**NUCLEAR PHYSICS-16SCCPH8**

**UNIT-V**

**ELEMENTARY PARTICLES**

**CLASSIFICATIONS OF ELEMENTARY PARTICLES:**

**BARYONS (Heavy Particles):**

* Proton
* Neutron
* Lambda
* Sigma
* Xi
* Omega

Lambda, Xi, Omega are HYPERONS. Every Baryons has an antibaryons. +1 is assigned baryon. -1 is assigned for antibaryons.

**MESONS**:

* Pion
* Kaon
* Eta

The rest mass of the particles varies between about 250me and 1000me. The mesons are agents of interaction between particles inside the nucleus. Baryons and mesons are jointly called HADRONS.

**LEPTONS**:

* Photon
* Neutrino
* Electron
* Muon

**PARTICLES AND ANTI PARTICLES:**

* Electron – Positron
* Proton -antiproton
* Neutron-antineutron
* Neutrino- antineutrino

**FUNDAMENTAL INTERACTIONS:**

Four basic interactions are summarised below

1. **Strong interaction:**

* A familiar example of strong interaction is nuclear forces.
* It is independent of electric charge
* Range is about 10-15m
* Time interval is about 10-23s

1. **Electromagnetic Interaction:**

* It operate on all charges
* It is charge dependent
* The range is infinite
* Interaction through photons
* Example electron- positron pair from gamma rays

1. **Weak interactions:**

* Time interval is about 10-10s.
* Range is less than 10-17m
* Characteristic time about 10-10s
* It is responsible for decay of strange and non-strange particles and for non leptonic of strange particles.

1. **Gravitational Interactions:**

* Weakest type of interactions
* It has infinite range
* Intermediate through gravitons
* Weak forces affect every particles other than photon.

**PIONS AND MUONS:**

Pi mesons are particles with mass intermediate between that of an electron and a proton. To explain the short range of internucleonic force, the pion considered as a quantum of this force.

It was predicted by Yukawa. Subsequently it was discovered by Powell and co -workers.

Its (π0) mass is about 135Mev/c2 or about 250 times the electron mass with integral spin. Charged pions have mass of 140 Mev/c2. All pions strongly interacted with matter.

p+p p+p+ π0

p+n p+p+ π-1

p+p p+n+ π+

Muons like a charged pions, are also elementary particles with mass intermediate between that of an electron and a proton. It has a mass only 106 Mev/c2 and does not interact strongly with matter. Its spin ½. Muons are electrically charged either positively or negatively and it carry one unit of charge. They are unstable particles and emit electrons. Muons also discovered in cosmic radiation.

**K-MESONS OR KOANS:**

* While working with a counter controlled cloud chamber in a string magnetic field, with a lead sheet interposed along the diameter of the chamber ,Rochester and Butler observed a paired of track of oppositely charged pions originating apparently at a common point. It was not a case of collision process producing the pair, for then a host of other particles would have originated in the lead plate. The event was

Attributed to spontaneous disintegration of a neutral particle that left no track in the chamber and the particle was termed as K0 meson.

The disintegration was represented as

K0 π++ π-1

* K mesons are charged positively and negatively K+ and K- that decay into three charged pions.

K+ π++ π++ π-1

K- π-1+ π++ π-1

* All K decays assigned to single group of mesons are called K mesons or Kaons. Both charged and neutral. Masses being 975 mefork0 and 966 me for K+ and K-.
* The mean life of Kaon sabout10-10to 10-8 s.
* It is the characteristic of the weak interaction decays.
* Kaons are known as the strange particles
* All Kaons have zero spin, they are bosons.
* Kaons available in giant accelerators.