Physics of topological magnetic skyrmions and potential skyrmion-based applications

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The aim of the tutorial will be to introduce why, and to present how, the concept of topology and chirality can also be exploited in modern magnetism [1] as a mean to stabilize and manipulate some novel magnetic quasi-particles such as magnetic skyrmions (see Fig. 1a) that might be technologically relevant [2-3]

I will first shortly introduce the micromagnetic modelling of these magnetic skyrmions and review the material multi-layered systems which have been developed in the last couple of years allowing the room temperature stabilization of these non-collinear spin nano-textures. I will then describe what are the different mechanisms for skyrmion nucleation and introduce the mechanisms of spin-orbit torque responsible for the motion of skyrmions in nanostructures. Another important experimental demonstration achieved recently has been the electrical detection of topological spin textures. Finally, I will describe how these basic bricks i.e. skyrmion nucleation, motion and detection can be combined for the development of skyrmion based devices for logic gate operations or neuromorphic computing.

References

[1] A. N. Bogdanov & C. Panagopoulos, Nat. Rev. Phys. 2, 492 (2020)
[2] A. Fert, N. Reyren, V. Cros "Magnetic skyrmions; advances in physics and potential applications" Nat. Rev. Mat. 2, 17031 (2017)
[3] C. Back et al, "The 2020 Skyrmionic Roadmap", J. Phys. Appl. D, 53, 363001 (2020)

Figures

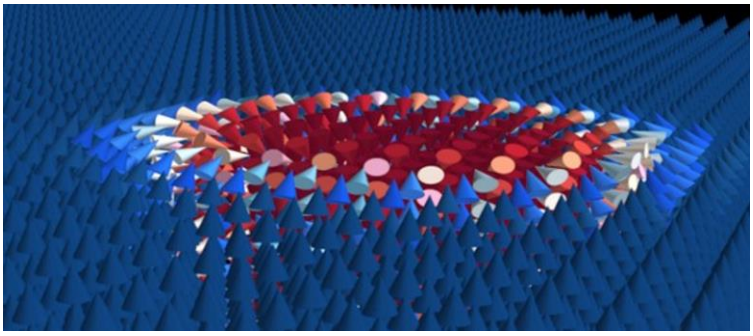

Figure 1: Schematic view of an isolated magnetic skyrmion

EU grant SKYTOP (H2020 FET Proactive 824123), FLAG-ERA SOgraphMEM, FET Pathfinder TSAR (964931 and ANR-20-CE42-0012-01(MEDYNA) are acknowledged for their financial support.