PhD Position: Hyperpolarized long-lived nuclear spin states

Long-lived nuclear spin states are collective states of coupled magnetic nuclei that are insensitive to major relaxation mechanisms. The phenomenon of long-lived nuclear spin states was first described in Southampton in 2004 and generated much interest since it represented a realistic way to transcend the "T1 limit" - which had previously been thought to be a fundamental limit on the lifetime of nuclear spin order. Extension of spin-order lifetime has many potential applications to nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI) experiments. The combination with nuclear hyperpolarization is particularly appealing and potentially important. Nuclear hyperpolarization techniques permit the transient enhancement of NMR and MRI signals by up to 5 orders of magnitude, and are already been used for clinical diagnosis of metabolic disorders such as those caused by cancer. However the applications of this revolutionary method have been limited by the T1 lifetime. By using long-lived spin states, it should be possible to extend the lifetime of nuclear hyperpolarization, which could extend the field of applications further. This project will involve the development of hyperpolarization and long-lived state methodology, using a combination of the dissolution-DNP technology available in Southampton and parahydrogen-based methodology available at the Bruker site in Coventry. A specific aim of the project is to apply the hyperpolarized singlet-state methodology to the enhancement of NMR signals in microfluidic devices.

The student will be jointly supervised by Prof Malcolm H Levitt and Dr Marcel Utz, whose speciality is NMR microfluidics. The student will participate in the training courses offered by the Integrated Magnetic Resonance CDT, of which Southampton is a partner.

For further information about applying contact Dr Marcel Utz (marcel.utz@gmail.com) or iMR.CDT@warwick.ac.uk.

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