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Quantum Science Distinguished Lecture Series

Semiconductors for quantum technologies

Prof. Jonathan Finley

Walter Schottky Institut - Centre for Nanotechnology and Nanomaterials
Technische Universität München (TUM), Germany

Nuffield Music Annex, Building 2A, Room 2065
Wednesday 25 February 2015, 5pm – 6pm. Refreshments served from 4.30pm
Register your place: http://quantumscience-finley.eventbrite.co.uk

Abstract: The application of ultrafast optical techniques to probe and manipulate discrete quantum states in solids benefits from the possibility to apply established methods from quantum optics such as coherent control, optical pumping, resonant light scattering and dynamical decoupling. Moreover, such all-optical approaches open the way to inter-connect different quantum systems via photonic channels in integrated architectures. In this talk, we will explore several research themes pursued in my group in which individual, optically active semiconductor quantum dots are embedded within electrically tunable, tailored photonic nano-materials and addressed via resonant and near-resonant optical pulses. For example, we have applied multicolour ultrafast pump-probe spectroscopy to study coherent exciton and electron spin dynamics over timescales ranging from a few picoseconds up to ~10gs. Results show how the polarisation state of light can be faithfully mapped onto the exciton or electron spin, manipulated via geometric phase control and read out via spin-selective stimulated exciton emission, conditional biexciton absorption or via spin-charge conversion and luminescence recycling. By blue-detuning the laser pulse from the excitonic transitions we demonstrate how dissipation arising from exciton-LA phonon interactions can be used for high fidelity state preparation and measure the spectral function of the exciton-phonon coupling.

Biography: Jonathan Finley obtained a Ph.D. in experimental physics in 1998 at the University of Sheffield working under the guidance of Prof. M. S. Skolnick (FRS). His PhD research focused on the use of optical spectroscopic techniques to probe fundamental physical, electronic, optical and quantum processes in III-V semiconductors and their associated nanostructures. After graduation, a Royal Society Research Fellowship took him to TUM where he worked as a postdoctoral fellow (1998-2000) with Prof. Dr. Gerhard Abstreiter at the Walter Schottky Institut. During that period he pioneered the development of quantum dot memory structures that allow optically induced single charge preparation and readout in InAs and Ge QDs and their electrical or optical detection.

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