OUR VISION

LaiQa is a Horizon Europe project funded by the EU aiming to enhance the technology readiness level of critical components for space-quantum systems as well as bring functional QKD components together with advanced system integration concepts for future quantum space internet.

Motivation

LaiQa project aims to advance Quantum Key Distribution (QKD) technology for future quantum satellite networks and space-based secure communication. These networks are envisioned to securely exchange encryption keys across global devices. Initiatives like the European Quantum Communications Infrastructure (EuroQCI) highlight the need for secure quantum space communication. LaiQa aims to support Euro-QCI by developing critical QKD components for the space segment. LaiQa also aims to introduce advanced technology platforms for on-board components, paving the way for a future quantum space internet. It plans to conduct space qualifications, demonstrations, and contribute to EU standards for QKD and Quantum Communications in space segments.

LaiQa CONCEPT

Concept - Objectives

LaiQa comes as a technology intensive research and innovation action aiming to develop and advance critical components and technologies necessary to build a global spaced-based quantum network. LaiQa envisions to realize unconditionally secure quantum communications over long distances bringing functional QKD components together with advanced system integration techniques towards deployable space-QKD systems. The project's objectives will include the development of space-deployable, high-brightness 1550 nm Entangled Photon Pair Source (EPPS), a space-suitable Decoy State - BB84 Prepare and Measure (P&M) source, a photonic integrated EPPS for next generation on-board sender stations, a quantum memory for long-distance entanglement distribution, an advanced fiber coupling/adaptive optics system for converged space/terrestrial QKD segments, and software components towards the optimization of LaiQa architecture.

The project will demonstrate P&M- and entanglement (ENT-) based QKD systems both in lab/terrestrial FSO testbeds and in field demonstrations in Helmos Optical Ground Station (OGS). LaiQa will also mobilize its consortium to prioritize standardization activities that focus on space components for P&M- and entanglement- QKD, consider interfaces and parameters for them to propose specification standards and potentially trigger new standardization activities within EU.

Factsheet

Call identifier: HORIZON-CL4-2023-SPACE-01-62
Topic: Quantum Communication Technologies for space systems
Project No: 101135245
Timeline: 1 January 2024 – 31 December 2026
Overall budget: €2,499,718.56
EU contribution: €2,499,718.56
Project Website: horizon-laiqa.eu
Consortium: 8 Partners (5 countries)

Concept - Objectives

LaiQa will develop components required for building a space Quantum Communication system, by bringing novel quantum sources for P&M-QKD and ENT-QKD together with innovative FSO-to-fiber coupling optics. LaiQa will demonstrate P&M- and ENT-QKD systems both in lab/terrestrial FSO testbeds and in field demonstrator in Helmos Observatory. This two-phase approach based on components development and QKD system demonstration will boost the project's solid exploitation plan. Specific targets in LaiQa are:

- Develop a space-deployable, high brightness 1550 nm EPPS with GHz scale Pair Generation Rate and high fidelity.
- Develop a 1550 nm space-suitable DS-BB84 source.
- Develop a photonic integrated EPPS for Next-Generation on-board transmitters.
- Develop a Quantum Memory for Long-distance Entanglement Distribution via Quantum Repeater Nodes.
- Advanced fiber-coupling/AO system for converged space/terrestrial QKD segments
- Development of software components towards the optimization of LaiQa architecture
- Develop a comprehensive plan for the standardization of quantum space technologies using LaiQa technologies as a framework.

LaiQa architecture includes the critical space and ground terminal Quantum Communication components supporting both P&M- and ENT-based satellite QKD protocols to deliver quantum keys across optical ground terminals. LaiQa's architecture has been carefully designed considering the technology advancements required in both space- and ground-infrastructure segments to optimize the availability of quantum key resources in end users and the enable features of future deployments.

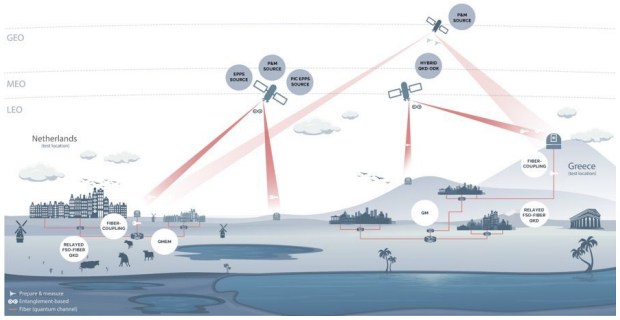

Figure 1. Artistic layout of LaiQa's Architecture

The vision of end-to-end LaiQa's satellite Quantum Space Internet architecture is underpinned on the use of novel on-board photon sender stations which are combined with 1550nm free-space optics for the low-loss detection and distribution across the terrestrial ground fiber-based QCI segments. LaiQa's ground-terminal components will ensure that the innovations that LaiQa brings in the space segment can be delivered in scenarios applied for satellite links orbiting at different altitude grades (LEO/MEO/GEO) and telescopes (<0.3m diameter mini-OGSs up to 2.3m telescope OGS).

Impact

LaiQa aims to develop critical Quantum Communication components for secure space communications, aligning with the European Space-enabled Quantum Network roadmap. It will provide innovative components for both P&M-QKD and ENT-QKD systems, contributing to the Security And cryptoGrAphic mission (SAGA) phases. LaiQa will deliver space-qualified DS-BB84 sources for on-board P&M-QKD and advanced systems for 1550nm photon coupling in EU ground terminals. It will also enable on-board photon pair generation and terrestrial systems for entangled state distribution through Euro-QCI fiber networks. Innovative PIC-based implementations for photon-pair generation and space-oriented quantum repeaters will be developed. Standardization and certification efforts will parallel system development.

Figure 2. The envisaged timeline for the proposed roadmap

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