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Physicists develop new method to combine conventional internet with the quantum internet

Researchers at Leibniz University Hannover send entangled photons and laser pulses of the same color over a single optical fiber for the first time.

Four researchers from the Institute of Photonics at Leibniz University Hannover have developed a new transmitter-receiver concept for transmitting entangled photons over an optical fiber. This breakthrough could enable the next generation of telecommunications technology, the quantum Internet, to be routed via optical fibers. The quantum Internet promises eavesdropping-proof encryption methods that even future quantum computers cannot decrypt, ensuring the security of critical infrastructure.

"To make the quantum Internet a reality, we need to transmit entangled photons via fiber optic networks," says Prof. Dr. Michael Kues, Head of the Institute of Photonics and Board Member of the PhoenixD Cluster of Excellence at Leibniz University Hannover. "We also want to continue using optical fibers for conventional data transmission. Our research is an important step to combine the conventional Internet with the quantum Internet."

In their experiment, the researchers demonstrated that the entanglement of photons is maintained even when they are sent together with a laser pulse. "We can change the color of a laser pulse with a high-speed electrical signal so that it matches the color of the entangled photons," explains Philip Rübeling, a doctoral student at the Institute of Photonics researching the quantum Internet. "This effect enables us to combine laser pulses and entangled photons of the same color in an optical fiber and separate them again."

This effect could integrate the conventional Internet with the quantum Internet. Until now, it has not been possible to use both transmission methods per color in an optical fiber. "The entangled photons block a data channel in the optical fiber, preventing its use for conventional data transmission," says Jan Heine, a doctoral student in Kues' group.
With the concept demonstrated for the first time in the experiment, the photons can now be sent in the same color channel as the laser light. This implies that all color channels could still be used for conventional data transmission.
"Our experiment shows how the practical implementation of hybrid networks can succeed," says Prof. Michael Kues.
The research results were published in Science Advances.

Original article:
Philip Rübeling, Jan Heine, Robert Johanning and Michael Kues
Quantum and coherent signal transmission on a single frequency channel via the electro-optic serrodyne technique
Science Advances (2024)
https://doi.org/10.1126/sciadv.adn8907

Note for the editors:

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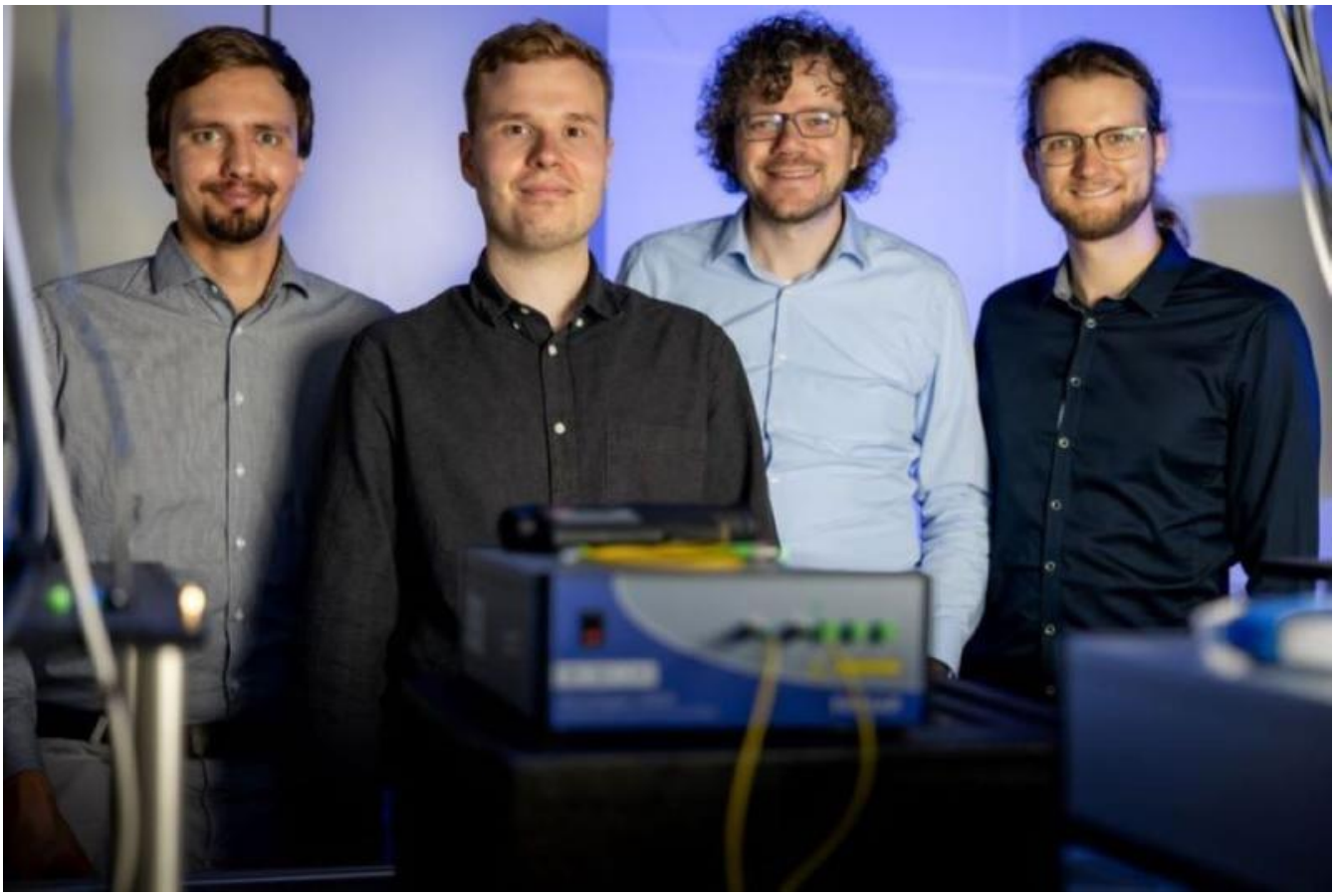

The four researchers in the quantum optics lab are Jan Heine, Philip Rübeling, Michael Kues, and Robert Johanning (from left).
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