Asymmetrical behaviors of second-order photon correlation functions due to interference effects

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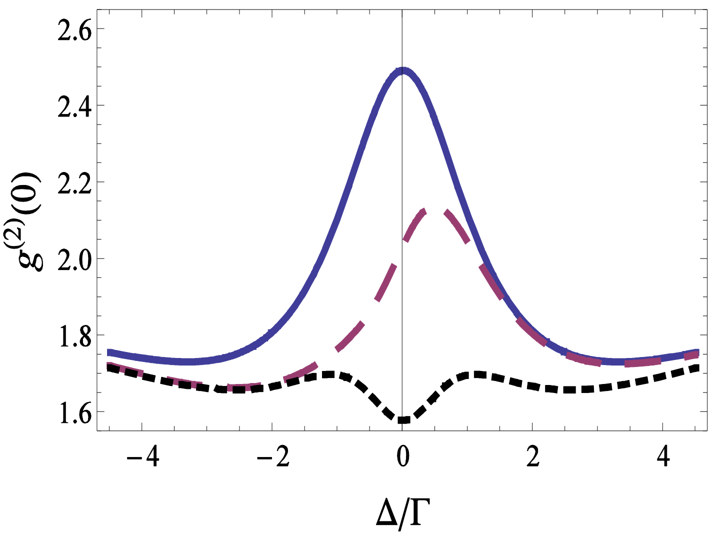
Cooperative interactions among multiple emitters occur when the inter-particle separations are of the order of the emission wavelength or smaller. Typical cooperative phenomena, like superradiance or subradiance, are taking place in a completely or partially excited multiparticle ensemble. These collective behaviors were observed in a wide range of systems including, respectively, real or artificial atoms, or molecules, highly charged ions, solid state media, etc..

Here, we discuss the dynamics of a laser-pumped two-level quantum dot ensemble inside a microcavity [1]. The developed approach applies to a real atomic sample as well. Respectively, both the microcavity mode and the qubit subsystem are pumped with two distinct coherent electromagnetic fields. The laser that resonantly pumps the qubit ensemble can be moderately intense meaning that the corresponding Rabi frequency is larger than the qubit-cavity coupling strength as well as the spontaneous and cavity decay rates. In these circumstances, we found enhanced photon-photon correlations. Furthermore, the photon statistics shows oscillatory steady-state behaviors. This is due to the interplay between the cavity and the spontaneous emission processes. Additionally, we found that the microcavity photon statistics depends on the phase difference of the applied coherent sources that can be a convenient mechanism to influence the second-order photon-photon correlations. An asymmetrical steady-state behavior of the second-order photon correlation function versus cavity-field detuning is observed as well due to the relative phase dependence (see the Figure where the steady-state behaviors of the second-order photon correlation function are depicted as function of the laser frequency with respect to the transition one, and for different phases [1]). Note that larger photon correlations are useful for a number of practical applications like new photon sources or in many-body phenomena with strongly interacting photons.



[1] V. Ciornea, P. Bardetski, M. A. Macovei, JETP **123**, 582 (2016).