Study of backgrounds in sPHENIX-INTT hits

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At Brookhaven National Laboratory (BNL) in the United States, the sPHENIX experiment has begun with the goal of studying the precise properties of the quark gluon plasma (QGP) state by colliding gold nucleus accelerated by the heavy-ion collider RHIC. The INTT is among the three sPHENIX tracking detectors and provides excellent timing resolution by allocating correct time stamp of collisions in each INTT hit data. To evaluate the performance of INTT under the beam circumstances, we intensely studied the background contamination in INTT hits recorded in Au + Au at the collision energy of 200 GeV. This article summarizes the backgournd measured during the commissioning period in July 2023.

There exist hits in the data that are displaced from the collision timing, and they are a constant temporal presence, they provide background for the measurement. This background is also considered to be included in the collision data. Therefore, we estimated the amount of background obtained. In this case, we measured the data both with and without the beam.

Figure 1 shows the beam data taken by time window of 127 beam clock (bco). The peak was attributed to hits originating from collision. The others were background data. Compared to the beam hit, the background was less than 1%. The plot also shows that the background behaved in a mysterious way. This behavior is under investigation.

Data without beams were also analyzed. The INTT also has hits even without beam. Such hits originate from cosmic rays and electrical noise backgrounds from the sensor or the readout chip.[2] To measure these noise hit background rates, data were taken using a clock trigger while there was no beam in RHIC. A clock was used for the trigger and only INTT was measured. Figure 2 shows the number of noise hits per event as a function of run.

The results show that approximately 10–15% of the beam background was noise. It is also known that most of this noise is owing to chip defects or hot channels.

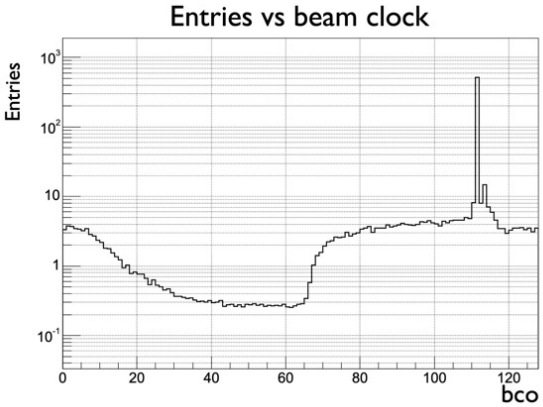

Fig. 1. Beam data taken by timing window of 127 bco Each is normalized. by the number of events.

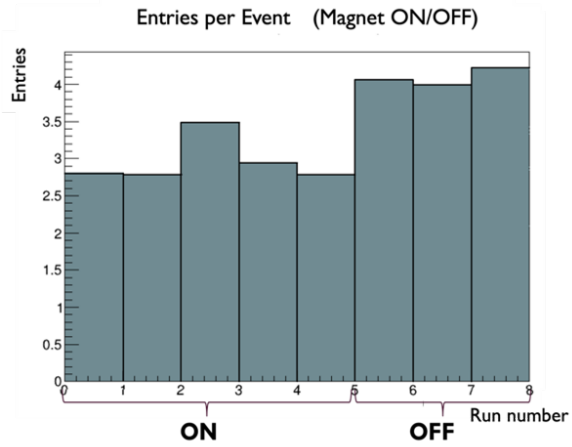

Fig. 2. Amount of noise without beam per run. Each value is normalized by the number of events. Magnet is sPHENIX core magnet.

Therefore, it is expected that the amount of background can be further reduced by hot channel masking.

In this study, we measured the amount of background using INTT, and found that the amount of background per event was very low, indicating that INTT is a very clean detector. The low amount of noise not related to the beam also indicates that the noise generated by the INTT is also low, thus reconfirming that the INTT is a very robust detector.

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References

1) sPHENIX collaboration, sPHENX Beam Use Proposal (2023).
2) C. Aidala *et al.*, Nucl. Instrum. Methods Phys. Res. A **755**, 44 (2014).

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