Current induced magnetic vortex core Dynamics

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A magnetic nanoparticle in a vortex state is a promising candidate for the information storage. One bit of information corresponds to the upward or downward magnetization of the vortex core (vortex polarity).

We study the dynamics of the magnetic vortex driven by a spin current. We show that in spite of Heisenberg magnets [1] the vortex dynamics in a real nanodot is very nontrivial.Using a simple analytical model and numerical simulations we show that a non-decaying vortex motion can be excited by a dc spin current, whose intensity exceeds a first threshold value as a result of the balance between a spin-torque pumping (due to the spin-torque effect) and damping (due to the Gilbert relaxation).

The irreversible switching of the vortex polarity takes place for a current above a second threshold [2]. The mechanism of the switching, which involves the process of creation and annihilation of a vortex-antivortex pair is described analytically, using a rigid model, and confirmed by detailed spin-lattice simulations. Such a mechanism is very general and does not depend on the details how the vortex dynamics was excited [3].

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