Master Sciences, Technologies, Santé
Mention Physique Fondamentale et Applications

M2 Sciences des Matériaux et Nano-Objets (SMNO)

Sorbonne Université, ENS Ulm, Chimie ParisTech, ESPCI, l'École Polytechnique

Proposition de stage 2019-20

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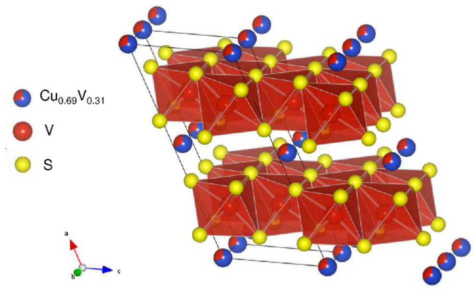
Fermi-liquid to non-Fermi-liquid crossover in strongly correlated transition metal sulfides

It is well known that conventional superconducting metals and alloys are well described by a classic Fermi liquid (FL) picture where electron-electron correlations are moderate. Within this picture, the critical temperature is typically low, T_c ~1-10 K, limited by the characteristic phonon frequency, ω ~10-100 meV. A completely different situation is found in high-T_c superconductors, such as cuprates and Fe-based pnictides, characterized by much larger T_c's~100 K. In these materials, superconductivity is obtained by doping a parent Mott insulating and antiferromagnetically (AFM) ordered phase in two dimensions (2D) [1]. This unconventional superconducting state is concomitant to a significant renormalization of the quasiparticle effective mass [2], leading to non-Fermi liquid (NFL) properties. These exotic properties suggest that electronic correlations in 2D play a fundamental role in the mechanism of superconductivity. It is therefore interesting to study other doped 2D systems where electronic correlations can lead to a FL instability.

In order to address this issue, we propose to investigate the NFL electronic and transport properties of $(Cu_{1-x}V_x)(VS_2)_2$ single-crystals [3]. In this 2D system (see figure), the carrier density in the metallic VS_2 layers can be controlled by the cationic substitution in the $Cu_{1-x}V_x$ chains located between adjacent layers. As a first objective, we shall study the NFL low-temperature behaviour of the electrical resistivity of the layers as a function of doping and magnetic field. Second, we shall investigate the effect of high pressure on the above behavior, which is expected to weaken the correlations and induce a recovery of the FL state.



[1] C. de la Cruz *et al.*, Nature **453**, 899 (2008).
[2] A. I. Coldea *et al.*, Phys. Rev. Lett. **101**, 216402 (2008) ; M. M. Qazilbash *et al.*, Nature Physics **5**, 647 (2008) ; H. Ding et al., J. Phys. Cond. Matter **23**, 135701 (2011).
[3] A. Gauzzi, H. Moutaabbid, Y Klein, G. Loupias and V. Hardy, J. Phys.: Condens. Matter **31**, LT01 (2019); Y. Klein *et al.*, J. Solid State Chem. **184**, 2333 (2011).

Techniques utilisées: Low-temperature transport measurements as a function of magnetic field and pressure.
Qualités du candidat requises: Strong background in solid state physics

Rémunération éventuelle du stage: Oui
Possibilité de poursuivre en thèse ? Oui
Si oui, mode de financement envisagé : bourse du ministère ou ANR