ICFO

SEMINAR: Photonic Integrated Circuits and Quantum-Dot Spin-Photon Interfaces for Quantum Computing Hardware

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12:00 to 13:00

Seminar Room

Photonic quantum technologies rely on two complementary capabilities. The first is manipulating single photons with high fidelity in scalable integrated circuits. The second is making those photons interact with one another, which requires a material qubit to mediate. In this seminar I will present my work on both sides of this problem.

In the first part, I will describe the photonic quantum hardware platform of the company Quandela and my work in the photonic integrated circuits team. There I modelled and designed a broadband integrated beam splitter, one of the elementary building blocks of a photonic quantum processor. I will discuss the processing architecture and the design constraints that matter most for quantum applications: a stable splitting ratio over a wide wavelength range, low loss, and robustness to fabrication tolerances.

In the second part, I will turn to my work at C2N on semiconductor quantum dot-micropillar cavity devices, which serve as bright single photon sources for photonic processors. Here, however, I will look at them from a different perspective: as an efficient interface between the spin of a single confined charge and the polarization of a single photon. Because of optical selection rules, a photon reflected from the device undergoes a large, spin-dependent rotation of its polarization. This enables spin-photon entanglement and, ultimately, spin-mediated gates acting on incoming photons, providing the photon-photon interaction that linear optics alone cannot offer.

Together, these two projects illustrate how integrated photonic circuits and spin-photon interfaces can be combined in future photonic quantum computers and quantum networks.

Hosted by: Prof. Dr. Valerio Pruneri