Probing the quantum-classical connection with open quantum dots

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Open quantum dots provide a natural system in which to study both classical and quantum features of transport. From the classical point of view these dots possess a mixed phase space which yields families of closed, regular orbits as well as an expansive sea of chaos. As a closed test bed, they provide a natural system with a very rich set of eigenstates. When coupled to the environment through a pair of quantum point contacts, each of which passes several modes, the original quantum environment evolves into a set of decoherent and coherent states, which eventually couple to the classical states discussed above. The manner of this connection is governed strongly by decoherence theory. The remaining coherent states possess all the properties of pointer states. These states are naturally studied via traditional magnetotransport at low temperatures. More recently, we have used scanning gate (conductance) microscopy to probe the nature of the coherent states, and have shown that families of states exist through the spectrum in a manner consistent with quantum Darwinism.