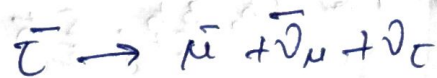


B.Sc-III, Paper-VI, Group-A (Nuclear Physics)

(1) Photons:- Photon represents a quantum of radiation that travels with the velocity of light and possesses an energy $h\nu$, where h is Planck's constant and ν the frequency of radiation. It is a stable particle having zero rest mass and no rest energy. By virtue of motion it possesses a mass $h\nu/c^2$. Its spin is 1 and is thus a boson.

(2) Leptons:- Particles, which do not respond to strong interactions but only to weak and electromagnetic interactions are referred to as leptons. They are all fermions of spin $1/2$. Their masses are smaller than that of the pion, the lightest meson. So far we know twelve leptons, electron (e^-), electron neutrino (ν_e), positron (e^+), positron anti neutrino ($\bar{\nu}_e$), pair of muons ($\mu^-; \mu^+$), pair of tauons ($\tau^-; \tau^+$) and three muon neutrinos (ν_μ) and tauon neutrinos (ν_τ) and their anti particles. Leptons appear to have no internal structure. Muons have mass of about $200 m_e$ and spin $1/2 \hbar$. Tauons have heavier than muons. They are unstable and decay into muons and two neutrinos.



All neutrinos are stable, having zero charge and spin $1/2 \hbar$ and negligible (or zero) mass.

Hadrons:- They are subject to strong nuclear interactions.

Hadrons are subdivided into

(a) mesons (b) Baryons.

(a) Mesons:- Mesons are strongly interacting and include pions ($\pi^{\pm,0}$), kaons ($K^{\pm,0}$) and η -meson (η^0)

all having masses between that of a pion and a nucleon.

Further, there are charmed mesons ($D^{\pm,0}$) and beautiful ($B^{\pm,0}$) which are heavier than nucleons.

Pions are responsible for short range nuclear forces and exist as positively and negatively charged or neutral particles.

Kaons are produced due to interactions of high-energy particles at a very short range due to short nuclear force.

η^0 exists as a neutral particles with a short lifetime. All mesons have zero spin and odd parity and hence are Bosons.

(b) Baryons:- The baryons have half odd-integral spin i.e. $\frac{1}{2}, \frac{3}{2}, \frac{5}{2}$ etc. They obey

Fermi-Dirac Statistics and are called fermions.

Thus, Baryons are strongly interacting fermions.

Baryons have rest mass intermediate between that of a nucleon and a deuteron. These include protons and neutrons and hyperons that include Lambda (Λ^0)

Sigma ($\Sigma^{\pm,0}$), Xi (Ξ^0) and omega (Ω^-) particles and their antiparticles. Hyperons are strange particles, unstable and were first discovered in cosmic rays. Total No. of baryons in the universe is conserved.

Translation: $\Xi \rightarrow \Xi$