

PhD Studentship in Quantum Nanophotonics

Three-year programme at UCL and the London Centre for Nanotechnology

It has been known for more than a century that nature at its deepest level is not described by classical physics, but rather by quantum mechanics. Quantum theory relies on unfamiliar concepts such as superposition and entanglement, which seem to have no relation to the everyday world around us but which nonetheless describe the behaviour of matter and its interaction with light in great detail. Although these quantum concepts have demonstrated their usefulness in the lab, it has not been possible so far to exploit them in actual devices.

This is starting to change. A new class of technology is emerging that aims to take advantage of quantum mechanics to do things that are not possible using classical physics. In particular, it was realised that information can be processed in fundamentally more efficient ways if it is not encoded in classical binary form, but rather in the *quantum state* of an object. This idea can be applied to such diverse tasks as quantum simulation, communication and computation. Therefore, many groups around the world are currently trying to develop small quantum devices.

In the newly established Quantum Nanophotonics group, we focus on optically active semiconductor nanostructures. Semiconductors - which are at the heart of modern photonics and electronics - are particularly appealing because they can host electronic and nuclear spins with exceptional quantum coherence properties. Using optically active III-V materials allows for ultrafast manipulation of individual spins using lasers, and enables coupling spins to photons which can then be transported inside optical fibres. Our ultimate goal is to develop ways of coherently coupling multiple electronic and nuclear spins in the nanostructure, and to exploit this for making practical devices that harness the power of quantum mechanics.

This 3-year EPSRC-funded PhD studentship will be based in the Quantum Nanophotonics group that is being set up at the London Centre for Nanotechnology and the UCL Department of Electronic & Electrical Engineering. You will learn a variety of advanced nanofabrication techniques to fabricate and process the semiconductor nanostructures; low-temperature (4 Kelvin) confocal microscopy to locate single spins inside the nanostructures; and coherent optical techniques to manipulate and probe the quantum state of coupled spins. If you're an outstanding and motivated student, you're strongly encouraged to apply!

Details: If you're interested in this PhD project, please contact Dr Jeroen Elzerman for more details (j.elzerman@ucl.ac.uk) or go to www.phys.ethz.ch/~elzerman (my old website; a new one is coming).

Eligibility: UK or EU nationality required. The position would suit candidates with undergraduate or master's degrees in Physics, Electrical Engineering or related disciplines, with a 2.1 degree or higher.

Studentship: £15,590 tax-free stipend per annum, plus Home fees.

Applications: should be made using the UCL postgraduate study application form. Candidates should indicate on the application form under 'Programme of Study' that they are applying for the studentship above. See:

<http://www.ucl.ac.uk/prospective-students/graduate-study/application-admission/apply-online/>

Closing date: Monday, 31 December 2012

Related links:

Quantum Nanophotonics group: www.phys.ethz.ch/~elzerman (new website is underway)

London Centre for Nanotechnology: www.london-nano.com

UCL Department of Electronic & Electrical Engineering: www.ee.ucl.ac.uk

University College London: www.ucl.ac.uk