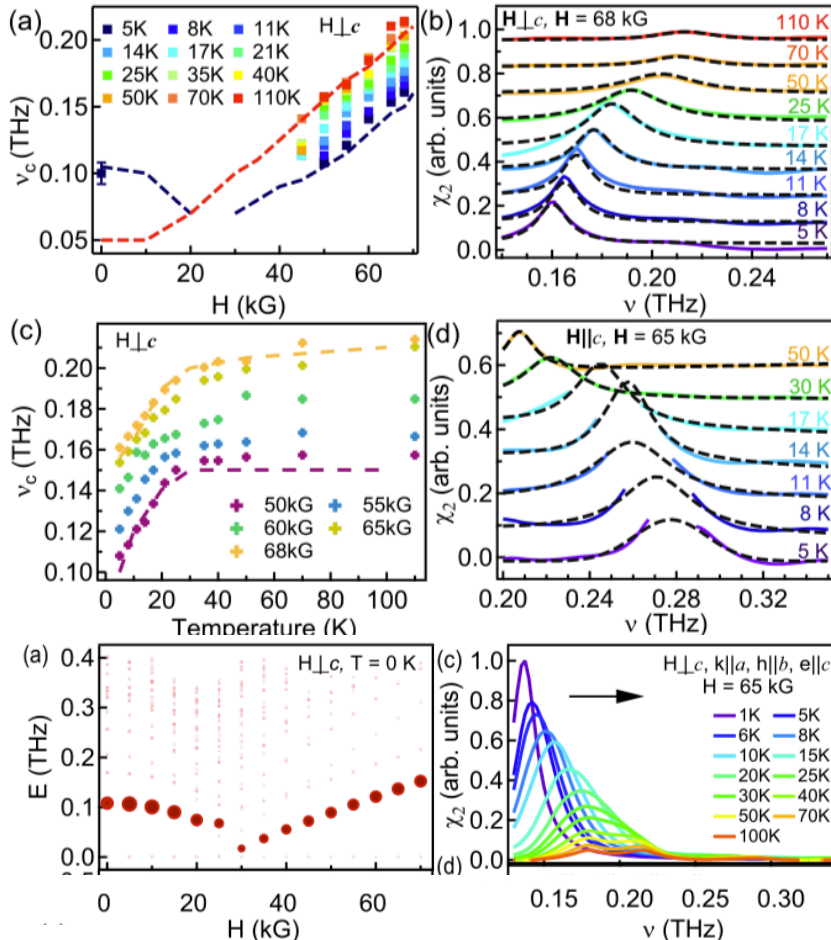


Probing magnon dynamics and interactions in a ferromagnetic spin-1 chain

Institute for Quantum Matter EFRC DE-SC0019331



Scientific Achievement

Using time-domain THz spectroscopy, we measure the low-energy EM response of the spin-1 ferromagnetic spin chain NiNb_2O_6 as a function of temperature and external magnetic field. Prominent magnetic excitations are seen at low T . As we warm the system, we unexpectedly observe a T dependent renormalization of the lowest energy spin-excitation, which has a strong dependence on field direction. Using theoretical arguments, exact diagonalizations and finite temperature dynamical Lanczos calculations, we connect this renormalization to a picture of magnon-magnon interactions.

Significance and Impact

We show we can tune the magnon-magnon interaction from repulsive to attractive by changing the field direction. As far as we know this capacity is unprecedented in condensed matter systems and similar effects have only been demonstrated in cold atoms by tuning through a Feshbach resonance. It is a novel consequence of the chain's spin-1 nature.

Research Details

NiNb_2O_6 crystals were grown by the floating zone method. THz experiments were performed in dc external fields up to $H = 68$ kG in perpendicular geometries. Spin-wave like modes were excited using the time-dependent magnetic field of the THz pulse, which allows measurements in the manner of high frequency spin-resonance.

Prashant Chauhan, Fahad Mahmood, Hitesh J. Changlani, S. M. Koohpayeh, N. P. Armitage, under review, arXiv:1907.06542 (2019)



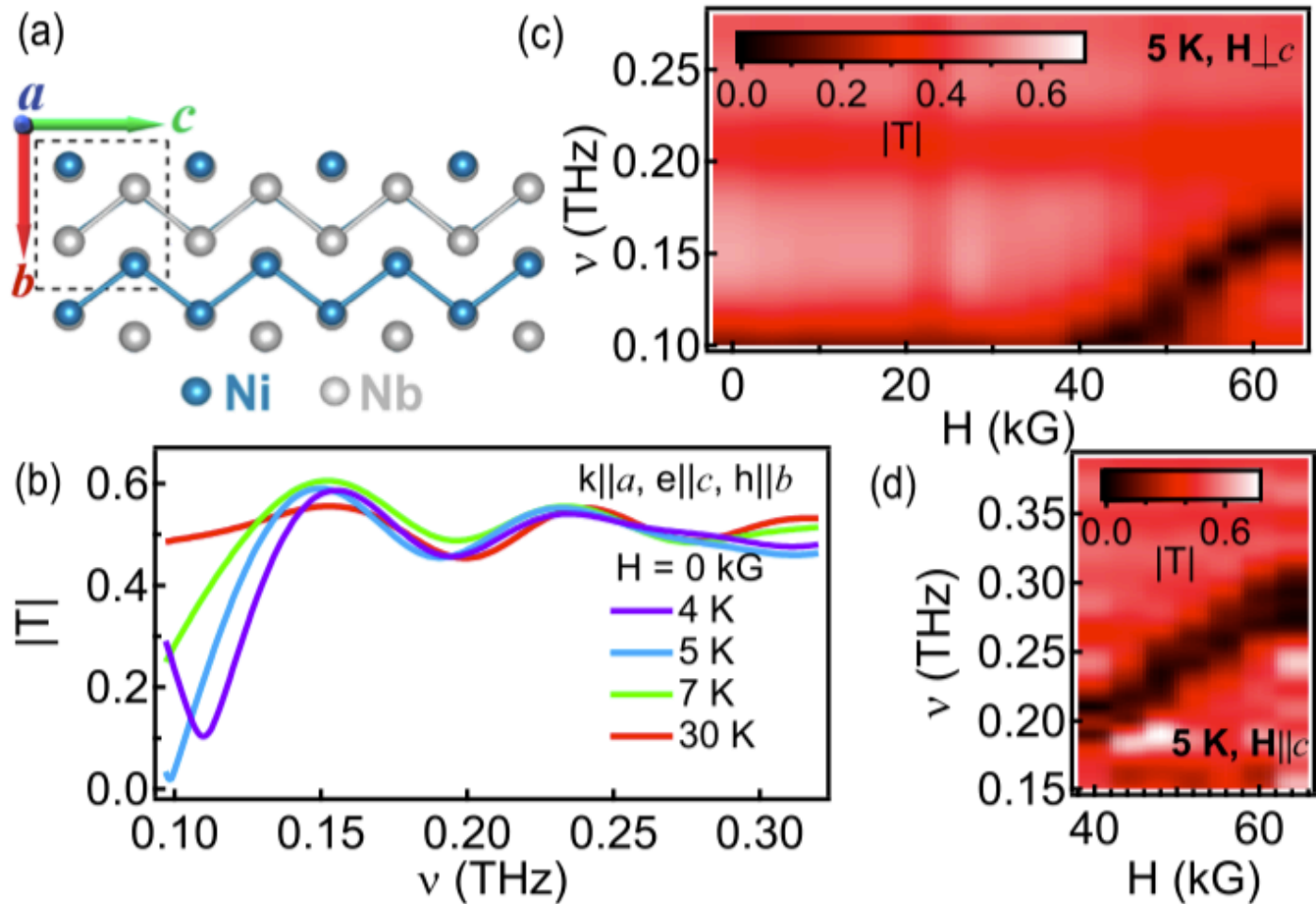
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