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Magneto-Raman studies of magnons in 2D magnetic materials and quantum magnet CoTiO3

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Raman spectroscopy is a versatile technique due to its non-destructive nature, surface sensitivity, and low energy sensitivity, down to a few meV. These attributes naturally lead to the use of Raman scattering as a probe of quantized spin waves, or magnons, in magnetic materials. Our custom-built magneto-Raman system comprises of a triple grating spectrometer, a magneto cryostat with optical access, and multiple continuous wave laser lines that cover the entire visible spectrum. We first explore the magnetic excitations in two-dimensional (2D) magnetic materials. Magnetic excitations in van der Waals (vdW) materials, especially in the 2D limit, are an exciting research topic from both the fundamental and applied perspectives. From the antiferromagnetic magnon gap excitation in FePS3[1] to the hybridization of a two-magnon excitation with the phonons in MnPSe3[2], our magneto-Raman studies revealed a rich set of magnetic excitations in the family of vdW magnet MPX3, where M is a transition metal, P is phosphorous, and X is Sulfur or Selenium. Second, we look at our unpublished results on an exciting quantum material, CoTiO3. We follow the evolution of the Brillouin Zone center excitations of not only the optical magnon, but also several spin-orbit excitations across the magnetic transition temperature. Our experiment provides a high-resolution measurement of these magnetic modes at k=0. Additionally, by applying the external magnetic field along the c-axis and along a hexagonal axis, we reveal the highly anisotropic g-factor of these magnetic excitations. Surprisingly, we measure the beginning of a magnetically induced crossing between the acoustic and optical magnon. Our results are supported by density functional theory (DFT) and linear spin wave theory (LSWT), as well as being consistent with inelastic neutron scattering experiments in the literature. [1] McCreary et al. Phys. Rev. B 101, 064416 (2019) [2] Mai et al. SCIENCE ADVANCES. 29 Oct 2021. Vol 7, Issue 44