

Lec 0: PreludeWhat is quantum mechanics?

① Quantization discrete values, for example spectral lines from excited atoms,

② wave-particle duality

electron scattering Davidson-Germer

$$\lambda = \frac{h}{p} \quad h \text{ Planck's constant}$$

③ Fundamental uncertainty

$$\Delta x \Delta p \geq \frac{h}{2\pi} \approx \hbar$$

uncertainty
needs definition

$\hbar$ quantum of action, unit of phase space

solves problem of Boltzmann entropy

④ superposition

for example electron spins as up and down
neither up or down until measured.

⑤ problem of measurement

result is either up or down, and after
measurement remains so.

collapse of wave function, Born rule

⑥ Entanglement

example 2 electrons distinguished spatially as a, b can have state

a up, b down and b up, a down

such that the spins are anti-correlated over arbitrary distance.

Einstein, Podolsky, Rosen (EPR) paradox

Theory:

Quantum state are vectors in

Hilbert space, $|\psi\rangle$.