In-depth study of dynamics in coupled magnonic waveguides

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Magnonic waveguides are fundamental building blocks in the logic devices based on spin waves [1,2]. In general, they are of multimodal character. However, while going to sizes of tens of nanometers, their single-mode regime range can reach a few GHz. In the past, fabrication of such waveguides was almost impossible, but current techniques are giving wide range of possibilities including structures with complex geometries [3]. We investigate numerically the spin-wave dynamics in the system of two dipolar-coupled magnonic waveguides. In an in-depth study, we analyse the effect of plenty of physical and geometrical parameters. In terms of coupling strength, waveguides aligned in the form of a planar structure, the most common type of alignment studied experimentally, seems to be a worse choice than the vertically-stacked waveguides, i.e., one placed over another. From the side of fabrication, vertical stacking enables small separation between the waveguides, giving the possibility for strong coupling. One of the interesting features of the vertically-stacked waveguides is a no-gap mode crossing at which frequency the wave transmission between the waveguides in prohibited. This frequency can be controlled by the external magnetic field. Making a mismatch by shifting one of the waveguides in plane, one can control the interaction between the spin-wave modes. In a right geometry, it is possible to reach almost constant transmission length between the waveguides in a wide range of frequencies allowing the possibility to transfer wide wave packets from one conduit to another.

References:

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