

Study of RPC detector with different gas mixture compositions using HARDROC front-end ASIC

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The present study includes the integration and commissioning of Resistive Plate Chambers (RPCs) detector with HARDROC front-end electronics. HARDROC is a 64 input channel ASIC that amplifies, shapes and discriminates the negative fast detector signals. This paper reports the performance of glass RPC detector under different R134a/i-C₄H₁₀/SF₆ gas mixture compositions. The preamplifier gain, DAC threshold and the window size of data acquisition with respect to external trigger were optimized according to RPC signals and kept uniform during data taking in all gas compositions. The performance measures include the cosmic muon detection efficiency as well as the cluster size and count rate for the single gap RPC operated in avalanche mode. The detectors are readout by 2.8 cm X 30 cm copper strips. The number of consecutive strips or readout channels fired at the same time by the passage of charged particle as a function of electronegative SF₆ gas is presented.

Summary

The India-based Neutrino Observatory (INO) is a multi-institutional participation project, aspire to set up an underground experimental facility for probing neutrino physics in West Bodi Hills, Theni district of Tamil Nadu. The laboratory cavern will be located at 1,300 metres beneath the rock cover to diminish the naturally occurring cosmic rays. The 50kton Iron Calorimeter (ICAL) detector is the central experiment at this facility with the aim to determine the mass hierarchy using atmospheric neutrinos. The ICAL detector at INO will consist of three modules, each having the dimensions of 16.2m X 16m X 14.5m made out of 150 alternating layers of soft iron slabs and resistive plate chambers (RPCs). The detector will be magnetized with approximately 1.5 Tesla magnetic field so that muons charge arising from the charged current interaction of neutrinos or anti-neutrinos with the target iron nuclei can be identified, which is important for studying matter effects. Glass-based resistive ormanance is studied. The performance study of single gap RPC likelike effused as vital detector component. RPCs are gaseous parallel plate detector, count rate and cluster size integrated with HARDROC based relow cost of production, RPCs are economically favourable in cases where thousands of square area is required to be covered. The ICAL RPCs have two-dimensional readout perpendicular to each other and each plane contains 64 readout strips. The complete ICAL detector will have millions of channels, external connections and cables. Such a large number of channels require an efficient, robust and cost-effective readout system. The attributes like detector embedded chip, low power consumption, compactness and 64 channel readout potentiality at the same moment make HARDROC a perfect choice for front-end electronics for INO-ICAL RPCs. HARDROC is a 64-channel front-end ASIC designed to readout negative fast and short current pulses from detectors. The gain of each channel can be tuned individually from 0 to 2 over 8 bits. HARDROC provides a semi-digital readout with three thresholds tunable between 10fC up to 10 pC. The three thresholds are set by three integrated 10-bit DACs. In this paper, we present results obtained from a study performed to optimise parameters like preamplifier gain and DAC value settings. The prototype glass RPC of size 30cm X 30cm were tested with cosmic rays in the lab with a gas mixture of R134a/i-C₄H₁₀/SF₆. The percentage of SF₆ is varied and its effect on the RPC performance is studied. The performance study of single gap RPC like efficiency, count rate and cluster size integrated with HARDROC based readout electronics will be presented.

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