Coherent phenomena of polymers and perovskites in the strong light-matter interaction regime

A system enters the strong light-matter interaction regime when the coupling between optical emitters and a photon mode exceeds the respective losses. In a suitable ensemble of emitters, for which only few solid-state materials qualify, this can furthermore lead to collective effects where spontaneously created coherence extends over distances of many micrometers.

In this talk, I will present our work on creating room-temperature polariton condensates by placing a conjugated polymer in an optical microcavity. We exploit the nonlinearity to realize ultrafast all-optical transistors and logic gates. Furthermore, nanostructuring one of the cavity mirrors allow us to effectively create lattices and arbitrary potential landscapes, with the long-term perspective of an analogue quantum simulator.

For emitters with high oscillator strength and very low inhomogeneous broadening and dephasing, coherent collective emission can even occur without a cavity. When assembling colloidal lead halide perovskite nanocrystals into cuboidal "supercrystals" their uniquely strong coupling via the vacuum modes allows the ensemble to spontaneously synchronize and emit a superfluorescent burst of light.

Thilo Stöferle

Short Curriculum Vitae

Since 2007	Permanent position as Research Staff Member at IBM Research in Rüschlikon, Quantum Technology group
2006 – 2007	Postdoc at IBM Research in Rüschlikon, Exploratory Photonics group
2005 – 2006	Postdoc at ETH Zürich, Quantum Optics group of Prof. Tilman Esslinger
2001 – 2005	Graduate studies at ETH Zürich, Quantum Optics group of Prof. Tilman Esslinger PhD thesis: *„Exploring Atomic Quantum Gases in Optical Lattices"* Awards: Dimitris N. Chorafas Prize and Medal of ETH Zurich
1995 – 2001	Undergraduate study of physics at Ruprecht-Karls-Universität Heidelberg Diploma thesis: *„Studies of the Adsorbate Systems Xe/Au(111) and Alkanethiols/Au(111) Using the 3He Spin-Echo Spectrometer"* Supervisor: PD Maarten Dekieviet