISSA/ISAS)

Kool, Martijn	Participant	University of Washington
Kopp, Travis J	Participant	Mathematics Department
Krawitz, Marc	Participant	Boston University
LAI, CHING-JUI	Participant	University of California
Lang, William E.	Participant	Instituto de Ciencias Matemáticas (CSIC-UAM-UCM-UC3M)
Langer, Adrian	Participant	Université de Pau et des Pays de l'Adour
Larsson, Daniel	Participant	Columbia University
Lee, Yuan-Pin	Participant	Johannes-Gutenberg-University Mainz
Lehn, Christian	Participant	Johannes-Gutenberg-Universität Mainz
Li, Jun	Participant	Institute of Mathematics "Simion Stoilow" of the Romanian Academy
LI, LI	Participant	University of Illinois at Urbana-Champaign
Li, Weiping	Participant	Princeton University
Liu, Chiu-Chu Melissa	Participant	Princeton University
Lo, Jason	Participant	University of Michigan
Logvinenko, Timothy	Participant	University of Liverpool
López-Martín, Cristina	Participant	University of Michigan
Lowrey, Parker	Participant	University of Texas
Maclagan, Diane	Participant	University of Illinois at Urbana-Champaign
Macri, Emanuele	Participant	University of Oxford
Manolache, Cristina	Participant	SISSA/ISAS
Marcus, Steffen	Participant	University of Toronto
Marian, Alina	Participant	University of California
Markwig, Hannah	Participant	Universität Hannover
Matusevich, Laura Felicia	Participant	Harvard University
Maulik, Davesh	Participant	Nagoya University
McKernan, James	Participant	University of Illinois at Urbana-Champaign
Mehrotra, Sukhendu	Participant	University of Utah
Meinhardt, Sven	Participant	University of Illinois at Urbana-Champaign
Melo, Margarida	Participant	Max-Planck-Institut für Mathematik
Mezzetti, Emilia	Participant	University of Tokyo
More, Yogesh	Participant	University of Tokyo
Morrison, David R.	Participant	University of Minnesota Twin Cities
Morrison, Ian	Participant	Texas A&M University
Mulase, Motohico	Participant	University of Georgia
Mustata, Andrei Dragos	Participant	Università di Roma ``La Sapienza''
Nagao, Kentaro	Participant	Princeton University
NAKAOKA, Hiroyuki	Participant	University of Tokyo
Neeman, Amnon	Participant	University of California
Nevins, Thomas A.	Participant	IMPA
Niu, Wenbo	Participant	North Carolina State University
Oblomkov, Alexei A	Participant	University of California
Oblomkov, Alexei A	Participant	Columbia University
Ohkawa, Ryo	Participant	University of Warwick
OLUWATOYIN, AYENI RUTH	Participant	Brigham Young University
Oprea, Dragos	Participant	University of California
Osserman, Brian David	Participant	University of Connecticut
Pagani, Nicola Tito	Participant	University of California
Pandharipande, Rahul	Participant	Hong Kong University of Science and Technology
Pasarescu, Ovidiu-Florin	Participant	University of Minnesota Twin Cities
Payne, Sam	Participant	Marshall University
Pham, Tuan Dang Anh	Participant	University of Glasgow
philippe, durand	Participant	University of Massachusetts
Plaza Martín, Francisco José	Participant	Scuola Normale Superiore
Popa, Mihnea	Participant	Brandeis University
Pugin, Thibaut	Participant	University of Warsaw
Reid, Miles	Participant	California State University Channel Islands
Ross, Joe	Participant	University of Utah

Rydh, David	Participant	University of California
S, M	Participant	Princeton University
Sacca', Giulia	Participant	Princeton University
Sanchez-Gomez, Dario	Participant	Stanford University
Sano, Taro	Speaker	University of California
Satriano, Matt	Participant	uiuc
Sawon, Justin	Participant	Chaminade University
Schlesinger, Enrico	Participant	École Normale Supérieure
Schlueter, Dirk Christopher	Participant	Texas A & M University
Schuerg, Timo	Speaker	University of California, San Diego
Schwede, Karl Earl	Notetaker	University of Illinois Urbana-Champaign
Sengupta, Tathagata	Participant	Brandeis University
Setayesh, Iman	Participant	Ruhr-Universität Bochum
Shende, Vivek	Participant	Scuola Normale Superiore
Sheshmani, Artan	Participant	University of California
Smith, Gregory G.	Participant	Australian National University
Smith, Roy Campbell	Participant	University of Georgia
Smyth, David Ishii	Participant	University of California
Sosna, Pawel	Participant	Rheinische Friedrich-Wilhelms-Universität Bonn
Srinivas, Vasudevan	Participant	Albert-Ludwigs-Universität Freiburg
Stapledon, Alan Michael	Participant	Queen's University
Starr, Jason Michael	Participant	SUNY
Steinberg, David	Participant	University of British Columbia
Stellari, Paolo	Participant	University of Georgia
Stiller, Peter F.	Participant	University of California
Stillman, Mike	Participant	Massachusetts Institute of Technology
Swinarski, David Joseph	Participant	University of Georgia
Szendroi, Balazs	Participant	University of British Columbia
Taipale, Kaisa	Participant	Universität Duisburg-Essen
Thomas, Richard Paul Winsley	Participant	University of Utah
Tian, Zhiyu	Participant	Washington University
To, Jinhyung	Participant	Princeton University
Toda, Yukinobu	Participant	Tata Institute of Fundamental Research
Todorov, Joro	Participant	Max-Planck-Institut für Mathematik
Tommasi, Orsola	Participant	Universität Hannover
Tseng, Hsian-Hua	Participant	Harvey Mudd College
Tucker, Kevin Francis	Participant	Universität Bayreuth
Tyler, Eiko Nakayama	Participant	University of Warwick
Tzeng, Yu-Jong	Participant	Duke University
Ulfarsson, Henning Arnor	Participant	American Institute of Mathematics
Urbinati, Stefano	Participant	Universidade Federal de Pernambuco
Vakil, Ravi	Participant	University of Utah
Van der Wyck, Fred	Participant	Brown University
Venkatram, Kartik	Participant	Stanford University
Viehweg, Eckart	Participant	Stanford University
Viray, Bianca	Participant	Universitaet Bayreuth
Vistoli, Angelo	Participant	University of Oxford
Viviani, Filippo	Participant	University of California
Wood, Melanie Matchett	Participant	University of Colorado
Xu, Chenyang	Participant	Tata Institute of Fundamental Research
Yuan, Yao	Participant	SISSA/ISAS
Zhang, Ziyu	Participant	Georg-August-Universität zu Göttingen
Zhu, Yi	Participant	University of Connecticut
Zinger, Aleksey	Participant	Colorado State University

Modern Moduli Theory Workshop
Held: February 23 to February 27, 2009
The Mathematical Sciences Research Institute

Participant Information
149 officially registered participants

Gender (n = 149 participants)		
Male	75.84%	113
Female	24.16%	36
Declined to state	0.00%	0

Ethnicity (n = 107 participants)		
White	70.09%	75
Asian	20.56%	22
Hispanic	0.00%	0
Pacific Islander	0.00%	0
Black	0.00%	0
Native American	0.00%	0
Declined to state	9.35%	10

Report on the MSRI workshop
Combinatorial, Enumerative, and Toric Geometry
23–27 March 2009

Organizers

Michel Brion (Université de Grenoble)
Anders Buch (Rutgers University)
Linda Chen (Swarthmore College)
William Fulton (University of Michigan)
Frank Sottile (Texas A & M University)
Harry Tamvakis (University of Maryland)
Burt Totaro (University of Cambridge)

Scientific Description

Algebraic geometry has long been a central subject within mathematics, enjoying deep and substantial connections to other parts of mathematics. In particular, the interplay between algebraic geometry and algebraic combinatorics has led to many important developments for both fields. One reason is that tools from both fields can be used to study their common objects. Another reason is that varieties with special combinatorial structures often arise in other mathematical fields, which leads to great interest in understanding these structures. Some of these algebraic varieties with important combinatorial structures include toric varieties, flag varieties and their Schubert subvarieties, degeneracy loci, and many moduli spaces. Powerful tools have been developed coming from algebraic topology, combinatorics, commutative and computational algebra, complex and symplectic geometry, and representation theory, to study the objects in this field. The last 15 years have seen an explosion of interest in these topics, in particular the Schubert Calculus, toric varieties, and quantum cohomology have consistently attracted many leading younger researchers. This workshop highlighted this part of modern algebraic geometry within the context of the broader parent program at MSRI. It presented, at a very high level, the state of the art in combinatorial, enumerative, and toric algebraic geometry.

Need here a paragraph on the statistics of the workshop: Number of people who attended, etc.

Organizational Structure

The workshop was organized using the standard five-day workshop format at MSRI. There were four 60 minute talks each day except on Wednesday, when there were two 60 minute talks in the morning. The structure left ample time for informal discussion between and after talks.

Funding of participants was undertaken with the guideline of funding as many graduate students and recent PhDs (three years or less) as possible. An effort was made to also accommodate more established researchers in the field who do not have other sources of support, including those from underrepresented groups.

Program of Talks

We give a short description of each of the 18 invited talks, in chronological order.

Mircea Mustata, University of Michigan. *On asymptotic invariants of graded sequences of ideals*.

Mustata discussed examples of sequences of ideals, including symbolic powers, base loci of powers of line bundles, and ideals defined by divisorial valuations, and how interest is in the asymptotic behavior of certain invariants of such sequences, such as log canonical thresholds and multiplier ideals. For monomial ideals, these invariants often reduce to convex geometry. The main object of the talk was asymptotic multiplier ideals, which produce another sequence of ideals but with many natural inclusions reversed (as compared to the behavior of the original sequence of ideals). Often, this new sequence of ideals is asymptotically better behaved, but close enough to the original ideals to give useful information. This was illustrated for monomial ideals and Mustata posed a number of open questions.

Lev Borisov, University of Wisconsin. *Strong exceptional collections of line bundles on Fano toric Deligne-Mumford stacks*.

In joint work with Hua, Borisov described how the derived category of a Fano toric Deligne-Mumford stacks is generated by line bundles with vanishing pairwise Ext-groups, generalizing the well-known example of projective spaces (The derived category of P^n is generated by $O(i)$ for $i=0,,n$ and $Ext^a(O(i),O(j))=0$ for all $0\le i,j\le n$ and $a>0$.)

Nicolas Perrin, Universität Bonn. *Towards a Littlewood-Richardson rule in the Kac-Moody setting*.

Perrin presented joint work with Chaput, generalizing work of Thomas and Yong, giving a rule for some structure constants of flag manifolds. Specifically, when u,v,w are all Λ-minuscule, the structure constant $c_{u,v}^{w}$ is given by the jeu de taquin on a poset associated to w (the heap of w). Their proof holds for all G/P when G is finite-dimensional, as well as in some cases when G is an infinite-dimensional Kac-Moody group, in which case a technical condition of slant-finite is required.

Izzet Coskun, University of Illinois at Chicago. *Geometric positivity in the cohomology of homogeneous varieties*.

After recalling his geometric Littlewood-Richardson rule for type A flag varieties, Coskun defined restriction varieties, which are generalizations of Schubert varieties in orthogonal flag varieties. These are restrictions of Schubert varieties from type A flag varieties. Coskun described a positive geometric-combinatorial formula for computing the class of a restriction variety as a sum of Schubert classes. This is the start of his program for a geometric Littlewood-Richardson rule for orthogonal Grassmannians.

Ezra Miller, Duke University. *Equivariant transversality and K-theoretic positivity*.

Miller describes joint work with Anderson and Griffeth, which gives a proofs of conjectures by Griffeth-Ram and Graham-Kumar regarding the signs of Schubert structure constants in the equivariant K-theory of homogeneous spaces. They showed that these signs alternate with codimension, which generalizes Brion's result that the structure constants in ordinary K-theory have alternating signs, as well as Graham's theorem that the structure constants in equivariant cohomology are non-negative.

Kiumars Kaveh, University of Toronto. *Convex bodies, semi-groups of integral points, algebras of finite type, and geometry of linear series on varieties*.

Kaveh describes joint work with Khovanskii, in which it is proved that if $S\subset Z^n$ is a semi-group and $C(S)\subset R^n$ is the cone it generates, then all points of $C(S)\cap Z^n$ that are sufficiently far from the boundary $\partial C(S)$ are also in S. This result is applied to recover some theorems from

algebraic geometry and convex geometry, and also to obtain new results on the asymptotical behavior of linear series on complete varieties.

David Speyer, Massachusetts Institute of Technology. *What can we learn about matroids from K-theory?*

A (representable) matroid M records which sets of d columns in a $d\times n$ matrix are linearly independent. The row span of the same matrix defines a point x in the Grassmannian $Y=Gr(d,n)$ of d-planes in C^n. Speyer exploits this to define invariants of matroids in the K-theory of Grassmannians. Specifically, fix a vector bundle V on Y, and consider the toric variety $X=(C^*)^n.x\subset Y$. Speyer shows that the sheaf Euler characteristic $\sum_{i\geq 0}(-1)^i \dim H^i(X,V|_X)$ depends only on M and not on the choice of representing point x in Y. General (non-representable) matroids are handled by constructing a class in the K-theory of Y that represents $\mathcal{O}_X$ when M is representable. The hope is that all isomorphism classes of matroids can be distinguished by invariants of this type.

Diane MacLagan, Warwick University. *Tropical bounds on nef cones.*

MacLagan explains joint work with Angela Gibney, in which the nef cone of a projective variety Y is bounded below using methods from tropical algebraic geometry. The idea is to embed Y in a suitably chosen toric variety $X(\Delta)$ and exploit the explicitely known intersection theory on this variety.

Sam Payne, Stanford University. *Boundary complexes of varieties.*

The boundary complex of an algebraic variety is the dual complex of the boundary divisor in a log resolution of a compactification. Payne proved that the homotopy type of this complex is independent of the choice of resolution and compactification, and gave relations between these complexes, weight filtrations, and tropicalizations. He also discussed relations with dual complexes of resolutions of singularities, and posed some open problems and conjectures.

Jenia Tevelev, University of Massachusetts Amherst. *Compactifications of Subvarieties of Tori.*

Tevelev reported on joint work with Hacking and Keel, developing an analogy between submanifolds of abelian varieties and subvarieties of tori. For sufficiently nice subvarieties, compactifications are well described by fan structures on the tropicalization. The example of moduli of del Pezo surfaces was explained in detail.

Leonardo Mihalcea, Duke University. *Quantum K-theory of Grassmannians.*

Mihalcea describes joint work with Buch, which gives a way to compute the quantum K-theory of Grassmannians. The main result is a formula stating that the equivariant K-theoretic Gromov-Witten invariants on a Grassmannian are equal to Euler characteristics computed on a two-step flag variety. This was proved earlier by Buch-Kresch-Tamvakis in the special case of non-equivariant cohomological Gromov-Witten invariants. The obtained Gromov-Witten invariants can be used to compute the equivariant quantum K-theory ring of Givental and Lee.

Kai Behrend, University of British Columbia. *The virtual Betti numbers of the Hilbert scheme of points on a Calabi- Yau threefold.*

Let Y be a Calabi-Yau manifold and $Y^{[n]}$ the Hilbert scheme of n points in Y. Behrend describes joint work with Bryan and Szendroi that aims to define virtual Betti numbers encoding certain Euler characteristics of $Y^{[n]}$. One question that arises is if there exists a map $f:M\to C$ such that $Y^{[n]}$ is (locally) equal to the zero section $Z(df)$ of the differential of f. If so, then the Betti

numbers can be constructed if there exist a global object Φ glued together by objects Φ_f defined by these maps. It is conjectured that this is the case.

Thomas Lam, Massachusetts Institute of Technology. *K-theoretic Schubert calculus for the affine Grassmannian*

Lam described joint work with Schilling and Shimozono, which gives a GKM-style representation of the K-theory of an affine Grassmannian as a subring of a large power of the representation ring of the maximal torus. Lam also gave a simple identity that uniquely identities the Hopf algebra structure of the K-theory ring.

Tara Holm, Cornell University. *The K-theory of symplectic orbifolds.*

Holm described how symplectic techniques can be used to compute stringy invariants of orbifolds. The main examples include weighted projective spaces and symplectic toric orbifolds, where it is shown that the orbifold K-theory is torsion free. The main theorem (with Goldin, Knutson, Harada, and Kimura) gives a surjective map from a direct sum of ordinary *K*-theory rings of manifolds to the orbifold *K*-theory of a symplectic quotient.

Bernd Sturmfels, University of California at Berkeley. *The Hilbert scheme of the diagonal in a product of projective spaces*.

Sturmfels explained a connectedness result for multigraded Hilbert schemes, and also presented a result with Dustin Cartwright stating that all points in a particular Hilbert scheme are radical ideals.

Nicolas Ressayre, Université Montpellier II. *GIT-cones and applications*.

The cone of possible eigenvalues of three Hermitian matrices with zero sum can be generalized by looking for non-zero tensor products multiplicities for representations of linear algebraic groups. Other generalizations come from the theories of quiver representations and geometric invariant theory. Ressayre explained a common generalization of these viewpoints, involves the cone generated by *G*-equivariant line bundles (with a non-zero section) on a projective *G*-variety. **Prakash Belkale**, University of North Carolina. *Horn and saturation conjectures for the symplectic and odd orthogonal groups*.

The Horn cone of eigenvalues of triples of hermitian matrices that sum to zero is generalized to the eigencone of an arbitrary simple simply connected complex algebraic group, which is a rational polyhedral cone defined by inequalities from the Schubert calculus. A map between groups gives rise to a map between eigencones, suggesting a relation between the Schubert calculus on different groups. Belkale explains his joint work with Kumar giving such a relation for embeddings of symplectic and odd-orthogonal groups into the special linear group. **Allen Knutson**, Cornell University. *Frobenius splitting of matrix Schubert varieties and positroid varieties, with applications to juggling*.

Knutson began his talk with a minicourse on Frobenius splitting, illustrating it with a very simple proof that Fulton's matrix Schubert varieties are compatibly split and therefore reduced, normal, Cohen-Macaulay and have rational singularities. Matrix Schubert varieties are subvarieties of $n \times n$ matrices; extending his proof to $k \times (n-k)$ matrices and the Grassmannian of k-planes in n-space gives a collection of compatibly split subvarieties of the Grassmannian, called positroid varieties which are reduced, normal, Cohen-Macaulay and have rational singularities. These give a stratification of the Grassmannian with the strata naturally indexed by juggling patterns of length n involving k balls with maximal height n.

MSRI Mathematical Sciences Research Institute

Combinatorial, Enumerative and Toric Geometry

March 23, 2009 to March 27, 2009

Schedule

Monday March 23, 2009		
09:30AM - 10:30AM	Mircea Mustata	On asymptotic invariants of graded sequences of ideals
10:30AM - 11:00AM	Coffee, tea in the atrium	
11:00AM - 12:00PM	Lev Borisov	Strong exceptional collections of line bundles on Fano toric DM stacks
12:00PM - 02:00PM	LUNCH	
02:00PM - 03:00PM	Nicolas Perrin	Towards a Littlewood-Richardson rule in the Kac-Moody setting.
03:00PM - 03:30PM	Coffee,Tea in the atrium	
03:30PM - 04:30PM	Izzet Coskun	Geometric positivity in the cohomology of homogeneous varieties
Tuesday March 24, 2009		
09:30AM - 10:30AM	Ezra Miller	Equivariant transversality and K-theoretic positivity
10:30AM - 11:00AM	Coffee,Tea in the atrium	
11:00AM - 12:00PM	Kiumars Kaveh	Convex bodies, semi-groups of integral points, algebras of finite type, and geometry of linear series on varieties
12:00PM - 01:30PM	LUNCH	
01:30PM - 02:30PM	David Speyer	TBD
02:30PM - 03:00PM	Coffee, Tea in the atrium	
03:00PM - 04:00PM	Diane Maclagan	Tropical bounds on nef cones
04:00PM - 05:00PM	Piano performance by Harry Tamvakis in the Simons Auditorium	
05:00PM - 06:00PM	Reception in the atrium	

Wednesday March 25, 2009		
09:30AM - 10:30AM	Sam Payne	Boundary complexes of varieties (See Abstract)
10:30AM - 11:00AM	Coffee,Tea in the atrium	
11:00AM - 12:00PM	Jenia Tevelev	Compactifications of Subvarieties of Tori
Thursday March 26, 2009		
09:30AM - 10:30AM	Constantin Leonardo Mihalcea	Quantum K theory of Grassmannians
10:30AM - 11:00AM	Coffee,Tea in the atrium	
11:00AM - 12:00PM	Kai Behrend	The virtual Betti numbers of the Hilbert scheme of points on a Calabi- Yau threefold
12:00PM - 01:30PM	LUNCH	
01:30PM - 02:30PM	Thomas Lam	K-theoretic Schubert calculus on the affine Grassmannian
02:30PM - 03:00PM	Coffee, tea int he atrium	
03:00PM - 04:00PM	Tara Holm	The K-Theory of Symplectic Orbifolds
Friday March 27, 2009		
09:30AM - 10:30AM	Bernd Sturmfels	The Hilbert scheme of the diagonal in a product of projective spaces
10:30AM - 11:00AM	Coffee, Tea in the atrium	
11:00AM - 12:00PM	Nicolas Ressayre	GIT-cones and applications
12:00PM - 01:30PM	LUNCH	
01:30PM - 02:30PM	Prakash Belkale	Horn and saturation conjectures for the symplectic and odd orthogonal groups.
02:30PM - 03:00PM	Coffee,Tea in the atrium	
03:00PM - 04:00PM	Allen Knutson	Frobenius splitting of matrix Schubert varieties and positroid varieties, with applications to juggling

Currently Available Videos

- **Mircea Mustata** , On asymptotic invariants of graded sequences of ideals *March 23,2009, 09:30 AM to 10:30 AM*
- **Lev Borisov** , Strong exceptional collections of line bundles on Fano toric DM stacks *March 23,2009, 11:00 AM to 12:00 PM*
- **Nicolas Perrin** , Towards a Littlewood-Richardson rule in the Kac-Moody setting. *March 23,2009, 02:00 PM to 03:00 PM*
- **Izzet Coskun** , Geometric positivity in the cohomology of homogeneous varieties *March 23,2009, 03:30 PM to 04:30 PM*
- **Ezra Miller** , Equivariant transversality and K-theoretic positivity *March 24,2009, 09:30 AM to 10:30 AM*
- **Kiumars Kaveh** , Convex bodies, semi-groups of integral points, algebras of finite type, and geometry of linear series on varieties *March 24,2009, 11:00 AM to 12:00 PM*
- **David Speyer** , What can we learn about matroids from K-theory? *March 24,2009, 01:30 PM to 02:30 PM*
- **Diane Maclagan** , Tropical bounds on nef cones *March 24,2009, 03:00 PM to 04:00 PM*
- **Sam Payne** , Boundary complexes of varieties *March 25,2009, 09:30 AM to 10:30 AM*

- **Evgueni Tevelev** , Compactifications of Subvarieties of Tori *March 25,2009, 11:00 AM to 12:00 PM*
- **Constantin Leonardo Mihalcea** , Quantum K theory of Grassmannians *March 26,2009, 09:30 AM to 10:30 AM*
- **Kai Behrend** , The virtual Betti numbers of the Hilbert scheme of points on a Calabi- Yau threefold *March 26,2009, 11:00 AM to 12:00 PM*
- **Thomas Lam** , K-theoretic Schubert calculus on the affine Grassmannian *March 26,2009, 01:30 PM to 02:30 PM*
- **Tara Holm** , The K-Theory of Symplectic Orbifolds *March 26,2009, 03:00 PM to 04:00 PM*
- **Bernd Sturmfels** , The Hilbert scheme of the diagonal in a product of projective spaces *March 27,2009, 09:30 AM to 10:30 AM*
- **Nicolas Ressayre** , GIT-cones and applications *March 27,2009, 11:00 AM to 12:00 PM*
- **Prakash Belkale** , Horn and saturation conjectures for the symplectic and odd orthogonal groups. *March 27,2009, 01:30 PM to 02:30 PM*
- **Allen Knutson** , Frobenius splitting of matrix Schubert varieties and positroid varieties, with applications to juggling *March 27,2009, 03:00 PM to 04:00 PM*

Speaker List

MSRI Workshop:

Combinatorial, Enumerative and Toric Geometry

March 23 to March 27, 2008

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institue
Allen Knutson	Speaker	University of California, San Diego
Anders S Buch	Speaker	Rutgers University
Bernd Sturmfels	Speaker	UCB - University of California, Berkeley
Burt Totaro	Speaker	University of Cambridge
David Speyer	Speaker	Massachusetts Institute of Technology
Diane Maclagan	Speaker	University of Warwick
Evgueni Tevelev	Speaker	University of Massachusetts
Ezra Miller	Speaker	University of Minnesota
Frank Sottile	Speaker	Texas A & M University
Harry Tamvakis	Speaker	University of Maryland
Izzet Coskun	Speaker	University of Illinois
Kai Behrend	Speaker	University of British Columbia
Kiumars Kaveh	Speaker	University of Toronto
Lev A. Borisov	Speaker	University of Wisconsin, Madison
Linda Chen	Speaker	Ohio State University
Michel Brion	Speaker	Université Joseph Fourier
Mircea Mustata	Speaker	University of Michigan
Nicolas Perrin	Speaker	Universität Bonn
Nicolas Ressayre	Speaker	Institut de Mathématiques et de Modélisation de Montpellier
Prakash Belkale	Speaker	University of North Carolina
Ravi Vakil	Speaker	Stanford University
Sam Payne	Speaker	Stanford University
Sandor J Kovacs	Speaker	University of Washington
Tara Suzanne Holm	Speaker	Cornell University
Thomas Lam	Speaker	Harvard University
William Fulton	Speaker	University of Michigan

Participant List

MSRI Workshop:

Combinatorial, Enumerative and Toric Geometry

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at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Abhinav Kumar	Participant	Massachusetts Institute of Technology
Abraham Martin del Campo	Participant	Texas A&M University
Ahmad Saeid Yasamin	Participant	University of North Carolina
Alan Michael Stapledon	Participant	University of Michigan
Alastair Craw	Participant	University of Glasgow
Alberto Lopez	Participant	Universität Zürich
Alex Fink	Participant	UC Berkeley
Alexander Woo	Participant	St. Olaf College
Alicia M. Dickenstein	Participant	University of Buenos Aires
Allen Knutson	Speaker	University of California, San Diego
Amin Gholampour	Participant	California Institute of Technology
Amy Ksir	Participant	U.S. Naval Academy
Ana-Maria Castravet	Participant	University of Arizona
Andrew Critch	Participant	University of California
Andrzej Weber	Participant	University of Warsaw
Anthony Varilly	Participant	University of California
Anton Leykin	Participant	University of Illinois
Arend Bayer	Participant	University of Connecticut
Atsushi Ito	Participant	University of Tokyo
Benjamin Thorsten Nill	Participant	Mathematical Institute, Freie Universitaet Berlin
Bernd Sturmfels	Speaker	UCB - University of California, Berkeley
Bianca Viray	Participant	University of California
Boris Pasquier	Participant	Hausdorff Center for Mathematics, Villa Maria
Brian David Osserman	Participant	UC Davis
Bryant Mathews	Participant	University of California
Burt Totaro	Participant	University of Cambridge
Carolina B. Araujo	Participant	IMPA
Charley Crissman	Participant	University of California
Chenyang Xu	Participant	Massachusetts Institute of Technology
Chirag Manmohan Lakhani	Participant	North Carolina State University
Christine M. Berkesch	Participant	Department of Mathematics
Christopher Jacques Hillar	Participant	University of California
Christopher James Davis	Participant	Massachusetts Institute of Technology
Cinzia Casagrande	Participant	Università di Pavia
Clinton Graydon McCrory	Participant	University of Georgia
Constantin Leonardo Mihalcea	Participant	Duke University
Craig Desjardins	Participant	Massachusetts Institute of Technology
Damiano Fulghesu	Participant	Scuola Normale Superiore
Damiano Testa	Participant	University of Oxford
Dan Abramovich	Participant	Brown University
Daniel Greb	Participant	Albert-Ludwigs-Universitaet Mathematisches Institut
Daniel Max Erman	Participant	University of California
David desJardins	Participant	UC Berkeley
David E Anderson	Note taker	University of Michigan

David R. Morrison	Participant	University of California
David Speyer	Speaker	Massachusetts Institute of Technology
Davide Fusi	Participant	University of Utah
Dennis Westera	Participant	Universität Wien
Dennis Ochse	Participant	TU Kaiserslautern
Diane Maclagan	Speaker	University of Warwick
Dumitru Ioan Stamate	Participant	Romanian Academy of Sciences
Dustin Alexander Cartwright	Participant	University of California
Edward Grant Clifford	Participant	University of Maryland
Edward Richmond	Participant	University of Oregon
Eleonore Faber	Participant	Universität Wien
Elizabeth Victoria McLaughlin	Participant	University of Maryland
Elizabeth Wulcan	Participant	University of Michigan
Emilia Mezzetti	Participant	University of Trieste
Eric Douglas Miranda	Participant	San Francisco State University
Eric Edward Katz	Participant	University of Texas
Eva Maria Feichtner	Participant	Universität Bremen
Evgueni Tevelev	Speaker	University of Massachusetts
Ezra Miller	Speaker	University of Minnesota
Federico Ardila	Participant	San Francisco State University
Filippo Viviani	Participant	Terza Università di Roma
Frank Sottile	Participant	Texas A & M University
Frederic Bihan	Participant	Université de Savoie (Chambéry)
Gergely Berczi	Participant	University of Oxford
Gregg Musiker	Participant	MIT, Department of Mathematics
Gueorgui Tomov Todorov	Participant	Univeristy of Utah
Gwyneth Rose Whieldon	Participant	Cornell University
Harry Tamvakis	Organizer	University of Maryland
Henning Arnor Ulfarsson	Participant	Brown university
Hiroshi Iritani	Participant	Imperial College London
Hsian-Hua Tseng	Participant	University of Wisconsin
Ignacio M Luengo	Participant	N/A
Izzet Coskun	Speaker	University of Illinois
Jack K Hall	Participant	Stanford University
James B. Carrell	Participant	University of British Columbia
Jamie Pommersheim	Participant	Reed College
Jarod Alper	Participant	Columbia University
Jaroslaw Artur Buczynski	Participant	Texas A & M University
Jason Cornelius Brunson	Participant	Virginia Polytechnic Institute and State University
Jenya Soprunova	Participant	Kent State University
Jose Luis Gonzalez	Participant	University of Michigan
Joseph Gubeladze	Participant	San Francisco State University
Joseph Rusinko	Participant	Winthrop University
Josephine T. Yu	Participant	Massachusetts Institute of Technology
Josh Russell Whitney	Participant	University of California
Kai Behrend	Speaker	University of British Columbia
Kaisa Taipale	Participant	University of Minnesota Twin Cities
Kelli Talaska	Participant	University of Michigan
Kevin Francis Tucker	Participant	N/A
Kiumars Kaveh	Speaker	University of Toronto

Klaus Altmann	Participant	Free University Berlin
kristine Jones	Participant	Cornell University
Kyungyong Lee	Participant	Purdue University
Laura Felicia Matusevich	Participant	Texas A&M University
Lawrence M. H. Ein	Participant	N/A
Lev A. Borisov	Speaker	University of Wisconsin, Madison
Lev Konstantinovskiy	Participant	University of Georgia
LI LI	Participant	University of Illinois at Urbana-Champaign
Linda Chen	Organizer	Ohio state university
Luca Moci	Participant	University of Roma Tre
Luis David Garcia-Puente	Participant	Sam Houston State University
Mahir Bilen Can	Participant	Tulane University
Manoj Kummini	Participant	Purdue University
Marcus Bodo Zibrowius	Participant	University of Cambridge
Margarida Melo	Participant	Terza Università di Roma
Maria Angelica Cueto	Participant	University of California
Mark Walker	Participant	University of Nebraska
Mauricio Fernando Velasco	Participant	University of California
May Shu-mei Shaw	Participant	Northcentral Technical College
Mehdi Garrousian	Participant	University of Western Ontario
Milena Dorota Pabiniak	Participant	Cornell University
Miles Reid	Participant	University of Warwick
Mircea Mustata	Speaker	University of Michigan
Morgan Brown	Participant	University of California
Mounir Nisse	Participant	Université Pierre et Marie Curie - Paris 6
Nicholas James Proudfoot	Participant	University of Oregon
Nicolas Perrin	Speaker	Universität Bonn
Nicolas Ressayre	Speaker	N/A
Ning Hao	Participant	SUNY
Olivier Debarre	Participant	École Normale Supérieure
Orsola Tommasi	Participant	Universität Hannover
Paolo Aluffi	Participant	Florida State University
Paramasamy Karuppuchamy	Participant	University of Virginia
Peter F. Stiller	Participant	Texas A & M University
Prakash Belkale	Speaker	University of North Carolina
Qendrim Gashi	Participant	Max-Planck-Institut für Mathematik
Ragni Piene	Participant	University of Oslo
Raman Sanyal	Participant	University of California
Ravi Vakil	Speaker	Stanford University
Richard Martin Hain	Participant	Duke University
Richard Rimanyi	Participant	University of North Carolina
Robert Edman	Participant	University of Minnesota Twin Cities
Roi Docampo Alvarez	Participant	University of Illinois
Roman Zrotowski	Participant	Thomas M. Cooley Law School
Sam Payne	Speaker	Stanford University
Sami H Assaf	Participant	Massachusetts Institute of Technology
Sandor J Kovacs	Participant	University of Washington
Sandra Di Rocco	Participant	K.T.H.
Sebastian Zwicknagl	Participant	University of California
Serkan Hosten	Participant	San Francisco State University
Shihoko Ishii	Participant	Tokyo Institute of Technology

Shizuo Kaji	Participant	Fukuoka University
Shuchau Bi	Participant	University of California
shuichi iida	Participant	University of Tokyo
Silvia Brannetti	Participant	Terza Università di Roma
Steffen Marcus	Participant	Brown University
Stephen Ames Mitchell	Participant	University of Washington
Tai Huy Ha	Participant	Tulane University
Takehiko Yasuda	Participant	Kagoshima University
Tara Suzanne Holm	Speaker	Cornell University
Thomas Lam	Speaker	Harvard University
Tom C. Braden	Participant	University of Massachusetts, Amherst
Tommaso de Fernex	Participant	University of Utah
Tomohide Terasoma	Participant	University of Tokyo
Travis J Kopp	Participant	University of Washington
Trygve Johnsen	Participant	University of Tromso
Ulrich Derenthal	Participant	Albert-Ludwigs-Universität Freiburg
Valerie Marie Hower	Participant	Georgia Institute of Technology
Veronica Crispin Quinonez	Participant	University of Oregon
Wenchuan Hu	Participant	Massachusetts Institute of Technology
Weronika Julia Buczynska	Participant	Texas A & M University
William Fulton	Organizer	University of Michigan
Y.P. Lee	Participant	University of Utah
Yogesh More	Participant	University of Missouri
Yoonsuk Hyun	Participant	Massachusetts Institute of Technology
Yunfeng Jiang	Participant	University of Utah
Zach Teitler	Participant	Texas A & M University

Combinatorial, Enumerative and Toric Geometry Workshop

Held: March 23 to March 27, 2009

The Mathematical Sciences Research Institute

Participant Information
172 officially registered participants

Gender (n = 172 participants)		
Male	72.67%	125
Female	27.33%	47
Declined to state	0.00%	0

Ethnicity (n = 172 participants)		
White	65.64%	107
Asian	19.02%	31
Hispanic	6.75%	11
Pacific Islander	0.00%	0
Black	0.00%	0
Native American	0.61%	1
Declined to state	7.98%	13

Economic Games and Mechanisms to Address Climate Change
Sea Change Foundation Grant
Final Report

Responding to climate change takes strategy. How much greenhouse gas should each nation allow itself to emit? Will cap-and-trade or a carbon tax be more effective at reducing emissions? What policies will best spur innovative renewable energy technologies?

Mathematics is critical for answering questions like these. Game theory is the field of mathematics devoted to analyzing strategic interactions, and mathematical models are a key predictive tool. To make informed decisions, policymakers need mathematicians and economists to quantitatively analyze the likely results of different policies.

But until recently, only a few mathematicians have been working on climate change, and those few have been sprinkled around, working largely in isolation. Climate change is too critical and complex a problem for such a scattershot approach to be sufficient.

So recently, mathematicians have been coming together to share their expertise and encourage others to enter the field. The latest effort along these lines was a workshop the Mathematical Sciences Research Institute this May on Economic Games and Mechanisms to Address Climate Change sponsored by the National Science Foundation and the Sea Change Foundation. It brought together leaders in this emerging field to share ideas, exchange results, and plan future research.

This report summarizes the presentations of the speakers at the conference.

Rene Carmona, mathematical finance professor at Princeton University: How do we design an effective cap-and-trade system?

The U.S. will almost certainly implement a cap-and-trade system to control carbon emissions soon. President Obama has expressed his commitment to such a scheme, even going so far as to count on $78.7 billion in revenue in 2012 from the sale of greenhouse-gas emission permits (which he promises to return to taxpayers through a tax cut). Japan, Canada, Australia and New Zealand are designing cap-and-trade systems of their own.

In a cap-and-trade system, regulators set a target level for emissions (the “cap”) and issue credit certificates which are sold or distributed for free to the installations participating in the program. In order to ensure that the emission target is complied with, a penalty is levied for each unit of pollutant emitted outside the limits of a given compliance period. Firms may either reduce their own pollution or purchase emission credits in anticipation

of potentially significant penalties. This transfer of allowances by trading is considered to be the core principle leading to the minimization of the costs caused by regulation; firms that can easily reduce emissions will do so, while those for which it is harder buy credits. The cap can then be lowered over time, forcing producers to adopt increasingly clean technologies.

A cap-and-trade scheme is only a market mechanism, not a panacea, and policy makers need to develop a comprehensive approach to tackle the challenges of climate change. While many environmentalists hail the increasing political will toward an aggressive emission control policy, proponents of cap-and-trade systems still face tough resistance from influential pundits favoring a carbon tax. This heated debate is too often driven by political and populist arguments, anecdotally based on scientific methods or quantitative analysis. Princeton financial mathematics professor Rene Carmona proposes to anchor this debate in equilibrium economics theory and base the comparison of the multitude of designs on rigorous mathematical analysis and realistic numerical simulations.

The European Union established the largest mandatory carbon dioxide cap-and-trade program in 2005. It ran into problems that illustrate how critical careful design is. Typical criticisms of the EU ETS first phase, whether in the popular press on in congressional hearings, include: 1) fragility of the markets as evidenced by the price collapse of carbon emission certificates in April 2005, 2) emissions targets were missed, 3) prices paid by the end consumers for electricity shot up, while energy companies reaped enormous windfall profits. All in all, not a pretty picture! However, these mistakes do not have to be repeated, and Carmona is quick to emphasize that new measures have been taken to avoid them, for example changes in the allocation procedure and significant reduction of the number and the form of the allocation.

Regulators control several levers affecting the outcome of these climate change policies. Clearly, choosing the level of the cap and the penalty are important factors impacting the economic outcomes of the scheme. But the hot button is without the shadow of a doubt the way the emission permits are allocated: Should they be given away for free? Which installations should be endowed? Should these permits be auctioned? Grandfathered? Etc. And these questions barely form the tip of the iceberg. Powerful lobbyists point to excessive costs to the end consumers and to the loss of jobs due to production fleeing a taxing emission legislation.

Carmona's model provides a quantitative foundation to address these questions by predicting the prices of emissions permits and goods. Carmona assumes a classical competitive equilibrium model, where each company chooses the strategy that will bring in the highest earnings, independent of everyone else's actions. Each firm's earnings consist of the profit for each good they produce, plus anything they earn on the carbon market, less any penalties they have to pay. By predicting the strategy that is in the individual interest of each firm, Carmona can then find the aggregate effect of everyone's actions on the carbon market as a whole.

Here's an example of how his analysis works. To predict the cost of electricity, Carmona considers the strategy for each individual company. A company will begin by producing electricity using the technology that has the lowest overall cost, once the cost of permits is factored in. That might be, for example, nuclear, so each company with nuclear plants will fire them up. When all the nuclear plants are all producing at full capacity, power plants using the next most expensive technology, say hydropower, will be turned on. When that capacity is exhausted, the next most expensive technology will be used, and so on, until the demand is met. Suppose, with a cap-and-trade system in place, that the most expensive technology used is natural gas. Then the price to consumers, Carmona says, will be determined by the amount it costs companies to produce electricity using natural gas.

Based on a series of numerical experiments, Carmona's work shows that properly designed cap-and-trade systems do work. First, it quantifies the impact of the cap and the penalty on prices. It also confirms that in a competitive environment, allocation schemes do not affect prices, only the distribution of the costs. But most importantly, it offers numerical tools to quantify the differences between climate change policies, for example carbon taxes and cap-and-trade schemes based on a wide variety of allocation schemes. Obviously, a climate change policy comes at a cost, and this cost will be passed to the end-consumer if the regulation does not include provisions to return revenues from the taxes or the allowance auctions in the form of income tax reliefs or refunds to parties most affected by the price increases. While this "return of the proceeds of the policy" is not part of the model, the statistical distributions of the costs to the consumers and the producers can be tracked within the model. In fact, one can use this model to argue that a properly designed cap-and-trade system is a better solution than a carbon tax, the primary alternative. Indeed, because of the inelasticity of the demand for goods like electricity and the stochastic nature of demand for commodities, a carbon tax would need to be higher than economically necessary to reach the same emissions targets.

One of the main criticisms of the EU ETS was the excessive windfall profits of electricity producers. Unfortunately, some of these profits are very difficult to avoid, and the proposed auctions of permits do not offer a real solution. It seems fair to force producers to pay for allowances having a market value, but it does not change the equilibrium prices which the consumers will have to paid eventually. While windfall profits cannot be eliminated completely, regardless of whether permits are sold or given away, some allocation schemes can help the regulator control them, at least in a statistical sense.
The thrust of the research results presented by Professor Carmona is the analysis of allocation schemes where emissions permits are distributed dynamically proportionally to production. These allocation procedures are reminiscent of some of the "output based" allocations proposed by some economists to minimize the leakage effect.
While this effect was only mentioned, the impact on windfall profits was analyzed in great detail. However, simply comparing how much money a company would have made with and without a cap-and-trade system isn't appropriate, because the mix of energy sources will be inevitably different in the two situations. For an apples-to-apples comparison, one should compare profits to those made by producers without the cap-and-

trade legislation, should they had used the same mix of fuels they used with cap-and-trade. With this definition, Carmona and his collaborators noticed that auctioning permits rather than giving them away had little impact on windfall profits. However schemes with proportional allocations offer a better control of these profits. In fact the latter can be lowered significantly when the scheme design involves properly crafted incentives.

On one hand, the versatility of these schemes makes them very attractive because of the extensive control they provide to the regulators. But on the other hand, their complexity appears as a serious shortcoming, and there is little hope that they will ever be adopted by policy makers: regulations need to be articulated in simple terms in order to be embraced. This is a clear advantage of the carbon tax over some of the most sophisticated forms of cap-and-trade: even though they were regarded as "political suicide" by most US politicians not so long ago, they recently gained in appeal because of their transparency. The increased suspicion for some of the practices of the financial market did not help the cause of policies involving an intrinsic trading component.

Carmona emphasizes, however, that all these results are preliminary. The mathematical theory of cap-and-trade is still in its infancy and he wishes more mathematicians could be involved. This new research avenue offers exciting challenges and opportunities to mathematicians interested in climate change and willing to bring their mathematical expertise to bear with important environmental economics problems in shaping new financial markets.

Suzanne Scotchmer, economist at UC Berkeley: Will cap-and-trade spur innovation?

Any scheme that makes it expensive to emit carbon should, it seems, encourage the development of lower-emissions technologies. Producers can profit by emitting less carbon, and therefore have an incentive to license cleaner technologies. The licenses create a reward to innovation. But according to Suzanne Scotchmer, this story is a bit too simplistic when the price of carbon emissions is set in a cap-and-trade system.

Her analysis doesn't involve a complex model, as Carmona's does. Instead, she started with the observation that a cleaner technology will not lead to lower emissions under cap-and-trade, because emissions are set by the cap. Instead, it will lead to more electricity for the same carbon emissions.

Of course, that's a good thing. But this increase in supply means that that electricity will get cheaper, which reduces the profit for the producer – hardly what the producers are looking for. Furthermore, the new technology will reduce the demand for emissions permits, making their price fall. This reduces producers' willingness to pay for licenses

on the cleaner technology. This creates a negative feedback, decreasing the reward for finding a lower-emissions technology.

“How important is this feedback effect? We don’t know,” she says. “But we need game-changing innovations, and game-changing innovations are much more likely to create it.”

Scotchmer is now developing ways to quantify this effect and designing mechanisms to deal with it. One way of making the carbon market more able to provide continuing pressure toward innovation is to make the unify the markets for different forms of carbon emissions, for example, electricity generation, aluminum manufacturing and cement production. A single new technology is unlikely to lower the price of emissions permits if the market covers many industries in many states.

Scotchmer's research suggests that a carbon tax might be preferable to cap-and-trade. With a tax on carbon emissions, emissions are not fixed. Instead, the tax rate is fixed. Thus the new technology won’t create as much of an oversupply of electricity. The fixed tax rate may create a larger incentive for innovation, because it avoids the negative feedback that occurs when the emissions price falls under a cap-and-trade system.

However, Scotchmer points out that her analysis is far from complete and that she’s only looked at the simplest scenario, where the cap is fixed. In cap-and-trade systems, however, lawmakers can reduce the cap over time. This has the potential to restore the incentive to innovate. If a decreasing cap can keep up the pressure to innovate, the question then becomes figuring out the rate at which the cap should go down.

Scotchmer says she doesn’t yet know whether carbon taxes or cap-and-trade systems are the better way to go, but her research shows that the effect of cap-and-trade on innovation needs to be studied much more carefully.

Robert Pindyck, economist at MIT’s Solan School of Management: Should governments act now?

How much money should governments be spending to reduce carbon emissions?

Massive uncertainty makes that a very hard question to answer. What will the climate be like if we continue with business as usual? What economic impacts will the changes have? How much would it cost to significantly reduce future global warming? What technological improvements will come along that will make it cheaper to reduce emissions? No one has solid answers to any of those questions.

Nevertheless, governments have to decide how much they’re going to spend on climate change now. They can’t wait until the uncertainties have resolved themselves. Climate

scientists say that the very existence of life on Earth hangs in the balance, but to act, governments need quantitative analyses showing investment in averting climate change will pay off.

Most economic analyses to date, with the exception of Britain's controversial *Stern Review*, have suggested that governments shouldn't spend large amounts now to abate global warming and that the advantages of waiting for improved technology and greater knowledge will outweigh the benefits of immediate action. Many climate scientists have responded to such analyses with incredulity.

But Pindyck noted that these assessments, called "Integrated Assessment Models," all focus on the most probably outcomes based on current scientific knowledge, while ignoring the even worse outcomes that may happen but aren't especially likely. He wanted to know if by paying attention to these low-probability outcomes, he might be able to produce an economically justified, careful study that *would* justify spending a lot now to reduce climate change and its future impacts.

He built a model that estimated the fraction of current and future GDP a government would be willing to sacrifice to keep the increase in average global temperature below a given threshold. To understand the full range of possible increases in temperature and not just the most likely ones, he used a probability distribution that closely matched the ranges given in the studies used by the International Panel on Climate Change (IPCC) in its 2007 assessment. He also needed to know what the economic impacts of a given rise in temperature would be. Many might argue that that's simply beyond knowing, especially at the higher ends of the range that are not only outside human experience but also outside anything ice cores indicate have occurred in the Earth's history, and Pindyck doesn't disagree. But he points out that this intense uncertainty hasn't stopped economists from making their best guesses in Integrated Assessment Models. So he treated the results of those models in the same way that he treated the results of the studies used in the IPCC reports, finding a probability distribution that most closely matches the range of their estimates.

To tilt the field in favor of action, he used the direst predictions from the IPCC assessment and the Integrated Assessment Models. He also assumed that the "discount rate" is zero. The discount rate is effectively the interest charged on loans, and assuming a zero discount rate means that governments would be equally willing to spend a dollar now as to spend a dollar a hundred years from now.

Even so, he was unable to justify high rates of government spending, above, say 3 percent of GDP. Instead, his analysis supports a policy of small expenditures while waiting for technology to improve and for the science to become more definitive.

Pindyck says that these results point out that current studies suggest that truly terrible disasters just aren't all that likely. For example, the distribution he derived from the IPCC reports suggests that there is a 21 percent probability of an increase in temperature that is

greater than 4.5 degrees Celsius in 100 years. In that case, if the economic impact were at the high end of the range predicted by the Integrated Assessment Models, GDP could fall by 5.7 percent, which would be pretty bad. But the probability of such a drop in GDP is only 3.6 percent.

But the science about those unlikely events is particularly uncertain. For example, if the West Antarctic ice sheet were to collapse, sea levels would rise by 5 meters. Most experts agree that's not very likely, but they know little about just how unlikely it is.ec Such events could have extraordinarily high costs, and if there were solid enough information about them to include them in economic analyses, their outcomes might be different. Pindyck urges that more science be focused on trying to understand this.

Another difficulty is that economic analyses like these have little way of dealing with low-probability, truly terrible outcomes. If there's even a small chance that life on Earth will end, then an economic analysis would indicate that governments spend 100 percent of GDP on climate change. This is an unhelpful recommendation from an economist, however, because it is obviously politically and practically unfeasible.

Furthermore, Pindyck pointed out that he assumed that the costs of climate change are linear with temperature change, so that the economic impact of a six degree rise is double that of a three degree rise. But larger temperature rises may well be much worse than that, and modifying Pindyck's model to reflect that could also change the recommendation to policymakers.

Inez Fung, an eminent climate scientist at UC Berkeley, said, "This just shows that Pindyck can't help us." But Pindyck is an economist who is deeply concerned about climate change. The failure of his study to support strong action on climate change shows the need for more research to translate the urgency climate scientists feel from the analysis of their data into the quantitative language politicians can understand and act upon.

Prajit Dutta, economist at Columbia University: How can a global carbons-emission treaty be effective without world-wide cops?

Climate change is the biggest tragedy of the commons the world has ever seen. Nearly everyone acknowledges that global greenhouse gas emissions need to go down, but if a single country decides to reduce its emissions alone, it's not going to work. The reduced emissions won't be enough to stave off global warming, and the country's economy is likely to suffer to boot. The only solution is if everyone joins together.

The original tragedy of the commons – the overgrazing of public lands – can be solved with laws regulating cattle. At a global scale, though, there's no cop to enforce the laws.

The only solution, says Prajit Dutta, is to devise a treaty so that it's in everyone's self-interest to abide by it. And game theory is just the tool to develop and analyze such a treaty.

Dutta has researched a proposal in which the treaty would be designed to explode if anyone violates it. Everyone would agree to a strategy of emissions cuts, and if any country fails to meet its obligations under the treaty, none of the countries would be bound by it anymore. The environmental and economic consequences of the "business as usual" scenario are so bad, he says, that the very possibility of reverting to it can be used as a punishment to keep everyone in line. Dutta's analysis shows that in theory, it is possible with this scheme to get large emission cuts.

Dutta is continuing his research to look for punishments other than "business as usual" that would be more effective. His research indicates that there are, but he points out that for any treaty to have a chance of ratification, it is critical that it be simple enough that people can readily understand and implement it. So he's not inclined to study any very complex scenarios. Indications are, however, that some reasonably simple and effective threats may exist.

David Zetland, economist at UC Berkeley: How well do theories hold up to the real world?

Theories are all well and good, but real life doesn't always behave. Since David Zetland does most of his work in the muck and hubbub of the real world, he wanted to ground the discussion in reality by performing an experiment. The conference participants negotiated Kyoto II on the spot.

Zetland assigned the participants to four groups. The treaty was bilateral, to be negotiated between America and China. The bureaucrats formed a third group, and they gathered information and administered agreements. The final group was the rest of the world.

China presented the first proposal: a global cap-and-trade system, with emissions permits allocated according to population. In addition, China wanted to receive permits for projects done in other parts of the world with clean technology it develops. America responded with its own proposal, a global carbon tax, with the revenues divided according to gross domestic product.

Negotiations played out with small moves on either side until the US came up with a radical proposal: It offered a bribe to five of the eight countries constituting the rest of the world for the purposes of the experiment. If they voted for the US proposal, they'd receive annual international aid of 30 percent of their GDP.

Bribery worked. The US won.

While the game was played with tongue in cheek, Zetland had a serious purpose, which turned out to be beautifully illustrated by the game's unexpected conclusion. Human beings behave in unpredictable ways. To be useful guides, mathematical models have to allow for human uncertainty.

Conclusion

The field of the mathematics of climate change is just beginning to emerge, and it is desperately needed. One area mathematics has great potential to make a contribution is in modeling the many economic questions climate change raises. So far, economists and mathematicians have been working in significant isolation, forging the quantitative tools needed. While they've been making important progress, more people need to get involved and researchers' work needs to be better coordinated. Workshops like this one have the potential to increase the speed of development significantly by bringing key players together and bringing greater attention to mathematical climate change issues.

MSRI Mathematical Sciences Research Institute

Economic Games and Mechanisms to Address Change

May 04, 2009 to May 06, 2009

Monday May 4, 2009		
09:00AM - 09:40AM	Rene Carmona	Cap-and-Trade Market Models, Tutorial I
09:45AM - 10:25AM	Rene Carmona	Cap-and-Trade Market Models, tutorial II
10:30AM - 11:00AM	Tea, Coffee in the atrium	
11:00AM - 11:40AM	Michael Ludkovski	Optimal Switching to play Games with the Environment
11:45AM - 12:25PM	Suzanne Scotchmers "Cap and Trade: The problem of diffusion"	
12:30PM - 02:00PM	Lunch	
02:00PM - 02:40PM	James Bushnell (TBA)	
02:45PM - 03:25PM	Ronnie Sircar	Differential Games and Exhaustible Resources
03:30PM - 04:00PM	tea, Coffee in the atrium	
04:00PM - 05:30PM	Panel Discussion: Market Mechanisms as Solutions of Green House Gas Emissions: Interaction between Policy Makers, Economists and Mathematicians. (what will the Role of Mathematics be?)	
07:00PM - 09:00PM	The Roda Theatre in downtown Berkeley: The Math Behind the Cath: the Inside Story of Stents, Pacemakers, and other Medical Miracles	
Tuesday May 5, 2009		
09:00AM - 09:40AM	Prajit Dutta	Game Theory and Climate Treaties, Tutorial I
09:45AM - 10:25AM	Prajit Dutta	Game Theory and Climate Treaties, Tutorial II
10:30AM - 11:00AM	Tea, Coffee in the atrium	
11:00AM - 12:00PM	Robert Pindyck	Uncertainty, Extreme Outcomes, and Climate Change Policy.
12:30PM - 02:00PM	Lunch	
02:00PM - 02:30PM	Svetlana Pevnitskaya	An Experimental Investigation of Economic Incentives in Environmental Conservation, Sustainability and Renewable Energy
02:30PM - 03:00PM	Katerina Sherstyuk	Games with Dynamic Externalities and Climate Change Experiments
03:00PM - 03:30PM	Bard Harstad	The Dynamics of Climate Agreements
03:30PM - 04:00PM	Tea, Coffee in the atrium	
04:00PM - 05:30PM	David Zetland	Discussion: Climate change dynamics in theory, experiments and reality
05:30PM - 07:00PM	Reception in the Atrium	
Wednesday May 6, 2009		
09:00AM - 09:55AM	Max Auffhammer	TBD
10:00AM - 10:30AM	Tea, Coffee inthe atrium	
10:30AM - 12:00PM	Richard Gilman, David Housman, David Mond, Stephen Schecter	Panel Discussion: Game theory in the math curriculum (motivated by climate change!) (See Abstract)
12:00PM - 01:30PM	Lunch	
01:30PM - 03:00PM	Final discussion and future planning.	

Currently Available Videos

- **Rene Carmona** , Cap-and-Trade Market Models, Tutorial I *May 4,2009, 09:00 AM to 09:40 AM*
- **Rene Carmona** , Cap-and-Trade Market Models, Tutorial I I *May 4,2009, 09:45 AM to 10:25 AM*
- **Michael Ludkovski** , Optimal Switching to play Games with the Environment *May 4,2009, 11:00 AM to 11:40 AM*
- **Suzanne Scotchmer** , Cap and Trade: The problem of diffusion *May 4,2009, 11:45 AM to 12:25 PM*
- **James Bushnell** , Bushnell"s Talk *May 4,2009, 02:00 PM to 02:40 PM*
- **Ronnie Sircar** , Differential Games and Exhaustible Resources *May 4,2009, 02:45 PM to 03:25 PM*
- **Prajit Dutta** , Game Theory and Climate Treaties, Tutorial I *May 5,2009, 09:00 AM to 09:40 AM*
- **Prajit Dutta** , Game Theory and Climate Treaties, Tutorial II *May 5,2009, 09:45 AM to 10:25 AM*
- **Robert Pindyck** , Uncertainty, Extreme Outcomes, and Climate Change Policy *May 5,2009, 11:00 AM to 12:00 PM*
- **Svetlana Pevnitskaya** , An Experimental Investigation of Economic Incentives in Environmental Conservation, Sustainability and Renewable Energy *May 5,2009, 02:00 PM to 02:30 PM*
- **Katerina Sherstyuk** , Games with Dynamic Externalities and Climate Change Experiments *May 5,2009, 02:30 PM to 03:00 PM*
- **Bard Harstad** , The Dynamics of Climate Agreements *May 5,2009, 03:00 PM to 03:30 PM*
- **David Zetland** , Climate change dynamics in theory, experiments and reality *May 5,2009, 04:00 PM to 05:30 PM*
- **Max Auffhammer** , Auffhammer"s Talk *May 6,2009, 09:00 AM to 09:55 AM*
- **Richard Gilman, David Housman, David Mond, Stephen Schecter** , Panel Discussion: Game theory in the math curriculum (motivated by climate change!) *May 6,2009, 10:30 AM to 12:00 PM*

- **Richard Gilman, David Housman, David Mond, Stephen Schecter** , Panel Discussion: Game theory in the math curriculum (motivated by climate change!) *May 6,2009, 10:30 AM to 12:00 PM*
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- **Richard Gilman, David Housman, David Mond, Stephen Schecter** , Panel Discussion: Game theory in the math curriculum (motivated by climate change!) *May 6,2009, 10:30 AM to 12:00 PM*

Speaker List

MSRI Workshop:

Economic Games and Mechanisms to Address Climate Change

May 04, 2009 to May 06, 2009

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Auffhammer, Max	Speaker	University of California
Scotchmer, Suzanne	Speaker	Univ of California

Participant List

MSRI Workshop:

Economic Games and Mechanisms to Address Climate Change

May 04, 2009 to May 06, 2009

at Mathematical Sciences Research Institute, Berkeley California

Full Name	Role	Primary Institute
Adams, Malcolm	Participant	University of Georgia
Adams, Ronald	Participant	Florida Atlantic University
Auffhammer, Max	Speaker	University of California
Carmona, Rene	Lecture/Tutorial-org ctte	Princeton University
Champion, Richard Anthony	Participant	US Geological Survey
Chu, Uran W.	Participant	Oregon State University
Chueh, Emily	Participant	University of California
Creutzig, Felix	Participant	University of California
Dutta, Prajit	Lecture/Tutorial-org ctte	Columbia University
Eggert, Anthony	Panel	University of California
Erman, Daniel Max	Participant	University of California
Ezzedine, Souheil M.	Participant	LLNL
Fielden, Tom	Participant	Portland State University
Fischer, Marc L.	Participant	Lawrence Berkeley Laboratory
Gao, WeiZheng	Notetaker	Florida Atlantic University
Giansiracusa, Noah	Participant	Brown University
Gilman, Richard	Panel	N/A
Goldberg, Lisa Robin	Participant	MSCI Barra
Golombek, Rolf	Participant	University of Oslo
Harstad, Bard	Lecture/Panel	Northwestern University
Hoffman, Chris Eric	Participant	University of Washington
Housman, David	Panel	MIT
Hubenthal, Mark	Participant	University of Washington
Imanyuel, Larens	Participant	Universal System of Natural Units
Jones, Christopher R. T.	Organizer	University of North Carolina, Chapel Hill
Judd, Kenneth	Participant	Stanford University
Knittel, Chris	Panel	University of California
Korsan, Bob	Participant	N/A
Lee, C	Participant	N/A
Lemoine, Derek	Participant	University of California
Ludkovski, Michael	Lecture /Panel	University of California
Mihnea, Amalya	Participant	N/A
Mond, David Michael Quentin	Panel	University of Warwick
Nachbaur, James	Participant	UC Santa Barabara
NanTie, Gary	Participant	University of New York
Ovchinnikov, Sergei	Participant	San Francisco State University
Pevnitskaya, Svetlana	Lecture/Panel	Department of Economics, FSU
Pindyck, Robert	Lecture	Massachusetts Institute of Technology
Rong, Ying	Participant	N/A
Roth, Ilan	Participant	Space Sciences, UC Berkeley
Rutherfoord, Vermont Charles	Participant	Florida Atlantic University
Saad, Katherine	Participant	Pacific Gas & Electric
Schecter, Stephen	Panel	North Carolina State University
Schein, Andrew Ribet	Participant	Stanford University
Scotchmer, Suzanne	Speaker	Univ of California
Sherstyuk, Katerina	Panel	Department of Economics, University of Hawaii at Manoa
Sircar, Ronnie	Lecture/Panel	Princeton University
Stine, Alexander	Participant	University of California
Traeger, Christian Peter	Participant	University of California at Berkeley
Wang, Shouhong	Participant	Indiana University
Xu, Feng	Participant	University of California, Riverside
Zetland, David Jason	Organizer	N/A

Workshop: Economic Games and Mechanisms to Address Climate Change

Held: Spring 2009

The Mathematical Sciences Research Institute

Participant Information
52 participants

Gender (n = 52 participants)		
Male	90.38%	47
Female	9.62%	5
Declined to state	0.00%	0

Ethnicity (n = 62 participants)		
White	50.00%	26
Asian	13.46%	7
Hispanic	0.00%	0
Pacific Islander	0.00%	0
Black	0.00%	0
Native American	0.00%	0
Declined to state	36.54%	19

The MSRI summer graduate workshop on Toric Varieties

Organized by

David Cox (Amherst College) and Hal Schenck (University of Illinois at Urbana-Campaign)

Held at MSRI in Berkeley, CA June 15-26

The summer graduate workshop brought together a diverse group of 45 participants, ranging from first through fifth year graduate students, with backgrounds in combinatorics, algebraic and symplectic geometry, and commutative algebra. Toric varieties are a class of algebraic varieties (roughly speaking, objects which look locally like the zeroes of a system of polynomial equations) which lie at the interface of geometry, combinatorics and algebra. The class of toric varieties is both large enough to include a wide range of phenomena and concrete enough to provide an excellent computational environment. This atypical combination leads to applications in many other fields including string theory, coding theory, approximation theory and statistics. Toric varieties also provide a wonderful vehicle for teaching algebraic geometry.

Geometrically, a toric variety is an irreducible algebraic set in which an algebraic torus forms a dense open subset, such that the action of the torus on itself extends to an action on the entire set. Combinatorially, a normal toric variety is determined by a fan; the cones in the fan yield affine varieties and the intersection of cones provide gluing data needed assemble these affine pieces together. Algebraically, an embedded toric variety corresponds to a prime binomial ideal in a polynomial ring. More generally, a toric variety can be described by a multi-graded ring together with an irrelevant ideal. The importance of toric varieties comes from this dictionary between algebraic spaces, discrete geometric objects such as cones and polytopes, and multi-graded commutative algebra.

Because of the wide range of backgrounds, the workshop had a very intense schedule. In the evenings, there were background lectures on basic material in algebraic geometry (ranging, for example, from valuation rings to vector bundles to sheaf cohomology). Each morning, there were two one hour lectures on interpreting algebro-geometric concepts in the toric setting. After lunch, participants were presented with several different sets of problems, ranging from very computational (compute the Picard group of a Hirzebruch surface) to more theoretical (prove a lemma stated during the morning lecture). Participants broke up into small groups of six or seven people, helped when needed by the organizers and two very able TAs (Dustin Cartwright and Daniel Erman) from Berkeley. At the end of the afternoon, the groups presented their results to the whole workshop.

During the latter part of the second week, three guest speakers spoke on topics related to toric geometry: David Eisenbud on the cone of betti tables; Matthias Beck on normality and semigroups; and Sam Payne on toric vector bundles. Participants really enjoyed seeing research talks on topics they had just studied. Among other participant comments:

* The workshop was a truly amazing experience. The only way it to improve it is to make it longer!

* I can't believe how much I learned in these short two weeks.

* Excellent workshop. The problem session/presentation setup was very conducive to working together and understanding the material. Intensive but also fun.

* The format of the workshop, although incredibly intensive, was very effective. Although there was no way for me to have digested everything, I learned a lot. Also, I really enjoyed the problem sessions because it encouraged us to meet each other and socialize.

* The morning lectures gave us the big picture. The afternoon problem sessions filled in the details of the picture; I particularly enjoyed the group work. The evening lectures helped prepare us for the next day's topics. This was an awesome experience.

Lectures from the workshop are available on streaming video at the MSRI website, http://www.msri.org/calendar/sgw/WorkshopInfo/455/show_sgw,
and a draft version of the forthcoming AMS book "Toric Varieties"by Cox, Little and Schenck is available at http://www.cs.amherst.edu/~dac/toric.html

Toric Varieties

Invited Speakers

Cox, David	Amherst College
Schenck, Hal	Texas A&M University
Beck, Matthias	San Francisco State University
Eisenbud, David	UC Berkeley
Payne, Sam	Stanford University
Aragon, Cecilia	UC Berkeley

Participant List

MSRI Workshop:

Toric Varieties

June 15 - 26, 2009

at Mathematical Sciences Research Institute, Berkeley California

Name	Institution
Beaudry, Agnes	Northwestern University
Brannetti, Silvia	Terza Università di Roma
Chan, Melody	University of California
chavez, Anastasia maria	San Francisco State University
Chowdhury, Atoshi	Stanford University
Chung, KiRyong	Seoul National University
Contois, Mark	Washington University
Diemer, Colin	University of Pennsylvania
Dover, James	University of Oklahoma
Duncan, Alex	University of British Columbia
Dutle, Aaron	University of South Carolina
Escobar, Laura	San Francisco State University
Gibbins, Aliska	Ohio State University
Gudmundsson, Hilmar	Reykjavik University
Hardarson, Marteinn	Reykjavik University
Hinkelmann, Franziska	Virginia Polytechnic Institute and State University
Hsiao, Jen-Chieh	Purdue University
Kang, Ning	University of Texas
Kazanova, Anna	University of Massachusetts
Kodgis, Lisa	University of Hawaii
Kositwattanarerk, wittawat	Clemson University
Li, Zhiyuan	Rice University
Lin, Jan-Li	Indiana University
Lin, Kuei-Nuan	Purdue University
Mahmood, Fatima	Cornell University
Malmskog, Elizabeth	Coloroado State University
Mathews, Bryant	University of California
Miller, Jason	Ohio State University
Mondal, Pinaki	University of Toronto
Mukhopadhyay, Swarnava	University of North Carolina
Novoseltsev, Andrey	University of Alberta
O'Keefe, Augustine	Tulane University
Pabiniak, Milena Dorota	Cornell University
Pham, Vinh An	University of Missouri
Ravikumar, Vijay	Rutgers University
Sachitano, David	California State University
Seceleanu, Alexandra	University of Illinois at Urbana-Champaign
Shao, Yijun	University of Arizona
Slawinski, Mike	University of California
Sweet, Ross	Boston University
Tian, Zhiyu	SUNY
Trentacoste, Catherin	Clemson University
Wechter, Matthew	University of Illinois
Whitney, Josh Russell	University of California
Williams, Harold	University of California
Xie, Yu	Purdue University
Yaggie, Jon	San Francisco State University
Zhong, Changlong	University of Southern California
Zhu, Yi	Math Dept

Toric varieties

Held: June 15-26, 2009

The Mathematical Sciences Research Institute

Officially Registered Participant Information
49 participants

Gender (n = 49participants)		
Male	59.18%	29
Female	40.82%	20
Declined to state	0.00%	0

Ethnicity (n = 49 participants)		
White	52.94%	27
Asian	37.25%	19
Hispanic	3.92%	2
Pacific Islander	0.00%	0
Black	0.00%	0
Native American	1.96%	1
Declined to state	3.92%	2

Evaluating MSRI's Postdoctoral Fellowship Program

A Survey of 2004-2009 Postdoctoral Fellows

Background

MSRI's Postdoctoral Fellowship Program encompasses two distinct types of fellowships. The programmatic fellows are associated to MSRI's scientific programs, which last one to two semesters; these positions have existed as long as MSRI has. In addition, a new program supports external fellows for one to two years at a host institution (not MSRI). Both types of postdoctoral fellowship are intended for recent recipients of a Ph.D. in mathematics, and are carefully structured to incorporate the supervision of a research mentor. Fellows of both types are expected to spend their time on research activities, including paper writing, giving presentations at national conferences, and preparing an NSF grant proposal. External fellows may also teach one course per year and mentor students, with the assistance of their own mentors. Since Fall 2004, MSRI has granted 145 postdoctoral fellowship awards.

The MSRI directorate is in the process of formulating a plan for evaluating the impact of its postdoctoral fellowship programs. In order to have a preliminary indication of the impact of the programs, and to gain critical insight into the process of measuring that impact, MSRI has surveyed the postdoctoral fellows who received their awards during the five program years from Fall 2004 to Spring 2009. This report presents an analysis of the responses to that survey and related demographic data which were independently available from program records.

Methods

Deputy Director Barcelo designed a survey which addressed the current occupation of the fellows, the impact of the fellowship on fellows' careers, and research outcomes based on the work fellows conducted at MSRI. These questions were formulated mostly for multiple choice or numeric responses. Two scaled-answer questions and two open-ended questions allowed respondents to offer general feedback on the program. (A printed version of the survey is provided in Appendix A to this report.)

The survey was implemented as an anonymous online survey in Google docs. All postdoctoral fellows from academic years 2004-05 to 2008-09 were contacted by email and requested to complete the survey. The request was repeated once (by email) during the three weeks the survey was open. To preserve anonymity and to encourage responses by keeping the survey short, demographic data was not collected as part of the survey.

The most difficult issue in evaluating impact is to determine what would have happened to postdoctoral fellows had they not received the award. Critical here is finding

appropriate comparison groups and obtaining data on them. Given the limited time and other resources available for this study, it was only feasible (and only in certain cases) to compare data on MSRI fellows with data on the general population of cohort U.S. Ph.D.'s. Such data were obtained from the Annual Surveys of the Mathematical Sciences published by the AMS ([1]).

Findings

I. Description of the Population of Fellows

Since the Fall semester of 2004, MSRI has granted 145 postdoctoral fellowship awards, with cohorts ranging from 26 fellows in 2004-05 and 2006-07 to 34 fellows in 2008-09. The Institute has collected data on these fellows from both their fellowship applications, from a check-in form that all fellows complete upon arrival, and from a check-out form they complete upon departure.

Of these 145 fellows, 42 (29%) were women (Figure 1). Sixty-six (46%) identified themselves as White, and 10 (7%) identified themselves as members of non-Asian minority groups. Thirty-five fellows (24%) explicitly declined to specify their race or ethnicity; 21 (14%) did not specify race or ethnicity and also did not select the "decline to specify" option (Figure 2). One hundred and three (71%) fellows received their Ph.D. from a Group I public or private US institution; 34 (23%) received their Ph.D. from a foreign institution (Figure 3).

FIGURE 1

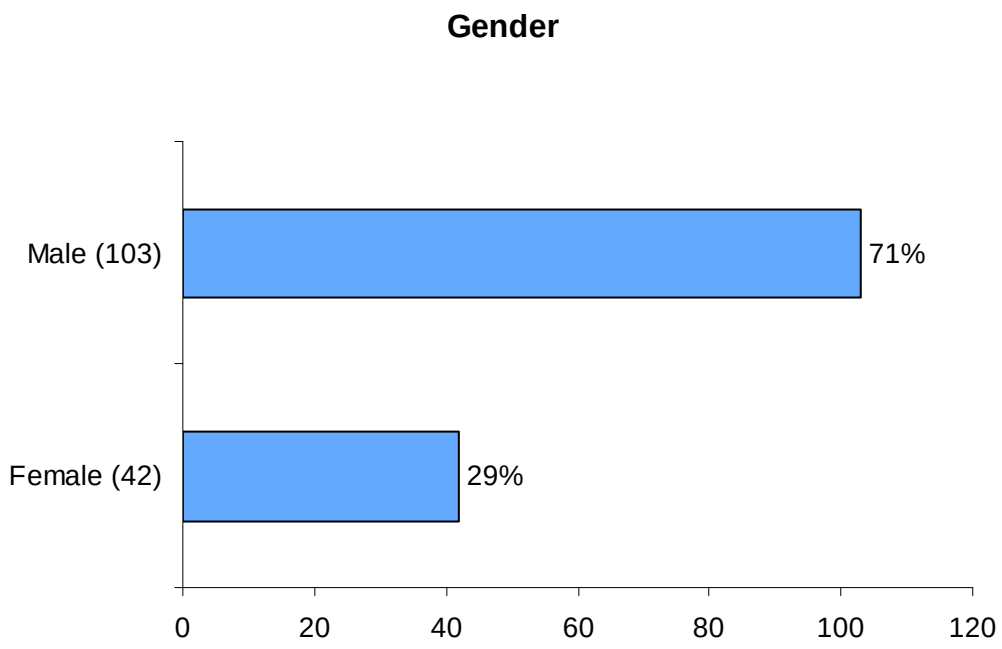
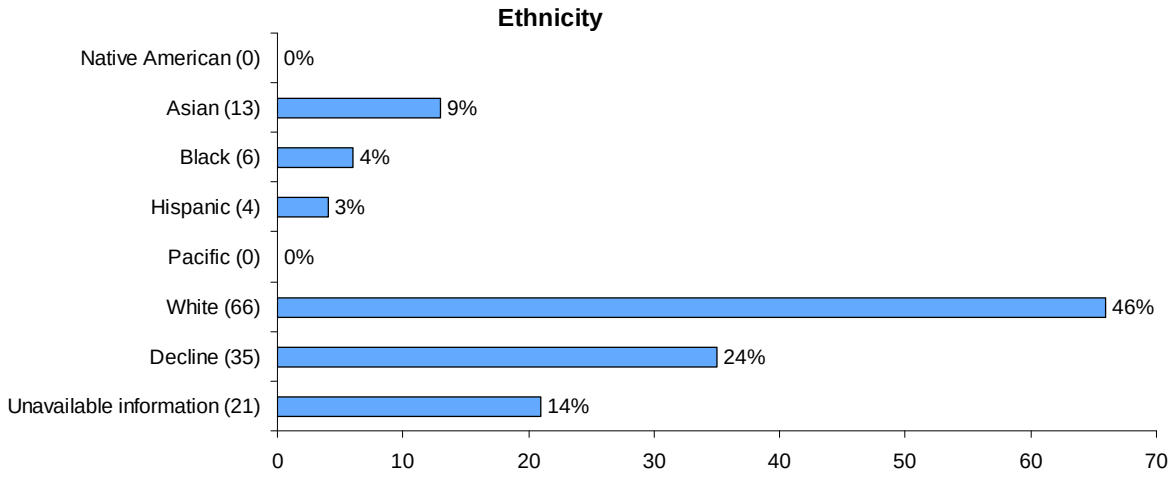


FIGURE 2



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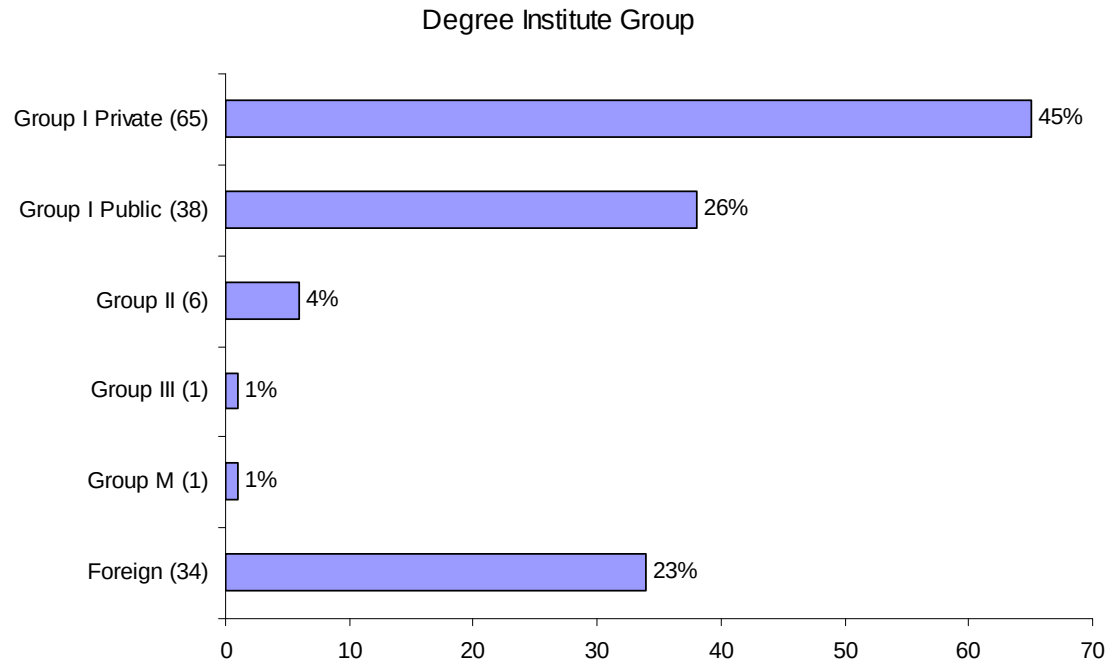
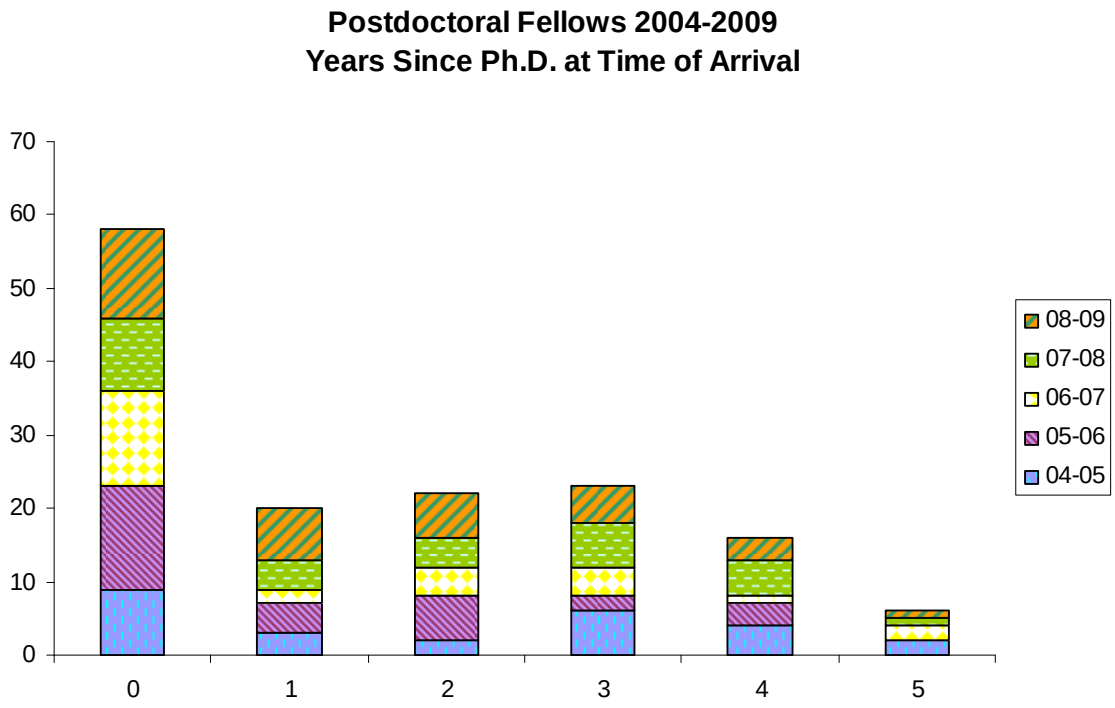


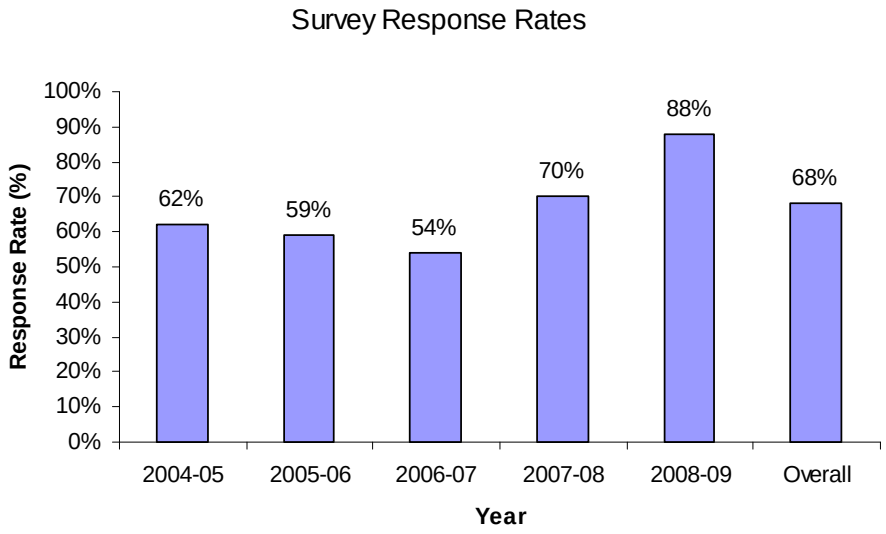
Fully 40% of fellows come to MSRI directly from graduate school; on average, fellows begin their fellowships 1.6 years after receiving their Ph.D (Figure 4).

FIGURE 4



Of the 145 fellows surveyed, 98 submitted responses during the three weeks the survey was open, for an overall response rate of 68%. Instructively, the response rate was highest (88%) for the most recent cohort, with rates dropping below 60% after two years (Figure 5).

FIGURE 5

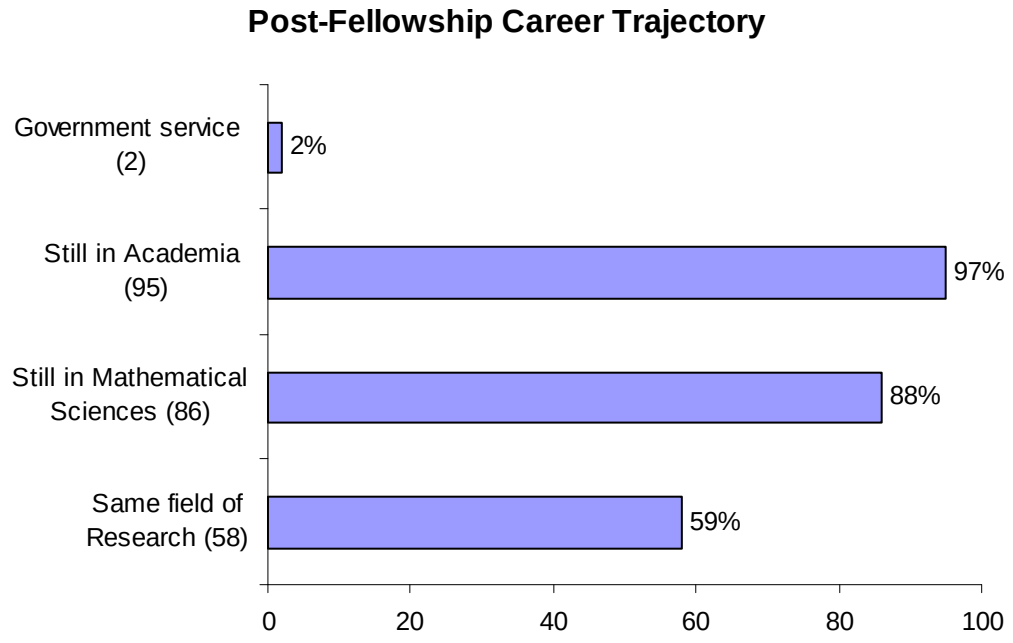


II. Current Occupations of Respondents

Two survey questions addressed the current occupation of the fellows, with the goal of determining to what extent fellows tend to persist in mathematical research and in academics in general. To some extent these questions can also gauge the time it takes fellows who remain in academia to find permanent employment.

Of the 98 respondents, 95 (97%) are still in academia, and 86 of those (91%) are still in the mathematical sciences (Figure 6). By contrast, the percentage of employed new doctoral recipients whose immediate post-degree job was in academia (including research institutes and other non-profits, and institutions outside the U.S.) for the years 2004-2008 ranges from 84% for 2004 degree recipients to 75% for 2008 degree recipients ([1, Table 2D]).

FIGURE 6

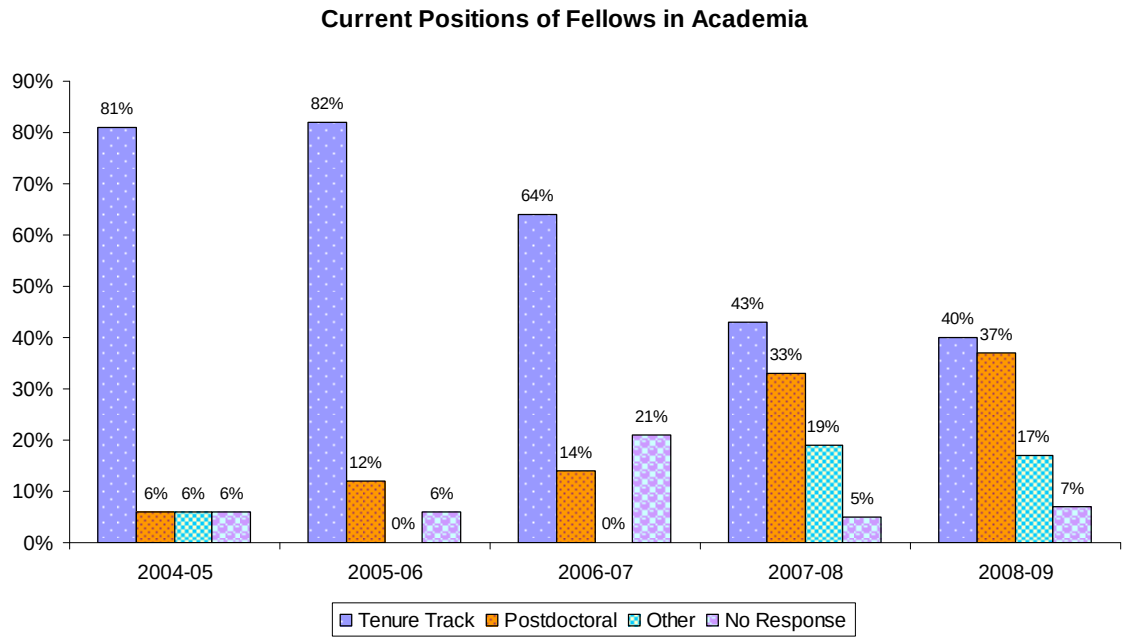


(Note: there appears to have been some difficulty in the interpretation of the survey questions, as several respondents identified themselves as assistant professors without indicating that they are still in academia, or gave their current position as a member of a mathematics department without indicating that they are still in the mathematical sciences, or indicated that they are still in the same field of research but not still in the mathematical sciences. The numbers in Figure 6 were obtained by inferring that respondents with academic positions are still in academia, etc.)

The percentage of respondents who report currently holding tenured or tenure-track positions varies by cohort, increasing from 40% for 2008-09 (the youngest cohort) to

over 80% for the 2005-06 and 2004-05 cohort (Figure 7). Over 30% of recent fellows (from program years 2007-08 and 2008-09) described their current employment as "postdoctoral". (The "Other" category contains responses such as "lecturer", "instructor", "visiting assistant professor", and "adjunct".)

FIGURE 7



Another way to assess the impact of the fellowship program is to compare the type of fellows' PhD-granting institution with the type of their immediate post-MSRI or current institution. (These figures come from MSRI's database of members.)

TABLE 1

Post Fellowship Employment 2004-2008

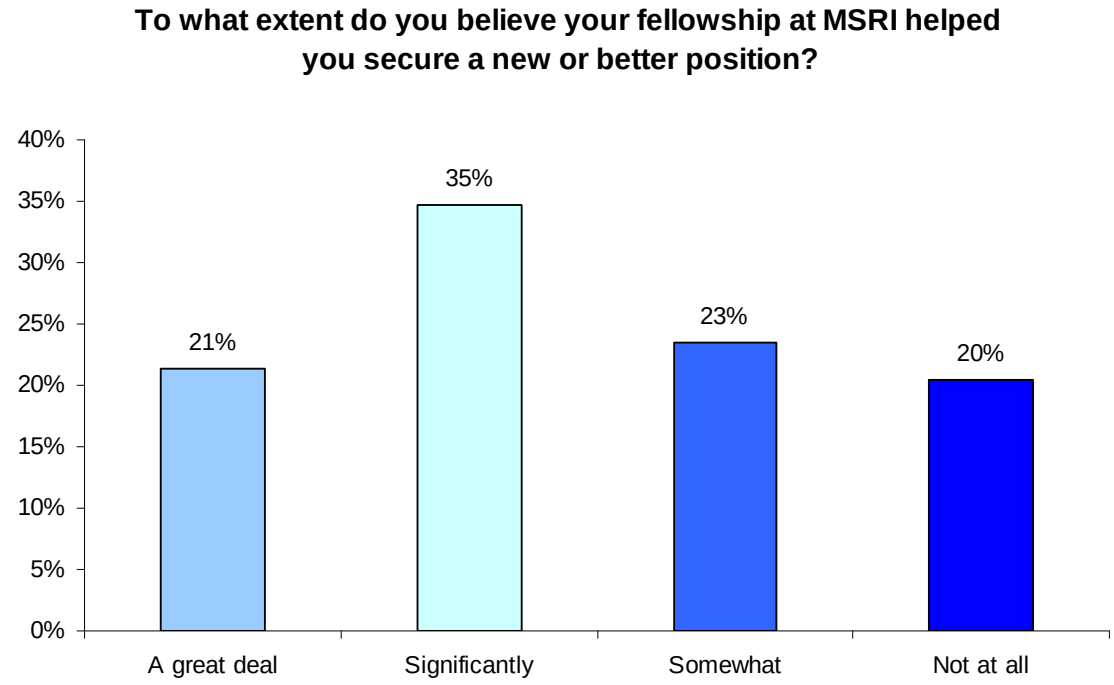
	Type of Doctoral Degree-Granting Institution					
Type of Employer	**Group I Private**	**Group I Public**	**Group II**	**Group III**	**Group M**	**Foreign**
Group I Private	22	8	1			6
Group I Public	16	12		1	1	3
Group II	8	4	2			2
Group III		2	1			
Group IV						1
Group M	2	2	1			
Industry						1
Non Group	8	3				
Foreign	8	6	1			21
Unknown	1	1				
Total	65	38	6	1	1	34

So, for example, 61 of the 111 fellows (55%) found post-Fellowship employment at Group I institutions, including 3 of the 8 fellows (38%) whose degree came from a US non-Group I institution. By comparison, only 12% of new (US) doctoral recipients in 2007-08 found immediate employment at Group I institutions, and only 5% of those whose degree came from a non-Group I institution did ([1, Table 2B]).

III. Impact of Fellowship Awards on Fellows' Careers

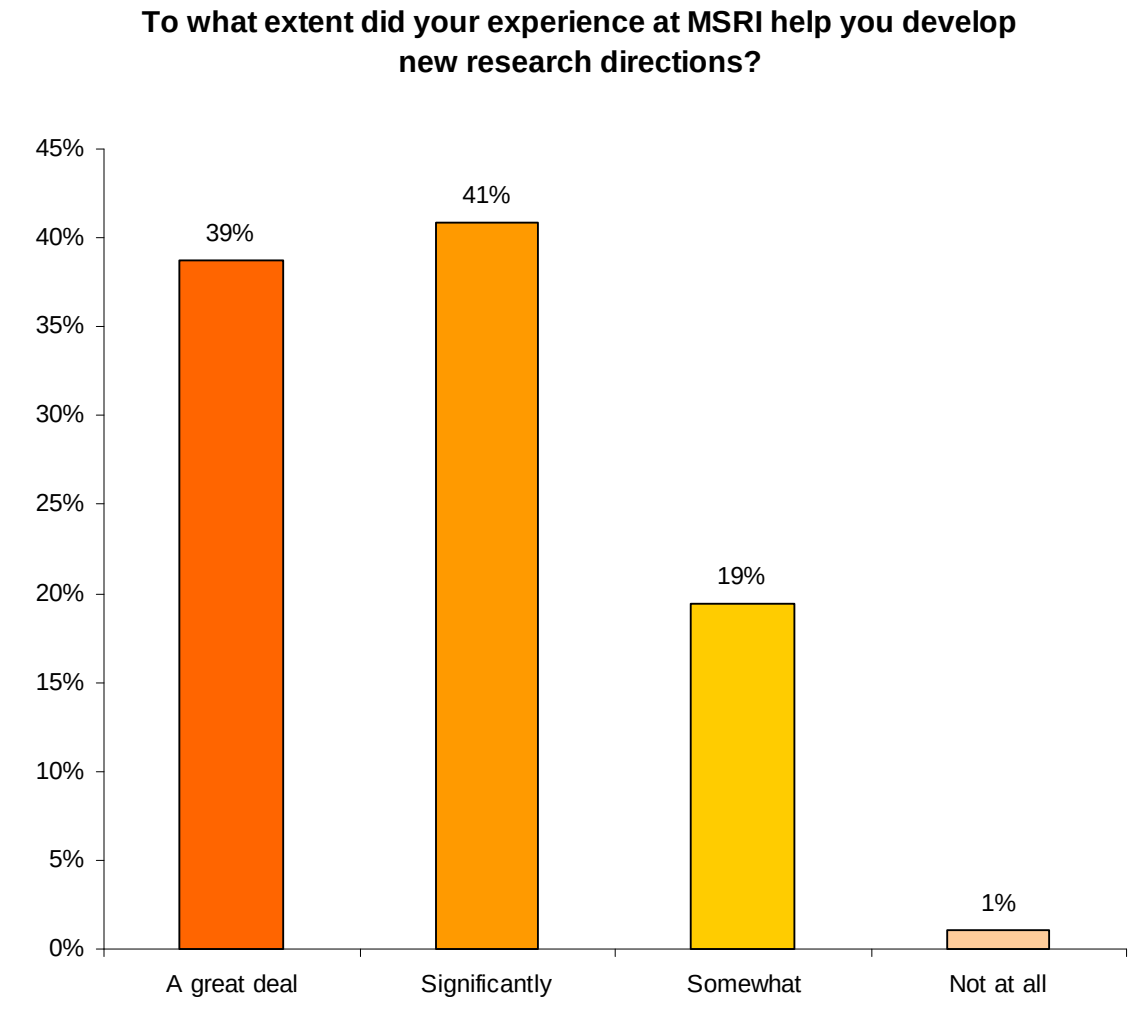
Four survey questions solicited subjective evaluations of the impact fellowship awards had on fellows' subsequent careers. When asked to what extent their fellowship helped them secure a new or better position, 56% of respondents answered either 'significantly' or 'a great deal' (Figure 8).

FIGURE 8



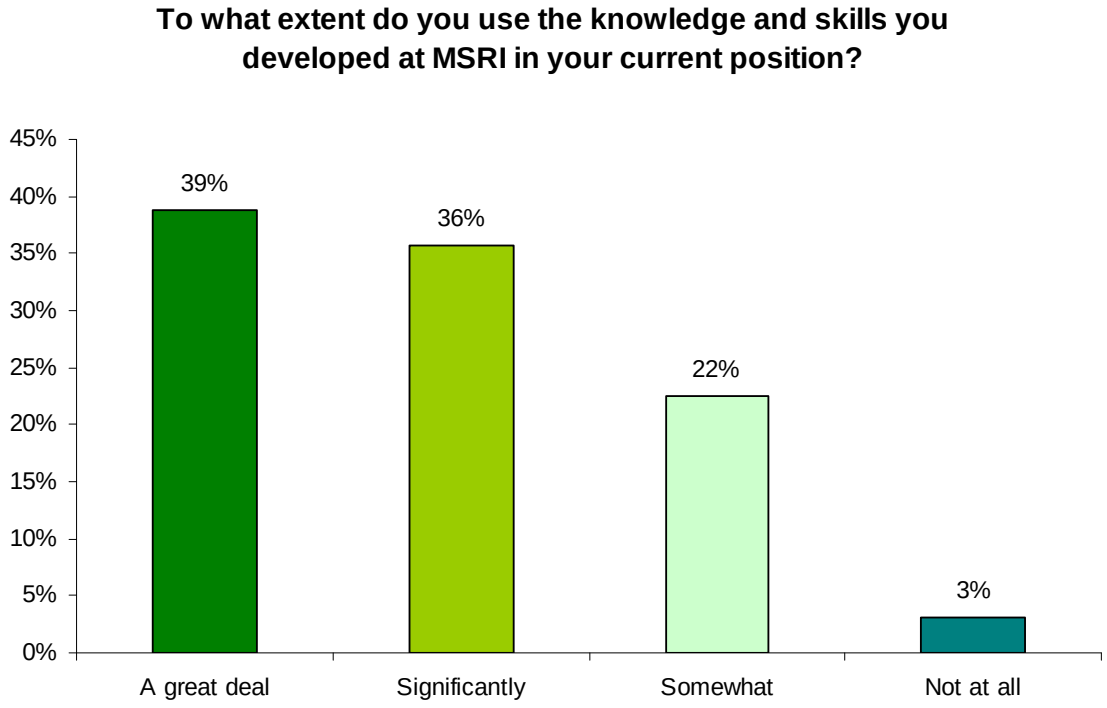
To assess the degree to which the postdoctoral experience aided in the development of new research, fellows were asked to what extent their experience at MSRI helped them develop new research directions. 80% of respondents answered either `significantly' or `a great deal' (Figure 9).

FIGURE 9



In order to gauge the effect of the postdoctoral fellowships on fellows' research capability, the survey asked about the extent to which fellows use knowledge and skills developed at MSRI in their current position. 75% of respondents answered either `significantly' or `a great deal' (Figure 10).

FIGURE10



IV. Outcomes from Research Conducted as Fellows

The survey solicited data on standard measures of research productivity such as the number of publications, the number of presentations given, and the amount of funding obtained. Fellows were asked to limit their responses to outcomes based at least partly on work done during their time at MSRI.

TABLE 2 Survey Responses for the question *"Estimate the number of papers you have published which resulted from your work at MSRI?"*

Year	Number of Respondents	Published papers related to the work at MSRI	Range Per Respondent	Average Per Respondent
2004-05	16	30	0 - 4	1.88
2005-06	17	44	0 - 7	2.59
2006-07	14	21	0 - 3	1.50
2007-08	21	50	1 - 5	2.38
2008-09	30	49	0 - 4	1.63

TABLE 3 Survey Responses for the question *"Estimate the number of presentations you have given based on your work at MSRI."*

Year	Number of Respondents	Total Number of Presentations	Range Per Respondent	Average Per Respondent
2004-05	16	102	0 - 15	6.38
2005-06	15	101	1 - 20	6.73
2006-07	12	50	0 - 10	4.17
2007-08	21	135	2 - 15	6.43
2008-09	29	70	0 - 10	2.41

TABLE 4 *Funding Obtained Post - Fellowship*

Year	Total Funds	Numbers of Grants	Number of Funded Individuals
2004-05	$1,033,000	29	13
2005-06	$1,936,000	17	14
2006-07	$598,000	6	5
2007-08	$666,563	17	11
2008-09	$80,200	8	8

A MathSciNet search was also performed to count, for each fellow, the number of peer-reviewed articles that have been published to date. Although not all publications listed will have been directly relevant to the fellows' postdoctoral work, these data provide an independent means of assessing fellows' research productivity during and after their time at MSRI. If similar data were available for a comparison population, the figures could give an indication as to the effect the postdoctoral experience has on fellows' research productivity.

Selected Post-Fellowship Research Grants
NSF CAREER Award (2 fellows)
Mathematical Association of America Tensor-SUMMA Grant
NSERC Discovery Grant

TABLE 5 **Number of Publications in MathSciNet**

Year	Total Number of Publications in MathSciNet	Range Per Respondent	Average Per Postdoc
2005-06	221	0 - 20	6.50
2006-07	128	0 - 13	4.27
2007-08	136	1 - 13	5.23
2008-09	152	1-19	5.24

Due to delays in publication time, the MathSciNet counts may not accurately represent the productivity of fellows less than a few years out of their postdoctoral position. To get an idea of the possible discrepancy, a comparison of arXiv.org preprint postings to MathSciNet listings was performed for a random sample of ten fellows from the 2005-06 cohort. However, it is difficult to draw any firm conclusions from the results.

TABLE 6 **ArXiv vs. MathSciNet**

10 Fellows from 2005-06

# of Arxiv postings	13	0	16	2	1	7	4	2	9	11
# MathSciNet postings	11	19	11	17	7	12	3	6	8	9

From this sample, it is evident that use of MathSciNet is more appropriate than the arXiv for evaluation of long-term productivity: people do not consistently post to the arXiv, and those that do often post non-publishable materials (such as lecture notes) or multiple versions of the same manuscript (as separate postings). More detailed study is called for, as it is possible that careful examination of arXiv postings may provide a useful metric of productivity for the one or two years following a postdoctoral position, when work performed has not yet had time to appear in the published record.

In order to evaluate the extent to which the MSRI postdoctoral fellowships have enhanced fellows' professional networking, the survey asked fellows to estimate the number of new professional contacts and the number of new coauthors they gained as a result of their experience at MSRI.

TABLE 7 **Survey Responses for the question *"Estimate the number of professional contacts you have gained as a result of your experience at MSRI."***

Year	Number of Respondents	Total Number of Professional Contacts	Range Per Respondent	Average Per Respondent
2004-05	16	177	0 - 50	11.06
2005-06	17	131	3 - 10	7.71
2006-07	14	118	1 - 30	8.43
2007-08	21	263	2 - 30	12.52
2008-09	30	254	2 - 25	8.47

TABLE 8 **Survey Responses for the question *"Estimate the number of new coauthors you have gained as a result of your experience at MSRI."***

Year	Number of Respondents	Total Number of New Coauthors	Range Per Respondent	Average Per Respondent
2004-05	16	18	0 - 4	1.13
2005-06	15	27	0 - 4	1.80
2006-07	13	20	0 - 3	1.54
2007-08	21	37	0 - 4	1.76
2008-09	29	41	0 - 4	1.41

A qualitative indicator of the fellowships' impact is provided by the number and quality of research awards won by fellows. MSRI fellows also go on to receive other prestigious postdoctoral fellowships.

Selected Post-Fellowship Awards
University of Washington Faculty Fellowship Award
Rollo Davidson Prize, 2008
Krill Prize for Excellence in Scientific Research
Prix Joliot-Curie
California Mathematics Council Student Activity Trust Award, 2007
Best Technical Paper, Sisters in Science: A One-Day Symposium of African American Women Architects, Engineers, Mathematicians, and Scientists, Museum of African American Technology Science Village, 2007

Selected Post-MSRI Fellowships
SAMSI New Researcher Fellowship
Hellman Fellowship
NSERC Postdoctoral Fellowship
Marie Curie Incoming International Fellowship
EPSRC Research Fellowship
Sloan Research Fellowship

V. Feedback

The survey asked fellows for feedback on MSRI's postdoctoral fellowship program. Two questions solicited ratings on a scale of 1 (terrible) to 6 (excellent), with 3 representing 'average'; these questions addressed the quality of the mentoring received and the quality of the fellows' overall experience in MSRI's postdoctoral fellowship program. When asked to rate the quality of the mentoring they received while at MSRI, 61% of respondents chose 'very good' or 'excellent' (Figure 11). When asked to rate their overall experience in MSRI's postdoctoral fellowship program, 84% of respondents chose 'very good' or 'excellent' (Figure 12).

FIGURE 11

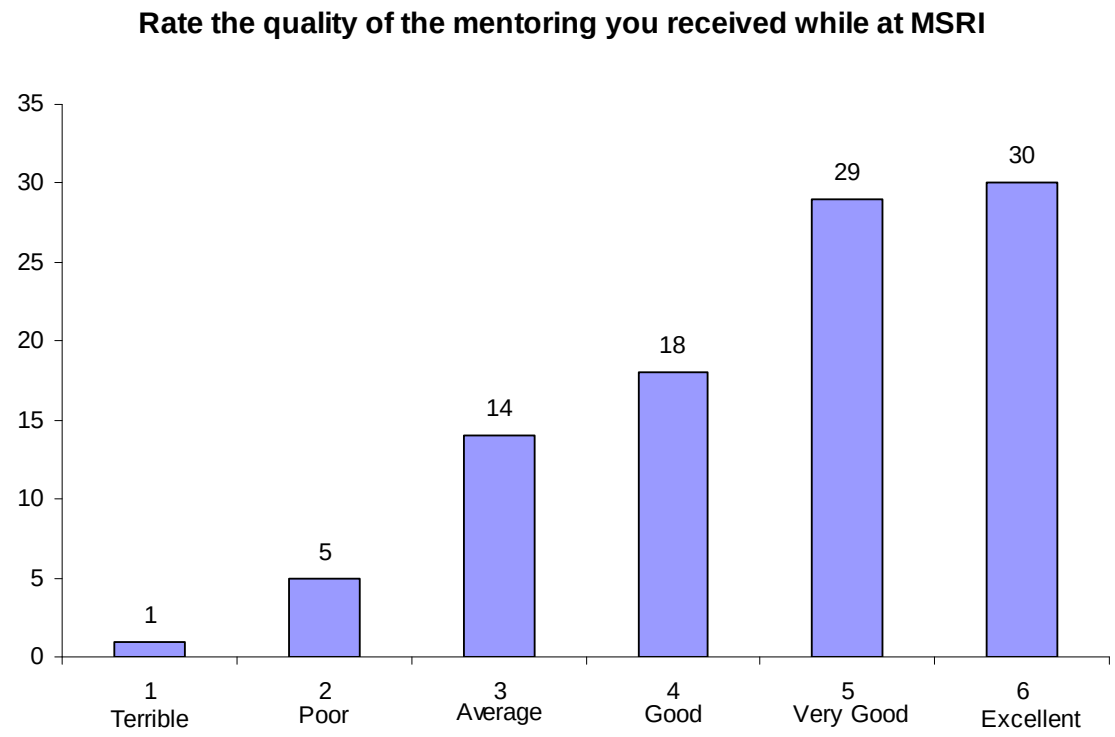
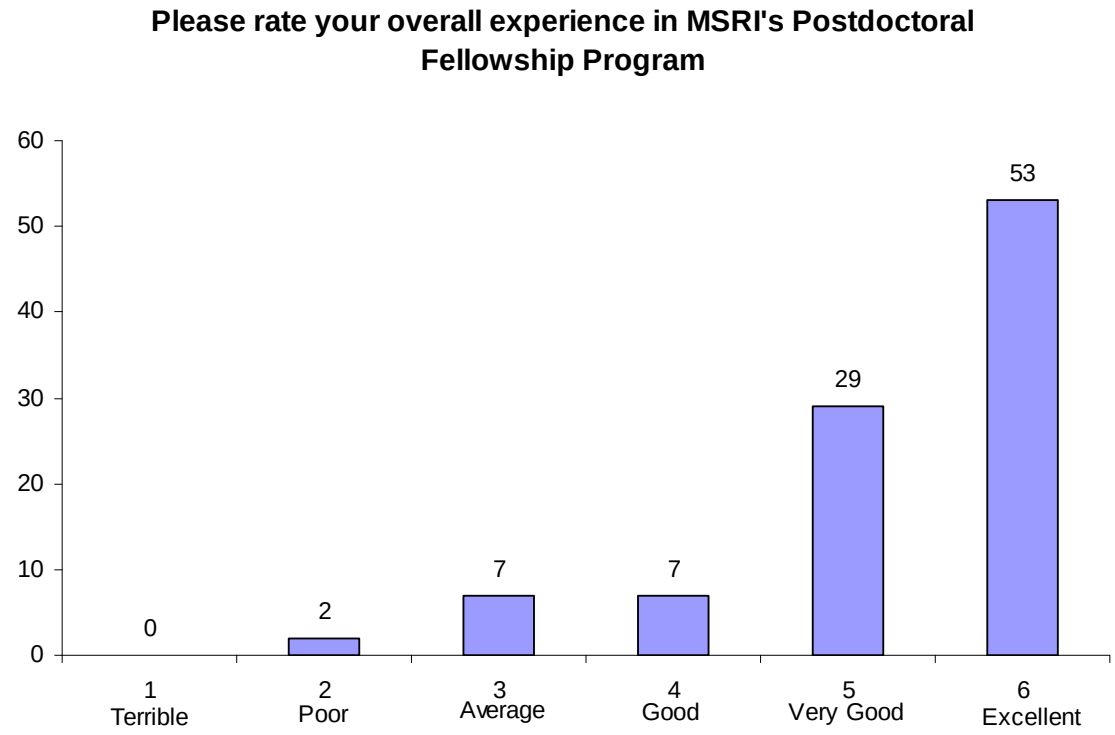


FIGURE 12



In addition, two open-ended questions were posed: the first asked for feedback on the strengths of the program, and the second asked for suggestions for improvement. (The complete set of responses can be found in Appendix B below.)

The most commonly-cited strength of the program was the presence of leading experts for extended periods. As one respondent put it: "My experience there was transformative. Being in the room as 5 of the most brilliant senior mathematicians in my field argued about fundamental ideas was worth at least as much as my graduate work. In fact, it provided big picture context of the challenges of the field that would have been impossible to provide in graduate school." Other respondents emphasized that not only are the experts present, they are accessible; and that this is due to the open format of the scientific programs and the collaborative atmosphere at the Institute.

Another widely praised strength of the program was the opportunity it provides for forming collaborations and making professional contacts. Such connections are especially vital to building the careers of postdoctoral fellows.

Suggestions for improvement centered mostly around the length of the program (too short) and the implementation of mentoring (somewhat sporadic). One respondent pointed out the difficulty of meshing a half-year appointment with prior and subsequent employment, and suggested somehow integrating the MSRI fellowships with postdoctoral appointments at associated institutions to create one- or two-year positions. (This fellow's term at MSRI pre-dated the program for external fellows.)

Feedback about the mentoring of postdocs was less specific. Some respondents reported interacting very little with, or even being unaware of, their mentors; others found their mentors to be a poor match mathematically or personally.

Commonly-Cited Strengths of the Program
Provides extended exposure to leading experts in a field
Greatly aids formation of collaborations and professional networking
Broadens participants' knowledge and perspective
Provides access to cutting-edge research in a field
Increases interdisciplinary connections and awareness
Facilitates uninterrupted periods of research for maximum productivity

References

[1] Polly Phipps, James W. Maxwell, and Colleen A. Rose, 2008 Annual Survey of the Mathematical Sciences in the United States (Second Report), Notices of the AMS (56) no. 7, August 2008.

Demographic Data of MSRI 5 Years Study

Summary: Visits by Year:

Year	Workshops	SGW	Members	Postdoc	Total
1999-00	1176	150	361	36	1723
2000-01	1822	124	344	31	2321
2001-02	1141	119	353	30	1643
2002-03	1456	96	306	31	1889
2003-04	1476	116	220	28	1840
1999-2004	**7071**	**605**	**1584**	**156**	**9416**
2004-05	1817	63	140	27	2020
2005-06	1496	257	231	29	1984
2006-07	1493	134	168	26	1795
2007-08	1888	134	266	30	2288
2008-09	1913	158	315	34	2386
2004-2009	**8607**	**746**	**1120**	**146**	**10473**

Workshop People vs Visits (2005-09)

Year	Visits	People
2004-05	1817	1434
2005-06	1496	1214
2006-07	1493	1304
2007-08	1888	1319
2008-09	1913	1512
2005-09	**8607**	**5743**

Member People vs. Visits (Database) since 1986

People	vs	Visits
4919		**7058**

of Workshops

Year	Scientific	Outreach & Diversity	SGW	Total
2005-06	17	3	5	25
2006-07	25	4	5	34
2007-08	18	4	4	26
2008-09	25	10	6	41
Total	**85**	**21**	**20**	**126**

Workshop Participant Summary

Year	Scientific	Outreach & Diversity	SGW	Total
2005-06	1230	266	188	1684
2006-07	1248	245	174	1667
2007-08	1527	361	177	2065
2008-09	1468	445	194	2107
Total	**5473**	**1317**	**733**	**7523**

Five years Demographic Summary 2004-2009 (Visits)

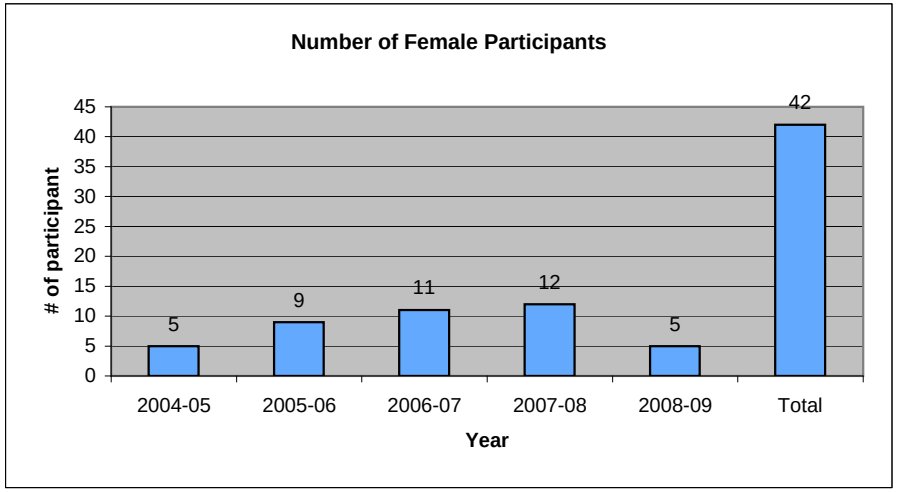
2004-05	Female	Home Institute in the US	Citizens & Perm. Residents	Foreign	Minorities	Native American	Asian	Black	Hispanic	Pacific	White
Program Participant	12%	62%	52%	48%	6%	0%	15%	6%	2%	0%	77%
Workshop Participant	25%	81%	64%	36%	9%	1%	18%	5%	3%	0%	73%
Postdoctoral Fellow	19%	27%	50%	50%	10%	0%	0%	12%	6%	0%	82%
2005-06	**Female**	**Home Institute in the US**	**# of Citizens & Perm. Residents**	**Foreign**	**Minorities**	**Native American**	**Asian**	**Black**	**Hispanic**	**Pacific**	**White**
Program Participant	17%	56%	38%	62%	7%	0%	31%	3%	7%	0%	59%
Workshop Participant	27%	82%	49%	51%	12%	1%	26%	7%	4%	0%	63%
Postdoctoral Fellow	31%	66%	24%	76%	17%	0%	18%	6%	6%	0%	71%
2006-07	**Female**	**Home Institute in the US**	**# of Citizens & Perm. Residents**	**Foreign**	**Minorities**	**Native American**	**Asian**	**Black**	**Hispanic**	**Pacific**	**White**
Program Participant	18%	62%	52%	48%	3%	0%	22%	3%	0%	0%	75%
Workshop Participant	30%	85%	57%	43%	8%	1%	20%	4%	4%	0%	72%
Postdoctoral Fellow	42%	81%	38%	62%	13%	0%	15%	15%	0%	0%	69%
2007-08	**Female**	**Home Institute in the US**	**# of Citizens & Perm. Residents**	**Foreign**	**Minorities**	**Native American**	**Asian**	**Black**	**Hispanic**	**Pacific**	**White**
Program Participant	17%	59%	50%	50%	6%	1%	12%	1%	3%	0%	83%
Workshop Participant	30%	75%	57%	43%	10%	1%	15%	2%	6%	0%	76%
Postdoctoral Fellow	40%	70%	39%	61%	11%	0%	18%	9%	0%	0%	73%
2008-09	**Female**	**Home Institute in the US**	**# of Citizens & Perm. Residents**	**Foreign**	**Minorities**	**Native American**	**Asian**	**Black**	**Hispanic**	**Pacific**	**White**
Program Participant	21%	54%	48%	52%	8%	0%	10%	0%	6%	0%	85%
Workshop Participant	33%	76%	58%	42%	10%	0%	20%	3%	5%	0%	71%
Postdoctoral Fellow	15%	65%	44%	56%	9%	0%	19%	0%	6%	0%	74%

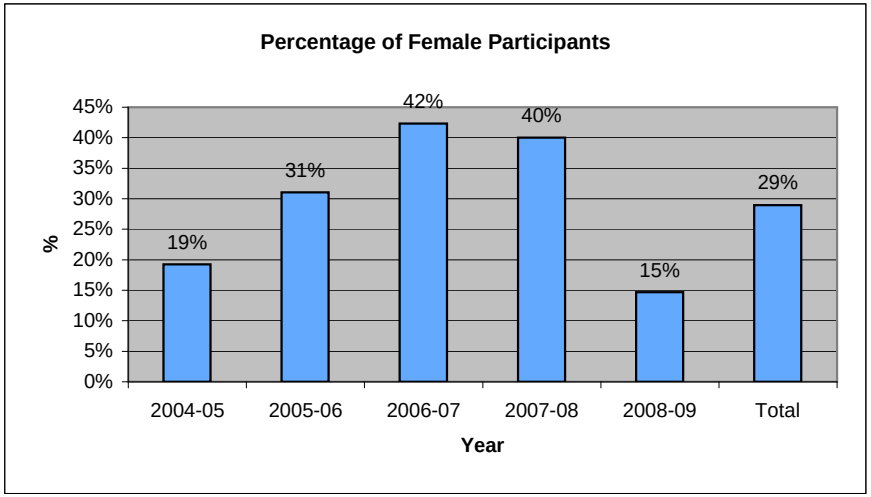
Summer Graduate Workshops	**Female**	**Home Institute in the US**	**# of Citizens & Perm. Residents**	**Foreign**	**Minorities**	**Native American**	**Asian**	**Black**	**Hispanic**	**Pacific**	**White**
2004	35%	84%	67%	33%	12%	0%	9%	7%	7%	0%	77%
2005	32%	79%	35%	65%	5%	0%	41%	4%	0%	1%	54%
2006	32%	85%	44%	56%	21%	0%	33%	3%	2%	0%	62%
2007	25%	84%	45%	55%	7%	0%	18%	6%	0%	0%	76%
2008	29%	91%	67%	33%	11%	0%	31%	6%	6%	1%	56%
2009	31%	89%	36%	64%	4%	0%	32%	1%	5%	0%	62%

**Statistic Calculation based on participants that replied to each cartegories.

MSRI Postdocs
2004 - 2009
Female Participation

Postdocs			
	Female	Total	%
2004-05	5	26	19%
2005-06	9	29	31%
2006-07	11	26	42%
2007-08	12	30	40%
2008-09	5	34	15%
Total	**42**	**145**	**29%**





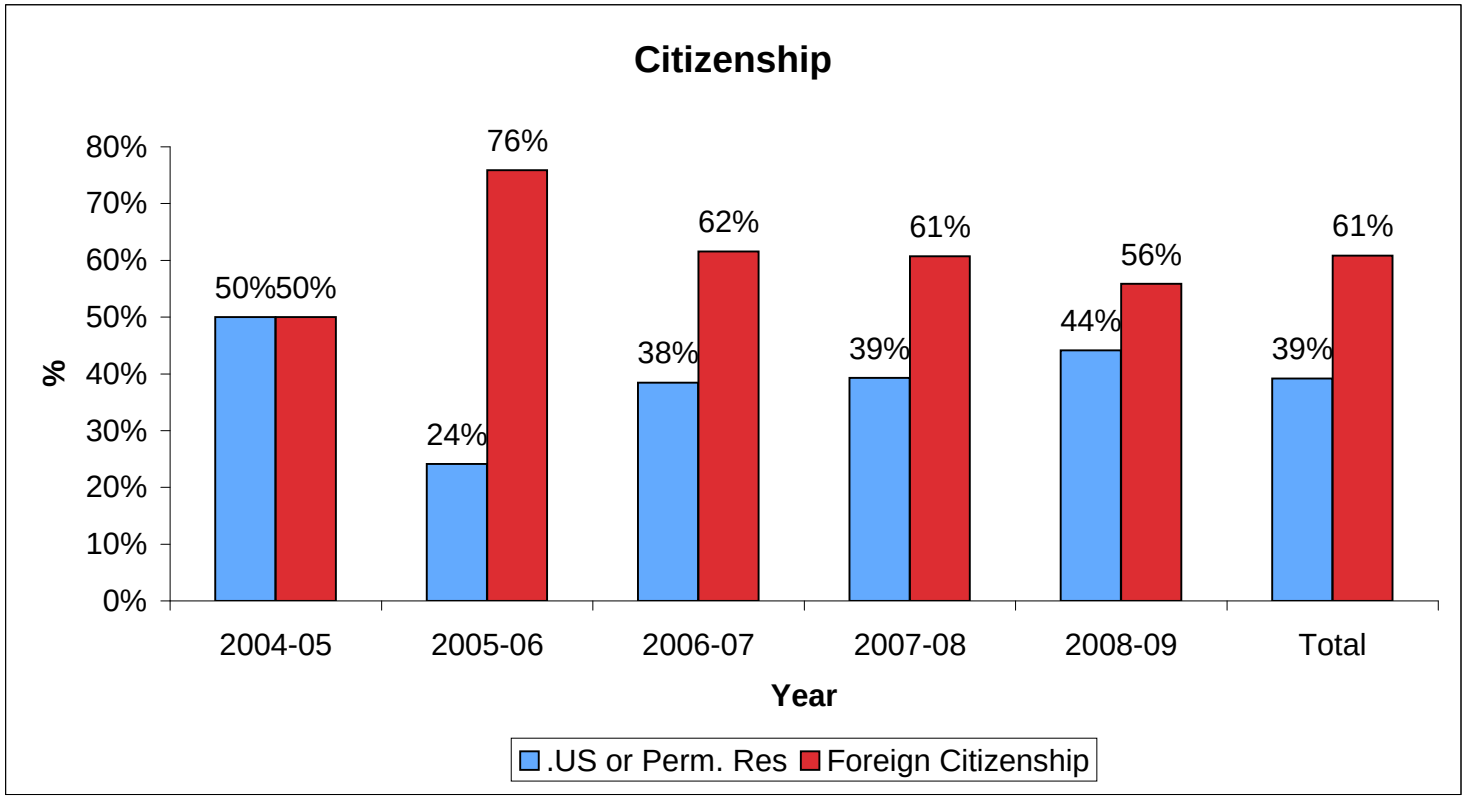
MSRI Postdocs
2004 - 2009
Ethnicity

	2004-05		2005-06		2006-07		2007-08		2008-09		Total	
Native American		0%		0%		0%		0%		0%	0	0%
Asian		0%	3	18%	2	15%	2	18%	6	19%	13	15%
Black	2	12%	1	6%	2	15%	1	9%		0%	6	7%
Hispanic	1	6%	1	6%		0%		0%	2	6%	4	4%
Pacific		0%		0%		0%		0%		0%	0	0%
White	14	82%	12	71%	9	69%	8	73%	23	74%	66	74%
Decline	7		12		13		1		2		35	
Unavailable information	2						18		1		21	
Grand Total	**26**		**29**		**26**		**30**		**34**		**145**	

	2004-05		2005-06		2006-07		2007-08		2008-09		Total	
Minorities Among US Citizens	1	10%	1	17%	1	13%	1	11%	1	9%	5	11%

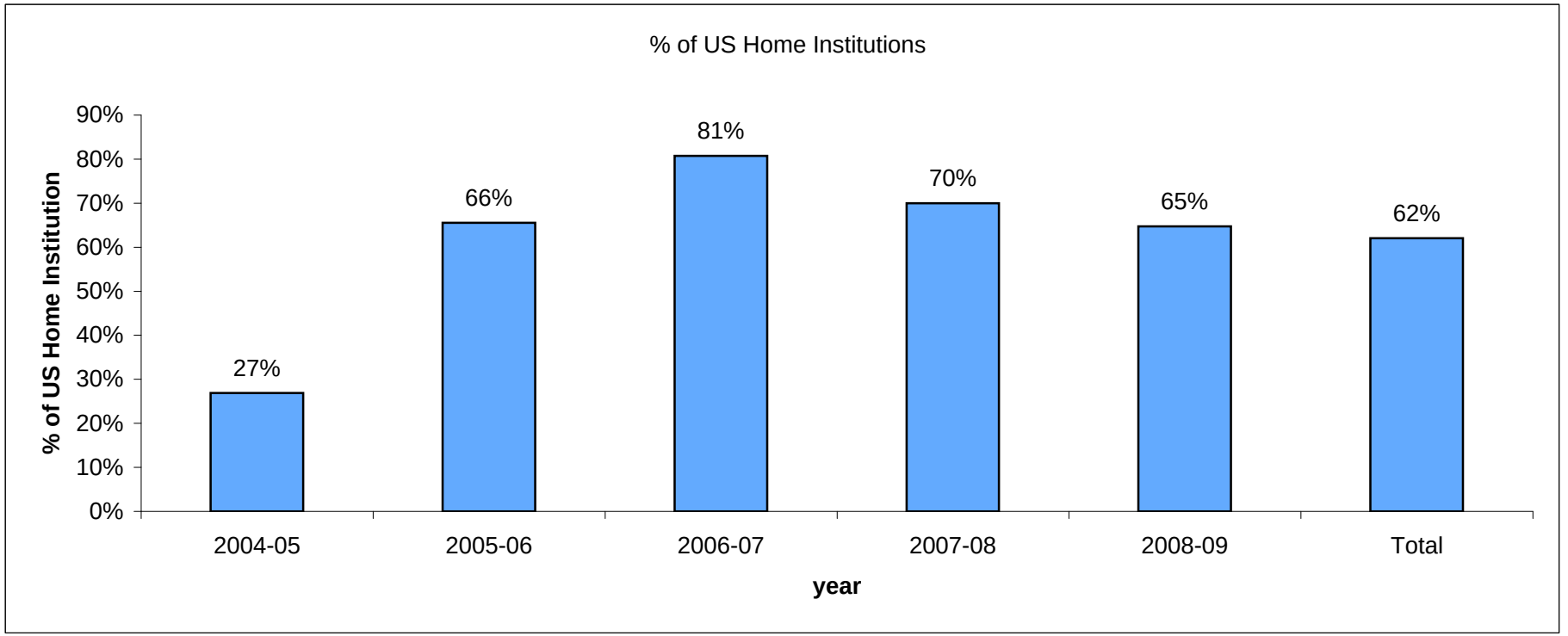
MSRI Postdocs
2004 - 2009
Citizenship

	2004-05	%	2005-06	%	2006-07	%	2007-08	%	2008-09	%	Total	%
USA	10		6		8		9		11		44	
US Permanent Resident	3		1		2		2		4		12	
US or Perm. Res.	13	50%	7	24%	10	38%	11	39%	15	44%	56	39%
Foreign Citizenship	13	50%	22	76%	16	62%	17	61%	19	56%	87	61%
Unavailable information	0		0		0		2		0		2	
Total # of postdocs	26		29		26		30		34		145	

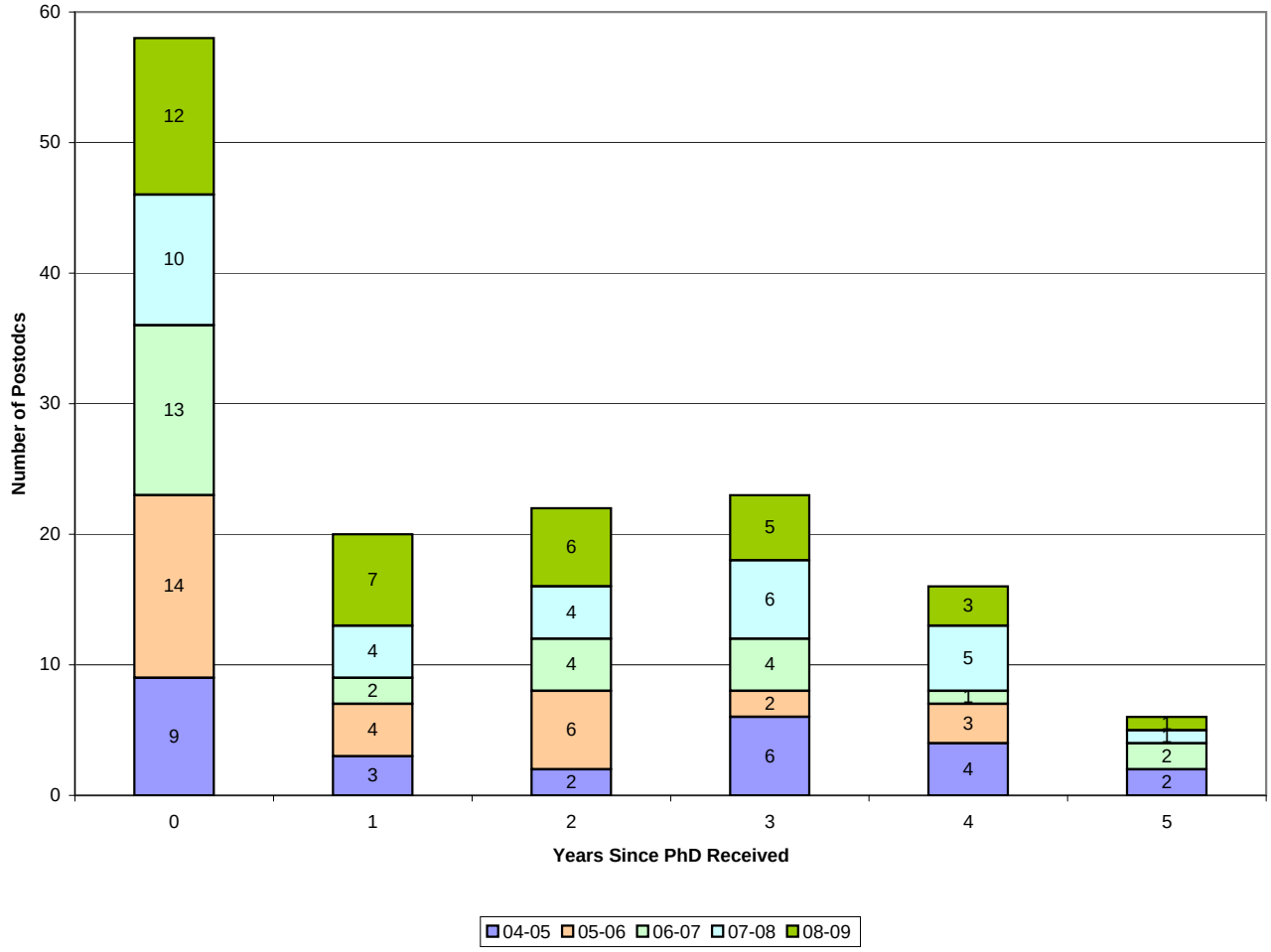


2004 - 2009
US Home Institutions

	2004-05	2005-06	2006-07	2007-08	2008-09	Total
US Home Institutions	7	19	21	21	22	90
Unavailable information		1	1	1	0	3
Total Members	26	29	26	30	34	145
% of US Home Institutions	**27%**	**66%**	**81%**	**70%**	**65%**	**62%**



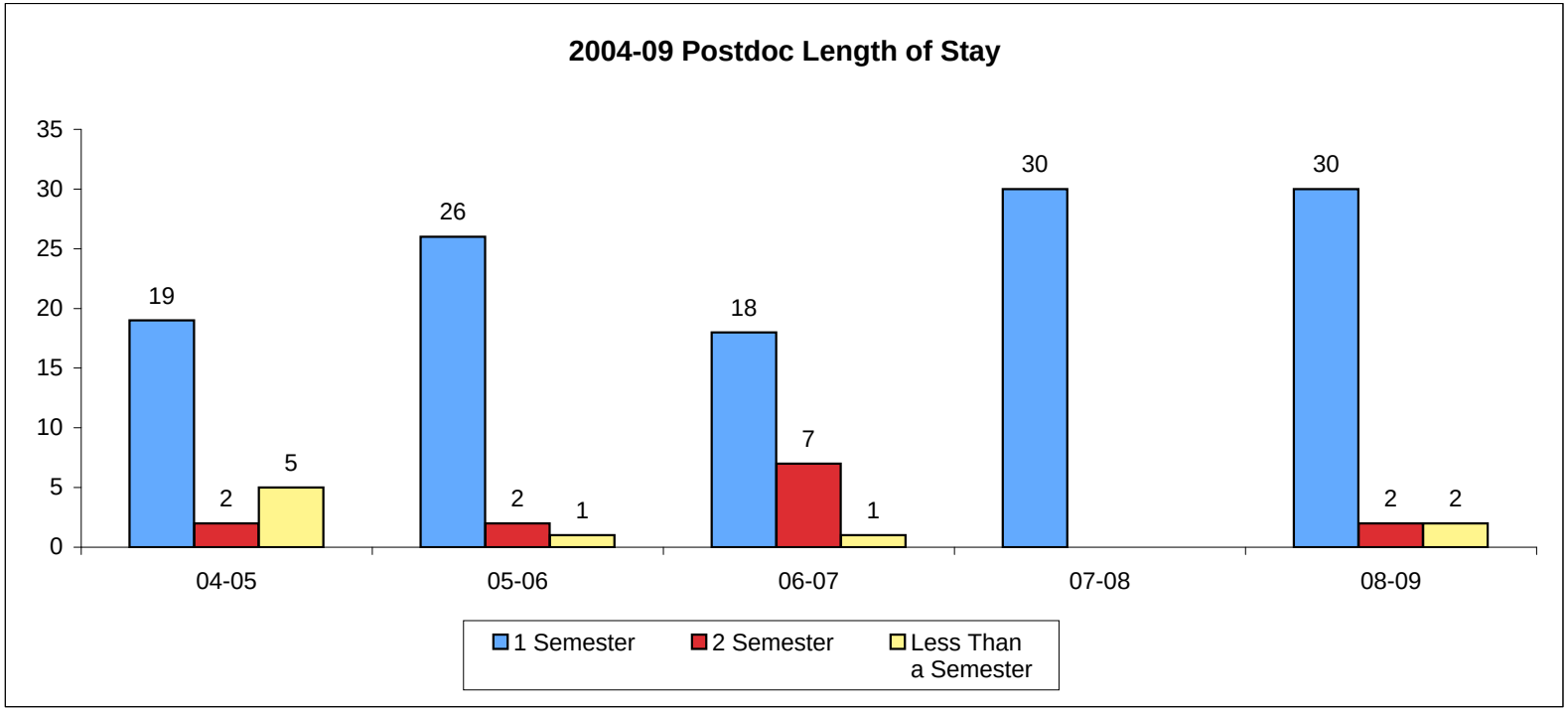
MSRI Postdoctoral Fellows 04-09 Years Since PhD



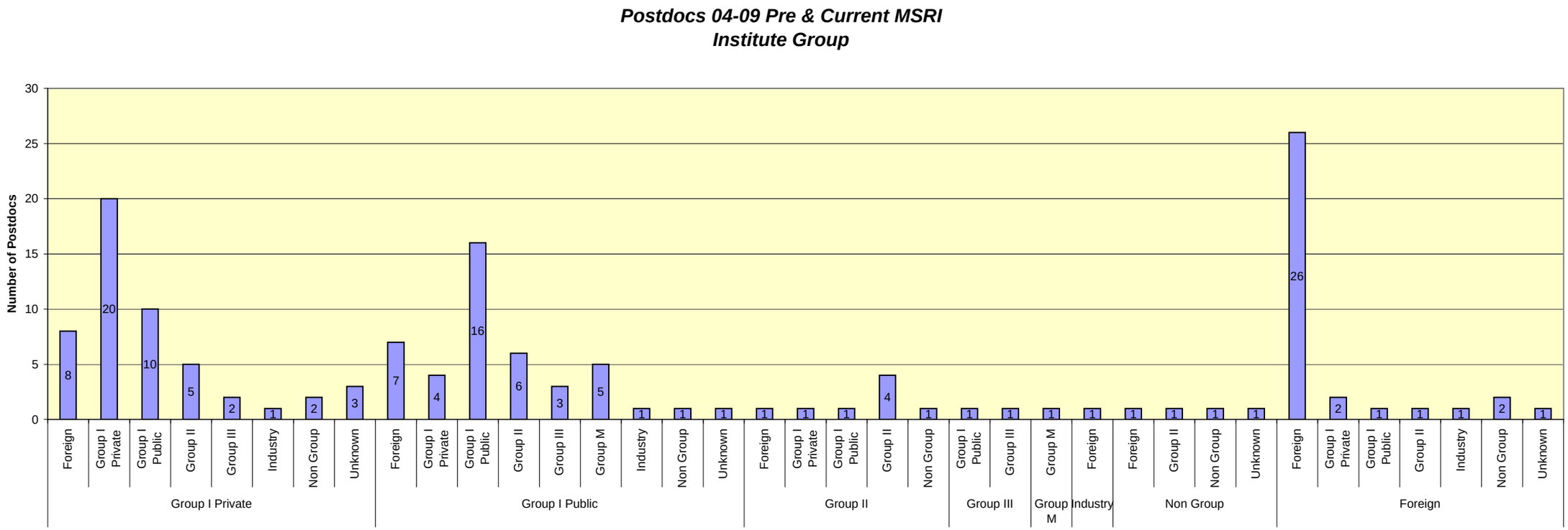
Yrs Since Phd at MSRI	04-05	05-06	06-07	07-08	08-09	Grand Total
0	9	14	13	10	12	58
1	3	4	2	4	7	20
2	2	6	4	4	6	22
3	6	2	4	6	5	23
4	4	3	1	5	3	16
5	2		2	1	1	6
Grand Total	**26**	**29**	**26**	**30**	**34**	**145**

MSRI Postdocs
2004 - 2009
Length of Stay

Year	1 Semester	%	2 Semester	%	Less Than a Semester	%	Total
04-05	19	73%	2	8%	5	19%	26
05-06	26	90%	2	7%	1	3%	29
06-07	18	69%	7	27%	1	4%	26
07-08	30	100%		0%		0%	30
08-09	30	88%	2	6%	2	6%	34
	123		13		9		145



MSRI Postdocs Placement Group (2004-2009)



PD Current Institution

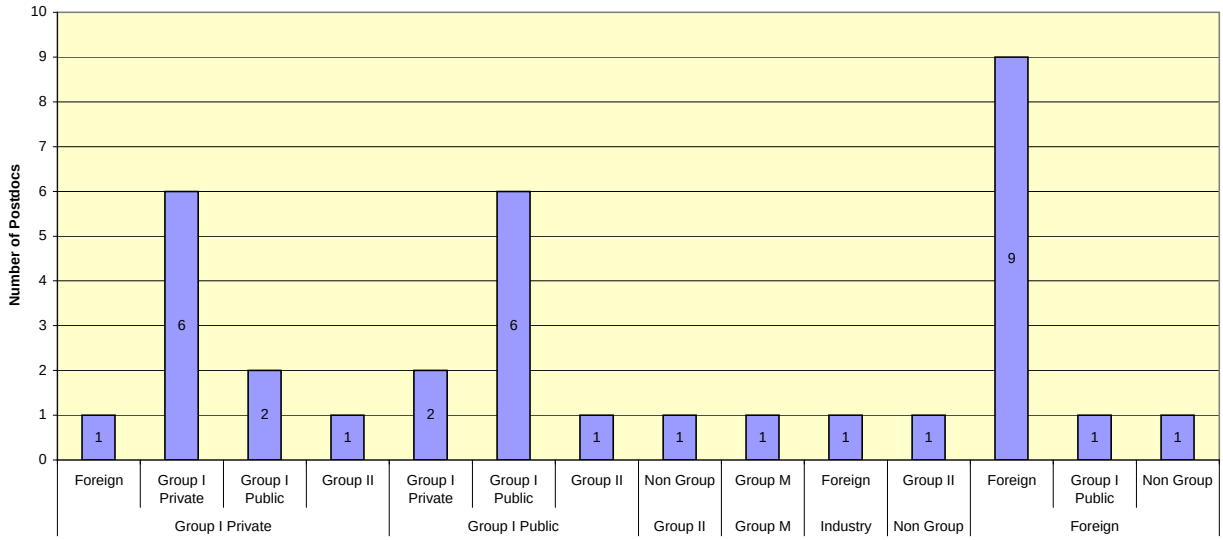
Group	#	%
I Private	27	18.6%
I Public	29	20%
II	17	11.70%
III	6	4.10%
Foreign	44	30%

MSRI Postdocs Placement Group (2004-2009)

Pre- MSRI Institute Group	Cur Institute Group	Count of Cur Institute Group	
Group I Private			
	Foreign	8	
	Group I Private	20	
	Group I Public	10	
	Group II	5	
	Group III	2	
	Industry	1	
	Non Group	2	
	Unknown	3	
Group I Private Total		**51**	**35%**
Group I Public			
	Foreign	7	
	Group I Private	4	
	Group I Public	16	
	Group II	6	
	Group III	3	
	Group M	5	
	Industry	1	
	Non Group	1	
	Unknown	1	
Group I Public Total		**44**	**30%**
Group II			
	Foreign	1	
	Group I Private	1	
	Group I Public	1	
	Group II	4	
	Non Group	1	
Group II Total		**8**	**5.50%**
Group III			
	Group I Public	1	
	Group III	1	
Group III Total		**2**	**1.40%**
Group M			
	Group M	1	
Group M Total		**1**	**0.70%**
Industry			
	Foreign	1	
Industry Total		**1**	**0.70%**
Non Group			
	Foreign	1	
	Group II	1	
	Non Group	1	
	Unknown	1	
Non Group Total		**4**	**2.80%**
Foreign			
	Foreign	26	
	Group I Private	2	
	Group I Public	1	
	Group II	1	
	Industry	1	
	Non Group	2	
	Unknown	1	
Foreign Total		**34**	**23.50%**
Grand Total		**145**	**100%**

MSRI Postdocs Placement Group (2004-2009)

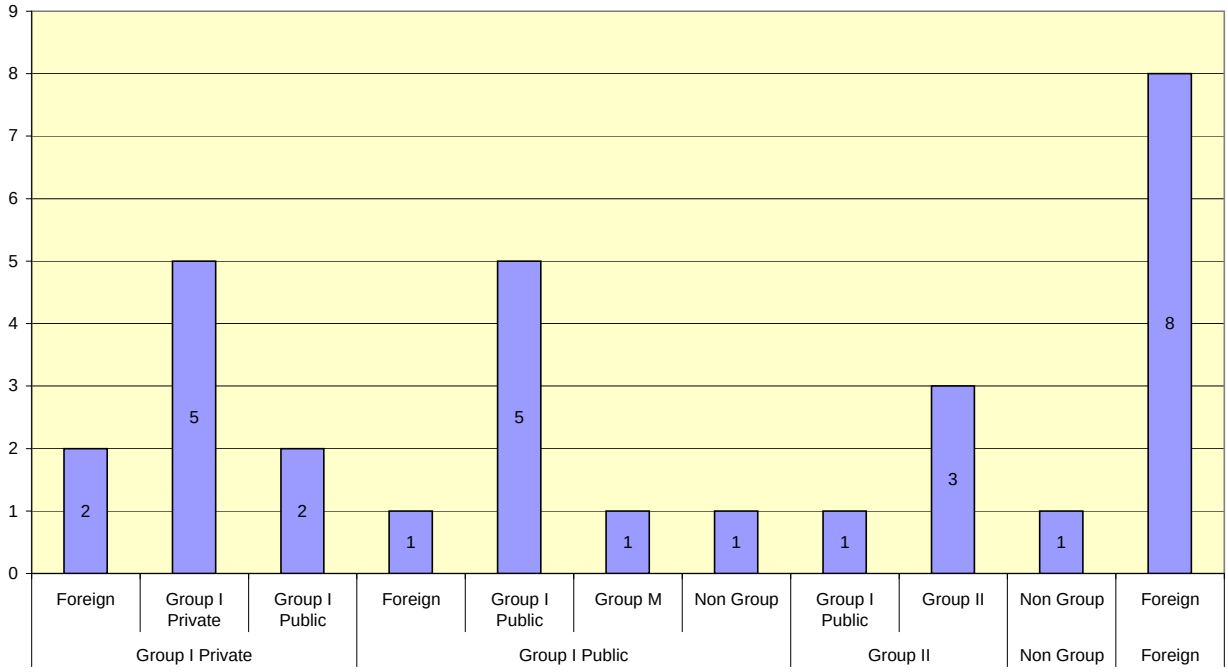
Postdocs 08-09 Pre & Current MSRI Institute Group



Year MSRI	08-09

Pre- MSRI Institute Group	Cur Institute Group	Count of Cur Institute Group
Group I Private		
	Foreign	1
	Group I Private	6
	Group I Public	2
	Group II	1
Group I Private Total		**10**
Group I Public		
	Group I Private	2
	Group I Public	6
	Group II	1
Group I Public Total		**9**
Group II		
	Non Group	1
Group II Total		**1**
Group M		
	Group M	1
Group M Total		**1**
Industry		
	Foreign	1
Industry Total		**1**
Non Group		
	Group II	1
Non Group Total		**1**
Foreign		
	Foreign	9
	Group I Public	1
	Non Group	1
Foreign Total		**11**
Grand Total		**34**

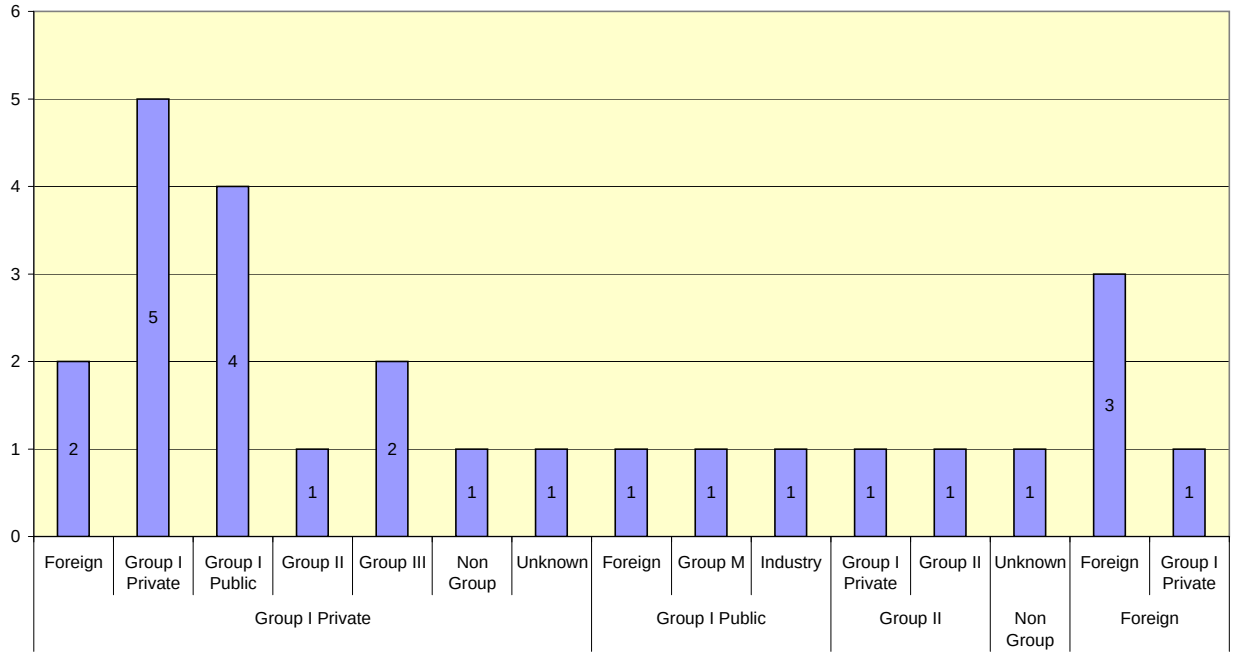
Postdocs 07-08 Pre & Current MSRI
Institute Group



Year MSRI	07-08

Pre- MSRI Institute Group	Cur Institute Group	Count of Cur Institute Group
Group I Private		
	Foreign	2
	Group I Private	5
	Group I Public	2
Group I Private Total		**9**
Group I Public		
	Foreign	1
	Group I Public	5
	Group M	1
	Non Group	1
Group I Public Total		**8**
Group II		
	Group I Public	1
	Group II	3
Group II Total		**4**
Non Group		
	Non Group	1
Non Group Total		**1**
Foreign		
	Foreign	8
Foreign Total		**8**
Grand Total		**30**

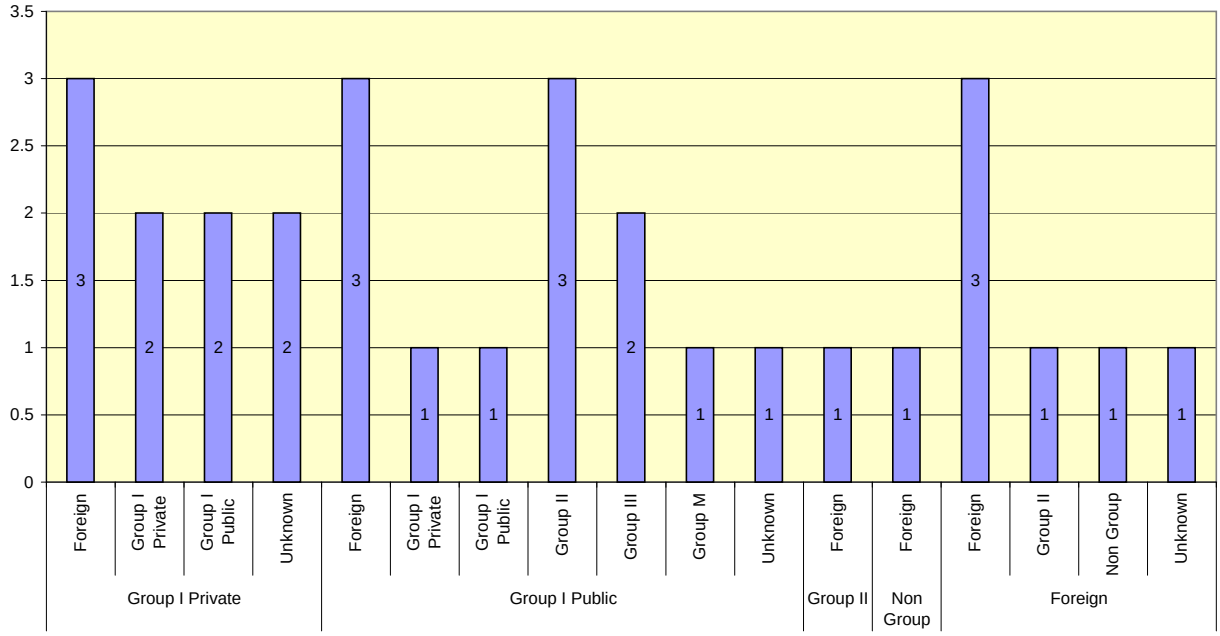
Postdocs 06-07 Pre & Current MSRI
Institute Group



Year MSRI	06-07

Pre- MSRI Institute Group	Cur Institute Group	Count of Cur Institute Group
Group I Private		
	Foreign	2
	Group I Private	5
	Group I Public	4
	Group II	1
	Group III	2
	Non Group	1
	Unknown	1
Group I Private Total		**16**
Group I Public		
	Foreign	1
	Group M	1
	Industry	1
Group I Public Total		**3**
Group II		
	Group I Private	1
	Group II	1
Group II Total		**2**
Non Group		
	Unknown	1
Non Group Total		**1**
Foreign		
	Foreign	3
	Group I Private	1
Foreign Total		**4**
Grand Total		**26**

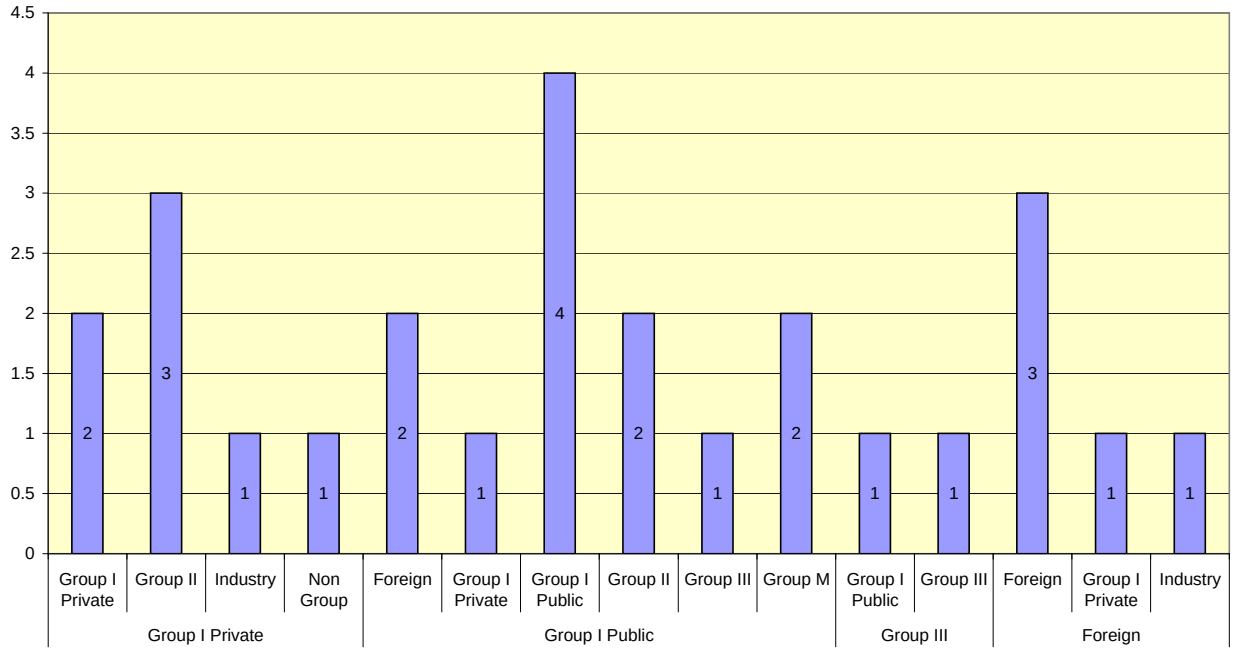
Postdocs 05-06 Pre & Current MSRI
Institute Group



Year MSRI	05-06

Pre- MSRI Institute Group	Cur Institute Group	Count of Cur Institute Group
Group I Private		
	Foreign	3
	Group I Private	2
	Group I Public	2
	Unknown	2
Group I Private Total		**9**
Group I Public		
	Foreign	3
	Group I Private	1
	Group I Public	1
	Group II	3
	Group III	2
	Group M	1
	Unknown	1
Group I Public Total		**12**
Group II		
	Foreign	1
Group II Total		**1**
Non Group		
	Foreign	1
Non Group Total		**1**
Foreign		
	Foreign	3
	Group II	1
	Non Group	1
	Unknown	1
Foreign Total		**6**
Grand Total		**29**

Postdocs 04-05 Pre & Current MSRI
Institute Group



Year MSRI	04-05

Pre- MSRI Institute Group	Cur Institute Group	Count of Cur Institute Group
Group I Private		
	Group I Private	2
	Group II	3
	Industry	1
	Non Group	1
Group I Private Total		**7**
Group I Public		
	Foreign	2
	Group I Private	1
	Group I Public	4
	Group II	2
	Group III	1
	Group M	2
Group I Public Total		**12**
Group III		
	Group I Public	1
	Group III	1
Group III Total		**2**
Foreign		
	Foreign	3
	Group I Private	1
	Industry	1
Foreign Total		**5**
Grand Total		**26**

Year 2005-06 Postdoc Publications in MathSciNet

Name		Publiciation Title
Barakat	**Aliaa**	
		MR2435651 (2009g:53135) Barakat, Aliaa(1-MIT) On the moduli space of deformations of bihamiltonian hierarchies of hydrodynamic type. (English summary) Adv. Math. 219 (2008), no. 2, 604--632.53D45 (35Q53 37K10)
Bejenaru	**Ioan**	
		MR2501036 Bejenaru, I.; Herr, S.; Holmer, J.; Tataru, D. **On the 2D Zakharov system with $L\sp 2$-Schrödinger data.** Nonlinearity 22 (2009), no. 5, 1063--1089. 35Q55 (35B30 35L70)
		MR2491621 Bejenaru, Ioan; Tataru, Daniel **Global wellposedness in the energy space for the Maxwell-Schrödinger system.** Comm. Math. Phys. 288 (2009), no. 1, 145--198. 81Q05 (35B30 35Q60 81V10)
		MR2443925 (2009g:35297) Bejenaru, Ioan; Tataru, Daniel **Large data local solutions for the derivative NLS equation.** J. Eur. Math. Soc. (JEMS) 10 (2008), no. 4, 957--985. (Reviewer: Peter E. Zhidkov) 35Q55 (35B30)
		MR2425697 (2009c:35428) Bejenaru, Ioan **Quadratic nonlinear derivative Schrödinger equations. II.** Trans. Amer. Math. Soc. 360 (2008), no. 11, 5925--5957. (Reviewer: Arthur H. Vartanian) 35Q55 (35B30)
		MR2425692 Bejenaru, Ioan; De Silva, Daniela **Low regularity solutions for a 2D quadratic nonlinear Schrödinger equation.** Trans. Amer. Math. Soc. 360 (2008), no. 11, 5805--5830. (Reviewer: Thomas Duyckaerts) 35Q55 (35A07 35B30 35B45)
		MR2427007 (2009g:35296) Bejenaru, Ioan **On Schrödinger maps. Amer. J. Math.** 130 (2008), no. 4, 1033--1065. (Reviewer: Luca Lorenzi) 35Q55 (35B30 35K55)
		MR2398238 (2009h:35392) Bejenaru, Ioan **Global results for Schrödinger maps in dimensions $n\geq 3$. Comm. Partial Differential Equations 33 (2008),** no. 1-3, 451--477. (Reviewer: Alexander A. Pankov) 35Q55 (35B30 42B99)
		MR2354991 (2008i:35124) Bejenaru, I.; Ionescu, A. D.; Kenig, C. E. **Global existence and uniqueness of Schrödinger maps in dimensions $d\geq 4$. Adv. Math.** 215 (2007), no. 1, 263--291. (Reviewer: Sergey G. Pyatkov) 35K55 (35K15 35K60 46E35 47H99)
		MR2235496 (2007e:35254) Bejenaru, Ioan **Quadratic nonlinear derivative Schrödinger equations.** I. IMRP Int. Math. Res. Pap. 2006, Art. ID 70630, 84 pp. (Reviewer: Arthur H. Vartanian) 35Q55 (35B30)
		MR2204680 (2007i:35216) Bejenaru, Ioan; Tao, Terence **Sharp well-posedness and ill-posedness results for a quadratic non-linear Schrödinger equation.** J. Funct. Anal. 233 (2006), no. 1, 228--259. (Reviewer: Justin A. Holmer) 35Q55 (35B30 35R25)
		MR1846666 (2002g:93053) Bejenaru, Ioan; Díaz, Jesus Ildefonso; Vrabie, Ioan I. **An abstract approximate controllability result and applications to elliptic and parabolic systems with dynamic boundary conditions. Electron.** J. Differential Equations 2001, No. 50, 19 pp. (electronic). (Reviewer: Quan Zheng) 93C20 (34G10 34H05 35B37 47N20 93B05)
Blair	**Matthew**	
		MR2457396 Blair, Matthew D. Spectral cluster estimates for metrics of Sobolev regularity. Trans. Amer. Math. Soc. 361 (2009), no. 3, 1209--1240. (Reviewer: Julian Edward) 35P20 (35J05 35L05 35P15 58J50)
		MR2407219 (2009d:58044) Blair, Matthew D.; Smith, Hart F.; Sogge, Christopher D. On multilinear spectral cluster estimates for manifolds with boundary. Math. Res. Lett. 15 (2008), no. 3, 419--426. (Reviewer: Elena A. Mazepa) 58J32 (35J10 35P20 58J50)
		MR2350410 (2008k:35386) Blair, Matthew D.; Smith, Hart F.; Sogge, Christopher D. On Strichartz estimates for Schrödinger operators in compact manifolds with boundary. Proc. Amer. Math. Soc. 136 (2008), no. 1, 247--256 (electronic). (Reviewer: Atanas G. Stefanov) 35Q40 (35B65 35J10)
		MR2233036 (2008i:35154) Blair, Matthew Strichartz estimates for wave equations with coefficients of Sobolev regularity. Comm. Partial Differential Equations 31 (2006), no. 4-6, 649--688. (Reviewer: Jason L. Metcalfe) 35L15 (35B45 35B65 35R05)
Bouchard	**Vincent**	
		MR2480744 Bouchard, Vincent; Klemm, Albrecht; Mariño, Marcos; Pasquetti, Sara **Remodeling the B-model.** Comm. Math. Phys. 287 (2009), no. 1, 117--178. 32Q25 (81T30 81T45)
		MR2483754 Bouchard, Vincent; Mariño, Marcos **Hurwitz numbers, matrix models and enumerative geometry. From Hodge theory to integrability and TQFT tt*-geometry, 263--283,** Proc. Sympos. Pure Math., 78, Amer. Math. Soc., Providence, RI, 2008. (Reviewer: Yunfeng Jiang) 14N10 (14N35 81T30 81T45)
		MR2454327 (2009j:14073) Bouchard, Vincent **Orbifold Gromov-Witten invariants and topological strings. Modular forms and string duality, 225--246,** Fields Inst. Commun., 54, Amer. Math. Soc., Providence, RI, 2008. (Reviewer: Hsian-Hua Tseng) 14N35 (14J32 81T30 81T45)
		MR2434526 Bouchard, Vincent; Donagi, Ron **On heterotic model constraints.** J. High Energy Phys. 2008, no. 8, 060, 39 pp. 81T30 (81T50)
		MR2417846 (2009e:14063) Bouchard, Vincent; Donagi, Ron **On a class of non-simply connected Calabi-Yau 3-folds.** Commun. Number Theory Phys. 2 (2008), no. 1, 1--61. (Reviewer: Mark Gross) 14J32 (32Q25)
		MR2365453 (2008m:81174) Aganagic, Mina; Bouchard, Vincent; Klemm, Albrecht **Topological strings and (almost) modular forms.** Comm. Math. Phys. 277 (2008), no. 3, 771--819. (Reviewer: Marcel L. Vonk) 81T45 (11F23 11Z05 32G20 32Q25 81T30)
		MR2229502 (2007f:81202) Bouchard, Vincent; Cvetič, Mirjam; Donagi, Ron **Tri-linear couplings in an heterotic minimal supersymmetric standard model.** Nuclear Phys. B 745 (2006), no. 1-2, 62--83. (Reviewer: Balázs Szendrői) 81T30 (14J32 14J81 81T60 81V22)
		MR2201999 (2006k:81284) Bouchard, Vincent; Donagi, Ron **An $\rm SU(5)$ heterotic standard model.** Phys. Lett. B 633 (2006), no. 6, 783--791. (Reviewer: Balázs Szendröi) 81T30 (14J32 81T60 81V22)
		MR2140507 (2006h:81260) Bouchard, Vincent; Florea, Bogdan; Mariño, Marcos **Topological open string amplitudes on orientifolds.** J. High Energy Phys. 2005, no. 2, 002, 35 pp. (electronic). (Reviewer: Pichai Ramadevi) 81T45 (57M27 81T30)
		MR2130115 (2005m:81284) Bouchard, Vincent; Florea, Bogdan; Mariño, Marcos **Counting higher genus curves with crosscaps in Calabi-Yau orientifolds.** J. High Energy Phys. 2004, no. 12, 035, 35 pp. (electronic) (2005). (Reviewer: Yukiko Konishi) 81T45 (14J32 57M27)
		MR2015164 (2005b:17050) Bouchard, Vincent; Skarke, Harald **Affine Kac-Moody algebras, CHL strings and the classification of tops.** Adv. Theor. Math. Phys. 7 (2003), no. 2, 205--232. (Reviewer: Alexander A. Borisov) 17B67 (52B20 81R10 81T30)
Byun	**Sun-Sig**	
		MR2515166 Byun, Sun-Sig **Hessian estimates in Orlicz spaces for fourth-order parabolic systems in non-smooth domains.** J. Differential Equations 246 (2009), no. 9, 3518--3534. 35K60 (46E30)
		MR2462578 Byun, Sun-Sig; Yao, Fengping; Zhou, Shulin **Gradient estimates in Orlicz space for nonlinear elliptic equations.** J. Funct. Anal. 255 (2008), no. 8, 1851--1873. 35J60 (35B45 35B65 35J25 46E30 46N20)
		MR2460025 (2009i:35133) Byun, Sun-Sig; Wang, Lihe **Fourth-order parabolic equations with weak BMO coefficients in Reifenberg domains.** J. Differential Equations 245 (2008), no. 11, 3217--3252. (Reviewer: Alan V. Lair) 35K35 (35B45 35B65 35K60)
		MR2456271 Byun, Sun-Sig; Wang, Lihe **Elliptic equations with BMO nonlinearity in Reifenberg domains.** Adv. Math. 219 (2008), no. 6, 1937--1971. 35J60 (35B45 35J25)
		MR2399163 (2009f:35061) Byun, Sun-Sig; Wang, Lihe **Gradient estimates for elliptic systems in non-smooth domains.** Math. Ann. 341 (2008), no. 3, 629--650. (Reviewer: Ingo F. Witt) 35J55 (35B45 35B65 35D10)

Name		Publiciation Title
		MR2384329 (2009h:35206) Byun, Sun-Sig; Wang, Lihe **Parabolic equations with BMO nonlinearity in Reifenberg domains.** J. Reine Angew. Math. 615 (2008), 1--24. (Reviewer: Michael Dreher) 35K55 (35K20) MR2373207 (2009i:35185) Byun, Sun-Sig; Wang, Lihe **$W\sp {1,p}$ regularity for the conormal derivative problem with parabolic BMO nonlinearity in Reifenberg domains.** Discrete Contin. Dyn. Syst. 20 (2008), no. 3, 617--637. (Reviewer: Matteo Bonforte) 35K60 (35B65 35D10 35K55) MR2375715 (2008m:35131) Byun, Sun-Sig; Wang, Lihe **$L\sp p$-estimates for general nonlinear elliptic equations.** Indiana Univ. Math. J. 56 (2007), no. 6, 3193--3221. (Reviewer: Rolando Magnanini) 35J65 (35B45 35B65 35D10 35J60) MR2345911 (2008f:35104) Byun, Sun-Sig; Wang, Lihe; Zhou, Shulin **Nonlinear elliptic equations with BMO coefficients in Reifenberg domains.** J. Funct. Anal. 250 (2007), no. 1, 167--196. (Reviewer: Maria Transirico) 35J60 (35B45 35R05 42B25) MR2336309 (2008j:35040) Byun, Sun-Sig; Wang, Lihe **Quasilinear elliptic equations with BMO coefficients in Lipschitz domains.** Trans. Amer. Math. Soc. 359 (2007), no. 12, 5899--5913 (electronic). (Reviewer: Maria Transirico) 35J60 (35B45 35B65 35J25 35R05) MR2328932 (2008i:35108) Byun, Sun-Sig **Optimal $W\sp {1,p}$ regularity theory for parabolic equations in divergence form.** J. Evol. Equ. 7 (2007), no. 3, 415--428. (Reviewer: Giovanni Pisante) 35K20 (35B65) MR2329320 (2008h:35131) Byun, Sun-Sig; Wang, Lihe **Parabolic equations in time dependent Reifenberg domains.** Adv. Math. 212 (2007), no. 2, 797--818. (Reviewer: Emmanouil Milakis) 35K20 (35B45 35B65 35R05) MR2276490 (2007m:35045) Byun, Sun-Sig; Chen, Hongbin; Kim, Mijoung; Wang, Lihe **$L\sp p$ regularity theory for linear elliptic systems.** Discrete Contin. Dyn. Syst. 18 (2007), no. 1, 121--134. (Reviewer: Siegfried Carl) 35J55 (35B65) MR2187159 (2007h:35142) Byun, Sun-Sig; Wang, Lihe **Parabolic equations in Reifenberg domains.** Arch. Ration. Mech. Anal. 176 (2005), no. 2, 271--301. (Reviewer: Florin Iacob) 35K20 (35B45 35R05) MR2139880 (2006a:35128) Byun, Sun-Sig; Wang, Lihe **$L\sp p$ estimates for parabolic equations in Reifenberg domains.** J. Funct. Anal. 223 (2005), no. 1, 44--85. (Reviewer: Rostislav Vodák) 35K20 (35R05 35R35) MR2110431 (2005i:35054) Byun, Sun-Sig **Elliptic equations with BMO coefficients in Lipschitz domains.** Trans. Amer. Math. Soc. 357 (2005), no. 3, 1025--1046 (electronic). (Reviewer: Maurizio Chicco) 35J25 (35R05) MR2110205 (2005i:35106) Byun, Sun-Sig **Parabolic equations with BMO coefficients in Lipschitz domains.** J. Differential Equations 209 (2005), no. 2, 229--265. (Reviewer: Rostislav Vodák) 35K20 (35B45 35R05) MR2107043 (2006e:35327) Byun, Sun-Sig; Wang, Lihe **The conormal derivative problem for elliptic equations with BMO coefficients on Reifenberg flat domains.** Proc. London Math. Soc. (3) 90 (2005), no. 1, 245--272. (Reviewer: Gary M. Lieberman) 35R05 (35J15) MR2069724 (2006b:35058) Byun, Sun-Sig; Wang, Lihe **Elliptic equations with BMO coefficients in Reifenberg domains.** Comm. Pure Appl. Math. 57 (2004), no. 10, 1283--1310. (Reviewer: Norbert Weck) 35J15 (35B65)
Cai	**Kaihua**	
		MR2221747 (2007e:35233) Cai, Kaihua(1-MSRI) Dispersion for Schrödinger operators with one-gap periodic potentials on $\Bbb R\sp 1$. (English summary) Dyn. Partial Differ. Equ. 3 (2006), no. 1, 71--92. 35Q40 (35B10 37K15 47B80 47E05)
Carter	**Jamylle**	
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Program Summary

# of programs	
Year	#
2005-06	4
2006-07	3
2007-08	4
2008-09	3
Total	14

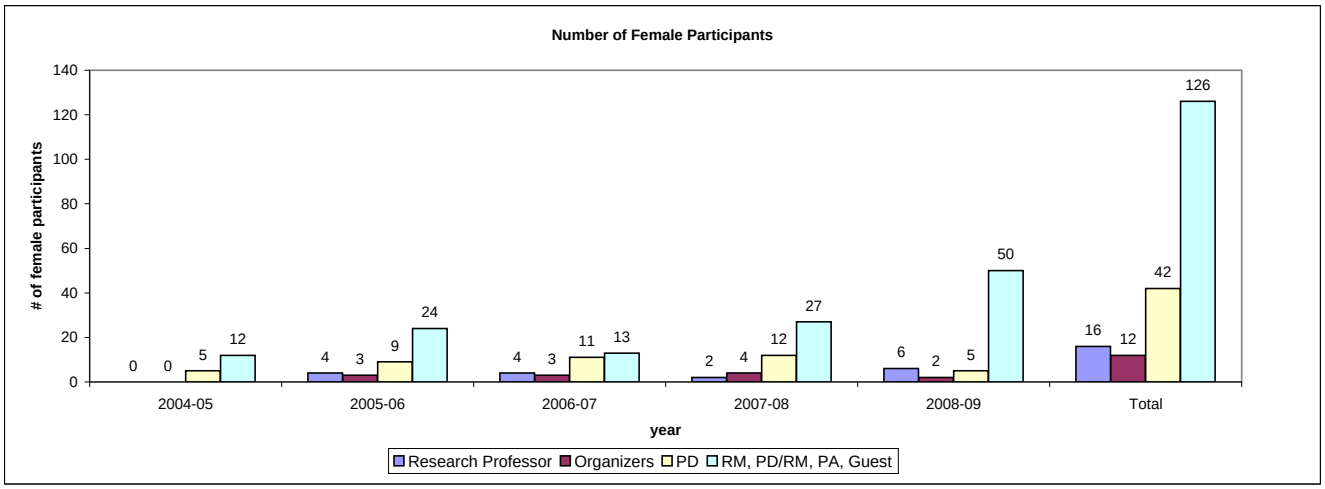
Number of Applicants			
Programs	PD	RP,RM	Total
2005-06	124	180	304
2006-07	201	127	328
2007-08	206	203	409
2008-09	265	262	527
2009-10	233	153	386
Total	1029	925	1954

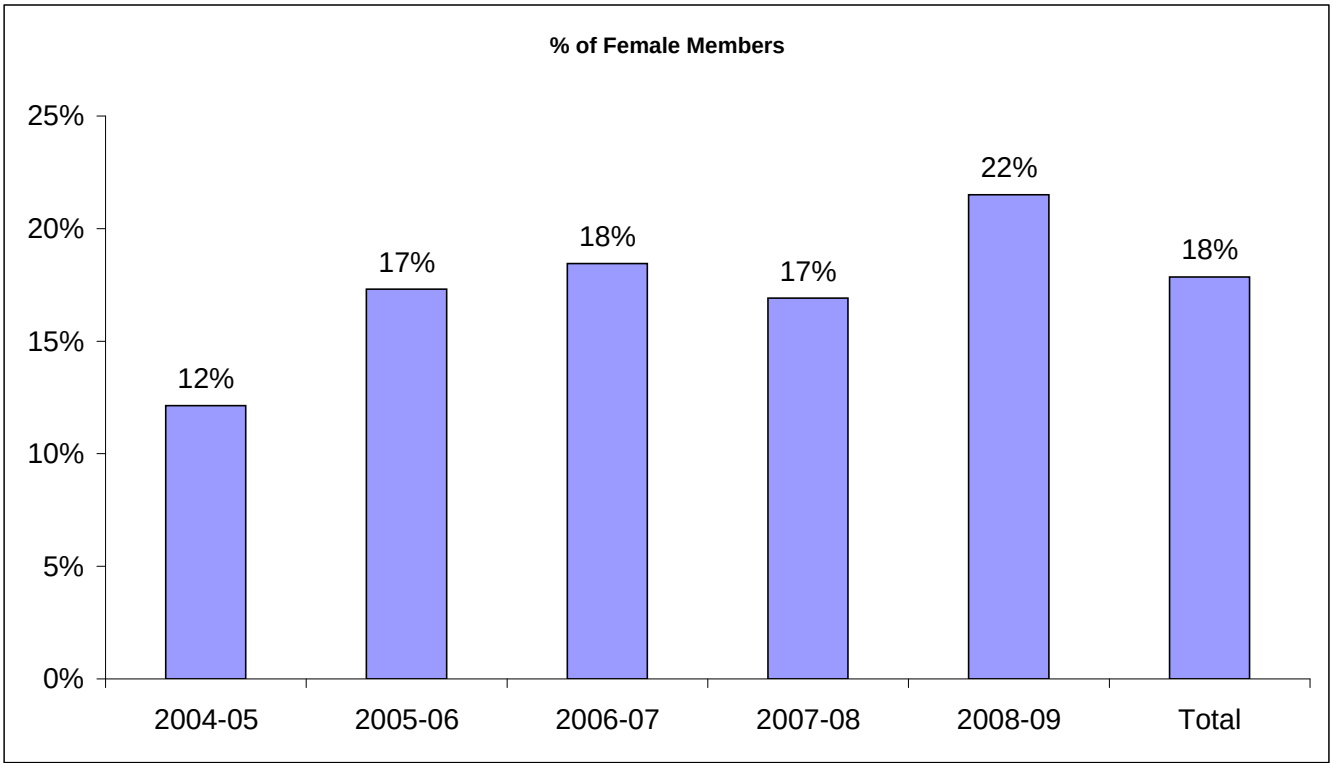
Program participant summary*				
Year	Members	Postdocs	Total	Person-Days
2005-06	202	29	231	12014
2006-07	142	26	168	12772
2007-08	236	30	266	21216
2008-09	259	34	293	19212
Total	839	119	958	65214

* distinct members

MSRI Members
2004 - 2009
Female Participation Summary

All Programs	2004-05	2005-06	2006-07	2007-08	2008-09	Total
Research Professor	0	4	4	2	6	16
Organizers	0	3	3	4	2	12
PD	5	9	11	12	5	42
RM, PD/RM, PA, Guest	12	24	13	27	50	126
Total	**17**	**40**	**31**	**45**	**63**	**196**
Members Total	140	231	168	266	293	1098
% of female members	**12%**	**17%**	**18%**	**17%**	**22%**	**18%**





MSRI Members

2004 - 2009
Female Participation Classifed by Participant Role

	Research Professor		
	Female	Total	%
2004-05	0	22	0%
2005-06	4	47	9%
2006-07	4	37	11%
2007-08	2	21	10%
2008-09	6	50	12%
Total	**16**	**177**	**9%**

	Organizers		
	Female	Total	%
2004-05	0	17	0%
2005-06	3	13	23%
2006-07	3	15	20%
2007-08	4	22	18%
2008-09	2	17	12%
Total	**12**	**84**	**14%**

	Postdocs		
	Female	Total	%
2004-05	5	26	19%
2005-06	9	30	30%
2006-07	11	25	44%
2007-08	12	30	40%
2008-09	5	34	15%
Total	**42**	**145**	**29%**

	RM, PD/RM, PA, Guests		
	Female	Total	%
2004-05	12	75	16%
2005-06	24	141	17%
2006-07	13	91	14%
2007-08	27	193	14%
2008-09	50	192	26%
Total	**126**	**692**	**18%**

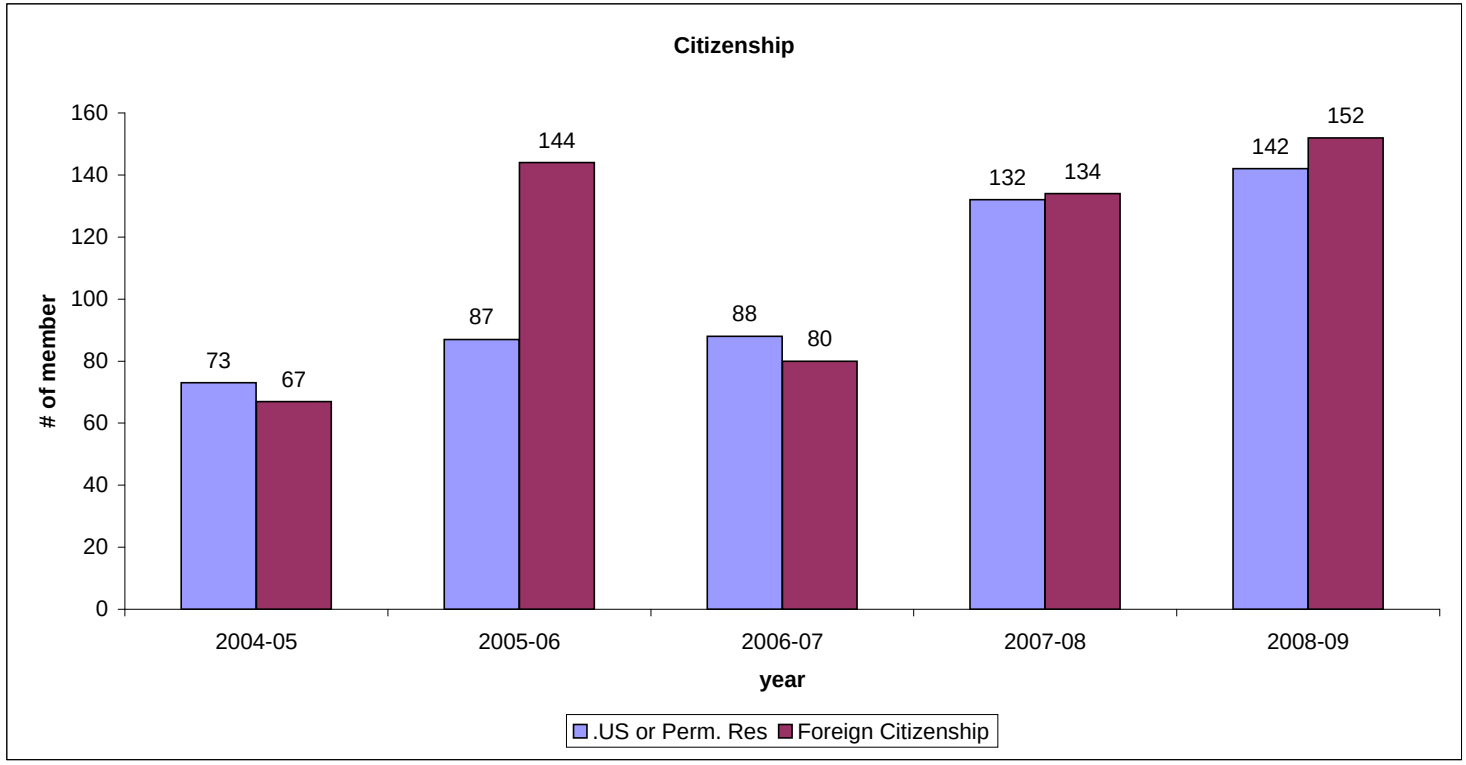
MSRI Members
2004 - 2009
Ethnicity

Ethnicity	2004-05		2005-06		2006-07		2007-08		2008-09		Total	
Native American		0%		0%		0%	1	1%	0	0%	1	0%
Asian	12	15%	35	31%	20	22%	16	12%	22	10%	105	16%
Black	5	6%	3	3%	3	3%	2	1%	0	0%	13	2%
Hispanic	2	2%	8	7%	0	0%	4	3%	12	5%	26	4%
Pacific	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
White	63	77%	66	59%	70	75%	113	83%	194	85%	506	78%
Decline	29		119		75		30		30		283	
Unavailable information	29		0		0		100		35		164	
Grand Total	**140**		**231**		**168**		**266**		**293**		**1098**	

	2004-05		2005-06		2006-07		2007-08		2008-09		Total	
Minorities Among US Citizens	3	6%	4	7%	2	3%	7	6%	8	7%	24	6%

MSRI Members
2004 - 2009
Citizenship

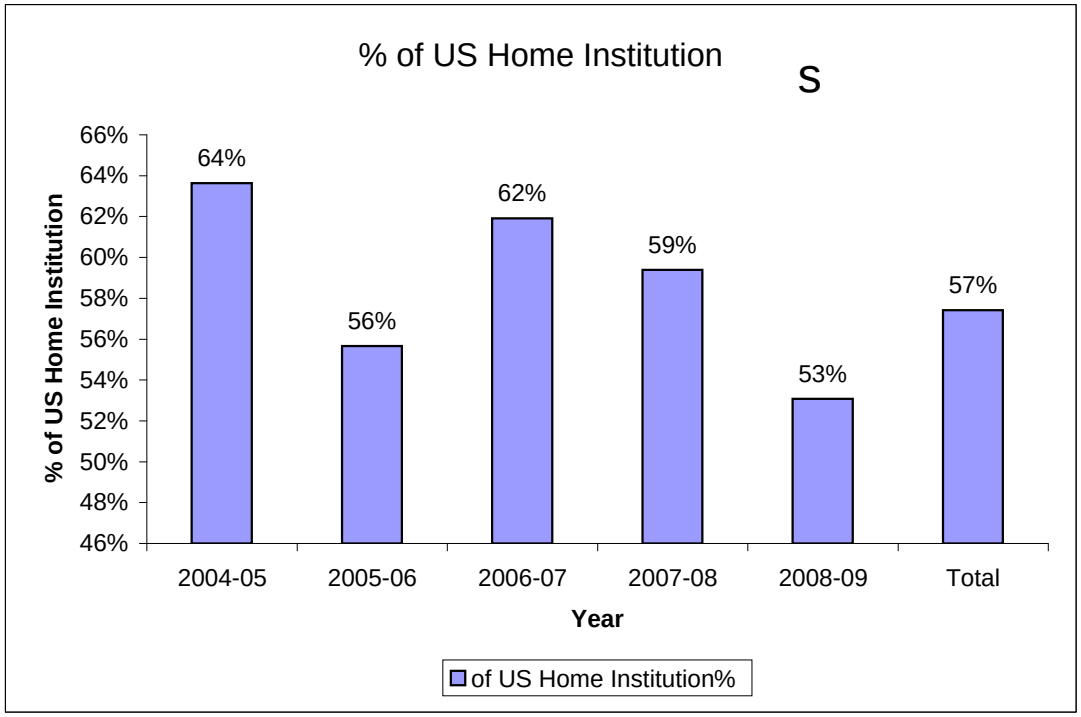
	2004-05	%	2005-06	%	2006-07	%	2007-08	%	2008-09	%	Total	%
USA	54		57		63		117		111		402	
US Permanent Resident	19		30		25		15		31		120	
US or Perm. Res.	73	52%	87	38%	88	52%	132	50%	142	48%	522	48%
Foreign Citizenship	67	48%	144	62%	80	48%	134	50%	152	52%	577	53%
Unavailable information	0		0		0		1		1		2	
Total	140		231		168		266		293		1098	



MSRI Members
2004 - 2009
US Home Institutions

s

	2004-05	2005-06	2006-07	2007-08	2008-09	Total
US Home Institution	35	113	104	158	155	565
Unavailable information	85	28	0	0	1	114
Total Members	140	231	168	266	293	1098
% of US Home Institutions	**64%**	**56%**	**62%**	**59%**	**53%**	**57%**



MSRI Length of Stay Summary

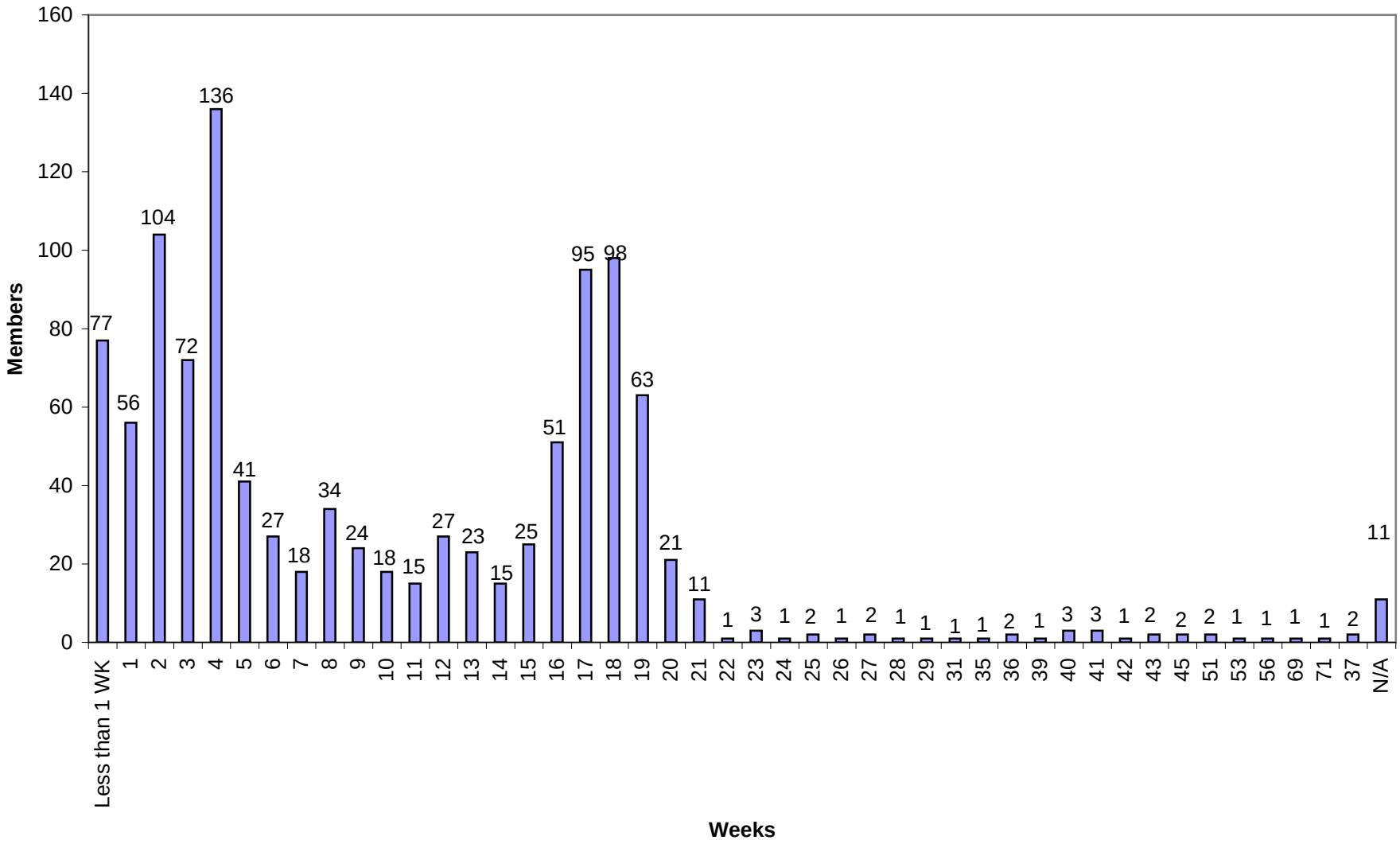
MSRI Year	04-05	05-06	06-07	07-08	08-09	Total	
Total Member Days	11159	12014	12772	21216	19212	76253	
Total Distinct Members	140	231	168	266	293	1098	
Member wt no days of stay	2	0	1	8	26	37	
Program days	255	255	262	248	255		
Average # of Days per Member	80.86	52.01	76.48	82.23	71.96	71.87	2.4 months
Average # of Members per Day	43.76	47.11	48.75	85.55	75.34	60	

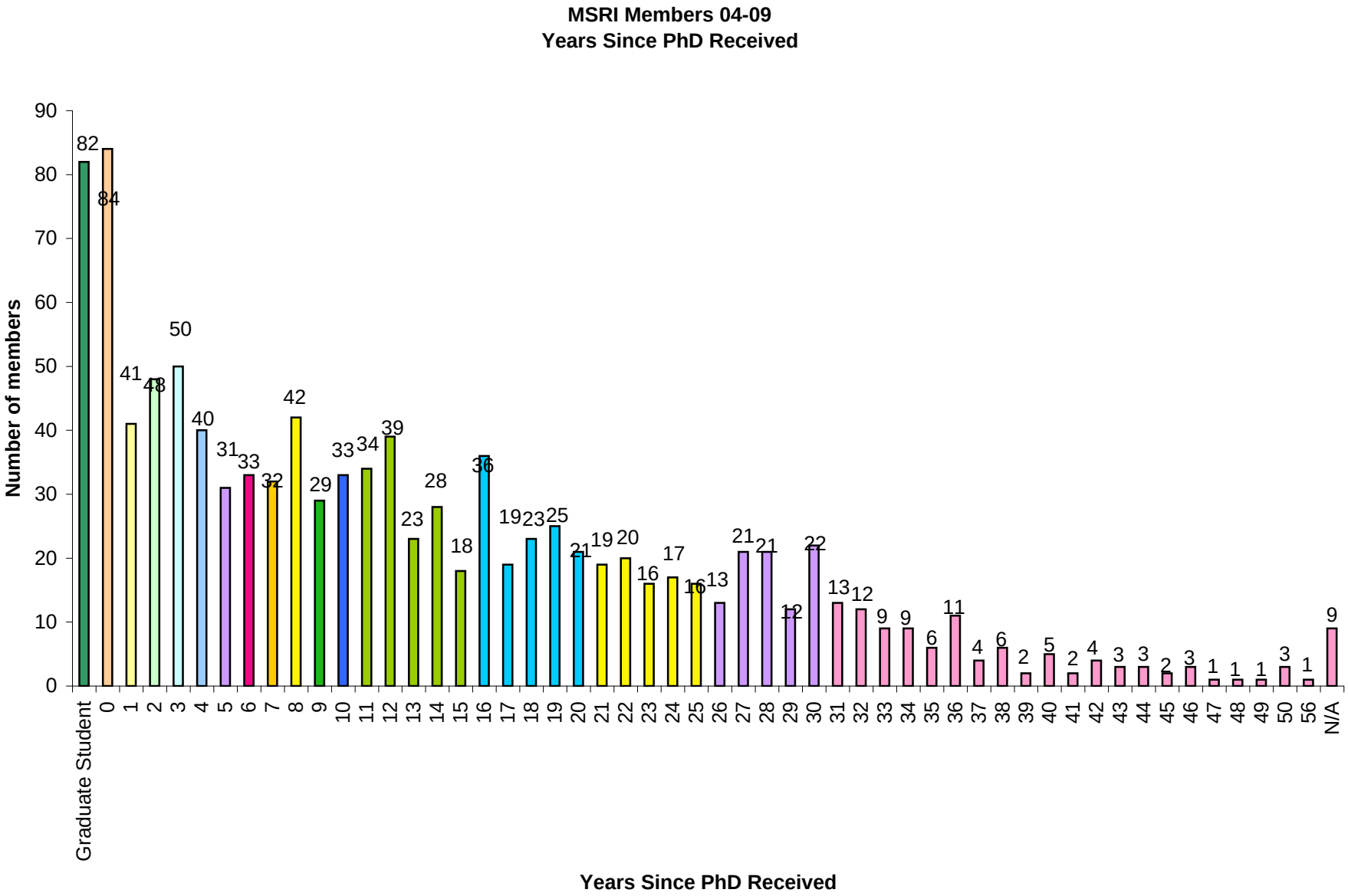
Family Name	First Name	Year PhD
Kesten	Harry	1958
Smale	Steve	1956
Fong	Paul	1959
Garsia	Adriano	1957
Springer	Tonny	1951
Furstenberg	Hillel	1958
Katznelson	Yitzhak	1959
Mumford	David	1960
Srinivasan	Bhama	1960

Member Home Institution Group Demographics

Year	04-05	05-06	06-07	07-08	08-09	Total
Group I Private	25	31	32	47	51	186
Group I Public	31	50	34	57	61	233
Group II	13	21	20	27	25	106
Group III	3	2	6	7	7	25
Group IV		1		7		8
Group M	4	5	3	6	3	21
non-Group	4	4	8	7	8	31
Foreign	56	115	64	107	138	480
Unknown	4	2	1	1		8
Total	140	231	168	266	293	1098

2004-09 Members' Visit Length




MSRI Members 04-09
Years Since PhD Received
Number of members
Years Since PhD Received
0
10
20
30
40
50
60
70
80
90
Graduate Student
0
1
2
3
4
5
6
7
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50
56
N/A
82
84
41
48
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9
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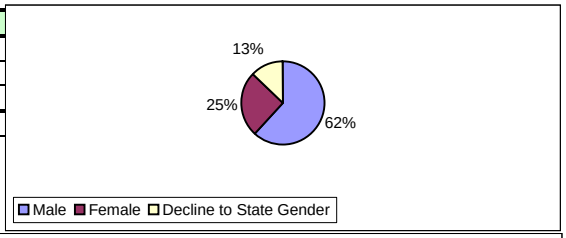
1
9

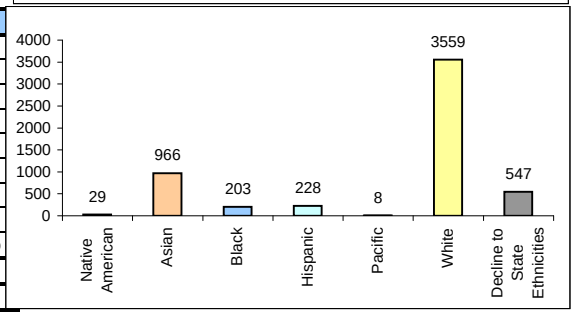
MSRI: Senior Members vs. Junior Members, 1999 - 2009											
		SENIOR			JUNIOR				% Distribution		
Years	Totals Members	Senior (RP,Organizers)	GM (Phd. Over 10 Years)	Total	Junior (Post Docs, Graduate Students)	GM (Phd. Between 5-10 Years)		Total	Senior	%	Junior
1999-00	361	41	140	181	61	119		180	50%	vs.	50%
2000-01	272	66	87	153	56	63		119	56%	vs.	44%
2001-02	353	79	114	193	57	103		160	55%	vs.	45%
2002-03	311	64	93	157	58	96		154	50%	vs.	50%
2003-04	232	63	76	139	36	57		93	60%	vs.	40%
99-04 Total	1529	313	510	823	268	438		706	54%		46%
2004-05	140	39	38	77	40	17		57	57%	vs.	43%
2005-06	231	60	65	125	63	39		102	55%	vs.	45%
2006-07	168	52	39	91	52	23		75	55%	vs.	45%
2007-08	266	43	94	137	91	33		124	52%	vs.	48%
2008-09	293	67	84	151	95	47		142	52%	vs.	48%
05-09 Total	1098	261	320	581	341	159		500	54%	vs.	46%

All Workshops Demographic Summary 2004-2009 (Visits)

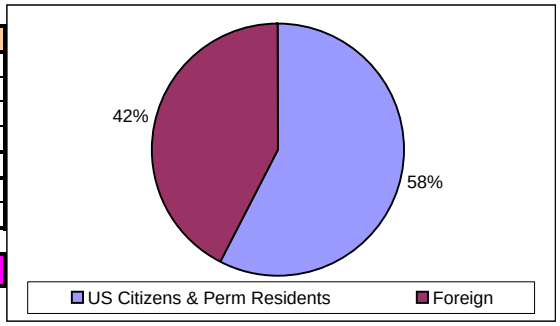
Gender	No.	%*	%
Male	5308	70.75%	61.7%
Female	2194	29.25%	25.5%
Decline to State Gender	1105		12.8%
No. of Participants	8607	100.00%	100.0%



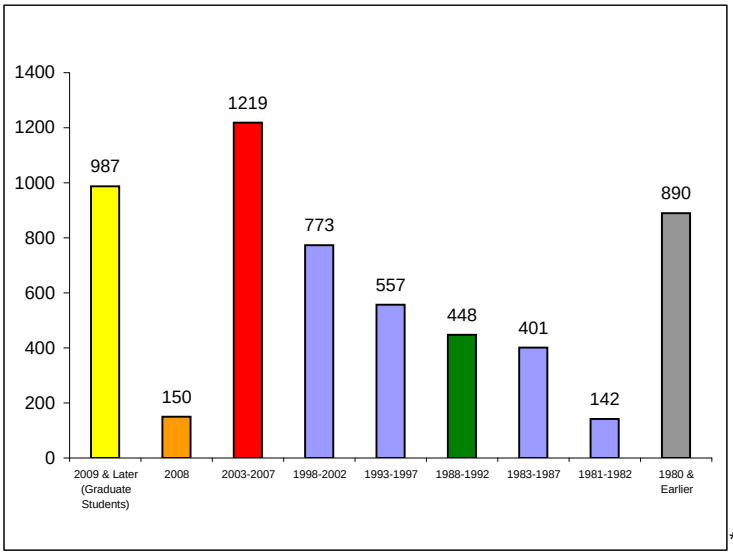
Ethnicities	No.	%*	%
Native American	29	0.59%	0.3%
Asian	966	19.34%	11.2%
Black	203	4.07%	2.4%
Hispanic	228	4.57%	2.7%
Pacific	8	0.16%	0.1%
White	3559	71.27%	41.3%
Decline to State Ethnicities	547		6.4%
Unavailable Information	3067		35.6%
Total no. of Participants	8607	100.00%	100.0%
Minorities	308	9.73%	3.6%



Citizenships	No.	%*	%
US Citizens & Perm Residents	3612	57.53%	42.0%
Foreign	2666	42.47%	31.0%
Unavailable Information	2329		27.1%
Total no. of Participants	8607	100.00%	100.0%
US Citizens	3167		36.8%
Perm. Residents	445		5.2%
Home Inst. in US	**5344**		**62.09%**



Year of Ph.D	No.	%*	%
2009 & Later (Graduate Students)	987	17.73%	12.2%
2008	150	2.69%	1.9%
2003-2007	1219	21.90%	15.0%
1998-2002	773	13.89%	9.5%
1993-1997	557	10.01%	6.9%
1988-1992	448	8.05%	5.5%
1983-1987	401	7.20%	4.9%
1981-1982	142	2.55%	1.8%
1980 & Earlier	890	15.99%	11.0%
Year Unknown	210		2.6%
Unavailable Info.	2327		28.7%
Total	8104	100.00%	100.0%



**Statistic Calculation based on all participants that did not decline.*

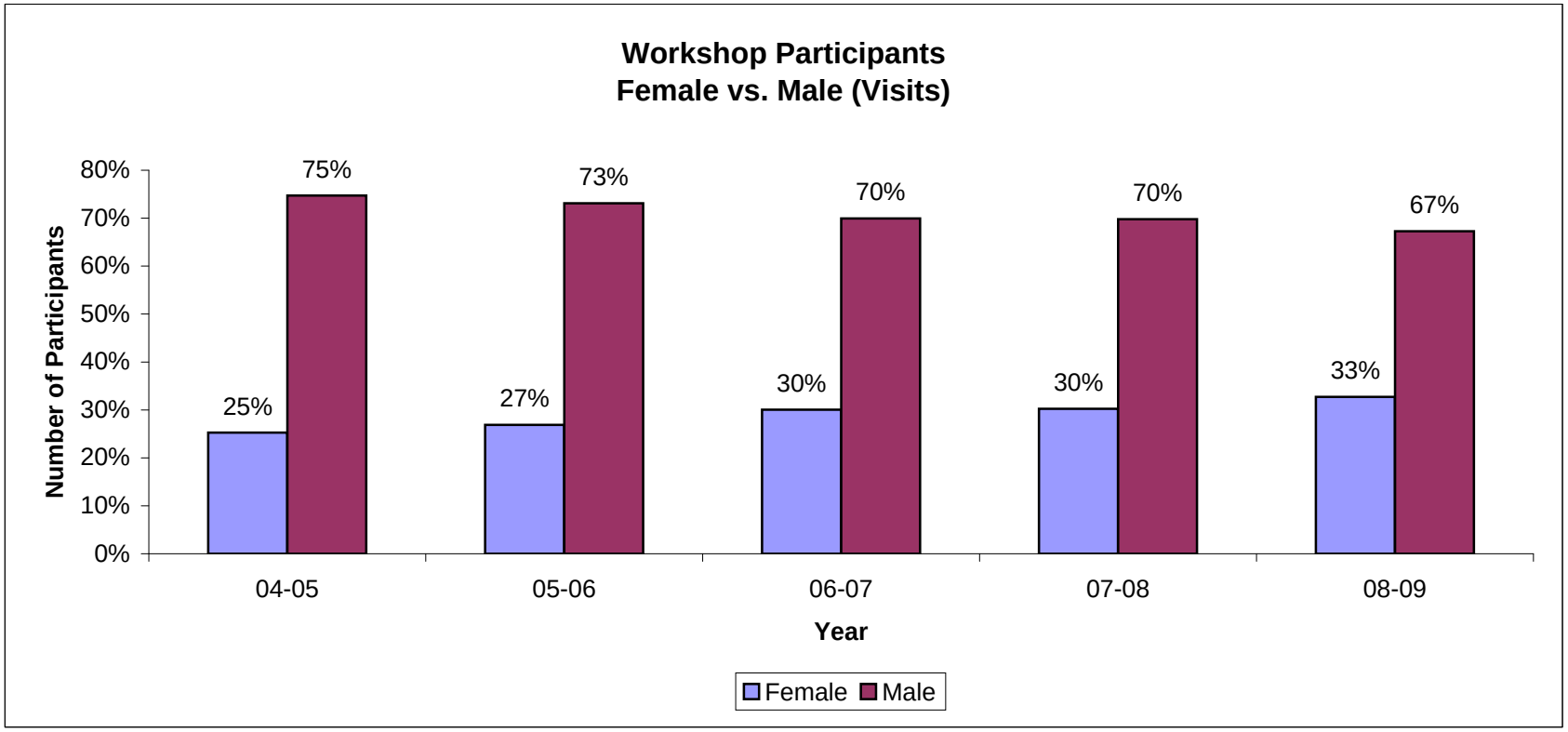
Workshop Type	Scientific	
Year	**Activity Title**	**Total**
05-06		
	Analytic Methods for Diophantine Equations	23
	Analytical and Stochastic Fluid Dynamics	50
	Cohomological Approaches to Rational Points	98
	Flavors of Groups	32
	Generalized McKay Correspondences and Representation Theory	81
	Geometric and Analytical Aspects of Nonlinear Dispersive Equations	68
	Introductory Workshop in Nonlinear Dispersive Equations	48
	Introductory Workshop in Nonlinear Elliptic Equations and Its Applications	70
	Introductory Workshop in Rational and Integral Points on Higher-Dimensional Varieties	114
	Mathematical Systems Biology of Cancer	87
	Mathematics of Markov Chain Monte Carlo	16
	Mathematics of Relaying and Cooperation in Communication Networks	112
	Minicourse on Stochastic ODE and connections with nonlinear PDEs	24
	MSRI Workshop for Women in Mathematics: An Introduction to Elliptic Partial Differential Equations	39
	New Developments in the Geometry and Physics of Gromov-Witten Theory	73
	Optimal Mass Transport and its Applications	75
	Probability, Geometry and Integrable Systems	52
	Recent Results in Nonlinear Elliptic Equations and their Interactions with Geometry	70
	Stringy Topology in Morelia	98
05-06 Total (Visits)		**1230**
06-07		
	Advances in Algebra and Geometry	124
	An Introduction to Multiscale Methods	34
	Analytic and Computational Aspects of Elliptic and Parabolic Equations	25
	CMI/MSRI Hot Topics Workshop: Modularity for GL(2) and Beyond	87
	Computing in Statistics	26
	Connections for Women: Computational Applications of Algebraic Topology	18
	Connections for Women: Dynamical Systems	45
	Connections for Women: Geometric Analysis and Nonlinear Partial Differential Equations	30
	Geometric Evolution Equations	48
	Hot Topics: Minimal and Canonical Models in Algebraic Geometry	42
	Interactive Parallel Computation in Support of Research in Algebra, Geometry and Number Theory	61
	Introductory Workshop on Computational Application of Algebraic Topology	62
	Introductory Workshop on Dynamical Systems with Emphasis on Extended Systems	80
	Introductory Workshop on Geometric Flows and Function Theory in Real and Complex Geometry	39
	Lectures on String(y) Topology	4
	Mathematical Issues in Stochastic Approaches for Multiscale Modeling	38
	Mathematics of Visual Analysis	38
	MSRI Symposium on Climate Change: From Global Models to Local Action	77
	Recent Developments in Arrangements and Configuration Spaces	37
	Recent Developments in Numerical Methods and Algorithms for Geometric Evolution Equations	15
	Stochastic Dynamical Systems and Control	36
	Workshop on Topological Methods in Combinatorics, Computational Geometry, and the Study of Algorithms	46
	Workshop on Application of Topology in Science and Engineering	50
	World Congress on Computational Finance: The First Decade	186
06-07 Total (Visits)		**1248**
07-08		
	CMI/MSRI Workshop: Modular Forms and Arithmetic	68
	Computation and Complex Systems	62
	Connections for Women: Geometric Group Theory	57
	Connections for Women: Introduction to the Spring, 2008 programs	47
	Connections for Women: Teichmuller Theory and Kleinian Groups	48
	Exterior Differential Systems and the Method of Equivalence	48
	Homological Methods in Representation Theory	81
	Hot Topics: Contact structures, dynamics and the Seiberg-Witten equations in dimension 3	53
	Introduction to Geometric Group Theory	117
	Introduction to Teichmuller Theory and Kleinian Groups	96
	Introductory Workshop on Combinatorial Representation Theory	134
	Introductory Workshop on the Representation Theory of Finite Groups	95
	Lie Theory	150
	Mathematical Systems Biology of Cancer II	60
	MSRI Summer Microprogram on Nonlinear Partial Differential Equations	47
	Topics in Combinatorial Representation Theory	129
	Topics in Geometric Group Theory	145
	Topics in Teichmuller Theory and Kleinian Groups	90
07-08 Total (Visits)		**1527**
08-09		
	Algebraic Statistics	64
	Broader Connections: Analysis on Singular Spaces	36
	Broader Connections: Ergodic Theory and Additive Combinatorics	53

08-09	**Classical Algebraic Geometry Today**	**166**
	CMI/MSRI Workshop: Modular Forms and Arithmetic	**74**
	Combinatorial, Enumerative and Toric Geometry	**175**
	Connections for Women: Algebraic Geometry and Related Fields	**82**
	Discrete Rigidity Phenomena in Additive Combinatorics	**64**
	Economic Games and Mechanisms to Address Climate Change	**56**
	Elliptic and Hyperbolic Equations on Singular Spaces	**72**
	International Conference on Cluster Algebras and Related Topics	**15**
	Introduction to Ergodic Theory and Additive Combinatorics	**60**
	Introductory Workshop on Analysis on Singular Spaces	**52**
	Low Dimensional Topology	**155**
	Macaulay 2 day	**12**
	Mathematical Genomics	**63**
	Modern Moduli Theory	**156**
	Modern Perspectives in Applied Mathematics	**16**
	Sage Days: Algebraic Geometry	**33**
	Topology of Stratified Spaces	**45**
	Western Algebraic Geometry Seminar	**19**
08-09 Total (Visits)		**1468**
Grand Total (Visits)		**5473**

Workshop Type	*Outreach & Diversity*	
Year	**Activity Title**	**Total**
05-06		
	Morehouse College/Spelman College/MSRI Workshop on Modern Mathematics: An Introduction to 2006-07 Programs at MSRI	56
	Raising the floor: Progress and setbacks in the struggle for quality mathematics education for all	137
	Women in Mathematics: The Legacy of Ladyzhenskaya and Oleinik	73
05-06 Total (Visits)		**266**
06-07		
	Critical Issues in Education: Teaching Teachers Mathematics	187
	Modern Mathematics: An Introduction to 2007-08 Programs at MSRI	42
	MSRI-UP: 2007 Undergraduate Program	16
06-07 Total (Visits)		**245**
07-08		
	Critical Issues in Education Workshop: Teaching and Learning Algebra	131
	Math Fest	12
	Modern Mathematics: An Introduction to MSRI's 2008-09 Programs	45
	MSRI's 25th Anniversary Celebration	153
	MSRI-UP 2008 research topic: Experimental Mathematics	20
07-08 Total (Visits)		**361**
08-09		
	Bay Area Circle for Teachers	29
	Great Circles 2009	97
	Math Institutes Modern Mathematics Workshop	49
	Promoting Diversity at the Graduate Level in Mathematics: a National Forum	111
	Teaching Undergraduates Mathematics	98
	Using Partnerships to Strengthen Elementary Mathematics Teacher Education	61
08-09 Total (Visits)		**445**
Grand Total (Visits)		**1317**

Workshop Participants 04-09 Male vs. Female (Visits)

Year	Female	%	Male	%	Total
04-05	384	25%	1135	75%	1519
05-06	350	27%	952	73%	1302
06-07	366	30%	852	70%	1218
07-08	477	30%	1101	70%	1578
08-09	617	33%	1268	67%	1885
Total	**2194**	**29%**	**5308**	**71%**	**7502**



MSRI Workshops (Visits)
2004 - 2009
Ethnicity

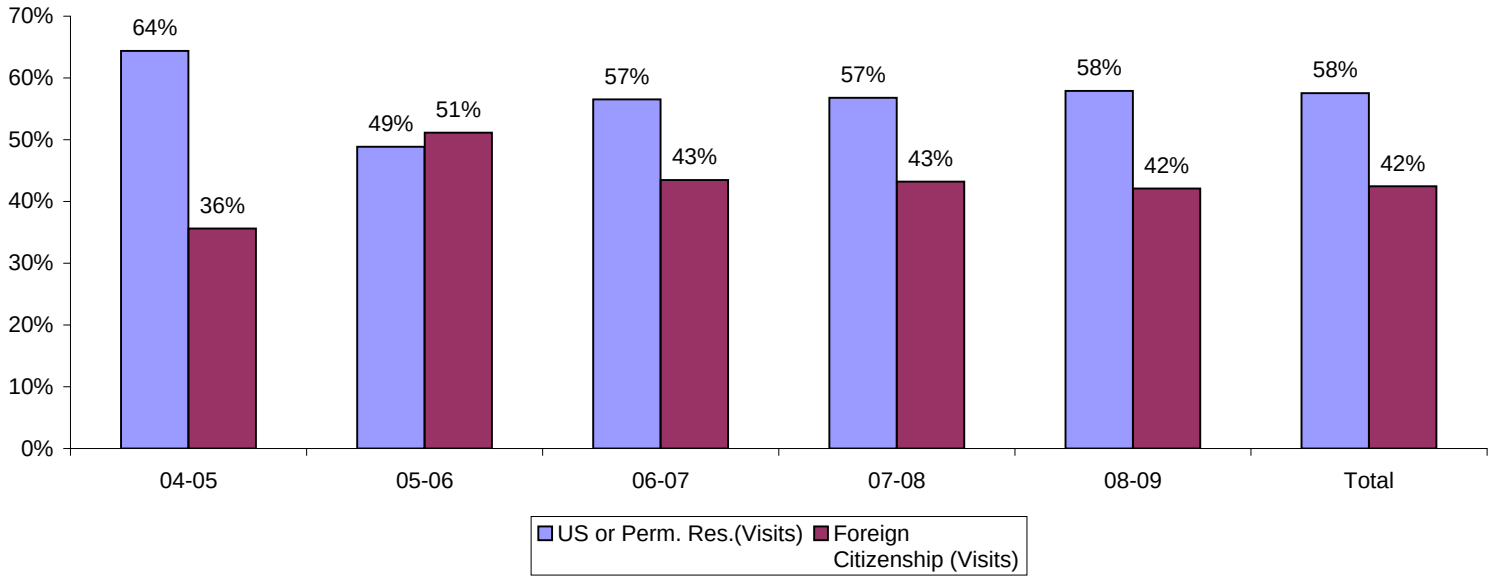
Ethnicity	2004-05	%	2005-06	%	2006-07	%	2007-08	%	2008-09	%	Total	%
Native American	9	1%	4	1%	4	1%	6	1%	6	0%	29	1%
Asian	170	18%	203	26%	144	20%	158	15%	292	20%	966	19%
Black	48	5%	58	7%	27	4%	19	2%	52	3%	203	4%
Hispanic	31	3%	32	4%	27	4%	64	6%	75	5%	228	5%
Pacific	2	0%	1	0%	4	0%	1	0%	1	0%	8	0%
White	701	73%	498	63%	520	72%	774	76%	1067	71%	3559	71%
Decline	148		77		67		118		137		547	
Unavailable information	708		625		702		749		283		3067	
Grand Total (Visits)	1817		1496		1493		1888		1913		8607	

Minorities	2004-05	%	2005-06	%	2006-07	%	2007-08	%	2008-09	%	Total	%
US Citizens (Visits)	818		414		395		695		845		3167	
Minorities Among US Citizens (Visits)	75	9%	48	12%	30	8%	67	10%	88	10%	308	10%

MSRI Workshop (Visits)
2004-2009
Citizenship

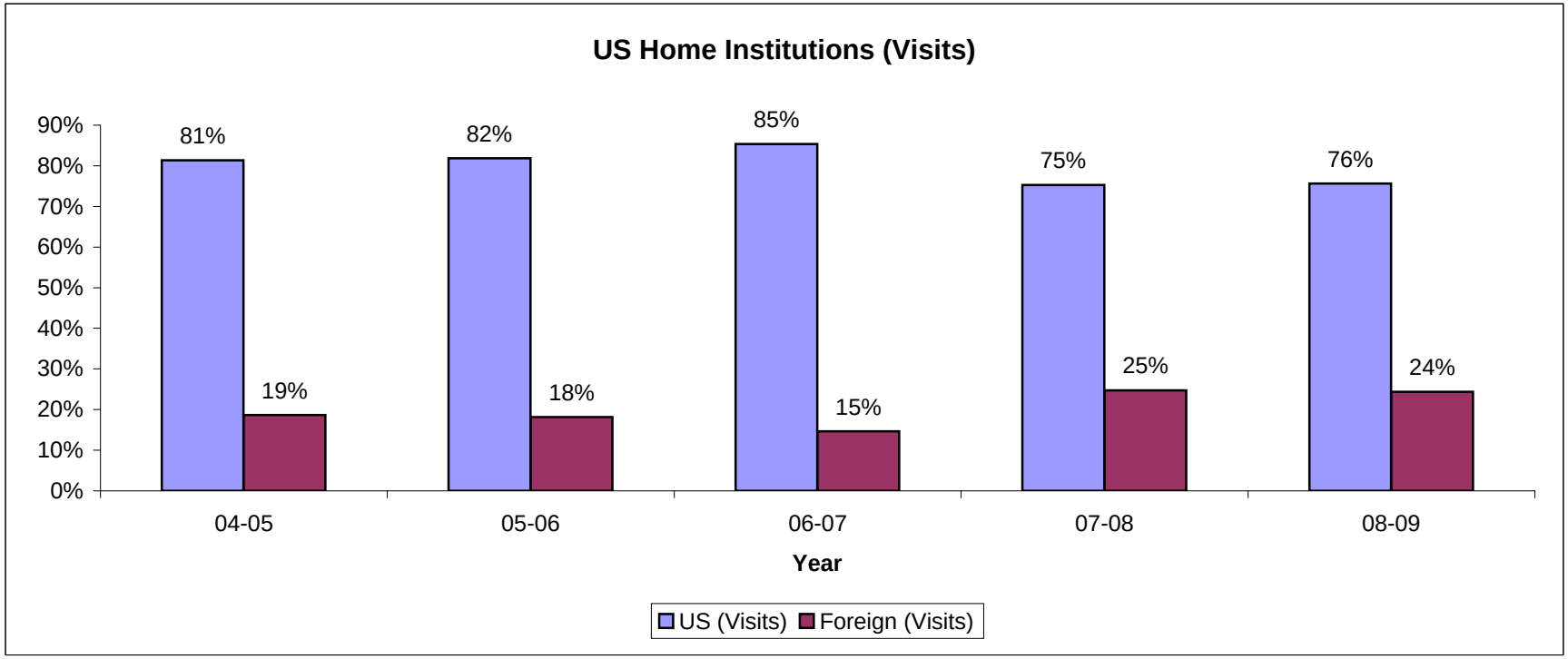
	04-05	%	05-06	%	06-07	%	07-08	%	08-09	%	Total	%
US Citizens (Visits)	818		414		395		695		845		3167	
Perm. Res. (Visits)	147		96		47		62		93		445	
US or Perm. Res.(Visits)	965	64%	510	49%	442	57%	757	57%	938	58%	3612	58%
Foreign Citizenship (Visits)	534	36%	534	51%	340	43%	576	43%	682	42%	2666	42%
Unavailable Information	318		452		711		555		293		2329	
Total (Visits)	**1817**		**1496**		**1493**		**1888**		**1913**		**8607**	

US Citizenship vs Foreign Citizenship (Visits)



US Home institutions 2004-2009 (Visits)

	04-05	%	05-06	%	06-07	%	07-08	%	08-09	%
US (Visits)	523	81%	1076	82%	957	85%	1405	75%	1383	76%
Foreign (Visits)	120	19%	239	18%	164	15%	461	25%	446	24%
N/A	1174		181		372		22		84	
Total (Visits)	**1817**		**1496**		**1493**		**1888**		**1913**	



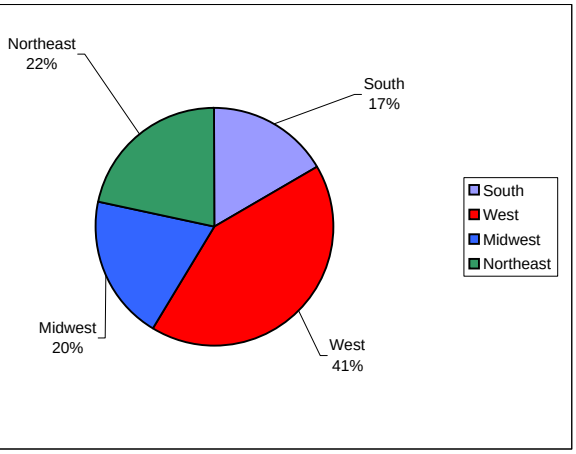
Home Institutions Classified by Region & Country (Visits)

Region	Area	Country	04-05	05-06	06-07	07-08	08-09	Grand Total (Visits)
Americas	Central America	MX		11	2	6		19
	Central America Total			11	2	6		19
	North America	CA	31	30	32	46	50	189
		US	523	1076	957	1405	1383	5344
	North America Total		554	1106	989	1451	1433	5533
	South America	AR				1	2	3
		BR		1	1	7	5	14
		CL					4	4
		CO		1	1			2
		UY				5		5
		VE				1		1
	South America Total			2	2	14	11	29
Americas Total (Visits)			**554**	**1119**	**993**	**1471**	**1444**	**5581**
Europe	Eastern Europe	BG	1				1	2
		BY				1	1	2
		CZ					3	3
		HU					4	4
		PL			1	5	3	9
		RO				3	4	7
		RU	2	2	1	1		6
		SK		1				1
	Eastern Europe Total		3	3	2	10	16	34
	Northern Europe	DK		1	3	6		10
		FI	3	1			2	6
		GB	14	24	42	83	74	237
		IE			3	6		9
		NO			1	1	6	8
		SE	3	1	1	1	7	13
	Northern Europe Total		20	27	50	97	89	283
	Southern Europe	AL					4	4
		CS			1			1
		ES		2	2	16	16	36
		GR	1	1		5		7
		IT	4	20	2	14	46	86
		PT		5	6	3	3	17
	Southern Europe Total		5	28	11	38	69	151
	Western Europe	AT		3		3	2	8
		BE		1	1	1		3
		CH	1	9	3	18	5	36
		DE	8	16	7	53	67	151
		FR	10	32	3	62	46	153
		LU					1	1
		NL	2	1	4		1	8
	Western Europe Total		21	62	18	137	122	360
Europe Total (Visits)			**49**	**120**	**81**	**282**	**296**	**828**
Asia	Eastern Asia	CN	3	5	2	3	3	16
		HK		1				1
		JP	14	28	23	41	30	136
		KR	4	2	3	27	14	50
		TW		7	13	2	1	23
	Eastern Asia Total		21	43	41	73	48	226
	South-central Asia	IN		7	2	5	8	22
		IR					2	2
		UZ	1					1
	South-central Asia Total		1	7	2	5	10	25
	South-eastern Asia	PH					3	3
		SG	1	1	1	2		5
	South-eastern Asia Total		1	1	1	2	3	8
	Western Asia	IL	11	2	2	11	14	40
		SA				3		3
		TR				4	7	11
	Western Asia Total		11	2	2	18	21	54
Asia Total (Visits)			**34**	**53**	**46**	**98**	**82**	**313**
Africa	Eastern Africa	UG					1	1
	Eastern Africa Total						1	1
	Southern Africa	ZA					4	4
	Southern Africa Total						4	4
	Western Africa	NG					1	1
	Western Africa Total						1	1
Africa Total (Visits)							**6**	**6**
Oceania	Australia and New Zeala	AU	4	21	1	14	1	41
		NZ	2	2		1		5
	Australia and New Zealand Total		6	23	1	15	1	46
Oceania Total (Visits)			**6**	**23**	**1**	**15**	**1**	**46**
N/A	N/A	N/A	1174	181	372	22	84	1833
	N/A Total		1174	181	372	22	84	1833
N/A Total (Visits)			**1174**	**181**	**372**	**22**	**84**	**1833**
Grand Total (Visits)			**1817**	**1496**	**1493**	**1888**	**1913**	**8607**

US Home Institutions Classified by States (Visits)

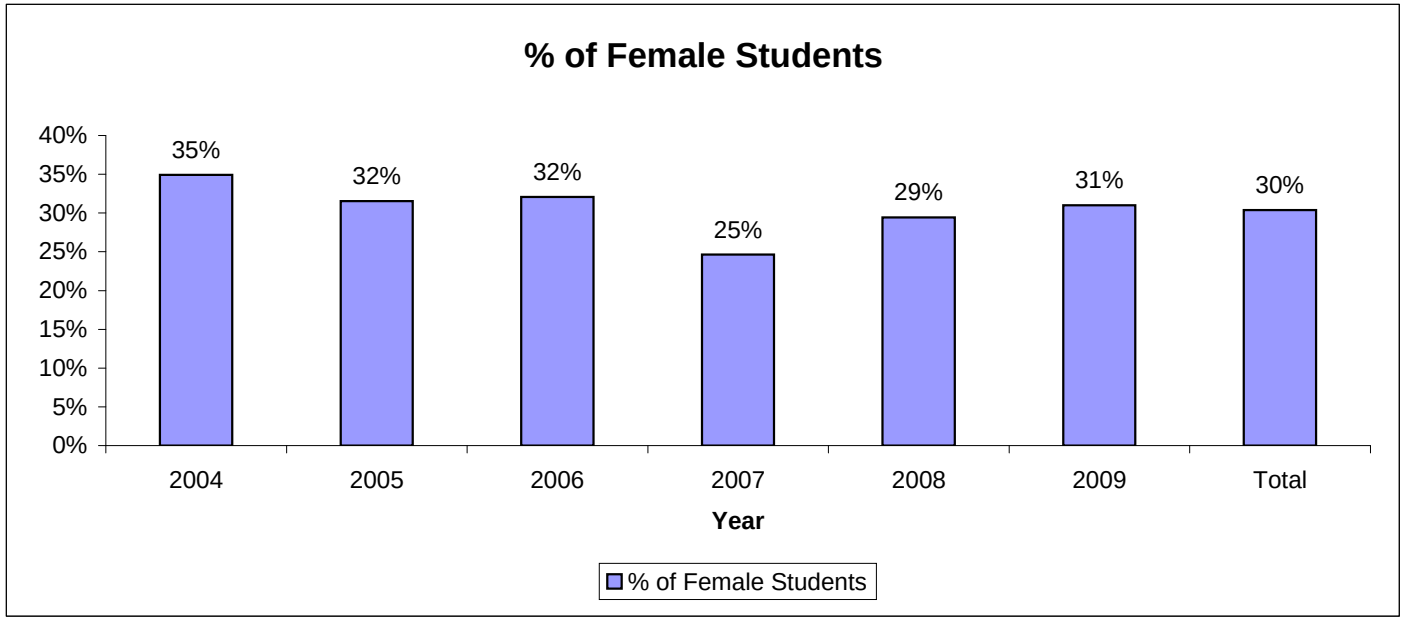
****Regions based on US Census classification***

State	#	%	US Pop. (2007 Census)
South	**888**	**16.8%**	**36.6%**
AL	-	0.0%	1.5%
AR	-	0.0%	0.9%
DE	3	0.1%	0.3%
DC	20	0.4%	0.2%
FL	87	1.6%	6.1%
GA	137	2.6%	3.2%
KY	16	0.3%	1.4%
LA	68	1.3%	1.4%
MD	83	1.6%	1.9%
MS	14	0.3%	1.0%
NC	117	2.2%	3.0%
OK	29	0.5%	1.2%
SC	11	0.2%	1.5%
TN	31	0.6%	2.0%
TX	187	3.5%	7.9%
VA	82	1.6%	2.6%
WV	3	0.1%	0.6%
West	**2,210**	**41.8%**	**23.2%**
AK	-	0.0%	0.2%
AZ	68	1.3%	2.1%
CA	1,761	33.3%	0.4%
CO	63	1.2%	0.5%
HI	11	0.2%	0.3%
ID	6	0.1%	12.1%
MT	2	0.0%	1.6%
NV	8	0.2%	0.9%
NM	25	0.5%	0.7%
OR	54	1.0%	1.2%
UT	103	1.9%	0.9%
WA	108	2.0%	2.1%
WY	1	0.0%	0.2%
Midwest	**1,046**	**19.8%**	**22.0%**
IL	325	6.1%	4.3%
IN	81	1.5%	2.1%
IA	47	0.9%	1.0%
KS	37	0.7%	0.9%
MI	219	4.1%	3.3%
MN	62	1.2%	1.7%
MO	45	0.9%	1.9%
ND	5	0.1%	0.2%
NE	35	0.7%	0.6%
OH	86	1.6%	3.8%
SD	-	0.0%	0.3%
WI	104	2.0%	1.9%
Northeast	**1,141**	**21.6%**	**18.1%**
CT	53	1.0%	1.2%
ME	9	0.2%	0.4%
MA	331	6.3%	2.1%
NH	14	0.3%	0.4%
NJ	182	3.4%	2.9%
NY	367	6.9%	6.4%
PA	107	2.0%	4.1%
RI	72	1.4%	0.4%
VT	6	0.1%	0.2%
Other	**-**	**0.0%**	**0%**
PR	-	0.0%	0%
Other	-	0.0%	0%
Total (Visits)	**5,285**	**100.0%**	**100.0%**



MSRI Summer Graduate Workshops
2004 - 2009
Female Participants Summary

Students			
	Female	Total	%
2004	22	63	35%
2005	81	257	32%
2006	43	134	32%
2007	33	134	25%
2008	48	163	29%
2009	49	158	31%
Total	**276**	**909**	**30%**



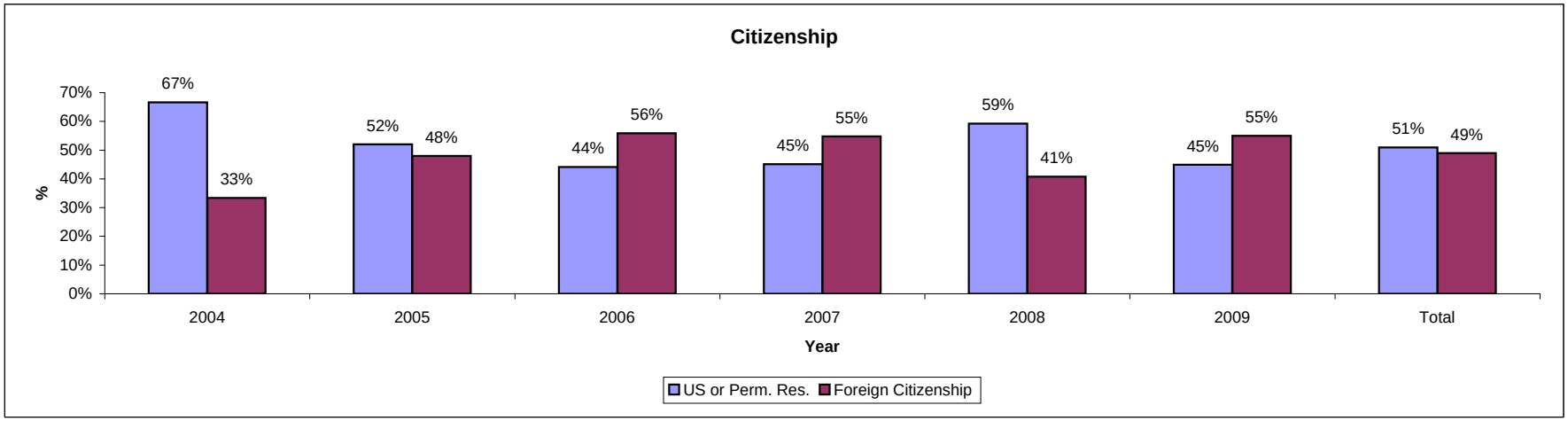
MSRI Summer Graduate Workshops
2004 - 2009
Ethnicity

All Participants	2004		2005		2006		2007		2008		2009		Total	
Native American	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Asian	4	9%	34	41%	21	33%	3	18%	27	31%	45	32%	134	31%
Black	3	7%	3	4%	2	3%	1	6%	5	6%	2	1%	16	4%
Hispanic	3	7%		0%	1	2%	0	0%	5	6%	7	5%	16	4%
Pacific		0%	1	1%		0%		0%	1	1%	0	0%	2	0%
White	34	77%	44	54%	39	62%	13	76%	48	56%	88	62%	266	61%
Decline	8		12		6		4		5		7		42	
Unavailable information	11		163		65		113		67		14		433	
Grand Total	**63**		**257**		**134**		**134**		**158**		**163**		**909**	

	2004		2005		2006		2007		2008		2009		Total	
Minorities Among US Citizens	5	12%	4	5%	3	21%	1	7%	7	16%	2	4%	22	8%

MSRI Summer Graduate Workshops
2004 - 2009
Citizenship

	2004	%	2005	%	2006	%	2007	%	2008	%	2009	%	Total	%
USA	42		78		49		14		45		66		294	
US Permanent Resident	0		11		0		0		3		1		15	
US or Perm. Res.	42	67%	89	52%	49	44%	14	45%	48	59%	67	45%	309	51%
Foreign Citizenship	21	33%	82	48%	62	56%	17	55%	33	41%	82	55%	297	49%
Unavailable information	0		86		23		103		77		14		303	
Total	63		257		134		134		158		163		909	



MSRI Summer Graduate Workshops
2004 - 2009
Participants' Home Institution Group Demographics

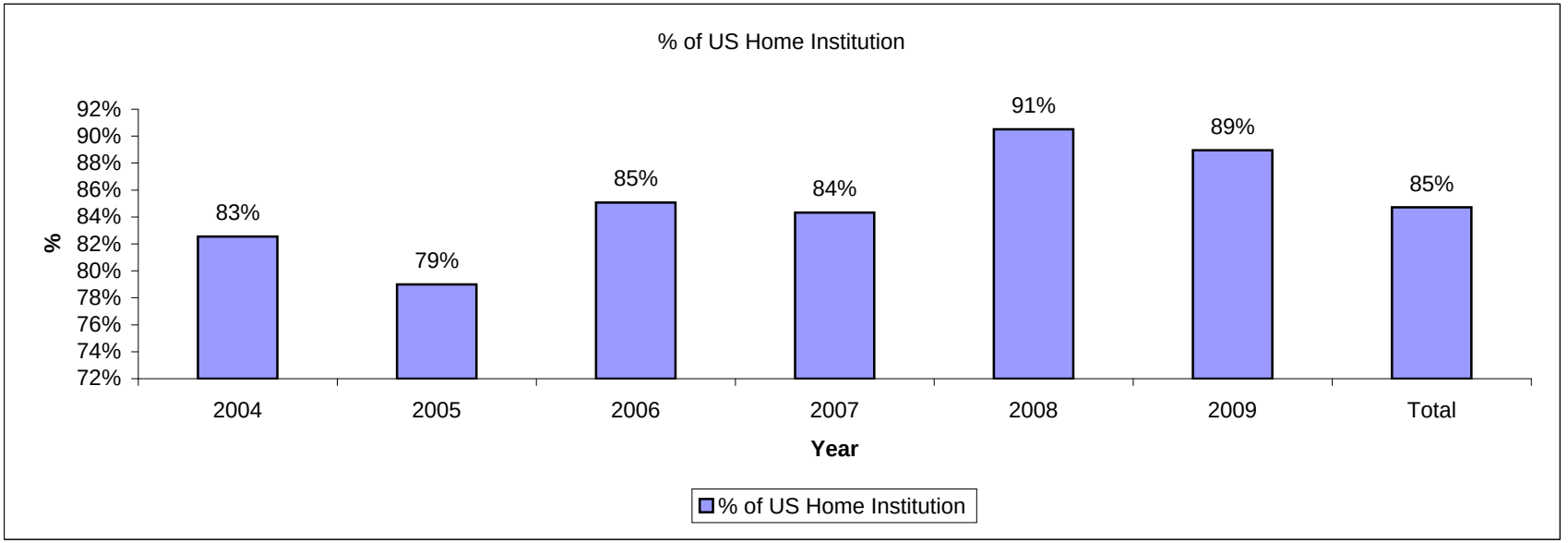
	2004	2005	2006	2007	2008	2009	Grand Total	%	Academic Sponsor	%
Foreign	11	54	20	21	15	18	139	15%	63	45%
Group I Private	11	53	23	36	35	29	187	21%	175	94%
Group I Public	23	77	46	36	48	44	274	30%	267	97%
Group II	13	44	30	27	31	43	188	21%	164	87%
Group III	2	17	6	11	17	24	77	8%	57	74%
Group IV		1	1	2	1	2	7	1%	1	14%
Group M	2	6	3	1	3	3	18	2%	8	44%
US Non-Group	1	5	5		8		19	2%	3	16%
Grand Total	**63**	**257**	**134**	**134**	**158**	**163**	**909**	**100%**	**738**	**81%**

Number of Summer Graduate Workshops

Year	# of SGW	# of participants
2004	3	63
2005	6	257
2006	5	134
2007	5	134
2008	4	158
2009	6	163
Total	**29**	**909**

MSRI Summer Graduate Workshops
2004 - 2009
Particpants' Home Institutions

	2004	2005	2006	2007	2008	2009	Total
US Home Institution	52	203	114	113	143	145	770
Foreign Home Institution	11	54	20	21	15	18	139
Total Students	63	257	134	134	158	163	909
% of US Home Institution	**83%**	**79%**	**85%**	**84%**	**91%**	**89%**	**85%**



Papers worked on by Members 2004-09

	Appeared/Accepted	Submitted	Distributable	Notes	Rough Drafts	Total
2004-05	3	17	13	17	13	63
2005-06	13	70	65	122	105	375
2006-07	10	52	53	90	101	306
2007-08	30	99	85	185	214	613
2008-09	21	110	96	260	158	645
Total	**77**	**348**	**312**	**674**	**591**	**2002**

For a complete list of publications 2004-09, please click below
https://secure.msri.org/9-09nsfsitevisit/files/binder/For Copy Central/II. Participant Data/F. List of Publications 2004-09.pdf