凝縮系物理学ゼミナール
Condensed Matter Seminar

Location: Room 413, School of Science Bldg. 5 (理学 5 号館 413 号室)
Time and date: 13:30 – 15:00, Wednesday, 10 April 2013

Magnetic vortex crystals in frustrated Mott insulator

Speaker: Dr. Yoshitomo Kamiya (紙屋 佳知 氏)
(Theoretical Division, T-4 and CNLS, Los Alamos National Laboratory, USA)

Abstract:

Materials that exhibit topological spin textures are attracting enormous interest because of their potential for spintronics [1-7]. Competition between Dzyaloshinskii-Moriya and ferromagnetic exchange interactions leads to skyrmion lattices in a class of materials that share a common crystal structure. This includes insulators, like Cu_2OSeO_3, that allow for energetically efficient manipulation of the magnetic textures with electric field gradients [5]. Here we propose a novel mechanism for the stabilization of magnetic vortex crystals in frustrated Mott insulators that enables tunable spin superstructures [8]. By modeling the frustrated quantum magnet $Ba_3Mn_2O_8$ [9] near its magnetic field-induced quantum critical point, we show that the quantum phase diagram includes novel magnetic vortex crystals, whose lattice parameter is controlled by the ratio between inter and intra-layer exchange. This property opens the attractive possibility of tuning the vortex density by applying pressure.

References:

[1] S. Mühlbauer et al., Science 323, 915 (2009)
[2] W. Münzer et al., PRB 81, 041203 (2010)
[3] X. Z. Yu et al., Nature 465, 901 (2010)
[4] X. Z. Yu et al., Nat. Mater. 10, 106 (2011)
[5] S. Seki et al., Science 336, 198 (2012)
[6] Y. Onose et al., PRL 109, 037603 (2012)
[7] T. Okubo, S. Chung, and H. Kawamura, PRL 108, 017206 (2012)
[8] Y. Kamiya and C. D. Batista, arXiv:1303.0012 (unpublished)
[9] M. Uchida et al., PRB 66, 054429 (2002)