Semiclassical methods

December 13, 2023

Abstract

These are my notes based on Prof. Batista's notes.

1 Coherent states in 1D particle

We have a quantum mechanical particle in 1D with momentum $\hat{\pi}$ and position $\hat{q}$, respectively following $[\hat{q}, \hat{\pi}] = i\hbar$

We have normalized operators as

$$\hat{P} = \frac{\hat{\pi}}{\sqrt{2m\omega_0}}, \hat{X} = \sqrt{\frac{m\omega_0}{2}}\hat{q} \tag{1}$$

m is mass of the particle, ω_0 is characteristic frequency of the system of interest. New operators are constructed such as they follow cannonical commutation relations as before with an extra factor of 1/2. We construct a new operator

$$\hat{a} = \frac{\hat{X}}{\sqrt{\hbar}} + i\frac{\hat{P}}{\sqrt{\hbar}} \tag{2}$$

which follows

$$[\hat{a}, \hat{a}^\dagger] = 1 \tag{3}$$

Questions to address?

1. Why am I looking at coherent states?
2. What are generators of Heisenberg-Weyl lie algrabra?
3. what is characteristic frequency of the system?
4. What does cannonical commutation relation tell us? If two random operators follow commutation relations as $i\hbar$, what can I say about them.
5. How to calculate coherent states from lie algebra?