

Summer Internship Project Report

Detection of Cosmic Muons Using Gas Detectors

Submitted by

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Acknowledgements

I would like to express my sincere gratitude to Dr. Sanjib Muhuri, my guide and mentor, for his invaluable support, guidance, and expertise throughout my internship on the simulation and experimental detection of cosmic muons using the ALICE detector. His vast knowledge and constant encouragement have been instrumental in shaping my understanding of this complex field of study. I am also grateful to the High Energy Group at VECC (Variable Energy Cyclotron Centre) for providing me with the necessary resources, infrastructure, and access to the ALICE detector. Their assistance and cooperation have been vital in carrying out the experimental phase of this internship. I extend my heartfelt appreciation to the Department of School of Physical Sciences at NISER (National Institute of Science Education and Research) for providing me with the opportunity to pursue this internship. The conducive academic environment and the support of the faculty have greatly contributed to my overall learning experience. I would like to acknowledge the collective efforts of the researchers, technicians, and staff members who have been associated with the project. Their contributions, suggestions, and collaboration have significantly enriched my internship journey. Lastly, I express my gratitude to my fellow interns and friends for their camaraderie, stimulating discussions, and continuous encouragement. Their presence has made this internship an enjoyable and enriching experience. In conclusion, I am immensely thankful to all individuals and institutions mentioned above for their unwavering support, guidance, and contributions, which have been instrumental in the successful completion of this internship.

VARIABLE ENERGY CYCLOTRON CENTRE, KOLKATA

Certificate

This is to certify that Mr. Anantha Padmanabhan M Nair, a student of the National Institute of Science Education and Research (NISER), has successfully completed a summer internship in the field of Cosmic Muons and its Detection by ALICE Detectors. The internship was conducted from 5/6/2023 to 29/7/2023, under the guidance and supervision of Dr. Sanjib Muhuri.

During the internship, Mr. M Nair demonstrated exceptional dedication, enthusiasm, and competence in conducting simulations, experimental data collection, and analysis related to cosmic muons and their detection using the ALICE detector. Through their hard work and perseverance, they contributed significantly to the understanding of cosmic muons' behavior and their energy deposition within the detector setup.

We commend Mr. M Nair for their exemplary performance, commitment to scientific inquiry, and collaborative spirit. Their active participation and insightful contributions have been instrumental in the success of the internship project.

We extend our best wishes to Mr. M Nair for a bright and successful future, both in their personal life and professional career. May they continue to excel in their academic pursuits and make significant contributions to the field of research.

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Sanjib Muhuri
(Project Guide)

Date:

Abstract

This report focuses on the simulation and experimental detection of cosmic muons using the ALICE (A Large Ion Collider Experiment) detector, employing the Geant4 simulation framework. The study aims to understand the behavior of cosmic muons and their energy deposition within the detector setup, consisting of a honeycomb gas detector filled with Argon and CO_2 . The simulation phase involved utilizing Geant4 to replicate the laboratory setup and simulate the interaction of cosmic muons with the detector. By accurately modeling the trajectory and behavior of cosmic muons, the simulation facilitated the calculation of their energy deposition within the ALICE detector. This process provided valuable insights into the expected behavior of cosmic muons within the simulated environment. Subsequently, the actual experimental phase involved collecting data from the ALICE detector in the laboratory. The detector, filled with Argon and CO_2 gases, accurately captured cosmic muons as they traversed through it. The collected data allowed for a comparison between the simulated and experimental results, validating the accuracy of the Geant4 simulation model and providing further insights into the behavior of cosmic muons. The internship report outlines the methodology employed during both the Geant4 simulation and the experimental data collection phases, including the parameters and variables considered. It discusses the data analysis techniques used to evaluate the energy deposition of cosmic muons and presents a comprehensive comparison between the simulated and experimental results.

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1 Introduction

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References

- [1] Shlomo Sternberg. *Group theory and physics*. Cambridge university press, 1995.