Indian underground physics programme

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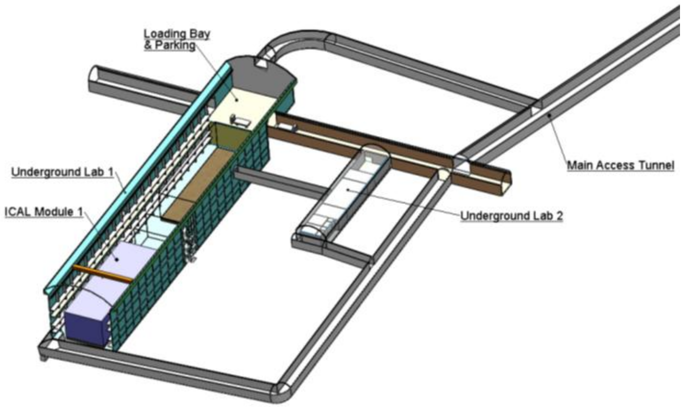
Atmospheric neutrinos were first detected at the Kolar Gold Fields (KGF) underground laboratory in India in 1965. In the late 80s, mining of gold at KGF became economically unviable and KGF underground laboratory was closed down.

India-based Neutrino Observatory (INO) is a newly proposed underground laboratory to be setup in the southern part of India to revive the neutrino physics programme in the country. A schematic view of the INO facility is shown in the figure and some of its basic features are given in the table. It is proposed to house a 50 kton magnetized iron calorimeter (ICAL) tracking detector in the big cavern, while a couple of smaller caverns will also be constructed to host other smaller experiments, such as those looking for neutrino-less double beta decay (NDBD) processes. The primary goal of ICAL is to study of neutrinos from various natural and laboratory sources. The NDBD will provide information on absolute effective mass of the neutrinos and will tell us if the total lepton number is violated. Ministry of Environment & Forests recently accorded both environment and forest clearance for this project.



Length of the tunnel	2 km (approx.)
Tunnel cross-section	7.5m wide and 7.5m high
Tunnel gradient	1:15
Rock overburden	1300m
Rock type and density	Charnockite, 2.9 gm/cc
Number of caverns	3 (one big and two small)
Size of the main cavern	132m × 26m × 20m (high)
Distance from CERN	7100 km
Distance from JPARC	6600 km

The neutrino observatory project is executed by the INO consortium of about 20 Indian scientific institutions and led by the Tata Institute of Fundamental Research (TIFR). It will be a world-class laboratory for underground science, primarily for neutrino physics. It will also involve in the development of detector and instrumentation for large scale experiments. When completed by 2015 at an estimated cost of around INR 10 billion, it will house the world's most massive magnet. Over 200 scientists would participate in this facility.

Among the most important issues that ICAL is capable of shedding light on is the neutrino mass hierarchy. This is possible because of ICAL's unique capability to identify lepton charge. In the realm of neutrino mass and mixing, ICAL can significantly aid in improving the precision of the atmospheric mass squared difference and the associated mixing angle**.** Using effects primarily due to earth's matter, it can also shed light on the octant of the atmospheric mixing angle. ICAL's capability to set bounds on the violation of CPT has also been explored. Its sensitivity to new long range forces has been studied. In addition, ICAL is capable of substantially adding to our present knowledge of very high energy cosmic ray muons due to its unique capability to access hitherto unexplored energy regions in this sector.

Several studies have also explored ICAL's capabilities as an end detector for a neutrino factory or a beta beam, in what would constitute Phase II of the experiment. This would allow highly precise measurements of very important parameters like the CP phase and the small mixing between two of the neutrino mass states.