Quantum Kinetics of the BEC of Microcavity Polaritons

Quantum well excitons and photons of the lowest mode of a microvcavity form polaritons which are in the low density range to a good degree 2D bosons. After a nonresonant excitation of the polaritons, the polaritons relax by polariton-polariton and polariton-phonon scattering in the lower polariton branch. Above a threshold the population of the ground state becomes much large than one. This phenomenon is interpreted as a finite-size, non-equilibrium BEC. Experimental evidence and corresponding studies of the Boltzmann kinetics are presented.In the second part we formulate a quantum kinetics of the condensation in terms of non-equilibrium Keldysh Green functions using the gap-free Popov approximation. In the framework of quantum kinetics, the equation of motion for the condensate amplitude, for the distribution of the excitations, and the normal and anomalous spectral functions are derived. The relation of the time-dependent description and of the equilibrium theory is discussed. Finally, the scattering self-energies for the excited states and the scattering integrals for the condensate amplitude are derived. As a simplification the two-time dependent particle propagators are expressed in terms of a product of a spectral function and of the one-time density matrix.