THE INDIA BASED NEUTRINO OBSERVATORY-ABOUT NEUTRINOS

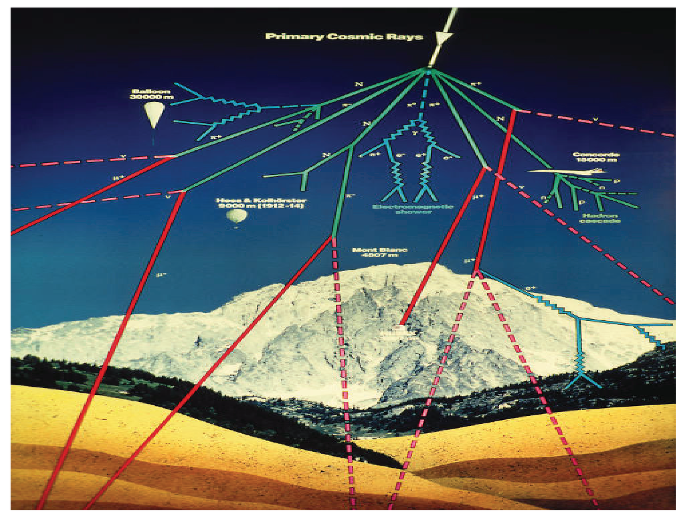
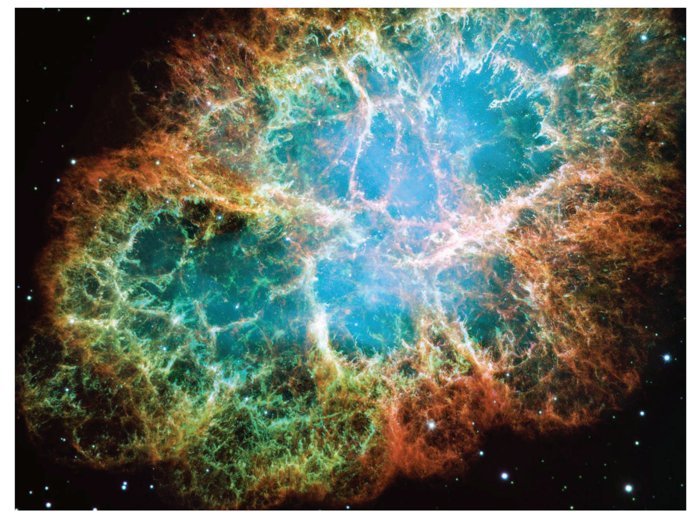
PROPERTIES

Charge	0
Mass	≈0
Spin	½ - Fermion
Types	3 : ν_e , ν_μ , ν_τ
Family	Lepton
Interaction	Weak

Neutrinos are chargeless, almost massless particles belonging to a class of particles called Leptons. They are half-integer spin particles and hence have the statistical behaviour of fermions. In the Standard Model of particle physics the three charged leptons, elec-tron, muon and the tao lepton each have their own partner neutrino. Neutrinos interact weakly and therefore their detection is extreme-ly difficult. They can easily pass through the earth and come out without any hindrance or deflection!. Not only that, they can even change their flavor as they travel.

SOURCES



Neutrinos are produced both artificially and naturally from a wide variety of sources.

Neutrinos from the sun (called solar neutrinos) are produced due to the thermonuclear reaction taking place in the sun's core. These neutrinos are less energetic with their energy being in the range of a few MeVs.

Million Electron Volt (MeV) is a convenient unit of energy often used in high energy physics. A flying mosquito has an energy of approximately a million million electron volts.

Neutrinos are also produced from the core of nuclear reactors. Nuclear reactors are the main source of artificially produded neutrinos. Their energy is also in the order of few MeVs.

Cosmic rays are one of the major sources of naturally produced neutrinos. These neutrinos are produced in the earths atmosphere due to nuclear interactions. They have a wide energy ranging from few thousands of Mev to hundreds of thousands of MeV.

Atmospheric neutrinos were first detected in 1965 at the Kolar gold mines in India. The India Based Neutrino Observatory will mainly probe atmospheric neutrinos.

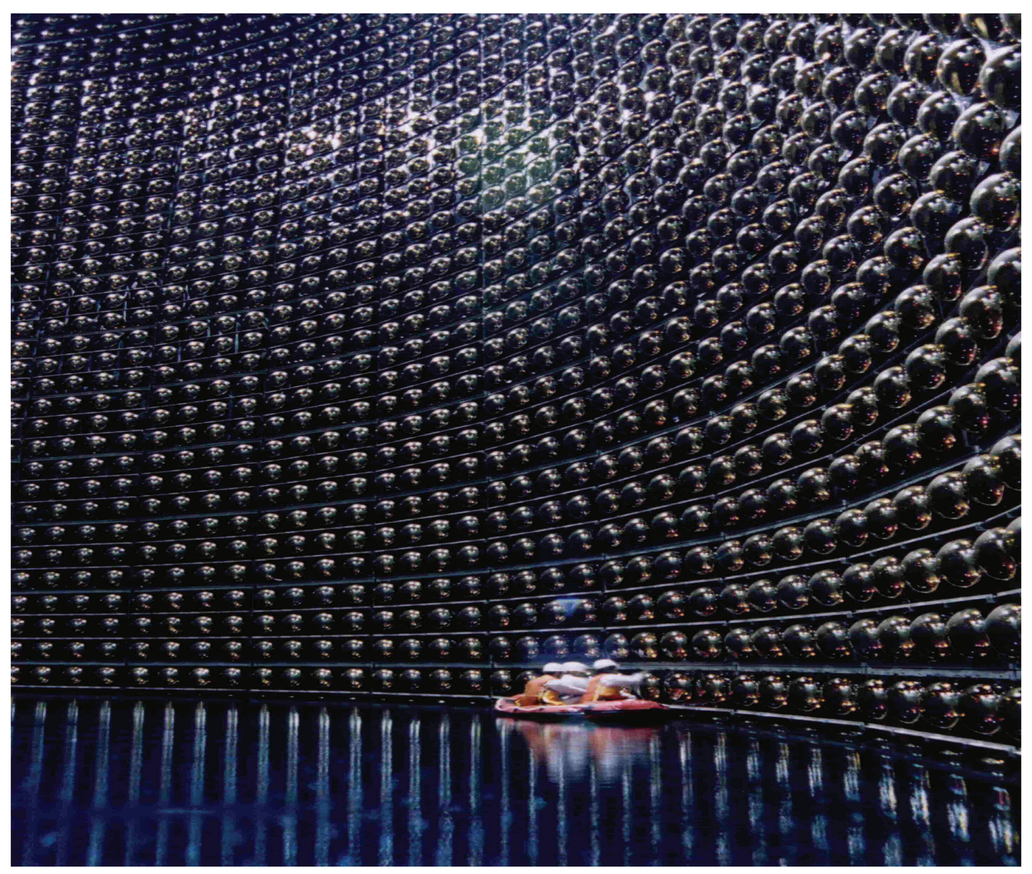
Another interesting source of neutrinos is the explosion of supernovae. They have an energy of few tens of MeVs.

Apart from these sources, neutrinos are also emitted from naturally found radioactive elements like Uranium. Radioisotopes of Potassium and Carbon present in the human body also emit neutrinos.

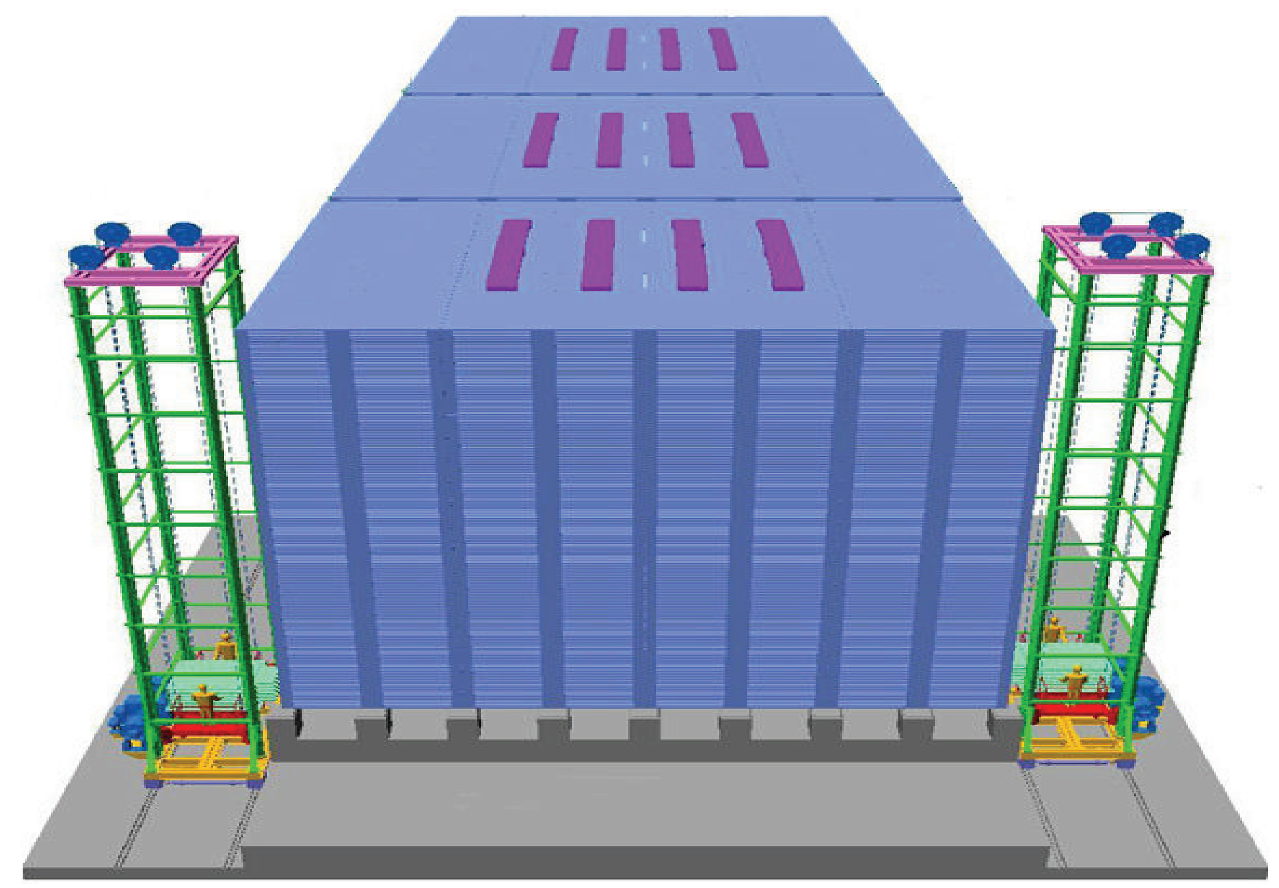
FLUX

Neutrinos are everywhere. They come from the Sun, they come from the atmo-sphere. Keep your hands open and every second approximately 12000 billion of neutrinos will pass through them and you never ever feel them.

DETECTION IN EXPERIMENTS


The Super Kamiokande


IceCube Neutrino Observatory


The ICAL detector for INO

When it comes to detection, neutrinos are one of the difficult particles to detect due to their weakly interacting nature. However, there are many experiments which have detected them. The detectors are usually placed underground in order to prevent cosmic rays and other noises from affecting them. Also, the detector size has to be big enough in order to sense a significant amount of neutrinos. The Super-Kamiokande detector in Japan is a tank of 42 m height and 39 m width containing 50000 tons of pure water and in all about 13000 photomultiplier tubes. Neutrinos are detected by the emission of Cerenkov light when they traverse the water medium at the speed of light.

The IceCube Observatory uses the same mechanism of Super-Kamiokande to detect neutrinos. Here, the icesheet at the south pole is used instead of the water tank.

The Iron Calorimeter (ICAL) detector is quite different from the above two detectors. It uses gaseous detectors called Resistive Plate Chambers (RPC) and iron layers to detect neutrinos. Neutrinos interact with matter in the iron plates and as a result charged particles are emitted which leave signals in the RPCs. A total of 27000 RPCs and 50 Kton of Iron will be used. A magnetic field is generated by coils running through the detector. The uniqueness of this experiment is its capability to differentiate between a postive charged muon and a negatively charged muon and thus between a muon neutrino and a muon anti neutrino that produced it.