Generating and Teleporting Enganglement for Quantum Networks & Quantum Internet

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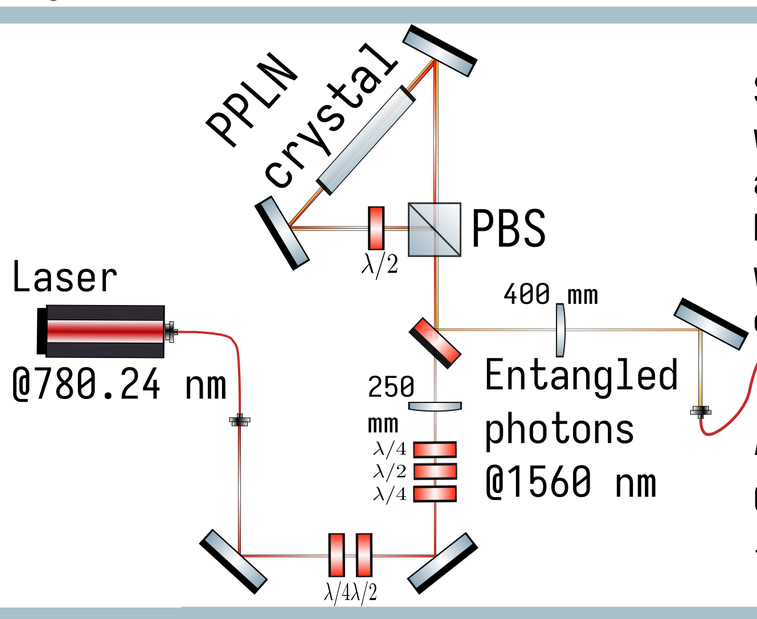
Entanglement is a key resource for quantum technologies of the future, and the development of the quantum internet. Having the ability to efficienty distribute it between distant parties is essential. We implement a Sagnac source of polarization entangled photons around 1560 nm for use in already existing fiber infrastructure. The source will be characterized in our lab at the Faculty of Mathematics and Physics in Ljubljana, and later will be used for entanglement distribution over large distances. An identical source will be built by partners at the Jozef Stefan Institute, allowing us to demonstrate teleporatation and entanglement swapping by performing Bell state measurements.

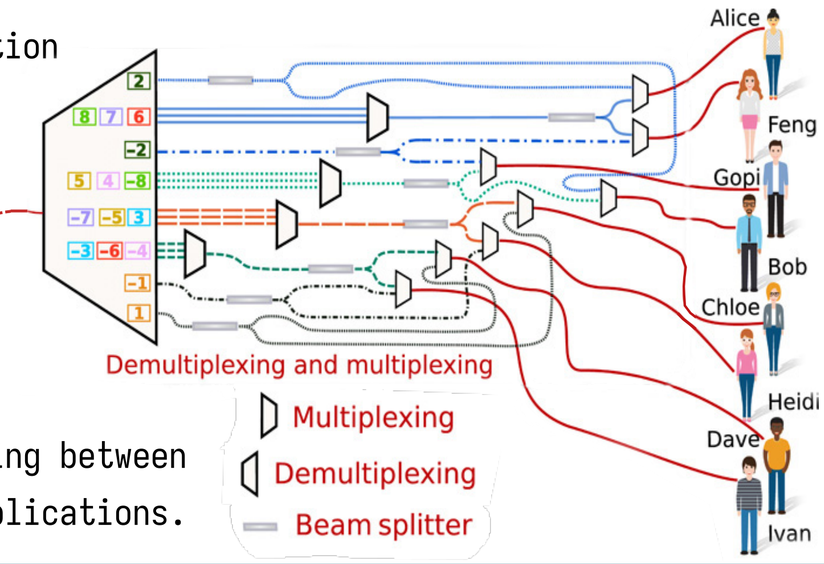


Motivation

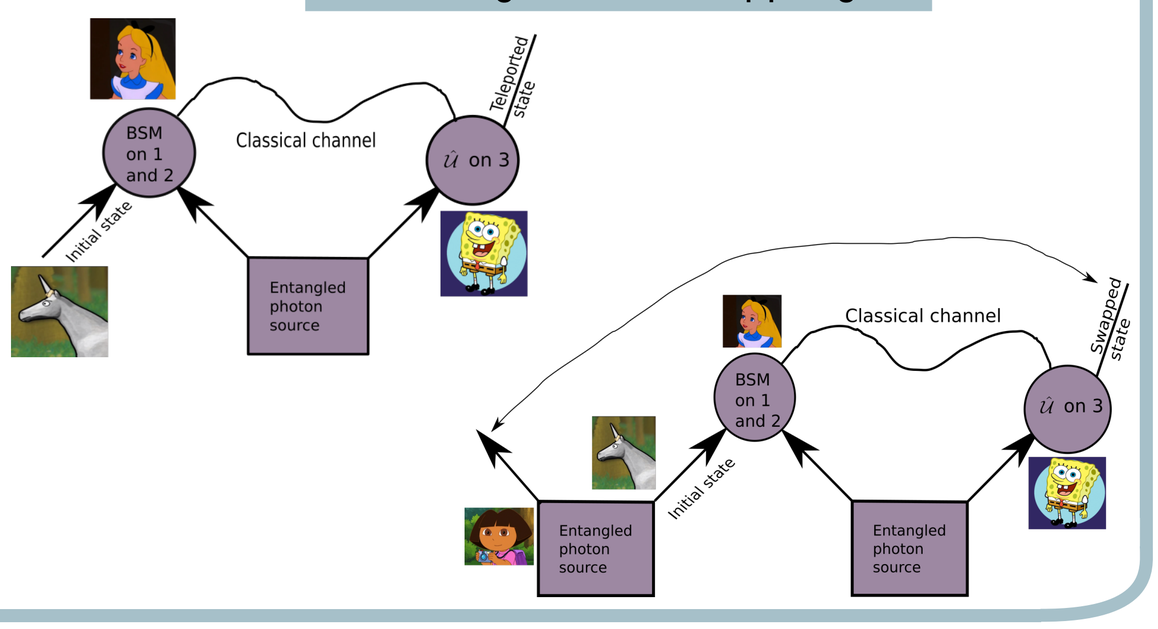
Sagnac interferometer in a minimal configuration with a 50 mm Type-0 PPLN crystal to create a bright source of entangled photons. By pumping the crystal bidirectionally we generate one of four maximally engangled states:

$$|\phi\rangle = |HH\rangle + e^{i\theta}\,|VV\rangle$$

After characterization we will demonstrate Quantum Teleportation and Entanglement Swapping between two distant parties, and possibly for QKD applications.



Quantum Teleporation and Entanglement Swapping



Current status

Optimizing alignment and coupling, testing various automation code, and tinkering with postprocessing for entanglement swapping.

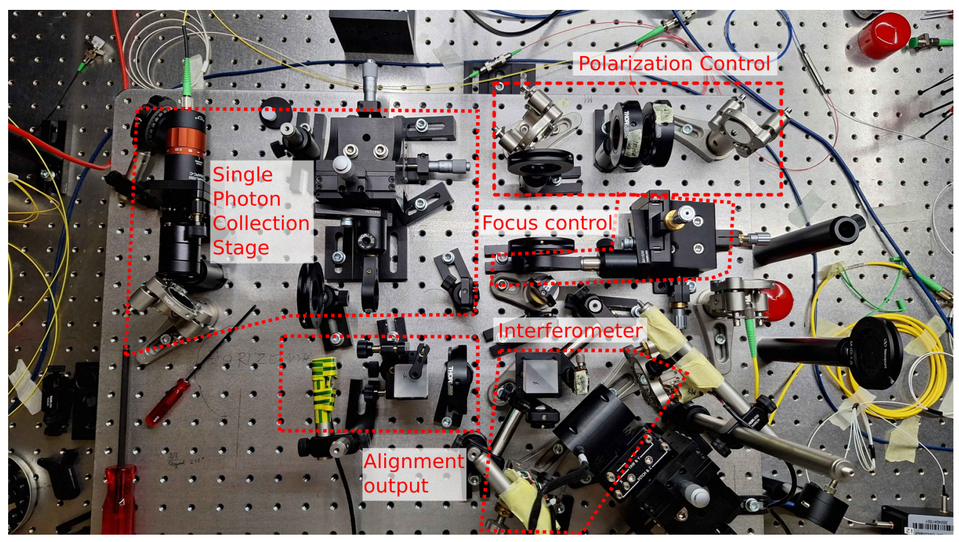


Photo of the current source design

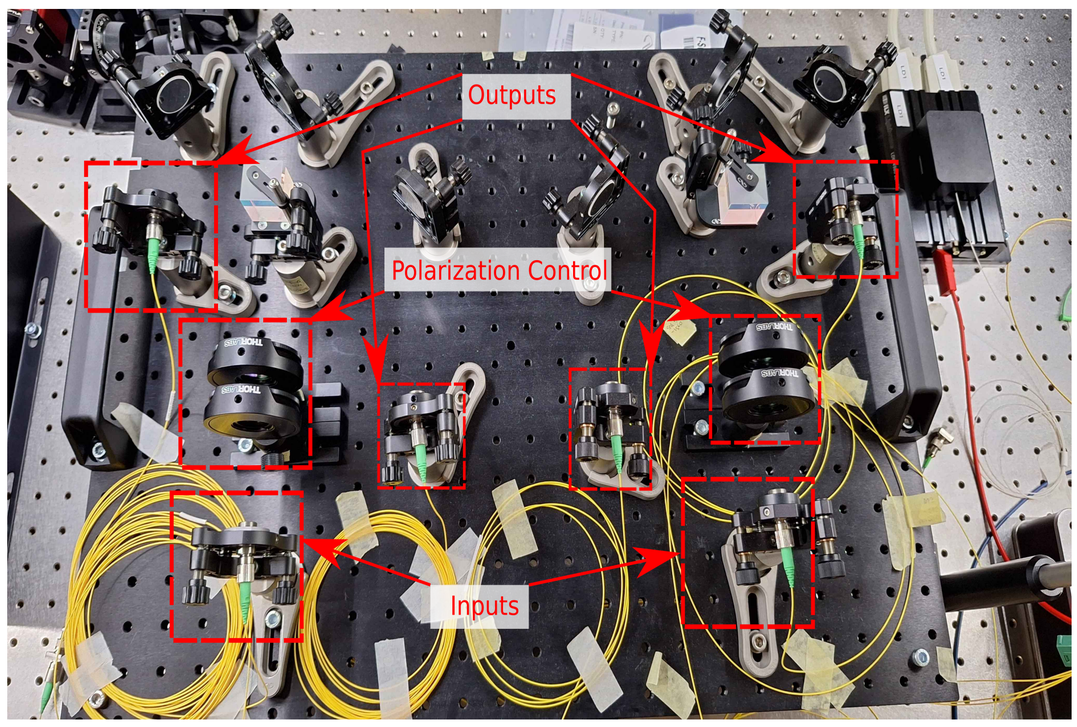
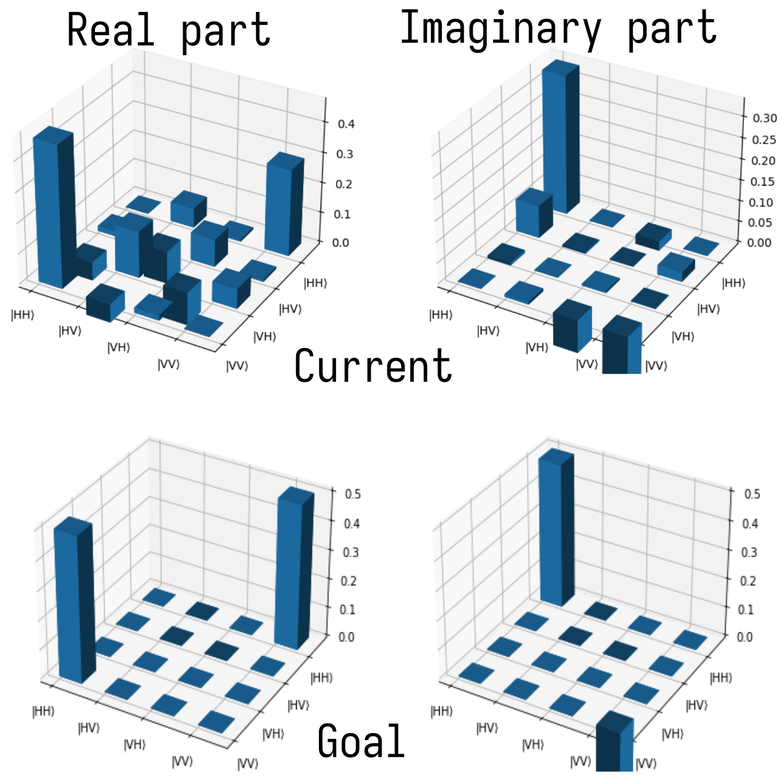


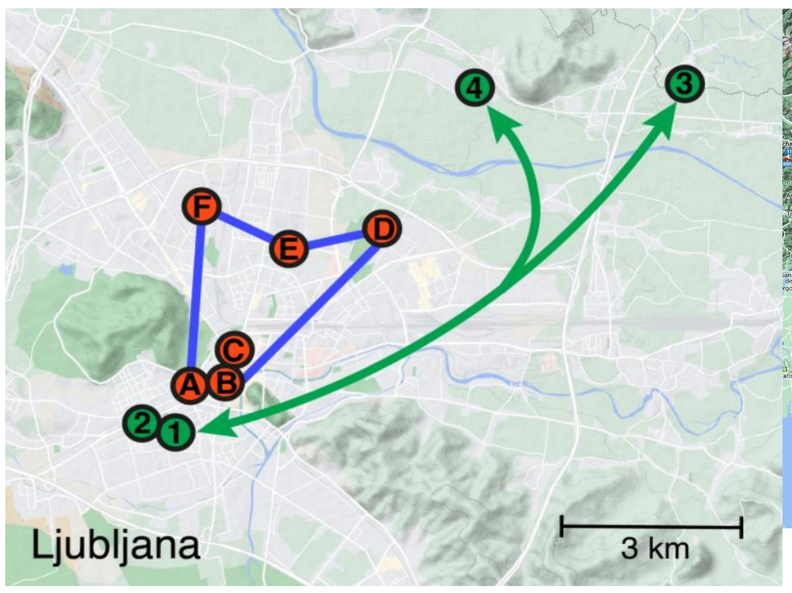
Photo of the analysis stage design

Tomography measurements

Currently trying to produce the entangled state $|\phi\rangle^{i}_{+} = |HH\rangle + i\,|VV\rangle$ Which has nearly been done, with a fidelity of $\approx$ 71%



Plans for the future



Ljubljana experimental and government network

Proposed Slovenian Quantum Network

Our group

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