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Effects of disorder on magnetic vortex dynamics[1]

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Experimental measurements of domain wall propagation are typically interpreted by comparison to reduced models that ignore both the effects of disorder and the internal dynamics of the domain wall structure. Using micromagnetic simulations, first we study vortex wall propagation in magnetic nanowires induced by fields or currents in the presence of disorder. We show that the disorder leads to increases and decreases in the domain wall velocity depending on the conditions. These results can be understood in terms of an effective damping that increases as disorder increases. As a domain wall moves through disorder, internal degrees of freedom get excited, increasing the energy dissipation rate [1]. Next we study the effect of disorder on vortex gyration in a magnetic disc. A vortex gyrating in a magnetic disc has two regimes of motion in the presence of disorder. At large gyration amplitudes, the vortex core moves quasi-freely through the disorder potential. As the amplitude decreases, the core can become pinned at a particular point in the potential and precess with a significantly increased frequency. In the pinned regime, the amplitude of the gyration decreases more rapidly than it does at larger precession amplitudes in the quasi-free regime. In part, this decreased decay time is due to an increase in the effective damping constant and in part due to geometric distortion of the vortex. A simple model with a single pinning potential illustrates these two contributions [2].

[1] Hongki Min, Robert D. McMichael, Michael J. Donahue, Jacques Miltat, and M. D. Stiles, Phys. Rev. Lett. **104**, 217201 (2010).

[2] Hongki Min, Robert D. McMichael, Jacques Miltat, and M. D. Stiles (unpublished).

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