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Small-angle neutron scattering of kinetically driven skyrmion lattice motion

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Skyrmions are topologically non-trivial spin textures that exhibit an exceptionally efficient coupling to spin currents, notably spin-polarized charge currents and magnon currents as observed in MnSi, FeGe, and Cu2OSeO3 [1, 2, 3]. This raises the question for the microscopic mechanisms that control the pinning of the skyrmion lattice, and how they depend on the topology, electronic structure, and disorder.

We report neutron scattering measurements of kinetically driven skyrmion lattice unpinning and motion by means of Time-Involved Small Angle Neutron scattering Experiment (TISANE) [4]. By interlocking the phases of neutron pulse, sample modulation, and detector signal, the technique allows to record data without major sacrifice in intensity at time-scales down to micro-seconds and provides a direct insight on the skyrmion lattice motion.

In our study we examined the unpinning process under changing field orientation for different materials including the metallic systems Mn1–xFexSi and the insulator Cu2OSeO3. We discuss our results in the light of methodological aspects of the TISANE technique [5] and recent theoretical predictions of walking skyrmions.

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Authors: METTUS, Denis (Technische Universität München); CHACON, Alfonso; BAUER, Andreas (Technische Universität München); MÜHLBAUER, Sebastian (Technische Universität München); BEZVERSHENKO, Alla (Institute for Theoretical Physics, University of Cologne, Cologne, Germany); HEINEN, Lukas (Institute for Theoretical Physics, University of Cologne, Cologne, Germany); Prof. ROSCH, Achim (Institute for Theoretical Physics, University of Cologne, Cologne, Germany); PFLEIDERER, Christian

Presenter: METTUS, Denis (Technische Universität München)

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