IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Space Communications and Navigation Systems (2)

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SPACE QUANTUM COMMUNICATIONS PROGRAMS AT THE ITALIAN SPACE AGENCY

Abstract

Space Quantum Communications are gaining much interest thanks to the possibility of globally distributing secure cryptographical keys for critical data encryption in world-wide telecommunication networks. Short- and long-term security of data is being in fact severely threatened by the development of Quantum Computers which have the potential to crack the encryption protocols used today. The use of the intrinsic unpredictability of Quantum Mechanics to create and distribute perfectly random keys (Quantum Key Distribution, QKD) is an attracting solution to this problem. QKD has been extensively researched in the last two decades and is now ready for practical implementation using photons as quantum information carriers, especially for application in fiber optic networks. Space QKD is attracting because it allows long reach secure key distribution overcoming the high loss of fiber optic links on the hundreds of kilometers scale. A network of satellites could distribute secure keys to base stations over very large areas creating new opportunities for the rapidly developing Space Economy. Last but not least, Quantum Technology in space offers a unique test bed for experiments in fundamental Physics.

In view of these opportunities the Italian Space Agency (ASI) has recently launched an RD program targeting the development of an innovative Space QKD system and the upgrade of the MLRO ground station, that already demonstrated the feasibility of Space QKD. The idea is that of operating the system at telecom wavelengths, around 1550 nm, taking full advantage of the hardware miniaturization offered by Integrated Photonics. The reduction of footprint, weight and power consumption of the QKD photonic gear is of paramount importance for space applications. In this respect Integrated Photonics is an important technological enabler. Two related projects are currently under way, QCommSpaceOne and QRNG. The project consortia, all formed by Italian Academy and RD centers, put together skills on

quantum information, system design and photonic integrated circuit design plus integrated photonic fabrication and packaging facilities, component/system tests and a base-station for satellite communications. QCommSpaceOne aims to the development of a full-fledged space QKD system prototype making use of a photonic Integrated transmitter. QRNG targets the implementation of a new concept miniaturized photonic integrated Quantum Random Number Generator in the GHz range. The generator provides perfectly random drive to the photonic encoders which prepare the quantum states conveying the secret key in the QKD sytem. The outputs of the two projects will be integrated in a final system prototype.