

## Examples of Perturbation Theory:

1. 
$$H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2 x^2 + \frac{\lambda}{4} x^4 \quad \lambda \ll \omega \quad \bar{x}^3$$

Calculate Energy shift to second order and ~~wave~~ eigenket to first order in perturbation theory.

What is the effect of the perturbation on the unperturbed levels?

2. Isotropic 2D H.O.

$$H_0 = \frac{p_x^2}{2m} + \frac{p_y^2}{2m} + \frac{m\omega^2}{2}(x^2 + y^2)$$

a. What are the degeneracies? What are the energies of the three lowest states?

b. Apply a perturbation:

$$V = \delta m\omega^2 x y$$

$\delta$ : dimensionless ~~rel~~ real number and  $\delta \ll 1$ .

Find:

(i) Zeroth order energy eigenket and the first order energy shift for each of the 3 lowest lying levels.