First commissioning results for SπRIT-TPC

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The aim of the SAMURAI Pion-Reconstruction and Ion-Tracker Time-Projection Chamber (SπRIT-TPC) [1]) project is to constrain the symmetry energy term in the nuclear-matter equation of state (EOS) at super-saturation density. It is proposed to compare π^+/π^- production ratio among various isospin asymmetry environments combining different unstable Sn beams and stable Sn targets in SAMURAI.

The first commissioning run using ^{79}Se beam was performed outside of the SAMURAI magnet in fall 2015. The performance of SπRIT-TPC and trigger systems were evaluated. Results revealed necessary modifications for upcoming physics campaign.

For the commissioning, the SπRIT-TPC was placed about 7 m away from the center of the SAMURAI magnet and lined up on 60 deg with the ^{79}Se secondary beam. Two targets of 0.5 mm natural Sn foil and 9 mm aluminum plate were mounted on a ladder in front of the TPC field cage window.

The overall readout system[3)] was prepared and three types of trigger arrays composed by plastic counters read by MPPCs were installed for opening a gating grid driver. (1) KATANA (KrAkow Trigger Array with amplitude discrimiNAtion) was placed at the exit window to reject the non reacting beam. (2) The Multiplicity Trigger Array[4)] was placed on the both sides of TPC to select high multiplicity events. (3) The active collimators was mounted in front of the target to reject beams hitting the target frame. The reaction trigger was provided by a start counter signal, no hit on the active collimator, low energy deposit in KATANA, and multiple hits on Multiplicity Trigger Array. The trigger condition was controlled through a trigger logic board.

The analysis framework, SπRITROOT[5)], has been developed for SπRIT-TPC experiment. Using this code, a typical high multiplicity 3D event display is shown in Fig.1. The straight tracks were reconstructed even in dense track regions just after the target.

The total number of reconstructed tracks per event was plotted for two different multiplicity selections with KATANA and Multiplicity Trigger Array in Fig.2. Higher multiplicity requirement resulted in higher multiplicity track events corresponding to central collision events.

The reaction vertex was extrapolated from tracks event by event and the Z-vertex of 84% events was found around the target within 5mm in sigma for high multiplicity events. The event ratio originating from the target depended on the trigger conditions.

The first commissioning of SπRIT-TPC was successfully performed outside of the SAMURAI magnet. The high multiplicity track events were reconstructed and the reaction vertex was found around the target. The gating-grid driver worked with the fast trigger provided by three trigger arrays. Modification of readout electronics and optimization of trigger system is under investigation for coming physics run.

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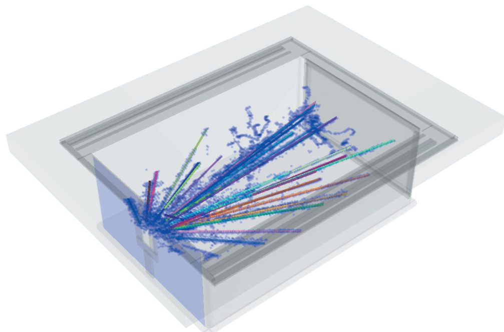

Fig. 1. A typical high multiplicity track event produced with ^{79}Se on Sn (nat.) target. The target was located 8.9 mm upstream from the field cage window.

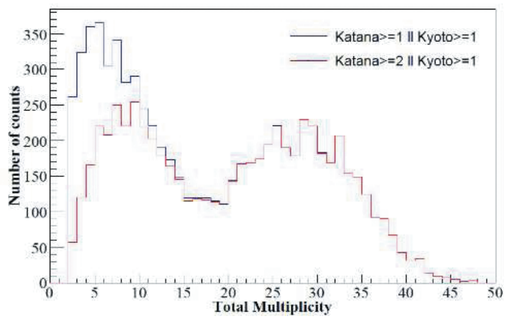

Fig. 2. The total multiplicity in the TPC gated on the multiplicity in the ancillary detectors KATANA and Multiplicity Trigger Array

References

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