Developing Quantum Communications in space for the future EuroQCI

ICFO takes part in the recently launched European projec QUDICE, aimed to develop components and subsystems fo ultra-secure space-based quantum communication.

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This last decade has witnessed an astonishing increase in the number of devices and systems connected to the global networks, sending information from one side of the world to the other. Huge volumes of sensitive information are being sent through the internet, and many are unaware of how easily data can be hacked and used for malicious intentions. Therefore, one of the major concerns nowadays is security.?

We are in urgent need to protect the sensitive information being transmitted in the mos secure way possible, not only protecting ground based in-fibre, but also free-spac communications

One of the most advanced cryptography techniques is the so-called Quantum Ke

Distribution (QKD), a promising solution to protect digital communications, guaranteein security based on the laws of quantum mechanics rather than on the computation capabilit of a hacker. In order to extend this ultra-secure system at European regional level, the mos promising way is to include satellite system networks into the technological solutions unde study.

The Project

Launched in January of 2023, QUDICE is a European project that focuses on developing components and subsystems for space-based QKD. The successful completion of this project will signify a game changer in space-based communications since it will permit a European network of satellites with quantum key distribution as the main service, enabling ultra-secure communications extended across the entire European region.

QUDICE, which stands for Quantum Devices and Subsystems for Communications in Space, gathers eleven partners (academic institutions, research organizations, and technology companies) from six European countries, experts in quantum technologies, in particular within the field of quantum communications. i¿½**The consortium has gained considerable experience from its precursor project Quango**i¿½, explains Giuseppe Vallone, Professor t the Dep. of Information Engineering of the University of Padova and Coordinator of t e project. i¿½**In Quango we had the opportunity to develop pioneering quantum technological components and systems in the lab with a technology readiness level of 4 (TRL4), in which we were able to make individual components work together as a System. Now in QUDICE we will bring the devices from breadboard demonstrations in a lab (TRL4) to a space qualified engineering model (TRL6)**i¿?

Objectives

QUDICE is already in full motion with the objective of obtaining the first prototypes by the end of 2024 and testing them in 2025. In particular, QUDICE will develop two sources for QKD (one for discrete- and the other for continuous-variable encoding), a Quantum Random Number Generator, a satellite Pointing, Acquisition and Tracking system, an Entangled Photon Source, a 5G system for QKD post-processing support and 5G QKD-secured connectivity service, and simulations to assess the performance of the developed quantum satellite communications components.

The project will be a key player in enabling the realization of a European network of satellites with QKD as its main security protocol approach.?

The EuroQCI Initiative

Today, there is an ongoing worldwide race between competing regions of the globe towards leadership in quantum technologies. In this race, the European Commission is eager to drive and integrate quantum technologies into the arena of telecom and network communications

in search of enabling an additional layer of security to our communications. It is working with all 27 EU Member States, and the European Space Agency (ESA), to design, develop and deploy ultra-secure communications both through terrestrial segments relying on fiber communications networks linking strategic sites at national and cross-border level, and space segments based on satellites.?

As Vallone highlights enthusiastically, i¿½**he European Commission has launched the long-term initiative European Quantum Communications Infrastructure - EuroQCI that seeks to secure quantum communication infrastructure spanning the whole EU, including its overseas territories. As part of this ambitious plan, QUDICE will be an essential technological key component and will play an importantly decisive role in the future deployment of this massive infrastructure.**i¿?

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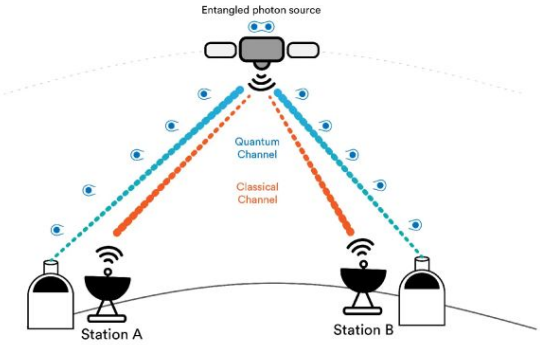

Transmission of QKD in free space using an Entangled Photon Source