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Artificial magnets as model systems : from the fragmentation of magnetization to the 6-vertex model

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Complex architectures of nanostructures are routinely elaborated using bottom-up or nanofabrication processes.

This technological capability allows scientists to engineer materials with properties that do not exist in nature, but also to manufacture model systems to explore fundamental issues which appeared in condensed matter physics.

One- and two-dimensional frustrated arrays of magnetic nanostructures are one class of systems for which theoretical predictions can now be tested experimentally.

These systems have been the subject of intense research in the last few years and have allowed the investigation of a rich physics and fascinating phenomena, such as the exploration of the extensively degenerate ground-state manifolds of spin ice systems, the evidence of new magnetic phases in purely two-dimensional lattices, and the observation of pseudo-excitations involving classical analogues of magnetic charges.

This talk aims at providing two examples of two-dimensional artificial magnets which allow to probe the low energy manifolds of two exotic Ising systems.

The first one is related to the seminal 6-vertex model and shows that it is possible to perform a scan through the 6-vertex model phase diagram with an appropriately designed artificial magnet [1].

In particular, the symmetric point of the square ice is recovered, providing with the opportunity to study the signatures of an algebraic Coulomb spin liquid.

Because of the experimental procedure used to reach the low energy manifold, quasi-particles are trapped in this disordered manifold, pointing to the need of thermal systems, but also emphasizing that these systems may be well suited to study out of equilibrium relaxation of monopole-monopole pairs in a near future.

The second one refers to a recent proposal, the fragmentation of magnetization [2], in an Ising kagomé model.

Here, we show it is possible to observe this intriguing phenomena, which corresponds to the splitting of the local degree