Spin wave dynamics in planar magnonic crystals and quasicrystals

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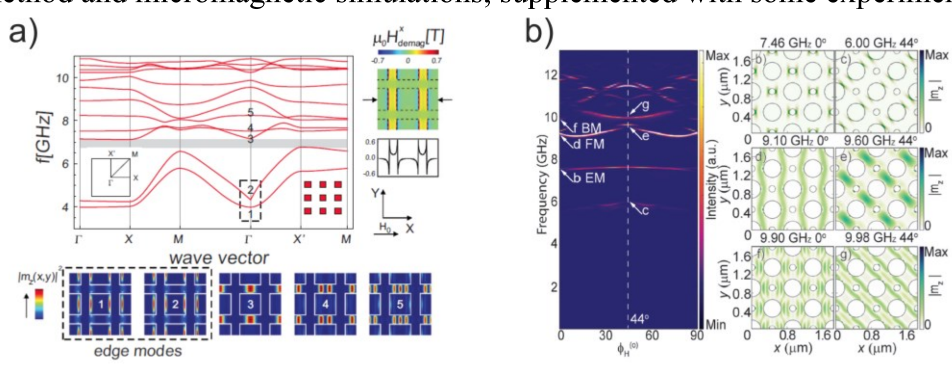
Magnonic crystals and quasicrystals are the structures where the magnetic properties change periodically and qusiperiodically in space, respectively. This kind of long range order leads to the appearance of forbidden frequency gaps in the spectrum of magnetic excitations – spin waves. In magnonics, similarly like for other sorts of systems (e.g. photonic systems), the geometry of the structure and the material composition are the main factors responsible for shaping the properties of wave excitations and determining their spectrum. However, the magnonic systems have a few unique features which make them particularly interesting. (i) There are two magnetic interactions of different kind: long range dipolar interaction and short range exchange interaction. They change differently when the sizes of the system are scaled up or down and therefore the spin wave spectrum cannot be scaled with sizes of the structure. (ii) Spin wave propagation for film geometry is strongly anisotropic in dipolar regime with respect to the direction of the external magnetic field, even for homogeneous layer. This introduces the additional source of the anisotropy which is purely related to periodicity or quasiperiodicity. (iii) The patterning of the film is responsible for the existence of inhomogeneous distribution of static demagnetizing field which, additionally to the spatial distribution of material parameters, affect the spin wave spectrum. The demagnetizing field, and thus the spin wave dynamics can be controlled by the change of the direction of external field.

We are going to discuss the mentioned features of planar magnonic crystals and quasicrystals by presenting the results of numerical calculations performed with the aid of plane wave method and micromagnetic simulations, supplemented with some experimental results.



Spin wave spectrum and profiles for (a) bi-component magnonic crystal[1] and (b) magnonic antidote lattice[2] calculated with the aid of plane wage method and micromagnetic simulations, respectively.

[1] J. W. Kłos, M. L. Sokolovskyy, S. Mamica, and M. Krawczyk, *The impact of the lattice symmetry and the inclusion shape on the spectrum of 2D magnonic crystals,* J. Appl. Phys. **111**, 123910 (2012).

[2] M. Zelent, N Tahir, R Gieniusz, J. W. Kłos, T. Wojciechowski, U. Guzowska, A Maziewski, J. Ding, A O. Adeyeye and M. Krawczyk*, Geometrical complexity of the antidots unit cell effect on the spin wave excitations spectra*, J. Phys. D: Appl. Phys. **50**, 185003 (2017).