INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: CPHT
CNRS identification code: UMR 7644
Internship director's surname: Chatzieleftheriou
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Internship location: CPHT, Ecole Polytechnique

Thesis possibility after internship: YES
Funding: NO If YES, which type of funding:

Title: Effects of strain and magnetic field on the electrons of quantum materials: a theoretical study of $Sr_3Ru_2O_7$

In a solid, electrons can move between atomic sites, with their motion determined by the crystal structure and playing a crucial role in the material's properties. $Sr_3Ru_2O_7$ is a strongly correlated quantum material exhibiting fascinating electronic and magnetic phenomena. Its properties are highly sensitive to external perturbations, such as mechanical strain and magnetic fields, which can induce magnetic transitions and quantum critical behavior. An important step toward understanding these phenomena is to investigate how external perturbations modify the electronic band structure, before accounting for the important electron-electron Coulomb interactions. The goal of this internship is to develop effective tight-binding models of $Sr_3Ru_2O_7$, starting from a simple model and progressively introducing more realistic features. Particular attention will be given to the interplay between strain and magnetic field and their effects on the electronic bands and magnetic susceptibility. The project will combine analytical calculations and numerical simulations. Depending on progress of the internship, electron-electron interactions may also be explored within perturbation theory. This work will provide a foundation for future studies using advanced many-body techniques, aiming to understand experimental observations in $Sr_3Ru_2O_7$.

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

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: YES