Magnonic Fabry-Pérot resonators as programmable phase shifters and energy concentrators

(complete result)

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An efficient control of the amplitude of spin waves propagating in YIG magnonic media was recently shown experimentally using Fabry-Pérot resonances [1]. The latter are formed due to spin-wave reflection from magnonic dispersion mismatches at interfaces between YIG regions with and without a metallic ferromagnet overlayer [2]. Here, we demonstrate that such structures, dubbed 'magnonic Fabry-Pérot resonators', can also serve as reprogrammable spin-wave phase-shifters. For example, Figure 1 shows the frequency dependence of the amplitude and phase of the spin-wave transmission coefficient for a magnonic Fabry-Pérot resonator formed by an 850 nm wide, 30 nm thick CoFeB stripe spaced by 5 nm from an 85 nm thick YIG film. A phase shift of $\sim\pi$ is achieved for spin waves at $\sim$1.25 GHz frequency by selectively switching the orientation of the magnetisation in the CoFeB stripe. Our experimental results are in a good agreement with those from micromagnetic simulations. The latter also reveal concentration of the spin-wave energy in the YIG film under the CoFeB stripe, which contrasts with spin-wave energy "trapping" [3] in the stripe itself for chiral magnonic resonators [4]. Such a device may act as a building block in future magnonic circuitry, while the spin-wave energy concentration may be used in construction of magnonic neurons [5].

The research leading to these results has received funding from the UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee (grant 10039217) as part of the Horizon Europe (HORIZON-CL4-2021-DIGITAL-EMERGING-01) under grant agreement 101070347 (MANNGA), funded by the EU. Yet, views and opinions expressed are those of the authors only and do not necessarily reflect those of the EU or UKRI, none of which can be held responsible for them.

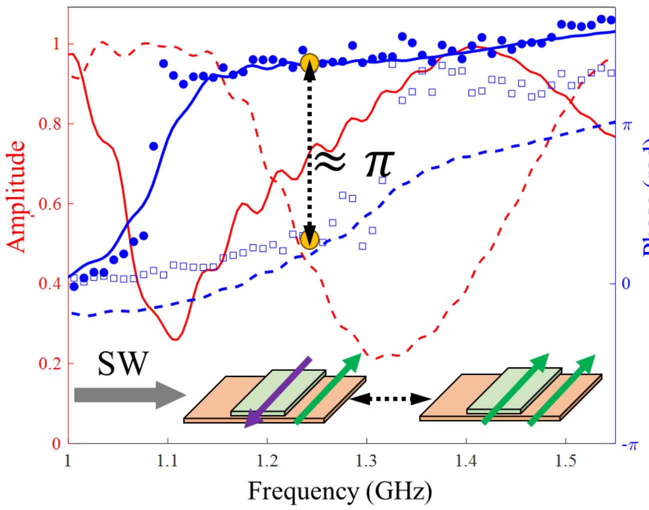

Fig. 1. The amplitude (red) and phase (blue) of the transmission coefficient are shown for a magnonic Fabry-Perot resonator in different magnetic configurations. The solid / dashed lines and filled / empty symbols correspond to the antiparallel / parallel alignments of the magnetisations in the CoFeB overlayer and YIG medium (see the insets). The lines and symbols are used for simulated and measured results, respectively.

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