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Title: Non-Classical and Stimulated Light Emission from Semiconductor Quantum Dots

Abstract: In the recent years, remarkable progress in semiconductor growth and processing techniques has enabled the fabrication of tailored optical micro-resonator structures, thus providing high application potential in photonic devices, as in low-threshold lasers. In such micro-resonators, the number of optical modes is strongly reduced which leads to an increase of the spontaneous emission (SE) coupling factor, ?. The theoretical limit of ? = 1, corresponds to the so-called "thresholdless" lasing. With increasing ?, the well-known step-like threshold behavior for conventional lasers (? 10-5) becomes smoother which makes the identification of the lasing onset complicated. Therefore, detailed investigations of the photon statistics (and also coherence length) of the emission are needed to identify the lasing onset for high-? lasers.

In this talk, selected results of optical investigations of the spontaneous and stimulated emission characteristics of self-assembled semiconductor quantum dots (III-V compound system) will be presented. In the first part, photon statistics of different light sources and the second-order correlation function (g(2)( )) will be discussed. Experimental investigations on single-photon generation from individual quantum dots will also be covered. In the second part of the talk, I will review recent results of comprehensive optical studies, focusing on the emission characteristics, photon statistics and coherence properties of QD based high-Q / high- β semiconductor micropillar lasers at cryogenics temperatures. A smooth transition from spontaneous decay with strong photon bunching and short field coherence to stimulated emission with a Poissonian statistics and significantly increased coherence time is observed. The measurements are compared to results of a microscopic theory for the coupled light-matter dynamics that describes the lasing properties of quantum dot micropillars.