Phase behavior of a 2D colloidal system on a triangular lattice

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We studied the phase behavior in 2D colloidal systems under the influence of an external periodic potential created by the interference pattern of laser beams forming a triangular lattice. In the special case, where the numbers of colloidal particles and of potential minima are commensurate, an integer number of particles gathers in each potential minimum. They form a *composite object* whose effective degrees of freedom are a few discrete orientational states. Upon increasing the strength of the external potential, first the composite objects orient, however, above some higher critical value, the long-range orientational order is lost.

In particular, we are interested in systems with composite objects of 2 or 3 colloidal particles, i.e., the dimers or trimers, respectively. In these systems, the orientational ordering provides a realization of 2D discrete spin models. The case of trimers can be mapped by the spin-$1/2$ Ising model whereas the system of dimers is mapped by a spin model characterized by several independent control parameters leading to a richer phase diagram. Our theoretical results are in good agreement with the recently reported experimental results. We predict that by varying the strength of the screened interaction among colloidal particles at least a part of the phase diagram of a spin model for dimers should be accessible by experimental studies.