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Magnetic order and interactions in two polytypes of V1/3NbS2

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Magnetically intercalated transition metal dichalcogenides (TMDs) provide a versatile three-dimensional (3D) material platform to explore quantum phenomena and functionalities that emerge from an intricate interplay between magnetism, band structure, and correlations.
I shall describe the observation of a nearly magnetization-free anomalous Hall effect (AHE) in V1/3NbS2. Our single-crystal neutron diffraction measurements identify a commensurate, collinear AFM order formed by intercalated V moments. In the magnetically ordered state, the spontaneous AHE is tenfold greater than expected from empirical scaling with magnetization [1].
Through X-ray and magnetic neutron diffraction evidence is provide for two structural polytypes. Both have A type AFM order but different easy axes, which profoundly impacts their anomalous Hall response. Using inelastic magnetic scattering we detect coherent spin wave excitations from both polytypes. By comparing the experimental spectra to those calculate through spin wave theory, we infer oscillatory three-dimensional RKKY type interactions and relate these to the underlying electronic band structure [2].
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[1] "Zero-field Hall effect emerging from a non-Fermi liquid in the collinear antiferromagnet V1/3NbS2," Mayukh Kumar Ray Mingxuan Fu, Youzhe Chen, Taishi Chen, Takuya Nomoto, Shiro Sakai , Motoharu Kitatani, Motoaki Hirayama, Shusaku Imajo, Takahiro Tomita, Akito Sakai, Daisuke Nishio-Hamane, Gregory T. McCandless, MichiTo Suzuki, Zhijun Xu, Yang Zhao, Tom Fennell, Yoshimitsu Kohama, Julia Y. Chan, Ryotaro Arita, Collin Broholm, Satoru Nakatsuji, Nature Communications 16, 3532 (2025).
[2] "Stacking-dependent anisotropic altermagnetism in V1/3NbS2,"Chris J. Lygouras, Nathan Prouse, Jack H. Drouin, Youzhe Chen, Laura Garcia-Gassull, Aleksandar Razpopov, Zili Feng, Mingxuan Fu, Lü Fang, Alexander I. Kolesnikov, Christina Hoffman, Yiqing Hao, Huibo Cao, Maxime A. Siegler, Robert J. Birgeneau, Roser Valentí, Satoru Nakatsuji, and C. Broholm, unpublished (2025).

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