LNCMI- Toulouse

Magnetism and superconductivity in extreme conditions

Summary

The subject proposed here consists in the experimental study of unconventional superconductors under combined extreme conditions of high pressures and intense magnetic fields.

Detailed subject

The LNCMI in Toulouse is today on the world podium of non-destructive pulsed magnetic fields, with a record of more than 90 teslas and the objective to go beyond 100 T in 2017. These extremely high magnetic fields allow changing continuously the basic properties of quantum magnets, where a non-conventional superconducting phase develops in the vicinity of a quantum magnetic phase transition. Amongst them, the heavy-fermion systems, where the electrons have effective masses of 100 to 1000 times the free electron mass - due to strong electronic interactions-, but also the novel iron-based superconductors, where the effective masses are smaller, but the superconducting temperatures higher.

Very recently, we have developed a new generation of pressure cells (within a France-Japan international collaboration), which allows us pushing forward the experimental limits and studying the 3D (*H*,*p*,*T*) phase diagram of these systems. Magnetoresistivity experiments will be performed to determine the 3D phase boundaries and Fermi surface of heavy-fermions and iron-based superconductors.

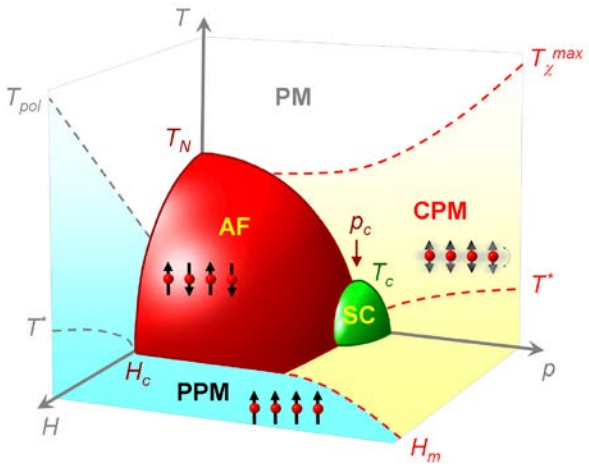

Figure: 3D phase diagram of heavy-fermion systems (p = pressure, H = magnetic field, T = temperature, AF = antiferromagnetism, SC = superconductivity, PM = paramagnetism, etc.)

Publications linked to the theme

1- "Pressure cell for transport measurements under high pressure and low temperature in pulsed magnetic fields", D. Braithwaite et al., Rev. Sci. Instrum. **87**, 023907 (2016).

2- *"Dichotomy between the hole and electrons behavior in the multiband FeSe probed by ultra high magnetic fields"*, M.D. Watson et al., Phys. Rev. Lett. **115**, 027006 (2015).

This Master internship could be extended into a PhD within the same research subject.

Background and skills expected

Background: Solid state physics, Magnetism, Superconductivity,
The candidate will be motivated to perform fine experiments on complex and fascinating physical systems.

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