Contribution submission to the conference Regensburg 2019

3D nanomagnetism and superconductivity: Current status and potential for future work — •Oleksandr Dobrovolskiy and Michael Huth — Goethe University, Frankfurt am Main

Extending 2D structures into the third dimension has become a general trend in various areas, including photonics, plasmonics and magnetics. This approach provides a means to modify conventional and to launch novel functionalities by tailoring vector potentials inducing anisotropic and chiral effects. Recently, there has been significant progress in the fabrication of free-standing ferromagnetic and superconducting nanostructures by focused particle direct-write techniques which is in part reviewed in [1]. In this respect, 3D shell structures such as framed tubes, spheres, Swiss rolls and helices are especially interesting as they offer unprecedented prospects for nanomagnetism and superconductivity because of topology and geometry-controlled effects. Namely, in magnetism, curvilinear geometry brings about two exchange driven interactions - effective anisotropy and antisymmetric vector exchange, i.e. an effective Dzyaloshinskii-Moriya interaction. In addition, another magneto-chiral contribution emerges due to the dipole-dipole interaction. In the case of superconducting nanostructures, the combination of low-dimensionality with a curvilinear geometry allows in principle for the observation of topology-driven effects, such as unconventional phase slips, reversible and irreversible switching, fractional flux-flow instabilities, and the Berezinskii-Kosterlitz-Thouless transition. [1] M. Huth, F. Porrati, O. V. Dobrovolskiy, FEBID meets materials science, Microelectron. Engineering, 185-186, 9-28 (2018).

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Email:	**Dobrovolskiy@Physik.uni-frankfurt.de**