Radiation physics lecture 1:**Introduction of Radiation physics**

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INTRODUCTION

X-rays were discovered by Roentgen in 1895.

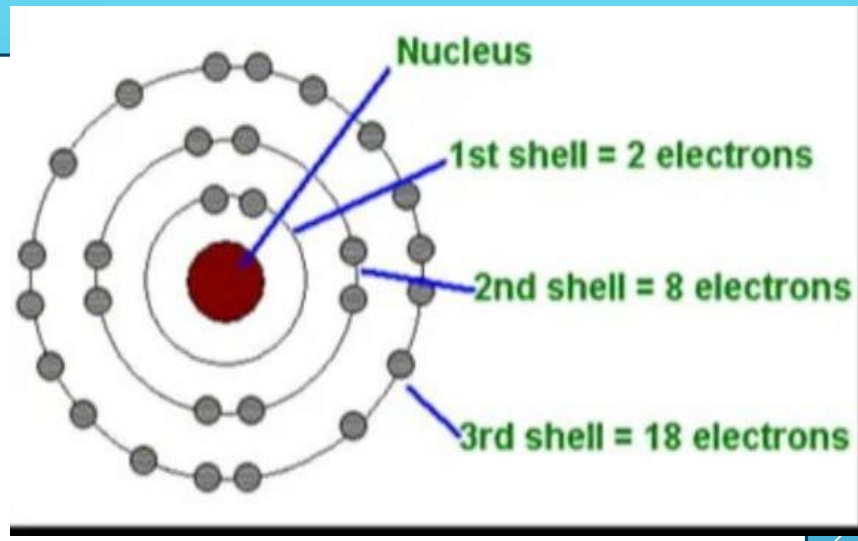
- He called them x-rays because their nature was then unknown.
- To understand the production and interactions of x-rays a basic knowledge of atomic physics is essential.

COMPOSITION OF MATTER

Anything that occupies space and has weight is called **matter**.

- **Atom** is basic unit of all matter.
- **Atom** is a fundamental unit of matter that can not be subdivided.

BOHR MODEL



In atomic physic, the Bohr model,

introduced by NEIL BOHR in 1983

Depicts

1.Central Nucleus: According to the Bohr model,

an atom consists of a small, positively charged

nucleus at its center. This nucleus contains protons, which are positively charged, and usually neutrons, which are electrically neutral. Together, protons and neutrons form the bulk of an atom's mass.

2.Electron Orbits: Surrounding the nucleus are electrons, which are negatively charged particles. In the Bohr model, these electrons are depicted as moving in specific, fixed circular orbits around the nucleus, much like planets orbiting the sun. Each orbit corresponds to a specific energy level.

3.Quantized Energy Levels: One of the most significant aspects of the Bohr model is the idea of quantized energy levels. Electrons can only occupy certain discrete energy levels or orbits. These energy levels are often referred to as "shells" or "orbitals." Electrons can move between these levels by absorbing or emitting specific amounts of energy.

4.Electrostatic Forces: Electrons are held in their orbits by electrostatic forces of attraction between the negatively charged electrons and the positively charged nucleus. These forces act to keep the electrons in their respective energy levels.

5.Emission and Absorption of Energy: When an electron transitions from a higher energy level to a lower one, it emits energy in the form of light or electromagnetic radiation (such as visible light or X-rays). Conversely, when it absorbs energy, it can move to a higher energy level.

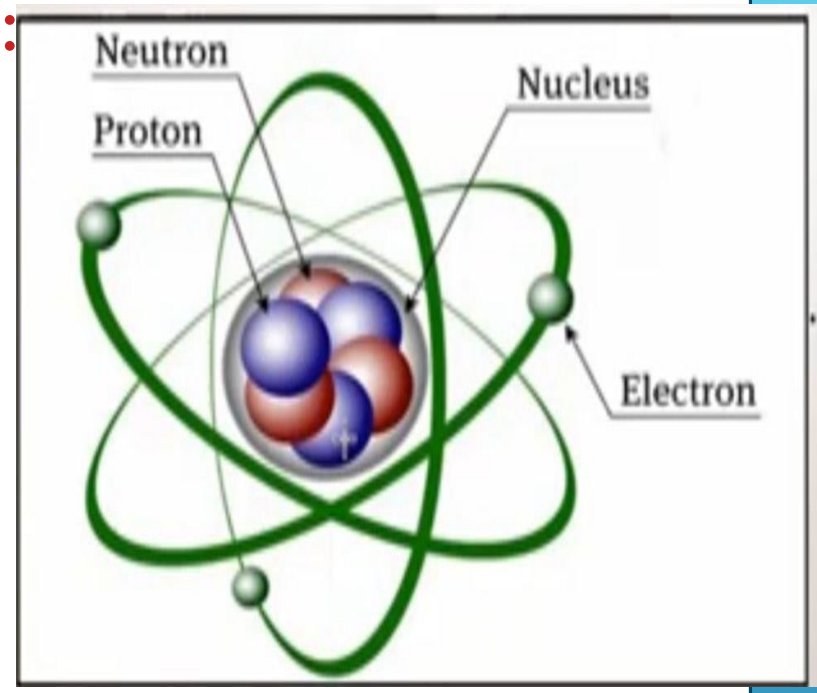
THE STRUCTURE OF ATOM

An atom consists of three main subatomic particles:

Protons: Positively charged particles found in the nucleus of the atom.

Neutrons: Neutral (no charge) particles also located in the nucleus.

Electrons: Negatively charged particles that orbit the nucleus in electron shells or energy levels.



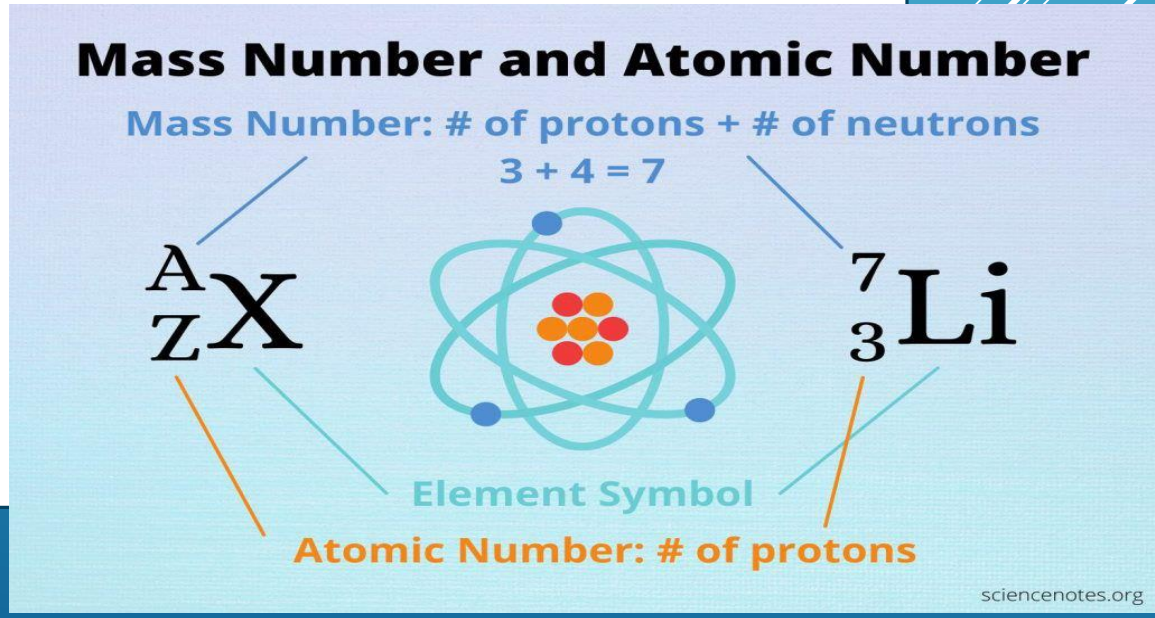
The protons and neutrons make up the nucleus at the center of the atom, while the electrons move in various energy levels or orbits around the nucleus. The number of protons determines the element of the atom, while the number of electrons should equal the number of protons to maintain a neutral charge.

the number of protons present in nucleus is called the atomic number [Z]

The total numbers of protons and neutrons in the nucleus is called atomic mass [A]

When the number of protons is equal to the number of electrons atom is known to be in stable state.

- The electrons in the orbit are maintaind by the electrostatic force between positively charged nucleus and negatively charged electrons on one hand balanced by the centrifugal force of the revolving electrons.

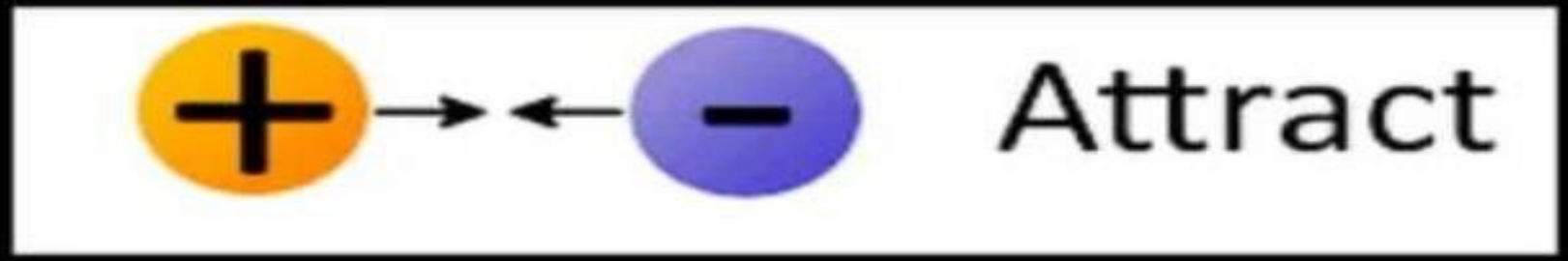


Electrostatic force, also known as Coulomb's law, is the fundamental force of attraction that exists between electrically charged objects. This force arises from the interaction between charged particles, particularly electrons (negatively charged) and protons (positively charged).

Centrifugal force is a concept used to describe the apparent outward force experienced by an object that is moving in a circular path

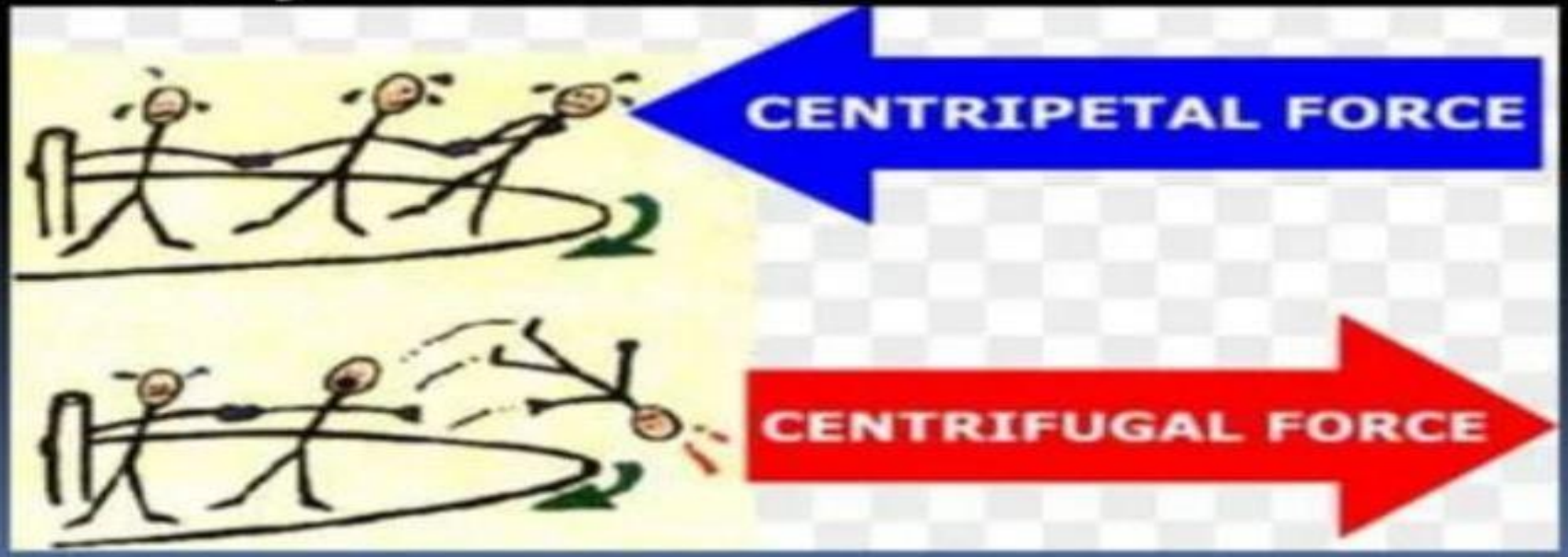
Electrostatic force

Force between electrons and nucleus.

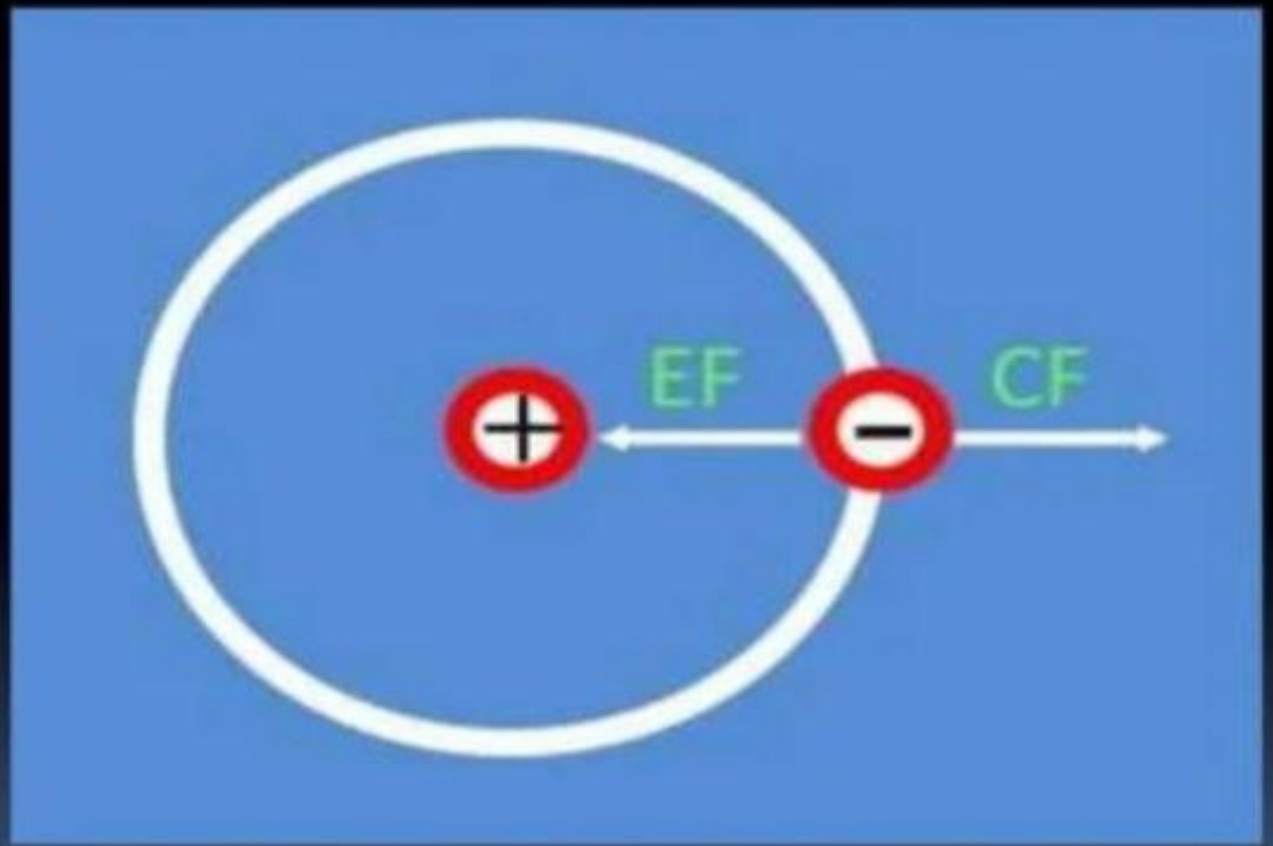


Centrifugal force

pulls electron from nucleus



- *Balance between electrostatic force and centrifugal force is required to keep electron in its orbit.*



BINDING ENERGY

Binding energy refers to the energy required to hold the nucleus of an atom together. It's the energy that binds protons and neutrons in the atomic nucleus due to the strong nuclear force. When nucleons (protons and neutrons) come together to form a nucleus, energy is released, and this energy is what keeps the nucleus stable. On the other hand, if you want to break apart the nucleus into its individual protons and neutrons, you need to supply energy equal to the binding energy to overcome the strong nuclear force.

RADIATION PHYSICS

Radiation physics is a branch of physics that deals with the study of ionizing and non-ionizing radiation and their interactions with matter.

ionizing radiation and non-ionizing radiation are two categories of electromagnetic radiation or subatomic particle radiation, and they differ in their ability to ionize atoms or molecules:

Ionizing Radiation:

Definition: Ionizing radiation refers to radiation with enough energy to remove tightly bound electrons from atoms or molecules, thereby creating ions (charged particles) in the process.

Examples: X-rays, gamma rays, alpha particles, beta particles, and certain high-energy subatomic particles (e.g., neutrons).

Properties: Ionizing radiation has high energy and can penetrate matter deeply. It can cause damage to biological tissues, including DNA, which can lead to cellular mutations and health risks such as cancer.

Applications: Ionizing radiation is used in medical imaging (X-rays and CT scans), radiation therapy for cancer treatment, industrial radiography, and nuclear physics research.

Non-Ionizing Radiation:

Definition: Non-ionizing radiation refers to radiation with lower energy that does not have enough power to remove electrons from atoms or molecules, thus not producing ions during interactions.

Examples: Radio waves, microwaves, infrared radiation, visible light, and ultraviolet (UV) radiation in the non-ionizing part of the UV spectrum.

Properties: Non-ionizing radiation has lower energy and generally does not penetrate matter as deeply as ionizing radiation. It's less likely to cause immediate damage to biological tissues or DNA.

Applications: Non-ionizing radiation is used in various everyday technologies, including radio and television broadcasting, microwave ovens, cell phones, Wi-Fi, and laser devices for communications and medical procedures.