UNIVERSITÉ CÔTE D'AZUR

Master thesis proposal

INPHYNI
INSTITUT DE PHYSIQUE DE NICE

Institut de Physique de Nice
Director: Guillaume Huyet

Title: Silicon Photonics for High-dimension Frequency entanglement Applications

Keywords: Multimode entanglement, Intensity Correlations, quantum optics and information

Scientific description:

The use of high-dimensional entangled states has recently attracted much attention as they enable the possibility of encoding large amounts of information on correlated photons with a major interest in applied as well as in fundamental quantum optics. On the other hand, quantum integrated photonics allows the development of practical, flexible, compact, and scalable solutions, holding the promise of technological breakthroughs in quantum information technology. The proposed experimental internship investigates both in theory and in experiments high-dimension frequency entanglement generated by non-linear interaction in silicon nitride-based (Si/SiN) microresonators: this platform can allow developing a complete set of flexible integrated functions, ranging from entanglement sources to adjustable configuration circuits, and optical detectors. The work will focus on light correlation in the continuous variable regime of quantum optics. The work main objectives are a) the theoretical analysis of multipartite entanglement criteria that can be used to prove multimode correlation outside the microresonator and b) the experimental implementation and verification of obtained criteria on an ongoing experiment for the generation of bright frequency-entangled states. The candidate will work on this experimental part with a PhD student in his third year of thesis. We look for candidates with some competences on continuous variable quantum optics. The theoretical part of project will be conducted in collaboration with the university of Lille and the university of Virginia, USA; the candidate will thus be asked to collaborate with the theoretical partners to contribute to the development of original theoretical tools for entanglement witness. Competences on non-linear optics, electronics and active control systems are welcome but not mandatory. From the practical point of view, the project will allow the candidate develop competences in both theoretical and experimental multimode quantum optics, thus offering the possibility of achieving a unique and extremely vast panel of skills. The candidate will also develop skills in guided optics, telecom and fibre components, data acquisition and processing.

Techniques/methods in use: theoretical quantum optics, integrated photonics
Applicant skills: Quantum physics and optics, experimental optics
Industrial partnership: N
Internship supervisor(s) (name, email, phone, …): Virginia D'Auria, virginia.dauria@univ-cotedazur.fr ; 0489 15 28 58

Internship location: Institut de Physique de Nice, Nice
Possibility for a Doctoral thesis: N (possibility to candidate to a MESRI scholarship)