QM: particles started with identical initial position/velocity & subjected to identical forces do not end up at identical locations → problem: describe those locations!

Consider N runs of an expt to measure location of an electron: $\{x_i\}$ locations

$$\text{probability density in a bin} = \frac{(\overset{\leftarrow \Delta N}{\#\text{ in bin}})/N}{\underset{\nwarrow \Delta x}{\text{bin size}}} \equiv \rho(x)$$

Normalization: $\int \rho(x)\,dx = 1$ [total probability = 1]

Expectation value
Average $\int x\,\rho(x)\,dx \equiv \langle x\rangle$

variance $\sigma^2 = \int (x-\langle x\rangle)^2 \rho(x)\,dx = \langle x^2\rangle - \langle x\rangle^2$

whats waving? sqrt(probability density) $\equiv \Psi$

more accurately $|\Psi|^2 = \Psi^*\Psi = \rho(x)$

Operator: maps functions (domain) → functions (range) eg ∂_x

position: x ; momentum: $\frac{\hbar}{i}\partial_x$; energy $= \Big(\underset{\substack{\uparrow\\ \text{KE}}}{-\frac{\hbar^2}{2m}\partial_x^2} + \underset{\substack{\uparrow\\ \text{PE}}}{V(x)}\Big) \equiv \overset{\text{Hamiltonian}}{H}$

Time Dependent Schrodinger Eq:
(TDSE)

$$i\hbar\,\underbrace{\partial_t}_{\text{so } \rho(x) \text{ will change ie particle will move}}\Psi = \left(-\frac{\hbar^2}{2m}\partial_x^2 + V(x)\right)\Psi = H\Psi$$

For reasons to be explained in future we typically write operator wedged between Ψ^* & Ψ

ie $\Psi^* x \Psi$, $\Psi^* \frac{\hbar}{i}\partial_x \Psi$, $\Psi^* H \Psi$

The following notations turn out to be useful

$$\langle f|\underset{\substack{\uparrow\\ \text{operator}}}{Q}|g\rangle \equiv \int f^* Q\, g\, dx$$

if $f=g$ $\langle g|Q|g\rangle = \langle Q\rangle$ eg expectation value

Note: Instead of moving blobs we will often be interested in standing waves as thats what sticks around.