TATA INSTITUTE OF FUNDAMENTAL RESEARCH

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Press Release

The Union Cabinet of the Govt. of India chaired by the Prime Minister, Shri Narendra Modi, has given its approval for the establishment of India-based Neutrino Observatory (INO) at an estimated cost of Rs. 1500 crores.

The INO project is jointly supported by the Department of Atomic Energy and the Department of Science and Technology. Infrastructural support is provided by the Government of Tamil Nadu where the project is located. Tata Institute of Fundamental Research (TIFR), Mumbai is the host institute for INO.

This project aims at building a world class underground laboratory primarily to study neutrinos. Determination of neutrino masses and mixing parameters is the most significant open problem in particle physics today and is the key goal of the INO project. The underground facility will develop into a full-fledged science laboratory for other studies as well in physics, biology, geology etc. all of which will exploit the special conditions existing deep underground. The underground laboratory will be set up near Pottipuram village, Theni District, Tamilnadu. In addition, an Inter -Institutional Centre for High Energy Physics (IICHEP) will also be established at the city of Madurai which is about 110 km from the proposed INO site for operationalizing the underground laboratory and also for detector R & D and human resource development.

Along with setting up the underground laboratory and the IICHEP, Government of India also approved the construction of a 50 kton magnetised Iron Calorimeter detector (ICAL) to study the properties of neutrinos and specially to address the issue of neutrino mass hierarchy. Understanding this will help the scientists to pick the correct theory beyond the standard model of particle physics and along with other accelerator based experiments worldwide, address the problem of matter-antimatter asymmetry of the universe. 21 research institutes, universities and IITs from India are currently working for setting up the ICAL detector. The 50 kton ICAL detector will consist of alternate layers of particle detectors called Resistive Plate Chambers (RPCs) and iron plates. The iron plates will be magnetized with 1.4 Tesla magnetic field. Over 30,000 RPCs will be used in this detector. A total of over 3.7 million channels of electronics will carry the signals from these RPCs to be finally stored in the computer.

The INO laboratory will also host other experiments apart from the currently proposed ICAL detector. Already several groups are planning to set up a neutrino-less double beta decay experiment to study the nature of the neutrinos. Another proposed experiment will look for the evidence of Dark Matter which constitutes about 23% of the total mass of the universe.

An INO Apex Committee co-chaired by Secretary, Department of Atomic Energy and Secretary, Department of Science & Technology, Govt. of India, will oversee the implementation of the INO

project. A Project Management Board chaired by Director, Bhabha Atomic Research Centre, Mumbai and a Scientific Management Board chaired by Director, Tata Institute of Fundamental Research, Mumbai will coordinate and monitor INO construction work and its scientific activities respectively. Prof. Naba K Mondal from Tata Institute of Fundamental Research, Mumbai who was earlier associated with the underground laboratory at Kolar Gold Fields has been designated as the Project Director of INO.

"This is the largest basic science project in India and is important for promoting scientific research using cutting edge of technology. There is tremendous potential of engaging science students across the country in basic research through this project" said Dr. R.K.Sinha, Secretary, Department of Atomic Energy, Govt. of India.

Prof. K.Vijayraghavan, Secretary, Department of Science & Technology, Govt. of India said "combining high-end training in the best of experimental physics with the best of research, INO will be the agent of transforming physics of this kind in India and will make a global impact. The outcome of this investment will be extraordinary and long term."

"Development of detector technologies for various particle physics experiments and their varied applications including societal applications in areas like medical imaging is an important aspect of the project." Said Mr. Sekhar Basu, Director BARC and chairman, INO Project Management Board.

"An important outcome of the project will be training young researchers in large scale experimental science, including detector instrumentation technology, an area which needs strong development in the country. As the host institute for the multi-institutional INO project, TIFR has played a nurturing role in growing it, and looks forward to rapid developments which will allow new science to be generated" said Prof. Mustansir Barma, Former Director of TIFR and Chairman, INO Scientific Management Board.

"On behalf of the members of INO collaboration, I would like to thank the Government of India, The Department of Atomic Energy and the Department of Science and Technology, Government of Tamil Nadu for making this dream of establishing INO as a premier high energy physics laboratory in the country possible." Said Prof. Naba Mondal, INO Project Director. "INO project will also contribute to the creation of highly skilled scientific manpower for carrying out research in the field of particle physics, astro-particle physics and nuclear physics and a strong industrial base in detector technology and related fields. Science students across the country will have the opportunity to participate in building sophisticated particle detectors and electronics data acquisition systems from scratch. It will also put India back on the world map of underground science, a position that was held by India during second half of the 20th century when Indian scientists had the privilege of working at the world's deepest underground lab at Kolar Gold Mines".

INO collaboration also gratefully acknowledges the Tamil Nadu Electricity Board and the Geological Survey of India for their assistance in site selection.
The Collaboration thanks the scientific community, especially the HEP community, for unstinting support to the project over the last decade or so when the R&D was being carried out."

About neutrinos:

Neutrinos are tiny electrically neutral members of a family of elementary particles called leptons of which the electron is the most familiar, being part of the atom. An elementary particle is one which

cannot be broken into further smaller pieces. Scientific discoveries in the past have found out that there are two cousins of the electron called the muon and the tau respectively 200 and 3500 times heavier. Each of these particles has a neutrino partner called the electron-neutrino, muon neutrino and the tau neutrino. They are chargeless and are almost massless.

Neutrinos are the second most abundant particle in the universe after photon. They were produced during the creation of the universe. They are also produced inside the core of the sun and other stars. Cosmic rays interacting with the atmosphere of the earth also produce neutrinos. They are also produced in large numbers in all the nuclear reactors around the world.

Most of these neutrinos pass through our body and we do not even realise it. They can even pass through the earth. The reason they can do this is because they interact very feebly with anything in their path. Though neutrinos are found in abundance, due to their weekly interacting nature, studying these particles in the laboratory is extremely difficult and need large detectors.

Neutrinos were originally thought to be massless. Recent experiments however have discovered an important facet about neutrinos, that they can change from one type to another as they travel. This transformation from one neutrino type to another is called neutrino oscillation and can not occur unless neutrinos have mass. The fact that neutrinos have mass has implications on our current understanding about the Universe and in areas like Nuclear Physics, Particle Physics, Astrophysics and Cosmology. This makes study of neutrinos a very interesting domain in scientific research. The discovery of neutrino oscillations is just the first step and there are several questions that are still unanswered.

INO-ICAL collaboration:

Physical Research Laboratory (PRL), Ahmedabad
Aligarh Muslim University
Harish Chandra Research Institute (HRI), Allahabad
Institute of Physics (IOP), Bhubaneswar
Utkal University, Bhubaneswar
University of Calicut
Panjab University , Chandigarh
Indian Institute of Technology, Madras (IITM)
The Institute of Mathematical Sciences (IMSc), Chennai
Delhi University
Saha Institute of Nuclear Physics (SINP), Kolkata
University of Calcutta , Kolkata
Variable Energy Cyclotron Centre (VECC), Kolkata
Lucknow University
American College, Madurai
Bhabha Atomic Research Centre (BARC), Mumbai
Indian Institute of Technology, (IITB), Mumbai
Tata Institute of Fundamental Research (TIFR), Mumbai
University of Mysore
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