Integrated spatial multiplexing of heralded single photon sources

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Future quantum photonic technologies will require reliable single photon sources to operate. Whilst there has been excellent progress in single quantum emitters for single photon generation on-demand, such as trapped atoms, molecules and quantum dots, each technology still has a number of hurdles to vault including efficient photon collection, wavelength tunability and cryogenic operation. The staple photon sources used around the world in quantum optics laboratories employ spontaneous parametric processes to generate pairs of photons, where the presence of one photon can be used to herald its partner, creating a heralded single photon source. Whilst these work at room temperature and photon emission directions can be tuned, their probabilistic nature is a problem and has limited them to low photon-number experiments. A solution to this was presented by Migdall et al. in 2002, where they proposed to take many probabilistic heralded photon sources and use fast active switching to route the generated photons to a single output. With enough sources this multiplexed device should create a source that is close to deterministic in its operation. In this talk I will present recent work employing on-chip heralded photon sources and all fiber-coupled filtering and switch devices to create integrated spatially multiplexed photon sources. I will first concentrate on the use of spontaneous four-wave mixing in two silicon photonic crystal waveguides and then move to a more recent experiment using spontaneous parametric down conversion in four periodically poled lithium niobate (PPLN) waveguides.

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Alex Clark received an MSc in Physics and a PhD in Quantum Photonics from the University of Bristol in 2005 and 2011 respectively. He was engaged in many projects in the Centre for Quantum Photonics, most notably his work with photonic crystal fibre to generate photons in a variety of quantum states, the demonstration of a quantum controlled-NOT gate in optical fibre and the creation of multi-qubit cluster states using fibre devices. He has successful collaborations with a number of other institutions including the University of Bath, Imperial College London, University of Nice, University of York, University of St Andrews and Thales Research, France. He joined the ARC Centre of Excellence for Ultrahigh-bandwidth Devices for Optical Systems (CUDOS) at the University of Sydney in 2011 and is now Project Leader of the Quantum Integrated Photonics Project. Alex is a member of the Institute of Physics and of the Optical Society of America and in 2013 he was awarded an ARC Discovery Early Career Researcher Award (DECRA). He is currently a Visiting Researcher in the Centre for Cold Matter at Imperial College London.