**Studentship Form**

The Precision Imaging Beacon wishes to promote cross-disciplinary interaction between Schools, with an expectation of at least two supervisors.

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| First Supervisors name | Richard Bowtell | School Addresses | Physics and Astronomy |
| Co Supervisors name | Dorothee Auer | School Addresses | Medicine |
| Co Supervisors name | Penny Gowland | School Addresses | Physics and Astronomy |
| Co Supervisors name | Paul Glover | School Addresses | Physics and Astronomy |
| Start date | Sept 2019 | Duration | 3.5 years |
| Student | TBC following selection process | | |
| Project Title | Evaluating the benefits and challenges of ultra-high field (11.7T) for magnetic resonance imaging and spectroscopy | | |
| Project Abstract | High magnetic field strength offers great benefits for magnetic resonance imaging and spectroscopy, providing improved spatial and temporal resolution, greater sensitivity to physiological changes - particularly for functional brain imaging - and access to new contrasts, such as those based on chemical exchange saturation transfer and magnetic susceptibility. High field also delivers greater spectral dispersion and enhanced sensitivity for MRS based on measurement of signals from 1H nuclei in metabolites. It also opens up new possibilities for metabolic and kinetic studies based on measurement of the signals from other nuclear species, including 13C, 17O, 31P, 23Na, 39K and even 7Li. For these reasons we are planning a major project to develop an ultra-high field (11.7 T) human MRI scanner facility at the University of Nottingham, which would be operated as a national facility. Realisation of the benefits of high field, will require the development of novel technologies and approaches that will overcome the challenges of operating at higher magnetic resonance frequencies. These include larger perturbations of the RF (radio-frequency) and static magnetic fields by the tissues of the human body, and greater sensitivity to small subject motions.  The aim of this PhD project is to provide a detailed characterisation of the benefits of ultra-high field for magnetic resonance imaging and spectroscopy (MRI/S), along with a comprehensive evaluation of some of the challenges that operation at UHF poses and an exploration of the methods that could be used to meet these challenges. Particular areas of focus would include evaluation of the efficacy of standard coil arrangements for RF transmission and reception at 500 MHz in the head and body (by using electromagnetic simulations); characterisation of typical NMR relaxation times in tissue at 11.7 T, and use of this information to establish the gains in contrast-to-noise ratio and spatial resolution that could be achieved in a range of MRI/S experiments with optimised sequence parameters at 11.7 T in the brain and body; characterisation of the effect of gradient (slew rate and peak gradient strength) and RF hardware (number and configuration of transmit and receive coils) on the achievable performance. This will involve implementation of electromagnetic simulations, application of magnetic resonance theory, experimental measurements that will be carried out in collaboration with other ultra-high field sites internationally, and interaction with the clinicians, neuroscientists and physicists, who are the potential users of an UHF scanner, as well as with the potential magnet and scanner manufacturers. | | |
| Graphic for Advertising  (Must be high resolution) |  | | |