

NÉEL INSTITUTE Grenoble

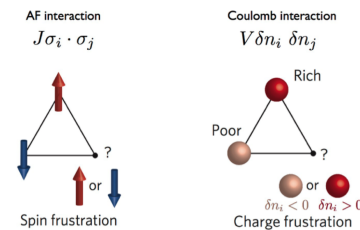
Topic for Master 2 internship – Academic year 2021-2022

Charge frustration as a route to bad metal behavior in correlated electron systems

General Scope:

In condensed matter, *frustration* --- the impossibility to satisfy certain physical constraints imposed to the elementary constituents --- leads to the emergence of original and often complex states: in magnetic systems, for instance, the frustration of spin-spin interactions can lead to spin liquid and spin glass phases, and to the appearance of collective excitations such as magnetic monopoles. In the group we study instead the concept of *charge frustration*, exploring the emergence of new phases and original properties of quantum matter.

Figure: an illustration of the phenomena of spin (left) and charge (right) frustration.



During this internship we intend to tackle an important open question in correlated electron systems: many materials of current interest exhibit a puzzling *bad metal behavior* whose physical origin is still not understood. Our point of view is that such bad metal behavior is caused by emergent low-energy excitations resulting from charge frustration.

Research topic and facilities available:

We propose to study theoretically electronic models with long range Coulomb interactions on low-dimensional lattices. The student will explore the emergence of collective excitations in strongly interacting electron systems and their consequences for charge transport. The models developed to this scope will be analyzed using appropriate many-body approaches, both numerical (exact diagonalization, classical and quantum MonteCarlo simulations) and analytical (perturbation theory in the strong coupling limit, random phase approximation).

The student will have the opportunity of learning important techniques for condensed matter theory, while at the same time getting acquainted with one of the hot topics in current research.

Possible collaboration and networking: University of L'Aquila (Italy), Tallahassee (USA)

Possible extension as a PhD:

YES

Required skills:

Solid basis in condensed matter theory, scientific programming, strong motivation.

Starting date: March 2022

Contact:

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