CRYOMAGNETIC SPECTROSCOPIES ON VAN DER WAALS MATERIALS

Jana K. VEJPRAVOVA

Charles University, Faculty of Mathematics and Physics, Ke Karlovu 5, 121 16 Prague 2, Czech Republic

Email: jana.vejpravova@matfyz.cuni.cz

Van der Waals materials and their heterostructures exhibit exceptional electronic and optical properties that can be finely tuned using external physical stimuli, such as photonic, magnetic, electric, and strain fields, or through proximity effects. Raman (Ra) and photoluminescence (PL) micro-spectroscopies have emerged as critical techniques for probing the electronic, optical, and spin properties of two-dimensional materials (2DMs) and their heterostructures [1-3]. By utilizing light with intrinsic chirality, these spectroscopic methods provide unique insights into spin and valley physics across various 2DMs. Of particular importance, Ra and PL spectroscopies enable the study of magnetic ordering and quantum phenomena in van der Waals materials, driven by their strong spin-lattice coupling [5]. Additionally, these techniques offer a deeper understanding of the interplay between magnetic, electronic, and optical phenomena in low-dimensional systems. In this presentation, I will present key findings from helicity-resolved cryomagnetic spectro-microscopy investigations conducted on prominent 2DMs. In this talk, selected results obtained on transition metal dichalcogenides, layered magnets, and hybrid layered architectures, including their rational design, fabrication, and performance under chiral light and magnetic field down to helium temperatures will be presented. These studies illuminate the potential of the 2DMs for future technological applications, ranging from quantum information processing to advanced spintronics and optoelectronics. Finally, opportunities for collaboration and academic exchange will be proposed.

References

[1] Haider G. et al. Adv. Funct. Mater. (2021) 2102196.
[2] Varade V. et al. ACS Nano 17, (2023) 2170.
[3] Varade V. et al. 2D Mater., 10, (2023) 025024.
[4] Verhagen T. et al, ACS Nano 14, (2020) 15587.
[5] Ghosh A. et al. Phys. Rev. B 105, (2023) L081104.