

# Neutrino project

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**Context:** The India based Neutrino Observatory (INO) is being planned in the Theni district in Tamil Nadu.

- In December 2017, the Cabinet Committee on Security cleared the India-based Neutrino Observatory project, to be built at an investment of Rs 1,500 crore.
- It is to be built at Pottipuram village, in Theni district, near the Tamil Nadu-Kerala border.
- It is an underground project and will comprise a complex of caverns. The main cavern, which will house the huge neutrino detector [50-kilo tonnes magnetised iron calorimeter], will be 130 m long, 26 m wide, and 30 m high. Two smaller caverns will be used for setting up experiments for neutrino double detector and dark matter. Approach to this complex will be by a 2km long tunnel.
- The India-based Neutrino Observatory (INO) will study atmospheric neutrinos only. Solar neutrinos have much lower energy than the detector can detect. Atmospheric neutrinos are produced from cosmic rays which consist of protons and heavy nuclei. These collide with atmospheric molecules such as Nitrogen to give off pions and muons which further decay to produce neutrinos
- The mountain consists of 1km of solid rock that filters away most of the charged particles from the cosmic rays. The filtered set consists of a part of the incident cosmic ray protons and pions and practically all the neutrinos.
- If the detector was placed at the surface of the mountain, it would pick up billions of cosmic ray muons every hour and about 10 neutrino events per day. After placing inside the rock, it would detect only 300 muon events per hour and about 10 neutrino events per day of

which 3 will be the desired muon neutrino events.

- The Tata Institute of Fundamental Research is the nodal institution. The observatory is to be built jointly with the Department of Atomic Energy and the Department of Science and Technology.
- Most of the neutrino detectors are at latitudes over 35 deg. It is possible to push such a detector down to almost 8 deg latitude in South India, within proximity to the Equator. This permits neutrino astronomy searches covering the whole celestial sky and study of solar neutrinos passing through the Earth's core.
- Locals fear that the excavation and blasts needed to bore the tunnel in the mountains will endanger the biodiversity of the Western Ghats. Some of the concerns voiced range from radiation, structural damage to the mountain to emission of hazardous chemicals. Scientists have junked all these claims as baseless and unfounded.

## **Neutrinos**

- Neutrinos are the smallest particles that form the universe.
- Atoms are made of proton, neutron and electron and neutrino is not a part of the atom
- It has very little mass, no charge, half spin
- It interacts weakly with matter
- Source can be solar system, other stars, cosmic rays , they can also be produced in lab
- 3 flavours- electron neutrino, Tau neutrino, muon neutrino. They can change from one flavour to another as they travel which is called as neutrino oscillation

## **Applications of such project**

- They give us information about the interior of the sun.
- they can be used in astronomy to discover what the universe is made up of.

- give us a clue about the origin of the universe and the early stages
- INO detectors may have applications in medical imaging.

### **Other countries who have neutrino facility**

**Underground** Canada, Kamioka in Japan and Gran Sasso, Italy

**Underwater** Amundsen-Scott South Pole Station, Antarctica.  
Antares – under Mediterranean sea off-coast of Toulon, France.

