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Investigation of the Spectral Fingerprints of Phonons and Magnons in Ferrimagnetic Oxides using Fourier-transformed Infrared Spectroscopy

The low-energy excitations of magnetic solids, as for instance magnons and phonons, are ultimately responsible for dynamic magnetization phenomena like demagnetization and magnetization switching, and therefore of paramount importance for a microscopic understanding of these processes.
Here, we report on a systematic study of the spectral fingerprints of these quasiparticles on ferrimagnetic Ho3Fe5O12 garnet using the Fourier-transformed Infrared Absorption (FTIR) technique. The ultimate goal of the project is to understand the role of these quasiparticles and their coupling during the thermal- and laser-driven magnetization switching processes. The measurements have been performed in transmission geometry at the THz beamline of Helmholtz-Zentrum Berlin employing photon energies between 1.2meV to 12.4meV upon varying the temperature, magnetic field magnitude and the light polarization. This approach allowed us to identify and disentangle the magnetic and phononic excitations as well as their hybrid modes. In particular, we observe pronounced peaks in the absorption spectra centered at 27cm-1 and 28.5cm-1, which we ascribe to an antiferromagnetic resonance and to a hybrid phonon-magnon mode, respectively.

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