Physics Colloquium

Thursday, 17 December 2020 | 17:00 – 18:00, Online with BBB

Phase transitions in the driven dissipative Jaynes-Cummings (JC) oscillator: monitoring an archetypal quantum nonlinearity in a "thermodynamic limit"

Dr. Themistoklis Mavrogordatos

Department of Physics, Stockholm University, Sweden

ABSTRACT

The breakdown of photon blockade in the driven dissipative Jaynes-Cummings (JC) model on resonance has revealed the significance of out-of-equilibrium quantum phase transitions in single-atom (cavity and circuit) QED, as predicted theoretically [1] and demonstrated experimentally [2]. In this talk, I will highlight the role of quantum fluctuations against the semiclassical response of the JC oscillator in three distinct regimes of operation defined by the ratio of the drive amplitude to the light-matter coupling strength [3]. I will focus on the persistence of photon blockade, which is an exemplary property of the inherently quantum and nonlinear JC interaction substantiating the strong-coupling single-atom ``thermodynamic limit''. In that limit, fluctuations are in continuous disagreement with the semiclassical predictions, as evidenced by the solution of the master equation and the corresponding single quantum trajectories unraveling the density operator. Such behavior is in contrast to the weak-coupling limit encountered in numerous macroscopic dissipative systems displaying coherence, with the laser being a characteristic representative, and reveals the distinct nature of quantum fluctuations as opposed to thermal noise.

References:

[1] H. J. Carmichael, Phys. Rev. X 5 (2015) 031028,
[2] J. M. Fink et al., Phys. Rev. X 7 (2017) 011012,
[3] Th. K. Mavrogordatos, Phys. Rev. A 100 (2019) 033810.