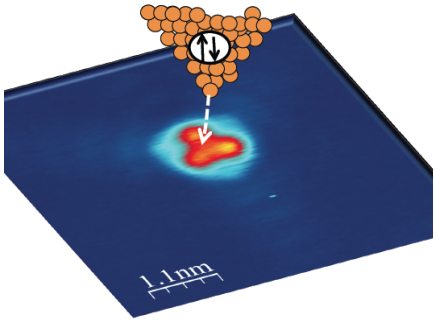
Master / PhD Thesis Project

Magnetic bound states in 2D superconductors

The presence of a nanoscale magnetic scatterer (a single atom, a molecule, a quantum dot etc.) on the surface of a superconductor can lead to the emergence of bound states with peculiar spatial and spectral properties within the superconducting gap. These states can be topologically trivial (the case of so-called Shiba states) or not (predicted Majorana zero modes).



Spatial map of a low-energy bound state around a Fe nanoisland on super-conducting Pb(111) and sketch of STM experiment.

In this project, we will investigate these states in two-dimensional superconductors. Here, the bound states can have a much longer spatial range, which will allow coupling several of them to engineer intriguing electronic properties. The superconducting substrate will consist of either (i) intrinsic superconductors in the single or few atomic layer limit, or (ii) single-layer graphene in which superconductivity is induced from a nearby superconductor. We will use a low-temperature Scanning Tunneling Microscope (STM), to track the signatures of the magnetic bound states and possible topological superconductivity with high spatial and energetic resolution.

The experimental work is at the interface between surface physics and quantum transport studies. The experiments will be performed using a milliKelvin STM available in the host group. The work encompasses collaboration between STM groups in Grenoble (both at Néel/CNRS and IRIG/CEA), together with FU Berlin. The work is further supported by strong interactions with theory groups. The student's work will include:

- Preparing and growing combinations of superconducting substrates and magnetic nanostructures, by self-assembly or single-atom manipulation.
- Performing low temperature scanning probe measurements, with a particular focus on quantum transport effects (Josephson effect, photon-assisted tunneling, …)
- Theoretical analysis and interpretation.

Collaboration and networking: The work bases on a strong experimental collaboration between Inst. Néel (J. Coraux, P. Mallet, J-Y Veuillen, C. Winkelmann), IRIG/CEA (V. Renard, C. Chapelier) and FU Berlin (K. Franke), as well as several theory groups.
Required skills: MSc level in Physics or Applied Physics. Prior experience in low temperature physics, surface science or nanoelectronics is a plus.

APPLY NOW!

To apply for this position, send your application (including your CV) to:
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