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Airborne Demonstration of a Quantum Key Distribution Receiver Payload

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Demonstrations of quantum key distribution (QKD) [1] with moving platforms are important to prove the viability of future satellite implementations. Thus far these demonstrations of QKD to aircraft have operated exclusively in the downlink configuration [2,3], where the quantum source and transmitter are placed on the airborne platform. While this approach has the potential for higher key rates, it is more complex and is not as flexible as an uplink configuration, which places the quantum receiver on the airborne platform [4]. Here we present the first successful demonstration of QKD to a receiver on a moving aircraft.

The apparatuses for our demonstration consist of a weak coherent pulse decoy state QKD source and transmitter located at a ground station at Smiths Falls-Montague Airport, and a QKD receiver located on a Twin Otter research aircraft from the National Research Council of Canada with schematics shown in Fig. 1. The airplane flew two path types: circular arcs around the ground station, and lines past the ground station. The distances for each type of pass varied from 3 km to 10 km.

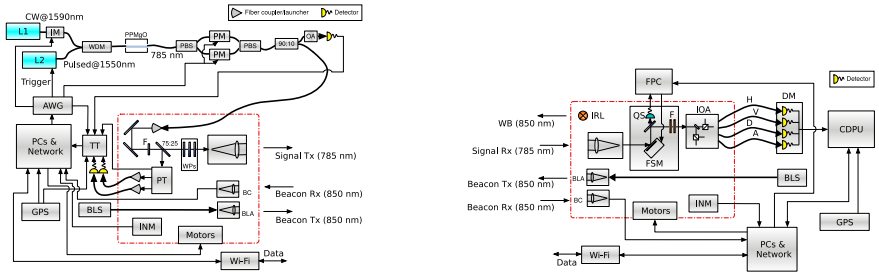

Fig. 1. Schematic diagrams of (left) the transmitter and (right) the receiver. Most receiver subsystems are custom designed and have clear path to flight for future satellite integration.

In total, we generated finite-size secure key in 5 passes, with one showing over 800 kb. The circular passes allowed for longer link times, whereas the line passes were more representative of a satellite pass over a ground station. Angular speeds (at the transmitter) between 0.4 °/s and 1.28 °/s were achieved. The major components in the receiver (fine pointing unit, integrated optics assembly, detector modules, control and data processing unit) have a clear path to flight.

References

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