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NMR relaxometry for biomedicine and advanced materials

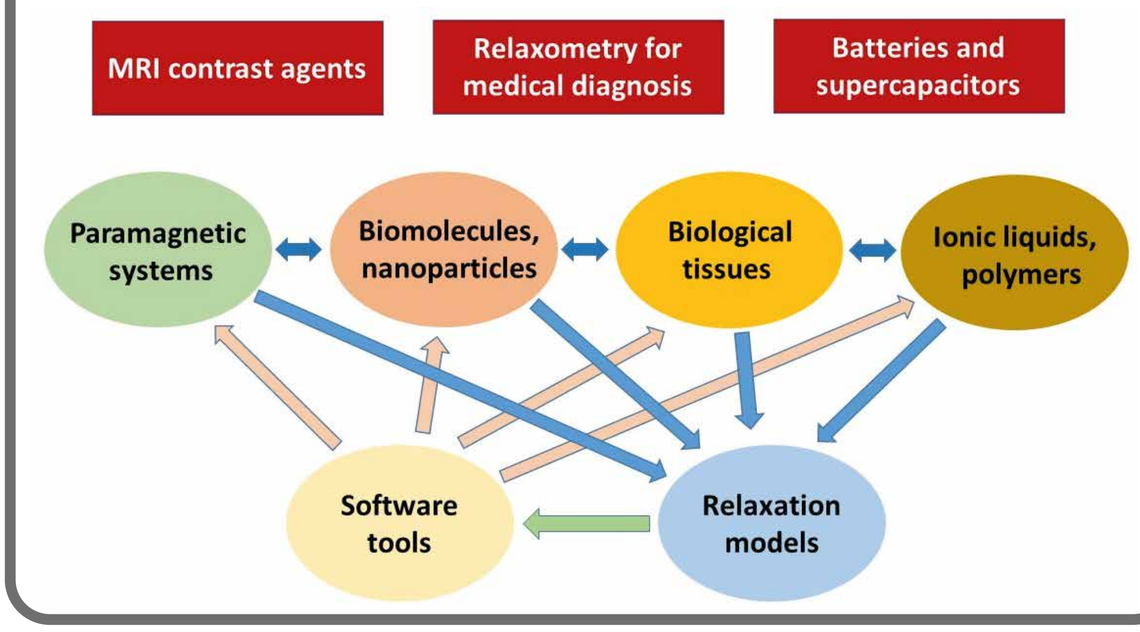
A multidisciplinary doctoral network for field-cycling NMR relaxometry

The **FC-RELAX project**, coordinated by the University of Florence (UNIFI) and financed by the Marie Skłodowska-Curie Actions program, intends to establish a doctoral network, involving some of the main European experts in the area of NMR Relaxometry. It comprises 10 academic partners and 3 companies from 8 European countries.

The project foresees the enrollment of 11 *doctoral candidates (DC)* and the organisation of several *training activities* and *workshops*, as well as *secondments* to take advantage of complementary expertise of our partners.

Objectives of project:

- **Creation of a multidisciplinary research training environment**
- **Research on key molecular processes occurring in biological systems and materials**
- **Fostering innovations in biomedical technology, medical diagnosis, ionic liquids for energy storage and innovative drugs**



MEMBERS

Academic partners

- **UNIFI** - Università degli Studi di Firenze, IT (Project coordinator)
- **CIRMMP** - Consorzio Interuniversitario Risonanze Magnetiche Metallo Proteine, IT
- **UWM** - Uniwersytet Warminsko-Mazurski w Olsztynie, PL
- **UMONS** - Université de Mons, BE
- **IST** - Instituto Superior Tecnico, PT
- **UROS** - Universität Rostock, DE
- **ENS** - Ecole Normale Nupérieure, FR
- **LUT** - Lappeenrannan-Lahden Teknillinen Yliopisto, FI
- **UNIABDN** - University of Aberdeen, UK
- **UNIVAQ** - Università degli Studi dell'Aquila, IT

Industrial partners

- **STELAR** - Stelar s.r.l.u., IT
- **BRACCO** - Bracco Imaging S.p.A., IT
- **RS** - Resonance Systems GmbH, DE

Field - Cycling

The strength of applied magnetic field is changed over several orders of magnitude.

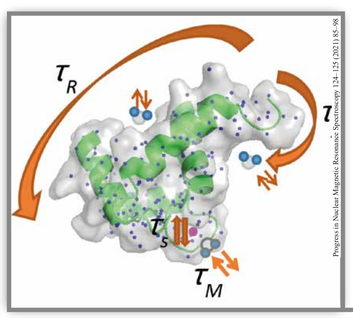
NMR

Nuclear Magnetic Resonance, based on the interaction between nuclear spins and magnetic fields, is widely used for the analysis of chemical compounds and for medical diagnosis (MRI).

Relaxometry

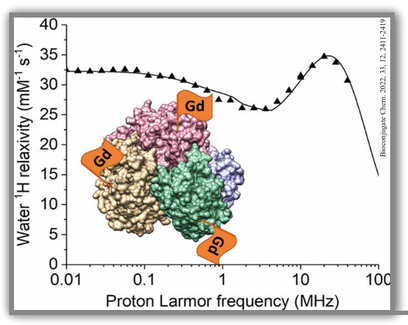
The field dependence of the nuclear spin relaxation rates informs about the molecular dynamics that take place in the analyzed sample.

FC NMR Relaxometry measures nuclear relaxation rates as a function of the magnetic field applied, called Nuclear Magnetic Resonance Dispersion (NMRD) profiles. These profiles can provide the *timescale of molecular motions* and many *structural and dynamic parameters*.



Molecular motions of a biomolecule in water solution

FC NMR Relaxometer



NMRD profile of a potential theranostic agent for MRI

UNIFI CONTRIBUTION:

Proton relaxivity of paramagnetic proteins and nanoparticles in confined environments

Giacomo Parigi
Supervisor

Adam Kubrak
Doctoral Candidate

Objectives

Software tools

Development of software tools for the analysis of NMRD profiles of paramagnetic molecules, proteins and nanoparticles.

Biomolecules & Nanoparticles

Acquisition and analysis of NMRD profiles of proteins and nanoparticles, to characterize and model their relaxivity

Paramagnetic systems

Acquisition and analysis of NMRD profiles of paramagnetic nanoparticles and complexes for MRI applications.