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Nuclear Physics

Binding energy

When proton and neutron combine to make a nucleus, some of the mass disappears because it is converted into an amount of energy. This energy is called binding energy.

Mass defect

A mass defect is defined as the difference between an atom's mass and sum of the masses of its protons, neutrons and electrons.

Packing fraction

The ratio between the mass defect (Δm) and the mass number (A) is called packing fraction (f).

$$f = \frac{\Delta m}{A}$$

Nuclear force

Since stable nuclei exist, it follows that there must be certain forces acting between their nucleons that bind them into the nucleus. These are called nuclear force.

Magic numbers

A nucleus is stable, if it has certain definite number of either protons or neutrons which is called magic numbers. They are 2, 8, 20, 50, 82 and 126.

Half life period

It is defined as the time required for one –half of the radioactive substance to disintegrate. $T_{1/2} = \frac{0.6931}{\lambda}$

Average or Mean life period

It is defined as the ratio of the total life time of all the radioactive atoms to the total number of such atoms in it.

$$\bar{T} = \frac{1}{\lambda}$$

Internal conversion

When a nucleus passes from a higher excited state to the ground state, the difference in energy of the two states is emitted as a γ -ray. As an alternative to γ -decay, an excited nucleus, in some cases, may return to its ground state by giving up its excitation energy to one of the orbital electrons around it. The emitted electron has a K.E equal to the lost nuclear excitation energy minus the binding energy of the electron on the atom. This process is called internal conversion.

Principle of ionization chamber

It is based on the principle of the charged sub-atomic particles can ionize. The number of ion-pairs produced gives us information not only on the nature of the incident particles but even on their energy.

Plateau region

In G-M counter, as the potential energy is increased, the counting begins and rises rapidly to a flat portion of the curve called plateau region.

Disadvantage of G-M counter

- (i) It is insensitive for a period of 200 to 400 μs following each pulse which prevents its use at high counting rate
- (ii) It cannot provide information about the particle or photon causing a pulse.

Principle of Betatron and its uses

It is based on the principle of a transformer. It is used to accelerate **electrons** to very high energy.

Principle of Electron synchrotron

It is based on the principle of the combined working of betatron and cyclotron.

Nuclear fission

The process of breaking up of the nucleus of a heavy atom into two, more or less equal fragments with release of a large amount of energy is called nuclear fission.

Nuclear fusion

Two or more light nuclei combine together to form a single heavy nucleus is called nuclear fusion.

Chain reaction

It is a self propagating process in which number of neutrons goes on multiplying rapidly almost in geometrical progression during fission till whole of fissile material is disintegrated.

Multiplication factor

The ratio of secondary neutrons produced to the original neutron is called the multiplication factor.

Thermonuclear reactions

At very high temperatures, the nuclei are able to overcome their mutual Coulomb repulsion and enter the zone of nuclear attractive forces. Hence these reactions are called thermonuclear reactions.

Threshold energy

It is defined as the minimum kinetic energy of the incident particle which will initiate an endoergic reaction.

Q-value

The amount of energy absorbed or released during the nuclear reaction is called Q-value.