Quantum-encrypted information transmitted over fiber more than 600 kilometers long

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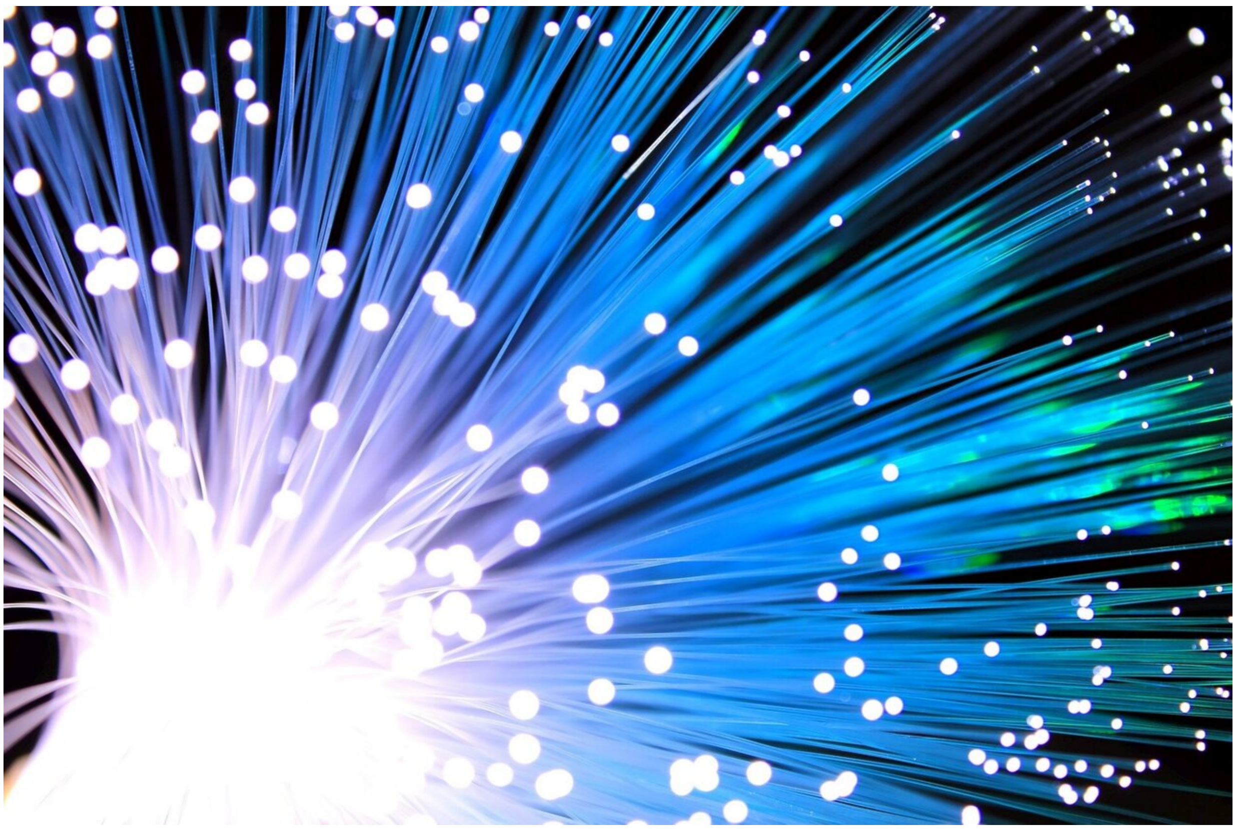

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By implementing a new signal stabilization technique, researchers were able to achieve secure quantum communication over a record 605 kilometers of fiber using the twin-field quantum key distribution (QKD) protocol. The new demonstration paves the way for transmitting highly secure, quantum-encrypted information over long distances, such as between cities.

Mirko Pittaluga from Toshiba Europe Limited and the University of Leeds, both in the UK, will present the research at the Frontiers in Optics + Laser Science Conference (FiO LS) all-virtual meeting.

"This research extends the range of fiber-based quantum communications beyond 600km for the first time, and we think the techniques we have introduced here may be relevant for other phase-sensitive single-photon applications," said Mirko Pittaluga. "This will allow us to build national and continental scale fiber networks connecting major metropolitan areas. Together with satellite links, we can now envisage truly global quantum networks," continued Andrew Shields, head of the quantum technology division at Toshiba Europe.

QKD allows two users in different places to establish a common secret string of bits by exchanging photons which are typically transmitted over an optical fiber. Achieving transmission over long distances is one of the biggest challenges for practical implementation of quantum communication because there is a fundamental limit to how far the photons can travel before the signal degrades due to scattering or absorption. While optical repeaters solve this problem for traditional fiber optic data transmission, it has proven difficult to create a reliable repeater for quantum encoded information.

The newly developed twin-field QKD protocol has the potential to overcome the distance limitation, but new methods are needed to use it with fiber lengths over 500 kilometers. In the new work, the researchers developed an experimental setup and phase stabilization technique for twin-field QKD. The stabilization approach, which is based on wavelength division multiplexing, uses two optical reference signals at different wavelengths to minimize the phase fluctuations over long distances.

The research team demonstrated that the new approach could accomplish repeater-like performance while tolerating optical losses beyond the traditional limit of 100 dB over a 605-kilometer-long quantum channel. They were also able to test different variants of the TF-QKD protocol. The new stabilization approach could also be applied to other quantum communication protocols and applications such as improving interferometric telescopes.

These results were obtained in a laboratory environment, but recently obtained experimental evidence confirms the applicability of this stabilization technique on field-deployed fibers. The team is now working to perform a field trial test.

More information: Conference: www.frontiersinoptics.com/home/

Pittaluga's presentation is scheduled for Monday, 01 November at 07:00 EDT (UTC—04:00).

Provided by The Optical Society

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