QUBIC
The Australian Research Council Centre of Excellence in Quantum Biotechnology

Fiber-based quantum spectroscopic diagnostic platforms for heart disease

Institution	University of Technology Sydney
Project details	Quantum spectroscopy is a cutting-edge technique that harness the unique properties of quantum-entangled photons to probe a bio sample using the idler photon (typically in the infrared or mid-infrared range) while detecting its entangled partner signal photon (usually in the visible or near-infrared range). By exploiting quantum interference, information such as absorption or refractive index experienced by the undetected idler photon is extracted from the interference pattern of the detected signal photon. This enables highly sensitive, label-free spectroscopy with extremely low light levels and eliminates the need for detectors at the illumination wavelength—an advantage particularly valuable for mid-IR biological imaging, where conventional detectors are expensive and inefficient. We have successfully developed a free-space optical setup demonstrating the feasibility of this technique which is available in CTCP Stage 1 report. As the next step, we plan to couple the undetected idler photon into an optical fiber, aiming to integrate the system with fiber- optic endoscopes for potential in vivo applications. This will require a focused literature review and targeted optical measurements to guide the design. **Expected aims and outcomes:** As the next step, we aim to couple the undetected photon into an optical fiber to enable compatibility with fiber-optic endoscopy systems for potential in vivo applications. This involves conducting a focused literature review to identify suitable mid-infrared fiber types which is used in fiber-optic endoscopy systems and coupling strategies that preserve quantum interference, as well as performing targeted optical measurements to evaluate coupling efficiency, idler beam spatial mode quality, and phase stability. The expected outcomes include a measurement of Mid-IR photon beam parameters, couple it into a fiber and quantitative characterization of fiber performance.
Who can apply	Students with experience or working in optics, photonics, physics, quantum optics
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