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

Recent advances in Electron Spin Resonance – Scanning Tunnelling Microscopy (**ESR-STM**) are now making possible the study of electron spin resonance on **single** adatoms or molecules. At C2N, we developed an ESR-STM instrument that will be used for continuous-wave and pulsed ESR-STM. Pulsed ESR-STM allows measurements of Rabi oscillations, Cf. Fig., to characterize quantum coherence at atomic scale[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.

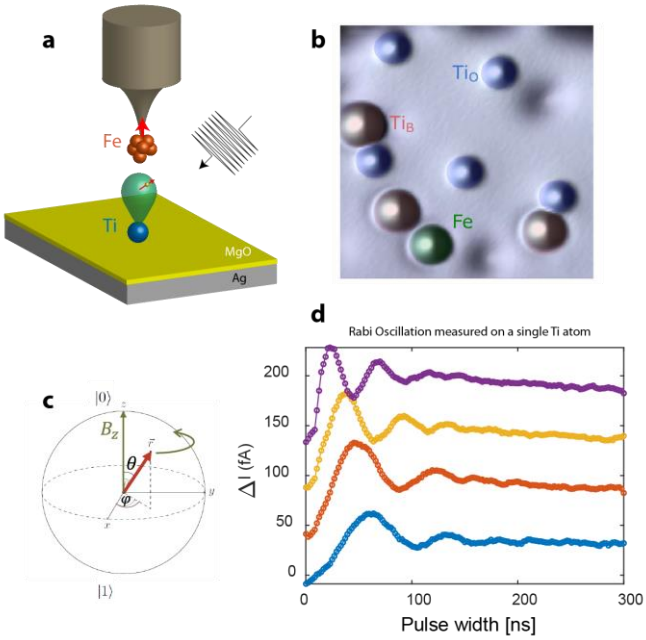

Figure 1 : a) Sketch of an STM tip above a single atom. b) Topographic STM image of Fe and Ti on MgO/Ag. c) Bloch sphere. d) Rabi oscillations resulting from the rotation of the spin on the Bloch sphere, for different tip height above the adatom.

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
Quantum Physics:	YES	Theoretical Physics:	NO