Satellite study proves global quantum communication will be possible

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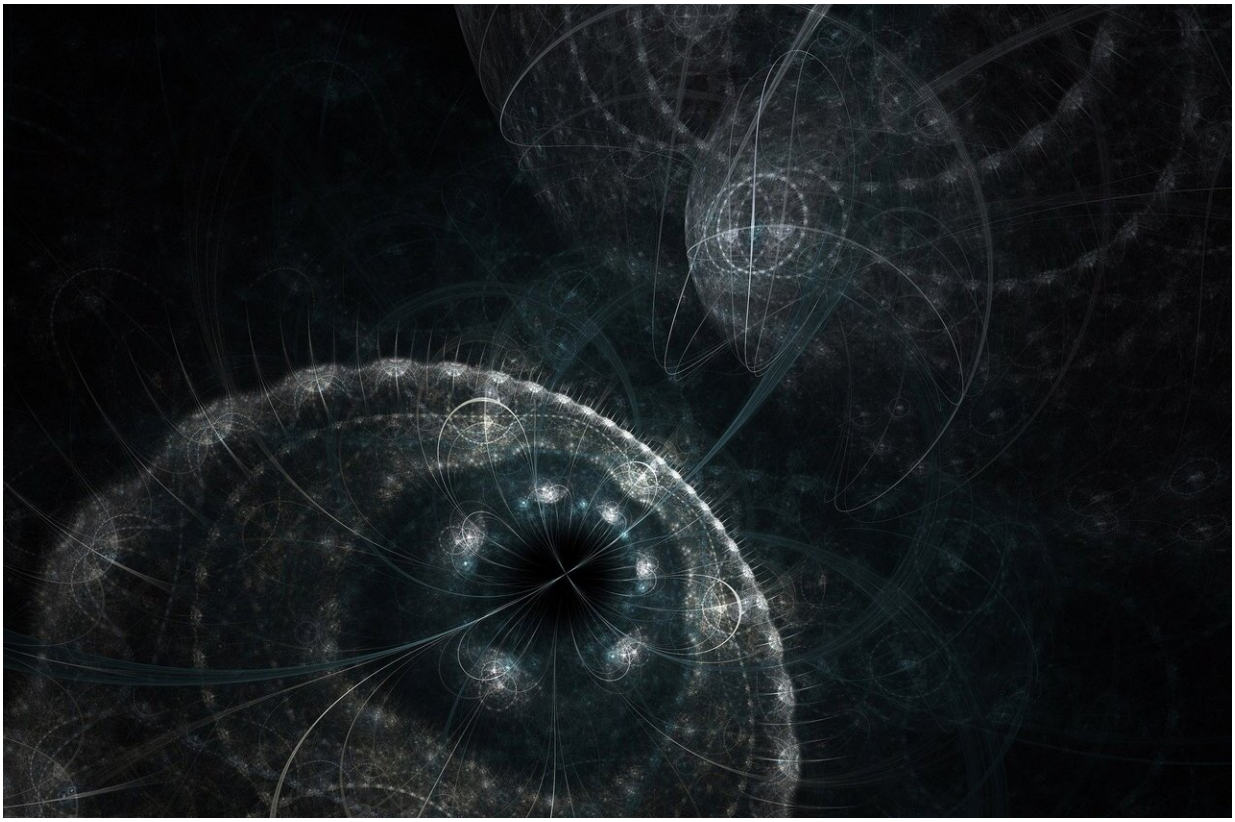

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Researchers in Italy have demonstrated the feasibility of quantum communications between high-orbiting global navigation satellites and a ground station, with an exchange at the single photon level over a

distance of 20,000km.

The milestone experiment proves the feasibility of secure quantum communications on a global scale, using the Global Navigation Satellite System (GNSS). It is reported in full today in the journal *Quantum Science and Technology*.

Co-lead author Dr. Giuseppe Vallone is from the University of Padova, Italy. He said: "Satellite-based technologies enable a wide range of civil, scientific and military applications like communications, navigation and timing, remote sensing, meteorology, reconnaissance, search and rescue, space exploration and astronomy.

"The core of these systems is to safely transmit information and data from orbiting satellites to ground stations on Earth. Protection of these channels from a malicious adversary is therefore crucial for both military and civilian operations.

"Space quantum communications (QC) represent a promising way to guarantee unconditional security for satellite-to-ground and inter-satellite optical links, by using quantum information protocols as quantum key distribution (QKD)."

The team's results show the first exchange of a few photons per pulse between two different satellites in the Russian GLONASS constellation and the Space Geodesy Centre of the Italian Space Agency.

Co-lead author Professor Paolo Villoresi said: ""Our experiment used the passive retro-reflectors mounted on the satellites. By estimating the actual losses of the channel, we can evaluate the characteristics of both a dedicated quantum payload and a receiving ground station.

"Our results prove the feasibility of QC from GNSS in terms of

achievable signal-to-noise ratio and detection rate. Our work extends the limit of long-distance free-space single-photon exchange. The longest channel length previously demonstrated was around 7,000 km, in an experiment using a Medium-Earth-Orbit (MEO) satellite that we reported in 2016."

Although high-orbit satellites pose a large technological challenge, due to losses from optical channels, Professor Villoresi explained the team's reasoning for focussing on high-orbiting satellites in their study.

He said: "The high orbital speed of low earth orbit (LEO) satellites is very effective for the global coverage but limits their visibility periods from a single ground station. On the contrary, using satellites at higher orbits can extend the communication time, reaching few hours in the case of GNSS.

"QC could also offer interesting solutions for GNSS security for both satellite-to-ground and inter-satellite links, which could provide novel and unconditionally secure protocols for the authentication, integrity and confidentiality of exchanged signals."

Dr. Giuseppe Bianco, which is the Director of the Space Geodesy Centre of the Italian Space Agency and co-author, said "The single photon exchange with a GNSS satellite is an important result for both scientific and application perspectives. It fits perfectly in the Italian roadmap for Space Quantum Communications, and it is the latest achievement of our collaboration with the University of Padua which is steadily progressing since 2003."

More information: Luca Calderaro et al, Towards quantum communication from global navigation satellite system, *Quantum Science and Technology* (2018). DOI: 10.1088/2058-9565/aaefd4

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