Dispersive Hund's Excitons in Magnetic van der Waals Materials

<u>Wei He^{1,2}</u>, Yao Shen¹, Jennifer Sears¹, Krzysztof Wohlfeld³, Francesco Barantani⁴, Jack W. Villanova⁵, Tom Berlijn⁵, Marton Lajer¹, Michael A. McGuire⁶, Jiemin Li⁷, Taehun Kim⁷, Mikołaj Walicki³, Jonathan Pelliciari⁷, Valentina Bisogni⁷, Steven Johnston^{8,9}, Edoardo Baldini⁴, Matteo Mitrano¹⁰, Mark P.M. Dean¹

¹Department of Condensed Matter Physics and Materials Science, Brookhaven National Laboratory, Upton, New York 11973, USA

²Present address: Stanford Institute for Materials and Energy Sciences, SLAC National Accelerator Laboratory, Menlo Park, California 94025, USA.

³Institute of Theoretical Physics, Faculty of Physics, University of Warsaw, Warsaw, PL-02093, Poland ⁴Department of Physics, The University of Texas at Austin, Austin, Texas 78712, USA

⁵Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831, USA

⁶Materials Science and Technology Division, Oak Ridge National Laboratory, 1 Bethel Valley Road, Oak Ridge, Tennessee 37831, USA

⁷National Synchrotron Light Source II, Brookhaven National Laboratory, Upton, New York 11973, USA ⁸Department of Physics and Astronomy, The University of Tennessee, Knoxville, Tennessee 37966, USA ⁹Institute for Advanced Materials and Manufacturing, The University of Tennessee, Knoxville, Tennessee 37996, USA

¹⁰Department of Physics, Harvard University, Cambridge, Massachusetts 02138, USA

Magnetic van der Waals (vdW) materials have emerged as a fertile platform for exploring novel many-body phenomena. Among these are Hund's excitons, an unusual class of excitons bound by Hund's exchange interactions. Using state-of-the-art resonant inelastic x-ray scattering (RIXS), we discovered Hund's excitons in both antiferromagnetic NiPS₃¹ and ferromagnetic CrI_3^2 — two topical magnetic vdW materials. Supported by exact diagonalization calculations, we identify these excitons' electronic character with similar spin-flip transitions in nature. By examining their dispersion, we uncover a close relationship between Hund's exciton propagation and low-energy magnetic excitations. Our research demonstrates RIXS as a powerful tool in studying exciton physics in magnetic vdW materials and open new avenues for magneto-optical applications.

Keywords [optional]: Magnetic van der Waals materials, exciton, electronic structure, resonant inelastic x-ray scattering.

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¹W. He, et al., "*Magnetically Propagating Hund's Exciton in van der Waals Antiferromagnet NiPS*₃", Nature Communications (15) 3496 (2024).

²W. He, et al., "*Dispersive Dark Excitons in van der Waals Ferromagnet CrI*₃", Physical Review X (15) 011042 (2025).