LNCMI-Grenoble

Nuclear Magnetic Resonance instrumentation and methods for high magnetic fields (36 T) and high frequencies (1.5 GHz)

Summary *(400 caractères maxi)*

In Nuclear Magnetic Resonance (NMR) magnetic field dependent phenomena attract considerable interest. In this context paramagnetic relaxation enhancement (PRE) is of particular importance, as it alters the image contrast in magnetic resonance imaging (MRI). LNCMI currently explores PRE up to 32.9 T / 1.4 GHz using novel PRE agents. The proposed internship offers design studies for NMR probes or development of advanced concepts for NMR signal treatment.

Detailed subject *(1200 caractères maxi dont une figure possible)*

Paramagnetic relaxation enhancement (PRE) in NMR has become an important subject for magnetic resonance imaging (MRI) in medicine and in material science. PRE reveals properties below the spatial resolution of MRI by tuning the image contrast. It is achieved by additional, paramagnetic relaxation induced by a contrast agent that influences the NMR relaxation rates of nuclei of its neighboring molecules in a liquid by a temporally modulated hyperfine interaction. Following the common trend in materials research, the available static magnetic fields in MRI are continuously increasing. Thus, the field dependence of PRE up to highest magnetic fields becomes highly relevant.

At LNCMI Grenoble PRE has started as a research and development activity in 2013 in collaboration with an NMR group at KIT Karlsruhe (Germany) [1,2]. Amongst others the project comprises development of a tailored ultra-high field NMR platform up to 36 T and 1.5 GHz. The proposed internship are part of that project. Depending on the interest and the skills of the candidate the following topics are proposed:

(i) Design studies for NMR probes operating from 1 - 2 GHz using Comsol simulation tools and model setups.

(ii) Development of advanced methods for treatment of experimental NMR data using Matlab.

(iii) Exploration of real-time correction methods for compensation of magnetic field fluctuations.

Tentatively, participation in a high field experiment is possible during the internship.

Publications linked to the theme

[1] J.R. Machado *et al.:* Nuclear Magnetic Resonance Relaxivities: Investigations of Ultrahigh-Spin Lanthanide Clusters from 10 MHz to 1.4 GHz, ChemPhysChem, **15**, 3608 (2014).

[2] G. Guthausen *et al.*: Characterisation and application of ultra-high spin clusters as magnetic resonance relaxation agents, Dalton Trans., **44**, 5032 (2015).

Background and skills expected

Motivation to work in an experimental laboratory on an international project. Experimental skills in scientific instrumentation, electronics, NMR, Matlab programming or simulation by Comsol will be an advantage.

Supervisor: Steffen KRÄMER

Contacts - Tel : +33 (0)4 76 88 74 44 **E-mail:** steffen.kramer@lncmi.cnrs.fr