

INTERNSHIP PROPOSAL

Laboratory name: C2N – Centre de Nanosciences et Nanotechnologies
 CNRS identification code: UMR 9001
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 Internship location: C2N, 10 boulevard Thomas Gobert, 91120 Palaiseau

Thesis possibility after internship: YES

Funding: NO (not identified yet)

If YES, which type of funding:

Quantum magnetism of spin chains studied by Electron-Spin-Resonance using spin-polarized Scanning Tunneling Microscopy with atomic resolution

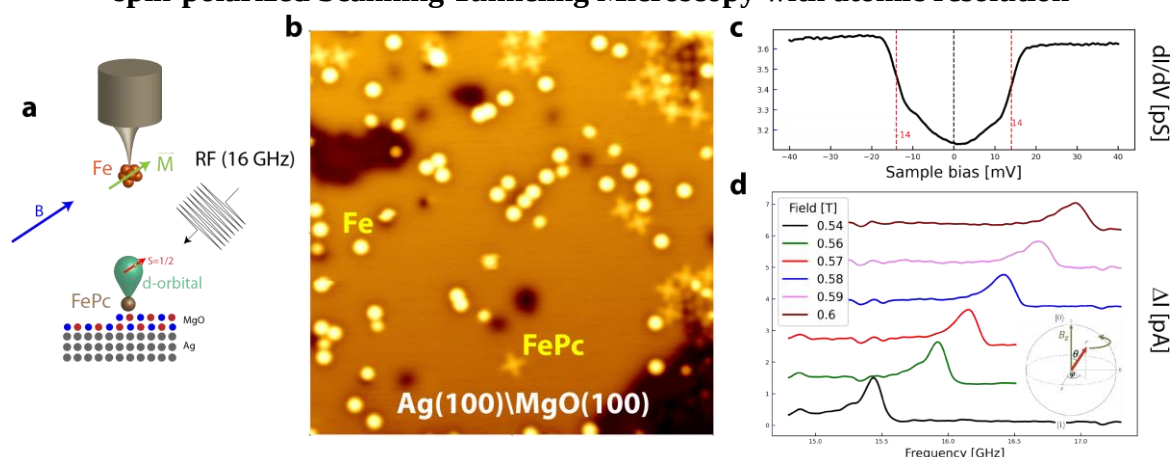


Figure 1 : a) Sketch of an STM tip above a single atom. b) Topographic STM image of Fe adatoms and FePc molecules on MgO/Ag. c) Inelastic tunneling spectrum measured on a single Fe adatom showing large magnetic excitations energies of 14 meV. d) Electron Spin Resonance spectrum measured on a single molecule with spin $S=1/2$.

Recent advances in Electron Spin Resonance – Scanning Tunnelling Microscopy (**ESR-STM**) are now making possible the study of ESR spectra on **single** adatoms or molecules. At C2N, Fig 1, we developed an ESR-STM instrument that is used for continuous-wave and pulsed ESR-STM[1,2].

The project of the master/PhD is to fabricate spin-chains from magnetic molecules and to characterize the quantum coherence properties of the chain with atomic resolution.

Such studies are of fundamental interest for the field of quantum magnetism with topologically non-trivial excitations, such as **Haldane spin-chains**, expected to have long quantum coherence time.

1. Wang, Y. et al. Universal quantum control of an atomic spin qubit on a surface.

npj Quantum Information 9, 1–6 (2023).

2. Zhang, X. et al. Electron spin resonance of single iron phthalocyanine molecules and role of their non-localized spins in magnetic interactions. Nat. Chem. 14, 59–65 (2022).

Techniques/methods in use:

STM and ESR in ultra-high vacuum and cryogenic conditions (400 mK)

Applicant skills: Experimentalist interested by experiments in Ultra High Vacuum (UHV) and cryogenic conditions and/or by high frequency measurements (GHz) and the programming of real time controller dedicated to Qubits (spins) manipulations.

Condensed Matter Physics: YES

Soft Matter and Biological Physics: NO

NO

Quantum Physics: YES

Theoretical Physics: NO

NO