

## **Dr. Rui Vasconcelos**

*Towards scalable photonic entanglement generation*

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Abstract:

This thesis focuses on the scalable generation of photonic cluster states and attempts a transition from photonic entanglement sources based on spontaneous parametric down-conversion (SPDC), which are intrinsically probabilistic, to sources based on atom-like single-photon emitters (SPE), which are fundamentally deterministic.

Firstly, a type-II SPDC source was characterised and modified to produce 4-qubit cluster states. These were then applied to the demonstration of elements of measurement-based error correction, where an arbitrary logical qubit is protected against phase noise.

Secondly, a scalable SPE-based entanglement-generation protocol, which resorts to a single optical transition of an emitter and an unbalanced polarising interferometer, is presented.

The basic unit of this iterative scheme is experimentally demonstrated, using a nitrogen-vacancy (NV) centre as the single-photon emitter, by producing an entangled state between a spin of the NV centre and the polarisation of an emitted photon.