SO FAR: General quantum state

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Quantum superposition of eigenstates

Mathematical description:

eigenstates → like basis vectors

polarization states:

choice of basis vectors

general state $a_{0°}|0°\rangle + a_{90°}|90°\rangle$

$$|a_{0°}|^2 + |a_{90°}|^2 = 1$$

position states of electron: one eigenstate (basis vector) for every point in space

$$|x\rangle$$

more general state: $a_{x_1}|x_1\rangle + a_{x_2}|x_2\rangle + \ldots$

most general: $\int d^3x\, \psi(x)\, |x\rangle$ ← eigenstate

integral = sum over all possible states

coefficient in superposition: COMPLEX NUMBER for every position

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WAVEFUNCTION

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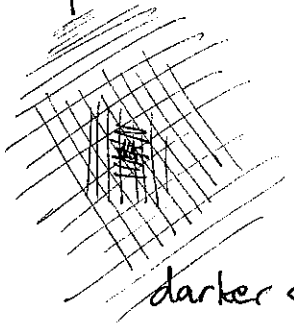
$\psi(x)$



darker ⇔ larger $|\psi|^2$

measure position →

$\psi(x) = 0$ except where we measure electron

repeat measurement →

same result.

If we measure position:

$|\psi(x)|^2$ gives probability density for finding electron at $\vec{x}$.

e.g.

prob. that we'll find electron in volume V $= \int_V d^3x \, |\psi(x)|^2$

(just like finding mass from mass density)

Net probability must be 1

$\therefore$ require $\int_{\text{all space}} d^3x \, |\psi(x)|^2 = 1$

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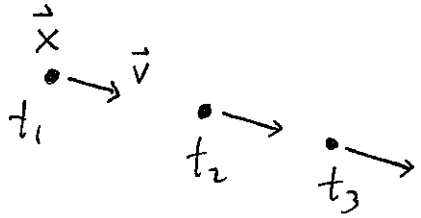
SUMMARY:

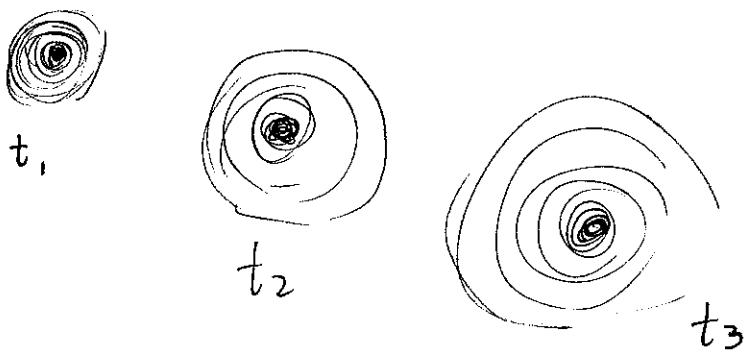
classical description of an electron



$\vec{x}(t)$ satisfies Newton's Laws $m\frac{d^2\vec{x}}{dt^2} = \vec{F}$

quantum description of electron

$\psi(x) \rightarrow$ can evolve with time



Need equation of motion for $\psi(\vec{x}, t)$

SCHRÖDINGER EQUATION.