Title : Time-frequency quantum information processing		
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Research Area: Quantum Optics, theoretical quantum information		
Methods: Design of quantum optical protocols, Theoretical quantum optics		
PhD track subject: The frequency degree of freedom of single photons provides a large dimensional and robust quantum encoding. The frequency is a continuous degree of freedom which can be used for defining a continuous encoding [1], but it can be also discretized so that to define frequency qudits or qubits [2,3]. The implementation of logical operations using the spectral degree of freedom is experimentally challenging. To tackle this goal, the Ph.D. track fellow will investigate theoretical methods for implementing frequency logical operations by probabilistic and deterministic schemes. The first step will be dedicated to the study of probabilistic methods, that can be implemented with only linear optics. While deterministic operations require non-linearity, and we will investigate the use of light-matter interactions to achieve such frequency logical operations.		
References : [1] N. Fabre, A. Keller, and P. Milman, Time and Frequency as Quantum Continuous Variables, Phys. Rev. A **105**, 052429 (2022). [2] N. Fabre et al., *Generation of a Time-Frequency Grid State with Integrated Biphoton Frequency Combs*, Phys. Rev. A **102**, 012607 (2020). [3] S. Francesconi, F. Baboux, A. Raymond, N. Fabre, G. Boucher, A. Lemaître, P. Milman, M. I. Amanti, and S. Ducci, *Engineering Two-Photon Wavefunction and Exchange Statistics in a Semiconductor Chip*, Optica **7**, 316 (2020).		