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Adiabatic protocols in driven many-body systems and the orthogonality catastrophe.

Quantum adiabatic protocols are routines in which the Hamiltonian of a quantum system undergoes gradual deformation from a given initial to a given final value. Adiabaticity means that the routine is performed slowly enough to ensure complete control, in some well-defined sense, over the system's quantum state. Adiabatic protocols offer a natural framework for coherent quantum state manipulation, therefore the last several years have been marked by increasing interest in their practical implementation. The existence of an adiabatically slow regime for every quantum protocol is guaranteed by the adiabatic theorem established by Born and Fock as early as 1928. However, the practically important question as to what specific conditions are needed to ensure adiabaticity of a given protocol remains a hard and largely unresolved problem. Here I discuss how this gap can be bridged for a broad natural class of physical systems, namely, many-body systems where a small move in the parameter space induces an orthogonality catastrophe. In this class, the conditions for adiabaticity are derived from the scaling properties of the parameter-dependent ground state without a reference to the excitation spectrum. This finding constitutes a major simplification of a complex problem, which otherwise requires solving nonautonomous time evolution in a large Hilbert space.