X-ray three-dimensional magnetic imaging, the future is brilliant!

Valerio Scagnoli (PSI)

Over the last years, we have worked towards developing methods to fabricate and characterize three-dimensional magnetic structures. Specifically, we have combined X-ray magnetic imaging with new iterative reconstruction algorithms to achieve X-ray magnetic tomography and laminography [1-4]. In a first demonstration, we have determined the three-dimensional magnetic nanostructure within the bulk of a soft $GdCo_2$ magnetic micropillar and we have identified the presence of Bloch points of different types [1, 3]. Subsequently, we have used the flexibility provided by the laminography geometry to perform time-resolved measurements of the magnetization dynamics in a two-phase micrometer size GdCo disk. Therefore, X-ray magnetic three-dimensional imaging, with its recent extension to the soft X-ray regime [5], has now reached sufficient maturity that will enable to unravel complex three-dimensional magnetic structures for a range of magnetic systems.

In this presentation, I will first give an overview of our recent results and review the current shortcomings of the magnetic tomography technique. Finally, I will discuss how diffraction-limited storage ring source, together with state of the art instrumentation, will allow three-dimensional magnetic nanotomography to thrive.

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[5] K. Witte et al., Nano Letters 20, 1305 (2020), https://doi.org/10.1021/acs.nanolett.9b04782