

Dr. Manoj Kumar Gupta (Assistant Professor of Chemistry, H.D. Jain College, Ara)

## Introduction

- Atomic nuclei are made of **protons and neutrons (nucleons)**
- Early models couldn't fully explain **nuclear stability**
- The **Shell Model** was proposed to explain why some nuclei are more stable than others

*Image suggestion:* Simple diagram of a nucleus with protons and neutrons

---

## History

- Proposed by **Maria Goeppert Mayer** and **J. Hans D. Jensen** (1949)
  - Developed after the discovery of **magic numbers**
  - Earned them the **Nobel Prize in Physics, 1963**
- 

## Basic Idea

- Nucleons move in **discrete energy levels (shells)** inside the nucleus
  - Shells are filled according to the **Pauli Exclusion Principle**
  - Analogous to **electron shells in atoms**
- 

## Assumptions of Shell Model

- Nucleons move **independently** in a mean potential
  - Each shell can hold a **limited number of nucleons**
  - **Paired nucleons** contribute to stability
  - **Spin-orbit coupling** splits energy levels further
- 

## Energy Levels in the Nucleus

- Shells labeled as: **1s<sup>1/2</sup>, 1p<sup>3/2</sup>, 1p<sup>1/2</sup>, 1d<sup>5/2</sup>...**
  - Number of nucleons in each shell: **2, 6, 12, 20...**
  - **Spin-orbit interaction** explains the observed magic numbers
-

## Magic Numbers

- Certain nucleon numbers are especially **stable**
  - **Magic Numbers:** 2, 8, 20, 28, 50, 82, 126
  - Nuclei with these numbers show:
    - High **binding energy**
    - Low **radioactivity**
    - Greater **stability**
- 

## Evidence for Shell Model

- Observed **abundance of nuclei with magic numbers**
  - Measurement of **nuclear spins and magnetic moments**
  - Nuclear reactions show **energy gaps between shells**
- 

## Applications

- Explains nuclear **stability trends**
  - Helps predict **radioactive decay**
  - Useful in **nuclear reactors** and **medical isotopes**
  - Important in **nuclear spectroscopy**
- 

## Summary

- Shell Model describes **nucleons in discrete energy levels**
- Explains **magic numbers** and nuclear stability
- Introduced **spin-orbit coupling** concept
- Crucial for understanding **nuclear structure and reactions**