



## MMQ10: Topological spin textures in two and three dimensions

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### Content:

Multidimensional topological spin textures are currently of great interest in condensed matter physics due to their rich science and potential applications in information technology. Two-dimensional (2D) textures such as vortices, skyrmions, and bimerons have been widely studied, owing to their nanoscale size, stability, and efficient control by magnetic field or electric current. Recent efforts are extending to 3D topological spin textures, including chiral bobbers, skyrmion and vortex strings, hopfions, Bloch points (see Figure 1). Besides, curvature has also emerged as a novel parameter to tailor magnetic and electronic properties, especially in quantum materials where topology and correlations are central, and the interplay of magnetic and structural chirality. These situations introduce genuine static and dynamic behavior that could be harvested for novel routes in information encoding.

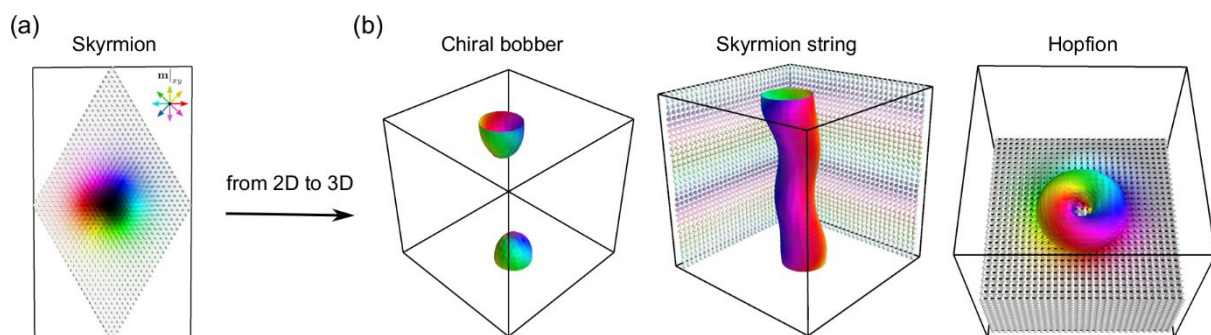


Figure 1: Examples of topological spin textures in two and three dimensions. (a) In 2D, skyrmions are localized spin configurations stabilized by chiral magnetic interactions. (b) In 3D, more complex magnetization textures can arise, including chiral bobbers, skyrmion strings, and magnetic hopfions, the latter characterized by closed vortex-like spin loops forming knotted field configurations.

This mini-colloquium (MC) brings together researchers working on the theory, materials design, and experimental characterization of topological 2D/3D spin textures. The focus includes both the microscopic level, with the interplay between magnetic interactions (exchange, DMI, magnetic anisotropy, Zeeman, and higher-order terms), spin-orbit coupling, and electronic structure, and the macroscopic level, which pertains to micromagnetism. Novel aspects include notably the emerging orbitronic concepts. Both collectively determine the stability, lifetime, topology, and current- or field-driven dynamics of these spin configurations. The program aims to provide a comprehensive overview of recent advances in both 2D systems, such as ultrathin films, interfaces, and van der Waals (vdW) materials, 3D systems, including bulk chiral magnets, magnetic multilayers, and intercalated vdW magnets, and their interplay in nanosized systems in which both arise in the volume and at the surface.

A central goal of this MC is to foster dialogue between different communities, spanning *ab initio* theory, atomistic spin models, micromagnetics, material science, and advanced experimental probes such as spin-polarized scanning tunneling microscopy, transmission electron microscopies, X-ray spectroscopies, NV center, all in statics or in dynamics with time resolution. By bridging length and time scales, the MC seeks to identify new mechanisms for developing and controlling topological spin textures and to assess their potential for next-generation information technologies. We aim to provide a platform for exchanging ideas, initiating collaborations, and defining future research directions in this rapidly evolving field.