P.G.SEMESTER-II
CC- V
Advances in Chemistry

Unit-I Nuclear Chemistry
Topic- Shell Model of Nucleus (PART - 1)

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Nuclear Models

There are three models of nucleus

- Liquid Drop Model
- Nuclear Shell Model
- Collective Model

Here we are going to discuss the Nuclear shell Model.

Nuclear Shell Model

- **Definition**

In nuclear physics, the **nuclear shell model** is a theoretical model to describe the **atomic nucleus (in terms of energy levels).**

- The nuclear shell model was proposed by **Dmitry Ivanenko** in 1932 and further developed independently by several physicists such as Maria Goeppert-Mayer, Eugene Paul Wigner and J. Hans D. Jensen in 1949.
- It must be noted this model is based on the Pauli exclusion principle to describe the structure of the nucleus in terms of **energy levels**.

Features of Shell Model

The important features of nuclear shell model are:

- The Shell Model is partly analogous to atomic shell model which describes the arrangements of electrons in an atom.
- The nucleons move randomly in a nucleus and collide into each other frequently in liquid drop model. The **shell model** suggests that each nucleon in a nucleus moves in a well defined orbit and hardly makes any collision. This is why this model is also called as **independent model.**.
- As Nuclear Shell Model is analogous to atomic shell model so filled shells results in greater stability
- The nucleons in a nucleus obey **Pauli exclusion principle(no two nucleons may occupy same state at the same time).** The neutrons and protons are treated separately when their states are considered . Each have its own array of available quantized states.

Features of Shell Model

- In this model each nucleon is assume to exist in shell just like in atomic model.
- The nuclei shell are associated with certain **Magic Numbers.**

Magic Number

In nuclear physics the magic number is the "Number of nucleons (either protons and nuetrons) such that are arranged into complete shell withen the atomic nucleus.

The seven most widely recognize magic numbers are 2,8,20,28,50,82,126.

The magic nuclei have special stability.

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Features of Magic Numbers

- If number of protons corresponds to magic numbers then we have greater numbers and stable isotopes.

i.e Calcium has six isotopes.

- The element whose Z and N is a magic number has abundance.
- The Electric quadro-pole moment tells about the charge distribution in nucleus that is either :
- symmetric or
- non-symmetric.

Spherical.

When Q is less than 0 then oblate,when greater than 0 then prolate.

Significance of Magic Numbers

- 1.The nuclei either proton number or neutron number equal to magic number are most stable as compared to other nuclei.
- 2. The number of isotopes containing magic number of protons are more than that of other nuclei. Example The number of isotopes of Ca(Z=20) is 6.
- 3. The number of naturally occurring isotones containing the magic number of neutrons are more than that of the other nuclei. Example N=82 has 7 isotones N=80 has 3 isotones

TO BE CONTINUED……

The students are requested to keep studying and stay tuned till further updates regarding the content .

THANK YOU !

You can mail your subject related queries on…

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