Cosmic Muon Simulations and Absolute Calibration for the sPHENIX Hadronic Calorimeters

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Abstract

The sPHENIX detector at Brookhaven National Laboratory's (BNL) Relativistic Heavy Ion Collider (RHIC) is scheduled to begin data acquisition in 2023. Its primary objective is to investigate the microscopic properties of the Quark-Gluon Plasma (QGP) through high-precision measurements of jets and heavy flavor observables. A key feature of the sPHENIX detector is the inclusion of hadronic calorimeters (HCals) at mid-rapidity, which are essential for the jet physics program.

Accurate jet reconstruction demands properly calibrated sPHENIX calorimeter systems during the entire data collection process. This study aims to build on previous cosmic testing efforts, which were conducted using individual HCal sectors in test benches, by investigating the potential for cosmic calibration with the complete sPHENIX apparatus in its data-taking position. In this poster, we will present a GEANT4-based study that employs a cosmic muon generator with a realistic zenith angle and energy distribution to examine the possibility of calibrating the HCals to the Minimum Ionizing Particle (MIP) scale using cosmic muon events. The muon rate predictions and observations will be utilized to plan routine cosmic running, ensuring the maintenance of the calibration for the lifetime of the sPHENIX experiment.