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Measurement of Reactor Anti-neutrinos with ISMRAN detector array

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Indian Scintillator Matrix for Reactor Anti-Neutrinos (ISMRAN) experiment is a very short-baseline (~ 13 m from the reactor core) and above-ground reactor anti-neutrino experiment, aiming to measure the energy spectrum of anti-neutrinos from the Dhruva research reactor, BARC, Mumbai. ISMRAN experiment is also sensitive to searching for sterile neutrino and monitoring the reactor thermal power in a non-intrusive way. Anti-neutrinos are indirectly detected by measuring the response of positron and neutron signals inside the ISMRAN volume which are created by inverse beta decay (IBD) process of anti-neutrino interaction with the plastic scintillator bars (PSBs). The ISMRAN detector setup consists of 90 PSBs, each having a dimension of 10cm x 10cm x 100cm and wrapped with Gadolinium foils, arranged in a matrix of 9x10 inside a passive shielding of 10 cm lead and 10 cm borated polyethylene. The complete setup is mounted on a movable base structure which will allow us to make the measurements at different distances from the reactor core.

In this article, we will describe the optical model, energy resolution model and energy non-linearity model of PSBs. We have also performed in-situ energy calibration at reactor off condition to understand the uniformity of detector response among the PSBs over the period of time. Measurement of backgrounds at reactor on and reactor off conditions and discriminating these backgrounds using machine learning technique will be presented in this article. We will also describe the signal-to-noise ratio, optimized selection process used to identify the anti-neutrino candidate events using the ISMRAN detector array.

The full scale ISMRAN experiment was installed and commissioned in the Dhruva reactor hall and the physics data campaign was started at the end of year 2021, in the round-the-clock mode.

Session

Neutrino Physics

Primary author: Mr DEY, Roni (Bhabha Atomic Research Centre(BARC))

Co-authors: Mr SEHGAL, Raman (Bhabha Atomic Research Centre(BARC)); Dr BEHERA, Shiba Prasad (Bhabha Atomic Research Centre(BARC)); Dr NETRAKANTI, Pawan Kumar (Bhabha Atomic Research Centre(BARC)); Dr MISHRA, Dipak Kumar (Bhabha Atomic Research Centre(BARC)); Dr JHA, Vishwajeet (Bhabha Atomic Research Centre(BARC)); Dr PANT, Lalit Mohan (Bhabha Atomic Research Centre(BARC))

Presenter: Mr DEY, Roni (Bhabha Atomic Research Centre(BARC))

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