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## **Phonon Convoy of Coherent Magnons in an Antiferromagnet**

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Spin waves, or magnons, are promising candidates for replacing charge carriers in nanoscale communication and information processing. In recent years, magnonics has expanded from ferromagnetic to antiferromagnetic (AFM) materials, where terahertz magnon frequencies and the absence of stray magnetic fields promise information-processing speeds and integration densities that were previously out of reach. However, these advantages come with substantial challenges: the high frequencies and the limited abilities of conventional magnetic-field-based tools make the control of magnon wavepackets demanding.

In this work, we propose an approach based on the interaction between coherent magnons and acoustic phonons. Although conventional resonant coupling, which requires an intersection of the magnon and phonon dispersion curves, is unavailable in AFMs, we exploit the effect of group-velocity synchronism (GVS). Through GVS, we selectively capture a specific spectral component of a broadband magnon wavepacket and maximize its modulation by coherent acoustic phonons.

In our experiments on bulk DyFeO<sub>3</sub>, an archetypical insulating antiferromagnet of the perovskite orthoferrite family, broadband magnon and phonon wavepackets are launched simultaneously by a highly absorbed femtosecond laser pulse. The magnon wavepacket is dispersive: its group velocity depends on wavevector and ranges from zero to approximately 20 km/s for large-wavevector magnons. As a result, the wavepacket spreads spatially during propagation. By contrast, the nondispersive phonon wavepacket in a form of a picosecond strain pulse travels at the longitudinal sound velocity preserving its shape. It locally modifies the magnetic anisotropy and exchange parameters and thereby modulates the magnon wavepacket. This modulation acts selectively on magnons whose group velocity matches the sound velocity. Using wavevector-selective time-domain Brillouin scattering (TDBS) to probe the joint propagation of coherent phonons and magnons, we unambiguously identify a signal contribution arising from magnon-phonon interaction governed by the GVS effect. Alongside the experimental observations, we develop a theoretical framework that accounts for the experimental findings and predicts the most striking manifestations of the magnon-phonon GVS effect in antiferromagnets.