QUBIC
The Australian Research Council Centre of Excellence in Quantum Biotechnology

Implementing Quantum Correlations for Spatial Resolution Improvement in Microscopy

Institution	The University of Melbourne
Project details	We are in the process of building a Quantum Image Scanning Microscopy (Q-ISM) system in our laboratory. This advanced super resolution microscopy approach overcomes the classical diffraction limit by a factor of approximately four by combining two distinct methods: image scanning microscopy and photon antibunching correlations. Achieving the desired enhancement in resolution involves the implementation of advanced computational and statistical analysis. Measurements of photon antibunching requires extremely high-speed single-photon avalanche diode (SPAD) arrays to make high precision temporal measurements of individual photon arrival times. These measurements provide a rich source of data for resolution improvement and enable the development of quantum fluctuation and correlation analysis. To continue advancing this project, we are seeking a student with programming experience in Matlab or Python to implement key algorithms for image resolution enhancement and fluorescence fluctuation analysis. Specifically, the student will analyse data to detect occurrences of photon antibunching, using antibunched photons to improve resolution. Additionally, the student will assist in the implementation of quantum fluorescence correlation and fluctuation analysis techniques to further optimize system performance. We have three main aims for this project: 1) Implement quantum correlations of photon antibunching to improve resolution, 2) Implement aim 1 with image scanning microscopy computations for further resolution improvement and 3) Explore fluorescence fluctuation and correlation analysis of photon antibunching
Who can apply	Physics, Computer Science, Engineering, Mathematics, or Statistics students are preferred. Some experience with programming in Python or Matlab is required.
Contatct / Project supervisors	Dr Michael Mlodzianoski - michael.mlodzianoski@unimelb.edu.au Dr Elizabeth Hinde - elizabeth.hinde@unimelb.edu.au