

Factsheet



ACRONYM 4D-NMR

FULL TITLE 4D-NMR – Single Molecule Nuclear Magnetic Resonance Microscopy for Complex Spin Systems

PROGRAMME HORIZON-EIC-2022-PATHFINDEROPEN-01

CONTRACT NUMBER 101099676

ABSTRACT Nanotechnology is emerging as a key area to address global challenges in health, energy, environment and information technologies. However, there are still being investigated most nanomaterials with bulk techniques, averaging over large samples, instead of looking at one single nanostructure with true nanoscale sensors. Particularly, Nuclear Magnetic Resonance (NMR) as the workhorse for bio/chemical synthesis and medical imaging is inherently limited to bulk samples. The most fundamental challenge, to turn NMR from an ensemble measurement technique (Commercial NMRs typically have a sensitivity of billions of molecules) into a nanoscale technique remains unsolved. In this project the consortium will overcome this challenge by reaching single molecule sensitivity, thus converting NMR into an imaging technique thanks to the exploitation of the unparalleled atomic resolution of the scanning probe microscopy (SPM) technology. This breakthrough will be based on resonant, high frequency, electromagnetic excitation and readout including important advances in GHz technology. The capabilities of the novel technology will be used to demonstrate the detection of single spin NMR and to test the limits of our understanding of nuclear-electron interactions, probing the physics of molecular nanoobjects, 1D carbon nanoribbons with delocalized coherent states, and 2D atomically-thin magnetic materials. This novel technology will not only open up new fundamental scientific insights but should also have a strong impact on the markets of NMR and SPM. In this context, the project will be a keystone, demonstrating the novel platform conceived as a versatile upgrade for commercially-available SPMs, that can routinely operate in various environments (vacuum, ambient, liquid) with a variety of molecules and materials.

DURATION 36 months (01/04/2023 – 31/03/2026)

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