Marwari college Darbhanga

Subject---physics (Hons)

Class--- B. Sc. Part 3

Paper –06 ; Group—A

Topic--- Beta Decay (Nuclear physics)

Lecture series. --66

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Beta Decay

Beta Decay is a type of radioactive decay in which a proton is transformed into a neutron or vice versa inside the nucleus of the radioactive sample. Processes like this and alpha decay allow the nucleus of the radioactive sample to get as close as possible to the optimum neutron/ proton ratio. While doing so, the nucleus emits a beta particle which can either be an electron or positron. Remember that there either a proton can turn to a neutron

or neutron to a proton. Electron and the positron are generated to obey the law of conservation of charge. The beta decay occurs via the weak interaction.

There are two types of beta decay:-

(1)beta minus (β-) decay

(2) beta plus (β+). decay

Beta-Minus Decay:

- In beta minus, a neutron is transformed to yield a proton causing an increase in the atomic number of the atom. The neutron is neutral but the proton is positive.
- To maintain conservation of charge, the nucleus in the process also produces an electron and an antineutrino.
- Antineutrino is the antimatter counterpart of neutrino. Both of these are neutral particles with little mass. They interact with matter very weakly and can even pass through the entire earth without being disturbed.
- In a beta minus decay, the change in atomic configuration is;

$$ {}^{A}_{Z}\mathrm{X} \rightarrow {}^{A}_{Z+1}\mathrm{Y} + e^{-} + \bar{\nu} $$

$$ N = p + e^{-} + v^{-} $$

Examples of beta minus decay include the decay of ^{14}C into ^{14}N and it usually occurs in neutron rich nuclei.

Beta-Plus Decay:

- In beta plus decay, the proton disintegrates to yield a neutron causing a decrease in the atomic number of the radioactive sample. The nucleus experiences a loss of proton but gains a neutron.
- Again, conservation of charge is important. The beta plus decay in order to obey the conservation law also yields a positron and a neutrino.
- A positron is the antimatter equivalent of an electron; the same in all aspects except that a positron has a positive charge.
- A Neutrino's behaviour is the same as the antineutrino's. Expressed in the equation it is,

$$^{A}_{Z}\mathrm{X} \rightarrow ^{A}_{Z-1}\mathrm{Y} + e^{+} + \nu$$

$$P = n + e^{+} + v$$

Beta plus decay can happen only if the daughter nucleus is more stable than the mother nucleus. This difference goes into the conversion of a proton into a neutron, a positron and a neutrino. There is no increase in mass number because a proton and a neutron have the same mass.