Dottorato di Ricerca in Fisica dell'Università degli Studi di Messina

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V.le F. Stagno D'alcontres 31, S. Agata, Messina

Dr. Stefano Portolan

CNRS - Institut Néel, Grenoble, France

"Emission spectrum of a quantum dot embedded in an off-resonant cavity"

Abstract

The physics of a quantum dot (QD) coupled to the off-resonant mode of a high finesse cavity exhibits peculiar features [1] that have no counterpart in CQED (atoms in cavities). In particular, strong photoluminescence (PL) signal at the cavity-like peak is always visible, even for very large detunings (up to 10 meV) [1,2], phenomenon known as "cavity feeding". At small detuning, cavity feeding can be brought by the coupling of the QD to an external reservoir (e.g. phonons) that can produce a significant change in the homogeneous spectral signature of the dot [3, 4, 5].
On the contrary, the sole phonon-induced dephasing cannot describe the large detuning scenario and in particular the physical mechanisms feeding the cavity and then allowing to see a nice cavity peak in non-resonant PL spectra [1]. We propose that, the far off-resonant excitation of the cavity is solely due to the mesoscopic nature of quantum-dot confinement, which in turn leads to an energetically broad cascaded emission of the QD. In this setting, cavity feeding and its photocorrelation signatures can be regarded as an intrinsic feature of QD-cavity systems that arises from the complicated QD multiexciton level structure
In this context, I will discuss the large and small cavity-dot detuning cases, and which microscopic processes are involved in each case. I will present our theoretical model for the QD-cavity system at the basis of our picture [6], how we perform numerical calculations of its semiclassical dynamics, and I shall compare its predictions with some experimental findings [6,7]. While a quantitative comparison between numerical and experimental results is intrinsically difficult, the qualitative agreement we achieve is excellent. In particular, the unusual correlation features found experimentally are naturally reproduced by the model and the simulations.

[1] Hennessy, K. et al. Nature 445, 896 (2007)
[2] Kaniber, M. et al. Phys. Rev. B 77, 161303(R) (2008)
[3] A Auffèves et. al.,, Phys. Rev. A **79**, 053838, (2009)
[4] Tarel and Savona, Phys. Rev. B **81,** 075305, (2010)
[5] J. Suffczynski et al., Phys. Rev. Lett. **103**, 027401 (2009)
[6] M Winger et al., Phys. Rev. Lett. **103**, 207403 (2009)
[7] N. Chauvin et al., arXiv:0907.3392