

CONDENSED MATTER THEORY SEMINAR

Subject: **Metal-insulator transitions, superconductivity, and magnetism in the two-band Hubbard model**

Speaker: **Dr. Luca Fausto Tocchio (Politecnico di Torino), Italy**

Date & time: **Friday, July 6th, 2018 at 3.15 p.m.**

Venue: **Seminar room 1.114**

Title: Metal-insulator transitions, superconductivity, and magnetism in the two-band Hubbard model

Abstract: We explore the ground-state properties of the two-band Hubbard model with degenerate electronic bands, parametrized by nearest-neighbor hopping t , intra- and inter-orbital on-site Coulomb repulsions U and U' , and Hund coupling J , focusing on the case with $J > 0$. Using Jastrow-Slater wave functions, we consider both states with and without magnetic/orbital order. Electron pairing can also be included in the wave function, in order to detect the occurrence of superconductivity for generic electron densities n . When no magnetic/orbital order is considered, the Mott transition is continuous for $n=1$ (quarter filling); instead, at $n=2$ (half filling), it is first order for small values of J/U , while it turns to be continuous when the ratio J/U is increased. A significant triplet pairing is present in a broad region around $n=2$. By contrast, singlet superconductivity (with d-wave symmetry) is detected only for small values of the Hund coupling and very close to half filling. When including magnetic and orbital order, the Mott insulator acquires antiferromagnetic order for $n=2$; instead, for $n=1$ the insulator has ferromagnetic and antiferro-orbital orders. In the latter case, a metallic phase is present for small values of U/t and the metal-insulator transition becomes first order. In the region with $1 < n < 2$, we observe that ferromagnetism (with no orbital order) is particularly robust for large values of the Coulomb repulsion and that triplet superconductivity is strongly suppressed by the presence of antiferromagnetism. The case with $J=0$, which has an enlarged $SU(4)$ symmetry due to the interplay between spin and orbital degrees of freedom, is also analyzed.

[1] C. De Franco, L.F. Tocchio, and F. Becca, arXiv:1805.01856