NCNR SEMINAR: AUGUST 16, 2024. 10:45 AM (EST)

Three-Dimensional Skyrmion Transitions Through Vortices and Monopoles

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Magnetic skyrmions define a unique class of topological object, characterized by a multi-directional twisting of spins which nucleate and annihilate on magnetic singularities, called Bloch points. In three dimensions, their stabilization into flexible tubes introduces enhanced dimensionalities and emergent phenomena which endows them with superior functionalities as information carriers in future spintronic devices. Unfortunately, a lack of bulk probes has prevented their complete characterization in three dimensions, inhibiting the development of modern skyrmion device architectures. Here, we present the first experimental visualizations of three-dimensional skyrmion topological transition pathways across field-induced phase trajectories in a bulk triangular lattice skyrmion host. Reconstructed spin textures uncover novel skyrmion formation pathways through field-perpendicular tubes, while stabilized tubes exhibit a zoology of exotic three-dimensional metastable topological structures and bundles. Interwoven vortex-antivortex lattices are observed to coexist with skyrmion lattices throughout the entire thermal equilibrium phase, facilitating topological transitions between Q=1 and Q=0 skyrmions and bundles through a coupling of merons and monopoles. We explore practical implementations of these objects and their dynamics in future spintronic devices, motivating three-dimensional logic infrastructures through composite topological objects and multi-bit encoding schemes which reimagine spintronic frameworks.

Friday, August 16, 2024
10:45 AM (UTC-05:00) Eastern Time (US & Canada) | Hybrid format
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