New Superconductors with Iron

General Scope:

Superconducting materials convey great promises for energy saving and storage, and for reducing our carbon footprint. This is obviously related to the possibility of electric-current transport without dissipation, and the reduction of mechanical friction by means of magnetic levitation. At present, they are commonly used in medical applications where they enable the generation of high and stable magnetic fields for magnetic resonance imaging (MRI). However, a major challenge for the actual take-off of an everyday superconducting technology lies in the discovery of appropriate materials with high superconducting transition temperatures \((T_c)\) and also with cheap and non-toxic elements. The project is to investigate the potential of FeSi as a novel building block for high temperature superconductivity. This investigation is motivated by the recent observation by the French community including the Néel Institute of superconductivity in LaFeSiH. In this context, the student will participate in the partnership among Grenoble, Bordeaux and Caen, highly competitive at international level.

Research topic and facilities available: Historically, superconductivity was believed not to coexist with magnetism. This was surprisingly shown to be wrong with discovery of superconductivity in Cu and Fe-based superconductors, both exhibiting high \(T_c\). In the Fe-based systems a new family has been discovered (LaFeSiH) with \(T_c=10\text{K}\) and based only on cheap and non-toxic elements. Our collaborative team aims at studying this family, increasing the \(T_c\), and deepen our understanding on the relationship between superconductivity, magnetism and the changes of structure that happen to appear in the Pressure-Temperature phase diagram. The student will perform transport, magnetic, optics, X-Ray and eventually Large Facilities measurements (ESRF) at ambient and under pressure on the new compounds grown at Bordeaux. Experimental Facilities: cryogeny, high pressure, transport, magnetic and optics measurements.

Possible collaboration and networking:

Networking: ANR project obtained in 2018. Collaborations: 2 teams of the Néel Institute, Bordeaux, Caen, ESRF, Italy/Belgium/USA (DFT calculations)

Possible extension as a PhD: YES.

Required skills: knowledge of condensed matter physics, curiosity, taste for delicate experiments.

Starting date: march-april 2019

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