Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Novel quantum behavior generated by traveling across a quantum phase transition[1] O.L. ACEVEDO, F.J. RODRIGUEZ, L. QUIROGA, Universidad de los Andes, N.F. JOHNSON, University of Miami — We report novel dynamical behavior in a multi-qubit–light system described by the Dicke model, which is being driven across its thermodynamic quantum-phase boundary. 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 the starting point. Depending on the quenching regime a highly non-trivial behavior emerges in both the qubit and radiation subsystems. For the former, we find that for some paths in parameter space the final fidelity of the near-adiabatic process does not depend on the direction of the trajectory, but depends only on the *speed* at which the path is traveled. This behavior is contrasted with Landau-Zener tunneling and the Kibble-Zurek mechanism. Furthermore, for some qubit subsystems, we identify purification and screening effects which could be used for quantum control. By contrast, the evolution of the Wigner function shows the radiation subsystem exhibits the emergence of complexity and non-classicality. These findings could be experimentally tested in several condensed matter scenarios – for example, diamond-NV centers and superconductor qubits in confined radiation environments.

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

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Date submitted: 29 Nov 2011 Electronic form version 1.4