Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: SPEC
CNRS identification code: UMR 3680
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Internship location: Service de Physique de l'Etat Condensé (SPEC), CEA Saclay (Orme des Merisiers) and Laboratoire de Physique des Solides, Bâtiment 510, 91405 Orsay
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ED PIF

Title: Exploring the physics of correlated metallic Kagome networks

Strong electronic correlations give rise to exotic forms of electronic orderings, such as high temperature superconductivity or colossal magnetoresistance. In parallel, solid-state physics has been shaken recently by the discovery of topological materials, where exotic fermions, such as Dirac or Weyl fermions have been discovered. Both properties are actively studied, but they rarely coexist in the same materials. Most topological materials known today are weakly correlated semiconductors, which are rather well described by band theory, unlike correlated systems. Finding similar properties in correlated systems could add new dimensions to the problem. Magnetism is for example common in correlated transition metal, giving rise to new topological properties.

We propose the study of systems containing Kagome planes of transition metals (Fe, Co, Rh…), which intrinsically bring together strong correlations and topologically non-trivial band structures. One example is the magnetic Weyl semimetal $Co_3Sn_2S_2$, which display a record large anomalous Hall effect, but where the strength and the role of correlation in these systems are still largely unknown.

The student will synthesize and characterize single crystals of the pure compound and to study the modifications of its properties by chemical substitution (Fe,Ni,Rh...).
A peculiar attention will be given to the structural and physical properties of crystals by using X-rays diffraction measurements (powder and single crystal) and magnetism (Squid, VSM). We will then perform angle resolved photoemission experiments at the SOLEIL synchrotron to study its electronic band structure and check for the presence of topological and/or correlated properties.

Techniques/methods in use: Crystal growth, EDS analysis, X-rays diffraction, magnetic measurements, Angle Resolved Photoemission.
Applicant skills: Good knowledge of Condensed Matter Physics especially electronic structures, Materials science.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: **YES**/~~NO~~ Soft Matter and Biological Physics: ~~YES~~/NO
Quantum Physics: **YES**/~~NO~~ Theoretical Physics: ~~YES~~/NO