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Terahertz-frequency magnon-phonon-polaritons in the strong coupling regime[1]

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Strong coupling between light and matter occurs when the two interact strongly enough to form new hybrid modes called polaritons. Thus far, the focus of strong coupling physics has been on either the electric or magnetic degrees of freedom, yet the ensuing physics and potential applications motivate the prospect of simultaneously coupling to both. Spintronics, in its quest toward long-range and terahertz (THz) frequency operation, would particularly benefit from such strong coupling because it provides a means for facile transport and interaction with THz spin information. Here we report our results on the strong coupling of both the electric and magnetic degrees of freedom to an ultrafast terahertz frequency electromagnetic wave. In our system, optical phonons in a slab of ferroelectric lithium niobate (LiNbO3) are strongly coupled to a THz electric field to form phonon-polaritons, which are simultaneously strongly coupled to magnons in an adjacent slab of canted antiferromagnetic erbium orthoferrite (ErFeO3) via the THz magnetic field. The strong coupling leads to the formation of new magnon-phonon-polariton modes, which we experimentally observe in the wavevector-frequency dispersion curve in the form of an avoided crossing, and in the time-domain as a normal-mode beating.

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