Self Assembly, Shape and the Entropic Bond

Entropy, information, and order are important concepts in many fields, relevant for materials to machines, for biology to econophysics. Entropy is typically associated with disorder; yet, the counterintuitive notion that a thermodynamic system of hard particles (colloids) might - due solely to entropy - spontaneously assemble from a fluid phase into an ordered crystal was first predicted in the mid-20th century. First demonstrated for rods, and then spheres, the ordering of colloids by entropy maximization upon crowding is now well established. In recent years, surprising discoveries of ordered entropic colloidal crystals of extraordinary structural complexity have been predicted by computer simulation and observed in the laboratory. These findings, which we present in this talk, demonstrate that entropy alone can produce order and complexity beyond that previously imagined, and that, in situations where other interactions are also present, the role of entropy in producing order may be greatly underestimated. We discuss the role of shape entropy in self assembly of colloidal systems, from nanoparticles to proteins.