Photon correlations in 0D polariton structures

T. Fink[1]*, C. Schneider[2], S. Höfling[2], A. İmamoğlu[1]
[1]Institute for Quantum Electronics, ETH Zürich, CH-8093 Zürich, Switzerland,
finkt@phys.ethz.ch
[2]Technische Physik, Universität Würzburg, D-97074 Würzburg, Germany
* Corresponding Author

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Abstract

Exciton-polaritons not only exhibit fascinating physical properties such as nonlinearities, superfluidity, and Bose-Einstein condensation at elevated temperatures, but also offer ease of tailoring their potential landscape, which makes them promising candidates for quantum simulation applications. However, all experiments to date can be described using a mean-field approach. Consequently, it has been a long-standing goal to demonstrate single-particle nonlinearities in these systems through the observation of polariton blockade [1].
To do so, one requires long polariton lifetimes τ (i.e. spectrally narrow quantum well excitons and a high-Q cavity), and strong lateral confinement of the photonic mode to achieve a sizable exciton-exciton interaction E_{nl}. For $1/\tau \sim E_{nl}$, one expects to see a reduced probability to find two photons at a time in the cavity, which is heralded by light leaking out of the cavity exhibiting photon antibunching.
Introducing high-quality quantum well samples and the latest generation of home-made fibers into a semi-integrated fiber cavity approach [2], we achieve record-high transverse confinement together with long polariton lifetimes. We employ a high time resolution photon correlation set-up to measure the photon statistics in these structures.

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