Relaxation Dynamics of Confined Microcavity Polaritons

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Microcavity polaritons are the result of the strong coupling between excitons and electromagnetic modes in semiconductor microcavities. Under a certain density, these quasi-particles behave as bosons and are very good candidates for investigating quantum phenomena in solid-state systems. This lead to the observation of effects such as Bose-Einstein condensation (BEC) and polariton lasers [1] [2].

In micropillars, it appeared that one can reach spontaneous quantum degeneracy of microcavity polaritons at lower excitation densities than in planar microcavities. This suggests that trapping significantly enhances the relaxation process.

We investigate the effects of lateral confinement on the relaxation of microcavity polaritons using photoluminescence excitation and resonant time resolved photoluminescence. In the investigated sample, polaritons are trapped in mesas consisting in local cylindrical variations of the cavity length[3].

The photoluminescence of confined polaritons under resonant excitation is distributed over the lower energy states. This points out significant relaxation processes of confined polaritons. We attribute this relaxation to thermalization via phonons and observe a strong dependance on the mesa diameter. The very good agreement of theoretical predictions with experiment brings us to a global representation of polariton relaxation in presence of a trap.

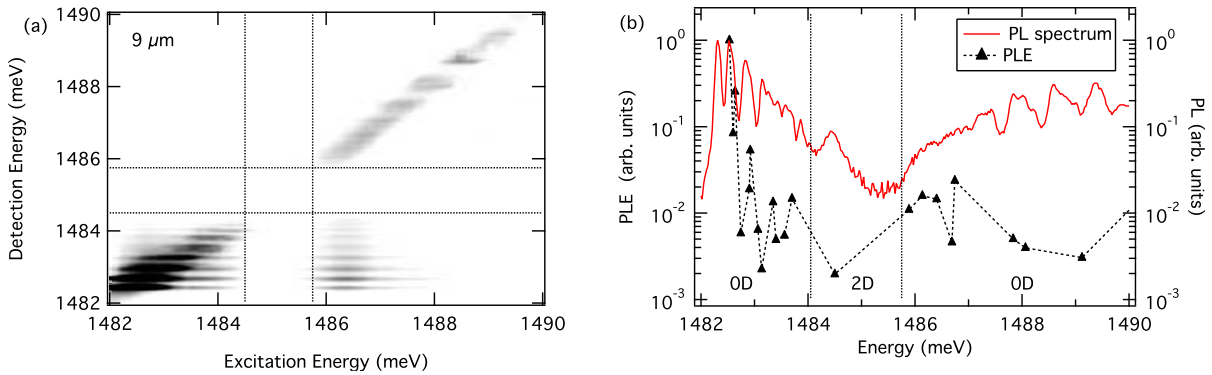

FIG. 1: PLE experiments on a 9 μm diameter mesa. (a) : image plot, (b) : spectrum and comparison with photoluminescence spectrum. The dotted lines separate planar from confined polariton energy ranges. The relaxation down to the lowest energy states and their relative intensities suggest an efficient thermalization process.

[1] Kasprzak et al.. Nature 443 (2006)
[2] Bajoni et al., Phys. Rev. Lett. 100 (2008)
[3] El Daïf et al., Appl. Phys. Lett. 88 (2006)