

## PARTICLE PHYSICS

### Particle physics:

The branch of Physics which deals with property, interaction and structure of elementary particles is called Particle Physics.

### Elementary particles or fundamental particles:

The particles which are structure-less, indivisible & aren't made up of any other particles are called elementary particles.

They are regarded as building Block or constituents of matter.

More than 200 elementary particles have been discovered.

E.g. Lepton, Quarks, etc.

### Antiparticles:

A subatomic particle having the same mass as a given particle but opposite electric (and magnetic) properties is called antiparticle.

Every kind of subatomic particle has a corresponding antiparticle, e.g. the positron has the same mass as the electron but an equal and opposite charge.

Particle	Symbol	Antiparticle	Symbol	Average life (sec)
Electron	$e^-$	Positron	$e^+$	stable
Proton	$p^+$	Antiproton	$\bar{p}$	Relatively stable
Neutron	n	Antineutron	$\bar{n}$	879
Neutrino	$\nu$	Antineutrino	$\bar{\nu}$	Stable
Muon	$\mu^-$	Antimuon	$\mu^+$	$2.2 \times 10^{-6}$
Tau	$\tau^-$	Antitau	$\tau^+$	$2.9 \times 10^{-13}$

### Pair Production and annihilation:

#### 1. Pair Production:

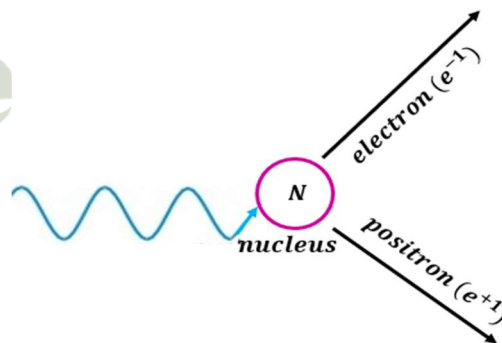
When a highly energetic radiation ( $\gamma$ -ray photon) falls on a heavy substance then it will be absorbed by its nucleus & energy exchanged by the photon give rise to production of particle and its antiparticle.

Such a phenomenon in which a radiation converts into a mass (pair of particle and antiparticle) is known as pair production.

i.e.  $\text{Photon} \rightarrow \text{electron} + \text{positron}$

$$\text{or, } \gamma \rightarrow e^- + e^+$$

The total rest mass energy of produced particles (electron- positron pair) is 1.02 MeV. Hence, the minimum energy of photon required for electron-positron pair production should be 1.02 MeV.



**Figure: Pair production**

*This process provides evidence for Einstein's mass- energy relation that **energy can be converted into mass.***

**Pair production** often refers specifically to a photon creating an electron positron pair near a nucleus.