Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Sorting Category: 17.1.2 (T)

Quantum hysteresis in coupled qubit-radiation systems[1] O.L. ACEVEDO, F.J. RODRIGUEZ, L. QUIROGA, Universidad de los Andes, N.F. JOHNSON, University of Miami — We study theoretically the dynamical response of a set of solid-state qubits arbitrarily coupled to a radiation field which is confined in a cavity. Driving the coupling strength in round trips, between weak and strong values, we quantify the hysteresis or irreversible quantum dynamics. The matter-radiation system is modeled as a finite-size Dicke model which has previously been used to describe equilibrium (including quantum phase transition) properties of systems such as quantum dots in a microcavity, and superconducting circuit QED. Here we extend this model to address *non-equilibrium* situations. Analyzing the system's quantum fidelity, we find that the near-adiabatic regime exhibits the richest phenomena, with a strong asymmetry in the internal collective dynamics depending on which phase is chosen as the starting point. We identify significant deviations from the conventional Landau-Zener-Stuckelberg formulae, in particular from cycles starting in the superradiant phase. In the diabatic or impulsive regime, the system remains quenched and there is little hysteresis. By contrast, depending on the specifications of the cycle, the radiation subsystem can exhibit the emergence of non-classicality, complexity and sub-Planckian structures as evidenced by its Wigner function.

[1]Facultad de Ciencias Research Funds, Universidad de los Andes.

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[X] Prefer Oral Session
[ ] Prefer Poster Session

Date submitted: 16 Dec 2011

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