Contribution ID: **30** Type: **Talk**

Enhanced Cavity Optomechanics with Quantum-Well Exciton Polaritons

Tuesday 2 May 2023 15:00 (30 minutes)

A key figure of merit in optomechanics is the single-photon quantum cooperativity (Cq). Recent works achieved a large cooperativity by engineering resonators with ultra-low mechanical and optical losses [1]. A complementary approach is to enhance optomechanical interactions while working with modest optical and mechanical quality factors. Less stringent bandwidth limitations in optomechanical conversion are thereby imposed [2], while suppressing optical heating and added noise [1].
In this context, GaAs- based resonators engineered to simultaneously confine photons, phonons and QW excitons offer an intriguing opportunity [3]: in the strong exciton-photon coupling regime the system hosts hybrid quasi-particles, or polaritons. These modes are both spectrally separated from the exciton-induced absorption peak, enabling large optical quality factors, while their excitonic component is extremely sensitive to strain fields owing to the large GaAs deformation potential, thus prospecting strong optomechanical interactions. We analytically model the tripartite interaction of light, QW excitons, and sound in three semiconductor microresonators architectures: when considering parameters complying with current GaAs technologies, we show that a near-unity Cq can be obtained for a single polariton excitation. Furthermore, we investigate how polariton nonlinearities modify dynamical back-action via squeezing [4].

[1] H. Ren, M. H. Matheny et al. - Nat. Comm. 11, 3373 (2020)
[2] Y.D. Wang and A.A. Clerk, PRL 108, 153603 (2012)
[3] G. Rozas, A.E. Bruchhausen et al. - PRB 90, 201302 (2014)
[4] N. Carlon Zambon, Z. Denis et al. PRL - 129, 093603 (2022)

Abstract category

Photonics

Primary authors: Dr CARLON ZAMBON, Nicola (ETH Zürich); Dr DENIS, Zakari (EPFL Lausanne); Dr DE OLIVEIRA, Romain (Université Paris Cité, CNRS, Paris); Dr RAVETS, Sylvain (Centre de Nanosciences et de Nanotechnologies (C2N), CNRS-Université Paris-Saclay, Palaiseau.); Prof. CIUTI, Cristiano (Université Paris Cité, CNRS, Paris); Prof. FAVERO, Ivan (Université Paris Cité, CNRS, Paris); Prof. BLOCH, Jacqueline (Centre de Nanosciences et de Nanotechnologies (C2N), CNRS-Université Paris-Saclay, Palaiseau)

Presenter: Dr CARLON ZAMBON, Nicola (ETH Zürich)