Unraveling Quantum Dissipation in Frequency Space

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A universal concept in the theory of open quantum systems is that a wave-function for describing the evolution of a quantum system interacting irreversibly with a reservoir can be derived by assuming the state of the reservoir is continuously monitored as the system evolves. Methods based on this idea have been used extensively in quantum optics and atomic physics for modeling processes such as the spontaneous decay of atoms and molecules and the output coupling of high quality optical and microwave cavities. Wave-function approaches such as these represent the simulation of an idealized experiment in which the information gained from the system is determined directly by the properties of the measurement apparatus used to monitor the output field. For example, direct detection of spontaneous emission by a photodetector leads to a quantum Monte Carlo simulation in which there are quantum jumps.

I will present a new method for unraveling the reservoir state by introducing a simulated measurement in which the measurement device has poor time resolution and instead may accumulate information about the energy of the decays. It is very general and applicable to the dynamics of all open quantum systems. Associated with the formalism is an efficient simulation method in which there are no quantum jumps of the system state and no stochastic fluctuations.