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### **Strong light-matter coupling in a cavity and free space: parametric interactions in atomic ensembles**

We consider theoretically and experimentally parametric interactions of laser pulses in an optically dense ensemble of resonant atoms in the regime of strong light-matter coupling. The spectrum condensation (lasing at collective vacuum Rabi sidebands) was studied in an active cavity configuration. Parametric processes under the strong light-matter coupling were proved even in free space. In contrast to bichromatic beats of two polaritons in a cavity, they were shown to appear due to interference between polaritonic wave packets of different group velocities. Contrary to strong-field effects, density- and coordinate-dependent transmission spectra of a probe display collective sideband amplification or dumping, which cannot be obtained in a single-atom model.

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