

communication

MARC JOFRE

Address: (to be filled)



PhD Thesis Defense MARC JOFRE 'Integrated Photonic Transmitters For Secure Space Quantum Communication'

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April 15, 2013

Monday, April 15, 11:00. ICFO Auditorium

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Optoelectronics

ICFO-The Institute of Photonic Sciences, SPAIN

An important issue in today's information society is the security of data transmission against potential intruders, which always put at risk the confidentiality. Current methods to increase security require that the two parties wishing to transmit information, exchange or share one or more security keys. Once the key has been identified, the information can be transferred in

a provable secure way using a one-time pad, i.e. the key length is as long as the plaintext. Therefore, the security of the information transmission is based exclusively on the security of the key exchange. Quantum cryptography, or more precisely quantum key distribution (QKD), guarantees absolutely secure key distribution based on the principles of quantum physics, according to which it is not possible to measure or reproduce a state (e.g. polarization or phase of a photon) without being detected. The key is generated out from the measurement of the information encoded into specific quantum states of a photon, named qubits. For example, a qubit can be created using properties such as the polarization or the phase of a photon.

Achieved goals of this thesis are the development of a new class of high speed integrated photonic sources for applications in quantum key distribution systems, capable of producing unprecedented qubit rates (100 Mbps - 1 Gbps) and transmitting those over larger distances than those achieved so far (>200 km). More specifically the work has been focused on developing faint pulse sources which can be used in very demanding environmental conditions, such as those in Space. For the development of these sources, apart from the optical design, the opto-mechanical engineering as well as the integration with the electronics is essential. One of the objectives was to achieve a very high level of integration and power efficiency, e.g. volumes and power consumption between 10 and 100 times smaller than those typical of a laboratory experiment. Moreover, work in related parts of a whole QKD transmission system has been carried out. In particular, a new scheme for a compact, fast and simple random number generator has been demonstrated successfully achieving a random number generation rate of 1.1 Gbps. Also, during the course of this thesis, the development and engineering of a free-space QKD optical link has been initiated.

This thesis makes use of novel ideas to alternatively demonstrate proof-of-concept experiments, which could then further develop into commercial products. To this end, close collaborations with world-wide leading companies in the field have been established. The Optoelectronics Group at ICFO has been involved in current European Space Agency (ESA) projects to develop a small footprint and low power consumption quantum transceiver and a high-flux entangled photon source.

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Thesis Advisor: Prof. Valerio Pruneri

