MSRI
Mathematical Sciences Research Institute

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Annual Report on the Mathematical Sciences Research Institute 2018–2019 activities supported by NSF Grant DMS-1440140 June 1, 2018 to May 31, 2019

July 2019

Mathematical Sciences Research Institute
Annual Report, 2018-19

1. Overview of Activities

This annual report covers MSRI's projects and activities supported by the NSF core grant, DMS-1440140, during the period of June 1st, 2018 to May 31st, 2019.

1.1 New Developments

The year 2018–19 was lively and productive one. In Fall 2019, we held one jumbo program: Hamiltonian Systems, from topology to applications through analysis, with lead organizer Albert Fathi (Georgia Institute of Technology). In Spring 2019, we held two regular sized programs: Birational Geometry and Moduli Spaces, with lead organizer Christopher Hacon (University of Utah) and Derived Algebraic Geometry, with lead organizer Bhargav Bhatt (University of Michigan). All four programs were very popular, and their workshops well attended. All programs had stellar researchers with three of them Clay Senior Scholars: Albert Fathi, Dennis Gaitsgory, and Claire Voisin.

In his recommendation letter, Professor Alessio Figalli describes Professor Fathi as "a top leader in dynamical systems and Hamilton Jacobi equations." Figalli points out that "The work of Fathi in these areas is worldwide recognized: he has given fundamental contributions to the development of weak KAM and Aubry-Mather theory, and he has obtained several crucial results concerning the regularity of critical subsolutions to the Hamilton-Jacob equation." Professor Lawrence Evans writes, "No one is better than Albert at extracting subtle dynamical information from variational formulations and from the Lax-Oleinik formulas for solutions to Hamilton-Jacobi equations." Evans also pointed out that Fathi "is a very clear lecturer, and has an absolutely wonderful, and wonderfully calm, personality." Fathi received the Sophie Germain Prize in 2013 and was recently promoted Chevalier des Palmes Académiques, in recognition for his eminent contribution to French education. In 2014, Fathi was an Invited Speaker, in the Dynamical Systems Session, at the International Congress of Mathematics in Seoul.

Professor Gaitsgory was a Junior Fellow of the Harvard Society of Fellows and a Prize Fellow of the Clay Mathematics Institute. He is the recipient of the 2000 Prize of the European Mathematical Society, and has been a professor at Harvard University since 2005. As the organizers noted in their nomination statement, "His contribution to Derived Algebraic Geometry (DAG) have fundamentally shaped the subject: besides various internal developments in DAG, the deep link between DAG and geometric Langlands program is due to him and his collaborators". The organizers stated that Gaitsgory will be a great influence on younger mathematicians. According to Vladimir Drinfeld, "Most of Dennis Gaitsgory's works are devoted to the geometric Langlands program. He is *the* leader in this field". Professor Kazhdan also writes, "Dennis is clearly the leader in this area". In Drinfeld's letter of recommendation, he states, "it was Gaitsgory who created the area as a "science" rather than a collection of ideas, attempts, and insights."

In 2016, Claire Voisin became the first female mathematician to be admitted to the Collège de France where she is holding the Chair of Algebraic Geometry. She is the recipient of the EMS Prize (1992), Sophie Germain Prize (2003), Satter Prize (2007), Clay Research Award (2008), Hein Hopf Prize (2015), CNRS Gold Medal (2018), and Shaw Prize (2017). She is a member of the Academia Europaea (2014) and is a foreign associate of the US National Academy of Sciences (2016). As the organizers of the program wrote in their nomination statement,

"Professor Claire Voisin is one of the leading figures worldwide in algebraic geometry. Her contributions are outstanding and cover a wide variety of fundamental areas in algebraic geometry including Hodge theory, rationality questions, syzygies, algebraic cycles, mirror symmetry and so on". Professor Totaro also writes, "Voisin is unquestionably the leading figure today in Hodge theory and algebraic cycles, which are central and difficult areas of algebraic geometry". According to Professor Enrico Arbarello, some of Voisin's more influential works are "her paper with Demailly on algebraic hyperbolicity, her solution of Green's conjecture, her work in symplectic geometry, her study of Chow groups of hyperkähler manifolds, her ideas on the decomposition of the diagonal". Profesor Arbarello concludes, "she has also inspired a new generation of women mathematicians, participating in activities designed to encourage this under-represented group."

Other luminaries, aside from the organizers listed in the program reports, were Valery Alexeev (University of Georgia), Dmytro Arinkin (University of Wisconsin), Bhargav Bhatt (University of Michigan), Lucia Caporaso (Roma Tre University), Gonzalo Contreras (Centro de Investigación en Matemáticas), Hélène Esnault (Freie Universität Berlin), Laurent Fargues (CNRS / Institut de Mathématiques de Jussieu), Wilfrid Gangbo (University of California, Los Angeles), Christopher Hacon (University of Utah), Lars Hesselholt (Nagoya University and University of Copenhagen), Jeffrey Lagarias (University of Michigan), James McKernan (University of California, San Diego), James Meiss (University of Colorado Boulder), Richard Montgomery (University of California, Santa Cruz), David Morrison (University of California, Santa Barbara), Vered Rom-Kedar (The Weizmann Institute), Antonio Siconolfi (Sapienza – Università di Roma), Chenyang Xu (MIT), Zensho Yoshida (University of Tokyo)

In all, MSRI awarded twenty (20) researchers the distinguished Chern, Eisenbud and Simons Professorships.

The organizers report striking results (see the Appendix for more details). Here is a small sample that gives a glimpse into the effervescent research activities that took place throughout the year.

Fall 2018, Hamiltonian Systems, from Topology to Applications through Analysis. A notable feature of the program was the abundance of collaborations, old and new, for scientists across the different fields studied in the program, from graduate students, postdocs and early career mathematicians to senior members. The common areas of MRSI were continuously occupied by small groups of $2-4$ researchers talking and discussing at the blackboards around the facility, as well as conversations in various offices. Among the results achieved were the following.

Chandre and Xu gave a proof of the existence of a family of invariant tori for the motion of a charged particle subjected to a strong circularly polarized laser field by exploiting the similarity of its Hamiltonian with the one of a dust particle revolving around a planet in a planar circular orbit around a star, subjected to radiation pressure.

Cristofaro-Gardiner and Mazzucchelli proved that a closed contact 3-manifold having a common period for its periodic Reeb orbits is Besse (i.e. all its Reeb orbits are periodic); the opposite implication was a classical theorem of Wadsley, and the two results thus combine to provide a spectral characterization of Besse contact 3-manifolds.

Montgomery investigated certain global properties of solutions to the spatial 4 body problem with zero total angular momentum and showed that if such a solution is bounded then it becomes coplanar over and over. This work was inspired by a brief conversation with R. Littlejohn early in the semester.

Lagarias and Montgomery put forward a surprising rotationally symmetric metric on the unit disc and computed its length and Laplacian spectrum and establish surprising connections between these sequences of positive numbers and the Riemann zeta function.

Spring 2019, Birational Geometry and Moduli Spaces. Exciting progress was made on the geometry of varieties in mixed characteristic, building on one hand on the recent breakthroughs in positive characteristic, and on the other hand, on the use of perfectoid techniques. In particular, there has been progress on the existence of flips for arithmetic 3-folds (by B. Bhatt, Zs. Patakfalvi and J. Waldron), and on the definition and properties of adjoint ideals in mixed characteristic (by L.Ma, Zs. Patakfalvi, K. Schwede, K. Tucker, and J. Witaszek).

There has been a lot of progress related to the study of K-stability of Fano varieties, with several collaborations involving MSRI members (J. Alper, Y. Liu, Zichuan C. Xu, and Z. Zhuang) as well as some short-term visitors (H. Blum and D. Halpern- Leistner). An important breakthrough was Xu's result saying that valuations minimizing the normalized volume are Abhyankar valuations. This was then applied in the global setting in joint work of Blum, Liu, and Xu to prove the openness of K-semistability in families; together with a previous result of Blum and Xu this allows the construction of an algebraic space parametrizing K-semistable Fano varieties.

As J. Kollár's moduli program had brought to conclusion several decade old open problems and thus opened up the possibility for the moduli theory of KSB-stable varieties to enter a new phase just before the program began, we have seen a group of young people starting and continuing research and collaboration in various groups at MSRI. This has already produced results on applying the general results in more concrete cases which had been missing from the theory (mainly due to the lack of the general results before): K. Ascher, K. DeVleming, and Y. Liu have collaborated on at least two sets of results about moduli spaces of plane curves and they plan to work together more as well as K. DeVleming and D. Stapleton obtained results on birationally simple fibrations. In addition to those mentioned already, D. Bejleri and G. Inchiostro also worked on this circle of ideas at MSRI and continue collaboration with the others in various groups.

Several participants worked on problems inspired by string theory and on application to string theory of birational geometry (Di Cerbo, Grassi, Morrison, Kovács). A member suggested in the exit survey that birational geometry and string theory should be a topic for a future program.

Spring 2019, Derived Algebraic Geometry. One of the highlights of the special semester was the opportunity it provided for discussions between mathematicians from the Birational Geometry and Moduli Spaces community and the Derived Algebraic Geometry community. An example of this is the work understanding chromatic Picard groups algebraically (I. Bobkova, T. Barthel, P. VanKoughnett, C. Westerland). These authors have improved our understanding of chromatic homotopy theory considerably by proving that $\mathrm{Pic}_n \to H^1(G_n, E_0^\times)$ splits when $p > 2$. Remarkably, this work was conceived in a conversation following a comment made by Bobkova in her DAG seminar talk at MSRI.

Another example was provided by the project on topological cyclic homology and arithmetic by Antieau-Mathew-Morrow-Nikolaus and its applications to Niziol's work. These authors have reinterpreted (and significantly sharpened) in terms of topological cyclic a fibre sequence first discovered Beilinson relating the cyclic homology of a ring R with that of R/p. They have been able to use this result to reproduce difficult calculations in arithmetic geometry, such as Niziol's calculation of the pro-étale cohomology of affine space.

The program also offered the opportunity for Brantner and Mathew to complete their massive project on developing an analog in characteristic p of the Deligne-Drinfeld philoshopy that deformation problems are governed by differential graded Lie algebras in characteristic 0. The answer, roughly, is to work with partition Lie algebras instead. In addition, Bhatt and Scholze have proven that p-adic K-theory is locally concentrated in even degrees when one works with the syntomic site of p-adically complete rings; this is analogous to the fact that the topological K-theory of a (nice) topological space is locally concentrated in even degrees (thanks to Bott periodicity and the Atiyah-Hirzeburch spectral sequence). This resolves a previous conjecture of the authors (jointly with M. Morrow).

This year, MSRI hosted two ***Hot Topics workshops***. The first, which took place during the Fall semester, was *Shape and Structure of Materials*, organized by Myfanwy Evans and Frank Lutz (both of TU Berlin), Dmitriy Morozov (Lawrence Berkeley National Laboratory), James Sethian (University of California, Berkeley), and Ileana Streinu (Smith College). The workshop was aimed at intensifying the interaction of mathematicians with material scientists, physicists and chemists on the structural description and design of materials. There were 55 registered participants and 19 talks.

The second Hot Topics workshop, which took place in the Spring semester, was *Recent Progress in Langlands Program,* organized by Mark Kisin (Harvard University), and Elena Mantovan and Xinwen Zhu (both of the California Institute of Technology). The purpose of the workshop was to explain Vincent Lafforgue's ground breaking work, constructing the automorphic to Galois direction of the Langlands correspondence for function fields. There were 89 registered participants and 19 talks, some consisting of several-part overviews.

The talks of all of our workshops were recorded and can be seen on our website at http://www.msri.org/web/msri/online-videos.

Funding. In 2018-19, of the support for program members (long-term visitors, excluding Postdocs), 63% came from the NSF and 37% from private funds. Of the support for workshop participants (short-term visitors, including summer graduate schools) 65% came from NSF, 5% from NSA, and 30% from private funds. These numbers demonstrate MSRI's ability to leverage the support that the NSF provides and thereby amplify its benefits; we feel that this is possible because the core NSF support provides such a strong foundation for, and endorsement of, MSRI's scientific quality.

Postdoctoral Program. Thirty-one (31) Postdoctoral Fellows participated in our three scientific programs and in the complementary program. Of those, twenty (20) were funded by this NSF grant.

Piotr Achinger was the Berlekamp Postdoctoral Fellow; Kristin DeVleming the Gamelin Fellow; Rosa Vargas the Huneke Fellow; Joseph Waldron the McDuff Fellow; Gabriel de Oliveeira Martins the Strauch Fellow; Thomas McConville the Uhlenbeck Fellow; Tina Kanstrupthe and Joseph Burby the Viterbi Fellows; and Lukas Brantner and Yuchen Liu the Della Pietra Fellows. For details, please see Section 3.

Collaborative Diversity Initiative. The Diversity Initiative consists of a series of workshops for members of groups that have been historically underrepresented in the mathematical sciences. These workshops are sponsored by a collaborative grant involving the eight NSF-funded US mathematical sciences institutes (AIM, IAS, ICERM, IMA, IPAM, MBI, MSRI, NIMBioS, and SAMSI). MSRI is the institute administering the grant. During the 2018–19 year, three events were supported by the Initiative. The Modern Math Workshop was held in October 2018 in San Antonio, Texas. It was organized by SAMSI and attracted 122 participants. The Blackwell-Tapia Conference was held in November 2018 in Providence, Rhode Island. Organized by ICERM, it attracted 118 participants. The Spring Opportunities Conference was held in April 2019 in San Jose, California. It was organized by AIM and attracted 45 participants.

Complete reports can be found in the SAMSI (for the MMW), IPAM (Blackwell-Tapia) and AIM (Spring Opportunities) annual (2018-19) reports.

Critical Issues in Mathematics Education. The Critical Issues in Mathematics Education (CIME) series of workshops addresses key problems in education today. They are designed to engage professional mathematicians in discussions with education researchers, teachers, and policy makers to improve mathematics education. This year's topic was on *Mathematical Modeling in K-16: Community and Cultural Contexts*. There were about 257 attendees, all very engaged in the discussions. It was funded through grants from Math for America and from the NSF Research on Learning and thus reported to them directly.

Public Understanding of Mathematics.

National Math Festival. The 2019 National Math Festival (NMF) took place on Saturday, May 4, 2019 at the Walter E. Washington Convention Center in Washington, DC. The NMF is a biennial celebration bringing more than 10,000 children and adults of all ages to the nation's capital and science museums around the country to celebrate the beauty, power, and fun of mathematics. Combining an array of compelling lectures and performances, which showcase the playful aspects of math and its many applications, with high-impact activities such as demos, mathletic events, dance, art-making, puzzles, and games, this free and open to the public event enlivens Washington D.C. every other spring and draws an enthusiastic and diverse audience. To make the Festival more accessible to students from traditionally underserved backgrounds, we established a School Preview Day at the 2019 NMF, with a focus on serving students at D.C. public schools.

The NMF aims to shape the public's view of mathematics by developing curiosity among its attendees through inquiry-based learning methods and illustrating the relevance of mathematics by focusing on practical implications, hands-on activities, and captivating demonstrations. The NMF provides resources and tools to leverage and sustain this curiosity after the Festival is over, including creating direct links between the NMF audience and permanent institutions around the country who can "pick up the baton" and further develop public interest in mathematics.

Some examples of activities from the 2019 NMF include a talk by Dr. Emily Riehl on the mathematics of voting, a performance of mathematical magic tricks by magician Mark Mitton, and a Make or Take Spiral offering free take-home resources and activities for math educators, parents, and kids. Additionally, collaborating with the Association of Science and Technology Center (ASTC) and Zometool, MSRI supported echo events with mathematical soap-bubbles at more than 80 museums in 41 states, involving an estimated 26,000 participants.

In the months leading up to the Festival, a series of online events were held including Q&As with mathematicians such as Dr. Robbert Dijkgraaf of the Institute for Advanced Study, Dr. Mary Lou Zeeman of Bowdoin College, and even retired NFL player John Urschel who is now pursuing a Ph.D. in mathematics at MIT. More information on past National Math Festivals and its associated activities can be found at www.nationalmathfestival.org.

MSRI maintains an archive of recorded presentation and other videos featuring many of the mathematicians who have participated in all of the Festivals. These videos are intended for a general audience and cover a wide variety of topics, from the mathematics behind scientific and natural phenomena to art, music, literature, and more.

The National Math Festival has been organized in 2015, 2017 and 2019, in Washington DC by MSRI, with collaboration from the Institute for Advanced Study and from MoMath, the National Museum of Mathematics. This year the National Science Foundation has renewed and increased its support for this major event, and participated in the 2019 program as well.

Mathical: Books for Kids from Tots to Teens. MSRI, in coordination with the Children's Book Council (CBC) and in partnership with the National Council of Teachers of Mathematics (NCTM) and the National Council of Teachers of English (NCTE), continued the Mathical Book Prize, which cultivates a love of mathematics in the everyday world.

The prize, which highlights math-inspiring fiction and nonfiction for youth ages PreK through high school, began to catch the public eye in 2018 with noteworthy recognition by MSRI's regional NPR affiliate, as well as a variety of earned news stories and social media mentions.

MSRI continues to partner with the nonprofit First Book to distribute Mathical titles and accompanying educational resources to schools and programs serving children in low-income communities. A national committee of mathematicians, librarians, educators, and early childhood experts selects each year's winners. The prize is supported by the Firedoll Foundation.

The 2019 Mathical Prize winners (published in 2018) are: Ages 2-4, *Crash Boom! A Math Tale* by Robie H. Harris, is a picture book that brings to life counting in an unexpected way; Ages 5-7, *Nothing Stopped Sophie* by Cheryl Bardoe, is the story of the groundbreaking self-taught mathematician and physics pioneer Sophie Germain, whose work on the concept of vibration patterns made her the first woman to win a grand prize from France's distinguished Royal Academy of Sciences; Ages 8-10, *The Miscalculations of a Lightening Girl* by Stacy McAnulty is about a home-schooled math whiz with obsessive compulsive disorder trying to get by in middle school; Ages 11-13, *To the Moon!* by Jeffrey Kluger and Ruby Shamir, is the exciting and inspiring true story of Apollo 8, the first crewed spaceship to break free of the Earth's orbit and reach the moon. Several honor books were also selected by the committee.

Films for Public Television. People who do and use mathematics often have fascinating stories and adventures to tell related to their work; and partly because their work itself is often hard for non-mathematicians to comprehend, these stories can have a special interest. As part of MSRI's commitment to telling the story of mathematics, we have produced a number of films about mathematicians; many have been directed by George Csicsery of Zala Films, whose first film about a mathematician, N is a Number, has become a classic. We think that each has something interesting for mathematicians and non-mathematicians alike.

All films are available on DVD or for online streaming (rental or purchase). Many have aired on public television networks in the United States, and at film festivals throughout the world. This year MSRI and George Csicsery have started production of a one-hour documentary film ***Secrets of the Surface: The Mathematical Vision of Maryam Mirzakhani*** about a remarkable mathematician, a brilliant woman and Muslim immigrant to the United States who became a superstar in her field whose contributions were recognized with a Fields Medal just a few years before her untimely death. The story of her life will be complemented with sections about Mirzakhani's mathematical contributions, as explained by colleagues and illustrated with animated sequences. Throughout, we will look for clues about the sources of Mirzakhani's insights and creativity. Release of the film is anticipated for early 2020. Learn more: http://www.zalafilms.com/secrets/

*Numberphile (*www.youtube.com/numberphile). Since January 2014, MSRI has supported Brady Haran's "Numberphile" channel on YouTube. MSRI has contributed both financial and intellectual support, with connections to some of the world's great mathematicians, and the number of subscribers has climbed from about 750,000 to nearly 3 million. For a sample of recent additions, we recommend an animal-filled puzzle about vertex covers and Alcuin numbers for graphs with MSRI Postdoctoral Fellow Annie Raymond; lessons about ideal auctions from Preston McAfee, formerly Chief Economist at Microsoft; and a playful exploration of h-vectors and the g-Conjecture with June Huh of the Institute for Advanced Study.

This year Numberphile has uploaded 50 videos, taking the total number to over 500. It has accumulated a further 71 million videos views, taking the total to 417 million. In addition, a further 18 supplemental videos and 10 podcasts were uploaded to the "extras channel" called Numberphile2. It is an unprecedented way to share mathematics with millions of people from all generations.

The CME Group-MSRI Prize in Innovative Quantitative Applications (http://www.msri.org/web/msri/activities/cme-prize) recognizes originality and innovation in the use of mathematical, statistical or computational methods for the study of the behavior of markets, and more broadly of economics.

The 13th annual Prize was awarded to Albert S. (Pete) Kyle, Charles E. Smith Chair in Finance, Robert H. Smith School of Business, University of Maryland on April 8, 2019 in Chicago for his work in market microstructure. Kyle is best known for his work in this area including topics such as high frequency trading, informed speculative trading, market manipulation, price volatility, the informational content of market prices, market liquidity and contagion. Professor Kyle is a Fellow of the American Finance Association in (2013) and a Fellow of the Econometric Society (2002). He has been a board member of the American Finance Association (2004-2006). He holds an honorary doctoral degree from the Stockholm School of Economics (2013). He was a staff member of the Presidential Task Force on Market Mechanisms (Brady Commission, 1987),

a consultant to the SEC (Office of Inspector General), CFTC, and U.S. Department of Justice, a member of NASDAQ's economic advisory board (2004-2007), a member of the FINRA economic advisory board (2010-2014) and a member of the CFTC's Technology Advisory Committee (2010-2012).

Congressional Briefings: Since December, 2017, MSRI, in cooperation with the American Mathematical Society, has run several Congressional Briefings in Washington highlighting the value to the U.S. of Federal funding for basic research. This year, the speakers and topics were

- May 22, 2018: "*Origami Meets Math, Science, and Engineering*." **Erik Demaine**, Professor of Computer Science, Massachusetts Institute of Technology
- December 4, 2018: "*From the Color of Birds to Nanomaterials and New Technology*." **Rodolfo H. Torres**, University Distinguished Professor of Mathematics, University of Kansas
- June 13, 2019: "*Addressing Threats and Vulnerabilities in Critical Interconnected Systems: Common Principles in Disease Outbreaks, Internet Malware, and Bank Failures*." **Jon Kleinberg**, Tisch University Professor in the Departments of Computer Science and Information Science, Cornell University.

These are sample of activities that MSRI organizes each year in its effort to reach out to the general population and share with them what mathematics is all about.

1.2 Summary of Demographic Data for 2018-19 Activities

During the academic year 2018–19, MSRI hosted 260 program members (31 of whom were Postdoctoral Fellows) and 1350 workshop participants.

The Postdoctoral program was particularly successful and is described in detail in Section 3. Of the Fellows, 26% were female, 36% were U.S. Citizens or Permanent Residents, and 58% listed a U.S. university as their home institution. Of those institutions, 56% are located in the Northeast, 22% in the West, 11% in the Midwest, and the remaining 11% in the South.

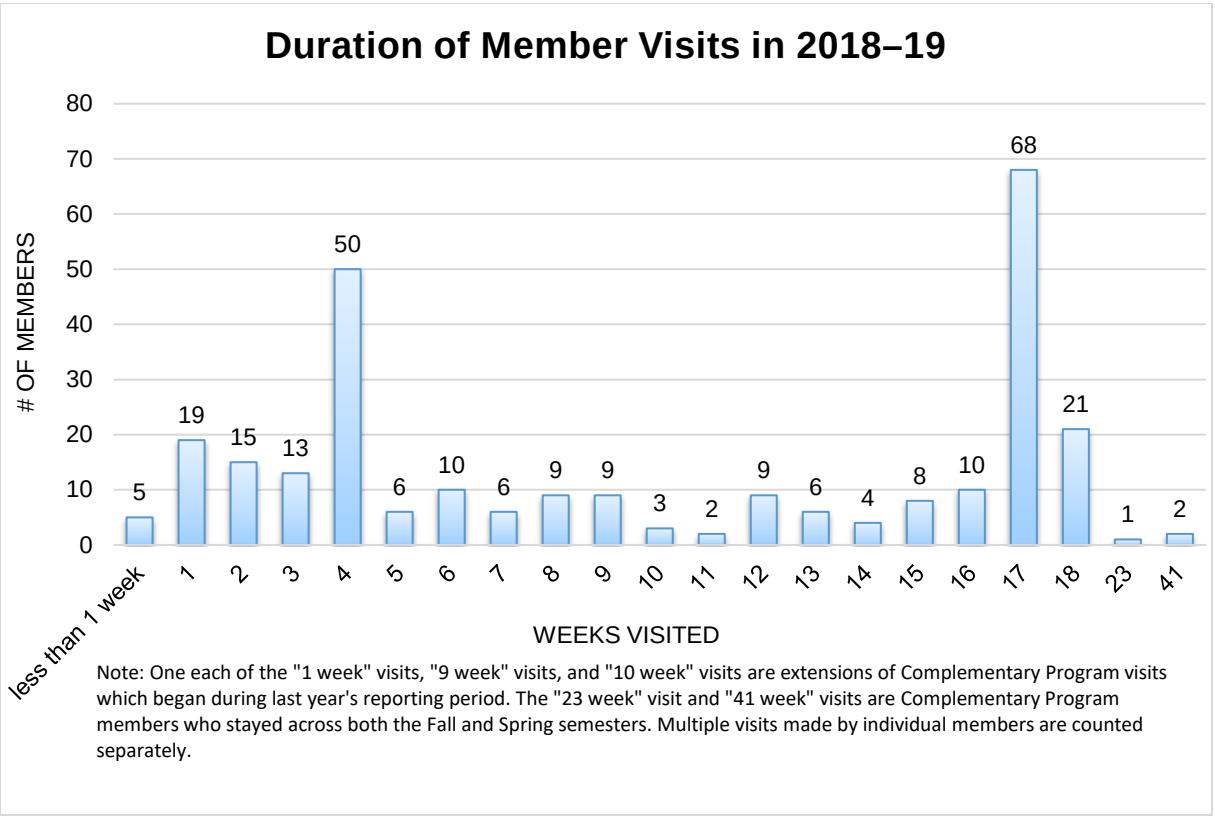
MSRI had a total of 260 long-term members. Members spent an average of 73 days (2.4 months) at MSRI per visit, with peak attendance in October for the fall semester and March for the spring semester. Of the members, 23% were female, 44% reported being U.S. Citizens or Permanent Residents and 48% listed a U.S. university as their home institution. Of those institutions, 30% are located in the West, 28% in the Northeast, 25% in the Midwest, and 17% in the South. Of the members, 53% received their Ph.D. during the year 2000 or later, 27% received one between 1981 and 1999, 7% received their Ph.D. in 1980 or earlier, and the remaining 14% were graduate students. Detailed demographic data can be found in Section 2.

In the 2018–19 workshops, MSRI hosted 1350 visitors (some individuals attended multiple events and are counted more than once). Of the workshop participants, 30% were female, 51% were U.S. Citizens or Permanent Residents, of which 10% reported being a member of an under-represented minority. In addition, 65% of the 1350 participants came from a U.S. institution. Demographic data on workshop participants can be found in Sections 2 and 4.

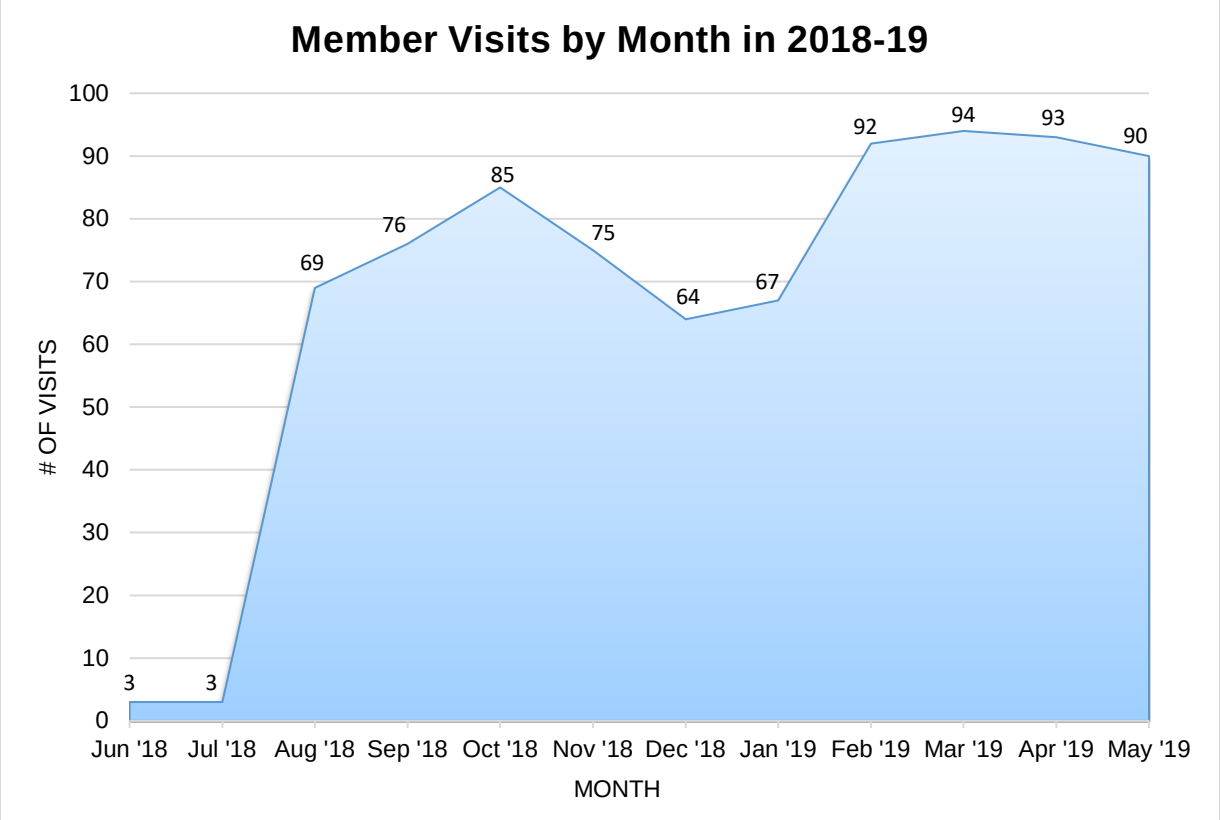
Member Visits Summary*

All program members	Summer 2018	Fall 2018	Spring 2019	2018-19	2004–19
Total Member Days	153	8,813	11,156	20,122	251,937
Total # of Member Visits	4	112	160	276	3,465
Average # of Days per Member Visit	38.25	78.69	69.73	72.91	72.71
Average # of Months per Member Visit	1.28	2.62	2.32	2.43	2.42
All female program members	**Summer 2018**	**Fall 2018**	**Spring 2019**	**2018-19**	**2009–19**
Total Member Days	0	1,512	2,751	4,263	40,543
Total # of Member Visits	0	22	39	61	546
Average # of Days per Member Visit	0.00	68.73	70.54	69.89	74.25
Average # of Months per Member Visit	0.00	2.29	2.35	2.33	2.48

**Please note that this table calculates member's visits, which can be multiple.*



Note: One each of the "1 week" visits, "9 week" visits, and "10 week" visits are extensions of Complementary Program visits which began during last year's reporting period. The "23 week" visit and "41 week" visits are Complementary Program members who stayed across both the Fall and Spring semesters. Multiple visits made by individual members are counted separately.



1.3 Scientific Programs and their Associated Workshops

There were three major and one complementary program that took place at MSRI during the 2018–19 year, as well as 8 programmatic workshops.

Note: Full descriptions of each activity can be found in the Appendix (Section 12) of this Annual Report. In the lists of organizers of each activity below, the name of the lead organizer(s) appears in blue.

Program 1: Hamiltonian Systems, From Topology to Applications Through Analysis
August 13, 2018 - December 14, 2018
*Organizers: Rafael de la Llave (Georgia Institute of Technology), **Albert Fathi** (Georgia Institute of Technology; École Normale Supérieure de Lyon), vadim kaloshin (University of Maryland), Robert Littlejohn (University of California, Berkeley), Philip Morrison (University of Texas, Austin), Tere Seara (Polytechnical University of Cataluña (Barcelona)), Sergei Tabachnikov (Pennsylvania State University), Amie Wilkinson (University of Chicago)*

Workshop 1: Connections for Women: Hamiltonian Systems, From Topology to Applications Through Analysis
August 16, 2018 - August 17, 2018
*Organizers: Marie-Claude Arnaud (Université d'Avignon), **Basak Gurel** (University of Central Florida), Tere Seara (Polytechnical University of Cataluña (Barcelona)*

Workshop 2: Introductory Workshop: Hamiltonian Systems, From Topology to Applications Through Analysis
August 20, 2018 - August 24, 2018
Organizers: Marie-Claude Arnaud *(Université d'Avignon),* Wilfrid Gangbo *(University of California, Los Angeles), **Vadim Kaloshin** (University of Maryland),* Robert Littlejohn (University of California, Berkeley), Philip Morrison (University of Texas, Austin)

Workshop 3: Hamiltonian Systems, From Topology to Applications Through Analysis I
October 08, 2018 – October 12, 2018
*Organizers: Alessandra Celletti (Seconda Università di Roma "Tor Vergata"), Rafael de la Llave (Georgia Institute of Technology), Diego del-Castillo-Negrete (Oak Ridge National Laboratory), Lawrence Evans (University of California, Berkeley), **Philip Morrison** (University of Texas, Austin), Sergei Tabachnikov (Pennsylvania State University), Amie Wilkinson (University of Chicago)*

Workshop 4: Hamiltonian Systems, From Topology to Applications Through Analysis II
November 26, 2018 – November 30, 2018
*Alessandra Celletti (Seconda Università di Roma "Tor Vergata"), Rafael de la Llave (Georgia Institute of Technology), Diego del-Castillo-Negrete (Oak Ridge National Laboratory), Lawrence Evans (University of California, Berkeley), **Philip Morrison** (University of Texas, Austin), Sergei Tabachnikov (Pennsylvania State University), Amie Wilkinson (University of Chicago)*

Program 2: Birational Geometry and Moduli Spaces (BGMS)
January 22, 2019 – May 24, 2019
*Organizers: Antonella Grassi (University of Pennsylvania), **Christopher Hacon** (University of Utah), Sándor Kovács (University of Washington), Mircea Mustaţă (University of Michigan), Martin Olsson (University of California, Berkeley)*

Workshop 1: Connections for Women: Derived Algebraic Geometry, Birational Geometry and Moduli Spaces
January 28, 2019 – January 30, 2019
*Organizers: Julie Bergner (University of Virginia), **Antonella Grassi** (University of Pennsylvania), Bianca Viray (University of Washington), Kirsten Wickelgren (Georgia Institute of Technology)*

Workshop 2: Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces
January 31, 2019 – February 08, 2019
*Organizers: Julie Bergner (University of Virginia), Bhargav Bhatt (University of Michigan), Christopher Hacon (University of Utah), **Mircea Mustaţă** (University of Michigan), Gabriele Vezzosi (Università di Firenze)*

Workshop 3: Recent Progress in Moduli Theory
May 06, 2019 – May 10, 2019
*Organizers: Lucia Caporaso (Roma Tre University), **Sándor Kovács** (University of Washington), Martin Olsson (University of California, Berkeley)*

Program 3: Derived Algebraic Geometry (DAG)
January 22, 2019 – May 24, 2019
*Organizers: Julie Bergner (University of Virginia), **Bhargav Bhatt** (University of Michigan), Dennis Gaitsgory (Harvard University), David Nadler (University of California, Berkeley), Nick Rozenblyum (University of Chicago), Peter Scholze (Universität Bonn), Gabriele Vezzosi (Università di Firenze)*

Workshop 1: Connections for Women: Derived Algebraic Geometry, Birational Geometry and Moduli Spaces
January 28, 2019 – January 30, 2019
*Organizers: Julie Bergner (University of Virginia), **Antonella Grassi** (University of Pennsylvania), Bianca Viray (University of Washington), Kirsten Wickelgren (Georgia Institute of Technology)*

Workshop 2: Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces
January 31, 2019 – February 8, 2019

*Organizers: Julie Bergner (University of Virginia), Bhargav Bhatt (University of Michigan), Christopher Hacon (University of Utah), **Mircea Mustaţă** (University of Michigan), Gabriele Vezzosi (Università di Firenze)*

Workshop 3: Derived Algebraic Geometry and Its Applications
March 25, 2019 – May 29, 2019
*Organizers: Dennis Gaitsgory (Harvard University), David Nadler (University of California, Berkeley), **Nick Rozenblyum** (University of Chicago), Peter Scholze (Universität Bonn), Brooke Shipley (University of Illinois at Chicago)*

Program 4: Complementary Program (2018-19)
August 13, 2018 - May 24, 2019

MSRI had a Complementary Program comprised of one postdoctoral fellow, Thomas McConville (Massachusetts Institute of Technology) and the following researchers: Sylvie Corteel (Université de Paris VII (Denis Diderot)), Hailong Dao (University of Kansas), Curtis Greene (Haverford College), Charlotte Hardouin (Institut de Mathématiques de Toulouse), Jeremiah Heller (University of Illinois at Urbana-Champaign), Milena Hering (University of Edinburgh), Wei Ho (University of Michigan), Fanny Kassel (Institut des Hautes Études Scientifiques (IHES)), Nikon Kurnosov (University of Georgia), Frank-Olaf Schreyer (Universität des Saarlandes), Julius Shaneson (University of Pennsylvania), Nicolò Sibilla (University of Kent at Canterbury), Matthew Stoffregen (Massachusetts Institute of Technology), Mariia Vlasenko (Polish Academy of Sciences), Volkmar Welker (Philipps-Universität Marburg), Paul Ziegler (University of Oxford)

1.4 Scientific Activities Directed at Underrepresented Groups in Mathematics

Connections for Women Workshops
During the 2018-19 academic year, MSRI hosted three Connections for Women workshops, one for each scientific program. The goal of these workshops was to facilitate networks among women and members of underrepresented minorities. For more information regarding each workshop, please refer to Section 1.3 above as well as the Appendix (Section 12).

Summer Research for Women in Mathematics
During the 2018 summer, MSRI hosted the Summer Research for Women in Mathematics program. The purpose of this program was to provide space and funds to groups of women mathematicians to work on a research project at MSRI. Research projects can arise from work initiated at a Women's Conference, or can be freestanding activities. Groups of two to six women with partial results on an established project submitted applications to the program. Each member of the group must have a Ph.D. in mathematics or advanced graduate standing. Each group was in residence at MSRI for a minimum of five working days, though a longer period of two-weeks is preferred. For more information regarding this program, please refer to Section 6 of this annual report.

SWiM 2018 was funded by an NSA grant. The report was filed independently to that agency, thus there is no report attached in Section 12: Appendix

Undergraduate Program: MSRI-UP 2018: The Mathematics of Data Science
June 16, 2018 – July 29, 2018
*Federico Ardila (San Francisco State University), Duane Cooper (Morehouse College), **Maria Franco** (Queensborough Community College (CUNY)), Rebecca Garcia (Sam Houston State University), David Uminsky (University of San Francisco), Suzanne Weekes (Worcester Polytechnic Institute)*

Please note: MSRI-UP is funded by an independent NSF grant, DMS-1659138. The report was filed independently to the NSF, thus there is no report attached in Section 12: Appendix.

***NSF Mathematics Institutes' Modern Math Workshop at SACNAS**
Location: SACNAS in San Antonio, Texas
October 10, 2018 - October 11, 2019
Hosted by SAMSI

***2019 Spring Opportunities Workshop**
Location: American Institute of Mathematics, San Jose, California
April 15, 2019 – April 17, 2019
Organizers: Brianna Donaldson (American Institute of Mathematics), Leslie Hogben, Michael Young (Iowa State University)

**Please note: The report of these activities is included in the host institute's annual report, thus there is no report attached in Section 12: Appendix.*

1.5 Summer Graduate Schools (Summer 2018)

SGS 1: Séminaire de Mathématiques Supérieures 2018: Derived Geometry and Higher Categorical Structures in Geometry and Physics
June 11, 2018 – June 22, 2018
Location: Fields Institute, Toronto, Canada
Organizers: Anton Alekseev (Université de Genève), Ruxandra Moraru (U. of Waterloo), Chenchang Zhu (Universität Göttingen)

SGS 2: The ∂-Problem in the Twenty-First Century
June 11, 2018 - June 22, 2018
Location: MSRI
Organizers: Debraj Chakrabarti (Central Michigan U.), Jeffery McNeal (Ohio State U.)

SGS 3: Mathematical Analysis of Behavior
June 17, 2018 - June 30, 2018
Location: HHMI / Janelia Research Campus
Organizers: Ann Hermundstad (Janelia Research Campus, HHMI), Vivek Jayaraman (Janelia Research Campus, HHMI), Eva Kanso (U. of Southern California), L. Mahadevan (Harvard U.)

SGS 4: H-principle
June 25, 2018 - July 06, 2018
Location: Tambara Institute, Tokyo, Japan
Organizers: Emmy Murphy (Northwestern U.), Takashi Tsuboi (U. of Tokyo)

SGS 5: Derived Categories
June 25, 2018 - July 06, 2018
Location: MSRI
Organizers: Nicolas Addington (U. of Oregon), Alexander Polishchuk (U. of Oregon)

SGS 6: IAS/PCMI 2018: Harmonic Analysis
July 01, 2018 - July 21, 2018
Location: PCMI
Organizers: Carlos Kenig (U. of Chicago), Fanghua Lin (Courant Institute), Svitlana Mayboroda (U. of Minnesota, Twin Cities), Tatiana Toro (U. of Washington)

SGS 7: Representations of High Dimensional Data
July 09, 2018 - July 20, 2018
Location: MSRI
Organizers: Blake Hunter (Microsoft), Deanna Needell (UCLA)

SGS 8: From Symplectic Geometry to Chaos
July 23, 2018 - August 03, 2018
Location: MSRI
Organizers: Marcel Guardia (Polytechnical U. of Cataluña, Barcelona), Vadim Kaloshin (U. of Maryland), Leonid Polterovich (Tel Aviv U.)

1.6 Other Scientific Workshops

Workshop 1: Hot Topics: Shape and Structure of Materials
October 01, 2018 - October 05, 2018
Location: MSRI
*Myfanwy Evans (TU Berlin), **Frank Lutz** (TU Berlin), Dmitriy Morozov (Lawrence Berkeley National Laboratory), James Sethian (University of California, Berkeley), Ileana Streinu (Smith College)*

Workshop 3: Hot Topics: Recent progress in Langlands Program
April 08, 2019 - April 12, 2019
Location: MSRI
*Mark Kisin (Harvard University), Elena Mantovan (California Institute of Technology), **Xinwen Zhu** (California Institute of Technology)*

1.7 Education & Outreach Activities

Critical Issues in Mathematics Education (CIME) 2019: Mathematical Modeling in K-16: Community and Cultural Contexts
March 06, 2019 - March 08, 2019
*Organizers: Julia Aguirre (University of Washington - Tacoma), **Cynthia Anhalt** (University of Arizona), Staffas Broussard (The Algebra Project), Ricardo Cortez (Tulane University), Michael Driskill (Math for America), Sol Garfunkel (Consortium for Mathematics and Its Applications (COMAP)), Genetha Gray (Salesforce), Maria Hernandez (North Carolina School of Science and Mathematics), **Rachel Levy** (MAA - Mathematical Association of America), Javier Rojo (Oregon State)*

CIME was funded by an independent grant. The report was filed independently to that agency, thus there is no report attached in Section 12: Appendix. For more information about CIME workshops, please visit our website at www.msri.org.

1.8 Program Consultants List

Consultant Name(s)	Consultant Disciplinary Specialty	Consultant Employer	Activity Title
Larry Abbott	Math Biology	Columbia University	Neuroscience meeting
Chris Bishop	Geometric Function theory and Complex Analysis	Stony Brook	Review Complex Dynamics proposal
Douglas Diamond	Economics	University of Chicago	MSRI-CME Group Prize
Darrell Duffie	Ecomonics	Stanford University	MSRI-CME Group Prize
John Ewing	Math, Education	Math for America	Critical Issues in Math Education workshop
Jack Gould	Economics	University of Chicago	MSRI-CME Group Prize
Sanford Grossman	Econ, Neuroscience	self	Neuroscience meeting, MSRI-CME Group Prize
Richard James	Phase Transformation in material	U. of Minnesota	Review Shape and Structure materials Hot Topic Workshop
Robert Klein	Mathematics education	Ohio University	Navajo Math Circles and Alliance for Indigenous Math Circles
Mimi Koehl	Biology	UC Berkeley	Insect Navigation
Andrew Lo	Economics	Massachussetts Institute of Technology	MSRI-CME Group Prize
Jane Long	Education	Stephen F. Austin State University	National Association of Math Circles
William Macallum	Education	University of Arizona	Educational workshops
Rafe Mazzeo	Differential geometry	Stanford University	Summer Graduate School
R. Preston McAfee	Ecomonics	Microsoft	MSRI-CME Group Prize
Robert Megginson	Fuctional analysis	University of Michigan	Critical Issues in Math Education
Leo Melamed	Economics	CME Group	MSRI-CME Group Prize
Paul Milgrom	Economics	Stanford University	Economics program, MSRI-CME Group Prize
Alvin Roth	Economics	Stanford University	Economics program, MSRI-CME Group Prize
Thomas Sargent	Economics	Stanford University	MSRI-CME Group Prize
Mark Saul	Education	Education Development Center	Great Circles
Jose Scheinkman	Economics	Columbia University	MSRI-CME Group Prize
Myron Scholes	Economics	Stanford University	MSRI-CME Group Prize
Tatiana Shubin	Number theory	San Jose State University	Navajo Math Circles and Alliance for Indigenous Math Cirlces
Hugo Sonnenschein	Economics	University of Chicago	MSRI-CME Group Prize
Nancy Stokey	Economics	University of Chicago	MSRI-CME Group Prize
Hal Varian	Economics	UC Berkeley and Google	Economics program
Diana White	Commutative algebra	University of Colorado, Denver	National Association of Math Circles
Hugh Woodin	Logic	Havard University	Decidability, definability and computability in number theory
Educational Advisory Committee (EAC)	See Section 10: Committee Membership		Using Partnerships to Strengthen Elementary Mathematics Teacher Education
Human Resources Advisory Committee (HRAC)	See Section 10: Committee Membership		MSRI-UP, GFA, GTC, GRTA, EGN and CP
Scientific Advisory Committee (SAC) & Board of Trustees (BOT)	See Section 10: Committee Membership		Geometric Functional Analysis and Applications (GFA) Geometric and Topological Combinatorics (GTC) Group Representation Theory and Applications (GRTA) Enumerative Geometry Beyond Numbers (EGN) Complementary Program (CP) Summer Graduate Schools

2. Program and Workshop Data

2.1 Program Member List

(See email attachment)

2.2 Program Members Summary

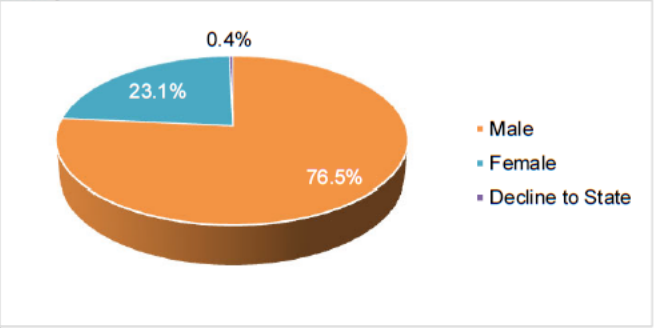
Programs	Distinct Members	US Citizens & Perm. Res.	Women	%	Minorities*	%	US Home Inst.	%
Hamiltonian systems, from topology to applications through analysis	107	48	21	*19.6%*	5	*10.4%*	46	43.0%
Birational Geometry and Moduli Spaces	67	29	19	*28.4%*	0	*0.0%*	39	58.2%
Derived Algebraic Geometry	69	29	14	*20.3%*	0	*0.0%*	32	46.4%
Complementary Program 2018-19	17	7	6	*35.3%*	0	*0.0%*	8	47.1%
Total # of Distinct Members	**260**	**113**	**60**	***23.1%***	**5**	***4.4%***	**125**	***48.1%***

* *Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

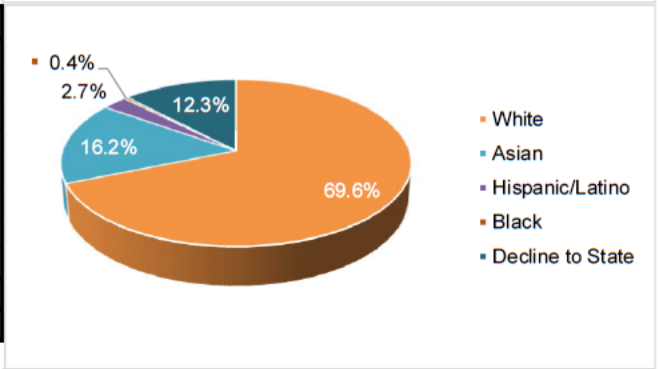
2.3 Program Members Demographic Summary

2018–19 Program Members Demographic Summary

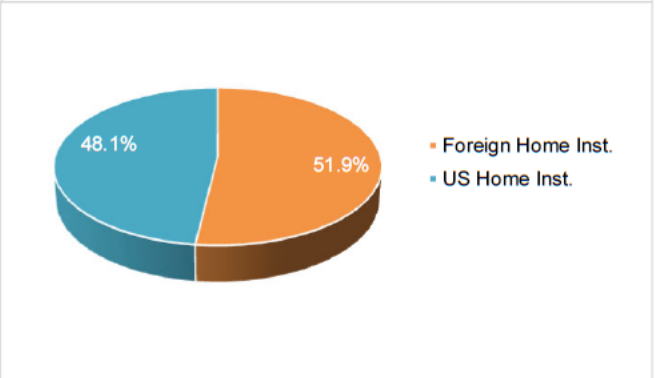
Gender	#	%
# of Distinct Members	260	100.0%
Male	199	76.5%
Female	60	23.1%
Decline to State	1	0.4%



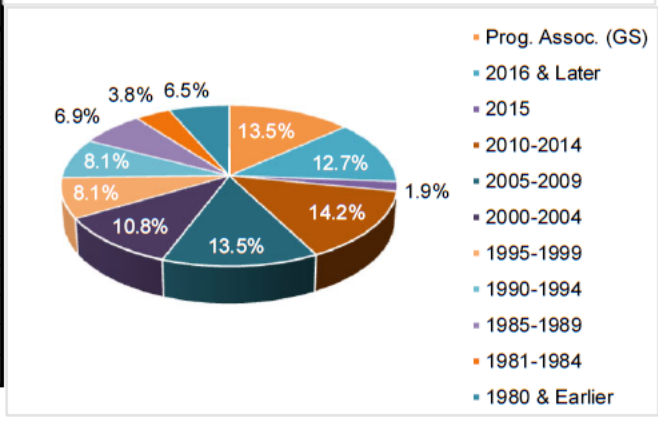
Race/Ethnicity*	#	%
White	181	69.6%
Asian	42	16.2%
Hispanic/Latino	7	2.7%
Black	1	0.4%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	32	12.3%
Unavailable Info.	0	0.0%
Minorities**	5	4.4%



Citizenships	#	%
Foreign Home Inst.	135	51.9%
US Home Inst.	125	48.1%
US Citizen & Perm. Residents	113	43.5%
Foreign	147	56.5%
US Citizens	95	36.5%
US Permanent Residents	18	6.9%



Year of Ph.D	#	%
Prog. Assoc. (GS)	35	13.5%
2016 & Later	33	12.7%
2015	5	1.9%
2010-2014	37	14.2%
2005-2009	35	13.5%
2000-2004	28	10.8%
1995-1999	21	8.1%
1990-1994	21	8.1%
1985-1989	18	6.9%
1981-1984	10	3.8%
1980 & Earlier	17	6.5%
Total # of Distinct Members	260	100.0%



**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

Programs

Hamiltonian systems, from topology to applications through analysis

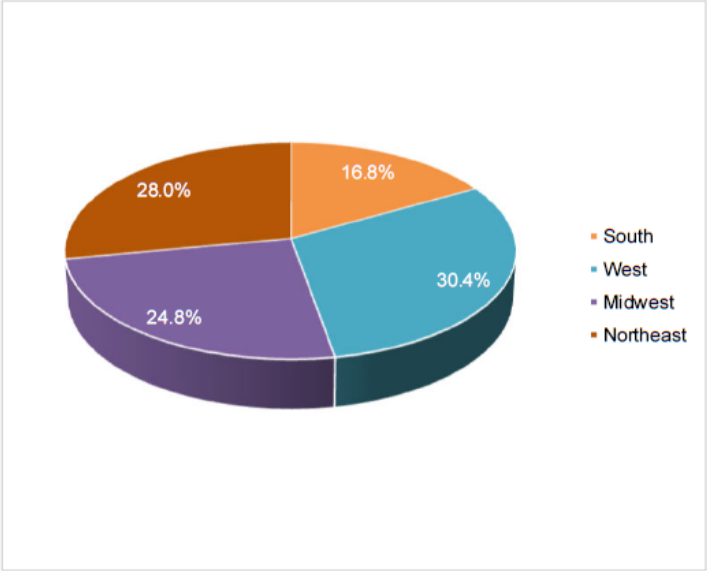
Birational Geometry and Moduli Spaces

Derived Algebraic Geometry

Complementary Program (2018-19)

2018-19 Program Members Classified by State

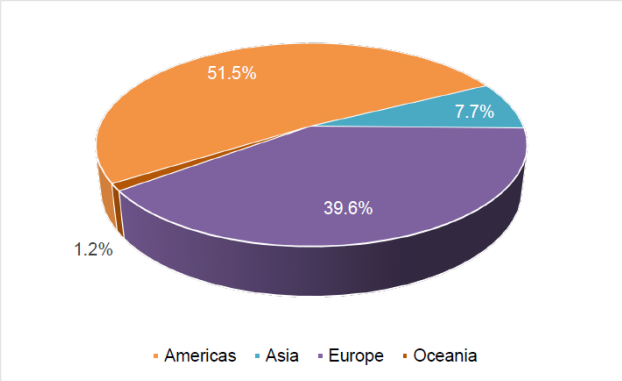
State	#	%	*2010 Census Population*
South	**21**	**16.8%**	*37.1%*
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	2	1.6%	*6.1%*
GA	6	4.8%	*3.1%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.5%*
MD	2	1.6%	*1.9%*
MS	0	0.0%	*1.0%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	6	4.8%	*8.1%*
VA	3	2.4%	*2.6%*
WV	2	1.6%	*0.6%*
West	**38**	**30.4%**	*23.3%*
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.1%*
CA	27	21.6%	*0.4%*
CO	1	0.8%	*0.5%*
HI	0	0.0%	*0.3%*
ID	0	0.0%	*12.1%*
MT	0	0.0%	*1.6%*
NM	1	0.8%	*0.9%*
NV	0	0.0%	*0.7%*
OR	0	0.0%	*1.2%*
UT	4	3.2%	*0.9%*
WA	5	4.0%	*2.2%*
WY	0	0.0%	*0.2%*
Midwest	**31**	**24.8%**	*21.7%*
IA	0	0.0%	*4.2%*
IL	10	8.0%	*2.1%*
IN	2	1.6%	*1.0%*
KS	2	1.6%	*0.9%*
MI	8	6.4%	*3.2%*
MN	2	1.6%	*1.7%*
MO	3	2.4%	*1.9%*
ND	0	0.0%	*0.2%*
NE	1	0.8%	*0.6%*
OH	0	0.0%	*3.7%*
SD	0	0.0%	*0.3%*
WI	3	2.4%	*1.8%*
Northeast	**35**	**28.0%**	*17.9%*
CT	2	1.6%	*1.2%*
MA	12	9.6%	*0.4%*
ME	0	0.0%	*2.1%*
NH	0	0.0%	*0.4%*
NJ	10	8.0%	*2.8%*
NY	5	4.0%	*6.3%*
PA	6	4.8%	*4.1%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	*0.0%*
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	125	100.0%	*100.0%*



**Regions based on US Census classification*

2018-19 Program Members Classified by Countries

Africa			**0**
Americas			**134**
	Central America	Mexico	4
	North America	United States	125
		Canada	3
	South America	Brazil	2
Asia			**20**
	East Asia	China	8
		Japan	6
		Korea, Republic of	1
	Western Asia	Israel	5
Europe			**103**
	Eastern Europe	Poland	3
		Russian Federation	3
	Northern Europe	Denmark	3
		Norway	2
		United Kingdom	15
	Southern Europe	Italy	16
		Spain	10
	Western Europe	Austria	1
		France	30
		Germany	18
		Switzerland	2
Oceania			**3**
	Australia and New Zealand	Australia	3
Grand Total			**260**



**Regions based on United Nations classification*

2.4 Workshop Participant List

(See email attachment)

2.5 Workshop Participant Summary*

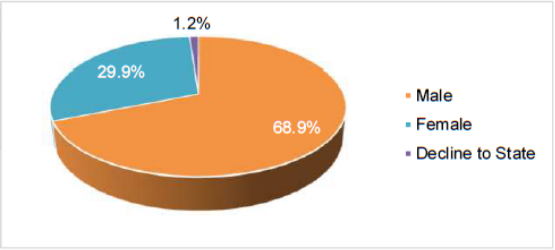
Workshops	Participants	US Citizens & Perm. Res.	%	Women	%	Minorities*	%	US Home Inst.	%
11 Scientific Workshops									
Connections for Women: Derived Algebraic Geometry, Birational Geometry and Moduli Spaces	115	56	*48.7%*	56	*48.7%*	2	*3.6%*	73	63.5%
Connections for Women: Hamiltonian Systems, from topology to applications through analysis	57	21	*36.8%*	25	*43.9%*	0	*0.0%*	27	47.4%
Derived algebraic geometry and its applications	150	69	*46.0%*	16	*10.7%*	4	*5.8%*	91	60.7%
Hamiltonian systems, from topology to applications through analysis I	123	53	*43.1%*	22	*17.9%*	4	*7.5%*	65	52.8%
Hamiltonian systems, from topology to applications through analysis II	95	40	*42.1%*	17	*17.9%*	3	*7.5%*	47	49.5%
Hot Topics: Recent progress in Langlands Program	89	35	*39.3%*	10	*11.2%*	1	*2.9%*	61	68.5%
Hot Topics: Shape and Structure of Materials	55	22	*40.0%*	18	*32.7%*	1	*4.5%*	28	50.9%
Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces	209	95	*45.5%*	48	*23.0%*	5	*5.3%*	134	64.1%
Introductory Workshop: Hamiltonian systems, from topology to applications through analysis	111	50	*45.0%*	28	*25.2%*	4	*8.0%*	59	53.2%
Recent Progress in Moduli Theory	147	64	*43.5%*	30	*20.4%*	2	*3.1%*	100	68.0%
Summer Research for Women in Mathematics	20	17	*85.0%*	20	*100.0%*	3	*17.6%*	17	85.0%
All 11 Workshops Total	**1,171**	**522**	***44.6%***	**290**	***24.8%***	**29**	***5.6%***	**702**	***59.9%***
1 Education & Outreach Workshop									
Critical Issues in Mathematics Education 2019: Mathematical Modeling in K-16: Community and Cultural Contexts	**179**	**168**	***93.9%***	**114**	***63.7%***	**42**	***25.0%***	**176**	**98.3%**
All 1 Workshop Total	**179**	**168**	***93.9%***	**114**	***63.7%***	**42**	***25.0%***	**176**	**98.3%**
All 12 Workshops Total	**1,350**	**690**	***51.1%***	**404**	***29.9%***	**71**	***10.3%***	**878**	***65.0%***

*Note that the overall workshop data in section 2.5 is not distinct as some participants attended multiple workshops, but the statistics of individual workshops found in Section 12, Appendix, were calculated on distinct participant data.

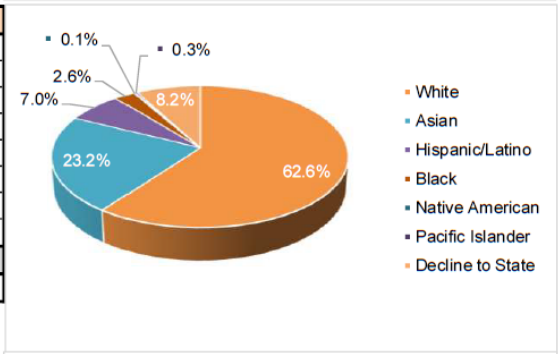
2.6 Workshop Participant Demographic Data

2018–19 Workshop Participants Demographic Summary

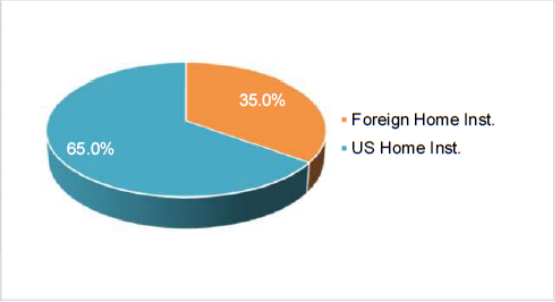
Gender	#	%
# of Participants	1350	100.0%
Male	930	68.9%
Female	404	29.9%
Decline to State	16	1.2%



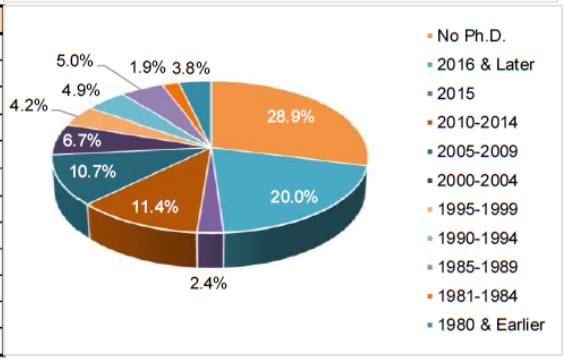
Race/Ethnicity*	#	%
White	845	62.6%
Asian	313	23.2%
Hispanic/Latino	95	7.0%
Black	35	2.6%
Native American	2	0.1%
Pacific Islander	4	0.3%
Decline to State	111	8.2%
Unavailable Info.	0	0.0%
Minorities**	71	10.3%



Citizenships	#	%
Foreign Home Inst.	472	35.0%
US Home Inst.	878	65.0%
US Citizen & Perm. Residents	690	51.1%
Foreign	660	48.9%
US Citizen	614	45.5%
Perm. Residents	76	5.6%



Year of Ph.D.	#	%
No Ph.D.	390	28.9%
2016 & Later	270	20.0%
2015	32	2.4%
2010-2014	154	11.4%
2005-2009	145	10.7%
2000-2004	91	6.7%
1995-1999	57	4.2%
1990-1994	66	4.9%
1985-1989	68	5.0%
1981-1984	26	1.9%
1980 & Earlier	51	3.8%
Total # Participants	1350	71.1%



**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2018–19 Workshops

Connections for Women: Derived Algebraic Geometry, Birational Geometry and Moduli Spaces

Connections for Women: Hamiltonian Systems, from topology to applications through analysis

Derived algebraic geometry and its applications

Hamiltonian systems, from topology to applications through analysis I

Hamiltonian systems, from topology to applications through analysis II

Hot Topics: Recent progress in Langlands Program

Hot Topics: Shape and Structure of Materials

Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces

Introductory Workshop: Hamiltonian systems, from topology to applications through analysis

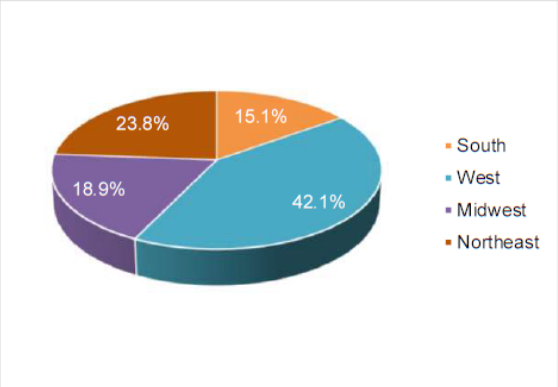
Recent Progress in Moduli Theory

Summer Research for Women in Mathematics

Critical Issues in Mathematics Education 2019: Mathematical Modeling in K-16: Community and Cultural Contexts

2018–19 Workshop Participants Classified by State

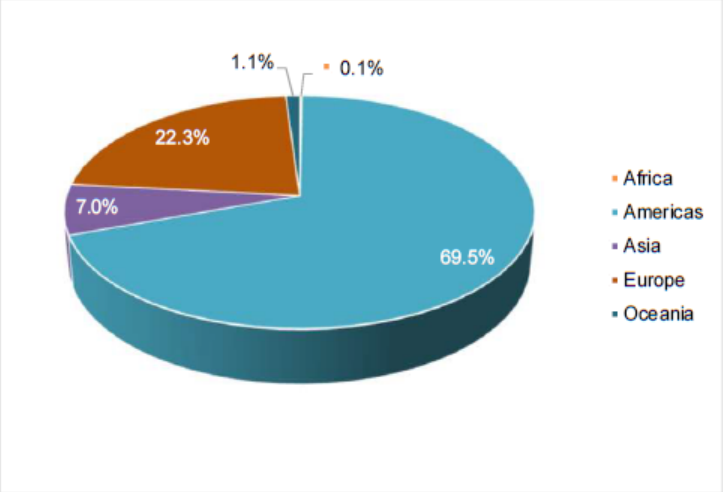
State	#	%	*2010 Census*
South	**133**	**15.1%**	*37.1%*
AL	0	0.0%	*1.5%*
AR	2	0.2%	*0.9%*
DE	1	0.1%	*0.3%*
DC	5	0.6%	*0.2%*
FL	12	1.4%	*6.1%*
GA	35	4.0%	*3.1%*
KY	0	0.0%	*1.4%*
LA	2	0.2%	*1.5%*
MD	9	1.0%	*1.9%*
MS	0	0.0%	*1.0%*
NC	4	0.5%	*3.1%*
OK	6	0.7%	*1.2%*
SC	5	0.6%	*1.5%*
TN	2	0.2%	*2.1%*
TX	34	3.9%	*8.1%*
VA	12	1.4%	*2.6%*
WV	4	0.5%	*0.6%*
West	**370**	**42.1%**	*23.3%*
AK	1	0.1%	*0.2%*
AZ	10	1.1%	*2.1%*
CA	276	31.4%	*0.4%*
CO	13	1.5%	*0.5%*
HI	1	0.1%	*0.3%*
ID	1	0.1%	*12.1%*
MT	4	0.5%	*1.6%*
NM	3	0.3%	*0.9%*
NV	0	0.0%	*0.7%*
OR	7	0.8%	*1.2%*
UT	34	3.9%	*0.9%*
WA	20	2.3%	*2.2%*
WY	0	0.0%	*0.2%*
Midwest	**166**	**18.9%**	*21.7%*
IA	2	0.2%	*4.2%*
IL	53	6.0%	*2.1%*
IN	9	1.0%	*1.0%*
KS	10	1.1%	*0.9%*
MI	49	5.6%	*3.2%*
MN	12	1.4%	*1.7%*
MO	9	1.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	3	0.3%	*0.6%*
OH	4	0.5%	*3.7%*
SD	0	0.0%	*0.3%*
WI	15	1.7%	*1.8%*
Northeast	**209**	**23.8%**	*17.9%*
CT	8	0.9%	*1.2%*
MA	66	7.5%	*0.4%*
ME	2	0.2%	*2.1%*
NH	1	0.1%	*0.4%*
NJ	45	5.1%	*2.8%*
NY	54	6.2%	*6.3%*
PA	26	3.0%	*4.1%*
RI	6	0.7%	*0.3%*
VT	1	0.1%	*0.2%*
Other	**0**	**0.0%**	*0.0%*
PR	0	0.0%	*0.0%*
Unavailable	0	0.0%	*0.0%*
Total	878	100.0%	*100.0%*



**Regions based on US Census classification*

2018–19 Workshop Participants Classified by Country

Africa			**2**
	Eastern Africa	Ethiopia	1
	Southern Africa	South Africa	1
Americas			**938**
	Central America	Mexico	19
	North America	Canada	31
		United States	878
	South America	Argentina	2
		Brazil	7
	Caribbean	Jamaica	1
Asia			**94**
	East Asia	China	33
		Japan	22
		Korea, Republic of	17
		Taiwan	1
	South-central Asia	India	5
		Iran, Islamic Republic of	3
	Western Asia	Israel	10
		Saudi Arabia	1
		United Arab Emirates	1
		Turkey	1
Europe			**301**
	Eastern Europe	Poland	4
		Romania	1
		Russian Federation	2
	Northern Europe	Denmark	14
		Norway	2
		Sweden	13
		United Kingdom	61
	Southern Europe	Italy	56
		Portugal	1
		Spain	25
	Western Europe	Austria	2
		France	59
		Germany	46
		Netherlands	2
		Switzerland	13
Oceania			**15**
	Australia & NZ	Australia	15
Grand Total			**1350**



**Regions based on United Nations classification*

2.7 Program Publication List

(Attachment in Research.gov)

2.8 Program Publication Work-In-Progress List

(Attachment in Research.gov)

3. Postdoctoral Program

3.1 Description of Activities

The postdoctoral program at MSRI is central to MSRI's mission of continued excellence in mathematics research. The programs MSRI organizes and hosts produce the leading research 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 2018-19 academic year, MSRI selected 31 postdoctoral scholars with research interests in the programs that MSRI offers. Of those postdocs, 20 were funded by the NSF Core Grant, 3 were funded by the NSA, and 11 were funded by private funds. There were 10 named postdoctoral fellows who received additional funding from the Berlekamp, Della-Pietra, Gamelin, Huneke, McDuff, Uhlenbeck, and Viterbi Endowments, as well as the Strauch Post-Doctoral Fellowship Grant.

Of the 31 Postdoctoral Fellows at MSRI, 8 (26%) were female, 11 (35%) were U.S. Citizens or Permanent Residents, and 20 (65%) came from a US institution. The program organizers were extremely satisfied with the Postdoctoral program and believed that it was by all accounts an enormous success.

On the next page are additional details on the NSF Postdoctoral Fellows for each program.

HAMILTONIAN SYSTEMS, FROM TOPOLOGY TO APPLICATIONS THROUGH ANALYSIS

Benedetti, Gabriele

Name: Gabriele Benedetti
Year of Ph.D: 2014
Institution of Ph.D.: University of Cambridge
Dissertation title: The contact property for magnetic flows on surfaces
Ph.D. advisor: Prof. Gabriel P. Paternain

Mentor while at MSRI: Prof. Sergei Tabachnikov

Institution prior to obtaining the MSRI PD fellowship: University of Heidelberg
Position at that institution: Junior Professor
Mentor (if applicable):

Institution (or company) where you are going after MSRI: University of Heidelberg
Position: Junior Professor
Anticipated length: 6 years

Postdoctoral fellow's comments:
I benefitted from the program in four essential ways: first, by exposing myself to new topics presented in the weekly seminars and in the thematic workshops. Second, by giving talks on my own research in front of an audience of senior researchers. Third, by starting new collaborations with other resident members. Fourth, by having the necessary time and space to continue working on ongoing research problems started before my arrival to Berkeley. As far as the first point is concerned, it was really useful to have many people giving talks about applied mathematics, as my background is more theoretical and I could get a feeling of what problems are of more concrete interest. For example, I work on the dynamics of charged particle in a magnetic field and I learned from Natalia Tronko that finding a magnetic field capable of confining ions and electrons inside a plasma is one of the key steps to achieve fusion. I also regularly attended the lecture series "Weak KAM Theory, Homogenization and Symplectic Topology" by Fraydoun Rezakhanlou. In this series, he mixed symplectic techniques, with which I am familiar, with techniques from probability theory, which are attractive to me in view of their possible application to my work.

As far as the second point is concerned, I gave a one-hour-long talk at the beginning of the semester in the Hamilton seminar, which is scheduled weekly on Friday at MSRI. The title of the talk was "A local systolic inequality in contact and symplectic geometry". I received some positive feedback about the exposition from my mentor Sergei

Tabachnikov and several members, especially Alexey Glutsyuk, got really interested in the topic.

I also gave a 45-minutes-long talk at the Postdoc workshop, which was organized mid-November at MSRI. The title of this second talk was "Integrable magnetic ows on the two-torus whose trajectories are all closed" and was based on some ongoing work in progress. Before giving the talk I presented the subject to my mentor Sergei Tabachnikov and we found out that he worked some fifteen years ago on a similar problem. The references that he suggested gave me further insight in carrying out my project.

Then, I also gave three informal talks to a group of about ten MSRI members (Gonzalo Contreras, Stamatis Dostouglou, Basak Gurel, Antonio Siconolfi, among others) about an interesting and challenging paper by Alexandra Monzner, Nicholas Vichery and Frol Zapolsky, which we wanted to understand better.

Finally, I gave to invited talks outside MSRI: one at the IAS/Princeton joint Symplectic Seminar on October 22 and one at the Northern California Symplectic Geometry Seminar at Berkeley on November 5.

As far as the third point is concerned, I started collaborating with Alfonso Sorrentino for a project on "Conformally symplectic dynamics". On the one hand, we hope to find some physically relevant example to the abstract setting of conformally symplectic vector fields. On the other hand, we look for a natural definition of the equation of motions in some at bundle over the phase space.

I also worked together with my mentor Sergei Tabachnikov and another postdoc Michael Harrison. We are trying to prove that ellipsoids are the only outer billiards in dimension larger than two possessing caustics. There is a paper by Berger proving an analogous statement for inner billiards and we hope to dualize its method to yield the desired result.

As far as the fourth point is concerned, I had the possibility to finish the corrections of the paper "A local contact systolic inequality in dimension three" submitted to the Journal of the European Mathematical Society. I also continued working with my collaborators Alberto Abbondandolo and Luca Asselle, both based in Germany, and Jungsoo Kang, based in South Korea. The electronic resources and the facilities at MSRI were beneficial to keep these collaborations going.

Overall, I enjoyed very much my staying at MSRI and the interaction with the staff and the other research members. There were many occasions for informal talks that gave a perspective of how my work fits

in the big picture of the current research on Hamiltonian systems. For example, the meetings with my mentor Sergei Tabachnikov have been of great inspiration and guidance to me, as he explained to me some of his results on billiard dynamics and frieze patterns.

The atmosphere within the group of postdocs was also extremely pleasant and it was the ideal outlet and discussion ground for all the big and small dificulties that young people in academia have to face. In particular, following the suggestion of the organizers of the program, I set up a weekly postdoc lunch with an invited senior member. We were very happy to have as guests Tere Seara, Vered Rom-Kedar, Philip Morrison, Margaret Beck, Jacques Fejoz, Cristel Chandre, among others. I had a very positive feedback from the other postdocs about these informal chats, where we discussed very diverse topics such as career planning, the interplay of mathematics and physics, writing grant applications, and so on.

Next January I will resume my position as a Junior Professor at the University of Heidelberg in Germany. New challenges are waiting for me, but the connections I have established and the experience I have gained during my stay will help me all along.

Burby, Joshua

Name: Joshua Burby
Year of Ph.D.: 2015
Institution of Ph.D.: Princeton University
Dissertation title: Chasing Hamiltonian structure in gyrokinetic theory
Ph.D. advisor: Hong Qin

Mentor while at MSRI: Phil Morrison

Institution prior to obtaining the MSRI PD fellowship: Courant Institute of Mathematical Sciences
Position at that institution: DOE Fusion Energy Sciences Postdoctoral Fellow
Mentor (if applicable): Harold Weitzner and Antoine Cerfon

Institution (or company) where you are going after MSRI: Los Alamos National Laboratory
Position: Feynman Fellow
Anticipated length: 3 years maximum
Mentor (if applicable): Xianzhu Tang and Luis Chacon

Postdoctoral fellow's comments:
This semester at MSRI has been the most intensely collaborative period of my academic career. My typical day at MSRI involved spending more

time visiting the offices of others than sitting in my own. There was always someone available who was eager to have a discussion, pitch a new idea, work on an unsolved problem, or listen to one of my own ideas. Overall, I started approximately ten collaborations this semester, and made substantial progress on most of them. In terms of career development, I believe that my appointment as a Viterbi Fellow this semester played an important role in my selection as a Feynman Fellow at Los Alamos National Laboratory starting in 2019. Moreover, coming from a physics background, I am extremely grateful for the opportunity I've had to make connections with the mathematics community working in Hamiltonian systems theory. I believe the relationships started here will have a lasting effect on the diversity of my research projects going forward. I also feel more confident in my ability to interact and collaborate successfully with mathematicians.

With George Miloshevich, I applied a tool from dynamical systems theory known as slow manifold reduction to develop a Hamiltonian description of the motion of "dark" plasmas. Generally speaking, the ionized gasses known as plasmas emit light due to the collective motion of their constituent particles. Dark plasmas are special in this respect because collective light emission does not occur. George and I uncovered some peculiar features of dark plasma dynamics, such as their piezoelectric properties. In addition, we were able to find an exact description of the Hamiltonian structure underlying this novel plasma state. I gave a talk on this work during one of the workshops hosted at MSRI this semester. We are in the process of writing a paper on our results.

With Phil Morrison, I helped uncover surprising features of the local Poisson geometry underlying kinetic plasma dynamics. Because it is generally helpful when designing structure-preserving integration schemes for kinetic plasmas, Phil and I were curious if we could identify a normal form for the Poisson structure governing weakly-nonlinear kinetic plasmas. In one space dimension, Phil had shown earlier that a particularly simple normal form could be identified wherein the Poisson tensor is constant. We discovered that in two or more space dimensions, such a normal form is surprisingly unavailable due to infinite-dimensional rank-changing events that occur at symmetric plasma states. We now hope to find an alternative normal form that in some sense makes the Poisson tensor "as constant as possible." Our hunch is that such a normal form would still be useful in numerical applications.

With Daniel Ruiz, who visited MSRI from Sandia National Laboratory for two weeks this semester, I discovered the variational structure underlying the dynamics of locally-plane-wave solutions of dissipation-free hydrodynamic models in the Eulerian frame. In general, the wave

dynamics in such models couples nonlinearly to the mean flow via ponderomotive effects such as wave-induced Reynolds stress. We noticed that previous work in this area uncovered variational principles in the special case where the waves appear locally-plane in the mean Eulerian frame. However, a variational description when the waves are locally-plane in the more-familiar (true) Eulerian frame was missing. We were able to find the missing variational structure by reformulating variational hydrodynamics using tools from the theory of elastic solids. Through helpful discussions with Richard Montgomery, we were then able to show that the symmetry group of our new variational principle contains the loop group of the symmetry group inherent to original hydrodynamic model. The loop parameter corresponds to the phase parameter describing locally-plane wave motion. One of the novel conservation laws associated with the loop group is a loop of circulation invariants. We have prepared a preprint of our work that we plan to submit to a mathematical physics journal within the month.

Besides the above, I am also actively involved in promising collaborations with Robert Mackay on hidden symmetries in the magnetic fields used to confined thermonuclear fusion, Bob Dewar on relaxed hydrodynamic flow between moving interfaces, Brad Shadwick on nonlinear wave dynamics in plasma wakefield accelerators, Cesare Tronci and Phil Morrison on the dangers of violating energy conservation in models of plasmas containing diffuse energetic particle populations, and Eugene Kur (who frequently visited MSRI from UC Berkeley this semester) on boundary conditions in Hamiltonian descriptions of dissipation-free kinetic plasma dynamics.)

Cheng, Hongyu

Name: HONGYU CHENG
Year of Ph.D.: 2017
Institution of Ph.D.: Shandong university
Dissertation title: Invariant manifolds to two classes of partial differential equations
Ph.D. advisor: Jianguo Si

Mentor while at MSRI: Marian Gidea

Institution prior to obtaining the MSRI PD fellowship: Chern Institute of Mathematics
Position at that institution: Postdoc
Mentor (if applicable): Jiangong You

Institution (or company) where you are going after MSRI PD: Chern Institute of Mathematics
Position: Postdoc
Anticipated length: 1 year

Mentor (if applicable): Jiangong You

Postdoctoral fellow's comments:
It is my honor to study here for one term. I meet a lot of master, such as professors Marian Gidea, Maria Teresa, Philip Morrison, I learn a lot from them. Moreover, I also attended the three workshops in this term here and give a talk in the another workshop of the postdoc in November.

My mentor at MSRI is professor Marian Gidea, we started a new project which combines the classical KAM theorem with the Arnold diffusion. We have not finished this project yet, but we keep our connections and try to finish it in next month. I also meet professor Rafael de la Llave, whose is my co-adviser of my PHD. We, here, finish our unfinished paper (it is about the stable manifold to the bounded solutions of the possibly ill-posed partial differential equation). Thank very much for the institutes, professors and all the people who denotes the fund.

I also gave my thankness to the staff of MSRI, they give me a convenient, comfortable, friendly circumstance for me to do research here. I benefited a lot from them. I think my fellowship will help me with finding a future position (I have not started to find job).

Thanks all the person again.

Harrison, Michael

Name: Michael Harrison
Year of Ph.D.: 2017
Institution of Ph.D.: Pennsylvania State University
Dissertation title: Skew flat fibrations and totally convex immersions
Ph.D. advisor: Sergei Tabachnikov

Mentor while at MSRI: Albert Fathi

Institution prior to obtaining the MSRI PD fellowship: Lehigh University
Position at that institution: CC Hsiung Visiting Assistant Professor

Institution (or company) where you are going after MSRI: Lehigh University
Position: CC Hsiung Visiting Assistant Professor
Anticipated length: 5 months (spring semester)

Postdoctoral fellow's comments:
During my fellowship I worked primarily on three articles. The first article, "Contact structures induced by skew fibrations of R^3", was

submitted in the summer, but it underwent some revisions during my time at MSRI. The second article "Fibrations of R^3 by oriented lines", is joint work with Emmy Murphy. We worked on this together during the Women in Math workshop at the start of the program, and I continued working on it for the next several months. It is more-or-less ready for submission. I then took several weeks to submit a number of job applications for the 2019-2020 academic year. Finally, in the last month, I made a lot of progress on a new article "Skew and spherical fibrations."

I met somewhat regularly with my mentor, Albert Fathi, to discuss my work and listen to his numerous suggestions. I met regularly with Sergei Tabachnikov and Gabriele Benedetti to discuss problems related to caustics of outer billiards. I gave a talk in the Friday seminar at MSRI and attended one outside conference "Knotted surfaces in 4-manifolds", at UMASS. I attended other talks and attended the Friday "member lunches," during which postdocs had the opportunity to question members about many aspects of academia.

I believe that my fellowship here will strongly impact my ability to find a future job -- I will know more definitively in a couple months.

I loved my time at MSRI and was very pleased with all aspects of my visit, including the office space, the daily tea, the hospitality, the wonderful staff, the beautiful view, and having a semester off of teaching. I would happily return, given the opportunity.

Jackman, Connor

Name: Connor Jackman
Year of Ph.D.: 2018
Institution of Ph.D.: UC Santa Cruz
Dissertation title: Free Homotopy Classes in some N-body problems
Ph.D. advisor: Richard Montgomery

Mentor while at MSRI: Jacques Fejoz

Institution prior to obtaining the MSRI PD fellowship: UC Santa Cruz
Position at that institution: Graduate Student

Institution (or company) where you are going after MSRI: CIMAT
Position: Postdoc
Anticipated length: 1 year
Mentor (if applicable): Gil Bor

Postdoctoral fellow’s comments:

I am very grateful for having participated in the program this semester at MSRI. The seminars and library were very inspiring to me, and the chance to meet with experts has helped guide my future projects.

One of these projects is to describe symbol sequences for Poincares second species solutions. These are solutions of the restricted 3-body problem which as the mass tends to zero tend to a collision. To get symbol sequences, we will need to find which side the massless body passes when the mass is non-zero. Meeting Laurent Niedermann here, who in one of his first papers with J.P. Marco proved existence of second species orbits, has helped me understand the analysis and ideas in this paper. I now confirmed that the bounds I am seeking to improve will indeed tell us this information. Currently I am writing a paper about symbol sequences arising from such methods (work I did in my thesis), and these last bounds will be the final piece in the paper.

Also, Laurent and Jacques F\'ejoz have helped guide me to useful references and taught me nice tricks for averaging over resonances. With Jacques, I am using this to examine the existence of a solution (with non-zero angular momentum) to the spatial 4-body problem which never lies in a plane -- which would answer a question posed by Montgomery at this workshop.

Another topic I learned more about here was the Jacobi-Maupertuis metric in celestial mechanics. Discussions with Rick Moeckel have interested me in the embedding problem of JM-metrics. These metrics may have a Hill boundary -- points at which the metric becomes zero, and the curvature goes to infinity. For central force problems, Moeckel proved this obstructs embeddings as surfaces of revolution in a whole neighborhood of the Hill boundary. For these examples, the Hill boundary is a curve. I have found examples, when the Hill boundary is a point, which do embed all the way up to this Hill boundary. To make these examples we start with the surface of revolution of an involute and then determine the appropriate JM-metric. It will be an interesting future project to see if any interesting JM-metrics can arise this way.

I think this fellowship has given my research program better focus on some specific projects, which other researchers will be interested in. And so, will be helpful for finding a future position.

Jaquette, Jonathan

Name: Jonathan Jaquette
Year of Ph.D.: 2018
Institution of Ph.D.: Rutgers University
Dissertation title: Counting and discounting slowly oscillating periodic solutions to Wright's equation
Ph.D. advisor: Konstantin Mischaikow

Mentor while at MSRI: Gonzalo Contreras

Institution prior to obtaining the MSRI PD fellowship: Rutgers University
Position at that institution: Graduate Student
Mentor : Konstantin Mischaikow

Institution where you are going after MSR: Brandeis University
Position: Postdoc
Anticipated length: 2 years
Mentor : Jonathan Touboul

Postdoctoral fellow's comments:
At MSRI I volunteered to be a social organizers for the postdocs. Together with the other social organizer, we arranged many well attended events, such as pumpkin carving, pizza socials, and board game nights. I enjoyed organizing the events, and doing so helped me gain leadership experience.

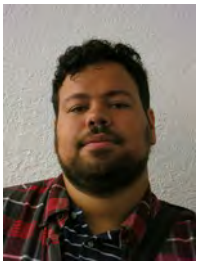
At MSRI I worked with many other mathematicians. Since I knew that Angel Jorba and Alex Haro were going to be at MSRI, (Alex for the semester and Angel for a month), I visited them at the University of Barcelona this summer for a month and a half to begin collaborations. With Angel, we discussed many possibilities, and eventually settled on working on a project on "High Accuracy Validation of Numerical Integration", together with his PhD student Joan Gimeno. This enabled us to jump into work at MSRI, and we have continued to work on this since Angel left MSRI. While I did not start a specific project with Alex Haro in Barcelona, we also had several discussions about different possible projects.

During Evelyn Sander's stay at MSRI, we had many discussions about possible projects, specifically relating to validated numerical continuation and computing invariant tori. Alex Haro is an expert on invariant tori, and we began a collaboration all together. Since Evelyn left MSRI, we all have continued to have regular Skype meetings.

One of the new collaborations I was happy to start was one with Margaret Beck. While I was familiar with her work, I had not met her

before coming to MSRI. We began a collaboration on a project "Validated spectral stability via conjugate points". For this project I started using a scientific computing library called CAPD for doing the validated numerics which was new to me. Maciej Capinski helped teach me how to use this package during his 1 month stay here. In addition, Margaret also gave me feedback on the talk I gave in the Postdoc seminar, and offered other career advice.

Overall, I would say that my experience at MSRI has be very beneficial. The weekly "Postdoc lunches with Research Members" was excellent, and I gained various insights into the hiring, grant reviewing, journal reviewing, etc. processes. My exposure to a wide array of research interests within dynamical systems has greatly helped me, especially in how I think about how to present my own research to general mathematicians. I have made many connections at MSRI which I believe will help me in securing future academic employment.



Martins, Gabriel

Name: Gabriel Martins
Year of Ph.D.: 2018
Institution of Ph.D.: UC Santa Cruz
Dissertation title: The Hamiltonian Dynamics of Magnetic Confinement and Instances of Quantum Tunneling
Ph.D. advisor: Richard Montgomery

Mentor while at MSRI: Basak Gurel and James Meiss

Institution prior to obtaining the MSRI PD fellowship: UC Santa Cruz
Position at that institution: PhD student
Mentor (if applicable): Richard Montgomery

Institution (or company) where you are going after MSRI: UC Berkeley
Position: Lecturer
Anticipated length: 6 months

Postdoctoral fellow's comments:

Activities:
The program provided me with a unique opportunity to get exposed to various techniques and different questions in the broad field of Hamiltonian dynamics. It was a good moment to develop new tools and try to apply them in the problems I have been working on. During the program I was able to continue my research on the dynamics of charged particles under the influence of magnetic fields and learn different perspectives on this problem, especially from mathematicians which are more closely connected to the plasma physics community.

Some collaborations I have started during the program are:
1) With James Meiss: We have discussed how to use guiding center theory to obtain confinement of charged particles with bounded energy using bounded magnetic fields in 3 dimensions.
2) With Victor Dods: We started developing some numerical simulations for the dynamics of charged particles under the influence of magnetic fields, which we will use these to analyze the Lyapunov exponents of these systems and find interesting periodic trajectories.
3) With Josh Burby and Robert McKay: Professor McKay has refined the definition of quasisymmetric magnetic fields. During the program Josh and I have been discussing their geometry and hopefully in the near future we will be able to obtain some stronger results about their properties.

I have also continued working on the dynamics of confinement of charged particles in manifolds with boundary of different dimensions. I have found new interesting examples in 3 dimensions and developed some new numerical simulations.

Some papers i have worked on during my stay were:
"The Hamiltonian Dynamics of Magnetic Confinement in Toroidal Domains" (submitted) https://arxiv.org/abs/1711.05388
"Examples of Magnetic Confinement in 3 dimensional tori" (in preparation)

Overall it was a great experience and I am very grateful for being able to interact with so many different mathematicians, learn so much and develop my work here for the past 6 months.

Miloshevich, George

Name: George Miloshevich
Year of Ph.D.: 2018
Institution of Ph.D.: The University of Texas at Austin
Dissertation title: Hamiltonian description of Hall and sub-electron scales of collisionless plasmas with reduced fluid models
Ph.D. advisor: Philip J. Morrison

Mentor while at MSRI: Zensho Yoshida

Institution prior to obtaining the MSRI PD fellowship: The University of Texas at Austin
Position at that institution: Graduate Student
Mentor (if applicable): Philip J. Morrison

Institution (or company) where you are going after MSRI: Observatoire de la Côte d'Azur
Position: Postdoctoral researcher

Anticipated length: 16 months
Mentor (if applicable): Emenaule Tassi

Postdoctoral fellow's comments:
I have greatly benefited from my stay at MSRI during the program "Hamiltonian systems, from topology to applications through analysis". It was fruitful in that I have started new, interesting projects and made progress in addressing the older questions I had from my dissertation. While a semester appears to me as a relatively short time to accomplish one specific task, it serves well to connect researchers working on related problems as well as those from further disciplines and start new projects. In fact, the program exposed me to quite a broad spectrum of people working in PDEs, symplectic topology, Hamiltonian dynamical systems, celestial mechanics and plasma physics who communicated their work through workshops, seminars as well as tea-time conversations at MSRI. Furthermore, the directives from administration/organizers made it inevitable for the participants to develop friendly relationships and exchange ideas.

I believe that the connections I have made here as well as the prestige provided by this place are going to be quite beneficial in my future academic career. For instance, I have started several collaborations, one involving another postdoctoral fellow at MSRI, Joshua Burby, with whom we set out to describe the evolution of plasma, prepared in a state where electromagnetic waves (higher frequency modes) are suppressed. In the process I have learned a useful technique for deriving asymptotic expansion to a reduced model on the so-called slow manifold that truncates the fast oscillations present in the full system (of particular interest for me was how the perturbed infinite-dimensional symplectic form, that describes the dynamics of the system using Hamilton's equations, can be deformed into the unperturbed where the small parameter, the inverse speed of light in our case, is set exactly to zero). In addition, I have started a collaboration with Emanuele Tassi (my future mentor) who while visiting MSRI this semester expressed interest in pursuing Hamiltonian formulations of relativistic spin-fluid systems coupled to general relativistic magnetohydrodynamic equations with some applications to astrophysics. Jeffrey Heninger, a graduate student at MSRI, is also involved in the project. I have had interesting discussions with Cesare Tronci (also visiting MSRI), regarding difficulties associated with ignoring quantum correlations in this system. The project is in the early stage, and I expect to work part time on it in Observatorie Cote d'Azur, Nice. Next year I plan to write two or three papers based on the material above.

Overall, I would like to express my deepest acknowledgements to both organizers and the generous donors that made our work possible. The

experience was further enhanced by the staff members who have created friendly atmosphere at work and have swiftly carried out the administrative tasks.

Toprak, Ebru

Name: Ebru Toprak
Year of Ph.D.: 2018
Institution of Ph.D.: University of Illinois at Urbana-Champaign
Dissertation title: GLOBAL DYNAMICS OF SCHRODINGER AND DIRAC EQUATIONS
Ph.D. advisor: M. Burak Erdogan

Mentor while at MSRI: James Meiss - Adrian Tudorascu

Institution prior to obtaining the MSRI PD fellowship: University of Illinois at Urbana-Champaign
Position at that institution: Graduate Student
Mentor (if applicable): M. Burak Erdogan
Institution (or company) where you are going after MSRI: Rutgers University
Position: Hill Assistant Professor
Anticipated length: 2.50 years
Mentor (if applicable): Avraham Soffer - Shadi Tahvildar-zadeh - Michael Kiessling

Postdoctoral fellow's comments:
Coming to MSRI right after I finished my Ph.D program has been extremely beneficial for me. My Ph.D studies focused on understanding the long time behavior of certain linear differential equations and my main purpose to join this program was to learn about nonlinear equations. In this path, I believe the workshops and seminar talks helped me a great deal. Even though I did not have the chance to start a new project at MSRI, my discussions with other postdocs stimulated my understanding on the behavior of some systems on certain manifolds.

MSRI provided me with a semester in which I did not have to teach. I believe this was a vey good opportunity. Instead of having to prepare lecture notes, I was able to focus on learning and producing. During my time at MSRI, I was able to finish a paper on the fourth order Schrodinger equation with my collaborator William R. Green. The paper has been submitted. We started a follow up paper together with M. Burak Erdogan.

I feel highly privileged being admitted by MSRI. Spending a semester in such a prestigious Institute will come with many other opportunities. I strongly believe that the connections that I made and the prominence that I gained will open new doors for my future.

Vargas, Rosa Maria

Name: Rosa Maria Vargas Magana
Year of Ph.D.: 2017
Institution of Ph.D.: Universidad Nacional Autonoma de Mexico
Dissertation title: Nonlocal shallow water wave models over variable topography
Ph.D. advisor: Professor Panayotis Panayotaros

Mentor while at MSRI: Professor Wilfrid Gangbo

Institution prior to obtaining the MSRI PD fellowship: Universidad Nacional Autonoma de Mexico
Position at that institution: Ph.D. student in Mathematics
Mentor (if applicable): NA
Institution (or company) where you are going after MSRI: University of Edinburgh at School of Mathematics
Position: Postdoctoral researcher
Anticipated length: 1 year
Mentor (if applicable): Professor Noel Smyth

Postdoctoral fellow's comments:
This postdoctoral experience at MSRI has been extremely productive and enjoyable. It was fantastic in all aspects that I will now describe briefly:

1. Participating in this program has broadened my knowledge and has expanded enormously my research interests in KAM theory, Dynamical Systems, Computer-assisted proofs, Averaging theory, Plasma Physics theory, Celestial Mechanics, Arnold Diffusion theory, Symplectic methods, Optimal transport theory and Mean Field games. I also expanded my experience in PDE equations arising in other disciplines.

2. At MSRI I found the perfect environment to generate very useful and enlightening discussions about mathematics, physics and about important academic topics with all the participants at the program. I had the great and unique opportunity to meet and talk about mathematics with outstanding researchers from around the world and other disciplines. I met and shared this wonderful experience with 13 postdocs at MSRI and several graduate students who also enjoyed the friendly atmosphere with the experienced researchers in the program. This program brought together many women mathematicians, who are inspiring and passionate. The connections formed here, both mathematical and personal will have a big impact on my research by creating new collaborations and networks.

3. The seminars, talks and lectures organized throughout the semester and during the workshops were very inspiring and provided an overview

of current active research areas in Hamiltonian Systems. The Program on Hamiltonian systems, from topology to applications through analysis was very well organized and MSRI provides a very supportive environment. The beautiful surrounding and the facilities are very positive and unique to stimulate research.

4. My experience with my mentor was excellent. I maintained close communication with my mentor Professor Wilfrid Gangbo throughout the whole program. We talked about my research interests and the projects I am pursuing. He gave me important advice on grant proposal writing, postdoctoral applications, and he gave me some very good feedback about my talks. I also attended his lectures on Topics in Analysis at UC Berkeley.

5. I participated in all the Workshops of the Program, I attended several talks of the seminars organized at MSRI such as Lunch with Hamilton seminar, Hamiltonian Seminar, Hamilton Colloquium, and the Grad Student Seminar. In the Hamiltonian Seminar I presented the talk on: A Whitham-Boussinesq water wave model and simple approximations of the nonlocal variable depth Dirichlet-Neumann operator (https://rosamariavargasmagana.files.wordpress.com/2018/12/Pres1.pdf). I participated in the Post-doc Workshop organized by Ebru Toprak and Tere Seara. I presented the talk on: Linear Whitham-Boussinesq modes in channels of constant cross-section and trapped modes associated with continental shelves (https://rosamariavargasmagana.files.wordpress.com/2018/12/Pres2.pdf). I also did a presentation in the Special event at MSRI with Noetherian Ring and women at MSRI about my work, accessible to graduate students from a variety of disciplines. Title: Surface water waves, from theory to applications: the problem of anomalous amplications of semidiurnal tides in the coast of Taiwan (https://rosamariavargasmagana.files.wordpress.com/2018/12/Pres3.pdf).

During my stay at MSRI, I was able to finish one manuscript and keep working on others, also I got some ideas to develop more interesting projects. Most of these ideas were raised up from discussions and approaches that I maintained with other participants and from their outstanding recommendations.

Submitted manuscripts and working on
I achieve the final version of the Manuscript: Linear Whitham-Boussinesq modes in straight channels of variable depth during the rst month of the program I submitted this manuscript by September 18, 2018. https://arxiv.org/abs/1809.09966 Then, motivated by some techniques developed in this paper and by reading recent literature in my topics of research. I recovered other unfinished manuscript on

Approximate Dirichlet-Neumann operator for sloping beach profiles and the manuscript on Bloch Theory, Spectral Gaps and Wannier Functions using approximate variable depth Dirichlet-Neumann operator for water waves.

Projects to begin

1. Numerical continuation of periodic traveling waves for the Whitham-Boussinesq system in variable depth. The aim of this project is to provide an exhaustive numerical analysis of the effects on the Stokes wave train for different choices of wavelengths and wave amplitude of variable depth. With Professor Alex Haro I would like to explore computer-assisted proofs of the existence of periodic orbits.

2. Trapped longitudinal modes along Continental shelves. Spectrum analysis of approximate variable depth Dirichlet-Neumann operator for water waves in 3D. The goal is to use spectral decomposition methods to separate the eigenfunctions that decay at innity from those that have oscillatory behavior. An extended study of the spectrum of this pseudo-differential operator associated with trapped modes along Continental shelves has been strongly inspired by the talks given by Professor Chongchun Zeng and Professor Margaret Beck.

3. Averaging theory (Nonlinear modulation theory) applied to the Whitham- Boussinesq equations in
at bottom and variable depth for the long-term evolution asymptotic analysis of the solutions of this system. Motivated by discussions with Professor Wilfrid Gangbo and Professor Robert Deward I revisited the Lagrangian formulation of the Water waves problem to extend the range of applicability of the surface waves we can describe. The aim is to obtain the modulations equations associated with the system.

Ideas to develop interesting projects

1. Paradifferential formulation of the Zakharov-Craig-Sulem water waves developed by Alinhac, Metivier, Alazard, Lannes with the aim to explore the pseudodi
erential operators arising in this formulation when topography is considered. This project has been motivated after some discussions with Professor Jean-Marc Lenard at MSRI.

2. Triadic-resonances in the Whitham-Boussinesq system when we consider bathymetry. This project has been motivated by the numerical computation of the full bandwidth of the normal modes for different athymetries. Recent work of Professor Marcel Guardia and Ph.D. Victor Vilaca Da Rocha presented at MSRI was very inspirational to revisit this problem.

3. Explore the nearly Hamiltonian formulation of a water waves model with constant vorticity in variable depth. With Mr. Luca Franzo.

Finally, I would like to thank Professor Craig Huneke and all the generous donors, including the National Science Foundation that was made possible this fellowship and this program. It was a privilege to participate as a postdoc here and I am very grateful for the wonderful experience I have had at MSRI. I feel that this semester has contributed greatly to my professional development and certainly will help me when I apply for my next postdoctoral or tenure-track position.

Vilaça Da Rocha, Victor

Name: Victor Vilaça Da Rocha
Year of Ph.D.: 2017
Institution of Ph.D.: Université de Nantes (France)
Dissertation title: Emphasising nonlinear behaviors for cubic coupled Schrödinger systems.
Ph.D. advisor: Benoît Grébert and Laurent Thomann

Mentor while at MSRI: Alex Haro and Rafael de la Llave

Institution prior to obtaining the MSRI PD fellowship: BCAM - Basque Center for Applied Mathematics (Bilbao, Spain)
Position at that institution: Postdoc
Mentor (if applicable): Luis Vega

Institution (or company) where you are going after MSRI: BCAM - Basque Center for Applied Mathematics (Bilbao, Spain)
Position: Postdoc
Anticipated length: 8 months
Mentor (if applicable): Luis Vega

Postdoctoral fellow's comments:
During this semester, I have the opportunity to give two seminars in MSRI to present my work (one in November, one in December). Furthermore, I also gave a seminar in UC Berkeley to share my mathematics with a new public in October. In the three cases, I'm really happy I had this chance to present some works, and the questions I had gave me new ways of extending these works.

I came in MSRI with a clear idea of a phenomena I wanted to understand. Today, if anything is still written, I have the certitude that I'm on the right way. In particular, I spoke about this with some people of Barcelona in MSRI (Alex Haro, Tere Serea, Amadeu Delshams and Pau Martins in particular), and we already planned to meet again in next January to continue working on this problem.

From this point of view, I'm really happy of the works I did in MSRI. I learned news mathematics, I met amazing people (research members such as MSRI members), and I discovered a really nice city.

I also take advantage from this position to create contacts with new people I want to work with, and I send two applications for new postdoc positions thanks to the people I've met here. Finally, I've no doubts that the participation in such an amazing semester has already a positive impact in my CV, and I'm sure it will help me for next applications. Therefore, my experience in MSRI in truly beneficial, even more than what I was expected, and I warmly thank all the people which made this semester stands.

I really doubt I would have formed either of this relationships had it not been for my time at MSRI, and for this I am extremely grateful.

Yu, Guowei

Name: Guowei Yu
Year of Ph.D.: 2013
Institution of Ph.D.: University of Minnesota-Twin Cities
Dissertation title: Homoclinic and Heteroclinic Orbits in Lagrangian Dynamical
Systems
Ph.D. advisor: Richard Moeckel

Mentor while at MSRI: Richard Montgomery

Institution prior to obtaining the MSRI PD fellowship: University of Turin, Italy
Position at that institution: Postdoc
Mentor (if applicable): Susanna Terracini
Institution (or company) where you are going after MSRI: Chern Institute of Mathematics, Nankai University, China
Position: Research Fellow
Anticipated length: Tenure-Track

Postdoctoral fellow's comments:
New research project: during my time at MSRI, I started a new research project with Richard Montgomery (my mentor at MSRI), Richard Moeckel (my Ph.D. thesis advisor and a research member at MSRI during the program) and Nathan Duignan (a visit graduate student from University of Sydney) on "Scattering of the planar three body problem with prositive energy". This project is still in an early stage, it may take another year to reach the final result we want. For the moment we have partially recovered some classical result that we needed and seem to be lost in the literatures. In particular our approach gives a more modern interpretation of this classical result.

Continued research project: at the same time, I have been working on two projections initiated before my arrival at MSRI: "Variational construction for heteroclinic orbits of the N-center problem" (joint with Kuo-Chang Chen from National Tsing Hua University), "An Index Theory for Singular Solutions of the Newtonian n-body Problem" (joint with Xijun Hu from Shandong University and Yuwei Ou from Sun Yat-Sen University). At this moment, we have already produced preliminary drafts of the results that we want in both projects and hope to have preprints ready to submit sometime next year.

Other activities: Together with Richard Montgomery, we organized a weekly seminar on "Celestial Mechanics" during the program. Besides members associated with the program, speakers of our seminar also including Mitsuru Shibayama, an associated professor from Kyoto University. I was also invited to give a talk at the Mathematical Biology and Dynamical System Seminar at Ohio University

Future Impact: Although I have already accepted a tenure-track position before I came to MSRI, I have no doubt that the new connections that I established and new ideas that I learned during my time at MSRI will be extremely rewarding in my future research and career.

Zhang, Jianlu

Name: Jianlu Zhang
Year of Ph.D.: 2014
Institution of Ph.D.: Nanjing University
Dissertation title: Asymptotic trajectories of the KAM torus
Ph.D. advisor: Cheng Chong-Qing

Mentor while at MSRI: Tere M. Seara

Institution prior to obtaining the MSRI PD fellowship: University of Maryland, College Park
Position at that institution: Postdoctor
Mentor (if applicable): Vadim Kaloshin

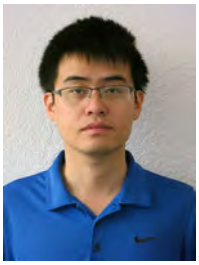
Institution (or company) where you are going after MSRI: Academy of Mathematics and Systems Science, Chinese Academy of Sciences.
Position: Assistant Researcher
Anticipated length: Tenure-track
Mentor (if applicable): None

Postdoctoral fellow’s comments:
I really enjoy my staying in the MSRI. Berkeley is a peaceful city and we can focus on our research without any bother. Several collaborations are made in this place. Joint with my mentor, Tere Seara, we figured out

the instability of the restricted 4 body problem, and follow this framework there are 2 papers in writing. One is almost done, it's about the oscillatory orbits in this setting. The other one, concerning the diffusion orbits, is in progress now.

Another collaboration is with the Dr. Marcel Guardia. We can trying to find erratic dynamics in the restricted 3 body problem, e.g. the infinitely many elliptic islands, and the estimate of the Hausdorff dimension of the oscillatory orbits. As the first step, we need to construct the separatrix map for this model. With a non area-preserving approach, we have already give the expression for this map. We are still simplifying it to adapt it to the further applications.

In such a short time, MSRI did a good job to gather so many experts together, and condense their inspiration together, which will definitely lead to a fruitful result. Thanks to the energetic staffs and effective policies, they keep the MSRI running smoothly and fast.



Zhang, Lei

Name: Lei Zhang
Year of Ph.D.: 2017
Institution of Ph.D.: Georgia Institute of Technology
Dissertation title: Analysis and Numerical Methods in Solid State Physics and Chemistry
Ph.D. advisor: Rafael de la Llave

Mentor while at MSRI: Vered Rom-Kedar

Institution prior to obtaining the MSRI PD fellowship: University of Toronto
Position at that institution: Postdoc
Mentor (if applicable): Ke Zhang and Konstantin Khanin

Institution (or company) where you are going after MSRI: University of Toronto
Position: Postdoc
Anticipated length: 1.5 years
Mentor (if applicable): Ke Zhang and Konstantin Khanin

Postdoctoral fellow's comments:
MSRI is probably the best place in the world to do research. It provide a quiet and beautiful environment to focus on our work. It also provide the opportunity for us to interact and collaborate with a ton of people, including leading experts in the field and promising junior researchers. Here, I started quite a few collaborations with people from all over the world. I started working with my mentor, Vered Rom-Kedar, on the properties of a new family of interval exchange maps she discovered. I

started working with Renato Calleja on studying the properties of rotational standard map using parameterization method. I started working with Gonzalo Contreras and Alfonso Sorrentino on the Aubry-Mather Theory and homogenization on foliations. I started working with Jianlu Zhang on the properties of Peierls barrier on generalized Frenkel-Kontorova model on Z^d. Some of them may become papers eventually. Many of these opportunities will not be possible without the program. I'm not looking for a position right now since my previous position hasn't finished. But I learned about several possible positions and I will probably apply to some of them in the future. All in all, this program in MSRI helped me start to consider different problems, interact and collaborate with different people, which enables me to develop essential skills for future jobs and future life.

DERIVED ALGEBRAIC GEOMETRY

Achinger, Piotr

Name: Piotr Achinger
Year of Ph.D.: 2015
Institution of Ph.D.: University of California at Berkeley
Dissertation title: K(pi, 1) Spaces in Algebraic Geometry
Ph.D. advisor: Arthur Ogus

Mentor while at MSRI: Wiesława Nizioł

Institution prior to obtaining the MSRI PD fellowship: IMPAN Warsaw
Position at that institution: Assistant Professor
Mentor (if applicable):

Institution (or company) where you are going after the MSRI PD fellowship: IMPAN Warsaw
Position: Assistant Professor
Anticipated length: 7 years
Mentor (if applicable):

Postdoctoral fellow's comments:
I was delighted to spend this semester at the MSRI. My interests fit roughly in between the two programs (DAG and BGMS), so I had a great many opportunities to engage in scientific collaboration and learned a lot of new concepts and ideas. Things I have been thinking about while at the MSRI (some of them are at a very early stage of development) are listed below. This has been a very intense semester and it would be difficult to summarize everything.

1) Homotopy types for varieties defined by formal Laurent series
This is an ongoing project with Mattia Talpo (London/Pisa) who visited the MSRI twice during the semester. We benefited greatly from

discussions with Bhargav Bhatt, Martin Olsson, Elden Elmanto, Wiesława Nizioł, Pierre Colmez, Jakub Witaszek, and Mauro Porta. Another postdoc in the DAG program, Tasos Moulinos, is also interested in a similar questions.

2) Compactification for log schemes
Again with Mattia Talpo, we started thinking about extending the Nagata compactification theorem to logarithmic schemes, conjectured by Shiho.

3) F-splittings and liftings mod p^2, degenerations
In a paper with Maciej Zdanowicz, we construct "canonical coordinates" on deformation spaces of certain varieties in characteristic p. Following a suggestion of Sean Keel, I am trying to investigate a surprising connection between these coordinates and a different conjectural coordinate system coming from mirror symmetry ideas. Discussions with Jakub Witaszek and Tony Yu were very inspiring.

4) Irregular connections
I have been interested in irregular singularities of differential equations for some time. During this semester, a number of mathematicians (Nikita Rosenblyum, Dima Arinkin, Helene Esnault, and others) started a seminar devoted to this topic, from the perspective of the geometric Langlands program.

5) Prismatic cohomology
I am very interested in p-adic cohomology theories, having had quite a bit of contact with p-adic Hodge theory in the past. I attended and gave a talk in the prismatic cohomology seminar.

6) Non-archimedean aspects of o-minimality
A short-lived seminar I co-organized with my mentor, Wiesława Nizioł.

I don't think the fellowship helped me with finding a position, since I have already secured that before coming to the MSRI.

Bobkova, Irina

Name: Irina Bobkova
Year of Ph.D.: 2014
Institution of Ph.D.: Northwestern University
Dissertation title: Resolutions in K(2)-local homotopy theory at p=2
Ph.D. advisor: Paul G. Goerss

Mentor while at MSRI: Michael Hill

Institution prior to obtaining the MSRI PD fellowship: Institute for Advanced Study

Position at that institution: Member

Institution (or company) where you are going after the MSRI PD fellowship: Institute for Advanced Study
Position: Member
Anticipated length: until July 31, 2019

Institution (or company) where you are going after the MSRI PD fellowship: Texas A&M University (August 16, 2019 - onwards)
Position: Assistant Professor
Anticipated length: tenure-track

Postdoctoral fellow's comments:
I have worked on several projects during my fellowship. I have been doing revisions on the submitted paper "Spanier--Whitehead duality in the K(2)-local category at p=2". I have worked on the projects which I started before arriving at MSRI: "The exotic Picard group of the K(2)-local category at p=2" with A. Beaudry, P. Goerss and H.-W. Henn and "The K(3)-localization of a finite complex" with A. Beaudry an P. Bhattacharya. While at MSRI I started working with T. Barthel, P. VanKoughnett and C. Westerland on two projects which are in early stages. In addition, I've had several useful conversations with M. Hill and V. Stojanoska.

I did find the MSRI experience beneficial because many people with interests and background similar to mine were also at MSRI and it was easy to begin conversations on projects that were interesting to all of us. Normally, all of us are at different universities, geographically far from each other and it would be hard for us to meet if it wasn't for MSRI.

Brantner, David Lukas Benjamin

Name: David Lukas Benjamin Brantner
Year of Ph.D.: 2017
Institution of Ph.D.: Harvard University
Dissertation title: The Lubin-Tate Theory of Spectral Lie Algebras
Ph.D. advisor: Jacob Lurie
Mentor while at MSRI: David Gepner

Institution prior to obtaining the MSRI PD fellowship: Merton College, Oxford University
Position at that institution: Junior Research Fellow
Mentor (if applicable): Ulrike Tillmann

Institution (or company) where you are going after the MSRI PD fellowship: Merton College, Oxford University
Position: Junior Research Fellow

Anticipated length: (if it is a tenure track position just write tenure-track): about 2.5 years.
Mentor (if applicable): Ulrike Tillmann

Postdoctoral fellow's comments:
I wish to thank MSRI, its supporting institutions and individuals, and the organisers for giving me the opportunity to participate in this outstanding programme. Over these past 4 months, I have benefitted greatly from the productive and supportive atmosphere at MSRI, where I could work around many of the global leaders of my field.

First, I concluded my work on a paper with Mathew on "Deformation Theory and Partition Lie algebras". In this project, we introduce the correct notion of Lie algebras in finite and mixed characteristic for the purposes of deformation theory. Indeed, we prove that our partition Lie algebras are sufficiently powerful to capture formal moduli problems in these contexts, thereby generalising a result of Lurie and Pridham (which was in turn based on work of Deligne, Drinfeld, and Feigin). Moreover, we describe the operations acting on the homotopy groups of partition Lie algebras. An 89-page preprint was made public under arXiv identifier 1904.07352, and the paper was recently submitted to a journal.

During my time at MSRI, I had the opportunity to present this research in several talks. First, I delivered a general audience talk at the annual academic sponsor's meeting. The unusually senior and mathematically diverse audience made this a particularly rewarding experience. During the days after this meeting, I had the opportunity to discuss my research with Stephen Della Pietra, the sponsor of my fellowship, and several other distinguished members of the MSRI Board of Trustees. I also presented my work in the MSRI derived algebraic geometry seminar, the MIT topology seminar (my visit to Cambridge was supported by the academic sponsor's programme), and in Constantin Teleman's deformation theory seminar.

These talks increased the visibility of my research outside my usual community, which is particularly helpful as partition Lie algebras are constructed using homotopy theory, but address questions in classical algebraic geometry in finite and mixed characteristic. In discussions related to my talks, I learned about further potential applications of partition Lie algebras. I was recently invited to three further seminar talks in Strasbourg, Paris, and Princeton, and asked to join an ongoing collaboration on related questions.

I have made progress on several other research goals, often in collaboration with other members of one of the two programmes:

1. In a forthcoming paper with Knudsen and Hahn, we use the main theorem of my PhD thesis and a result of Knudsen to compute the Lubin-Tate homology groups of certain configuration spaces, thereby addressing a circle of old conjectures by Ravenel. At chromatic height 1, our project studies complex vector bundles on configuration spaces. In several Skype meetings during this semester, we made substantial progress in our understanding of the differentials in the relevant spectral sequence, which allowed us to significantly improve our previous results. We hope to submit this paper in the near future. I am currently also working on a generalisation of this project to the mod p homology of manifolds (using the operations on partition Lie algebras mentioned above).

2. In a related project, I managed to establish a relation between the p-completed complex K-theory of the two-fold loop space of the three-sphere and the theory of prisms of Bhatt and Scholze. While I was not able to come up with a computation-free proof yet, I found an argument based on the old work of Langsetmo. I benefited from helpful conversations with Bhatt and Hesselholt, and also from the prismatic cohomology learning seminar.

3. Together with Heuts, Hahn, and Yuan, we managed to prove that nilpotent v_n-periodic Lie algebras are complete, which allows us to deduce that various new spaces have convergent v_n-periodic Goodwillie towers. This complements my earlier paper “The v_n-periodic Goodwillie tower of wedges and cofibres“ with Heuts, in which we constructed several simple examples of spaces with divergent tower. Our collaboration benefited greatly from our joint participation in both the MSRI conference “Derived algebraic geometry and its applications” and the Oberwolfach Arbeitsgemeinschaft on elliptic cohomology.
4. In ongoing joint work with Mathew (and potentially also Antieau-Nikolaus), we try to develop Cartier theory for derived formal abelian groups, thereby partially relying on the theory of partition Lie algebras. During this term, I managed to compute the zeroth homotopy group of the free derived commutative formal group on the affine line.

5. Together with Westerland, we study Lie algebras in braided monodical oo-categories in order to get a better understanding of primitives of braided Hopf algebra. Eventually, we hope to apply our theory to the study of Hurrwitz spaces. This project is potentially related to the aforementioned project with Knudsen and Hahn.

6. Together with Wheldon, a member of the parallel binational geometry programme, we try to extend a known correspondence between finite purely inseparable morphisms of height 1 and foliations to higher heights using partition Lie algebras. Moreover, we try to interpret the

Dyer-Lashof-like operations acting on partition Lie algebras in terms of concrete geometric constructions.

I also held more informal discussions with Paul VanKoughnett; our aim is to extend an older computation of myself and Boxer of the equivariant Picard group of the special affinoid in Drinfeld upper half space to the entire Drinfeld upper half space. Moreover, I held discussions with Piotr Achinger on conditions under which a BTT theorem could hold true in characteristic p.

My research was supported by very helpful regular meetings with my mentor David Gepner, during which we discussed my progress on some of the above projects. Moreover, we came up with several candidate functors constructing partition Lie algebras from spaces: the eventual goal is to construct Lie algebraic models for (nilpotent) p-local spaces, thereby generalising theorems of Mandell and Heuts. Our discussions also helped me in deepening my understanding of elliptic cohomology. This was developed further in the MSRI elliptic cohomology learning seminar (organised by Gepner) and the Oberwolfach Arbeitsgemeinschaft on this same topic, where I delivered two talks.

My time at MSRI was both happy and productive, and therefore extremely beneficial to me. I hope that the recent visibility of my finished research, the further development of ongoing research, and the initiation of new projects in the intersection of geometry and homotopy theory will eventually help me in finding a position once I will apply for tenure track jobs.

Elmanto, Elden

Name: Elden Elmanto
Year of Ph.D.: 2018
Institution of Ph.D.: Northwestern
Dissertation title: Motivic Contractibility of the Space of Rational Maps
Ph.D. advisor: John Francis

Mentor while at MSRI: Benjamin Antieau

Institution prior to obtaining the MSRI PD fellowship: University of Copenhagen
Position at that institution: Postdoc
Mentor (if applicable): Lars Hesselholt

Institution (or company) where you are going after the MSRI PD fellowship: Harvard University
Position: Benjamin Peirce Fellow (postdoc)
Anticipated length: 3 years
Mentor (if applicable): Mike Hopkins

Postdoctoral fellow's comments:
My stint at MSRI has been extremely productive, if not, the most productive time of my mathematical careers so far. I will break down the research narratives I pursued or started pursuing during my stay in MSRI in the following paragraphs.

1. Milnor excision in motivic homotopy theory (with Marc Hoyois, Ryomei Iwasa and Shane Kelly). We pursued the idea that invariants of schemes which are represented in Morel-Voevodsky's category of motivic spectra could have Milnor excision. While we were not able to prove this in full generality, we were able to do so for those with "torsion coefficients" and over a field. We are currently writing up the paper and it is almost complete. This collaboration also benefited from discussions with participants, namely, Ben Antieau, Bharghav Bhatt, Akhil Mathew and Kestutis Cesnavicius.

2. Semiorthogonal Decompositions and Etale Descent (with Benjamin Antieau). We proved a general criterion for descending semiorthogonal decomposition along etale morphisms. The write-up is also nearly finished.

3. Spaces of algebraic cobordism (with Marc Hoyois, Adeel Khan, Vladimir Sosnilo and Maria Yakerson). I finished working on the final details of a project about describing the infinite loop spaces of algebraic cobordism at MSRI. A lot of these were sorted out at MSRI while Marc Hoyois was here.

4. Power operations on normed motivic spectra (with Jeremiah Heller and Tom Bachmann). I also finished the final details on a 3-part paper constructing power operations on normed motivic spectra over the mod-2 motivic cohomology spectrum. Again a lot of these details were sorted out at MSRI while Jeremiah Heller was here.

All in all, the ability to pop by the office of the world expert at a particular subject was extremely beneficial. I do not see any other environment except this DAG semester at MSRI where this could have been possible.

Kanstrup, Tina

Name: Tina Kanstrup
Year of Ph.D.: 2015
Institution of Ph.D.: Aarhus University
Dissertation title: Demazure descent theory
Ph.D. advisor: Sergey Arkhipov

Mentor while at MSRI: Sam Raskin

Institution prior to obtaining the MSRI PD fellowship: Aarhus University
Position at that institution: Visiting scientist

Institution (or company) where you are going after the MSRI PD fellowship: University of Massachusetts at Amherst
Position: postdoc
Anticipated length: 3 years
Mentor (if applicable): Alexei Oblomkov

Postdoctoral fellow's comments:
My primary research area is geometric representation theory which is an adjacent field to derived algebraic geometry. When I came I had a project in mind that requires DAG but no real idea of how to approach it, so my primary goal in coming to MSRI was to properly learn to work with DAG. I learned a lot from talking to people that I would be very unlikely to have figured out on my own. Among the people I've talked to are Sam Raskin, David Nadler, Dima Arinkin, Nick Rozenblyum, Sarah Scherotzke, Nicolò Sibilla, Eugene Gosky (UC Davis), Ivan Mirkovic and Constantin Teleman. I also learned a lot from organizing the DAG learning seminar. The problem I'm working on is a piece of a much bigger story and I had hoped that it would be easy for the right people working in the area. However, it turned out to be harder than anticipated. I started collaborating with David Nadler about this and I'm confident that we can solve it together.

Moulinos, Tasos

Name: Tasos Moulinos
Year of Ph.D.: 2018
Institution of Ph.D.: University of Illinois at Chicago
Dissertation title: Invertibility and Topological K-theory
Ph.D. advisor: Benjamin Antieau; Brooke Shipley

Mentor while at MSRI: Markus Spitzweck

Institution prior to obtaining the MSRI PD fellowship: CNRS, University of Toulouse (France)
Position at that institution: Postdoc
Mentor (if applicable): Bertrand Toën

Institution (or company) where you are going after the MSRI PD fellowship: CNRS, University of Toulouse (same as above)
Position: Postdoc
Anticipated length: 2 years
Mentor (if applicable): Bertrand Toën

Postdoctoral fellow's comments:
My time at MSRI led to a number of new research ideas. Partly through conversations, with my mentor Markus Spitzweck, I had an idea for a new paper to write on filtrations in the spectral setting. I also continued work on my main current project alongside my collaborator Marco Robalo, who was at MSRI for several months as well. I gave a lecture on this project in the derived algebraic geometry seminar. I believe that my time at MSRI was a unique oppurtunity; it was a very active semester and feel lucky to have been able to be exposed to the various seminars and discussions that have taken place. I am sure this will help me both in terms of the connections made with other researchers, and in terms of better understanding where my own ideas fit within the larger picture. I am sure this will help me in my future employment endeavors.

Speirs, Martin

Name: Martin Speirs
Year of Ph.D.: 2018
Institution of Ph.D.: University of Copenhagen
Dissertation title: On the algebraic K-theory of coordinate axes and truncated polynomial algebras
Ph.D. advisor: Lars Hesselholt

Mentor while at MSRI: Hélène Esnault

Institution prior to obtaining the MSRI PD fellowship: University of Copenhagen
Position at that institution: Ph.D student

Institution (or company) where you are going after the MSRI PD fellowship: n/a
Position: n/a
Anticipated length: n/a

Postdoctoral fellow's comments:
My experience as a postdoctoral fellow at MSRI was very postive. Having just finished my Ph.D a few months prior I was in need of some time to submit papers from my thesis on the one hand, and to start new projects on the other. The fellowship was helpful for both purposes. During the first couple of months I finished two papers from my thesis and submitted them to journals. I also had several opportunities to explain my work to researchers within my field, such as Benjamin Antieau, Matthew Morrow, Tasos Moulinos, Elden Elmanto, and Lukas Brantner. During the semester I have interacted with a lot of researchers at the forefront of my area (topology, K-theory, arithmetic geometry) such as Benjamin Antieau, Akhil Mathew, Matthew Morrow, Georg Tamme, Martin Olsson, Weislawa Niziol, David Gepner, Tobias Barthel, and Bhargav Bhatt.

Over the course of the semester I developed several new ideas and research projects, most of which are now under way. With Elden Elmanto I am discussing a potential analytic and overconvergent version of topological Hochschild homology. With Ryomei Iwasa I am working on the question of computing K-theory of normal crossings, following work of Land-Tamme. With Sanjana Agarwal I am working on computing topological cyclic homology of some quasi-regular semiperfectoid algebras. I am also working on extensions of my thesis work in several directions. All of these projects were started during my fellowship.

Regarding my search for positions after the fellowship I have received letters of recommendation and a lot of advice from senior members of the programme. I am confident that my fellowship will help me both in my immediate future finding a position, and also later since I now have a much greater network of people to contact regarding research and career advice.

VanKoughnett, Paul

Name: Paul VanKoughnett
Year of Ph.D.: 2018
Institution of Ph.D.: Northwestern University
Dissertation title: Localizations of E-theory and transchromatic phenomena in stable homotopy theory
Ph.D. advisor: Paul Goerss

Mentor while at MSRI: Craig Westerland

Institution prior to obtaining the MSRI PD fellowship: Purdue University
Position at that institution: Golomb Visiting Assistant Professor

Institution (or company) where you are going after the MSRI PD fellowship: (same as above)
Anticipated length: 3 years total, 2 more starting next year

Postdoctoral fellow's comments:
I spent much of the beginning of the semester on old collaborations - a paper on tmf-cooperations with Dominic Culver (still in progress) and one on Goerss-Hopkins obstruction theory with Piotr Pstragowski. Though neither of my coauthors was here, I found the supportive research environment, and the wonderful audience of homotopy theorists to share my work with, incredibly helpful.

I also got a lot out of the numerous seminars and reading groups, particularly one on prismatic cohomology and one on Lurie's approach

to elliptic cohomology, and a seminar I ran with some of the other postdocs on p-adic geometry and topological Hochschild homology. The time available for me to spend with this new and innovative material helped me move from acquaintance with it down the road to mastery. I've begun over the last month to work on a project related to elliptic cohomology that applies Lurie's technology to exterior powers of p-divisible groups.

But by far my favorite thing about working here has been collaborating. I've had a really successful collaboration with Irina Bobkova, Tobias Barthel, and Craig Westerland, using a broad mix of ideas from homotopy theory and derived algebraic geometry to get a decomposition of the Picard group of the K(n)-local homotopy category. Irina and I have also been working on a number of other projects, including one investigating relationships between notions of K(n)-local duality and one attempting to prove a conjecture of Mark Behrens about a factorization of the K(2)-local sphere into "hemispheres" having to do with elliptic curves. The work has not always been so fruitful - one of the semester's more comical moments was a collaboration on E(n)-local duality with Mike Hill, Craig Westerland, and Vesna Stojanoska, which I thought could be used to disprove the chromatic splitting conjecture for about a week before realizing that not only had I misunderstood the conjecture, but that the results themselves were 30 years old.

I'm not going on the job market next year, and it's hard to say how MSRI will affect whatever happens when I do. But mathematically speaking, my time here has helped me develop a new and more mature direction in my research. I think these programs are incredible and hope MSRI keeps doing them for years to come.

BIRATIONAL GEOMETRY AND MODULI SPACES

Bragg, Daniel

Name: Daniel Bragg
Year of Ph.D.: 2018
Institution of Ph.D.: University of Washington
Dissertation title: Twistor Spaces for Supersingular K3 Surfaces
Ph.D. advisor: Max Lieblich

Mentor while at MSRI: Martin Olsson

Institution prior to obtaining the MSRI PD fellowship: University of California, Berkeley
Position at that institution: RTG postdoctoral scholar
Mentor (if applicable): Martin Olsson

Institution (or company) where you are going after the MSRI PD fellowship: University of California, Berkeley
Position: NSF postdoctoral scholar
Anticipated length: 3 years
Mentor (if applicable): Martin Olsson

Postdoctoral fellow's comments:
I believe that being a postdoctoral fellow at MSRI this Spring was extremely helpful in jump-starting my research career. I found the two simultaneous programs in algebraic geometry fantastic. I have the impression that everyone I knew in algebraic geometry from all over the world was present at some point. I feel very lucky that I had the chance to participate in a joint program in my area the year after my PhD.

While at MSRI this Spring, I started and finished a number of joint projects with MSRI members and visitors. Max Lieblich and I completed our joint paper "Perfect points on genus 1 curves and consequences for supersingular K3 surfaces," which is now submitted for publication. I began a collaboration with MSRI member Ben Antieau, on which we are in the final stages of writing up our results. I have also been working on a project with Alex Perry and Davesh Maulik. While neither were officially attached to MSRI this Spring, they came to MSRI for program events, and our collaboration started as a result of our conversations at MSRI. Similarly, I have been working on a project with MSRI visitors Siddharth Mathur and Jack Hall. Finally, I have begun at least two other projects with MSRI members this Spring which are still in formative stages. Of these six projects, I believe that at least three would not have happened at all if it were not for the MSRI joint program this Spring, while the remaining projects were greatly accelerated.

In conversations with MSRI members and visitors this Spring, I have also developed some ideas for several personal projects which I expect will occupy me for the next few years at least.

In addition to improving my research, this program allowed me to greatly expand my network. I had the opportunity to meet many senior researchers from around the world. As a result of these meetings, I have been invited to give several talks in various locales. I expect that my activities as a postdoc in the BGMS program will be very helpful for me in finding employment in the future.

DeVleming, Kristin

Name: Kristin DeVleming
Year of Ph.D.: 2018
Institution of Ph.D.: University of Washington
Dissertation title: Moduli of surfaces in P^3
Ph.D. advisor: Sándor Kovács

Mentor while at MSRI: Elham Izadi

Institution prior to obtaining the MSRI PD fellowship: University of California, San Diego
Position at that institution: Postdoc
Mentor (if applicable): James McKernan

Institution (or company) where you are going after the MSRI PD fellowship: University of California, San Diego
Position: Postdoc
Anticipated length: Fall 2018 – Spring 2021 (3 years)
Mentor (if applicable): James McKernan

Postdoctoral fellow's comments:
I spent time at MSRI extending results in my dissertation, Moduli of surfaces in P3, and generalizing those results to higher dimensions. I collaborated with Kenneth Ascher and Yuchen Liu on our forthcoming paper, currently titled Wall crossing for K-moduli spaces of plane curves. I collaborated with David Stapleton on another paper titled Birationally simple fibrations. I also began working with Kenneth Ascher to generalize results from an existing paper joint with Amos Turchet titled Uniformity for integral points on surfaces, positivity of log cotangent sheaves, and hyperbolicity. It was beneficial to be at MSRI because my collaborators were also there; discussions are much easier in person than via Skype. I hope that my fellowship has helped introduce myself and my work to the other research members, especially senior faculty who may be instrumental in my future job search.

Flapan, Laure

Name: Laure Flapan
Year of Ph.D.: 2017
Institution of Ph.D.: University of California Los Angeles (UCLA)
Dissertation title: Hodge structures with Hodge numbers (n,0,…,0,n) and their geometric realizations
Ph.D. advisor: Burt Totaro

Mentor while at MSRI: Claire Voisin

Institution prior to obtaining the MSRI PD fellowship: Northeastern University
Position at that institution: Postdoctoral Fellow and Research Instructor

Institution (or company) where you are going after the MSRI PD fellowship: Massachusetts Institute of Technology (MIT)
Position: Postdoctoral Fellow and Pure Math Instructor
Anticipated length: 2 years
Mentor (if applicable): Davesh Maulik

Postdoctoral fellow's comments:
I had a very productive semester at MSRI. For the most part I worked on projects and collaborations that I had started prior to coming to MSRI. I revised and resubmitted two papers to journals as well as completed a rough draft of a paper for a new project I had begun just before coming to MSRI. I also began a new collaboration with two other postdocs at MSRI, Alex Perry and David Stapleton (both of whom were visiting in an unofficial capacity), which would not have been possible without the regular interaction facilitated by the program. Additionally, I helped organize together with my mentor Claire Voisin, a learning seminar to read a paper that both of us had been interested in for a long time but had found too inaccessible to read alone. I found the experience of participating in the seminar very helpful and I learned a lot of new things from it. I anticipate that what I learned will have great research implications for me in the future. Also as a result of my mentorship by Claire Voisin, I received an invitation to officially visit her in Paris this coming spring and attend her series of lectures at the College de France. This also will be of enormous professional benefit to me.

Jiang, Chen

Name: Chen Jiang
Year of Ph.D.: 2015
Institution of Ph.D.: University of Tokyo
Dissertation title: On boundedness of volumes and birationality in birational geometry
Ph.D. advisor: Yujiro Kawamata

Mentor while at MSRI: Valery Alexeev

Institution prior to obtaining the MSRI PD fellowship: Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU), University of Tokyo
Position at that institution: Project Researcher

Institution (or company) where you are going after the MSRI PD fellowship: Shanghai Center for Mathematical Sciences, Fudan University
Position: Young Investigator
Anticipated length: tenure-track

Postdoctoral fellow's comments:
I am in the BGMS program, usually I attended BGMS seminars, AG colloquia, and discussed with my mentor every week. Often I discussed with people during tea time or lunch time, but basically I worked alone on my own project.

I gave a talk in BGMS seminar about Noether inequality and a pre-talk for phd students. After my talk, Fabrizio Catanese asked my a question on the Noether inequality for 3-folds with birational canonical map. We discussed this for a while and rediscovered a result proved by Joe Harris. We are trying to work more on this direction.

When I first met with my mentor Valery Alexeev, we tried to find some problem we are both interested in to work on, but we stuck at some point. So I talked with him about my own project about the minimal log discrepancies of 3-dimensional non-canonical singularities and he gave me some suggestions. In the middle of April I figured out how to completely solve my problem and wrote up a paper "A gap theorem for minimal log discrepancies of non-canonical singularities in dimension three", arXiv:1904.09642.

I was invited to Johns Hopkins University to give two seminal talks, partially supported by MSRI postdoc grant.

I discussed with V.V. Shokurov and Jingjun Han at JHU and we started a collaboration about the index conjecture in dimension three, which is an application of my work mentioned above. Also at MSRI, I got more interested in K-stability and tried to work on some problem, but no progress yet.

I found my experience at MSRI beneficial, because I met many experts in my area, and learnt a lot of new stuff in the discussions, seminars, and workshops. Also I like the research environment here (but the weather is awful sometime) and the life in Berkeley is enjoyable. I got a lot of help from discussions with my mentor, so I appreciates the mentor program of MSRI very much.

Finally, my fellowship did not help my with finding a future position (because I already got a tenure-track position before I came), but the experience here is definitely meaningful to my career.

Liu, Yuchen

Name: Yuchen Liu
Year of Ph.D.: 2017
Institution of Ph.D.: Princeton University
Dissertation title: Kähler-Einstein metrics and normalized volumes of valuations
Ph.D. advisor: János Kollár

Mentor while at MSRI: Chenyang Xu

Institution prior to obtaining the MSRI PD fellowship: Yale University
Position at that institution: Gibbs Assistant Professor
Mentor (if applicable): Sam Payne

Institution (or company) where you are going after the MSRI PD fellowship: Yale University
Position: Gibbs Assistant Professor
Anticipated length: two years
Mentor (if applicable): Sam Payne

Postdoctoral fellow's comments:
I participated in almost all events of the BGMS program as well as a few seminars and conference talks of the DAG program. I spoke at the BGMS seminar as well as the lecture series on K-stability. I wrote a paper entitled "On the sharpness of Tian's criterion for K-stability" jointly with Ziquan Zhuang, a program associate at MSRI. I have been writing two other papers: "Wall crossing for K-moduli spaces of plane curves" joint with Kenneth Ascher and Kristin DeVleming, both are members at MSRI; "Optimal destabilization of K-unstable Fano varieties" joint with Harold Blum and Chuyu Zhou, a short term visitor and a program associate respectively. I also had many discussions with Chenyang Xu, my mentor, on the K-moduli conjecture and related problems. My stay at MSRI was very pleasant and productive. I had chances to talk to many of the top mathematicians in algebraic geometry as well as many strong young researchers. The conferences, seminars and discussions at MSRI have broaden and deepen my research direction tremendously. I think the work I have done and initiated at MSRI will be very beneficial both to my research path and to my academic career.

Martinelli, Diletta

Name: Diletta Martinelli
Year of Ph.D.: 2016
Institution of Ph.D.: Imperial College London
Dissertation title: Effective topological bounds and semiampleness questions
Ph.D. advisor: Prof Paolo Cascini

Mentor while at MSRI: Prof Carolina Araujo

Institution prior to obtaining the MSRI PD fellowship: University of Edinburgh
Position at that institution: Postdoc
Mentor (if applicable): Prof Arend Bayer

Institution (or company) where you are going after the MSRI PD fellowship: University of Glasgow
Position: Postdoc
Anticipated length: two years
Mentor (if applicable): Prof Micheal Weymss

Postdoctoral fellow's comments:
During the semester I worked on three main projects: one about birational contractions on Hyperkaehler varieties, supervised by Arend Bayer, a new project about the birational geometry of the blow up of the projective space in n very general points joint with Carolina Araujo, Ana Maria Castravet and Inder Kaur and a a new joint project with Daniel Halpern-Leistner about the modular interpretation of the target of a birational contractions of a Hyperkaehler variety. I benefited a lot from several discussions with several research members, especially on the explicit birational geometry of Fano varieties and the wall-crossing phenomena.

The experience at MSRI was very beneficial: I started new collaborations and I increased my network of professional contacts. During the semester I went to the Netherlands for job interviews in Amsterdam, Utrecht and Nijmegen. In order to prepare for that I arranged a mock interview that was very helpful. I received offers for tenure track positions from Utrecht and from Amsterdam, and I think that the mentoring I received at MSRI was an important factor in the success of the interviews.

The only comment that I feel I should make is that in the BGMS program there were mainly postdocs and very established professors, it would have been nice to have a bit more people in an intermediate level of their career to facilitate more the interactions with the young people and the more senior ones, especially at the beginning of the program.

Waldron, Joe

Name: Joe Waldron
Year of Ph.D.: 2016
Institution of Ph.D.: University of Cambridge
Dissertation title: On the Log Minimal Model Program for Threefolds in Positive Characteristic
Ph.D. advisor: Caucher Birkar

Mentor while at MSRI: James McKernan

Institution prior to obtaining the MSRI PD fellowship: Princeton University
Position at that institution: Instructor
Mentor (if applicable): János Kollár

Institution (or company) where you are going after the MSRI PD fellowship: Princeton University
Position: Instructor
Anticipated length: 1 year remaining
Mentor (if applicable): János Kollár

Postdoctoral fellow's comments:
Prior to MSRI, my ongoing research could be divided into two main parts: developing the log minimal model program (LMMP) in mixed characteristic, and investigating exotic Fano varieties over imperfect fields of positive characteristic. I have made progress on both of these during the semester at MSRI, and began new collaborations in both directions, as well as unrelated ones.

The main aim of my mixed characteristic work is to construct flips for mixed characteristic threefolds. Flips are a key part of the LMMP, which itself is at the heart of the modern birational classification of varieties. Before MSRI I had been working on this problem with Zsolt Patakfalvi, but we had hit a roadblock in the proof of a certain lifting result for our mixed characteristic analogue of test ideals. During the program we worked with Bhargav Bhatt to attempt to fix this issue, but ultimately it seems that the definition of mixed characteristic test ideal we were attempting to use was insufficient for the task. Fortunately there is another definition available coming from the work of Linquan Ma and Karl Schwede, using recent progress in commutative algebra regarding the direct summand conjecture. There are many obstacles remaining before we can apply these new objects in birational geometry, but ultimately it seems to stand more chance of success. During the program, I began new projects with Linquan Ma, Karl Schwede, Kevin Tucker and Jakub Witaszek aiming to develop the results which will be needed to use these techniques in birational geometry. Hopefully it will soon be possible to recast my older unfinished work with Patakfalvi in the new language, and again attack the flip problem.

In addition to the direct progress towards the problem of flips, my time at MSRI has helped my mixed characteristic research immensely due to the Derived Algebraic Geometry (DAG) program. In particular, it seems likely that the correct framework for mixed characteristic birational geometry will require the use of DAG through the prisms and functorial perfectoidizations of Bhatt and Scholze. My time at MSRI has enabled

me to become familiar with many of the required techniques, which hopefully will prove crucial in my future research.

The second stream of my research involves regular Fano varieties which fail to be smooth. These are important to the log minimal model program, because they can arise as the generic fibre of Mori fibre spaces and represent the failure of generic smoothness. As such they are a phenomenon which is new in positive characteristic. One generally expects Fano varieties to be bounded in any given dimension, and this predicts that the exotic ones described above should only appear in small characteristics in any given dimension.

During my time at MSRI I was able to finish an ongoing project with Lena Ji in which we prove general structural results on normal varieties which are not geometrically reduced, and apply these results to bound the anticanonical volume of regular del Pezzo surfaces. The bulk of this work was in fact completed during the program, and we expect the resulting preprint to appear very shortly. I also put the final touches to an existing paper with Omprokash Das on the LMMP for threefolds over imperfect fields which should also appear shortly.

My research on Fano varieties over imperfect fields has also benefited from the presence of the DAG program. In particular, Lukas Brantner explained to me an object he had discovered during his work on partition Lie algebras and deformation theory in positive characteristic, and was interested in investigating. We were both surprised to discover that a particular instance of his object controls the existence of my exotic Fano varieties, and so we had been studying the same phenomenon from wildly different viewpoints. This collaboration is still in early stages, but will continue after the program ends and it seems likely that combining our vastly differing expertise will enable progress which would have been impossible otherwise.

Finally, I began a project on resolution of singularities with my MSRI mentor James McKernan. While we have no definitive results to report as yet, we have found approaches which seem promising. I have been very happy with the MSRI mentoring system. Working with James has been very enjoyable, and it has been my first research in an intriguing area (resolution of singularities) which I had never considered looking at previously.

Overall, I have found the MSRI experience to be incredibly beneficial. The research focused environment has enabled me to begin several new projects with new collaborators in both new and old directions, as well as finishing existing projects. The concurrent DAG program has given me access to new techniques and ideas which could be key in my future

research, and which I might not have encountered otherwise. I have no doubt that the work I have carried out here, and that which I could have started no-where else, will increase my chances of obtaining a future position.

Witaszek, Jakub

Name: Jakub Witaszek
Year of Ph.D.: 2018 (the title was officially conferred in 2019)
Institution of Ph.D.: Imperial College London
Dissertation title: On the Frobenius morphism and Mori theory
Ph.D. advisor: Paolo Cascini

Mentor while at MSRI: Christopher Hacon

Institution prior to obtaining the MSRI PD fellowship: Institute for Advanced Study, Princeton
Position at that institution: Member (postdoctoral fellow)
Mentor (if applicable): Kiran Kedlaya

Institution (or company) where you are going after the MSRI PD fellowship: Institute for Advanced Study
Position: Member (postdoctoral fellow)
Anticipated length: 2 months (and then moving to the University of Michigan for 3 years)
Mentor (if applicable): Kiran Kedlaya

Postdoctoral fellow's comments:
First, during the MSRI program I collaborated with Christopher Hacon. Among other things, we almost finished the article on the Minimal Model Program in low characteristics. Furthermore, I almost finished writing my own article on Keel's theorem in mixed characteristic. The discussions with other participants of the program on algebraic spaces and stacks were very helpful in my concluding this project. Moreover, I started a collaboration with Linquan Ma, Karl Schwede, Kevin Tucker, and Joe Waldron on adjunction in mixed characteristic. Last, I spent some time on working on some other projects of mine: with Takumi Murayama on effective base point freeness, and with Kiran Kedlaya and Daniel Litt on tame morphisms of curves.

I participated in activities and seminars from both programs. Apart from giving a talk at the main BGMS seminar, I actively participated in the seminar on prismatic cohomology at which I also gave a talk. I really enjoyed the fact that there were two interrelated programs at the same time at the MSRI -- I benefited a lot from discussing mathematics and collaborating with other birational geometers, but I also learned a lot on derived algebraic geometry which I hope will be beneficial in my research.

I am certain that the MSRI program has helped me in finding a job in the future.

COMPLEMENTARY PROGRAM

McConville, Thomas

Name: Thomas McConville
Year of Ph.D.: 2015
Institution of Ph.D.: University of Minnesota
Dissertation title: Biclosed Sets in Combinatorics
Ph.D. advisor: Pavlo Pylyavskyy

Mentor while at MSRI: Hélène Barcelo

Institution prior to obtaining the MSRI PD fellowship: Massachusetts Institute of Technology
Position at that institution: Applied Mathematics Instructor
Mentor (if applicable): Alexander Postnikov

Institution (or company) where you are going after the MSRI PD fellowship: University of North Carolina - Greensboro
Position: Visiting Assistant Professor
Anticipated length: (if it is a tenure track position just write tenure-track): 1 year
Mentor (if applicable): Richard Fabiano

Postdoctoral fellow's comments:
During my time at the MSRI this year, I started two new projects and continued work on several others. In the Fall term, I began a collaboration with Volkmar Welker, another member of the Complementary Program. He introduced me to many new ideas in Combinatorial Commutative Algebra. We were motivated to unify two distinct generalizations of associahedra by means of secant varieties. Such varieties have been of particular interest recently due to their connection with computational aspects of matrix multiplication.

In the Spring term, I met regularly with Hélène Barcelo and Curtis Greene in which we discussed topological aspects of hyperplane arrangements, particularly focusing on Deligne's proof of a special property of simplicial hyperplane arrangements. Our objective is to apply similar techniques to reprove and generalize some more recent results on certain subspace arrangements defined by Coxeter groups. Both of these collaborations are ongoing, and likely would not have been feasible without the support of the MSRI.

I have also worked on several papers, collaborating remotely with a few different groups. To this end, the teleconferencing room in the library at the MSRI has been a valuable resource for me, allowing me to regularly meet with my collaborators in Boston and Montreal, which has resulted in several new papers appearing on the arXiv and in the publication pipeline.

I am also grateful to Hélène, Volkmar, and Curtis for their assistance in my preparation for job applications and interviews. They especially provided a lot of advice on my job talk, research and teaching statements, and let me know what to expect from the on-campus interviews. Their support helped me significantly.

3.2 Postdoctoral Fellow Placement List

2018-19 Postdoc Pre/Post-MSRI Institution Group

Family Name	First Name	Pre-MSRI Institution Name	Pre-MSRI Institution Group	Post-MSRI Institution Name	Post-MSRI Institution Group	Program
Achinger	Piotr	IMPAN, Warsaw	Foreign	IMPAN, Warsaw	Foreign	DAG
Benedetti	Gabriele	University of Heidelberg	Foreign	University of Heidelberg	Foreign	HST
Bobkova	Irina	Institute for Advanced Study	non-group	Texas A&M University	Public Large	DAG
Bragg	Daniel	University of California, Berkeley	Public Large	University of California, Berkeley	Public Large	BGMS
Brantner	Lukas	Merton College, Oxford University	Foreign	Merton College, Oxford University	Foreign	DAG
Burby	Joshua	Courant Institute	Private Large	Los Alamos National Laboratory	Non-group	HST
Cheng	Hongyu	Chern Institute of Mathematics	Foreign	Chern Institute of Mathematics	Foreign	HST
DeVleming	Kristin	University of California, San Diego	Public Large	University of California, San Diego	Public Large	BGMS
Elmanto	Elden	University of Copenhagen	Foreign	Harvard University	Private Large	DAG
Flapan	Laure	Northeastern University	Private Small	Massachusetts Institute of Technology	Private Large	BGMS
Harrison	Michael	Lehigh University	Private Small	Lehigh University	Private Small	HST
Jackman	Connor	UC Santa Cruz	Public Small	Centro de Investigación en Matemáticas	Foreign	HST
Jacquette	Jonathan	Rutgers University	Public Large	Brandeis University	Private Large	HST
Jiang	Chen	University of Tokyo	Foreign	Fudan University	Foreign	BGMS
Kanstrup	Tina	Aarhus University	Foreign	University of Massachusetts, Amherst	Public Medium	DAG
Liu	Yuchen	Yale University	Private Large	Yale University	Private Large	BGMS
Martinelli	Diletta	University of Edinburgh	Foreign	University of Glasgow	Foreign	BGMS
Martins	Gabriel	UC Santa Cruz	Public Small	UC Berkeley	Public Large	HST
McConville	Thomas	Massuchusetts Institute of Technology	Private Large	University of North Carolina - Greensboro	Public Small	CP
Miloshevich	George	University of Texas, Austin	Public Large	Observatoire de la Côte d'Azur	Foreign	HST
Moulinos	Tasos	CNRS, University of Toulouse	Foreign	CNRS, University of Toulouse	Foreign	DAG
Speirs	Martin	University of Copenhagen	Foreign	*to be determined*	*to be determined*	DAG
Toprak	Ebru	University of Illinois, Urbana-Champaign	Public Large	Rutgers University	Public Large	HST
VanKoughnett	Paul	Purdue University	Public Large	Purdue University	Public Large	DAG
Vargas	Rosa Maria	Universidad Nacional Autonoma de Mexico	Foreign	University of Edinburgh	Foreign	HST
Vilaça Da Rocha	Victor	Basque Center for Applied Mathematics	Foreign	Basque Center for Applied Mathematics	Foreign	HST
Waldron	Joe	Princeton University	Private Large	Princeton University	Private Large	BGMS
Witaszek	Jakub	Institute for Advanced Study	non-group	University of Michigan	Public Large	BGMS
Yu	Guowei	University of Turin, Italy	Foreign	Chern Institute of Mathematics	Foreign	HST
Zhang	Jianlu	University of Maryland, College Park	Public Large	Chinese Academy of Sciences	Foreign	HST
Zhang	Lei	University of Toronto	Foreign	University of Toronto	Foreign	HST

Highlights

A majority of the MSRI postdocs came from Public Large and Foreign institutions. Of the 7 postdocs coming from Public Large institutions, four returned to Public Large institutions, two went to Foreign institutions, and one went to a Private Large institution. Of the 14 postdocs coming from Foreign institutions, eleven returned to Foreign institutions, one went to a Private Large institution, one went to a Public Medium institution, and one has not yet determined their next institution.

Of the four postdocs who came from Private Large institutions, two went back to Private Large institutions, one went to a Public Small institution and one to a non-grouped institution.

Two postdocs came from Private Small institutions, of whom one returned to a Private Small institution and one to a Private Large institution. Of the two postdocs who came from a Public Small institution, one went to a Foreign institution and one to a Public Large institution. Of the two postdocs from non-grouped institutions, both went to Public Large institutions.

3.3 Postdoctoral Fellow Participant Summary

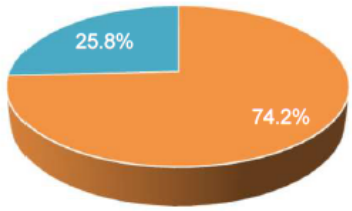
Programs	Distinct Postdocs	US Citizens & Perm. Res.	Women	%	Minorities*	%	US Home Institution	%
Hamiltonian Systems, from Topology to Applic	14	5	3	21.4%	0	*0.0%*	8	57.1%
Derived Algebraic Geometry	8	2	2	25.0%	0	*0.0%*	3	37.5%
Birational Geometry and Moduli Spaces	8	3	3	37.5%	0	*0.0%*	6	75.0%
Complementary Program 2018-19	1	1	0	0.0%	0	*0.0%*	1	100.0%
Total # of Distinct Postdocs	**31**	**11**	**8**	***25.8%***	**0**	***0.0%***	**18**	***58.1%***

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

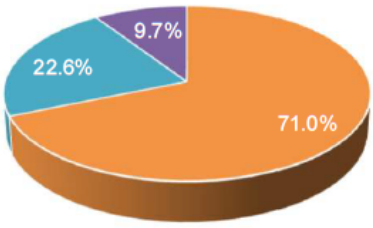
3.4 Postdoctoral Fellow Demographic Data

2018-19 Postdoctoral Fellows Demographic Summary

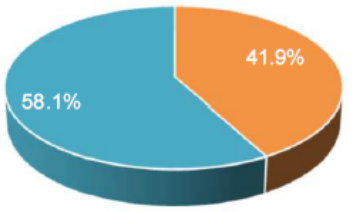
Gender	#	%
# of Distinct Members	31	100.0%
Male	23	74.2%
Female	8	25.8%
Decline to State	0	0.0%



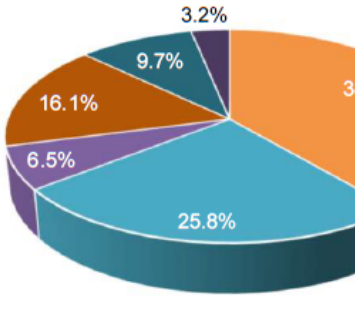
*Race/Ethnicity**	#	%
White	22	71.0%
Asian	7	22.6%
Hispanic/Latino	3	9.7%
Black	0	0.0%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	0	0.0%
Unavailable Info.	0	0.0%
Minorities**	0	0.0%



Citizenships	#	%
Foreign Home Inst.	13	41.9%
US Home Inst.	18	58.1%
US Citizen & Perm. Residents	11	35.5%
Foreign Citizens	20	64.5%
US Citizens	10	32.3%
US Permanent Residents	1	3.2%



Year of Ph.D	#	%
2018	12	38.7%
2017	8	25.8%
2016	2	6.5%
2015	5	16.1%
2014	3	9.7%
2013	1	3.2%
Total # of Distinct Members	31	100.0%



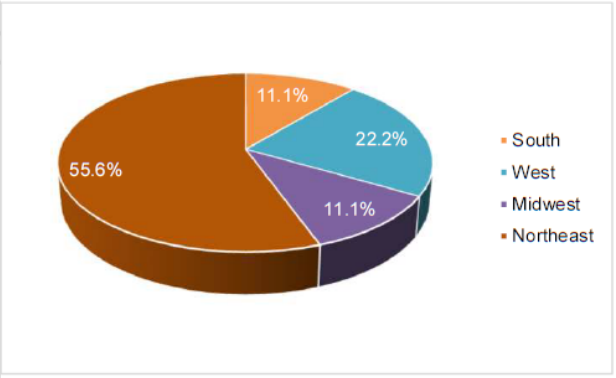
**Race/ethnicity selections are non-exclusive.*
***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

Programs

Hamiltonian Systems, from Topology to Applications Through Analysis
Derived Algebraic Geometry
Birational Geometry and Moduli Spaces
Complementary Program 2018-19

2018-19 Postdoctoral Fellows Classified by State

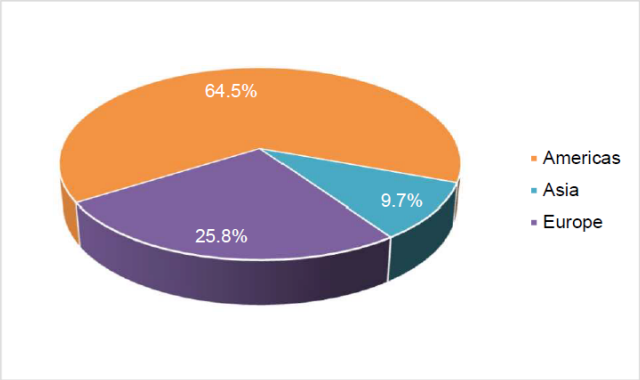
State	#	%	*2010 Census*
South	**2**	**11.1%**	*37.1%*
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.1%*
GA	0	0.0%	*3.1%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.5%*
MD	1	5.6%	*1.9%*
MS	0	0.0%	*1.0%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	1	5.6%	*8.1%*
VA	0	0.0%	*2.6%*
WV	0	0.0%	*0.6%*
West	**4**	**22.2%**	*23.3%*
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.1%*
CA	4	22.2%	*0.4%*
CO	0	0.0%	*0.5%*
HI	0	0.0%	*0.3%*
ID	0	0.0%	*12.1%*
MT	0	0.0%	*1.6%*
NM	0	0.0%	*0.9%*
NV	0	0.0%	*0.7%*
OR	0	0.0%	*1.2%*
UT	0	0.0%	*0.9%*
WA	0	0.0%	*2.2%*
WY	0	0.0%	*0.2%*
Midwest	**2**	**11.1%**	*21.7%*
IA	0	0.0%	*4.2%*
IL	1	5.6%	*2.1%*
IN	1	5.6%	*1.0%*
KS	0	0.0%	*0.9%*
MI	0	0.0%	*3.2%*
MN	0	0.0%	*1.7%*
MO	0	0.0%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	0	0.0%	*3.7%*
SD	0	0.0%	*0.3%*
WI	0	0.0%	*1.8%*
Northeast	**10**	**55.6%**	*17.9%*
CT	1	5.6%	*1.2%*
MA	3	16.7%	*0.4%*
ME	0	0.0%	*2.1%*
NH	0	0.0%	*0.4%*
NJ	4	22.2%	*2.8%*
NY	1	5.6%	*6.3%*
PA	1	5.6%	*4.1%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	*0.0%*
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	18	100.0%	*100.0%*



**Regions based on US Census classification*

2018-19 Postdoctoral Fellows Classified by Country

Africa			**0**
Americas			**20**
	North America	Canada	1
		United States	18
	Central America	Mexico	1
Asia			**3**
	Eastern Asia	China	2
		Japan	1
Europe			**8**
	Eastern Europe	Poland	1
	Northern Europe	Denmark	2
		United Kingdom	2
	Southern Europe	Spain	1
	Western Europe	France	1
		Germany	1
Oceania			**0**
Grand Total			**31**



**Regions based on United Nations classification*

3.5 Postdoctoral Research Member Placement List

Postdoctoral Research Members (PD/RMs) are individuals who qualify at the Postdoctoral Fellows level, but were invited as Research Members. This usually happens when they are ineligible for the postdoctoral fellowship for some reason, for example, they are unable to attend the full length of the program. In 2018-19, there was one PD/RM at MSRI.

PDRM Pre/Post-MSRI Institution Group

Family Name	First Name	Pre-MSRI Institution Name	Pre-MSRI Institution Group	Post-MSRI Institution Name	Post-MSRI Institution Group
Ascher	Kenny	Princeton University	Private Large	Princeton University	Private Large

3.6 Postdoctoral Research Member Summary

Programs	Distinct PDRMs	US Citizens & Perm. Res.	Women	%	Minorities*	%	US Home Institution	%
Derived Algebraic Geometry	1	1	0	0.0%	0	*0.0%*	1	0.0%
Total # of Distinct PDRMs	**1**	**1**	**0**	***0.0%***	**0**	***0.0%***	**1**	***100.0%***

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

4. Graduate Program

In 2018-19, 711 graduate students visited MSRI to participate in our workshops (389 graduate students), summer graduate schools (286 graduate students), and programs (36 graduate students). While the majority of the graduate students who visited MSRI were participants in our workshops or summer graduate schools, a smaller number of them were invited and funded as 'Program Associates' in our scientific programs.

4.1 Summer Graduate School (SGS)

Every summer, MSRI organizes several summer graduate schools (usually two weeks each), most of which are held at MSRI. Attending one of these schools 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.

Graduate students from MSRI Academic Sponsoring Institutions or from Department of Mathematics at U.S. Universities are eligible for summer schools. For each institution, MSRI provides support for one or two students per summer, and will support up to four students if one of the students is female and one is from a group that is underrepresented in the mathematical sciences. MSRI covers travel and local expenses with the maximal allowance for travel reimbursement being $600 for students from U.S. and Canadian universities (depending on the point of origin), and $700 for students from other sponsoring institutions.

The application procedure is as follows: The summer graduate schools and the open enrollment period for the summer of year n+1 are announced in August of year n. Graduate students must be nominated by their Director of Graduate Studies during the enrollment period. MSRI accepts nominees on a first-come first-served basis up to the limits of the capacity of each school, which is around 40-50 for onsite schools. If the chosen school is already full, the students are either kept on a waiting list or the nominating institution may make nominations to other schools until their quota is reached.

The following is a list of the eight Summer Graduate Schools that took place during the summer of 2018. Altogether 38 lecturers and TAs, and 286 graduate students participated in these schools. Of those graduate students, 30% were female. See the table in section 4.2 for detailed demographic data.

For a complete report on each SGS, please refer to the Appendix.

SGS 1: Séminaire de Mathématiques Supérieures 2018: Derived Geometry and Higher Categorical Structures in Geometry and Physics
June 11, 2018 – June 22, 2018
Location: Fields Institute, Toronto, Canada
Organizers: Anton Alekseev (Université de Genève), Ruxandra Moraru (U. of Waterloo), Chenchang Zhu (Universität Göttingen)

SGS 2: The ∂-Problem in the Twenty-First Century
June 11, 2018 - June 22, 2018
Location: MSRI
Organizers: Debraj Chakrabarti (Central Michigan U.), Jeffery McNeal (Ohio State U.)

SGS 3: Mathematical Analysis of Behavior
June 17, 2018 - June 30, 2018
Location: HHMI / Janelia Research Campus
Organizers: Ann Hermundstad (Janelia Research Campus, HHMI), Vivek Jayaraman (Janelia Research Campus, HHMI), Eva Kanso (U. of Southern California), L. Mahadevan (Harvard U.)

SGS 4: H-principle
June 25, 2018 - July 06, 2018
Location: Tambara Institute, Tokyo, Japan
Organizers: Emmy Murphy (Northwestern U.), Takashi Tsuboi (U. of Tokyo)

SGS 5: Derived Categories
June 25, 2018 - July 06, 2018
Location: MSRI
Organizers: Nicolas Addington (U. of Oregon), Alexander Polishchuk (U. of Oregon)

SGS 6: IAS/PCMI 2018: Harmonic Analysis
July 01, 2018 - July 21, 2018
Location: PCMI
Organizers: Carlos Kenig (U. of Chicago), Fanghua Lin (Courant Institute), Svitlana Mayboroda (U. of Minnesota, Twin Cities), Tatiana Toro (U. of Washington)

SGS 7: Representations of High Dimensional Data
July 09, 2018 - July 20, 2018
Location: MSRI
Organizers: Blake Hunter (Microsoft), Deanna Needell (UCLA)

SGS 8: From Symplectic Geometry to Chaos
July 23, 2018 - August 03, 2018
Location: MSRI
Organizers: Marcel Guardia (Polytechnical U. of Cataluña, Barcelona), Vadim Kaloshin (U. of Maryland), Leonid Polterovich (Tel Aviv U.)

4.2 Summer Graduate Schools 2018 Data

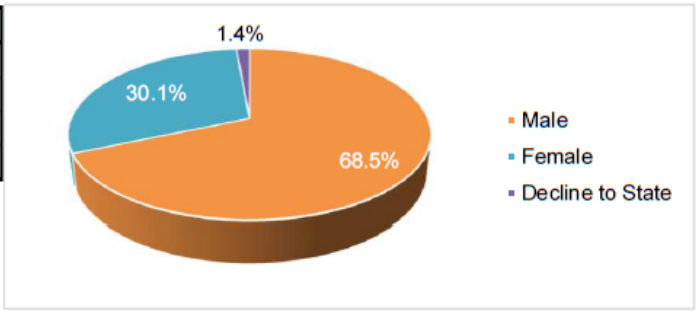
Summer Graduate Schools	# of Students	US Citizens & Perm. Res.	Women	%	Minorities*	%	US Home Institution	%
Derived Categories	56	27	13	23.2%	4	*14.8%*	46	82.1%
From Symplectic Geometry to Chaos	33	20	10	30.3%	7	*35.0%*	27	81.8%
H-principle	15	5	3	20.0%	2	*40.0%*	14	93.3%
IAS/PCMI 2018: Harmonic Analysis	36	12	10	27.8%	1	*8.3%*	30	83.3%
Mathematical Analysis of Behavior	24	10	15	62.5%	2	*20.0%*	20	83.3%
Representations of High Dimensional Data	53	23	22	41.5%	5	*21.7%*	47	88.7%
Séminaire de Mathématiques Supérieures 2018: Derived Geometry and Higher Categorical Structures in Geometry and Physics	34	17	8	23.5%	2	*11.8%*	25	73.5%
The ∂-Problem in the Twenty-First Century	35	16	5	14.3%	1	*6.3%*	35	100.0%
Total # of Students	**286**	**130**	**86**	***30.1%***	**24**	***18.5%***	**244**	***85.3%***

** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the total number of US citizens & Permanent Residents.*

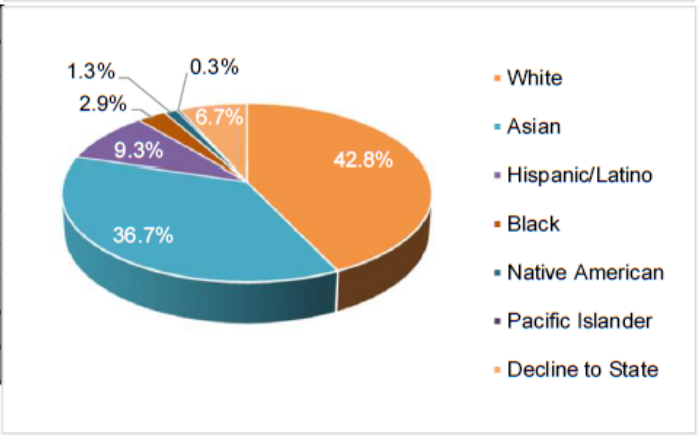
Summer Graduate School Demographic Data

2018 Summer Graduate Schools Demographic Summary

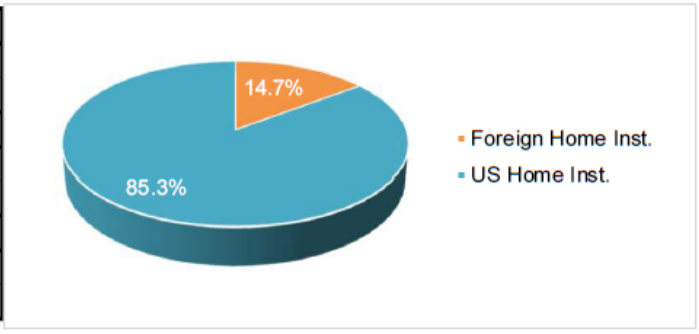
Gender	#	%
# of Students	286	100.0%
Male	196	68.5%
Female	86	30.1%
Decline to State	4	1.4%



*Race/Ethnicity**	#	%
White	134	42.8%
Asian	115	36.7%
Hispanic/Latino	29	9.3%
Black	9	2.9%
Native American	4	1.3%
Pacific Islander	1	0.3%
Decline to State	21	6.7%
Unavailable Info.	0	0.0%
Minorities**	24	18.5%



Citizenships	#	%
Foreign Home Inst.	42	14.7%
US Home Inst.	244	85.3%
US Citizens & Perm. Res.	130	45.5%
Foreign Citizens	156	54.5%
US Citizens	120	92.3%
US Permanent Residents	10	100.0%



**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

Summer Graduate Schools

Derived Categories

From Symplectic Geometry to Chaos

H-principle

IAS/PCMI 2018: Harmonic Analysis

Mathematical Analysis of Behavior

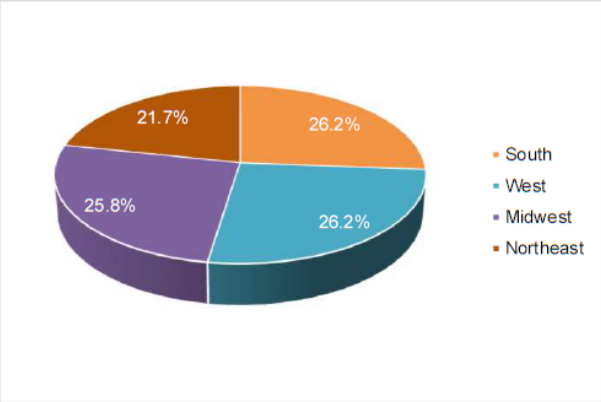
Representations of High Dimensional Data

Séminaire de Mathématiques Supérieures 2018: Derived Geometry and Higher Categorical Structures in Geometry and Physics

The ∂-Problem in the Twenty-First Century

2018 Summer Graduate School Students Classified by States

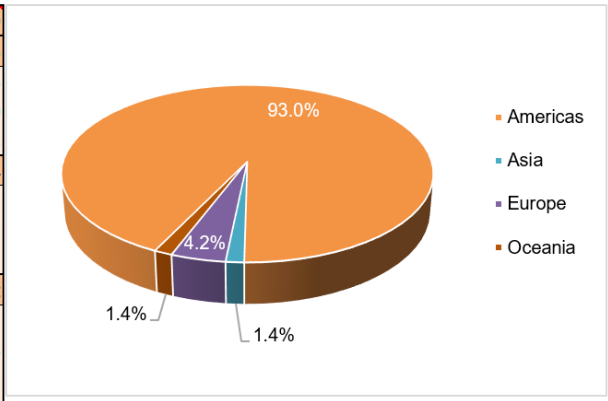
State	#	%	*2010 Census*
South	**64**	**26.2%**	*37.1%*
AL	1	0.4%	*1.5%*
AR	1	0.4%	*0.9%*
DE	2	0.8%	*0.3%*
DC	3	1.2%	*0.2%*
FL	4	1.6%	*6.1%*
GA	5	2.0%	*3.1%*
KY	3	1.2%	*1.4%*
LA	6	2.5%	*1.5%*
MD	8	3.3%	*1.9%*
MS	0	0.0%	*1.0%*
NC	10	4.1%	*3.1%*
OK	3	1.2%	*1.2%*
SC	2	0.8%	*1.5%*
TN	4	1.6%	*2.1%*
TX	9	3.7%	*8.1%*
VA	3	1.2%	*2.6%*
WV	0	0.0%	*0.6%*
West	**64**	**26.2%**	*23.3%*
AK	0	0.0%	*0.2%*
AZ	7	2.9%	*2.1%*
CA	39	16.0%	*0.4%*
CO	3	1.2%	*0.5%*
HI	0	0.0%	*0.3%*
ID	0	0.0%	*12.1%*
MT	0	0.0%	*1.6%*
NM	0	0.0%	*0.9%*
NV	0	0.0%	*0.7%*
OR	6	2.5%	*1.2%*
UT	4	1.6%	*0.9%*
WA	5	2.0%	*2.2%*
WY	0	0.0%	*0.2%*
Midwest	**63**	**25.8%**	*21.7%*
IA	2	0.8%	*4.2%*
IL	11	4.5%	*2.1%*
IN	8	3.3%	*1.0%*
KS	6	2.5%	*0.9%*
MI	12	4.9%	*3.2%*
MN	3	1.2%	*1.7%*
MO	7	2.9%	*1.9%*
ND	2	0.8%	*0.2%*
NE	2	0.8%	*0.6%*
OH	6	2.5%	*3.7%*
SD	0	0.0%	*0.3%*
WI	4	1.6%	*1.8%*
Northeast	**53**	**21.7%**	*17.9%*
CT	4	1.6%	*1.2%*
MA	15	6.1%	*0.4%*
ME	0	0.0%	*2.1%*
NH	0	0.0%	*0.4%*
NJ	5	2.0%	*2.8%*
NY	17	7.0%	*6.3%*
PA	11	4.5%	*4.1%*
RI	0	0.0%	*0.3%*
VT	1	0.4%	*0.2%*
Other	**0**	**0.0%**	*0.0%*
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	244	100.0%	*100.0%*



**Regions based on US Census classification*

2018 Summer Graduate School Students Classified by Countries

Africa			**0**
Americas			**266**
	Central America	Mexico	3
	North America	Canada	19
		United States	244
Asia			**4**
	Eastern Asia	Hong Kong	1
		Japan	2
		Korea, Republic of	1
Europe			**12**
	Northern Europe	Sweden	1
	Southern Europe	Italy	3
		Spain	2
	Western Europe	Austria	1
		Germany	4
		Netherlands	1
Oceania			**4**
	Australia & New Zealand	Australia	4
Grand Total			**286**



**Regions based on United Nations classification*

4.3 Program Associates

Program Associates (graduate students participating in the programs) benefit greatly from the opportunity to interact with leaders of a field and postdoctoral fellows, gaining intense exposure to current ideas and trends in their area of specialization. They were closely supervised and essentially benefit from all member privileges, including shared office space. Each Program Associate was provided with an access card to the building, which allows them to use the premises at any time, as well as bus, library and sports facilities access passes. A grant from the National Security Agency (H98230-18-1-0269) provided funding to eligible Program Associates at $2,000 per month for up to four months. There were 36 graduate students who resided at MSRI for an extended period of time during the academic year 2018-19. See the table in section 4.4 for a detailed description of the demographic data.

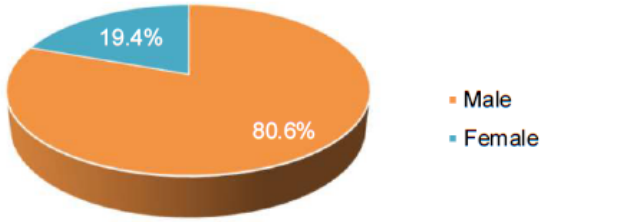
4.4 Program Associate Data

Programs	Distinct Prog. Assoc.	US Citizens & Perm. Res.	Women	%	Minorities*	%	US Home Institution	%
Hamiltonian systems, from topology to applications through analysis	15	6	4	26.7%	0	*0.0%*	5	33.3%
Birational Geometry and Moduli Spaces	9	3	1	11.1%	0	*0.0%*	7	77.8%
Derived Algebraic Geometry	12	2	2	16.7%	0	*0.0%*	6	50.0%
Total # of Distinct PAs	**36**	**11**	**7**	***19.4%***	**0**	***0.0%***	**18**	***50.0%***

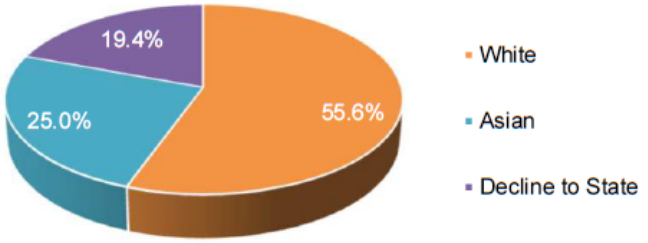
** Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic/Latino, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

2018-19 Program Associate Demographic Summary

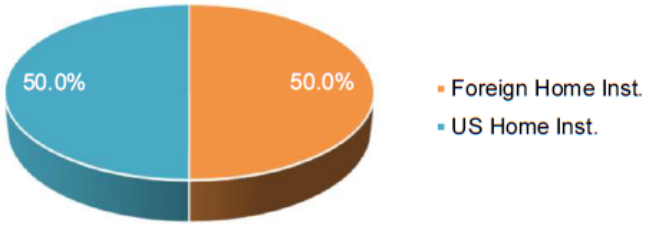
Gender	#	%
# of Distinct Members	36	100.0%
Male	29	80.6%
Female	7	19.4%
Decline to State	0	0.0%



*Race/Ethnicity**	#	%
White	20	55.6%
Asian	9	25.0%
Hispanic/Latino	0	0.0%
Black	0	0.0%
Native American	0	0.0%
Pacific Islander	0	0.0%
Decline to State	7	19.4%
Unavailable Info.	0	0.0%
Minorities**	0	0.0%



Citizenships	#	%
Foreign Home Inst.	18	50.0%
US Home Inst.	18	50.0%
US Citizens & Perm. Res.	11	30.6%
Foreign Citizens	25	69.4%
US Citizens	11	30.6%
US Permanent Residents	0	0.0%



**Race/ethnicity selections are non-exclusive.*

***Minorities are US citizens & Permanent Residents who declare themselves American Indian, Black, Hispanic, or Pacific Islander. Minority percentage is calculated by dividing the number of Minorities by the number of US citizens & Permanent Residents.*

Programs

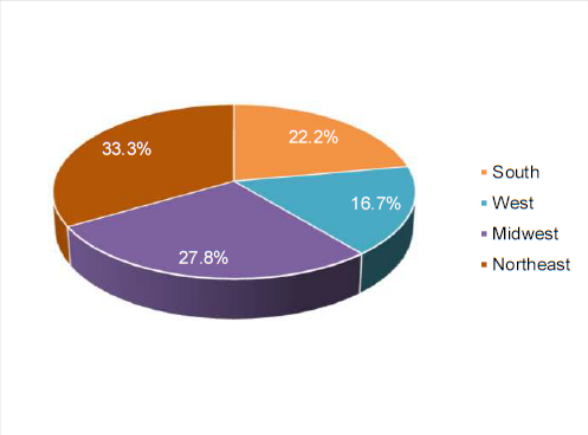
Hamiltonian systems, from topology to applications through analysis

Birational Geometry and Moduli Spaces

Derived Algebraic Geometry

2018-19 Program Associates Classified by State

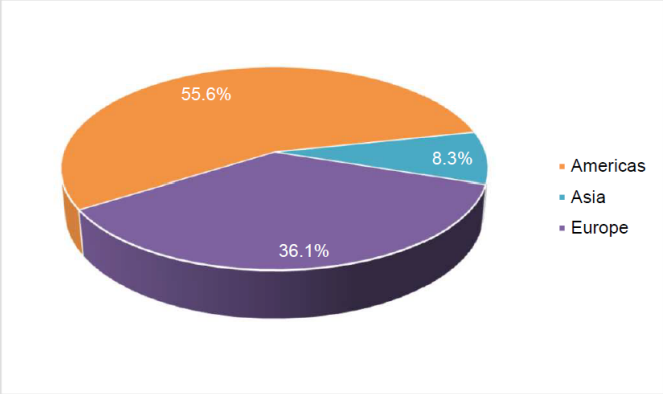
State	#	%	2010 Census
South	**4**	**22.2%**	***37.1%***
AL	0	0.0%	*1.5%*
AR	0	0.0%	*0.9%*
DE	0	0.0%	*0.3%*
DC	0	0.0%	*0.2%*
FL	0	0.0%	*6.1%*
GA	1	5.6%	*3.1%*
KY	0	0.0%	*1.4%*
LA	0	0.0%	*1.5%*
MD	0	0.0%	*1.9%*
MS	0	0.0%	*1.0%*
NC	0	0.0%	*3.1%*
OK	0	0.0%	*1.2%*
SC	0	0.0%	*1.5%*
TN	0	0.0%	*2.1%*
TX	1	5.6%	*8.1%*
VA	1	5.6%	*2.6%*
WV	1	5.6%	*0.6%*
West	**3**	**16.7%**	***23.3%***
AK	0	0.0%	*0.2%*
AZ	0	0.0%	*2.1%*
CA	1	5.6%	*0.4%*
CO	0	0.0%	*0.5%*
HI	0	0.0%	*0.3%*
ID	0	0.0%	*12.1%*
MT	0	0.0%	*1.6%*
NM	0	0.0%	*0.9%*
NV	0	0.0%	*0.7%*
OR	0	0.0%	*1.2%*
UT	0	0.0%	*0.9%*
WA	2	11.1%	*2.2%*
WY	0	0.0%	*0.2%*
Midwest	**5**	**27.8%**	***21.7%***
IA	0	0.0%	*4.2%*
IL	1	5.6%	*2.1%*
IN	0	0.0%	*1.0%*
KS	0	0.0%	*0.9%*
MI	1	5.6%	*3.2%*
MN	0	0.0%	*1.7%*
MO	1	5.6%	*1.9%*
ND	0	0.0%	*0.2%*
NE	0	0.0%	*0.6%*
OH	0	0.0%	*3.7%*
SD	0	0.0%	*0.3%*
WI	2	11.1%	*1.8%*
Northeast	**6**	**33.3%**	***17.9%***
CT	1	5.6%	*1.2%*
MA	2	11.1%	*0.4%*
ME	0	0.0%	*2.1%*
NH	0	0.0%	*0.4%*
NJ	2	11.1%	*2.8%*
NY	0	0.0%	*6.3%*
PA	1	5.6%	*4.1%*
RI	0	0.0%	*0.3%*
VT	0	0.0%	*0.2%*
Other	**0**	**0.0%**	***0.0%***
PR	0	0.0%	*0.0%*
Other	0	0.0%	*0.0%*
Total	18	100.0%	*100.0%*



**Regions based on US Census classification*

2018-19 Program Associates Classified by Country

Africa			**0**
Americas			**20**
	North America	Canada	1
		United States	18
	South America	Brazil	1
Asia			**3**
	East Asia	China	1
	Western Asia	Israel	2
Europe			**13**
	Northern Europe	United Kingdom	2
	Western Europe	Austria	1
		France	3
		Germany	1
	Southern Europe	Italy	3
		Spain	2
	Eastern Europe	Russian Federation	1
Oceania			**0**
Grand Total			**36**



**Regions based on United Nations classification*

4.5 Graduate Student List

(Participants who attended 2018-19 workshops, excluding Summer Graduate Schools)
(See e-mail attachment)

4.6 Graduate Student Data*

(Participants who attended 2018-19 workshops, excluding Summer Graduate Schools)

Workshops	Participants	US Citizens & Perm. Res.	Women	%	Minorities*	%	US Home Institution	%
10 Scientific Workshops								
Connections For Women: Hamiltonian Systems, From Topology To Applications Through Analy	12	4	6	50.0%	0	0.0%	10	83.3%
Introductory Workshop: Hamiltonian Systems, From Topology To Applications Through Analysis	21	9	5	23.8%	1	11.1%	15	71.4%
Hot Topics: Shape And Structure Of Materials	19	4	9	47.4%	0	0.0%	6	31.6%
Hamiltonian Systems, From Topology To Applications Through Analysis I	32	9	8	25.0%	1	11.1%	17	53.1%
Hamiltonian Systems, From Topology To Applications Through Analysis II	23	8	5	21.7%	1	12.5%	13	56.5%
Connections For Women: Derived Algebraic Geometry, Birational Geometry And Moduli Spaces	48	16	25	52.1%	0	0.0%	31	64.6%
Introductory Workshop: Derived Algebraic Geometry And Birational Geometry And Moduli Spac	90	32	22	24.4%	2	6.3%	62	68.9%
Derived Algebraic Geometry And Its Applications	54	21	2	3.7%	2	9.5%	36	66.7%
Hot Topics: Recent Progress In Langlands Program	37	8	1	2.7%	0	0.0%	25	67.6%
Recent Progress In Moduli Theory	39	13	8	20.5%	0	0.0%	32	82.1%
All 10 Workshops Total	**375**	**124**	**91**	**24.3%**	**7**	**5.6%**	**247**	**65.9%**
1 Education & Outreach Workshop								
Critical Issues In Mathematics Education 2019: Mathematical Modeling In K-16: Community And Cultural Contexts	14	10	9	64.3%	5	50.0%	14	100.0%
All 1 Workshops Total	**14**	**10**	**9**	**64.3%**	**5**	**50.0%**	**14**	**100.0%**
All 11 Workshops Total	**389**	**134**	**100**	**25.7%**	**12**	**9.0%**	**261**	**67.1%**

*Note that the overall graduate student data in section 4.6 is not distinct as some participants attended multiple workshops, but the statistics of individual workshop found in Section 12, Appendix, were calculated on distinct participant data.

5. Undergraduate Program

5.1 Description of Undergraduate Program

Please note: MSRI-UP is funded by an independent NSF grant, DMS-1659138. The report was filed independently to the NSF in March 2019, thus there is no report attached in Section 12. Appendix.

The MSRI Undergraduate Program (MSRI-UP) is a comprehensive summer program designed for undergraduate students who have completed two years of university-level mathematics courses and would like to conduct research in the mathematical sciences. Due to funding restrictions, only U.S. citizens and permanent residents are eligible to apply and the program cannot accept foreign students regardless of funding.

The main objective of the MSRI-UP is to identify talented students, especially those from underrepresented groups, who are interested in mathematics and make 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.

This objective is 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.

During the summer, each of the 18 student participants will:

- participate in the mathematics research program under the direction faculty and graduate students mentors.
- complete a research project done in collaboration with other MSRI-UP students
- give a presentation and write a technical report on his/her research project
- attend a series of colloquium talks given by leading researches in their fields
- attend workshops aimed at developing skills and techniques needed for research careers in the mathematical sciences and
- learn techniques that will maximize a student's likelihood of admissions to graduate programs as well as the likelihood of winning fellowships
- receive a $3100 stipend, lodging, meals and round trip travel to Berkeley, CA.

After the summer, each student will:

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

MSRI-UP 2018: The Mathematics of Data Science
June 16, 2018 – July 29, 2018

The theme of the 2018 MSRI-UP was the Mathematics of Data Science and the research leader was Dr. David Uminsky, Associate Professor of Mathematics and Statistics at the University of San Francisco. The research program was focused on the core role of (linear) algebra in current research and application areas of Data Science ranging from unsupervised learning, clustering and networks, to algebraic signal processing and feature extraction, to the central role linear algebra plays in deep machine learning. The project topics were driven by the areas of interest of the students (environmental, social, economic), limited only by access to relevant data.

6. Summer Research for Women in Math

6.1 Description of Summer Research for Women in Math

Please note: Summer Research for Women is funded by a private grant and not through this NSF grant. Thus, there is no report in Section 12, Appendix.

The Summer Research for Women in Math (SWiM) program was initially piloted in the summer of 2017 in response to the number of unfinished research projects resulting from the Algebraic Combinatorixx 2 workshop that took place at BIRS in May of that year. The SWiM program provides space and funding for small groups of women researchers to spend two or more weeks at MSRI during the summer to work on an established research project and is designed to improve the odds of completion and enhance the quality of products resulting from these collaborations.

In the summer of 2017, four groups of women who had begun research projects at the BIRS Algebraic Combinatorixx 2 workshop reunited at MSRI to continue their work. The follow up program in summer of 2018 was flooded with applications. Twenty-two groups comprised of 80 researchers submitted proposals and, with supplemental funding from the NSA, MSRI was able to increase the number of invited groups to six (a total of 21 researchers).

The strong impact of the pilot program on the women who participated is clearly illustrated by the comments we received at the end of their stay. Some of the comments are reproduced below.

6.2 Testimonials from Participants

"I appreciated the setup where all I need to do is research, as every practical aspect including meals and coffee breaks was taken care of. With my research partner, we had multiple daily discussions (some on the sunny terrace, which is very inspiring) and we wrote a research report, which will soon be polished to a paper for submission."

—Roza Aceska (Ball State University)

"While many aspects were beneficial, the most valuable one was the insulated and supportive environment. While visiting, my colleagues and I could ignore all external concerns and focus uniquely on the mathematics research. If we needed anything from food to computational resources, they were provided and the staff was amazingly friendly and helpful."

—Nina Fefferman (University of Tennessee)

"There was a total lack of worry about practical things -- my housing and meals were taken care of, my plane ticket was booked by MSRI, we were given bus passes -- everything was taken care of. Then all I had to do was show up and think about math. It was great. I loved the library, I found all the books I needed there and could just go sit in a corner and work when I needed peace and quiet. We had plenty of office space and boards to work at. I was very happy with all of the logistics of the program. Thank you so much for making it run so smoothly."

—Emily Norton (Max Planck Institute for Mathematics)

"I had the opportunity to completely immerse myself in the project, thinking about it and nothing else for two weeks, without the distractions (social, work, domestic) I have at home. We were pretty stuck at the start, and there were certain snags I had to come back to over and over and over until things finally became clear to me. I also got to know two of my collaborators better personally which I think is beneficial in terms of comfort, trust, willingness to ask stupid questions, etc."

—Tracy Payne (Idaho State University)

"In addition to working on the research that we wrote about in our proposal, we were able to advance several new lines of research and outline future grant proposals. This was far more than I imagined would have been possible during such a short time span and shows the power of everyone being in the same place."

—Suzanne Sindi (University of California, Merced)

6.3 Summer Research for Women 2018 Participants

Group 1: Title Unknown
Zajj Daugherty *(City College of New York)*, Iva Halacheva *(Hebrew University of Jerusalem)*, Mee Song Im *(United States Military Academy)*, Emily Norton *(Max Planck Institute for Mathematics)*

Group 2: How Parasite Risks Can Impact the Evolution of Social Behaviors and Emergent Population Organization
Nina Fefferman *(University of Tennessee)*, Candice Price *(University of San Diego)*, Suzanne Sindi *(University of California, Merced)*, Nakeya Williams *(United States Military Academy)*, Shelby Wilson *(Morehouse College)*

Group 3: Lie algebraic question with applications to Riemannian geometry
Carolyn Gordon *(Dartmouth College)*, Meera Mainkar *(Central Michigan University)*, Tracy Payne *(Idaho State University)*, Cynthia Will *(Universidad Nacional de Córdoba)*

Group 4: Quasisymmetric Macdonald Polynomials and Their Relationship to the Double Affine Hecke Algebra
Zajj Daugherty *(City College of New York)*, Angela Hicks *(Lehigh University)*, Sarah Mason *(Wake Forest University)*, Elizabeth Niese *(Marshall University)*

Group 5: The classifcation of closed Riemannian manifolds with positive or nonnegative sectional curvature is a long-standing problem in Riemannian geometry
Christine Escher *(Oregon State University)*, Catherine Searle *(Wichita State University)*

Group 6: Dynamical Sampling Strategies in solving PDEs
Roza Aceska *(Ball State University)*, Yeon Hyang Kim *(Central Michigan University)*