Exercise 2

TDSE: Correlation Amplitude

We initialize a linear combination of the N lowest lying energy state of the harmonic oscillator (in the top panel), and evolve the state in time (bottom panel). We graph the fidelity (which in this case represents the correlation amplitude p.78 in Sakurai) of the time-evolved state with the initial state and see revivals.

One may easily identify two timescales. The decay time of the initial state, and the revival time.

- Try varying both the number of input states N, and the trap frequency omega
- How do these variables affect the decay time and the revival time?

TDSE: Exponentially damped force

Here we look at problem 5.23 in Sakurai covered in the course. We initialize the ground state of the harmonic oscillator and at t = 0, apply a constant force. In the top panel, we find the stationary states for initialization and comparison. In the bottom panel, we calculate the behavior under the application of the time dependent force. The net effect is that at time t=0, we displace the harmonic oscillator and in an exponential manner move it towards the origin.

In the 3 plots to the right in the lower panel we plot the overlap of the state with the 3 lowest energy states. Note that you can change the scale on the graphs.

- Vary the amplitude of the force and the timescale of the damping, and observe the behavior.
- When does the approximation made in the calculation break down?