Quantum SHO

Distinct SHO $E_0 \neq 0$

$= \frac{1}{2} \hbar \omega$

$$\psi_n(x) = N_n \cdot H_n(\alpha x) \cdot \exp\left(-\frac{\alpha^2 x^2}{2}\right)$$

polynomial

H_n is even/odd for even "n" odd "n"

Dirac

$$\psi_n = c_i \phi_i + c_j \phi_j + \dots$$

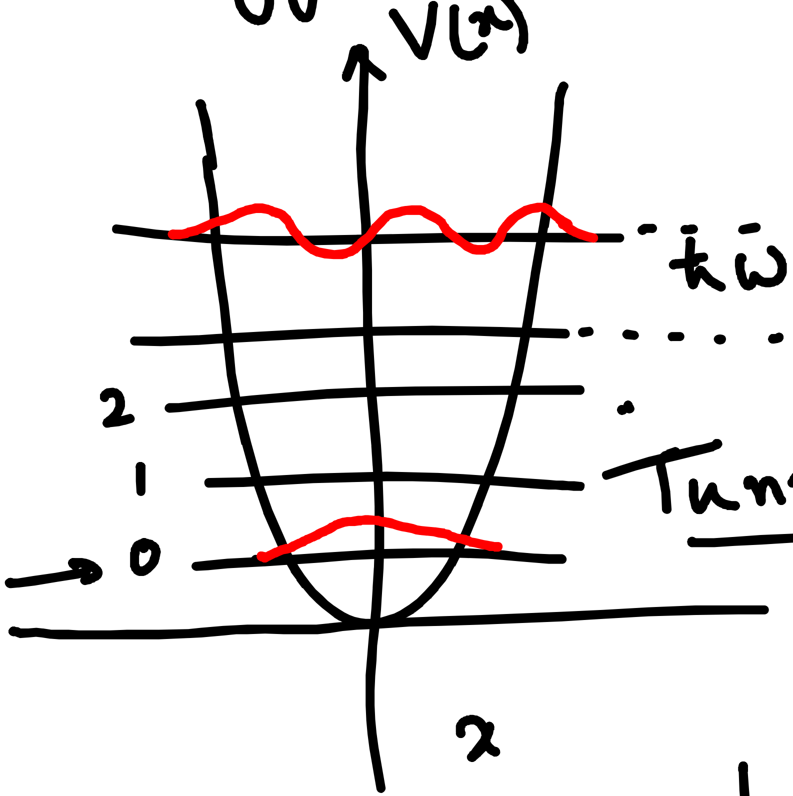
$$= \sum_{x = ijk\dots} c_x \psi_x$$

$$\langle \psi_n \rangle = |c_i|^2 + |c_j|^2 + \dots$$

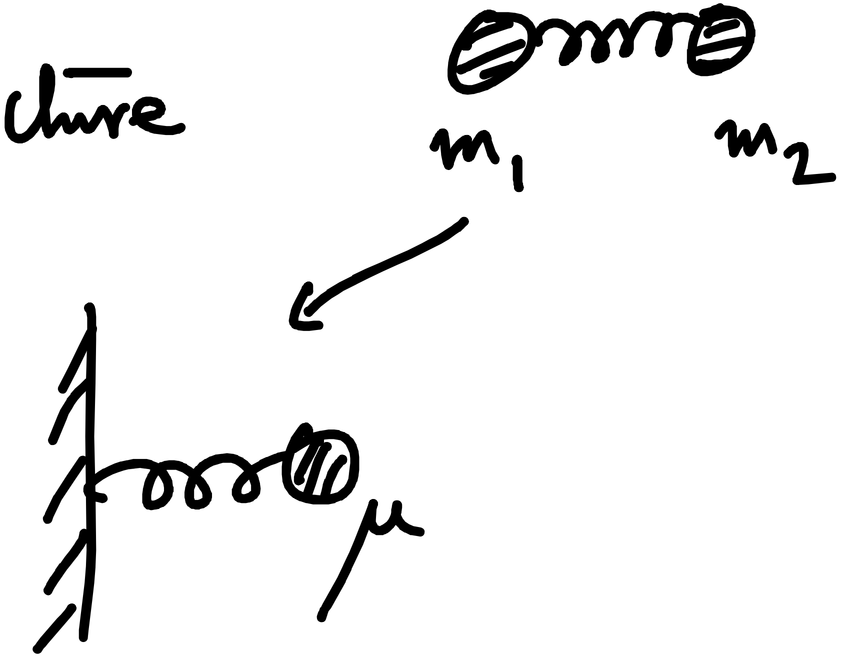
"Energy" Constrained Cases $\longrightarrow$ KE

Overlap of states $\longrightarrow$ Smooth PE constrain

"Integral"



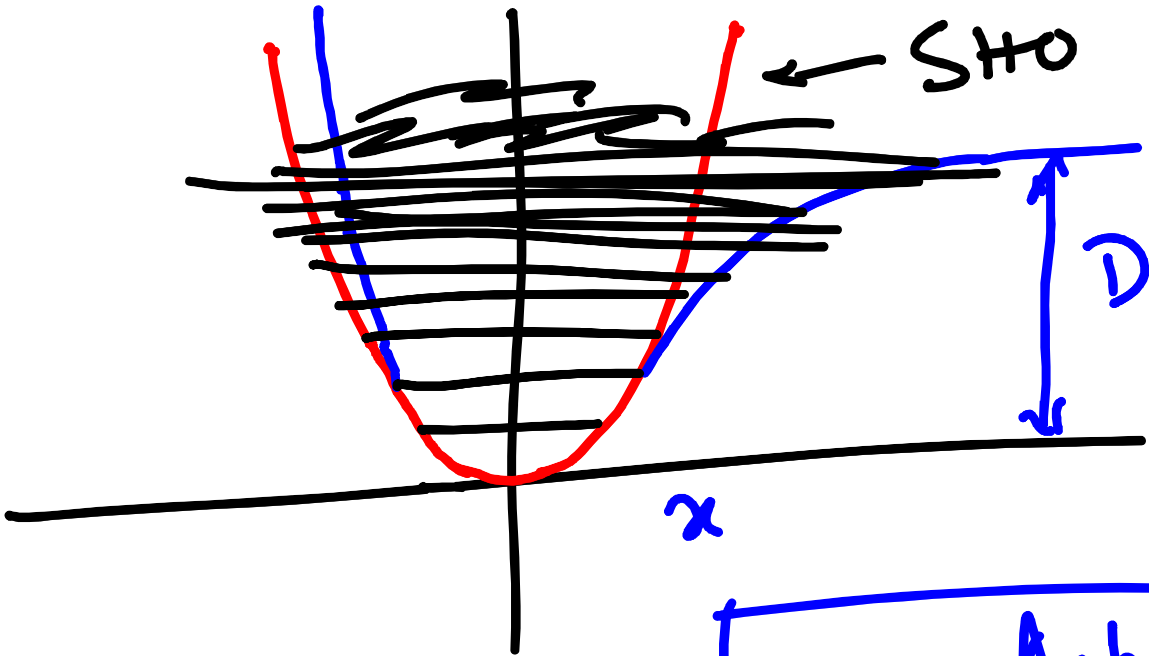
"Tunnelling" picture



$$\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}$$

Morse Potential

$$V(x) = D\left(1 - e^{-\alpha x}\right)^2$$



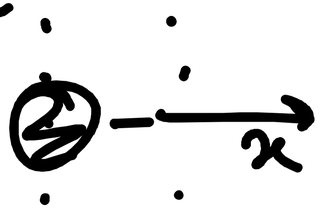
$$E_n = \left(n + \frac{1}{2}\right)\hbar\omega - \tilde{x}\left(n + \frac{1}{2}\right)^2$$

$\tilde{x} \longrightarrow$ Anharmonicity factor

Rigid Rotor

$KE = \frac{1}{2m} p_x^2$

Momentum (translation)



$\hat{p}_x = -i\hbar \frac{d}{dx}$

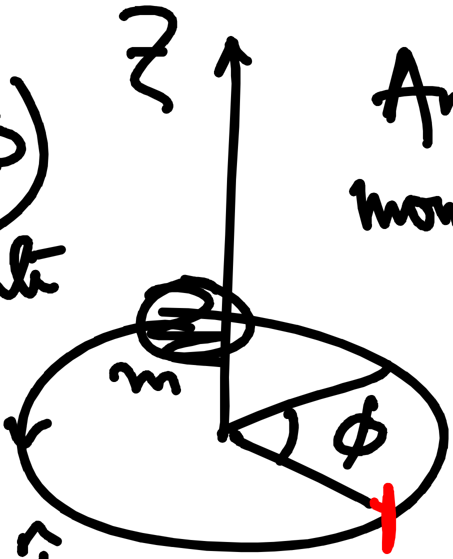
$(\hat{p}_x, x)$ as conjugate pair

$\Delta x \, \Delta p_x$

(L_z, ϕ) conjugate

$\Delta L_z \Delta \phi$

Angular momentum



$\hat{L}_z$ (angular momentum operator)

$$KE = \frac{L_z^2}{2I}$$

$$= \frac{1}{2} I \omega^2$$

Dimensions

$L \xrightarrow[\Xi]{} \hbar$ $\Psi(\phi)$