Magnetic vortex crystals in frustrated Mott insulator

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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$_2$OSeO$_3$, 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$_3$Mn$_2$O$_8$ [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.

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