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Pheliqs Quantum Physics & Engineering

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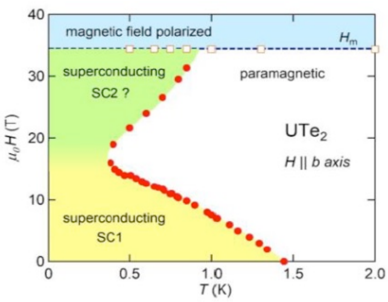
UGA Université Grenoble Alpes

GRENOBLE INP UGA

Master / PhD Thesis Project

Enlightening Spin-Triplet Superconductivity in UTe_2

Superconductivity is one of the most dynamic fields of research in solid-state physics, thanks to the continuous discovery of new superconductors, challenging our understanding of this phenomenon. Notably, in **quantum materials** like the high-Tc cuprate superconductors, the iron pnictides, or the heavy fermion systems, completely new mechanisms are involved for the building of Cooper pairs, leading to a so-called unconventional pairing, and novel physical properties.
The recently discovered superconductor UTe_2 is an extreme example of the surprises brought by unconventional superconductors: it shows magnetic field reinforced superconductivity, leading to an exceptionally high (for such a low T_c superconductor) superconducting critical field (see Figure below). Under pressure, we also discovered transitions between different superconducting phases, and yet another completely anomalous behaviour of the upper critical field. Most of these properties remain unexplained today, but are certainly closely connected to the fact that UTe_2 is a "**spin-triplet/p-wave**" **superconductor,** or even a mixed singlet/triplet superconductor under pressure! Spin-triplet superconductivity has been found only in a handful of compounds; however, it is presently highly sought-after for its intrinsic **topological properties**.



In this Master 2 project, we will notably explore the high-field phase (green state on the figure) of UTe_2, which seems to be governed by completely new physics. Few measurements can probe the superconducting state in such high-field, low temperature conditions. Our new high precision dilatometer, able to detect length changes of 10^{-3}nm on a mm-size crystal, is an ideal probe. This is due to the strong interplay between lattice and electronic properties, arising from the dominant role of exchange in the electronic correlations. With thermal dilatation (change of length with temperature) or magnetostriction (change of length with field) measurements, down to very low temperatures (20 mK) and in high magnetic field, we will look for a potential field-induced phase transition between low and high fields, and measure the field-evolution of the superfluid density.

A PhD can follow this Master project, where in addition uniaxial stress experiments are planned to further explore this emergent quantum material. Strong coupling with theorists from the laboratory (two ongoing PhDs on this subject) should trigger clear progress in the understanding the exciting physics of UTe_2.

APPLY NOW!

To apply for this position, send your application (including CV) by e-mail to: Georg.Knebel@cea.fr

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