Light-Matter Interactions in Semiconductors: From Condensates of Exciton-Polaritons to Scalable Platforms for Quantum Information Processing

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Light-matter interactions lie at the heart of a very broad range of fundamental physics and applications. At a single particle level, such interactions enable all-optical quantum control of qubits which is of great interest for quantum information. At a more macroscopic level, these interactions are a key to collective phenomena such as condensation of exciton-polaritons in microcavities. In this talk I will present my previous and current research which is unified under the broad field of light-matter interactions in semiconductors. In particular, I will briefly introduce polariton condensates along with the typical experimental methods used for their study and will cover a few exciting experiments ranging from the observation of pinned singly-charged vortices to the demonstration of a polaritonic Josephson junction. Moving from such collective quasi-particle phenomena to the investigation of more discreet quantum emitter systems, I will then address experimental efforts on the coherent control of scalable quantum emitter platforms. More specifically, I will present recent work on site-controlled quantum dots and silicon vacancies in diamond, and will conclude with an overview of my vision for future research.

Konstantinos Lagoudakis is currently a Research Associate in the group of Nanoscale and Quantum Photonics of Prof. Jelena Vuckovic at Stanford University. His areas of expertise span from polariton condensates in microcavities to quantum control of solid state qubits.