1NN results- Masters Project

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1 Two-dimensional Hubbard model

The 2D Hubbard model has been an object of scientific study for decades. Theories suggest that this model can accurately resemble the behaviour of cuprate superconductors. In this section a whole phase diagram (as a function of Coulumb repulsion and chemical potential) is studied in detail. Functional renormalization group is used to solve (up to a truncated approximation) the Hubbard model hamiltonian for both the nearest neighbour and next nearest neighbour cases.

1.1 Whole phase diagram

FRG was used to solve the two-dimensional Hubbard model for several Tight Binding models of varying next-nearest hopping strengths. The calculated points span the whole of the electronic band and include Coulumb repulsion values up to 20eV (or 2.5 times the bandwidth).

- Number of electrons was kept constant by adjusting the chemical potential accordingly
- Displacement of Van Hove singularity- displacement of phase diagram
- Preservation of stripes- but displacement of them
- SC order parameter
- General trend in SC Tc maximised
- Emergence of CDW phase

1.2 Superconducting region

After a closer inspection of the superconducting region, one concludes that this phase corresponds to a d-wave superconductor. Moreover, the superconducting transition temperature is maximised as the coulomb repulsion increases, closest to the magnetic instability.

1.3 Observation of stripes

- Stripes for integer values of the chemical potential
- Some stripes keep the same magnetic ordering trhoughout

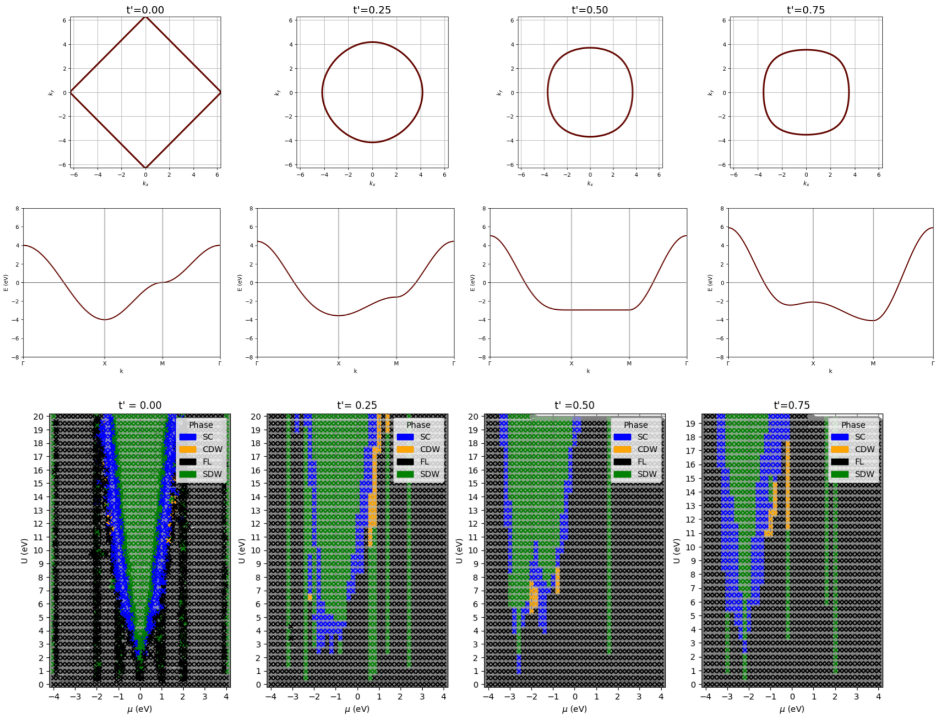

Figure 1: An example image

- Others transition from a FM to an AFM
- Stripes displaced with increasing t'

2 1NNN model

2.1 Phase diagrams

2.2 Magnetic double dome

2.3 Stripes

3 La2NiO4

3.1 Phase diagram