Universität Basel

Research Project

„Discovery and Nanoengineering of Novel Skyrmion-hosting Materials”

Third-party funded project

Project title „Discovery and Nanoengineering of Novel Skyrmion-hosting Materials”
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Magnetic Skyrmions are particle-like spin textures. They exhibit nanoscale dimensions and can be persistent due to topological protection. These nanoobjects have been first discovered at low temperatures in a small number of bulk single crystals of high purity and quality. Such chiral magnets are now of substantial interest for both fundamental condensed matter physics due to topological effects and applied sciences such as spintronics. The physics and manipulation of Skyrmions stabilized by Dzyaloshinskii-Moriya interaction (DMI) are relatively well established in bulk materials at low temperatures. The results promise novel device concepts in magnetic storage and information technology offering low power consumption. Technologically relevant structures will necessarily involve nanostructures operated at room temperature. The research on nanosystems is however mostly at the theoretical and numerical level because the relevant materials pose key challenges in the synthesis and fabrication of strain-free thin films that support the Skyrmion phase. Despite strong efforts, Skyrmions at room temperature have been observed only very recently in metallic ultrathin films and the bulk metallic alloy CoZnMn. Corresponding semiconductors and insulators that will decisively enhance the technological impact remain to be discovered.In this proposal we aim to go beyond the state-of-the-art of existing Skyrmionic schemes in that we intend to:-Systematically search for novel metallic, semiconducting, and insulating materials hosting Skyrmions at high temperatures-Achieve strain-free thin films and free-standing nanostructures with volume-DMI for Skyrmion-based devices -Image and manipulate Skyrmions up to the microwave frequency regime and down to the single Skyrmion level to set the base for Nanoskyrmionics.These ambitious goals can be achieved only by intimately combining different disciplines at their highest level and from diverse areas of research. In our proposal, we combine: computational materials discovery in condensed matter physics, chemical synthesis and molecular beam epitaxy, state-of-the-art neutron diffraction, nanotechnology and GHz spectroscopy. We propose to implement chemical precipitation from a solution as well as van der Waals epitaxy for strain-free thin film deposition. Direct correlation between the materials nature (structure, chemical composition, disorder configuration) and physical properties (magnetization, Skyrmion structure, dynamics) will be achieved by applying new computational and nanosensing techniques. The interdisciplinary efforts and results will lead to a paradigm-shift by providing a clear microscopic picture of the role and potential of Skyrmions in engineering, setting the stage for Skyrmionic science and technology at room temperature.

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ID	Kreditinhaber	Kooperationspartner	Institution	Laufzeit - von	Laufzeit - bis
4611569	Poggio, Martino	Grundler, Dirk, Prof.	EPFL	01.10.2017	30.09.2021
4611572	Poggio, Martino	White, Jonathan, Researcher	PSI	01.10.2017	30.09.2021
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