

MA 25: Focus Session: Physics of the van der Waals Magnetic Semiconductor CrSBr I (joint session HL/MA)

The session is the first part of the focus session on the physics of the van der Waals magnetic semiconductor CrSBr, with a main session on Friday morning. The focus session is jointly organized by HL and MA.

Time: Wednesday 15:00–15:30

Location: H15

MA 25.1 Wed 15:00 H15

Doping-control of excitons and magnetism in few-layer CrSBr — ●FARSANE TABATABA-VAKILI^{1,2,3}, ANNA RUPP², HUY NGUYEN², ANVAR BAIMURATOV², and ALEXANDER HÖGELE^{2,3} — ¹Institute of Condensed Matter Physics, Technische Universität Braunschweig, Braunschweig, Germany — ²Fakultät für Physik, Munich Quantum Center, and Center for NanoScience (CeNS), Ludwig-Maximilians-Universität München, München, Germany — ³Munich Center for Quantum Science and Technology (MCQST), München, Germany

In two-dimensional (2D) magnets, phenomena distinct from bulk magnetism have been revealed, such as sensitivity to charge doping and electric field in few-layer CrI₃. Within the class of 2D magnets, air-stable CrSBr stands out as an antiferromagnetic semiconductor with a high Néel temperature, excitons coupled to the magnetic order, and exciton-magnon coupling. In this talk, I will present our work on doping-control of excitons and magnetism in few-layer CrSBr [1]. We demonstrate that both exciton and magnetic transitions are sensitive to field-effect charging, exhibiting bound exciton-charge complexes and doping-induced metamagnetic transitions. We further visualize magnetic domain formation induced by magnetic field or charge-doping at the metamagnetic transition all-optically by raster-scan reflectance imaging. Our work identifies few-layer CrSBr as a rich platform for exploring collaborative effects of charge, optical excitations, and magnetism.

[1] F. Tabataba-Vakili et al., Nat. Commun. 15, 4735 (2024).

MA 25.2 Wed 15:15 H15

Proximity-Induced Exchange Interaction and Prolonged Valley Lifetime in MoSe₂/CrSBr Van-Der-Waals Heterostructure with Orthogonal Spin Textures — ●ANDREAS BEER¹, KLAUS ZOLLNER¹, CAIQUE SERATI DE BRITO^{1,2}, PAULO E. FERIA JUNIOR¹, PHILIPP PARZEFALL¹, TALIEH S. GHIASI³, JOSEP INGLA AYNÉS³, SAMUEL MAÑAS-VALERO⁴, CARLA BOIX-CONSTANT⁴, KENJI WATANABE⁵, TAKASHI TANIGUCHI⁵, JAROSLAV FABIAN¹, HERRE S. J. VAN DER ZANT³, YARA GALVÃO GOBATO², and CHRISTIAN SCHÜLLER¹ — ¹UR, Regensburg, Germany — ²UFSCar, São Carlos, Brazil — ³TU, Delft, Netherlands — ⁴ICMol, València, Spain — ⁵NIMSC, Tsukuba, Japan

We report a comprehensive optical study of a ML-MoSe₂ on the layered A-type antiferromagnetic semiconductor CrSBr. The band alignment of the material combination is under debate. Here, we adopt the type-III band alignment picture. By performing co-circular polarized PL and reflection contrast (RC) experiments, we observe that the atomic proximity of the materials leads to an unexpected breaking of time-reversal symmetry, despite the originally perpendicular spin texture in both materials, which are further supported by first-principles calculations. Moreover, time-resolved PL and time-resolved RC measurements identify a very long-lived dynamic charge-transfer process in the heterostructure, consistent with a type-III band alignment. Our findings suggest band bending, and efficient Förster resonance energy transfer within the heterostructure. Finally time resolved Kerr ellipticity measurements reveal a two magnitudes prolonged valley lifetime.