The School of Natural Sciences

Presents

Superradiance, Photon phase diffusion and number squeezed State

Seminar Series – Physics & Applied Mathematics

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ABSTRACT:

Recently, strong coupling regimes of BEC atoms inside an optical cavity and superconducting qubits inside a micro-wave circuit cavity were achieved experimentally. The strong coupling regimes in both systems were described by the Dicke model. Here we study the cavity transmission and Fluorescence spectra by solving the Dicke model by $ 1/ N $ expansion. In the normal state, we find a $ \sqrt{N} $ behavior of the collective Rabi splitting consistent with the experimental data. Inside the superradiant phase, we identify a high frequency mode and also an emergent quantum phase diffusion mode at a finite $ N $ and determine their corresponding spectral weights. We also work out many remarkable experimental consequences of this quantum phase mode such as its low frequency, high spectral weight, photon number squeezing properties and photon statistics. We argue that recent experimental advances should motivate a new emerging interdisciplinary field of quantum optics and quantum phases which can be dubbed as "Strongly correlated quantum optics ".

BIOGRAPHY:

Prof. Ye earned his PhD from Yale University working on theoretical condensed matter. He went on to conduct his post-doctoral work at Harvard University and Jones Hopkins University before joining Penn State University as an assistant professor. Prof. Ye has worked on wide areas of condensed matter physics such as Quantum Antiferromagnets, Quantm spin glass, Quantum phase transitions, Kondo problems, Colossal Magnetoresistance Manganites, High temperature superconductivity, Bilayer Quantum Hall effects, and Non-relativistic Quantum field theory. In the last 3 years, he has been focused on the emerging interdisciplinary field of quantum optics and strongly correlated quantum phases such as photoluminescence spectrum from the exciton superfluids in electron-hole bilayer system or exciton-polariton systems and .cold atoms or superconducting quantum bits inside a cavity.

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