Stimulated Thermalization and Long-Range Spatial Coherence of Bose-Einstein Condensates in Plasmonic Lattices

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We study Bose-Einstein condensation of surface plasmon polaritons in strongly coupled lattice modes of a nanoparticle array covered with fluorescent molecules at room temperature. The plasmonic condensate is a manifestation of macroscopic quantum coherence in unprecedented, sub-picosecond, timescales. We study the dynamics in an experiment that utilizes the open cavity character of the system. Spatially resolved spectra and momentum space measurements reveal three distinct regimes as a function of excitation pump fluence: lasing, (incomplete) thermalization, and Bose–Einstein condensation [1]. By varying the lattice size, we show that the thermalization occurs through a stimulated process. Experiments with Michelson interferometer in a retroreflector configuration show that the condensation is accompanied by extended spatial coherence in two dimensions. Above the condensation threshold, the first-order spatial correlation function is nearly constant over array sizes up to half a millimeter [2]. We find that both spatial and temporal coherence display non-exponential decay; the results suggest power-law or stretched exponential behaviour with different exponents for spatial and temporal correlation decays.

References

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