Condensed Matter Seminar

Special Seminar

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Tuesday, April 1 ◆ 4:00 P.M. ◆ Rm 202 Nieuwland Sci Hall

Skyrmions in chiral magnets have been generating tremendous excitement since their recent discovery, both due to their intrinsic science interest and for possible applications. Skyrmions can be driven with an applied spin-polarized current and appear to have many similarities to vortices in type-II superconductors. Here we numerically simulate skyrmions driven over random and periodic arrays of defects or pinning using a combination of particle-based models and continuum models. For random disorder, we show that there can be a transition from a skyrmion crystal phase to a skyrmion glass phase, while for a periodic pinning array we find that various types of skyrmion lattice structures can be stabilized. Under an applied drive we show that for weak pinning, the skyrmions depin elastically, while for strong pinning, the skyrmions depin plastically. In both cases, there are distinct features in the resulting transport curves, and we find that in the presence of pinning the Hall angle continuously changes as a function of drive in the moving phase as the effectiveness of the pinning changes. We consider how this depends on the pinning strength distribution. In the plastic depinning case, at high drives there is a transition to a dynamically ordered state which we compare to the dynamical reordering observed for driven vortices in type-II superconductors. With periodic pinning, the Hall angle changes in discrete steps for increasing drive as the skyrmion motion locks to different symmetry directions of the underlying pinning array.

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