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Pechukas-Yukawa approach to quantum systems with discrete energy spectra

The success of a perturbation theory expansion is determined by the appropriate choice of the zero-order approximation. The Pechukas-Yukawa formalism provides a promising alternative approach to the description of perturbed quantum systems with discrete energy spectra. It implicitly uses the matrix elements of the Hamiltonian in the basis of exact instantaneous eigenstates rather than the eigenstates of the unperturbed Hamiltonian. In this formalism, the evolution of the energy spectrum due to the perturbation is reduced to the classical dynamics of a 1D gas with cubic repulsion (a modified Calogero-Sutherland model). We develop the kinetic theory of this gas (BBGKY chain of equations for the probability distribution functions), which serves as the basis for the equations for the density matrix of the underlying quantum system.