Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Simulation of dissipative quantum dynamics in the presence of strongly-interacting and structured environments: a many-body approach to memory effects ALEX CHIN, Ulm University, JAVIER PRIOR, Universidad Politécnica de Cartagena, SUSANA F. HUELGA, MARTIN B. PLENIO, Ulm University — Quantum systems which interact strongly with complex and structured environments are receiving increasing attention due to their importance in contexts such as solid-state quantum information processing and bio-molecular quantum dynamics. Unfortunately, these systems are difficult to simulate as the system-bath interactions cannot be treated perturbatively, and standard approaches are invalid or inefficient. Here we combine time-dependent density matrix renormalization group methods with techniques from the theory of orthogonal polynomials to provide an efficient method for simulating open quantum systems at zero and finite temperatures. Using this technique we demonstrate a number of novel dynamical effects which result from long bath memories induced by either sharp spectral structures or strong coupling, and comment on how these can be exploited to drive efficient transport in small networks. We also show how our technique can be used to find the equilibrium properties of excitations in strongly renormalizing environments, and present some results on the quantum phase transition in the sub-Ohmic spin-boson model.

Alex Chin
Ulm University

Date submitted: 16 Nov 2010 Electronic form version 1.4