



Neutrinos

Why in News?

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

What was the Experiment?

- 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.

What are Neutrinos?

- **About:** Neutrinos are the **second most abundant particles in the Universe after photons** (light particles), produced in copious amounts in the **cores of stars**.
- **Properties:** Because they are so ubiquitous, **their properties are windows into the microscopic structure of the universe**.
 - For example, 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.
- **Significance:** 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.**

What are Anti-Particles?

- 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.

UPSC Civil Services Examination Previous Year Question (PYQ)

Q. In the context of modern scientific research, consider the following statements about 'IceCube', a particle detector located at South Pole, which was recently in the news: (2015)

1. It is the world's largest neutrino detector, encompassing a cubic kilometre of ice.
2. It is a powerful telescope to search for dark matter.
3. It is buried deep in the ice.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (d)

[Source: TH](#)

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