COLLÈGE DE FRANCE 1530

Jeunes Equipes de l'Institut de Physique du Collège de France

Dynamics of competing orders in Floquet driven quantum materials

Time-dependent periodic perturbations can dynamically change the state of a system, a celebrated textbook example is the Kaptiza pendulum, whose unstable equilibrium position becomes dynamically stable under periodic drive. Similar ideas are currently being actively explored in condensed matter physics and ultra cold atoms to "Floquet" engineer through periodic driving novel phases of matter which are not stable in thermal equilibrium[1,2]. One promising direction is to consider systems which display competing quantum orders in their equilibrium phase diagram and use periodic drive to manipulate and control this competition.

The goal of this Internship and PhD proposal is to study the non-equilibrium dynamics of electrons in presence of charge density wave (CDW) and superconducting (SC) instabilities. These types of competing orders appear ubiquitously in the phase diagram of transition metal dichalcogenides (TMD) such as NbSe2 and NbS2, which offer an ideal playground to explore novel exotic states of matter. We will study models for TMD under periodic driving and discuss the possibilities of Floquet engineering of the mutual coupling between CDW and SC. This will be achieved using complementary techniques including microscopic time-dependent Floquet mean-field theory for the broken symmetry phases, possibly including the role of lattice degrees of freedom using Keldysh techniques[3], as well as phenomenological approaches based on time-dependent Ginzburg Landau for the coupling between competing orders.

(Internship in collaboration with I. Paul, MPQ Paris-Cite')

[1] F. Peronaci, O. Parcollet, M.Schiro, Physical Review B 101 (16), 161101 (2020)

[2] F. Peronaci, M.Schiro, O. Parcollet, Physical Review Letters 120 (19), 197601 (2018)

[3] M. Lakehal, M. Schiro, I. Paul, Physical Review B 102 (17), 174316 (2020)

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