SU2P Entrepreneurial Fellowship

Case Study:- Chandra Mouli Natarajan

Title: Employing superconducting nanowire single-photon detectors in quantum information experiments

Objective

To employ high performance telecom single-photon detectors for use in advanced quantum information networks. Quantum information networks hinge on the techniques to generate, manipulate and detect single-photon states of light. One of the key challenges is to exchange information between a solid-state quantum memory and a single-photon state. The range of potential applications encompasses quantum cryptography for secure communications, quantum memories for long distance data transmission and growth of secure networks. This project aims to provide vital underpinning technology for the growing quantum information industry.

Project 1: Quantum-dot spin–photon entanglement via frequency down-conversion to telecom wavelength

Cryptographic technologies lie at the heart of information security, and are a paramount concern for military agencies, financial organisations and the telecommunications industry. In quantum cryptography, encoding information using single- photons, promises long distance communication with security guaranteed by the laws of physics. The majority of single-photon sources and quantum memories demonstrated to date operate at wavelengths outside of the main telecommunications band at 1550 nm. Therefore these technologies are not yet suitable for deployment in long distance networking applications. There is thus an urgent need for high performance single-photon sources at 1550 nm wavelength to enable exploitation of the existing global fibre-optic infrastructure by the quantum cryptography industry. The superconducting single-photon detector (SSPD) offers free-running photon counting at telecom wavelengths with picosecond timing resolution and low dark counts. {*de Greve et al. Nature 492 421 (2012); Pelc et al. Optics Express 20 27510 (2012)*}

Project 2: Review on Superconducting Nanowire Single-Photon Detector.

The SU2P fellowship was used to write up a topical review on the Superconducting Nanowire Single-Photon Detectors (SNSPDs) for Superconducting Science and Technology Journal, IOP Publishing. {*Natarajan et al. SUST 25 063009 (2012)*}

Project 3: Quantum detector tomography of a time-multiplexed superconducting nanowire single-photon detector at telecom wavelengths

Superconducting nanowire single-photon detectors (SNSPDs) was both studied as a binary detector and in an 8-bin, fiber based, Time-Multiplexed (TM) configuration at repetition rates up to 4 MHz. {*Natarajan et al. Optics Express 21 893 (2013)}*

Personal development

This Fellowship enabled me to undertake ambitious collaborative work that provided a tremendous opportunity for me to build my skills. I relished the opportunity to work alongside distinguished researchers at SPRC and make key contributions in quantum information science field.