

On-line SPICE-SPIN+X Seminars



Wednesday, 16th February 2022, 15:00 (CET)

The seminar will be via Zoom ([Meeting ID: 892 9147 0088](#)) and live streamed in the SPICE YouTube Channel.

Mathias Weiler,
TU Kaiserslautern



Magneto-Acoustic Waves in Magnetic Thin Films

Spin waves form the basis for the field of magnonics, where they are used for information transport and processing [1]. Surface acoustic waves (SAWs) are widely employed as frequency filters in mobile communication technology. SAWs have group velocities comparable to that of spin waves and consequently can be generated with magnon-compatible wavelengths and frequencies. In magnetic media, spin waves can interact with SAWs which defines the field of magnetoacoustics. Magneto-acoustic phenomena can be used to excite and detect magnetization dynamics acoustically and control SAW propagation magnetically. Because of the ellipticity of the magneto-acoustic driving fields, as well as the spin-wave non-reciprocity due to dipolar coupling and the Dzyaloshinskii-Moriya interactions [2,3], magneto-acoustic waves are thereby generally chiral and non-reciprocal.

I will introduce the fundamentals of magnetoacoustics and then discuss the symmetry and non-reciprocity of magneto-acoustic waves in magnetically ordered thin films and heterostructures [4-6]. We quantitatively model the SAW-spin wave interaction based on the Kalinikos-Slavin equation and spin wave excitation by elliptically polarized coherent phonons to reveal that the magnon-phonon coupling is driven not only by magneto-elastic interactions [7] but also by magneto-rotation [4,8]. Our experiments furthermore demonstrate that SAW based spin-wave spectroscopy provides a sensitive measurement of the spin-wave dispersion and the Dzyaloshinskii-Moriya interaction. Non-reciprocal magneto-acoustic waves may be useful for the implementation of miniaturized on-chip microwave isolators.

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- [4] M. Küß et al., Phys. Rev. Lett., 125, 217203 (2020)
- [5] M. Küß et al., Phys. Rev. Applied, 15, 034060 (2021)
- [6] M. Küß et al., Phys. Rev. Applied, 15, 034046 (2021)
- [7] M. Weiler et al., Phys. Rev. Lett. 106, 117601 (2011)
- [8] M. Xu et al., Sci. Adv. 6, eabb1724 (2020)