High temperature BEC with photon-like atomic polaritons in the biconical waveguides

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We study the problem of high-temperature Bose-Einstein condensation (BEC) of atom-light polaritons in a waveguide cavity appearing due to the interaction of two-level atoms with (nonresonant) quantized opticalradiation in the strong-coupling regime and in the presence of optical collisions with buffer gas particles. Specifically, we propose a special biconical waveguide cavity, permitting localization and trapping of low-branch (LB) polaritons imposed by the variation of the waveguide radius in longitudinal direction. We have shown that the critical temperature of BEC occurring in the system can be high enough- a few hundred kelvins; it is connected with the photon-like character of LB polaritons and strongly depends on waveguide cavity parameters. In the case of a linear trapping potentialwe obtain an Airy-shaped
polariton condensate wave function.

Single and dual core vortices in polariton systems

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The formation and the dynamics of polariton vortices in semiconductor microcavities are considered. It is shown that, depending on the parameters, the vortices can have either single or dual cores. Possible experimental realisations of the vortices are also discussed.

Generation of Bessel plasmons in a metal-dielectric structures

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Theory is developed of generation of Bessel plasmons (BPs) and their superposition in metal-dielectric structure. The possibility is shown of excitation of two types of BPs characterized by various profiles of longitudinal component of electric vector inside the metal film. The dependence is investigated of conditions of Bessel plasmons excitation on optical properties of structure components. The intensity distribution for Bessel Plasmon field is calculated. Bessel plasmon multi-tip on the base of a superposition of BPs is proposed for probing the surface simultaneously through several channels with nanoscale resolution. Experimental set-up is elaborated for its realization.