Quantum Physics

Recitation 4: Wag the Dog

1. Use the provided iPython notebook `recitation4.ipynb` to find the numerical solution of Schrödinger equation for an anharmonic oscillator,

$$\frac{d^2\psi}{d\xi^2} = (\xi^2 - K)\psi, \quad \xi \equiv \sqrt{\frac{m\omega}{\hbar}}x, K \equiv \frac{2E}{\hbar\omega},$$

   Find the ground state and the first three excited state energies (to five significant digits) for the anharmonic oscillator by the *wag-the-dog* method (GR 2.54). Changing K, and notice what the "tail" of the wave function does. For the first and third excited states, you need to change the initial conditions (`ics`) to $u(0) = 0, u'(0) = 1$.

2. Find the first four allowed energies of an infinite well (to five significant digits) by appropriate changes to the differential equation. You should be looking for a solution such that $u(1) = 0$.

3. Change the Python code and solve numerically Schrödinger equation for an anharmonic oscillator,

$$\frac{d^2\psi}{d\xi^2} = (\xi^2 + \frac{\xi^4}{10} - K)\psi, \quad \xi \equiv \sqrt{\frac{m\omega}{\hbar}}x, K \equiv \frac{2E}{\hbar\omega}.$$

   Find the ground state and the first three excited state energies (to five significant digits) for the anharmonic oscillator.