Contribution ID: **9** Type: **Oral**

Qualification of Eco-Friendly Gas Mixture forAvalanche-mode Operation of RPCs

Thursday 16 February 2017 17:10 (20 minutes)

INO (India-based Neutrino Observatory) [1] is an underground scientific facility to determine different properties of atmosphericneutrinos. One part of this facility is a 50 kton Iron Calorimeter (ICAL), a sampling calorimeter, which comprises of nearly 30000 Resistive Plate Chambers (RPCs) arranged in 151 layers interspersed with iron plates. The gas mixture used in Bakelite basedRPC is a mixture of R134a (a kind of Freon), Isobutane, and SF6 (Sulphur Hexa-Fluoride).Owing to huge Global Warming Potential (GWP) of this mixture (˜ 1403), this needs to be substituted with any eco-friendly without compromising the performance of ICAL. Several studies for alternative gases with lower GWP have considered HFO-1234ze (another kind of Freon with GWP ˜6) [2].
In this work, we propose to study the qualification of a mixture of Argon (GWP ˜ 0), CO2 (GWP ˜‘1) with a small amount of SF6 (˜ 22300) for avalanche-mode operation of RPC. To begin the qualification process, we plan to find out the streamer probability of the new gas mixture at different operating voltages. To estimate the streamer probability, the electronic charge produced in the RPC by the muon will be estimated from the simulation of RPC signal for each operating voltage. That will be compared to the number of electrons when an avalanche transforms to a streamer which is planned to be estimated following a calculation available in [3].

References:
1. ICAL collaboration, S. Ahmed et al., Physics Potential of the ICAL detector at the India-based Neutrino Observatory (INO), arXiv: 1505.07380.
2. Further Gas mixtures with low environment impact, 13th workshop on Resistive plate chambers and related detectors 22-26 Feb. 2016 Ghent, Belgium, 2016 JINST 11 C 09012,
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Presentation type

Oral

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