State vectors $|\psi\rangle$ $\Longleftrightarrow$ ↗, ↖ ...

Ex: $\binom{a}{b}$ w/ $a,b \in \mathbb{C}$; $\psi(x)$ $\longleftrightarrow$ $\vec{r}$, $\vec{v}$ (direction + magnitude)

Tell us all there is to know about a system

Can add and multiply:

$|\xi\rangle = \overset{\in\mathbb{C}}{c_1} \cdot |\psi_1\rangle + \overset{\in\mathbb{C}}{c_2}|\psi_2\rangle$ $\longleftrightarrow$ a · ↗ = ↗, ↗ + ↖ = ↑

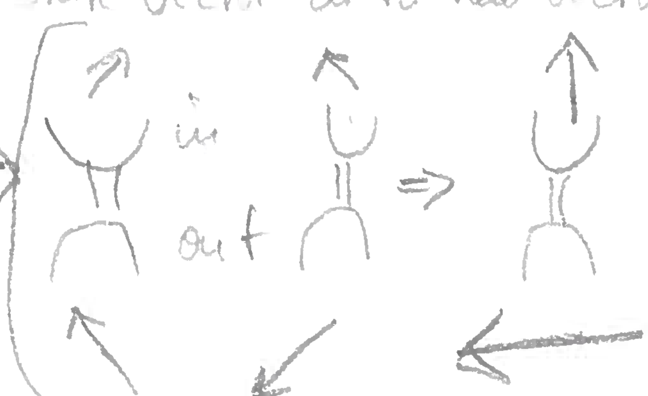
Basis vectors: $\binom{1}{0}$ and $\binom{0}{1}$ or $|x_0\rangle$, $|p_i\rangle$ (PSEUDO) $\longleftrightarrow$ Basis vectors: $\vec{v} = \sum v_i \hat{e}_i$

Operator: machine that turns state vector in to new vector

$O|\psi_1\rangle = |\varphi_1\rangle$, $O|\psi_2\rangle = |\varphi_2\rangle$

$\Longrightarrow$

$O|\xi\rangle = c_1|\varphi_1\rangle + c_2|\varphi_2\rangle$ $\longleftrightarrow$



Eigenstate $|\varphi_0\rangle$

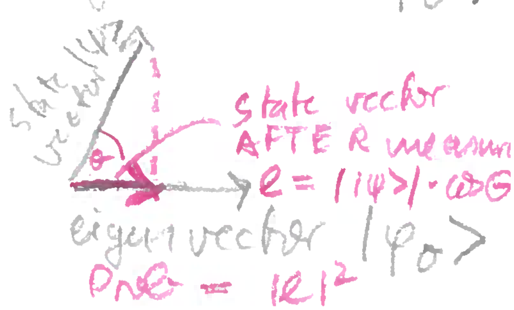
$\Longrightarrow O|\varphi_0\rangle = \overset{\in\mathbb{C}\text{ eigen value}}{o}|\varphi_0\rangle$

real for any observable, is equal to the value you would measure for that observable $\longleftrightarrow$

Measurement:

1) Possible outcomes MUST be Eigenvalues of Observable, o.
2) AFTER measurement, State vector = Eigenstate $|\varphi_0\rangle$
3) Probability (density) for o = |overlap (projection)|^2

e.g. $P_{rob}(x \ldots x+\Delta x) = |\psi(x)|^2 \Delta x$ $\longleftrightarrow$



Expectation value $\langle \mathcal{O} \rangle = \sum_{\mathcal{O}} \text{Prob}(\mathcal{O}) \cdot \mathcal{O}$ ("Mean")

QM: $\langle \mathcal{O} \rangle_\psi = \langle \psi | \mathcal{O} | \psi \rangle$

e.g. $\psi(x)$: $\langle \mathcal{O} \rangle_\psi = \int_{-\infty}^{\infty} \psi^*(x) \cdot (\mathcal{O}\, \psi(x))\, dx$

Examples: $\langle x \rangle_\psi = \int_{-\infty}^{\infty} \psi^*(x) \cdot x \cdot \psi(x)\, dx$

$\langle x^2 \rangle_\psi = \int_{-\infty}^{\infty} \psi^*(x) \cdot x^2 \cdot \psi(x)\, dx$

Λ (Note: $\sigma_x = \sqrt{\langle x^2 \rangle - \langle x \rangle^2}$

$\langle p \rangle_\psi = \int_{-\infty}^{\infty} \psi^*(x) \frac{\hbar}{i} \frac{\partial \psi(x)}{\partial x}\, dx$

Warning: do NOT confuse $\langle \mathcal{O} \rangle$ with Probability for specific $\mathcal{O}_i$!

Time-dependence: $i\hbar \frac{\partial}{\partial t} |\psi\rangle(t) = H |\psi\rangle(t)$

Schrödinger Equation. H = Hamiltonian Operator (represents energy). Ex.: $H = \frac{p^2}{2m} + V(X)$

Eigenstates: $|\varphi_E\rangle$ with $H |\varphi_E\rangle = E \cdot |\varphi_E\rangle$

$|\varphi_E\rangle(t) = |\varphi_E\rangle e^{-iEt/\hbar}$ stationary solutions