



Physics Colloquium

Tuesday, 3 December 2024 at 16:30

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Exploring three dimensional nanomagnetism -and beyond!

Extending nanomaterials to three dimensions results in opportunities for increased density and interconnectivity, with the possibility to go beyond the physics of planar systems. This has recently been exemplified by nanomagnetism, where advances in methodologies have driven breakthroughs in our physical understanding, leading to the discovery of exotic spin textures, non-reciprocal dynamics and curvature-induced effects.

In this talk we will address two main challenges of 3D nanomaterials.

First, can we map 3D order at the nanoscale? We start by considering ferromagnets, for which we have developed X-ray magnetic tomography and laminography, to map 3D magnetic configurations, and their GHz dynamics. In this way, we gain insight into textures such as nanoscale magnetic vortex rings and Bloch point singularities. With X-ray magnetic tomography established for ferromagnets, we next develop new imaging capabilities for a wider range of materials. By harnessing coherent X-rays, we exploit phase dichroism to open up the study of previously inaccessible ferromagnetic systems. Next, we go beyond ferromagnets by establishing linear dichroic tomography, gaining access to 3D orientation fields: from crystallographic defects in catalysts, to 3D antiferromagnets.

A second challenge concerns the local control of phenomena. Topological textures, which naturally exist within the bulk, can also be introduced and controlled via the patterning of curvilinear geometries. In ferromagnets, we harness chiral geometries to realise new magnetic configurations, and tailor the energy landscape of topological defects. We can extend this geometric control beyond ferromagnets to a broader range of quantum nanomaterials, as we have demonstrated for 3D superconducting nanostructures in which we obtain local reconfigurable control of the superconducting order parameter.

This new understanding and control of phenomena in 3D magnetic systems – and beyond! – paves the way not only for enhanced understanding of these systems, but also towards the next generation of technological devices.



Host: Dr. Alexander Tsirlin

Venue: Universität Leipzig, Faculty of Physics and Earth Sciences
04103 Leipzig, Linnéstraße 5, Small Lecture Hall

Everyone is welcome to a reception with coffee, drinks and cookies in the Aula following the talk.

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