

M.S. Thesis Defense

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Date: March 23, 2026

Time : 12.00 p.m. - 2.00 p.m.

Venue: William R. & Norma B. Harvey Library Auditorium

Online: <https://jlab-org.zoomgov.com/j/1608207228>

Chair of the MS Committee: Dr. Michael Kohl, Department of Physics

Gain Match Studies for Gas Electron Multipliers for the MUSE Experiment at PSI

Abstract

The Proton Radius Puzzle, the discrepancy between proton charge radius measurements from electron-proton and muon-proton systems, remains a major challenge in modern nuclear physics. The Muon Scattering Experiment (MUSE) at the Paul Scherrer Institute addresses this problem by simultaneously measuring electron and muon scattering with alternating beam polarities to control higher-order corrections affecting the radius extraction. Central to the experiment is a Gas Electron Multiplier (GEM) telescope used to track individual beam particles at different beam momenta. This thesis presents the analysis of GEM detector data from raw signals to reconstructed clusters and hits, including studies of detector efficiency, spatial resolution, and signal response. A detailed investigation of GEM gain response is also performed, focusing on strip-level gain uniformity along both X and Y readout axes. Using a custom diagnostics framework within the PSI analysis software, cluster properties and strip occupancies were analyzed to generate normalized gain maps while accounting for pedestal subtraction, common-mode noise, and dead channels. These results characterize gain uniformity across the detectors and provide essential calibration input for improving tracking reconstruction and reducing systematic uncertainties in the proton radius measurement.

Biography

Angel Chisom Christopher Ndukwe is a M.S. candidate at Hampton University. She began her academic journey at Hampton University in 2017. Driven by her passion for understanding the fundamental laws of nature, she dedicated herself to rigorous study and research. After completing her B.Sc. degree in Physics at Hampton University, she was employed in the Physics Department from 2020-2023 as a research assistant, before entering the M.S. program in Fall 2023. Angel has worked on the MUSE experiment at Paul Scherrer Institute (PSI) on software and data analysis. Her research focus lies in the characterization of Gas Electron Multiplier (GEM) Detectors, which are crucial components used in the MUSE experiment, where she has showcased her expertise and made notable contributions to the MUSE collaboration and to several conferences.