Titolo: REASE: REsilient computing Architecture in the Space quantum communication Era

Codice Progetto: 2022YEEB9Y

Responsabile scientifico UNIPD: Marta Bagatin

Coordinatore nazionale: Politecnico di Torino

Partner-Unità di ricerca: Istituto Nazionale di Fisica Nucleare, Università degli Studi di Padova

CUP: C53D2300360006

Bando: PRIN 2022 - Decreto Direttoriale n. 104 del 02-02-2022

Durata: 28/09/2023 - 27/09/2025 (24 mesi)

Budget totale progetto: 317.972,00 €

Budget UNIPD: 115.619,00 €

Abstract del progetto: The REASE project aims at developing innovative clustering technology able to significantly improve the performances and robustness of reconfigurable computation in space and in Quantum Key Distribution (QKD) systems.

Quantum Key Distribution (QKD) is a leading technology of Quantum Communication (QC) since it allows to realize a secrecy protocol, safe and resilient to any external attack. Recently, QKD transmitters have been successfully tested on CubeSat, enabling QCs for satellite. However, given the requested computation level, the hardware architecture capable to sustain a continuous data generation and transfer requires a multi-core system based on Field Programmable Gate Arrays (FPGAs) capable to implement a provably secure and reconfigurable QKD and fully exploit its potential.

The final goal of the project is to develop and build an innovative architectural prototype, suitable for space satellite, integrating resilient reconfiguration capabilities, and validated with radiation beam campaigns.

Cluster computation nodes based on radiation hardened self-reconfigurable Field Programmable Gate Arrays (FPGAs) will provide the optimal computational platform without introducing overhead in terms of performance such as data rate, throughput, memories interface access rate, when applying Radiation-Hardening Assurance (RHA) techniques at the cluster level.

Simulation-based radiation particle interaction with matter based on fully integrated particle physics Monte Carlo will provide a prototype implementation compliant with the Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO)tools radiation environment, necessary to improve the physical geometry of the cluster embedded within a satellite. Moreover, it will measure the criticality and sensitive position and study the fine cluster topology structure.

A will provide the monitoring systems integrated withQKD communication data acquisition system and online data analysis the REASE computational architecture to provide the necessary measurement feedback performed during radiation beam testing using protons, heavy ions, and ultra-energetic heavy ions.

A to continuously sustain the transmission of new random data and analysisDedicated Quantum Communication application will be developed, implemented, and tested to provide the necessary feedback for robust and real-time quantum communication testbed.

The REASE team includes experts in robust design techniques for reconfigurable architectures, quantum key distribution algorithms and implementation techniques for FPGA, radiation effects modeling on satellite physical structure, and radiation beam testing campaigns. The proposed project will take advantage of outstanding and promising results achieved by the REASE proponents in previous and ongoing projects. In this condition, the 2-year time window suits correctly the ambitious goal of the project.

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA