Two-dimensional (2D) layered magnetic materials (LMMs) form a newly emerging class of atomically thin van der Waals (vdW) materials with extraordinary physical features, highly suitable for modern opto-, spin- and valleytronic devices. The family of LMMs rapidly grew, in search for a material that hosts **stable magnetic order at room temperature**. Up to now, **several hundreds of LMMs** have been **theoretically predicted,** and **dozens of them have been synthesised and characterized**. The largest groups of LMMs are: di- and trihalides (*e.g.* CrI_3), TMDs (*e.g.* 1T-VS_2), tri- and tetrachalcogenides (*e.g.* $FePS_3$ and $CrPS_4$), metal-chalcogene-halides (*e.g.* CrSBr), and oxychlorides (*e.g.* VOCl). Due to their extremely low thickness, experimental revealing the microscopic order of magnetic moments, which determines the macroscopic properties of materials and the temperature of magnetic phase transition, are the fundamental problems of LMMs characterisation.

In this project, **we will modify the magnetic properties and explore the full phase diagram of bulk and thin layers of selected LMMs by tuning the interlayer distance**. It is planned to study optical, vibrational, and magnetic properties of individual magnetic vdW materials, *e.g.* CrSBr. **The innovative aspect of the project** lies in the **combination of various optical experimental techniques**, such as photoluminescence (PL), reflectance contrast (RC), and Raman scattering (RS), with **different extreme perturbation conditions**, namely temperature, pressure, and magnetic field. The choice of materials is motivated by the current state-of-the-art in the research of 2D magnetic materials, which allows us to make educated predictions of potential scientific findings.

The **main experimental techniques** used in the project will be **PL, RC, and RS**, which will be employed to investigate optical, vibrational, and magnetic properties of LMMs structures in a wide range of external conditions, *i.e.* from **room** to **liquid helium temperatures**, in **external magnetic fields** up to **30 T**, and in **external pressure** up to **50 GPa.** The most unique aspect of the project is the possibility to **combine different techniques** (*e.g.* PL and RS) and **various extreme conditions** (*e.g.* T=5 K, B=30 T, P=10 GPa) **during a single study shot**, which will be available within planned collaboration with the National High Magnetic Field Laboratory in Grenoble, France.

Investigation of the optical, vibrational and magnetic properties of 2D layered magnetic materials will have **a significant impact on the development of solid-state physics as well as material sciences**. This is associated with the considerable interest of scientific community in the magnetic vdW materials and the arising need to understand new physics behind novel functionalities, phenomena, and on-demand material properties.