

3. Neutrinos

Why in News?

- physicists working with the Kamioka Liquid Scintillator Antineutrino Detector (KamLAND) in Japan has recently reported that after analysing two years' data, they could not find signs that neutrinos could be their own anti-particles.

Highlights

- KamLAND looks for an event called neutrinoless double beta-decay.
- In normal double beta-decay, two neutrons in an atom turn into two protons by emitting two electrons and two electron antineutrinos.
- In neutrinoless double beta-decay, the anti-neutrinos aren't emitted, which can happen only if anti-neutrinos are just different kinds of neutrinos.
- Neutrinos are the second most abundant particles in the Universe after photons (light particles), produced in copious amounts in the cores of stars.
- Because they are so ubiquitous, their properties are windows into the microscopic structure of the universe.
- One open question about neutrinos is whether they are their own antiparticles. If they were, physicists will have a way to explain why the universe has more matter than antimatter.
- Probing of oscillations of neutrinos and their relations with mass are crucial in studying the origin of the universe.
- Sources of Neutrinos: Neutrinos are created by various radioactive decays; during a supernova, by cosmic rays striking atoms etc.
- Every elementary particle has an antiparticle. If the two meet, they will destroy each other in a flash of energy.
- The electron's antiparticle is the positron. Similarly, neutrinos have anti-neutrinos.
- However, an electron is distinguishable from a positron because they have opposite charges. Neither neutrinos nor anti-neutrinos have electric charge, nor any other properties to really differentiate between them.
- One way to classify subatomic particles is as matter particles and force-carrying particles. Neutrinos are matter particles, or fermions. Fermions can be further split as Dirac fermions or Majorana fermions. Dirac fermions are not their own anti-particles, whereas Majorana fermions are.