PhD Position: Quantum information processing with single electron spins in levitated diamonds

A computer based on quantum information would be able to solve certain problems which are intractable with other types of computer. It is natural to use the spin of an electron as a quantum bit because spin down is '0', spin up is '1', and all possible superposition states can be accessed with magnetic resonance. Nitrogen-vacancy (NV) centres in diamond have isolated electrons and nuclei which can store quantum information at room temperature for unprecedentedly long times. Single electron spins can be studied thanks to the optical properties of these centres.

A key challenge with NV centres is to couple multiple NV centres. Our approach is to build an exciting new experiment: a levitated diamond particle, 100 nm to 1 µm in size, held up by optical and ion trapping. To make our scheme work we will need to cool the centre-of-mass vibrational state of the trapped particle to the quantum mechanical ground state. Our collaborators in UCL (Prof Peter Barker's group) have already demonstrated the levitation of 1 µm diamonds, so the focus of this project will be to build in pulsed electron paramagnetic resonance (EPR) at 2.9 GHz with an optical readout.

A great reason for trying this experiment is that it could tell us something new about the crossover between classical and quantum physics. The vibrating diamond particles are large enough that they would generally obey classical physics, but we seek to study their quantum mechanical vibrations. This project is part of an EPSRC grant that has just been awarded to Warwick, UCL, Imperial and Southampton.

In the course of this research, you will acquire skills in magnetic resonance and optical technologies as well as an understanding of quantum information theory.

We are looking for highly motivated people with a strong background in physical sciences, a love of technology and the desire to work in teams. We offer you a lab with extraordinary equipment and the chance to follow up on your own ideas.

For further information contact Gavin Morley (gavin.morley@warwick.ac.uk)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, Southampton, Aberdeen and Nottingham.