

Neutrinos ('Ghost Particles') Can Remotely Track Spent Nuclear Fuel

Researchers have developed a technique using neutrinos ('ghost particles') to remotely monitor spent nuclear fuel and detect unauthorized plutonium extraction.

It is a non-intrusive nuclear safeguards tracking technique that measures antineutrino emissions from spent nuclear fuel to prevent illicit nuclear weapons material diversion.

KEY EXAM POINTS

- Researchers identified a unique **neutrino** signature from **spent nuclear fuel** assemblies stored in cooling pools.
- The method allows **remote detection** of illicit fuel removal without requiring physically intrusive inspection of radioactive **reactor cores**.
- Spent nuclear fuel contains **plutonium-239**, a critical fissile ingredient used in **nuclear weapons** development.
- **International Atomic Energy Agency (IAEA)** inspectors can use this non-intrusive monitoring technique for global nuclear **non-proliferation safeguards**.
- **Antineutrinos** are emitted during the **beta decay** of radioactive fission products present in the spent nuclear fuel rods.

STATICS & SYLLABUS FOCUS

Neutrinos are subatomic particles with neutral charge and extremely small mass, commonly termed as 'ghost particles'.

The International Atomic Energy Agency (IAEA) was established in **1957** as an autonomous intergovernmental organization headquartered in **Vienna, Austria**.

India-based Neutrino Observatory (INO) is a proposed underground physics laboratory project located at **Pottipuram** in **Theni district**, Tamil Nadu.

Frederick Reines and **Clyde Cowan** first experimentally discovered the existence of the neutrino in **1956**.

Plutonium-239 is produced in nuclear reactors from **Uranium-238** through neutron capture and subsequent beta decays.

The **Non-Proliferation Treaty (NPT)** entered into force in **1970** to prevent the spread of nuclear weapons and technology.

Nuclear fission is the reaction in which a heavy nucleus splits into smaller nuclei, releasing a massive amount of energy.

REVISION FLASHCARD

Neutrinos ('ghost particles') from spent nuclear fuel enable non-intrusive remote tracking to detect illicit plutonium extraction.

Syllabus Relevance: Relevant for Unit 1 (General Science - Physics) and Unit 2 (Current Events - Science & Tech / IAEA Safeguards) in Group 1, 2, 2A & 4 exams.

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