Development of a tracking algorithm for sPHENIX-INTT

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The sPHENIX experiment is a collider experiment using RHIC (Relativistic Heavy Ion Collider) at Brookhaven National Laboratory. It aims to reveal the nature of Quark-Gluon-Plasma and nucleon structure. sPHENIX has four tracking detectors MVTX, TPC, TPOT, and INTT. INTT is a two-layer barrel detector which covers full azimuthal angles and pseudorapidity within ± 1.1. INTT is located between the MVTX and TPC. INTT uses silicon strip sensors 78 μm $\times$ 320 μm $\times$ 20 mm or 16 mm. INTT has a good timing resolution less than single bunch crossing time ($\sim$106 ns), preventing pile up phenomena even in high rate circumstances. The commissioning of sPHENIX using Au + Au collision with center-of-mass energy $\sqrt{s_{NN}}$ = 200 GeV started in May 2023.

A tracking algorithm based on INTT hits was developed using PYTHIA Monte Carlo data for $p + p$ and low multiplicity nucleon collisions in no magnetic field. Once the algorithm establishes successful track reconstruction in $p + p$, it will be applied to Au + Au where multiplicity is higher. In this analysis, the algorithm was developed using a simulation as input.

A track is reconstructed in the following procedure.

As the first step, one hit in the inner barrel and one hit in the outer barrel are selected as track seeds. The correlated pairs that require an angle difference in the x-y plane less than 0.01 in radian are tagged as track seeds. Using multiple track seeds, the collision point is calculated. In order to reconstruct a collision point, the distance of closest approach (DCA) between each pair of the hits and the origin is calculated. The collision point is reconstructed as the average of DCA. The track seeds and the collision point are fitted with a liner function using the least-square method to obtain the momentum vector with better precision.

Fig. 1 shows the reconstructed tracks and INTT hits in x-y and r ($= \sqrt{x^2 + y^2}$) -z planes. The green lines and black points correspond to the reconstructed tracks and INTT hits, respectively. Most of hits are reconstructed to the tracks.

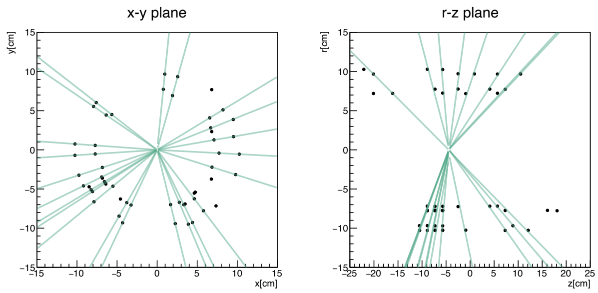

Fig. 1. Event of the reconstructed tracks (green line) and INTT hits (black) in x-y (left) and r-z (right) planes.

The track reconstruction efficiency as a function of pseudorapidity is evaluated. The efficiency is the ratio of reconstructed tracks to the generated tracks in the simulation. If the angular differences were within 3σ from the means of fitted Gaussian distribution, it was regarded that the track could reconstructed successfully. The track reconstruction efficiency is shown in Fig. 2. The average efficiency appears to be 63.3 $\pm$ 0.3%. The efficiency is low and has large dependence. Those of hits which are not participated in the reconstructed tracks are one of major candidates of the cause of the inefficiency. Every single hit should be a symbol of trajectory since there is no background in the Monte Carlo data. It seems the efficiency calculation has issues. Further investigation is in progress.

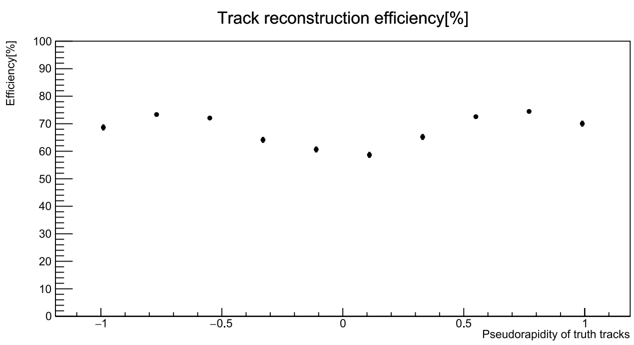

Fig. 2. The track reconstruction efficiency as a function of pseudorapidity.

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