Measurement of multiplicity in the RHIC-sPHENIX experiment

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The sPHENIX experiment[1] started in 2023 at Relativistic Heavy Ion Collider at Brookhaven National Laboratory. The main purpose of the sPHENIX experiment is to study properties of quark gluon plasma and fine structure of nucleons. INTermediate Tracker (INTT) is a sPHENIX tracking detector that covers psuederapidity $|\eta| < 1.1$ and full azimuth. INTT is built of short (long) silicon strip sensors with dimensions 78 μm $\times$ 16 (20) mm. INTT measures the hit positions of charged particles and their deposited energy using 3 bit ADC. INTT has a function to set eight different threshold values corresponding to the 3 bits of the ADC. This allows efficient separation of signal and noise. Additionally, with a good timing resolution, INTT can identify the single beam crossing where a collision takes place. This article reports the psuederapidity dependence of charged particle production in $\sqrt{s_{NN}} = 200$ GeV Au + Au collisions measured with INTT.

The psuedorapidity of INTT hit is calculated based on the z-coordinate of the collision vertex ($Z_{\rm vtx}$) measured by Minimum Bias Detector (MBD). MBD comprises of a pair of Cherenkov detector arrays surrounding the north and south sides of the beam pipe with respect to the collision point, covering the psuedorapidity $3.5 < |\eta| < 4.6$. A hit observed in a given strip of INTT sensor is converted into x, y, and z coordinates based on the actual spacial geometry of INTT detector. Multiple ADCs observed within adjacent hit strips are embedded as a relevant cluster ADC in the data.

To remove the backgrounds, the following analysis cuts are applied:

(1) $Z_{\rm vtx}$ cut: The events reconstructed outside the $Z_{\rm vtx}$ range of the MBD detectors are considered as irrelevant. In this analysis, events reconstructed in $|Z_{\rm vtx}| > 20$ cm region are eliminated.
(2) Channel mask: Every single channel is classified as good/dead/cold/hot based on the hit rate analysis of all channels.[2] Only good channels are used.
(3) Timing cut: Every INTT hit data is followed by the time stamp of the relevant collision.[3] Only hits with the correct time stamp with respect to a trigger timing are employed.
(4) ADC cut: The ADC cut is optimized by comparing with a simulation (PYTHIA) prediction. Clusters having ADC < 45 are eliminated because there are almost no true hits below 45 according to the simulation.

Figure 1 shows the η distribution of run20869. The distribution has an asymmetric shape and more data are on the positive side. This is because the average of the $Z_{\rm vtx}$ distribution is strongly shifted towards the negative side in this run.

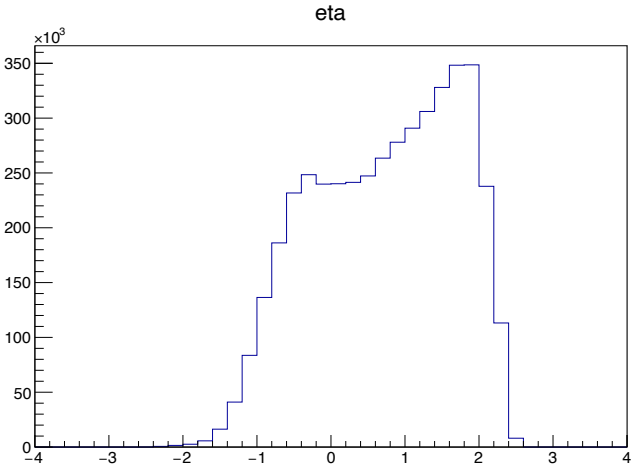

Fig. 1. η distribution in run20869. All the analysis cuts are applied.

We will compare the eta distribution with the simulation (PYTHIA) results to evaluate the efficiency and acceptance. For this purpose, the ADC distribution in the simulation is being adjusted to match the data.

References

1) I. Nakagawa, in this report.
2) J. Hwang *et al.*, in this report.
3) R. Shishikura *et al.*, in this report.

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