St. John Baptist De La Salle Catholic School, Addis Ababa

The Discovery of the Nucleus

Physics Group 1

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About Atom and Its Discovery

Atoms, the fundamental units of matter, consist primarily of empty space. The core of an atom, the nucleus, contains protons and neutrons. Electrons orbit this nucleus in shells. While protons are positively charged, neutrons carry no charge, resulting in a positively charged nucleus. Electrons, negatively charged, are bound to the nucleus by electrostatic forces. The hydrogen atom, an exception, consists of a single proton and no neutrons.

Discovery of the Atom

Robert Brown (1827): First observed Brownian motion, providing indirect evidence of atoms.

Albert Einstein (1905): Theoretical explanation of Brownian motion, enabling calculation of atomic sizes.

Jean-Baptiste Perrin (1908): Experimental verification of Einstein's theory, determining accurate sizes for atoms and molecules.

John Dalton (1803): Introduced atomic theory based on the law of multiple proportions.

Isotopes

Isotopes are variants of elements with the same number of protons but different numbers of neutrons. They exhibit identical chemical properties but differ in mass. Isotopes can be stable or radioactive. Techniques for measuring isotopic compositions provide insights into matter's origin and history.

Discovery of Protons

William Prout (1815): Suggested atoms are made of hydrogen atoms (protyles).

Eugen Goldstein (1886): Discovered canal rays, noting the high charge-to-mass ratio of hydrogen ions.

Ernest Rutherford (1911): Gold foil experiment leading to the discovery of the nucleus.

Rutherford (1917): Proved hydrogen nuclei (protons) are present in all atoms.

Discovery of Neutrons

Herbert Becker & Walther Bothe (1930): Observed penetrating radiation from alpha particles on light elements.

Frederic & Irene Joliot-Curie (1932): Noted high-energy protons ejected by this radiation.

James Chadwick (1932): Discovered neutrons by observing uncharged radiation interacting with paraffin wax.

Discovery of Electrons

J.J. Thomson (1897): Discovered the electron through cathode ray experiments, demonstrating that atoms have internal structure.

Subatomic Particles

Atoms consist of electrons, protons, and neutrons. Electrons are the least massive, with a negative charge, while protons are positively charged, and neutrons are neutral. Protons and neutrons are composed of quarks held together by the strong force, mediated by gluons.

Bohr Model of the Atom

Niels Bohr's model depicts the atom with a central nucleus orbited by electrons in shells. Each shell can hold a specific number of electrons. This model helps visualize electron arrangements and chemical properties of elements.

Quantum Numbers

Schrödinger's model requires three quantum numbers to describe electron orbitals:

Principal (n): Size of the orbital.

Angular (l): Shape of the orbital.

Magnetic (m): Orientation of the orbital in space.

Strong and Weak Nuclear Forces

Strong Nuclear Force: Binds protons and neutrons in the nucleus, overcoming electrostatic repulsion.

Weak Nuclear Force: Responsible for nuclear decay and transformations within the nucleus.

Binding Energy

Binding energy is the energy required to disassemble a nucleus into its constituent protons and neutrons, or the energy released when these particles are bound together.

The End

Thank You!