

Titre:

Systèmes intégrés de distribution quantique de clés à variables continues à haute performance

Title:

System integration of high-performance continuous-variable quantum key distribution

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Thesis subject:

The thesis is situated in the field of quantum information and in particular quantum cryptography. A central application in this field is quantum key distribution (QKD), which allows two parties to share a secret key that can be subsequently used for message exchange, even in the presence of eavesdroppers with unlimited power. This is impossible by classical means. Continuous-variable (CV) QKD, where the key information is encoded on the quadratures of the electromagnetic field, is particularly appealing from a practical point of view in that it only requires off-the-shelf telecom components for their implementation as our group has previously shown in long-distance fibre-optic experiments. The current focus is on the photonic and network integration of such systems.

In this doctoral project, we will address challenges that are found on the way to the development of advanced cost-effective telecom network integrated CV-QKD systems that are ready to operate in a deployed optical fibre environment. These include the conception and implementation of solutions for a system operation in the so-called local Local Oscillator configuration, with suitable modulation schemes (and associated security proofs), as well as with adapted high-speed electronics. The thesis work will also include the characterization of photonic integrated CV-QKD transmitter and receiver chips on both the silicon and indium phosphide platforms, and their use for secret key generation. This will be crucial for future scalable solutions for QKD systems. The deployment of the developed systems in dedicated optical fibre links that will be part of the Paris quantum communication testbed currently under development and the demonstration of specific use cases will also be pursued in this thesis.

Additional remarks:

The PhD student will work in the framework of large European and regional projects (OpenQKD and ParisRegionQCI) that include several academic and industrial partners. This will give multiple opportunities for interactions with groups in the partner institutions.

The thesis work addresses questions coming from a variety of fields: quantum information, cryptography, optics, photonic integration, telecom networks, and electronics.

The doctoral project is primarily of experimental nature. The subject requires knowledge in quantum mechanics, optics, electronics, signal processing, information theory, and cryptography.