



***Post-doctoral Researcher Position  
at the Laboratoire National des Champs Magnétiques Intenses - Toulouse***

**Superconductivity induced by a magnetic field in correlated electron systems**

Intense magnetic fields allow continuously changing the basic properties of numerous materials, as correlated-electron metals where a non-conventional superconducting phase can develop 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 - constitute one of the most promising experimental targets. In several of these systems it has been found that superconductivity can be enhanced or induced by a high magnetic field. The most spectacular case is the new superconductor UTe<sub>2</sub> where multiple re-entrant superconducting phases have been discovered. The investigation of these phenomena requests extremely challenging experiments. For example, the study of field-induced superconductivity in UTe<sub>2</sub> requires magnetic fields up to more than 45 T, temperatures below 1 K, and the possibility to control the orientation of the crystal to apply the field in a very specific direction.

**Missions**

The postdoctoral researcher will perform state-of-the-art experiments on heavy-fermion systems under combined extreme conditions of intense magnetic field, high pressures, and very low temperatures. In particular, he/she will study the emergence of superconducting phases induced by a magnetic field. The main targets will be the investigation of the new superconductor UTe<sub>2</sub> and the search for new cases of field-induced superconductivity. He/she will be involved into instrumentation projects aiming to allow these studies in a dilution fridge and with a rotation probe in a <sup>3</sup>He cryostat dedicated to pulsed fields. In addition to his/her research activity, he/she will be sometimes part of a local contact team receiving external users for high-field experiments on correlated electron systems at the LNCMI-T.

**Activities**

The postdoctoral researcher will mainly perform electrical-resistivity and magnetization experiments under pulsed magnetic fields. He/she will prepare the samples, their electrical contacts, their cabling to the probe. For high-pressure experiments, he/she will also prepare the cell. He/she will perform the high-field experiments, under various sets of environments (<sup>4</sup>He, <sup>3</sup>He, dilution fridges, pressure cells, rotation probes, 60-T, 70-T and >90-T magnets), analyze the data, write papers, and present the results in international conferences. He/she will also have the possibility to participate to neutron scattering studies of magnetic order and magnetic fluctuations, when complementary information to the high-field studies performed in Toulouse will be expected.

## **Skills**

A PhD in experimental physics and a solid background in the study of correlated-electron systems are required. A strong motivation to perform cutting-edge experiments under extreme conditions is expected. For that purpose, good technical skills (or a will to acquire them) are essential. Large sets of data will be accumulated, and programming skills may also be useful to analyze the data. Fluent spoken and written English are needed to communicate efficiently the results (high-impact journals, talks in conferences etc.).

## **Work context**

The Laboratoire National des Champs Magnétiques Intenses in Toulouse (LNCMI-T) is one of the few facilities worldwide delivering non-destructive pulsed magnetic fields up to more than 90 teslas. Such extremely high magnetic fields constitute a powerful tool for the study of condensed matter physics. In addition to the internal research performed by its staff, the LNCMI offers an access to his experiments under high magnetic field to external researchers, via the submission of scientific proposals evaluated by an international selection committee. The postdoctoral researcher will work in the scientific team ‘Quantum conductors and magnets’ of the LNCMI-T. He/she will collaborate with researchers and engineers at the LNCMI-T and with researchers from the CEA-Grenoble and Tohoku University in Japan.

## **Funding and salary**

The postdoctoral research position is funded for  $\approx 1$  year by the Agence Nationale de la Recherche, with the possibility of an extension of up to two more years funded by the LNCMI (total  $\approx 3$  years). The gross salary will be between 2800 and 3960 € / month, depending on the work experience, which corresponds to a net salary between 2250 and 3200 € / month (after deduction of social security and income taxes). The start date can be as soon as possible.

## **Contact:**

Applications should be sent to William Knafo ([william.knafo@lncmi.cnrs.fr](mailto:william.knafo@lncmi.cnrs.fr)).

## **References:**

1. “Comparison of two superconducting phases induced by a magnetic field in  $UTe_2$ ”, W. Knafo *et al.*, [Commun. Phys. 4, 40 \(2021\)](#).
2. “Destabilization of hidden order in  $URu_2Si_2$  under magnetic field and pressure”, W. Knafo *et al.*, [Nature Phys. 16, 942–948 \(2020\)](#).
3. “Field-reentrant superconductivity close to a metamagnetic transition in the heavy-fermion superconductor  $UTe_2$ ”, G. Knebel *et al.*, [J. Phys. Soc. Jpn. 88, 063707 \(2019\)](#).
4. “Pressure cell for transport measurements under high pressure and low temperature in pulsed magnetic fields”, D. Braithwaite *et al.*, [Rev. Sci. Instrum. 87, 023907 \(2016\)](#).
5. “Heavy fermions in a high magnetic field”, D. Aoki *et al.*, [C. R. Physique 14, 53 \(2013\)](#).