

# **NÉEL INSTITUTE Grenoble**

## **Topic for Master 2 internship – Academic year 2023-2024**

### **Exotic superconductivity in flat band materials**

#### **General Scope :**

Superconductivity is a fascinating state of matter corresponding to zero electrical resistance and magnetic field expulsion occurring in some materials cooled down below a critical temperature. Microscopically it corresponds to a condensate of electron pairs. Such a condensate of fermions can occur only because electrons paired up to form Cooper pairs. In conventional superconductors, the glue binding the electron pairs is the exchange of lattice vibrations: the phonons.

In some materials, such as magic-angle graphene superlattices, superconductivity may result from electronic correlations rather than conventional electron-phonon coupling. These electronic correlations would be more pronounced in materials with flat electronic bands. Theory suggests that the flatter the bands, the higher the critical temperature. The challenge of this project is to test this prediction experimentally.

#### **Research topic and facilities available :**

The aim of the internship is to produce nanostructure superconductors that reproduce theoretical structures proposed to generate flat bands and measure how the critical temperature varies with the flatness of the bands. To this end, the student will be trained in nano lithography and low-temperature resistance measurement techniques.

#### **Possible collaboration and networking :**

The project is part of the Institut Néel's collaboration with the theoretician George Bouzerar. This project has been submitted to the ANR for funding. Thesis funding has been requested.

#### **Possible extension as a PhD : yes**

#### **Required skills:**

Solid state physics knowledge, taste for experimental manipulation and strong motivation.

#### **Starting date : March or April 2024**

#### **Contact : Institut Néel - CNRS :**

Florence Lévy-Bertrand, 04 76 88 12 14, [florence.levy-bertrand@neel.cnrs.fr](mailto:florence.levy-bertrand@neel.cnrs.fr)

Cécile Naud, 04 56 38 71 76, [cecile.naud@neel.cnrs.fr](mailto:cecile.naud@neel.cnrs.fr)

More information : <http://neel.cnrs.fr>