Exotic Quantum Devices Lab

Fully integrated control of localized excitons in 2D semiconductors

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Modern methods in nanofabrication have revolutionised the fields of physics, electronics, optics and chemistry. Shaping a solid medium at the nanometre to micrometre scale has given rise to enhanced control of electronic, optical and mechanical systems, in particular the ability to control a system's quantum behaviour. While the tendency of many technologies to scale down and miniaturise necessarily introduces fabrication challenges, it also provides the opportunity to control and exploit a variety of quantum systems including photons, electrons, holes and combinations thereof.

The very recent discovery of a new class of atomically thin (two dimensional) semiconductor material is providing a completely new platform in which to observe and control quantum states. These materials known as the transition metal dichalcogenides (TMDs) can trap excitations at defect sites, which themselves can be tuned by applying electric, magnetic or even strain fields (stretching and compressing). Performing this level of control in a fully integrated way by means of nanofabricated control structures, is of utmost importance for their applications in a technological setting.

This project will combine the latest advances in nanofabrication processing with this new class of atomically thin semiconductor material to explore and exploit the novel properties of localised excitations. Such excitations—known as excitons—will be used to develop new types of single photon sources, and novel ways in which to store and manipulate quantum information in a solid-state environment.

The project bridges the gap between materials science and quantum optics, it is therefore a very exciting opportunity for a student who is willing and able to learn a wide variety of experimental and fabrication techniques. These include single-photon quantum optics, fluorescence and spectroscopy, through to fabrication and handling of two-dimensional materials and their integrated control structures. Importantly, this position will start during the beginning phase of the newly established *Exotic Quantum Devices Laboratory* headed by Dr Matthew Broome, hence the candidate will gain vital experience in setting up new equipment and infrastructure.

This PhD position will be aligned with the Materials Physics Doctorate scheme (go.warwick.ac.uk/MPDOC). This gives access to a tailored research degree to help you exploit our outstanding materials growth, fabrication, characterisation and computational capabilities, and those at central facilities. A broad education in Condensed Matter Physics is provided through dedicated modules under the Midlands Physics Alliance Graduate School, and external courses.

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