

Pressure-induced magnetic ground states in a frustrated van der Waals magnet

Master 2

Summary (400 caractères maxi)

The Laboratoire National des Champs Magnétiques Intense de Grenoble is a CNRS large scale facility specialized in the production of high magnetic fields, up to 43T. The Visible Optics team is investigating the properties of van der Waals materials by optical means since their discovery in 2005. We have developed a specific instrumentation for spatially resolved optical spectroscopy of different type (photoluminescence, reflectance, Raman scattering) in extreme conditions of low temperature, high magnetic field and of high hydrostatic pressure, necessary to investigate the properties of these layered materials.

Detailed subject (1200 caractères maxi dont une figure possible)

Bulk CrOCl is an orthorhombic van der Waals magnet with a very rich magnetic phase diagram originating from the on-lattice frustration. At low temperatures, it is an antiferromagnet. Applying an external magnetic field induces a cascade of magnetic phase transitions characterized by magnetic unit cells much larger than the crystallographic one that have distinct signatures in the zone-folded phonon spectrum. We have recently shown that Raman scattering is a good probe to investigate these different magnetic phases [1]. Our recent results show that the magnetic order is sensitive to the number of layers which points towards the role of the interlayer interaction to stabilize a specific magnetic order. Within this internship, we propose to apply hydrostatic pressure to bulk CrOCl to reduce the interlayer separation, the van der Waals gap, to increase/modify the interlayer interaction and probe the resulting magnetic ground state with Raman scattering techniques [2]. We will then apply an external magnetic field and investigate the modifications in the sequence of magnetic ground state as a function of the interlayer separation.

Interactions et collaborations éventuelles :

Andres Saul (CINAM), Benoit Grémaud (Centre de Physique Théorique, Marseille), théorie
Zdenek Sofer, Prague (croissance du matériaux)

Période envisagée pour le début du stage : Mars-Avril 2026 - Ce stage pourra se poursuivre par une thèse.

Publications linked to the theme

- [1] A. Pawbake et al. ACS Nano **19**, 23693, (2025) and arXiv:2506.09680
- [2] I. Breslavetz et al., Rev. of Scien. Instr. 92, 123909 (2021) and arXiv:2201.01947

Background and skills expected :

interest in experimental solid state physics, ideally optical spectroscopy and cryogeny but we are patient and interested to teach you these techniques.

Open to M2 Matière Quantique or Nanophysics

Supervisor : E-mail: clement.faugeras@lncmi.cnrs.fr Tel : 04 76 88 10 56