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Investigation on RPC Performance with Argon-based Gas Mixtures

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Content:
The Iron Calorimeter (ICAL) at the India-based Neutrino Observatory (INO) is designed to study various aspects of the neutrino oscillation, in particular, the neutrino mass hierarchy using the matter effects independent of CP phase [1,2]. The magnetized calorimeter will be populated with an alternate array of iron plates and Resistive Plate Chambers (RPCs) for tracking the muons produced from the charged current interaction of atmospheric neutrinos with the iron. About thirty thousand RPCs will be operated in avalanche mode using Freon based gas mixture for extracting the position and timing information of the muons. However, the high global warming potential (GWP) of the gas mixture (˜ 1403) calls upon to search for an alternative with low GWP that can substitute the present mixture without compromising the ICAL objectives.

In this work, the feasibility of using Argon based gas mixtures for operating the RPC was investigated. The dynamics of charge development in an RPC was simulated using a code [3] based on COMSOL Multiphysics software [4] which was suitably modified to test the eligibility of Argon based gas mixtures and determine the parameters for avalanche mode operation for those mixtures. To complement the numerical results, some experimental measurements were carried out using a Bakelite RPC. The numerical as well as the experimental investigations for the qualification of the proposed gas mixtures were compared to that of the standard Freon based mixtures.

References:
[1] Physics Potential of the ICAL detector at the India-based Neutrino Observatory (INO), The ICAL Collaboration, arXiv: 1505.07380v2 (2017)
[2] Physics Potential of the ICAL detector at the India-based Neutrino Observatory (INO), The ICAL Collaboration, Pramana –Journal of Physics 88 (2017) 79
[3] Modelling of avalanches and streamers by finite elements with COMSOL: step-by-step guide, RD51-NOTE-2011-005
[4] COMSOL Multiphysics, http://www.comsol.com

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