Colloids, Lattice Gasses, and Other Models with Hard Constraints

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Colloids are binary mixtures of molecules with one type of molecule suspended in another where all non-overlapping arrangements are equally likely. It is believed that at low density typical configurations will be well-mixed throughout, while at high density they will separate into clusters, suggesting a phase transition occurs as the density of both types of molecules increases. In this talk we will discuss various strategies for sampling configurations of non-overlapping particles including lattice gasses and colloids in order to gain empirical evidence of this conjecture. Then we will show how to characterize the two phases for a general family of "interfering colloid models" by demonstrating that they exhibit a "clustering property" at high density and not at low density. The clustering property holds when there is a region with very high area to perimeter ratio and very high density of one type of molecule. A special case of interfering colloids is mixtures of squares and diamonds on $Z^2,$ which correspond to the Ising model at fixed magnetization.