

PhD Position: Quadrupolar relaxation-based methods in FFC MRI

Fast field-cycling MRI is a novel method, which uses rapidly-switched magnetic fields to explore the magnetic field-dependence of magnetic resonance phenomena. Previous studies in FFC MRI have shown that quadrupolar relaxation is an interesting tool for the non-invasive study of protein accumulations *in vivo*. Examples include applications in osteoarthritis, sarcopenia and cancer. However, previous work only made use of one quadrupolar nucleus, namely nitrogen 14, whereas many other quadrupolar nuclei exist that could be used in biological systems. Hence this project aims to extend FFC MRI methods based on quadrupolar relaxation using other quadrupolar nuclei that are relevant for medicine.

One aspect of this project is to identify the quadrupolar nuclei that could be relevant for bio-medical studies. One obvious case is that of oxygen-17, but others may be found such as sodium-23, chlorine-35 and 37 or aluminium-27 (with potential application in Alzheimer's disease). The candidate nuclei will have to be assessed in terms of strength of nuclear coupling, peak position in the dispersion spectrum, degree of interaction with water (or other detectable substrate) and quality of contrast that can be obtained *in vivo*.

Most quadrupolar nuclei have a low abundance in nature so it is likely that interesting candidates will have to be introduced as contrast agents. The form of the contrast agent can be tailored to target specific applications, depending on the nuclei of interest. All contrast agents developed will have to be analysed by FFC NMR relaxometry to check for the presence of quadrupolar peaks, and to measure the influence of physical and chemical parameters (pH, temperature, etc.).

Work will also be carried out to improve the techniques that are used to assess quadrupolar relaxation. For example, it is known that double-resonance techniques exist that should result in larger signals and shorter scan times. This part of the project would aim to optimise and apply these double-resonance techniques to the quadrupolar nuclei targeted in the study.

The PhD student will be based at the University of Aberdeen, which is the world leader in FFC-MRI methodology. The student will make regular visits to the University of Southampton, which has world-leading facilities and expertise in spin dynamics. See the groups' web pages at: <http://www.ffc-mri.org/> and at: <http://www.mhl.soton.ac.uk/public/Main/index.html>

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The Centre for Doctoral Training in Integrated Magnetic Resonance is collaboration between researchers at the Universities of Warwick, St Andrews, Dundee, Southampton, Aberdeen and Nottingham.