

## Press Release: UK-Canada research partnership aims to expand global quantum network



The quantum internet will allow quantum-secure communication on a global scale. A new collaborative project between the UK and Canada, that has been awarded funding from the [Quantum Communications Hub](#), will establish a key satellite link for quantum communication across the Atlantic.

Quantum key distribution (QKD) is a method for distributing encryption keys which is secure against eavesdropping or decryption. QKD is being rolled out worldwide across terrestrial, fibre-based networks. For intercontinental distances, QKD will have to rely on satellites, which exchange particles of light called photons with ground stations to generate the encryption keys.

The [Quantum Encryption and Science Satellite \(QEYSSat\)](#), led by the Canadian Space Agency and supported by researchers at the University of Waterloo, is currently on track to be launched into a low-earth orbit in early 2024. The new project awarded by the Hub to researchers at Heriot-Watt University will allow connections from UK-based ground stations to QEYSSat using a new high-rate entangled photon source.

Professor Thomas Jennewein, faculty member at the University of Waterloo's Institute for Quantum Computing, and QEYSSat Science Team lead scientist said:

"I am very excited as this new collaborative project allows us to extend our Canadian network to our UK partners, who are developing innovative solutions for high-rate photon pair sources, and to also study the interface between satellite links and ground networks."

Quantum key distribution requires the exchange of individual photons—light particles—between sender and receiver. A unique feature of QEYSSat when compared to other quantum satellites is having the quantum receiver on the satellite. Putting sensitive detectors in space has challenges but enables photonic uplinks in addition to downlinks, which allows us to test how new quantum sources on the ground improve the uplink quality.

The research teams on both sides of the Atlantic will exploit the uplink feature and develop quantum sources capable of distributing pairs of entangled photons from the ground to QEYSSat, as well as simultaneously to remote terrestrial fibre networks. Entanglement is the unique property of quantum physics that gives correlations – stronger than any with which we are familiar in everyday life – between two or more quantum systems, even when these are separated by large distances. This correlation allows the ground stations, which are often located outside of cities to benefit from reduced levels of light pollution and atmospheric turbulence, to connect to metropolitan fibre networks, thus enabling truly intercontinental quantum networks between end users in the UK and Canada.

Professor Alessandro Fedrizzi, lead investigator for Heriot-Watt University said:

“The QEYSSat satellite will be one of the most advanced quantum satellites in orbit, and this new collaboration will allow us to conduct quantum experiments including secure encryption on a truly global scale.”

This project also augments the work already being carried out by the Quantum Communications Hub – funded through the [UK National Quantum Technologies Programme](#) – in its extensive programme of work on satellite QKD. The Hub, which includes Fedrizzi and his group in its investigating team, is developing a satellite QKD In-Orbit Demonstrator (IOD) which includes a CubeSat (small satellite) and an optical ground station, both of which will be fitted with Hub-developed quantum technologies. The technology developed through this project will directly complement the Hub’s IOD when this is launched later in the Hub project lifetime.

Further progress towards a global quantum secured communications network in space is being made through another on-going project that received funding bilaterally from the UK (via Innovate UK) and Canada (via Natural Sciences and Engineering Research Council of Canada) in November 2020, which will further expand the capabilities of the QEYSSat mission. The consortium project, ‘[ReFQ](#)’, which is jointly led by Quantum Communications Hub partners Craft Prospect (UK team) and the University of Waterloo (Canadian team together with Honeywell Canada, the Canadian Space Agency, and the University of Calgary), aims to integrate a source of quantum signals developed by Hub partners the Universities of Bristol and Strathclyde with a novel protocol devised by the University of Waterloo team. This system will enable the QEYSSat microsatellite to transmit quantum signals using auto-compensation that will simplify the alignment between space and ground quantum states. The transmitter will connect with ground stations on both sides of the Atlantic, acting as a proof-of-concept demonstration for a global quantum secured communications network.