Title of PhD project	**Development of clinically specific tissue microstructural biomarkers from quasi-diffusion imaging**	
Supervisor	Dr Thomas Barrick	SGUL
Co-Supervisor	Professor Franklyn Howe	SGUL
Co-Supervisor	Dr Matt Hall	National Physical Laboratory
Co-Supervisor	Dr Philip Benjamin	SGUL
Brief description of project	This is an exciting opportunity to join a multidisciplinary translational magnetic resonance imaging research group that is developing quantitative biomarkers for tissue microstructural imaging using a novel biophysical model of the diffusion process. In this neuroimaging project the aim is to develop imaging biomarkers that are specific to identification of healthy and pathological brain tissue microstructure. This project will use Quasi-Diffusion Imaging (QDI), a novel, model-based, quantitative diffusion magnetic resonance imaging methodology developed at St George's, University of London. The successful applicant will derive new quantitative QDI biomarkers that are specific to different brain pathologies. Computer simulations of the diffusion environment in health and disease will be developed and applied to determine biomarker sensitivity and specificity to microstructural features such as, cell size, axonal degeneration, demyelination, brain tumour infiltration and cellularity. The new QDI biomarkers will be applied to imaging data acquired from healthy participants, and patients with pathology, including brain tumours, traumatic brain injury, small vessel disease and post COVID-19 fatigue. Application to a range of patients with known pathology will allow determination of biomarker sensitivity and specificity to pathology. This project will provide valuable new imaging biomarkers of tissue microstructure and potential surrogate markers for	

	treatment trials that can be applied in a wide range of clinical settings.
Skills we expect a student to develop/acquire whilst pursuing this project	• Develop understanding of the quasi-diffusion model of diffusion dynamics. • Develop techniques for simulation of quasi-diffusion within healthy and pathological tissue microstructure. • Develop novel imaging methods and apply statistical methods to data. • Develop understanding of the physics of MRI, with emphasis on diffusion MRI techniques, and how neuroimaging may be used in general to influence patient care and clinical decisions. • Develop knowledge of how neuroimaging data can be analysed with application to clinical needs. • Gain experience in processing and analysing large multimodal datasets. • Presentation of findings at clinical and academic conferences, in peer review publications and through public engagement. • Understand challenges and opportunities of using patient data in translational research.
Particular prior educational requirements for a student undertaking this project	Minimum 2:1 honours degree. The ideal candidate will have studied at BSc or MSc level in one of: Computer Science, Physics, Engineering or Mathematics/Statistics or have a background in Magnetic Resonance Imaging or Neuroimaging.
Project key words	Magnetic Resonance Imaging Quantitative Imaging Quasi-Diffusion Imaging Neuroimaging Diffusion Dynamical Modelling Tissue Microstructural Modelling
Possible under 1+4 route? Master's options identified.	No
MRC Core Skills developed through this project	Quantitative skills Interdisciplinary skills
MRC LID themes	Translational and Implementation Research
Further reading	Quasi-diffusion magnetic resonance imaging (QDI): A fast, high b-value diffusion imaging technique The Mathematics of Quasi-Diffusion Magnetic Resonance Imaging