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Dynamics of point singularities in magnetic nanodots under the field influence

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Magnetic vortices are structures with closed magnetic flux that can form the ground state in submicron size particles. They are prominent candidates for high-speed memory and high-density data storage by encoding bits as polarity direction (up or down) and magnetic flux direction (clockwise or counter-clockwise). Therefore it is important to control the switching of the vortex polarity. The switching process in thick nanoparticles is known [1] to be mediated by a Bloch point singularity, while the switching process in thin nanoparticles can be mediated by a linear singularity via planar vortex [2].

Using in-house made 3D spin-lattice simulator (SLaSi) we modeled the switching in disk shaped particles under the influence of external DC magnetic field. Different types of magnets were studied: (i) Heisenberg magnets with easy-plane anisotropy by exchange or single-ion type and (ii) isotropic nanomagnets with dipolar interaction.

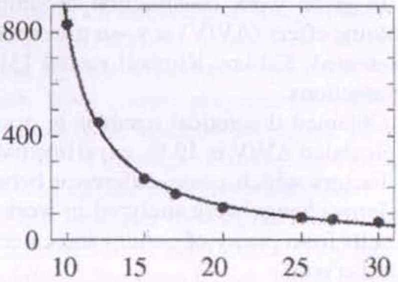

Fig. 1. Velocity (in units of $a_0\omega$) of the Bloch point as function of disk thickness (in units of the lattice constant a_0); ω is ferromagnet resonance frequency.

(i) Magnetization reversal in Heisenberg magnets is mediated by two Bloch points which are injected from face surfaces of nanodot. In the absence of the surface anisotropy the switching is accompanied by planar vortex creation. We found that the Bloch point speed is proportional to the field amplitude and inversely proportional to the sample thickness. The Bloch point viscosity is shown to be nonlinear function of the damping.

(ii) Only one Bloch point was observed during the switching in nanodots, where the point mobility is smaller than for Heisenberg magnets.

We proposed the analytical description of the magnetization field with account two Bloch points.

[1] A. Thiaville *et al*, Phys. Rev. B **67**, 094410 (2003).
[2] V. P. Kravchuk and D. D. Sheka, Phys. Solid State, **49**, 1923 (2007).