Tata Institute of Fundamental Research
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Internal Seminar

Entropy Driven Phase Transitions in Hard Core Lattice Gases

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Entropy driven phase transitions are often observed in nature. Examples include freezing transition in a system of hard spheres, disordered-nematic-smectic transition in a system of long rods, ordering transition in adsorbed layers of gases on metallic surface etc. Hard core lattice gas models, where particles constrained to be on lattices interact only through excluded volume interactions, are minimal models to study entropy-driven phase transitions. The emergent phases and the different phase transitions depend only on the shape and density of the particles, as the temperature does not play any role. Despite a long history of study, it is not understood what the precise dependence between the shapes of the particles and the emergent phases is.

In this talk, I will discuss in detail the phase diagram of four models of differently shaped particles both in two and three dimensions. These are (a) 2x2 hard squares, (b) mixture of 2x1 dimers and 2x2 squares on a square lattice, (c) 2x2x1 hard plates on a cubic lattice and (d) Y-shaped particles on a triangular lattice. Each of these models are motivated from physical examples, which I will elaborate on. Using both analytical techniques and large-scale Monte Carlo simulations the phase diagram of the models are obtained. The nature of the phase transitions are characterised in detail.

Friday, Mar 22nd 2019

11:30 AM (Tea/Coffee at 11:00 AM)

Seminar Hall, TIFR-H