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## Antarctic Impulsive Transient Antenna: ANITA

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### Why in News

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Recently, NASA's **Antarctic Impulsive Transient Antenna (ANITA)** has detected the unusual **upward movement** of neutrinos in Antarctica.

- Instead of the high-energy neutrinos streaming in from space, they seem to have come from the Earth's interior, before hitting the detectors of ANITA.  
Usually, the high-energy particles move top to bottom (i.e. from space to the earth). However, ANITA has detected an anomaly i.e. particles have been detected travelling bottom to top.
- **Earlier, researchers had also located a deep-space source for high-energy neutrinos** through the **Ice Cube Neutrino Observatory** at a U.S. scientific research station at the South Pole in **Antarctica**.  
The India-based Neutrino Observatory (INO) is located at the **Bodi West Hills region** in Theni District of **Tamil Nadu**.

### Antarctic Impulsive Transient Antenna

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- **Antarctic Impulsive Transient Antenna (ANITA)** is a radio telescope instrument to detect **ultra-high energy cosmic-ray neutrinos** from a scientific balloon flying over the continent of Antarctica.
  - It involves an array of radio antennas attached to a helium balloon which flies over the Antarctic ice sheet at 37,000 meters.
  - At such a height, the antennas can listen to the cosmos and detect high-energy particles, known as neutrinos, which constantly bombard the planet.
- It is the **first NASA observatory for neutrinos** of any kind.

- ANITA detects neutrinos ping-pong in from space and colliding with matter in the Antarctic ice sheet through the **Askaryan effect**.
  - The Askaryan effect is the phenomenon whereby a particle **traveling faster** than the phase velocity of light in a **dense dielectric** (such as salt, ice or the lunar regolith) produces a shower of secondary charged particles.
    - When neutrinos smash into an atom, they produce a shower of detectable secondary particles. These detectable secondary particles allow us to probe where they came from in the universe.
    - However, neutrinos pose no threat to human beings and pass through most solid objects. Additionally, they rarely do interact with matter.
  - It is named after GURGEN Askaryan, a Soviet-Armenian physicist who postulated it in 1962.

## Neutrinos

- Neutrinos are **electrically neutral, undisturbed** by even the strongest magnetic field, and **rarely interact with matter**. The direction from which they arrive points directly back to their original source.
- Neutrinos are produced during natural radioactive decays and all sorts of nuclear reactions in nuclear power reactors, particle accelerators or nuclear bombs.
- However, the most common sources of neutrinos are celestial phenomena i.e. the birth and death of stars, collisions, and explosions happening in space.

## Way Forward

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- The ANITA experiment has definitely detected something unusual and unexpected about neutrinos but there are many competing theories about it. There are a number of potential candidate particles that could account for the results from ANITA.
- Further, there are so many unknown properties about neutrinos that astrophysicists and scientists are still trying to unravel.
- It contemplates that there is new physics out there to be found which will help to study the origin of the universe and big bang theory in the future.

## Source:BL