Seminar: Hard Condensed Matter Theory

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Room: Media Raum, 03-431 (Staudinger Weg 7)
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Skyrmions in symmetric bilayers

Magnetic skyrmions in ultrathin films require a strong chiral interaction. It is usually provided by the Dzyaloshinskii-Moriya interaction, of the interfacial type for ultrathin films. For single films, in an asymmetrical architecture, it has been shown that the skyrmion size and stability depend extremely sensitively on all sample parameters. Multilayers with typically 10 repetitions of an asymmetrical structure have also being studied, showing robust skyrmions but, as realized recently, a degraded chirality of the domain wall due to magnetostatic effects.

In order to retain, by construction, the benefits of both the magnetostatic interaction and the Dzyaloshinskii-Moriya interaction, we have studied symmetric bilayers of ultrathin films, each in an asymmetric structure. In such a system, we obtain robust skyrmions with a typical 100 nm diameter, show that they can be nucleated by localized current injection using sharp electrodes, measure their current-induced propagation with up to 60 m/s longitudinal velocity, and observe their transverse deflection according to the gyrovector sign. These experiments were performed inside a magnetic force microscope. In addition, high-resolution skyrmion shapes have been systematically mapped using the NV-center magnetic microscope and the measured distributions have been compared to micromagnetic simulations, using a physical description of magnetic disorder based on magnetic layer thickness fluctuations.

[1] Current-induced skyrmion generation and dynamics in symmetric bilayers, A. Hrabec, J. Sampaio, M. Belmeguenai, I. Gross, R. Weil, S.M. Cherif, A. Stashkevich, V. Jacques, A. Thiaville, and S. Rohart, Nat. Commun. 8, 15765 (2017). [2] Skyrmion morphology in ultrathin magnetic films, I. Gross, W. Akhtar, A. Hrabec, J. Sampaio, L. J. Martinez, S. Chouaieb, B. J. Shields, P. Maletinsky, A. Thiaville, S. Rohart, and V. Jacques, arXiv:1709.06027 (2017).