

# Quantum Information and Computing

Assignment 5 (due in two weeks)

November 22, 2022

1. **Time-dependent Schrödinger Equation** Consider the time-dependent one-dimensional quantum harmonic oscillator defined by the Hamiltonian:

$$H = \frac{\hat{p}^2}{2m} + \frac{\omega^2(\hat{q} - q_0(t))^2}{2m} \quad (1)$$

with  $q_0(t) = t/T$  and  $t \in [0 : T]$ . Given  $|\Psi_0\rangle = |n = 0\rangle$  (ground state of the Harmonic oscillator), compute  $|\Psi(t)\rangle$  for different values of  $T$ . Plot the square norm of  $|\Psi(t)\rangle$  as a function of  $q$  at different times, and the average position of the particle as a function of  $t$ .