Track-seed reconstruction for sPHENIX-INTT

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The sPHENIX collaboration studies Quark-Gluon-Plasma using the Relativistic Heavy Ion Collider at Brookhaven National Laboratory. The sPHENIX detector consists of four tracking detectors: MVTX, INTT, TPC, and TPOT. INTT is a two-layer barrel detector that covers the full azimuthal angle and pseudorapidity within ±1.1. INTT uses 320 μm-thick silicon strip sensors, with each strip measuring 78 μm × 20 mm or 16 mm. INTT is located between MVTX and TPC, and performs hit position and timing measurements for track detection. In 2024, experimental data were collected using $p + p$ collisions with center-of-mass energy $\sqrt{s} = 200$ GeV.

An algorithm for track-seed reconstruction using INTT was developed for data acquired in 2024 with a magnetic field. The track-seed is an initial estimate of a particle's trajectory from detector hits. The INTT track-seed reconstruction ensures the healthiness of the data and removes the noise of the detector. This plays a crucial role in detector studies and quality assurance. The track-seeds were reconstructed using the following procedure. Hits in the inner and outer layers of INTT were grouped to form track-seeds. Because particles come from a collision point, we looked for hits on the inner and outer layers whose angular coordinates from the collision point were strongly correlated. To identify these hit-pairs as track-seeds, it is required that the differences in the azimuth and zenith angles be less than 0.04 and 0.2 radians, respectively. The momentum of the particle represented by the track-seed was determined using the collision point and the hit-pair coordinates for the data acquired under the magnetic field of 1.4 T.

Figure 1 is an event display that illustrates the reconstructed tracks of particles from the track-seeds in $p+p$ collision. The gray lines indicate the INTT detector, the filled circles indicate the hit positions, and the solid lines passing through the hits represent the reconstructed track-seeds. The colors assigned to each track are consistent across both panels. The track-seed reconstruction efficiency as a function of transverse momentum was evaluated with a sPHENIX detector simulation using a single muon as input and no magnetic field. The efficiency, defined as the ratio of the number of reconstructed to generated tracks passing through INTT in the simulation, is shown in Fig. 2. The scattering angle of multiple scattering depends on momentum, and because the algorithm selects track-seeds based on the angle, the efficiency also depends on momentum. The average value of the efficiency over the entire transverse momentum range was 84.4 ± 0.12%. The 15.6% inefficiency was further investigated and found to be caused by the dead and inactive areas of the sensors, which accounted for 13% of the 15.6%, whereas the algorithm caused an additional 3% loss in efficiency. For a more realistic estimation, calculation of the efficiency using monte carlo data for $p + p$ collision with (without) a magnetic field is in progress.

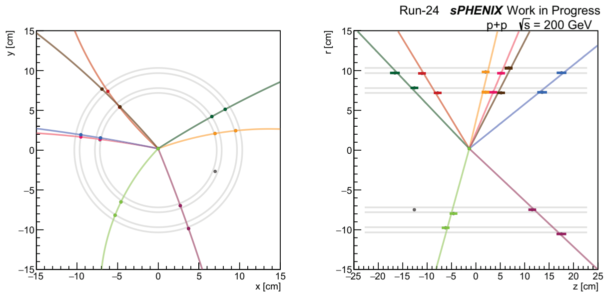

Fig. 1. Event of reconstructed track-seeds and INTT hits in the x-y (left) and the r-z (right) planes.

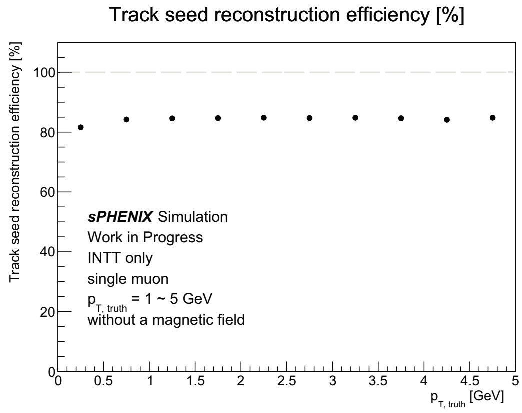

Fig. 2. Track-seed reconstruction efficiency as a function of transverse momentum of the generated particle [%].

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DOI:10.34448/RIKEN.APR.58-152