Field-driven super/subradiant lasing without imposed atomic cooperativity

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The first model of stationary superradiance, the superradiant laser, was suggested by Haake et al. [1]. Since then, several theoretical papers discussing this scheme, as well as some other models, have been published [2]. The key mechanism responsible for stationary superradiance in such lasers is the collective nonlinear spontaneous decay of one of the atomic states that is imposed by an additional, "passive" resonator. As we have shown recently [3], the super/subradiant lasing can be obtained by replacing the passive resonator by a second coherent pumping laser field, so that no initial atomic cooperativity is required. In this talk the results of semiclassical treatment of a three-level ladder model of super/subradiant laser will be discussed in details.

Fig. 1. Intensity and populations as functions of the number of atoms N. Left: Rabi frequencies on pump lasers are essentially different. Right: Rabi frequencies are of the same order of magnitude.

Figure 2. System phase portrait in terms of n-\(\Phi\) (field phase). Left: superradiant regime, the number of atoms is less than some critical value \(N_c\). Right: subradiant regime, \(N > N_c\).