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Theory for dissipative exciton-polariton condensates

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Exciton polaritons are hybrid bosonic quasiparticles arising at strong light-matter coupling in semiconductor microcavities under optical or electric excitation [1]. They demonstrate effective Bose-Einstein condensation and reveal general coherence features. The excitonic component gives these particles the possibility to interact, the photonic component allows to increase their mean free path in mesostructures and thus enhance the disorder-resistance. Due to their small effective mass (<<m0), polaritons can reveal quantum phenomena at relatively high temperatures [2]. However, all this phenomena occur under strong influence of the environment making polaritons an open quantum system, interacting, for instance, with a bath of acoustic phonons.

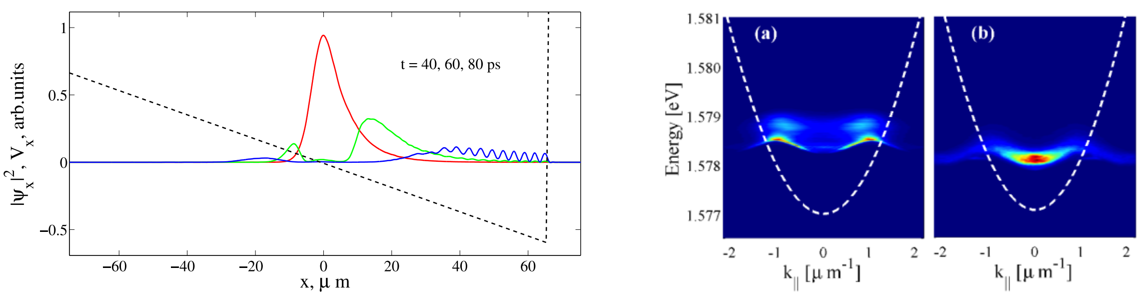

Figure 1. (left panel) Propagation of EPs along the potential slope in the quantum wire due to phonon-assisted relaxation [3]. The curves correspond to the particle concentration profile in x space for different times: 40 (red or dotted line), 60 (green or dashed line), and 80 ps (blue or solid line). The particles are introduced by a coherent Gaussian pump of the duration of 20 ps of the theoretical experiment. Particles propagate along the wire (green and blue curves), suffering losses caused by their finite lifetime and reflecting from the end of the wire. The interference of the incoming and reflected waves produces fringes clearly visible at 80 ps. (right panel) Numerical spectra of EP condensate in the high-power limit [5]: dependence of particle occupation at different energies as a function of in-plane momentum, $k_{\parallel}$ at the pump rates (a) P_0 = 30 and (b) P_0 = 40 $\mu m^{-2} ps^{-1}$.

We have developed theoretical approaches which describe transport of polaritons in direct space and their occupation of energy states in reciprocal space, in particular, the advanced Gross-Pitaevskii approach [3] and the quantum jump approach [4], accounting for the interaction of polaritons with external reservoirs such as the thermal bath of acoustic phonons and the pumping reservoirs. We will also address polariton loading in periodic potentials [5].

[1] C. Schneider, A.Rahimi-Iman, J.Fisher, I.G.Savenko, et al., Nature 497, 348 (2013)
[2] J. D. Plumhof, T. Stoferle, L. Mai, et al., Nature Mat. 13, 247-252 (2013)
[3] I. G. Savenko, T.C.H. Liew, and I.A. Shelykh, Phys. Rev. Lett. 110, 127402 (2013)
[4] H.Flayac, I.G.Savenko, M.Mottonen, T.Ala-Nissila, Phys. Rev. B 116, 115117 (2015)
[5] K. Winkler, O. A. Egorov, I.G.Savenko, et al, Phys. Rev. B 93, 121303(R) (2016)

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