

Molecular quantum dynamics: Exercises series 3

Problem 1: Ion in a uniform electric field

Consider an ion with charge Q in a uniform electric field E . As you know, the interaction potential is a “linear ramp,” $V(q) = -QEq$. Assume that the ion is described by a Gaussian wavepacket (initially and therefore at all times),

$$\psi(q, t) = \exp \left\{ \frac{i}{\hbar} \left[\frac{1}{2} \alpha_t (q - q_t)^2 + p_t (q - q_t) + \gamma_t \right] \right\}.$$

Following the procedure from class, substitute the wave function ansatz into the TDSE in order to

- a) find the differential equations for α_t , q_t , p_t , and γ_t .
- b) Solve them, i.e., find α_t , q_t , p_t , and γ_t as explicit functions of their initial values and of time.

Remark: Note the difference from Tannor: we factor out $-i/(2\hbar)$ from α_t .

Read Chapter 2 (except for Section 2.2.2) and Sections 3.1, 3.2, 3.3 of Tannor.