A MULTI-ENCODING, MULTI-PROTOCOL QUANTUM KEY DISTRIBUTION TRANSMITTER

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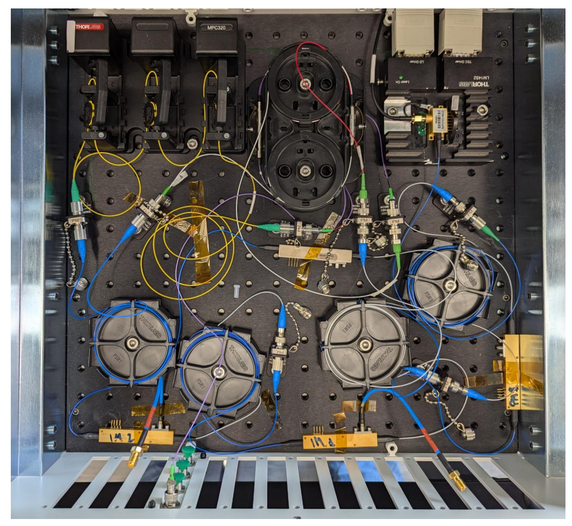
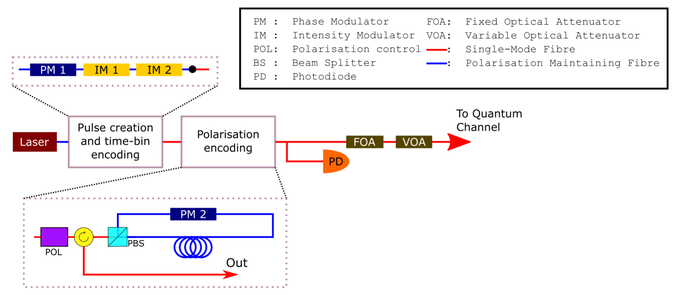
Motivation

Quantum Key Distribution is gaining momentum as a countermeasure against weak key-sharing protocols. Over the last decade, implementation of QKD systems has been growing over the world, funded by private companies and governments alike. However, many players in the field are developing their own technology, which can lead to incompatibility when communicating between different countries, for example.

This work presents a quantum key distribution transmitter which is able to encode information in both the polarisation and the time-bin/phase degrees of freedom, and can generate qubits according to several different protocols.

The transmitter can both be used in free-space and over a fibre optic link, but it is mainly designed for aircraft FSO experiments.





Working principle

The time-bin encoding is performed by a phase modulator and two intensity modulators (one for pulse carving, one for decoy state implementation), which is a very simple setup and allows for quick testing.

The polarisation encoding module is based on the POGNAC encoder developed by the University of Padova [1], which allows for a self-compensating polarisation modulation while not disturbing the time-bin encoding if not in use.

The flight terminal

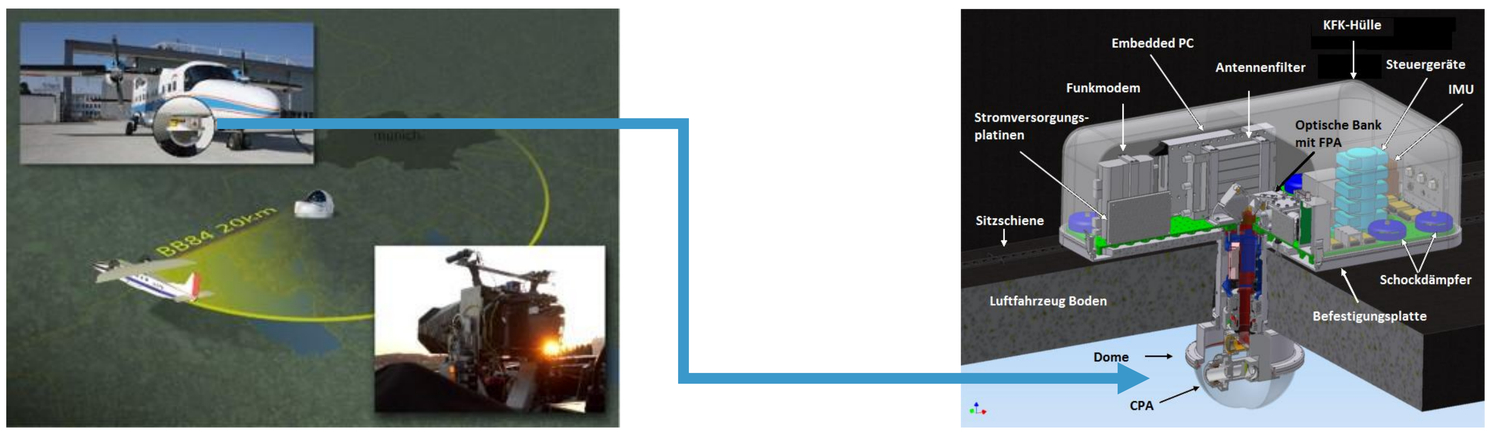
Our transmitter will be coupled to the DLR-developed FELT-II terminal, which features all the FSO components needed to route light towards the ground station, and integrates a classical channel used for alignment and beaconing.

The FELT-II will also be able to seamlessly multiplex signals from our QuNET partner institutions.

Experiments

The transmitter has been tested in the lab and the preliminary experiments show a good agreement with the major literature results.

We will further test the transmitter in several field experiments, one taking place in Berlin between two buildings belonging to our project partner institutions, and three planned aircraft experiments where the QKD transmitter is combined with the FSO terminal developed by DLR and the signal is recorded by our optical ground station in Oberpfaffenhofen (OGSOP)



QuNET

The QuNET initiative is a German, government-funded project involving several public and private German research institutes. Its goal is to establish a QKD network across Germany, with technology provided by all partners and several industrial collaborations. QuNET is part of the larger framework of EuroQCI, the European initiative to build an EU-wide, QKD-enabled network.

References

[1] Agnesi, C., et al. "POGNAC: an all-fiber self-compensating polarization modulator for QKD." **Frontiers in Optics**. Optica Publishing Group, 2019.

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