## Data readout of the intermediate silicon tracker

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The sPHENIX<sup>1</sup>) experiment is a new collider experiment at Relativistic Heavy Ion Collider (RHIC). The primary target is to study the properties of the quark gluon plasma (QGP) by measuring Jet phenomena and Upsilon particles generated by 200 GeV Au-Au and pp collisions. INTermediate silicon Tracker (INTT) is a track detector implemented in the sPHENIX and is a barrel-shaped two-layer detector with a silicon strip sensor. INTT can preform high-speed signal processing and is required to provide the timing information to other tracking detectors. It is thus crucial for every single INTT hit to be followed by correct beam crossing tag in data. This way, INTT can reconstruct tracks with clear identification of the collision they originated from. However, we found the indication of mixed up hits from different collisions in the commissioning data we collected last year. This issue needs to be understood and resolved because it degrades the performance of INTT.

The beam crossing tag is given in the unit of a RHIC beam clock unit, namely BCO. This time stamp must be matched to the trigger timing called BCO\_FULL which is measured using another timing detector (MBD) of sPHENIX detector system. Figure 1(a) shows the correlation between BCO and BCO\_FULL in same event. A clear correlation was observed. This indicates INTT hits are well tagged by correct BCO time stamp in the data. Under the ideal circumstances, there should be no correlation in BCO between this and the previous event as demonstrated in Fig. 1(b), We found this was not always the case. As shown in Fig. 1(c), a weak but certain diagonal correlation between hits belonging to "this" and "previous" collision event was observed in certain data. This suggests that the previous and current collision data were mixed. Such a hit with misidentified time stamp is referred to as a Mixed-up hit.

To pin down the origin of the Mixed-up hits, we inspected possible effect of the hit multiplicity. The result

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Fig. 1. (a) BCO vs BCO\_Full in same event. (b) BCO vs BCO\_Full of previous event without mix event. (c) BCO vs BCO\_Full of previous event with mix event.

is shown in Fig. 2. The horizontal axis is the number of hits on the Mix-up and the vertical axis is the number of hits on the previous event. As evident, within the range of approximately 1–30 mix-up hits, the number of mix-up hits increased with larger number of hits.



Fig. 2. Correlation between the number of mixed up hits and previous event hits.

The goal of this study was to fix the issue. For the purpose, the further investigation is underway, and we plan to resolve this issue in preparation for p-p collisions to be measured in Run- $2024.^{1}$ )

## Reference

1) sPHENIX Collaboration, sPHENX Beam Use Proposal (2023).