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Stuttgarter Physikalisches Kolloquium

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Dienstag, 8. Juni 2021 | **16.15 Uhr** | **Online-Vortrag**

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Three-dimensional nanomagnetism: from textures in the bulk to patterned magnetic nanostructures

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Abstract

Three dimensional magnetic systems promise significant opportunities for applications, for example providing higher density devices and new functionalities associated with complex topology and greater degrees of freedom [1,2]. With recent advances in both characterization and nanofabrication techniques, the experimental investigation of these complex systems is now possible, opening the door to the elucidation of new properties and rich physics.

For the characterization of 3D nanomagnetic systems, we have developed techniques to map both the three-dimensional magnetic structure, and its response to external excitations. In a first demonstration of X-ray magnetic nanotomography [3,4], we determined the complex magnetic structure within the bulk of a μm-sized soft magnetic pillar. The magnetic configuration contained vortices and antivortices, as well as Bloch point singularities [3]. With these new datasets comes a new challenge concerning the identification of such nanoscale topological objects within complex reconstructed magnetic configurations. To address this, we have recently implemented calculations of the magnetic vorticity [5,6], that make possible the location and identification of 3D magnetic solitons, leading to the first observation of nanoscale magnetic vortex rings [6].

In addition to the static magnetic structure, the *dynamic* response of the 3D magnetic configuration to excitations is key to our understanding of both fundamental physics, and applications. With our recent development of X-ray magnetic laminography [7,8], it is now possible to determine the magnetisation dynamics of a three-dimensional magnetic system [7].

Finally, recent advances in nanofabrication make possible the fabrication of complex 3D magnetic nanostructures [9], leading to the realisation of artificial chiral structures [10] and 3D spintronic devices [11]. These new experimental capabilities for 3D magnetic systems open the door to complex three-dimensional magnetic structures, and their dynamic behaviour.

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