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Coulomb gas scaling of the non-equilibrium spin-boson model[1]

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— The nonequilibrium "spin-boson model," a localized electronic level coupled to a fluctuating two-state system and to two electronic reservoirs, is solved via an Anderson-Yuval-Hamann mapping onto a plasma of alternating positive and negative charges time-ordered along the two "Keldysh" contours needed to describe nonequilibrium physics. The interaction between charges depend on whether their time separation is small or large compared to a dephasing scale defined in terms of the chemical potential difference between the electronic reservoirs, and a decoherence scale defined in terms of the current flowing from one reservoir to another. A nonequilibrium scaling transformation is introduced. An important feature is the presence in the model of a new coupling, essentially the decoherence rate, which acquires an additive renormalization similar to that of the energy in equilibrium problems. The resulting flow equations are used to study the competition between the dephasing-induced formation of independent resonances tied to the two chemical potentials, and the decoherence which cuts off the scaling and leads to effectively classical long-time behavior.

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