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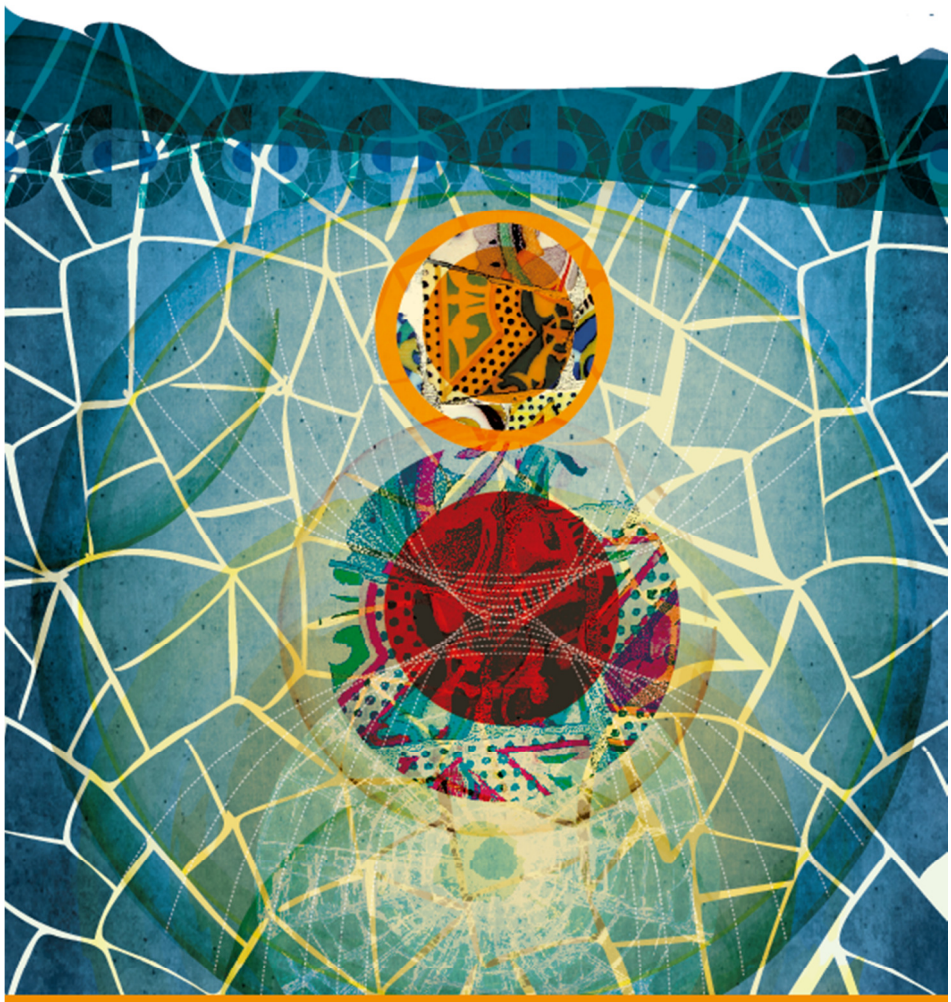

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Book of Abstracts

Fr.E.3_O1 - Domain wall on a magnetic helix with easy-tangential anisotropy

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Here, we demonstrate the curvature- and torsion-induced effects on the magnetization and the magnetic domain wall structure in 1D magnetic helices [1]. Coiling of a magnetic wire with the easy-axis anisotropy along the wire axis into a helix leads to an easy-tangential anisotropy and results in the following effects: (i) Appearance of an effective easy-plane anisotropy in a tangent-binormal-plane and rotation of the axis of the easy-axis anisotropy; (ii) Appearance of the effective Dzyaloshinskii term in the expression for the magnetic energy, which is proportional to the torsion and curvature of the wire [2]. Such a geometrical deformation from a straight wire into the helix can result in values of the Dzyaloshinskii constants comparable with estimations of surface induced ones in multilayer structures [3]. Domain walls in this curved system are described in the Frenet-Serret frame of reference offering the advantage that the magnetic anisotropy assumes the simplest form. The nonzero torsion results in the tilt of magnetization in the domain wall. This effect is similar to the one reported for structures with the intrinsic Dzyaloshinskii interaction [4]. The nonzero curvature results in coupling of the domain wall type (head-to-head or tail-to-tail) and the rotation of magnetization in the domain wall. All these effects are described analytically and confirmed by customized spin-lattice simulator SlaSi [5].

References:

[1] D. Sheka, V. Kravchuk, K. Yershov, Yu. Gaididei, arXiv: 1502.06482 (2015)
[2] Yu. Gaididei, V. Kravchuk, D. Sheka, PRL, 112, 257203 (2014)
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[5] http://slasi.rpd.univ.kiev.ua

TU.F-P83 - Geometry-induced effects on domain walls on curved surfaces

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Curved surfaces of nanoobjects result in the effective anisotropy-like effects and Dzyaloshinskii-like terms in the exchange energy [1]. Geometry of the Moebius ring allows combining of curvature-induced [1] and topological effects [2]. They influence the magnetic ground state as well as the magnetization dynamics. We study numerically and analytically the impact of curvature on the magnetic domain walls in Moebius ring of different sizes and easy-normal anisotropy [3]. Moebius ring topology leads to appearance of either longitudinal or transversal domain walls in the ground state. While the former wall type is favorable for the system with strong anisotropy (large quality factor, the ratio between the anisotropy and magnetostatic energies), the latter one appears when the quality factor is close to one. A vortex state is observed when the quality factor is small.
Furthermore, we show that the geometry induced Dzyaloshinskii interaction influences on the structure of the domain walls and determines their location in the Moebius ring. Namely, we found the presence of the coupling between the geometrical chirality of the Moebius ring and the direction of the magnetization rotation (magnetic chirality) of the walls: (i) The transversal domain wall always has the magnetic chirality opposite to the chirality of the Moebius ring and has a favorable position on the ring. (ii) The longitudinal domain wall is placed along the central line of the Moebius ring and has the same magnetic chirality as the sample.
The developed analytical approach can be readily applied to investigate a variety of geometries with vector fields defined on them. As an example, peculiarities of the magnetic domain wall structures will be discussed for the uniformly twisted strips.

References:

[1] Yu.Gaididei, V.Kravchuk, D.Sheka, PRL, 112, 257203 (2014)
[2] M.Yoneya, K.Kuboki, M.Hayashi, PRB, 78, 064419 (2008)
[3] O.Pylypovskyi, V.Kravchuk, D.Sheka, D.Makarov, O.Schmidt, Yu.Gaididei, arXiv:1409.2049 (2014)