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Magnetism in curved geometries[1]

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Deterministically bending and twisting two-dimensional structures in the three-dimensional (3D) space provide means to modify conventional or to launch novel functionalities by tailoring curvature and 3D shape. The recent developments of 3D curved magnetic geometries, ranging from theoretical predictions over fabrication to characterization using integral means as well as advanced magnetic tomography, will be reviewed. Theoretical works predict a curvature-induced effective anisotropy and effective Dzyaloshinskii-Moriya interaction resulting in a vast of novel effects including magnetochiral effects (chirality symmetry breaking) and topologically induced magnetization patterning. The remarkable development of nanotechnology, e.g. preparation of high-quality extended thin films, nanowires and frameworks via chemical and physical deposition as well as 3D nano printing, has granted first insights into the fundamental properties of 3D shaped magnetic objects. Optimizing magnetic and structural properties of these novel 3D architectures demands new investigation methods, particularly those based on vector tomographic imaging. Magnetic neutron tomography and electron-based 3D imaging, such as electron holography and vector field electron tomography, are well-established techniques to investigate macroscopic and nanoscopic samples, respectively. At the mesoscale, the curved objects can be investigated using the novel method of magnetic X-ray tomography. In spite of experimental challenges to address the appealing theoretical predictions of curvature-induced effects, those 3D magnetic architectures have already proven their application potential for life sciences, targeted delivery, realization of 3D spin-wave filters, and magneto-encephalography devices, to name just a few. Reference: R. Streubel et al.: Magnetism in curved geometries, J. Phys. D: Appl. Phys. 49, 363001 (2016).

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