Towards an adiabatic theorem for non-relativistic matter coupled to quantized radiation

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Abstract

The recently discovered extension of Kato's adiabatic theorem to eigenfunctions with embedded eigenvalue is applied to the ground state of the hydrogen atom interacting with a quantized field of massless bosons (photons) and a slowly changing electric or magnetic field. For time-dependent Hamiltonians $H(t/\tau)$, $t \in [0,\tau]$, that are unitarily equivalent to $H(0)$ and have a form factor that behaves like $|k|^{\beta-1/2}$, $\beta > 0$, as the wave vector k approaches $k = 0$, we obtain the upper bound $O(\tau^{-\beta/(\beta+1)})$ for the deviation from the adiabatic evolution. Our analysis is based on the fact that an infrared cutoff at $|k| = \sigma$ leads to a gap of size σ separating the ground state energy from the rest of the spectrum.