Plenary Talk PLV IX Thu 9:30 ZHG011

Enabling optical quantum technologies with semiconductor quantum dots. — •Pascale Senellart — Université Paris-Saclay, Centre de Nanosciences et de Nanotechnologies, CNRS, 10 Boulevard Thomas Gobert, 91120, Palaiseau, France

Semiconductor quantum dots have emerged as excellent sources of single and entangled photons, opening new paths for light-based quantum technologies. We develop quantum light sources and spin-photon interfaces using InGaAs quantum dots embedded in microcavities. These devices generate highly indistinguishable single photons at high rates, and are now fiber pigtailed for plug-and-play operation. These sources are incorporated into early quantum computing prototypes together with integrated photonic chips and detectors. A software stack allows full control of the system and enables users to run small-scale quantum protocols.

To scale up the number of qubits and implement error correction, we are adopting measurement-based quantum computing protocols based on photonic graph states. By exploiting the spin degree of freedom of a charge trapped in a quantum dot, we can now generate various spin multi-photon entangled states. These results paves the way for hybrid quantum computing that leverage both spin and photonic qubits. As a first example, we analysed the resource requirements for implementing a logical qubit and showed that our hybrid approach can reduce the number of components needed by six orders of magnitude compared to a fully photonic implementation.