Data readout of the intermediate silicon tracker

M. Kano,[*1,*2] Y. Akiba,[*2] J. Bertaux,[*2,*3] D. Cacace,[*4] R. G. Cecato,[*5] A. Enokizono,[*2] Y. Fujino,[*2,*6] M. Fujiwara,[*1,*2] T. Hachiya,[*1,*2] T. Harada,[*2,*6] S. Hasegawa,[*7] B. Hong,[*8] J. Hwang,[*2,*8] M. Ikemoto,[*1,*2] Y. Ishigaki,[*1,*2] T. Kato,[*2,*6] T. Kikuchi,[*2,*6] T. Kondo,[*9] T. Kumaoka,[*2] C. M. Kuo,[*10] R. S. Lu,[*11] N. Morimoto,[*1,*2] I. Nakagawa,[*2] R. Nouicer,[*4] G. Nukazuka,[*2] I. Omae,[*1,*2] R. Pisani,[*4] Y. Sekiguchi,[*2] C. W. Shih,[*2,*10] M. Shimomura,[*1] R. Shishikura,[*2,*6] W. C. Tang,[*2,*10] H. Tsujibata,[*1,*2] W. Xie,[*3] and H. Yanagawa[*2,*6]

The sPHENIX experiment is a new collider experiment at the 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 Au-Au and *p*-*p* collisions at $\sqrt{s_{NN}} = 200$ GeV. INTermediate silicon Tracker (INTT) is one of the tracking detectors implemented in the sPHENIX and is a barrel-shaped two-layer detector with a silicon strip sensor. INTT is capable of high-speed signal processing and is required to provide the timing information to other tracking detectors. Therefore, every single INTT hit must obtain precise timing information. Thus, INTT can reconstruct tracks with clear identification of which collision they originated from. However, we found some hits were mislabeled with incorrect crossing tags (event mix-up hereafter).[1)] This problem must 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, namely BCO. The BCO of hits must be matched with the trigger timing called BCO_FULL given by other timing detectors of sPHENIX. The difference between BCO_FULL and BCO was calculated within the same event, as shown in Fig. 1(a). A clear peak demonstrates a good correlation between the INTT hits and the trigger. This indicates synchronization of hits and triggers. Such a peak should not appear if we take the difference between the BCO and the BCO_FULL of the previous event, because the current INTT hits should not have any correlation with the previous trigger. However, a short but clear peak was observed, as shown in Fig. 1(b). This is direct evidence of the event mix-up, and some hits appeared to be misidentified with a subsequent BCO_FULL tag during data taking. Hereafter, these misidentified hits and events are called mix-up hits and mix-up events, respectively. The fractions of mix-up hits and mix-up events were calculated in a *p*-*p* data of Run24. The former indicates the number of hits rolled over to the consecutive trigger, whereas the latter represents the frequency of the mix-up events. Figure 2(a) shows the fraction of the mixed-up hits as a function of the run number. From this result, the fraction of the mixed-up hits was approximately 1%. Figure 2(b) shows the fraction of the mixed-up events as a function of the collision rate. In the plot, a positive correlation is observed. This can be caused by either mix-ups and/or accidents. More detailed analysis is ongoing to understand the problem.

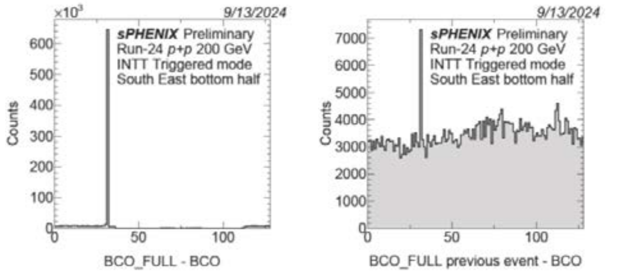

Fig. 1. (a) Difference between BCO_Full and BCO in the same event. (b) Difference between BCO_Full of previous event and BCO.

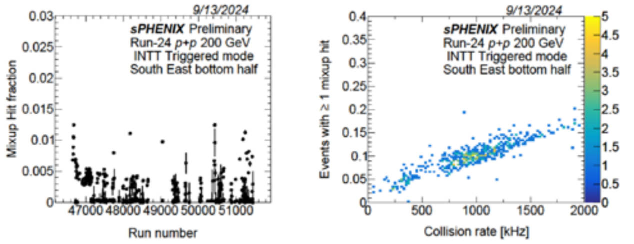

Fig. 2. (a) Mix-up hit fraction as a function of the run number. (b) Mix-up event fraction as a function of the collision rate.

Reference

1) M. Kano *et al.*, RIKEN Accel. Prog. Rep. **57**, 63 (2024).

*1 Department of Mathematical and Physical Sciences, Nara Women's University
*2 RIKEN Nishina Center
*3 Department of Physics and Astronomy, Purdue University
*4 Physics Department, Brookhaven National Laboratory
*5 Instrumentation Division, Brookhaven National Laboratory
*6 Department of Physics, Rikkyo University
*7 Advanced Science Research Center, Japan Atomic Energy Agency
*8 Department of Physics, Korea University
*9 Information Systems Technology Division, Tokyo Metropolitan Industrial Technology Research Institute
*10 Department of Physics, National Central University
*11 Department of Physics, National Taiwan University

DOI:10.34448/RIKEN.APR.58-200