The Flow Equation Approach to Non-Equilibrium Quantum Many-Particle Systems

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The flow equation approach [1,2] is a new nonperturbative analytical approach to quantum many-particle systems based on a sequence of infinitesimal unitary transformations that diagonalizes the Hamiltonian. The full Hilbert space is retained in this procedure, which makes this method particularly suited for studying non-equilibrium problems. In this talk I will present two applications of the flow equation approach to generic non-equilibrium problems.

i. Real time evolution of the spin-boson model: We investigate the spin-boson model that is prepared in some non-equilibrium initial state. The flow equation approach allows us to study the dynamics of this model on all time scales including its zero temperature quantum equilibration.
ii. Kondo model with voltage bias: Strong-coupling Kondo screening processes are in competition with current-induced decoherence, and this competition determines the phase diagram. We will discuss various physical observables like the dynamical and static spin susceptibility to get insights into the nonequilibrium steady state and to compare it with finite temperature equilibrium states.

[1] F. Wegner, Ann. Phys. (Leipzig) 3, 77 (1994)
[2] S. Kehrein, The Flow Equation Approach to Many-Particle Systems (Springer Tracts in Modern Physics, to appear in 2006)
[3] S. Kehrein, Phys. Rev. Lett. 95, 056602 (2005)