First and second order coherence of a polariton condensate

T. D. Doan[1], **Huy Thien Cao**[1], **D. B. Tran Thoai**[1], **H. Haug**[2]
[1]Ho Chi Minh City Inst. of Physics, Vietnam
[2] Inst. f. Theoretische Physik, J.W. Goethe-Universität Frankfurt, Germany

We investigate with a Boltzmann-Master equation approach the coherence properties of microcavity (mc) polaritons and compare the results with corresponding experiments in GaAs mc's. The spatial first-order coherence function is determined by the polariton population of the ground state and the excited states which are known from the solution of the Boltzmann equation. Fig. 1 shows how the spatial correlation increases with increasing pump powers. The results are in very good agreement with the double-slit experiment by Deng et al. [1] for GaAs mc's with a cavity life time of 2ps. The results do not leave much room for depletion effects in these mc's which have been predicted for CdTe mc's with stronger interactions[2].

The second-order correlation function $g^{(2)}$ of the polariton condensate is calculated by a Master equation for the probabilty to find n particles in the ground state. The rates between the excited states and the ground state known from the solution of the Boltzmann equation are corrected by a gain saturation [3]. The resulting $g^{(2)}(P/P_{th})$ show a smooth transition from the thermal limit ($g^{(2)} = 2$) below threshold to the coherent limit ($g^{(2)} = 1$) not to far above treshold. In order to explain the observed large correlations above the coherent limit which persist for a wide range of pump powers [4, 5, 6], we study the non-resonant two-polariton scattering processes introduced by [7] and also a kinetic depletion model. A fully satisfactory understanding is however up to now not reached.

References

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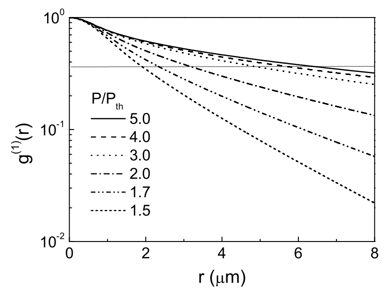

Figure 1: Calculated first-order coherence function $g^{(1)}(r)$ versus distances r for various normalized pump powers P/P_{th}