Between waves and patterns: spin wave freezing in films with Dzyaloshinskii-Moriya interaction

Jan Kisielewski,[1] Pawel Gruszecki,[2] Maciej Krawczyk,[2] Vitalii Zablotskii,[3] and Andrzej Maziewski[1]

[1] *Faculty of Physics, University of Bialystok, Bialystok, Poland*
[2] *Faculty of Physics, Adam Mickiewicz University, Poznan, Poland*
[3] *Institute of Physics, Czech Academy of Sciences, Prague, Czech Republic*

The relationship between propagating waves and static pattern formation is fascinating area of magnetism. Our research focuses on the spin-wave-induced spin reorientation transition (SRT) in magnetic films with perpendicular magnetic anisotropy and the Dzyaloshinskii-Moriya (DMI) interaction [1]. Specifically, we have discovered that propagating spin waves can freeze during SRT, resulting in the emergence of periodic magnetic domains that resemble the wave amplitude distribution. This process can occur due to changes in the magnetic field, magnetic anisotropy, film thickness, and the magnitude of DMI. Interestingly, the non-reciprocity inherent to DMI leads to the emergence of flowing magnetization patterns at SRT. This suggests a spontaneous breaking of translational symmetry and the formation of magnonic space-time crystals. These phenomena are universal and can occur in a wide range of magnetic materials. Consequently, our findings are crucial for the advancement of spintronics and magnonics.

References:

[1] J. Kisielewski et al., Phys.Rev.B (accepted)