Enabling Narrow-Linewidth Exciton-Polariton Lasers

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Exciton-polariton laser is a novel type of laser where coherence is inherited from a Bose-Einstein condensate, a thermodynamically favoured coherent many-body state. The condensation or the lasing process does not require population inversion. It hence occurs at a lower carrier density than conventional semiconductor lasers, making it promising for ultra-low power applications. Furthermore, polariton lasers are Kerr-type lasers where the nonlinearity arises from the interaction between polaritons, which are hybrid light-matter quasiparticles. In this presentation, I will present how a single-mode polariton laser can be achieved and how interactions strongly modify its spectral properties, enabling us to precisely measure the interaction strength and the excitation spectrum. I will also present a recent high-resolution spectroscopic investigation of the frequency drift and linewidths of polariton lasers, which reveals a record linewidth of 56 MHz or a coherence time in the excess of 5 ns, only limited by the resolution of our setup. This opens the possibility for multiple successive coherent manipulations of polariton condensates, which is essential for applications in classical and quantum computing.