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Local and nonlocal interactions in curved ferromagnets

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Magnetostatics and engineered anisotropy following the geometry of a magnetic nanoobject result in the coupling of a magnetic texture with geometry and topology of magnetic nanoparticles. It opens a novel ways for developing of novel devices, utilizing the third dimension at nanoscale [1].

In this talk, we discuss the influence of both, local and nonlocal interactions on the state of a ferromagnetic curvilinear shell. In the main order of the shell thickness, magnetostatics can be reduced to a local anisotropy [2]. Depending on the sample geometry, it takes the form of easy-tangential anisotropy in nanowires, biaxial anisotropy in curvilinear ribbons and easy-surface one in infinite shells [3]. We propose a framework allowing to distinguish effects of curvature from spurious effects of curvilinear reference frame. Local curvatures of thin shells put forth additional anisotropy and Dzyaloshinskii-Moria interaction of interfacial symmetry. Magnetostatic energy results in new nonlocal anisotropic and chiral energy terms in addition to the shape anisotropy in corrugated and curvilinear films. These interactions emerge in shells with nonzero mean curvature. In addition new chiral interaction appears due to the interaction surface and volume magnetostatic charges: it can exist both in flat but rough films and shells. We classify effects of curvature-induced chiral and anisotropic terms in exchange and magnetostatic energies on equilibrium states of magnetization by shell types according to mean and Gauss curvatures.

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[2] V. Slastikov, Math. Models Methods Appl. Sci. 15, 1469 (2005); G. Di Fratta, arXiv:1609.08040

[3] Y. Gaididei, A. Goussev, V. P. Kravchuk, O. V. Pylypovskyi, J. M. Robbins, D. Sheka, V. Slastikov, S. Vasylykevych, J. Phys. A. 50, 385401 (2017)

Primary author: Dr PYLYPOVSKYI, Oleksandr (Taras Shevchenko National University of Kyiv)

Presenter: Dr PYLYPOVSKYI, Oleksandr (Taras Shevchenko National University of Kyiv)