current atomic model

Enter Niels Bohr

Atomic Model of the early 1900s

- In 1917 Rutherford identified a particle with a positive charge called **a *proton***.
- He also thought that there were neutral particles in the nucleus called ***neutrons***. They were later identified by ***James Chadwick***
- Negatively charged ***electrons*** balanced the charge on the protons as identified by Millikan.

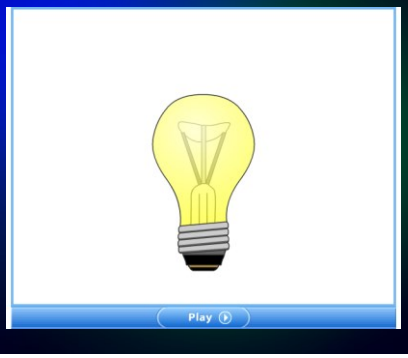
Max Planck added a twist to this theory with his Quantum Theory

Planck proposed that:

atom energy is absorbed or liberated in packets or chunks of energy. Planck called these packages of energy "quanta".

This was the birth of quantum physics in 1900

in other words...



. . . 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:

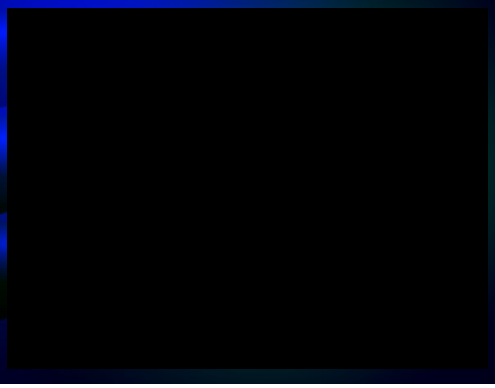
Bohr proposed a revolutionary model: An atom with discrete (Quantum) states

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)

ATOMIC SPECTRA

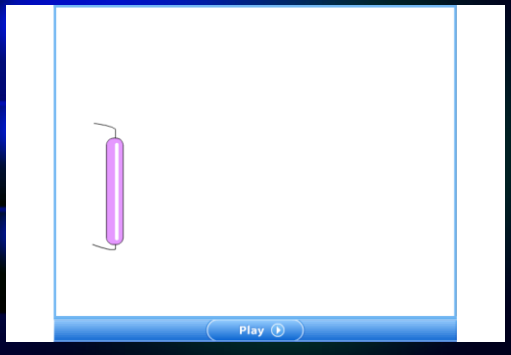


Bohr's Theory

- 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

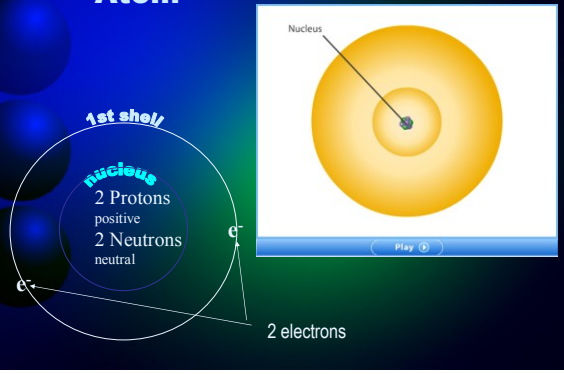
Energy Levels

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?

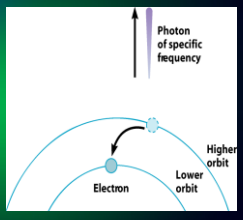
The Bohr Model the Helium Atom



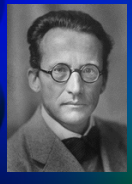
Bohr's theory

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

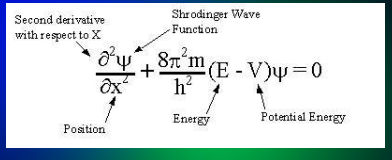


Erwin Schrödinger



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

Schrödinger's Equation



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.