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V Vlaminck

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## Shaping non-reciprocal spin wave beams in thin magnetic films

V. Vlaminck<sup>1,2</sup>

<sup>1</sup> IMT Atlantique, Institut Mines Telecom Atlantique, Microwave Dpt., CS 83818, 29238 Brest, France

<sup>2</sup> Lab-STICC (UMR 6285), CNRS, Technopole Brest-Iroise, CS 83818, 29238 Brest Cedex 3, France

corresponding author: [vincent.vlaminck@imt-atlantique.fr](mailto:vincent.vlaminck@imt-atlantique.fr)

### Abstract:

Magnonic devices, which take advantage of the versatility of spin waves, are anticipated to be a propitious alternative for efficient signal processing. Spin waves constitute the building blocks of novel wave computing methods such as spectral analysis [1], and neuromorphic computing [2], which are all interference based techniques. Recently, basics concepts of optics applied to spin waves demonstrated the possibility to shape and stir spin wave beams, suggesting prominent performance in particular tasks such as image processing and speech recognition [3]. Along these ideas, we demonstrated that the beamforming in ferromagnetic thin films follows directly the near-field interference pattern of the excitation geometry [4-7].

Here, we present several approaches that allows exciting non-reciprocal spin wave beams in thin magnetic films such as curvilinear antennas, grating of nanomagnets, and sharp constrictions. We first present a near-field diffraction model that benchmarks spin wave beamforming in thin films for any geometry. Then, we experimentally test our predictions using both spin wave spectroscopy and micro-focused Brillouin light spectroscopy to map diffraction patterns in the 2D plane. We will show in particular how a sharp constriction in an antenna can directly excite non-reciprocal caustic beams in an extended film when the suitable conditions of field and frequency meets an inflection point in the dispersion relation. These findings have important implications for the development of switchable spin wave splitters, passive spin-wave frequency-division demultiplexers, and magnonic interferometry.

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