TOULOUSE SPACE SHOW'18 June 26-28, 2018

Space quantum key distribution: a game changer in IT security?

Tuesday 26 June 2018, 13:45 - 18:00
Room: Argos

13:45 – 14:00 Introductions

14:00 – 14:30 Tutorial on QKD theory, technologies and applications

Eleni Diamanti, CNRS, Sorbonne Université, Vice-President Paris Centre for Quantum Computing

In this tutorial, we discuss the current landscape in the context of future quantum-safe secure communications that will include both classical and quantum cryptographic solutions. We describe the concept of quantum key distribution, the main protocols and technologies, as well as the state-of-the-art and practical challenges in the field. Using satellite systems allows overcoming the inherent losses of terrestrial optical channels and has attracted considerable attention in the last years. We review the main ideas and efforts in this direction in Europe and beyond, and describe possible applications and use cases.

14:30 – 15:00 Global Quantum Communication Network and Future Prospect

Yu-Ao Chen, Chief Engineer for Quantum Communication Beijing-Shanghai Backbone project, University of Science and Technology of China

It becomes the most ideal development route to realize the global wide area Global Quantum Communication Network and Future Prospect quantum communication, by realization of the metropolitan area quantum communication network via fiber, connection among two neighboring cities via repeaters, and connection between two remote regions via satellite relay. At present in China, Urban quantum communication network technology has matured, which has already been applied in some areas of national information security. The Beijing-Shanghai Backbone fiber optical quantum communication network over 2000 kilometers has been established in the end of 2016. The quantum satellite Micius has been successfully launched, and satellite-ground quantum communication has been accomplished. Connecting the satellite to the optical fiber quantum network on the ground, a preliminary wide area quantum network has been constructed, based on which, high precision global optical frequency transmission can be carried out, and some effects of quantum gravity and general relativity can be tested. At the same time, it also provides a platform for large-scale nonlocality testing for quantum mechanics.

15:00 – 15:30 Nanobob: A Cubesat Mission Concept For Quantum Communication Experiments In An Uplink Configuration

Erik Kerstel, Université Grenoble Alpes, Laboratory of Interdisciplinary Physics (LIPhy)

We present a ground-to-space quantum key distribution (QKD) mission concept and the accompanying feasibility study for the development of the low earth orbit CubeSat payload. The quantum information is carried by single photons with the binary codes represented by polarization states of the photons. Distribution of entangled photons between the ground and the satellite can be used to certify the quantum nature of the link: a guarantee that no eavesdropping can take place. The versatile space segment is compatible with a multiple of QKD protocols, as well as quantum physics experiments.

15:30 – 16:00 Quantum communication using satellites

Rupert Ursin, Group Leader and Deputy Director, IQOQI - Vienna, Austrian Academy of Sciences

Establishing an optical quantum communication (QC) link to a satellite is the most promising way to bridge large, or even global, distances. This has recently been shown by the Chinese quantum satellite Micius in the course of QUESS, a 100-million-dollar project which will be presented in my talk. I will then also describe the mission, which is currently in a industrial phase-A contract at the ESA level, to establish a QC link to the International Space Station ISS. A Cubesat mission was also investigated recently using a 3U+ and a 12U form factor, who's outcome I will also present during my talk.

16:00 – 16:15 Coffee Break

16:15 – 16:45 NASA vision for quantum communications in space

Barry Geldzahler, NASA Headquarters

NASA's decades long pursuit of laser communication took a first, important step with the Lunar Laser Communication Demonstration wherein data rates exceeding 600 Mbps were achieved routinely. We are now initiating the Decade of Light, in which we are pursuing industry-government partnerships to implement a laser communication network that comprises direct-to-Earth, cross-link, and ground-to-space capabilities. NASA is also on track for a deep-space laser communication capability as part of the NASA Discovery program. To enhance communication security, enable distributed quantum sensing and computing capabilities, and develop the technologies NASA and industry requires over the next decade and beyond, we are augmenting our laser communications development to include development of a scalable quantum network architecture capable of entanglement distribution and entanglement swap at rates that enable preliminary exploration of system utility. This talk describes NASA plans and strategic vision for implementing these goals.

16:45 – 17:15 ESA activities in the field of QKD

Eric Wille, ESA / ESTEC Optics Section European Space Agency

A broad overview of ESA's Quantum Key Distribution (QKD) activities will be given. ESA has worked on the technology development for QKD and scientific experiments with entangled photons since 2001. Long-distance experiments between Tenerife and La Palma have demonstrated that quantum keys can be distributed through a turbulent atmosphere. Different laser sources for QKD were developed to increase the TRL level. More recently, the interest of using space based QKD for commercial or governmental applications has increased and ESA started activities on investigating where QKD can provide an increased level of security in real-world applications. The ScyLight QUARTZ activity started to demonstrate the end-to-end performance of a space suitable QKD system in an operational environment with the target of providing a service in the next decade.

17:15 – 17:45 Space-QKD experience in NICT

Alberto Carrasco-Casado, Space Communications Laboratory, Wireless Networks Research Center, National Institute of Information and Communications Technology (NICT)

The National Institute of Information and Communications Technology (NICT) in Japan has a long experience in space optical communications and have recently carried out the first quantum-limited experiment from a space terminal by using SOTA (Small Optical TrAnsponder) onboard the microsatellite SOCRATES (Space Optical Communications Research Advanced Technology Satellite). The fundamentals of space QKD were demonstrated in this experiment, including the measurement on a ground telescope located in an urban area of Tokyo of non-orthogonal polarizations in the single-photon regime transmitted from a satellite in a 600-km LEO orbit reaching a Quantum Bit Error Rate (QBER) as low as 3.7% with key rates in the order of 1 kbps.

17:45 – 18:00 ENDING