

## Design, construction and performance of magnetised mini-ICAL detector module

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India-based Neutrino Observatory (INO) has proposed to build a 51kton magnetised Iron Calorimeter (ICAL) in an underground laboratory to be constructed near Madurai, South India. ICAL is aimed to precisely study the atmospheric neutrino oscillation parameters and determine the ordering of neutrino masses. ICAL will be built by stacking 151 layers of 56mm soft iron plates, spanning essentially a lateral area of 48m x 16m. The detector will deploy about 28,800 glass Resistive Plate Chambers (RPCs) of approximately 2m x 2m in area, inserted between the iron layers. About 3.6 million detector channels are required to be instrumented to read data.

During the detector R&D phase, many RPC detector stacks were constructed and operated by the collaboration for prolonged periods of time - several years, mainly studying long term performance of the RPC detectors. But a magnetised 'mini-ICAL' was proposed to be built, essentially exactly of the same design as that of ICAL and also using same detector components. This was expected to serve the purpose of understanding the engineering issues in constructing the ICAL, and at the same time provide important inputs on the ICAL's operating parameters and physics measurement capabilities. A veto wall is also being planned around the m-ICAL, to explore possibility of building ICAL like detectors on surface or at shallow depths. The veto wall will be made of extruded scintillator tiles and coupled to SiPMs through WLS fibres.

The mini-ICAL currently is in commissioning phase. It was built using 11 layers of 56mm soft iron plates, spanning a lateral area of 4m x 4m. A nominal magnetic field of 1.5 Tesla will be produced inside the iron plates, by passing about 650Amps current through two, 18-turn OFHC copper coils which are water-cooled. A total of 20 RPCs of about 2m x 2m in area - two per gap in the central region, will be inserted between the iron layers and readout using the electronics of the same design as that of ICAL. A software framework for analysis of mini-ICAL data is already in place.

We will describe design and construction details of the m-ICAL magnet, RPC detectors and electronics. We will also present performance of ICAL electronics in magnetic field, including its timing, track reconstruction and momentum resolutions etc.

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