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Felicitats a la nova graduada de doctorat de l'ICFO

La Dra. Jennifer Aldama s'ha graduat amb una tesi titulada ?Toward integrating continuous-variable quantum key distribution technology'

December 20, 2023

Felicitem la Dra. Jennifer Aldama que avui ha defensat la seva tesi a l'Auditori de l'ICFO.
La Dra. Aldama va obtenir el seu master en Fisica a la University of Puerto Rico. Es va unir a l'ICFO com a estudiant de doctorat al grup de recerca de Optoelectronics dirigit pel professor ICREA Dr. Valerio Pruneri.
La tesi de la Dra. Aldama titulada ?Toward integrating continuous-variable quantum key distribution technology' ha estat supervisada pel professor ICREA Dr. Valerio Pruneri and Dr. Sebastian Etcheverry Cabrera.

RESUMEN
Being able to secure confidential information is imperative in today's society, but advancements in quantum technologies pose a potential threat. In response, researchers are developing technologies based on quantum mechanics, such as quantum key distribution (QKD), in particular continuous-variable QKD (CV-QKD), which is emerging as a promising solution due to its compatibility with classical network infrastructures. However, current systems remain bulky and costly, limiting their widespread adoption. To address this challenge, the miniaturization and integration of QKD systems into monolithic photonic integrated circuits (PICs) have the potential to accelerate adoption across a broader market. This is due to the anticipated reductions in size, power consumption, production costs and overall system complexity.
This work presents four pulsed Gaussian-modulated coherent state (GMCS) CV-QKD systems based on discrete components and, in the last case, a PIC. The thesis begins with a modular system utilizing discrete components, such as phase and amplitude modulators. Notably, this prototype eliminates the need for phase locking, as the same laser serves as both a local oscillator and the source for generating quantum signals. The system mitigates Rayleigh backscattering by employing two channels, one for transmitting light and the other for transmitting coherent states. Demonstrations indicate its operability over metropolitan distances.

In the second approach, the system showcases the parallelization of CV-QKD signals and the coexistence of multiple quantum signals with a classical signal, spatially multiplexed through a multicore fiber (MCF). In this scenario, two lasers are employed, with one emitting the frequency locking signal propagating along one of the MCF's core.
The third proposal introduces a simplified CV-QKD transmitter (TX) that eliminates the need for a phase modulator in the GMCS generation. This system leverages the random properties of a distributed feedback (DFB) laser operating in the gain-switching (GS) mode. The study demonstrates the applicability of our proposed compact TX for GMCS generation in CV-QKD and its feasibility for integration into a metropolitan network.
Finally, we describe and characterize an InP-based PIC TX tailored for CV-QKD applications. System-level proof-of-principle experiments are conducted using a shared laser approach with a pulsed GMCS CV-QKD protocol over an 11 km optical fiber channel. The results indicate potential secret key rates of 52 kbps in the asymptotic regime and 27 kbps in the finite size regime, highlighting the capabilities of the proposed PIC design and, more broadly, the properties of InP technologies for monolithic integration of CV-QKD systems. All the proof-of-principle experiments outlined in this dissertation contribute significantly to the field of miniaturizing CV-QKD systems.

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