INRiM
ISTITUTO NAZIONALE
DI RICERCA METROLOGICA

PRESS RELEASE

INRiM DEMONSTRATES A NEW TECHNIQUE FOR IMPROVING LONG-DISTANCE QUANTUM KEY DISTRIBUTION IN A REAL FIELD

An experiment, performed by INRIM in collaboration with Toshiba Europe on 200 km of the Italian Quantum Backbone, shows that coherent laser interferometry considerably improves the performances of quantum key distribution protocols in long-distance, real-world networks. The study has been published on Nature Communications.

Turin, January 20th 2022 – **Quantum Key Distribution (QKD)** protocols enable cryptographic keys to be shared between distant parties with an intrinsic security guaranteed by the laws of quantum mechanics. This is made possible by the transmission of single photons, the elementary particles of which light is made of.

The interest for this subject extends well beyond the scientific community, and has now a strong strategic and commercial relevance. The European Commission, with the **"European Quantum Communication Infrastructure**" intitative, aims at integrating quantum key distribution technologies into specific services throughout the Union within the next 10 years, and INRIM takes part in the design of this infrastructure with the **OQTAVO project**.

One of the main obstacles towards the realization of a long-reach quantum network is the "fragility" of quantum signals: single-photon states carry an extremely low energy, which makes them hardly detectable, even more considering that 99% is lost after a 100 km travel in telecommunication optical fibers. In addition, the information carried by the remaining ones is severely distorted.

INRIM has already investigated these problems in a metrological context, and has developed, in collaboration with other NMIs, specific laser interferometry techniques that allow recovering the information which is transmitted through long-distance optical fiber. These techniques are nowadays at the core of **state-of-the-art atomic clock comparisons**.

Now, with a sinergic exploitation of coherent laser interferometry, single-photon technologies and quantum metrology, INRIM shows that the information contained in single photon states can be significantly improved, allowing lower error rates and increasing the length of exchanged messages. These improvements pave the way for

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more efficient QKD protocols exploiting the ***twin-field quantum key distribution*** technique, which is currently seen as the most promising candidate for long-reach quantum networks.

The experiment was conducted along a 200 km span of the Italian Quantum Backbone, a 1800 km infrastructure developed by INRiM for the atomic time and frequency distribution to research facilities and high-tech companies in Italy and science applications in fundamental physics, geophysical remote sensing, and quantum technologies.

This study, published on the renowned journal ***Nature Communications*** (**doi.org/10.1038/s41467-021-27808-1**, is also the result of a collaboration with **Toshiba Europe**, leading company in the development of commercial quantum technology products, and the network provider **TOP-IX Consortium**, active throughout northern Italy, that dedicated part of its infrastructure to this research.

This sinergy enabled to achieve an outstanding result on the road to developing an European quantum communication infrastructure.

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