Orientational order in systems with competing interactions

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Particles confined to nearly two dimensions with isotropic and competing pair interactions can self-assemble into a diversity of patterns, like stripes, bubbles and labyrinths. This phenomenology has been found in many different systems, like colloidal particles with core-softened interactions, diblock copolymers, microemulsions and magnetic systems. Competition between a short range attraction and a long range repulsion is known to produce a characteristic scale with a strong degeneracy of metastable states, although in colloidal systems with a repulsive soft-core the same basic phenomenology has been observed. The basic mechanism underpinning self-assembly in these systems is a spontaneous orientational symmetry breaking in an energy landscape with many metastable states. The large degeneracy together with strong fluctuations in quasi two dimensional systems, make low temperature/high density stripe or bubble patterns difficult to stabilize. In this talk I will show that an analysis of a suitable Landau free energy for these kind of systems leads to the presence of a nematic phase at intermediate temperatures/densities, with quasi-long-range orientational order. In this phase, the system is an anisotropic fluid. The breaking of orientational order preempts the emergence of more ordered structures at lower temperatures.