

Atomic nuclei are complex, quantum many-body systems whose structure manifests itself through intrinsic quantum states associated with different excitation modes or degrees of freedom. Collective modes (vibration and/or rotation) dominate at low energy (near the ground-state). The associated states are usually employed, within a truncated model space, as a basis in (coherent) coupled channels approaches to low-energy nuclear collision dynamics. However, excluded states can be essential, and their effects on the open (nuclear) system dynamics are usually treated through complex potentials. Is this a complete description of open system dynamics? Does it include effects of quantum decoherence? Can decoherence be manifested in reaction observables? I will discuss these issues and a coupled-channels density-matrix approach that makes it possible to quantify the role and importance of quantum decoherence in low-energy nuclear reaction dynamics.