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Magnetochiral effects in geometrically curved magnetic architectures

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Symmetry effects are fundamental in condensed matter physics as they define not only interactions but also resulting responses for the intrinsic order parameter depending on its transformation properties with respect to the operations of space and time reversal. Magnetic materials or layer stacks with structural space inversion symmetry breaking obtained much research attention due to the appearance of chiral Dzyaloshinskii-Moriya interaction (DMI) [1,2]. The latter manifests itself in the formation of non-trivial chiral and topological spin textures (e.g. skyrmions, bubbles, homochiral spirals and domain walls), that are envisioned to be utilized for prospective spintronic devices. At present, tailoring magnetochirality is done by the selection of materials and adjustment of their composition. Alternatively, space inversion symmetry breaking of the magnetic order parameter appears in geometrically curved systems [3]. In curvilinear ferromagnets, curvature governs the appearance of geometry-induced chiral and anisotropic responses, which introduce a new toolbox to create artificial chiral nanostructures from achiral magnetic materials suitable for the stabilization of non-trivial chiral textures [4,5].
Recently, much attention was dedicated to the exchange interaction, which enables curvature-induced extrinsic DMI as was proposed theoretically and validated experimentally for the case of conventional achiral magnetic materials [6]. Here, we demonstrate the existence of non-local chiral effects in geometrically curved asymmetric permalloy cap with the vortex texture. Using the full-scale simulation of the asymmetric nanodots we study how the vortex texture is changing with respect to the introduced sample asymmetry.

Reference list

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