Q10

Skyrmions, Vortices and Other Non-coplanar orderings in Frustrated Mott Insulators

C. D. Batista[1], Satoru Hayami[2] and S-Z.Lin[3]
[1]*Department of Physics and Astronly, University of Tennessee, Knoxville, TN, USA*
[2]*Department of Physics, Hokkaido University, Sapporo, Japan*
[3]*Los Alamos National Laboratory, NM, USA*

I will dsicuss different mechanisms for the stabilitzation of multiple-$\boldsymbol{Q}$ modulated structures, *such as skyrmion and vortex crystals*, in frustrated magnets. We will see that the triangular lattice (and any other C_6 invariant lattice) provides a simple realization of a high-symmetry system with six equivalent orientations for the helical ordering. This symmetry allows for anharmonic interactions between triple-$\boldsymbol{Q}$ modulations and the uniform magnetization induced by external field because $\boldsymbol{Q}_1 + \boldsymbol{Q}_2 + \boldsymbol{Q}_3 = \boldsymbol{0}$ [1]. Indeed, classical Monte Carlo simulations of a frustrated $J_1 - J_3$ classical Heisenberg model on a triangular lattice revealed a skyrmion crystal at finite temperature and magnetic field [2]. The origin of this phase is very different from the skyrmion crystals that emerge in chiral magnets out of the competition between Dzyaloshinskii-Moriya (DM) and ferromagnetic exchange interactions [3-5]. Moreover, because the chiral and U(1) symmetries are spontaneously broken in non-chiral magnets, their metastable single skyrmions have different properties [6-8].

In this presentation I will dicuss the role of symmetric exchange anisotropy and charge fluctuations on the stabilization of magnetic skyrmion and vortex crystals. We will see that both mechanisms provide efficient ways of stabilizing multiple-$\boldsymbol{Q}$ orderings. We will also see that non-magnetic impurities can induce magnetic vortices (merons) above the saturation field of frustrated Mott insulators [9] and stabilize skyrmion and vortex crystals below the saturation field [10,11].

References

[1] T. Garel and S. Doniach, Phys. Rev. B **26**, 325 (1982).
[2] T. Okubo, S. Chung, and H. Kawamura, Phys. Rev. Lett. **108**, 17206 (2012).
[3] A. N. Bogdanov and D. A. Yablonskii, Sov. Phys. JETP **68**, 101 (1989).
[4] A. Bogdanov and A. Hubert, Journal of Magnetism and Magnetic Materials **138**, 255 (1994).
[5] U. Rößler, A. Bogdanov, and C. Pfleiderer, Nature **442**, 797 (2006).
[6] A. O. Leonov and M. Mostovoy, Nature Communications 6, 8275 (2015).
[7] S.-Z. Lin and S. Hayami, Phys. Rev. B **93**, 064430 (2016).
[8] S. Hayami, S.-Z. Lin, and C. D. Batista, Phys. Rev. B **93**, 184413 (2016).
[9] Shi- Zeng Lin, Satoru Hayami and C. D. Batista, Phys. Rev. Lett. **116**, 187202 (2016).
[10] D. Batista, Shi-Zeng Lin, S. Hayami and Yoshitomo Kamiya, Reports on Progress in Physics, Volume **79**, Number 8.
[11] Satoru Hayami, Shi-Zeng Lin, Yoshitomo Kamiya, and Cristian D. Batista, Phys. Rev. B **94**, 174420.