Magnon-polarons in a surface magnetoacoustic wave resonator

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Spin waves form the basis for the field of magnonics, where they are used for information transport and processing [1]. Acoustic waves, in particular surface acoustic waves (SAWs), are widely employed as frequency filters in mobile communication technology. Spin waves and SAWs have comparable group velocities and wavelengths and are typically operated at microwave frequencies. In magnetic media, spin waves can interact with SAWs which defines the field of magnetoacoustics. Magnetoacoustic devices can be used to excite and detect magnetization dynamics acoustically and control SAW propagation magnetically [2-4].

Magnons and phonons can also hybridize in surface magnetoacoustic wave resonators [5-7]. We use a hybrid structure consisting of low-loss yttrium iron garnet (YIG) magnetic films and ZnO – based SAW resonators. In our heterostructures, a magnon-polaron forms due to the strong coupling of SAWs and spin waves (SW) as evidenced by the avoided crossing of acoustic and magnonic dispersions and Rabi-like oscillations of the chimera magnon-phonon quasiparticle in the time-domain [7]. We find degenerate dissipation rates below 1.5 MHz for magnons and phonons and a magnon-phonon coupling rate of about 5 MHz. The experimentally observed hybridization strength and anisotropy is well described by a phenomenological model that accounts for the characteristic anisotropic magnetoacoustic interaction [2] and spatial profiles of both magnon and phonon modes.

References:

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