Simulation of frustrated magnetic phases of ultracold bosonic atoms in an optical lattice

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Recent experiments have demonstrated that ultracold Rubidium-87 atoms in frustrated optical lattices can be used to simulate classical magnetism [1]. Here, we use classical Monte-Carlo to understand the equilibrium phase diagram of such systems. We consider a frustrated triangular lattice in which the tunneling energy in two spatial directions is negative, and is complex in the third spatial direction. We model the bosonic field by using a thermally fluctuating complex field and obtain several observables, such as the momentum space distribution of the atoms and the chirality of the state, both above and below the critical point. We discuss the relevance of our results to experiments, including non-equilibrium behavior arising from short quench times.

References:
[1] Struck, J., et al. (2011). Quantum simulation of frustrated classical magnetism in triangular optical lattices. Science, 333 (6045)