Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique des Solides
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Internship location: Laboratoire de Physique des Solides
Thesis possibility after internship: YES Funding: NO
Funding: YES If YES, which type of funding: ANR

Low dimensional iron based correlated materials : a playground for mixed quantum properties

Iron-based low dimensional compounds, embodied by the $BaFe_2Se_3$ family, present a multitude of remarkable properties. It is a ferroelectric insulator at room temperature and ambient pressure. At low temperature (T<250K), an exotic magnetic order (block magnetism) develops along the spin ladders formed by the iron sites (Fig. 1), and other anomalies occurs around 50K. This unusual magnetism arise from frustration and the multi orbital character may also play a role. This magnetic transition is accompanied with structural transition, making this compound a multiferroic. Under pressure, we observe an insulator to metal transition, a structural transition and also superconductivity. The coexistence or competition between all these properties is the subject of the internship/PhD. This study extends to the multiple members of the $BaFe_2Se_3$ family : substitution of Fe by Co or Ni (electron doping), substitution of Se by S or Te (chemical pressure), with temperature, pressure, electric and magnetic field environment, opening a very wide field of investigation.

To study this family, we use a large range of experimental techniques : X-ray diffraction (atomic structure), ARPES (band structure), X-ray absorption and emission (RIXS), Neutron scattering (magnetic structure and spin dynamics) both at the Laboratoire de Physique des Solides and on large facilities (synchrotrons and neutron reactors).

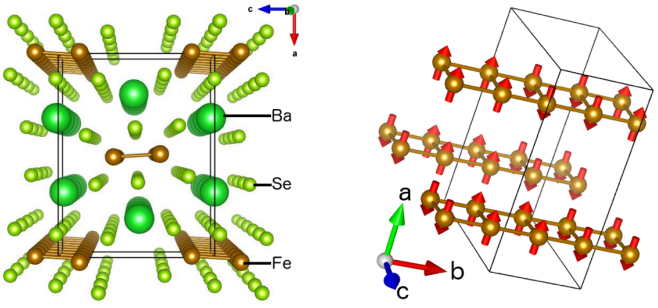

Figure 1 *: Left : Atomic structure of $BaFe_2Se_3$. Right : magnetic structure from the Fe spins below Néél temperature T_N=256K.*

Last publication on this thematic: W. Zheng et al. Rapid Com. Physical Review B 101, 020101(R) (2020)
Full publications list : https://ww.equipes.lps.u-psud.fr/baledent/publications.html

Condensed Matter Physics: YES Macroscopic Physics and complexity:NO
Quantum Physics: YES Theoretical Physics: NO