

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

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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 GdCo₂ 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.

- [1] C. Donnelly et al., Nature 547, 328 (2017), <https://doi.org/10.1038/nature23006>
- [2] C. Donnelly et al., New J. Phys. 20, 083009 (2018), <https://doi.org/10.1088/1367-2630/aad35a>
- [3] C. Donnelly et al., Nat. Phys. 17, 316 (2021), <https://doi.org/10.1038/s41567-020-01057-3>
- [4] C. Donnelly et al., Nat. Nanotechnol. 15, 356 (2020), <https://doi.org/10.1038/s41565-020-0649-x>
- [5] K. Witte et al., Nano Letters 20, 1305 (2020), <https://doi.org/10.1021/acs.nanolett.9b04782>

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