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Exciton-magnon drag in magnetic van der Waals materials

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Several members of the family of magnetic van der Waals materials have recently been found to support *magnetic excitons* – a rare type of optical excitation formed by spin-polarized electronic states in magnetic semiconductors and insulators. With properties that have no analog amongst excitons in conventional band semiconductors, these optical quasiparticles and their coupling to magnetic order shine a new light onto magneto-optic effects and quasiparticle interactions in magnetic solids.

In this talk, I will introduce excitons in magnetic van der Waals materials and how they couple with magnons and light [1, 2]. I will then focus on the results of our latest work on exciton transport in the layered antiferromagnet CrSBr [3]. Rich experimental signatures from this study include the observation of enhanced exciton propagation at the antiferromagnet-to-paramagnet phase transition, nearly isotropic transport despite a highly anisotropic electronic landscape, and ultrafast excitonic motion. To rationalize these results, a model based on the magnon-exciton drag effect is proposed (Fig. 1). Lastly, I will also discuss the highly unusual observations of exciton cloud contraction and superdiffusive behavior in bilayer crystals and conclude with an outlook on coherent Bosonic condensates in these materials.

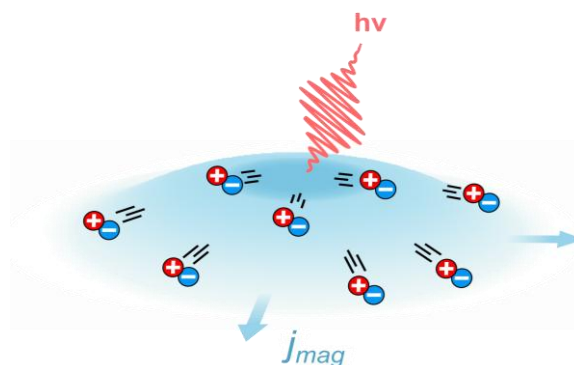


Figure 1: Schematic illustrating the magnon-exciton drag effect. A magnon current j_{mag} generated by ultrafast excitation accelerates excitons in the direction of the current.

- [1] Dirnberger, F. Quan, J., Bushati, R., et al., [Magneto-optics in a van der Waals magnet tuned by self-hybridized polaritons](#). *Nature* **620**, 533–537 (2023)
- [2] Shao, Y., Dirnberger, F. et al., [Magnetically confined surface and bulk excitons in a layered antiferromagnet](#). *Nat. Mater.* **24**, 391–398 (2025)
- [3] Dirnberger, F., Terres, S. et al., [Exciton transport driven by spin excitations in an antiferromagnet](#). *Nat. Nanotechnol.* **21**, 65–70 (2025).