PhD position on Advanced Integrated Quantum Photonics, LPMC, Université Nice Sophia Antipolis

by Sebastien_Tanzilli - published on 10 September, updated on 11 September 2015 at 12:09

Position at the Laboratoire de Physique de la Matière Condensée (LPMC), CNRS UMR 7336, Université Nice Sophia Antipolis, France

Team "Quantum Information with Light & Matter" (QILM)

Contact for Application: send CV, Motivation Letter, and possibly 2 Reference Letters to Sébastien Tanzilli

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Project framework

The team QILM at LPMC is looking for a PhD applicant on **advanced Integrated Quantum Photonics**, based on both **Lithium Niobate and Silicon platforms**. The main goal of the project lies in the **generation and manipulation of multi-photon states exploiting scalable and reconfigurable optical chips**.

- Duration : 36 months
- Starting : before the 1st of November 2015
- Grant from : ANR project Integrated Quantum Circuits based on Waveguides Arays (INQCA)
- Contract : with the CNRS
- Salary : approx. 1500 € net / month

Scientific framework

Of the physical approaches to both technological and fundamental explorations of Quantum Information Science (QIS), photonics is destined to play a major role. Among all possible qubit carriers, photons represent a natural choice for both quantum communication and metrology, but also a promising, although almost unexplored, alternative for quantum simulation and computing tasks. Single photons are model quantum systems, as they suffer negligible noise, interact weakly with their environment, can propagate over long distances in optical fiber, and are relatively easy to manipulate using integrated waveguide architectures. They also offer a variety of possible observables for qubit coding strategies, such as polarization, time and frequency bins, as well as path, which can be all manipulated using waveguide devices. Consequently, photons are at the heart of the first commercial quantum technology, i.e., quantum cryptography, with the perspective of implementing actual quantum networks showing unprecedented levels of secrecy.

Another prospect, in terms of next quantum technology to be developed, probably lies in photonic quantum simulators, which promise exponentially faster operation compared to their classical counterparts.

To be effective, all those quantum applications require advanced photonic quantum circuits exhibiting increased complexity in terms of number of computational channels, input states and flexibility for the manip- ulation of the related quantum properties. Practical solutions have emerged through the new field of integrated quantum photonics. This field, that drives strong international efforts, addresses the challenges of both scaling and stability in most quantum optical applications. Different waveguide platforms are currently investigated worldwide, including lithium niobate, III/V semiconductors, silica-on-silicon, laser-written glasses, and silicon, where the common pathway lies in the merging of building-block functionalities.

Among all these physical approaches, lithium niobate and silicon integrated photonics stands as a promising avenue for developing cost-effective quantum circuits, with the potential for on-chip signal processing thanks to the possibility of integrating electronics and photonics in a full monolithic fashion.

The goal of the project is to demonstrate the potential of integrated quantum photonics by exploiting a high level of integration density as well as arrays of coupled waveguides, to be implemented on lithium niobate or on silicon, or by using hybrid approaches. The objectives are to:

- strengthen research in this new and extremely fast developing strategic research field;
- bring together the key complementary areas of fundamental quantum optics and integrated photonics;
- work in close collaboration with the QILM partners, that are the Laboratoire de Photonique et de Nanostructures (LPN) and the Institut d’Electronique Fondamentale (IEF), both located in Paris area.

Working with photonic qubits involves hands on manipulation of lasers, optical system, single-photon detection, guided-wave optics, as well as high-end electronics. Thus, the work is experimentally very multifaceted. Besides the experimental work, a solid theoretical understanding will be necessary, and the candidate will also be expected to be able to work within a team