

# 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  $\alpha_t$ ,  $q_t$ ,  $p_t$ , and  $\gamma_t$ .
- b) Solve them, i.e., find  $\alpha_t$ ,  $q_t$ ,  $p_t$ , and  $\gamma_t$  as explicit functions of their initial values and of time.

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

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