Postdoc (M/F): Magnetism and superconductivity of chromium trihalide heterostructures

Depending on experience, from 3 081,33 € gross monthly

Mission

Van der Waals materials are emerging as highly versatile building blocks for numerous applications such as spintronics, superconductivity, nanoelectronics, and optics. These materials are particularly attractive for exploring new exotic physics because of their ability to be stacked in an infinite number of combinations, leading to unexpected physical properties. Superconductivity and strongly correlated phases discovered in twisted bilayer graphene are probably the most striking example of unforeseen phenomena revealed in Van der Waals heterostructures. The recent discovery of ferromagnetic order persisting down to the monolayer limit in these materials opens new opportunities for engineering hybrid quantum systems. The family of chromium trihalides, $CrCl_3$, $CrBr_3$, and CrI_3 (CrX_3, X = I, Br, Cl), represents one of the most promising classes of two-dimensional magnetic materials. Their integration into van der Waals heterostructures is expected to give rise to a wide range of exotic effects, especially when combined with transition metal dichalcogenides that exhibit strong Ising spin-orbit coupling as well as superconductivity. This represents a versatile and promising pathway toward the development of hybrid magnetic/superconducting systems.

The Spectroscopy of Novel Quantum States team at INSP specializes in low-temperature scanning tunneling microscopy (STM) to study the electronic, topological, and magnetic properties of a wide range of materials, from superconductors to magnetic systems and strongly correlated compounds. The team has recently initiated a research activity focused on van der Waals magnetic materials. Within the framework of the ANR MASCOTE project, we aim to investigate the coupling between these materials and superconductors, as well as the influence of magnetic order in Van der Waals systems on this coupling.

Activities

The postdoctoral researcher will be involved in the preparation of Van der Waals heterostructures by molecular beam epitaxy and by exfoliation/stamping under ultra-high vacuum. They will perform surface characterization of the samples using scanning tunneling microscopy. After these initial characterizations, they will conduct spin-polarized STM measurements to investigate magnetic order in van der Waals materials, as well as scanning tunneling spectroscopy to analyze the influence of coupling on superconductivity. The postdoctoral researcher will also contribute to the preparation of scientific publications and present the results at national and international conferences.

Skills

The postdoctoral researcher must have solid experience in surface physics under ultra-high vacuum. Excellent technical expertise is required, given the complexity of the laboratory's experimental setups. Prior knowledge of low-temperature scanning probe microscopy would be a strong advantage. The candidate should also demonstrate a strong ability and motivation to work collaboratively within a team.

Work environment

The Institut of Nanosciences of Paris is located on the Jussieu campus. The team the postdoctoral researcher will join operates four ultra-high-vacuum systems combining preparation and growth chambers with scanning tunneling microscopes, some of which operate at low temperature and under magnetic field. Several instruments have been designed in-house and require ongoing technical developments and maintenance, to which the postdoctoral researcher will actively contribute.

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