Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Magnetic vortex crystals in frustrated 3D Mott insulators ZHENTAO WANG, Department of Physics and Astronomy, Rice University, YOSHITOMO KAMIYA, iTHES Research Group and Condensed Matter Theory Laboratory, RIKEN, ANDRIY NEVIDOMSKYY, Department of Physics and Astronomy, Rice University, CRISTIAN BATISTA, Theoretical Division, T-4 and CNLS, Los Alamos National Laboratory — Topological spin textures, such as skyrmions, are of great interest to the field of spintronics and usually arise due to the interplay of Dzyaloshinskii-Moriya and exchange couplings. By contrast, using the BCC and FCC lattices as examples, here we demonstrate that frustrated spin exchange interactions alone can produce topological vortex crystals near the magnetic field-induced saturation transition of 3D bulk Mott insulators. Because of the magnetic frustration, the magnon spectrum of the high-field fully polarized state has multiple degenerate minima at different Q-vectors. This quantum paramagnet becomes gapless and goes through a Bose-Einstein condensation at the saturation field (quantum critical point). In this limit, we apply the dilute bosonic gas approximation to study the rich topological structures produced due to multi-Q condensation. We find that the vortex crystal phases span sizable regions in the phase diagrams of frustrated 3D Mott insulators with isotropic Heisenberg interactions, and are further stabilized by exchange anisotropies. Vortex strings emerge in the direction of the magnetic field and, depending on the distributions of the condensed modes, can form different exotic patterns.

Zhentao Wang
Rice Univ

Date submitted: 13 Nov 2014 Electronic form version 1.4