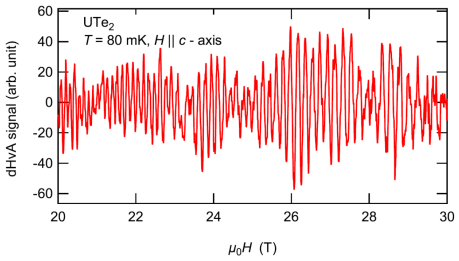
Master thesis Project

Topological superconductivity and Fermi Surface in UTe_2

General Scope: Topological superconductivity has become a subject of intense research due tc its potential for breakthrough in the field of quantum information. The key feature is the prediction of zero-energy excitations called "Majorana modes", present on the surface or in the vortex cores. However, despite intense research there is up to now no clear realization of a topological superconductor. Bulk systems are a promising possibility, with candidates found mainly among unconventional superconductors, which are also strongly correlated electron systems. More specifically, prominent systems for such topological superconducting states are superconductors with an odd parity superconducting order parameter, and their potential topological properties depend crucially from the topology of the Fermi surface. UTe_2 is one of the most prominent candidates for topological superconductivity.

Subject: UTe_2 is a strongly correlated electron system with very flat bands at the Fermi surface and thus the effective masses are expected to be very high. We propose a new approach to detect the quantum oscillations through the development of a new experimental technique (for IMAPEC), relying on a tunnel diode oscillator (TDO) circuit. The "TDO method" is a contact-less high frequency (10-50 kHz) ac susceptibility measurement, based on a resonance technique probing the electrical, magnetic and superconducting properties of a metal and has been shown to be very sensitive to quantum oscillations. This technique can also be used under high pressure.

Environment and collaborations: The study of topological superconductivity in strongly correlated uranium compounds is a central research activity of the IMAPEC team of PHELIQS with recently a strong focus on UTe_2. Fermi surface studies will be performed in the lab, but also in collaboration with the high magnetic field laboratories in Grenoble (static magnetic fields up to 36 T) and Toulouse (pulsed magnetic fields up to 70 T) where strong collaborations exist. High quality single crystals of UTe_2 are grown in IMAPEC lab and available. The candidate will further profit from strong theoretical support from the theory group of Pheliqs, and have the possibility to interact with groups in Japan where tight collaborations are well established.



Quantum oscillations in UTe_2 detected by the dHvA effect in high magnetic fields

Required skills: The candidate should have sound knowledge in solid state physics, good practical skills and strong interest in the development of instrumentation. The subject can be continued by a PhD thesis.

APPLY NOW!

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

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