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SHAPING NON-RECIPROCAL CAUSTIC SPIN-WAVE BEAMS

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Mastering spin waves interference at the sub-micron scale is central for the development of wave-based computing applications such as reservoir computing [1], holographic memory, or spectral analysis. The complexity of spin dynamics, inherently due to its dependence to numerous parameters, and the intricacy of magnon-magnon interactions, requires heavy computational methods, which can limit the scope of study. In this context, we developed an efficient tool to study the near-field diffraction (NFD) patterns of spin wave in homogeneous out-of-plane magnetized thin films for arbitrary distribution of excitation fields [2, 3]. In this communication, we present the adaptation of our NFD model to in-plane magnetized thin films, and reveal how caustic spin-wave beams can be directly emitted from a sharply constricted stripline. We show in particular the importance of not only meeting the suitable caustic conditions of field and frequency (see Fig. 1), but also having of a seemingly punctual source for shaping the caustic beam. Using spatially resolved micro-focused Brillouin light spectroscopy on various constriction sizes, we satisfyingly verify our predictions, and explore further the steerability as well as the caustic beams properties.

This work, which have important implications for the development magnonic interferometric devices, was supported by the French ANR project “MagFunc”, the U.S. Department of Energy under Award DE SC0020308, and the Transatlantic Research Partnership, a program of FACE Foundation and the French Embassy.

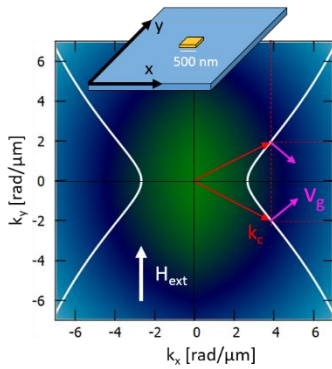


Figure 1. Slowness curve at 7.9 GHz for a 50 nm thick YIG film magnetized along y-axis under a bias field of 200mT.

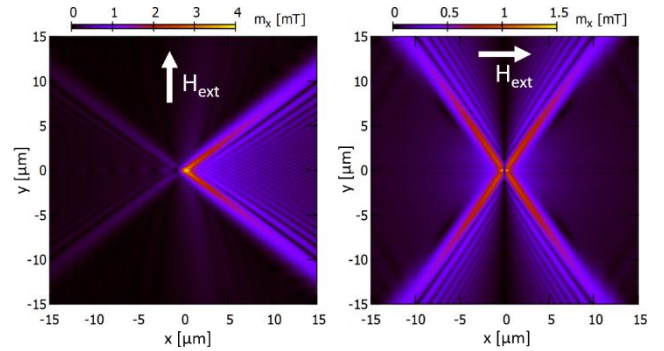


Figure 2. Corresponding NFD simulations for both field orientations.

- 1 A. Papp *et al.* (2021) Characterization of nonlinear spin-wave interference by reservoir-computing metrics”, *Applied Physics Letters* **119**, 112403.
- 2 V. Vlaminc *et al.* (2023) Spin wave diffraction model for perpendicularly magnetized films. *Journal of Applied Physics* **133**, 053903.
- 3 L. Temdie *et al.* (2024) Probing Spin Wave Diffraction Patterns of Curved Antennas, *Phys. Rev. Applied* **21**, 014032.