Vertex Correlation Between Beam Line Detector and SπRIT-TPC

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The main purpose of the SAMURAI Pion-Reconstruction and Ion-Tracker Time-Projection Chamber (SπRIT-TPC)[1] project is to constrain nuclear Equation of State (EOS) term in supra-density at around $\rho \approx 2 \cdot \rho_0$. In Spring 2016, the first experiments were performed at SAMURAI for different nuclear symmetry systems such as ^{132}Sn + ^{124}Sn and ^{108}Sn + ^{112}Sn. Since the experimental setup consisted of several independent detectors[2], data acquisition (DAQ) synchronization and relative position are one of the key concerns. Here, the correlation between beam line detectors and SπRIT-TPC will be reported to confirm them.

A schematic view of the experimental setup along the beam line is shown in Fig.1. There were two plastic scintillation counters and two Beam Drift Chambers (BDC), which determine the trigger timing and beam position in the target, respectively. The SπRIT-TPC was installed inside the SAMURAI dipole magnet. The reaction target was mounted on a ladder in front of the field cage window.

The absolute position of each detector in the SAMURAI laboratory frame was measured using a photogrammetry system[3]. Since SπRIT-TPC was placed inside the magnet and surrounded by the ancillary detectors, limited portion of the TPC was visible. Thus the outer and inner geometry measured beforehand were superimposed to visible reference target points to obtain the entire position.

A SπRITROOT analysis frameworkfor track reconstruction was developed. A reaction vertex was obtained as an intersection of multiple extrapolated tracks event by event. The reactions taking place at the target were chosen if the reaction vertex originated from the target. In Fig.2, X and Y correlations at the target between reconstructed vertices and beam positions measured by BDCs are shown. Clear correlations indicate success of DAQ synchronization and vertex reconstructions. The space resolution of SπRIT-TPC was estimated to be of the order of 1mm after subtracting the BDC resolution. The beam position would enable us to improve the momentum resolution especially for low momentum particles. It was also confirmed that the TPC was aligned within 200 μm accuracy from the non-magnetic field data.

The correlation between beam position and reaction vertex indicates the successful operation of DAQ synchronization and vertex reconstruction.

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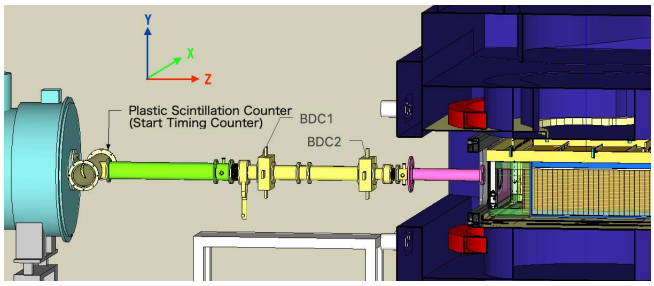

Fig. 1. Experimental setup at beam line in 2016. The coordinate is desccribed here.

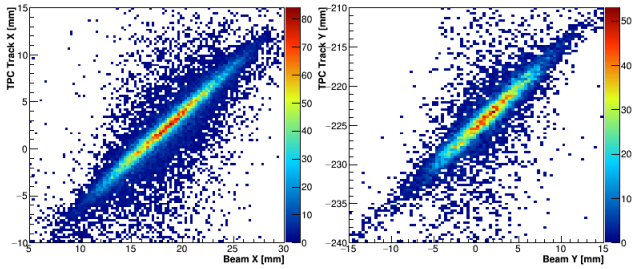

Fig. 2. Correlation at the target between vertex reconstructed by SπRIT-TPC and beam position measured by BDCs. Left and right sides show X and Y correlations, respectively.

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