First-Order Perturbation Theory

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1 Degeneracy Problem

Given a system that currently be regraded to have no interaction term in Hamiltonian, denoted as H_0. Physical choice of representing the state of the system would be the eigenstates Ψ_a of free-Hamiltonian with eigenvalues E_a, the eigen equation is the so-called time-independent Schrödinger's equation.

$$H_0\Psi_a = E_a\Psi_a \tag{1.1}$$

2 Wigner-Eckart theorem