Exciton-photon coupling in confined photonic structures: from strongly correlated photons to novel quantum devices

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I will review recent experimental effort to achieve strong polariton-polariton interaction in confined photonic nanostructures, with the aim of showing the ultimate limit of correlations at the level of single polariton excitations, or polariton quantum blockade [1]. The focus of the talk will be on strong exciton-photon coupling in photonic crystal platforms [2], such as waveguides and cavities in two-dimensional photonic crystal circuits, where unprecedented figures of merit in terms of high quality factors and diffraction limited mode volumes can be achieved [3]. Evidence for polariton lasing in photonic crystal cavities has been shown [4], and I will report on preliminary results towards single polariton blockade in such systems.

These results are particularly promising in view of recently proposed strongly interacting photonic systems in coupled cavity arrays, which will have impact both from fundamental and application-oriented developments. On the former side, the realization of strong polariton correlations holds promise for the understanding of quantum phase transitions in open systems [5], on the latter novel quantum polaritonic devices might be envisioned, such as single-polariton switches [6] or diodes [7]. I will describe such theoretical proposals within a common framework employing quantum open systems approaches.

References

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