Ultrafast Dynamics an Exciton-Polariton Gas in Organic Fabry-Perot Optical Microcavities

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We apply ultrafast optical probes to explore the nature of exciton-polaritons in organic-semiconductor-based optical microcavities. Cavity polaritons are bosonic quasi-particles arising when a photon confined in a cavity interacts strongly with an exciton. In practice, this is obtained by incorporating a thin film of a semiconductor in a Fabry-Pérot microcavity, with an excitonic transition degenerate with the optical resonance. The study of the dynamics of cavity polaritons in organic semiconductors is still at its infancy. These materials have advantageous properties of inorganic quantum structures, such as an energy gap ranging from the visible to the near infrared, high oscillator strengths, and high exciton binding energies (~0.5 eV) characteristic of Frenkel excitons in these materials. Such properties make organic-semiconductors-based optical microcavities extremely promising for groundbreaking applications such as organic polariton lasers, filters, switches, and light-emitting diodes

In this talk we present ultrafast probes of an exciton-polariton gas in Fabry-Perot microcavities of BODIPY derivatives at 4 K. We do so by imaging the Fourier plane of an objective lens that collects photons that leak out of the microcavity as a probe of the polariton gas. This allows us to identify the energy dispersion of the polariton gas. Moreover, with the aim of clarifying the coherence properties of the polaritons system, we show the results of an experiment of optical coherent control of the polariton state, based on the resonant excitation of the lower polariton branch with a sequence of two femtosecond phase-locked pulses.