INSTITUT NEEL Grenoble

PhD grant

Synthetic exploration of topological superconductivity

Context:

Combining superconductivity with topology in a material could lead to new types of quasiparticles such as Majorana zero modes and thus contribute to advances in the concept of quantum computing. Most efforts are concentrated on combining artificially engineered nanostructures with conventional superconductors. Another promising route is to use crystalline topological superconductors. Intrinsic topological superconductivity is believed to be observed in unconventional superconductors with p-wave and d-wave symmetries. Such compounds are rare and difficult to synthesize. Experimental efforts are required in crystal growth of high-quality samples, discovery of new materials and the characterization of their structures and properties. Symmetry considerations allowed us to identify promising candidate materials for topological superconductivity, such as UPt_3 and $LaNiGa_2$.
This PhD work takes place in conjunction with the LANEF chair of Excellence SyDcoM of Prof. Valentin Taufour, UC Davis, USA. The project is carried out at the two crystal growth groups of the Néel Institute and the Pheliqs laboratory in Grenoble. It also involves researchers from the MagSup team (Néel Institute) and the Imapec team (Pheliqs laboratory).

Objectives and available methods:

The project aims to establish new kinds of topological quantum materials through crystal synthesis of candidate materials and the understanding of their physical properties.
This project will involve extensive work in synthesizing intermetallic crystals using flux and Czochralski methods. Broader synthetic exploration will be possible with the available growth techniques in our labs (chemical vapor transport, optical floating zone, etc). The samples will be characterized by standard techniques. X-ray and Laue diffraction will be performed for crystal structures and orientation. Physical characterization will be carried out by measuring transport, heat capacity and magnetic properties.
Opportunities will be given to participate in the advanced characterizations performed by physicists using innovative techniques such as scanning SQUID microscopy, Raman spectroscopy and thermodynamic measurements under extreme conditions (very low temperature, high pressure and high field). Neutron scattering and synchrotron experiments can be performed at large scale facilities situated in Grenoble (ILL and ESRF).

Required profile:

The candidate must have a master degree or equivalent, and a strong interest in working at the interface between condensed matter physics, solid state chemistry and material science. Experience in solid-state synthesis and characterization would be desirable, as well as confidence in a laboratory setting environment.

Foreseen start for the grant: Fall 2022
Amount: 1680 € monthly net salary
Duration: 36 months

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