

**current
atomic
model**

Enter Niels Bohr

4-Bohr

... FINALLY

Niels Bohr puts it all together

Bohr added Planck's quanta idea (which was proven by Einstein) and Louis de Broglie's wave/particle theory to the Rutherford's atomic model.

THE BOHR ATOM:



BOHR

Bohr proposed a revolutionary model: An atom with discrete (Quantum) states

Bohr model explained how atoms emit light quanta and their stability.

He combined the postulates of Planck and Einstein to build characteristic energy states that atoms should possess.

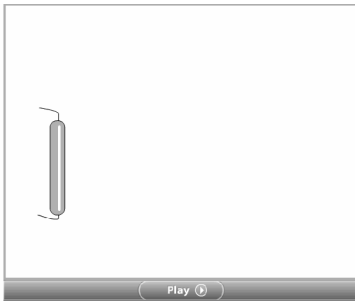
Model gave excellent agreement with experiment on atomic spectra.(1913)

Bohr's Theory

- Electrons exist at set levels of energy, at fixed distances from the nucleus.
- When an atom absorbs energy, the electron jumps to a level further from the nucleus
- If it radiated energy, that means that the electron is falling to a level closer to the nucleus.

Bohr's model was a huge leap forward in making theory fit the experimental evidence found by other physicists over the years.

in other words...



Bohr Model of the Atom

- **Nucleus** In the center, contains protons & neutrons
- **Protons** positive, one atomic mass unit (amu)
- **Neutrons** neutral, one amu
- **Shells** energy levels around nucleus
- **Electrons** negative, no effective mass

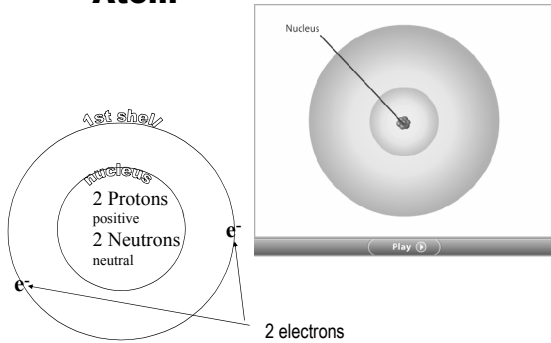
Energy Levels

There are several energy levels in which an electron *might be found*.

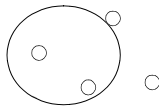
To move from one level to another an electron must gain or lose an exact amount of energy. *Quantum*

What do you mean...might be found?

The Bohr Model the Helium Atom



Where exactly are those electrons?



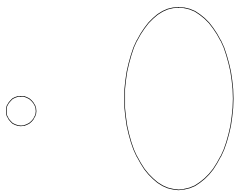
MEASUREMENT OF ELECTRON POSITION



Essence of uncertainty principle.

Act of measurement influences the electron -gives it a kick and it is no longer where it was !

Penny Probability



Erwin Schrödinger



- Austrian physicist.
- He shared a 1933 Nobel Prize for new formulations of the atomic theory.

Schrödinger's Equation

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{8\pi^2 m}{h^2} (E - V) \psi = 0$$

Labels in the diagram:
- Second derivative with respect to X (points to $\frac{\partial^2 \psi}{\partial x^2}$)
- Schrödinger Wave Function (points to ψ)
- Position (points to x)
- Energy (points to E)
- Potential Energy (points to V)

The solution to this equation is a wave that describes the quantum aspects of a system. However, physically interpreting the wave is one of the main philosophical problems of quantum mechanics.

Schrodinger's Cat



Schrodinger's cat is a famous illustration of the principle in quantum theory. Schrodinger's cat demonstrates the apparent conflict between what quantum theory tells us is true about the nature and behavior of matter on the microscopic level and what we observe to be true about the nature and behavior of matter on the macroscopic level.

First, we have a living cat and place it in a thick lead box. At this stage, there is no question that the cat is alive.

We then throw in a vial of cyanide and seal the box. We do not know if the cat is alive or if it has broken the cyanide capsule and died.

Since we do not know, the cat is both dead and alive, according to quantum law, in a superposition of states. It is only when we break open the box and learn the condition of the cat that the superposition is lost, and the cat becomes one or the other (dead or alive).

Schrodinger himself said that he wished he had never met that cat.

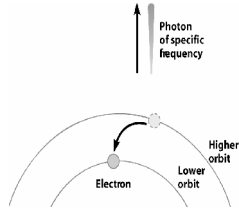
We know that superposition actually occurs at the subatomic level, because there are observable effects of interference, in which a single particle is demonstrated to be in multiple locations simultaneously.

What that fact implies about the nature of reality on the observable level (cats, for example, as opposed to electrons) is one of the stickiest areas of quantum physics. Schrodinger himself said, later in life, that he wished he had never met that cat.

Bohr's theory

Three rules:

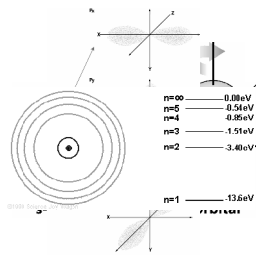
- Electrons only exist in certain allowed orbits
- Within an orbit, the electron does not radiate
- Radiation is emitted or absorbed when changing orbits



Electron Configuration

- Expressing the electron configuration of an atom or ion at the atomic level is the universal language of chemistry.
- The configuration is described by 4 quantum numbers. Just like a point can be described by the (x,y) coordinates, an electron can be described by 4 quantum numbers.

Electronic quantum numbers in atoms



1. Principle quantum number, n
 - Energy level
 - Average distance from nucleus
2. Angular momentum quantum number, l
 - Spatial distribution
 - Labeled s, p, d, f, g, h, ...
3. Magnetic quantum number
 - Spatial orientation of orbit
4. Spin quantum number
 - Electron spin orientation
