Quantum Mechanical World

Quantum Mechanics

The branch of physics and chemistry that examines the ***wave motion of objects on an atomic scale***.

...$\lambda_{particles} \approx$ dimensions of the surroundings in atomic environment.

The "Quantum Garage"

www.scienceteecher.com

Quantum Mechanical World

Heisenberg Uncertainty Principle

Werner Heisenberg
1901-1976
http://osulibrary.orst.edu

...it is impossible to know both the position and momentum (speed × mass) of a particle *at the same time*.

Mathematically:

$$\Delta x \bullet m\Delta u \geq \frac{h}{4\pi}$$

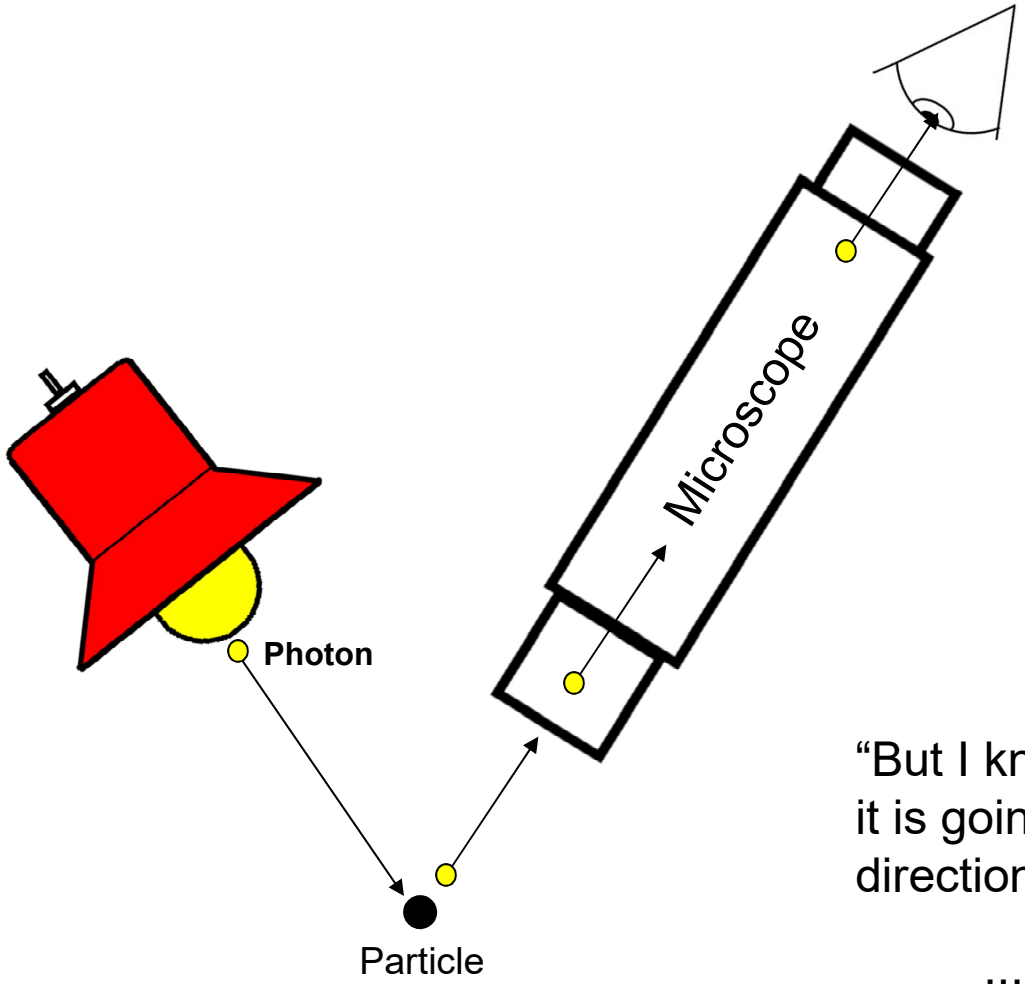
Δx: Uncertainty in particle's position.

If Δx is small you know the particle's position well but...

Δu: Uncertainty in particle's velocity.

Δu must be large and you have little information about the particle's speed.

Heisenberg Uncertainty Principle



"I see it! I know where it is!!!"

"But I know little about how fast it is going and in which direction."

... by observing, you have changed the experiment!

Quantum Mechanics
Schrodinger Equation

Schrodinger's Equation:

$$\left(\frac{\delta^2 \Psi}{\delta z^2} + \frac{\delta^2 \Psi}{\delta x^2} + \frac{\delta^2 \Psi}{\delta y^2} \right) + V \bullet \Psi = E \bullet \Psi$$

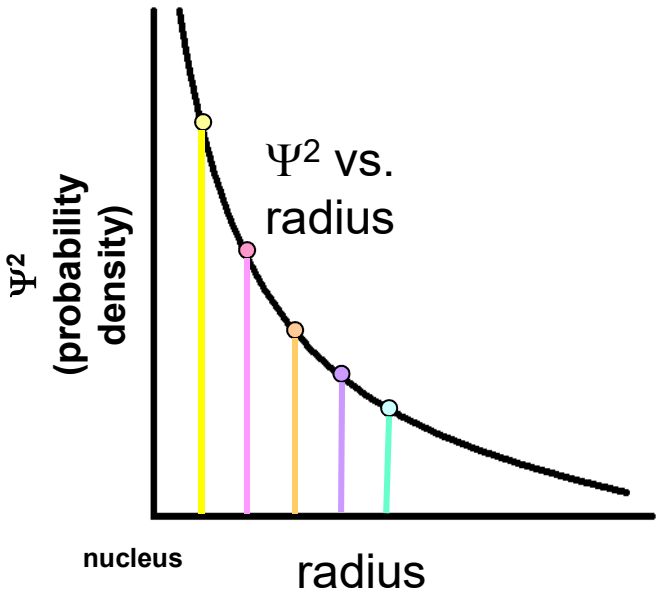
Erwin Schrodinger
(1887 – 1961)

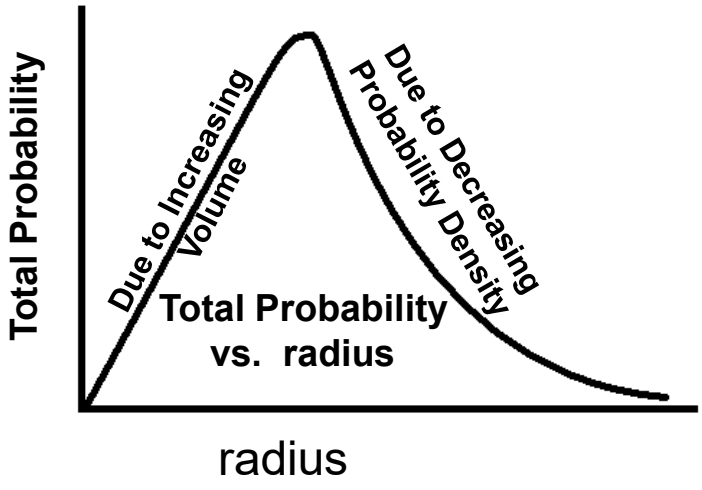
Equation is solved in various situations for Ψ

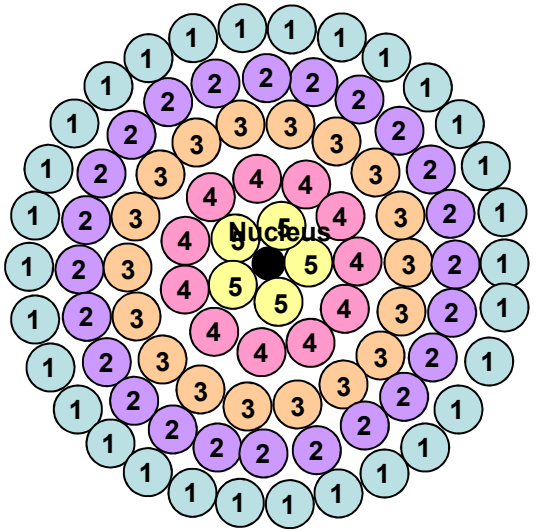
Ψ has no physical significance!

Ψ^2 is the ***probability*** of finding an electron in a specific space.

Solutions to the Schrodinger Equation







Probability = 5 × 5 = 25

Probability = 11 × 4 = 44

Probability = 18 × 3 = 54

Probability = 24 × 2 = 48

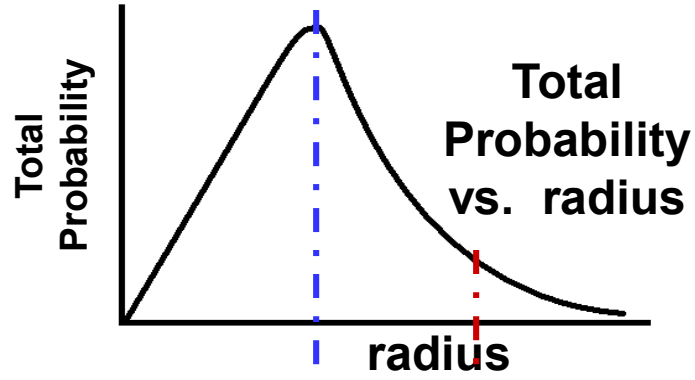
Probability = 30 × 1 = 30

Increasing probability

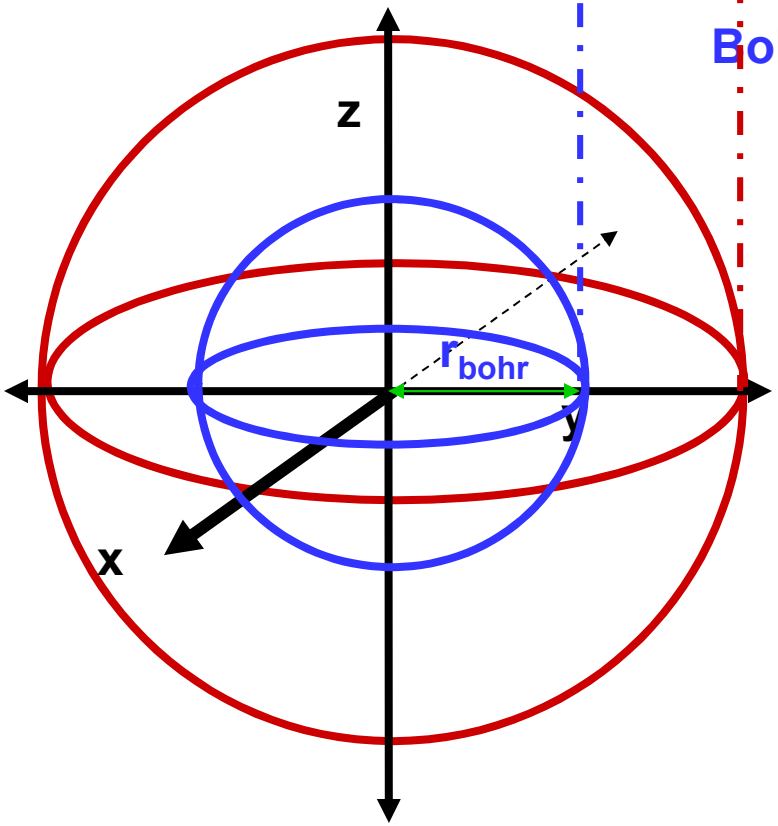
Greatest!

Decreasing Probability

The Quantum Mechanical Atom



Total Probability vs. radius



Bohr Radius:

0.529 Å = 5.29×10^{-11} m

...Distance to maximum Probability.

Orbital: A shape within which it is **90% certain** we'll find the electron