Particle identification of light charged particle by SπRIT-TPC in Sn-Sn isotopic reactions Ⅱ

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The main focus of the SπRIT-TPC[1)] project is to constrain the high-density nuclear equation of state by using heavy-ion reactions. SπRIT-TPC is designed to measure charged pions as well as light charged particles from central collisions, which have been predicted to be sensitive probes of dense nuclear matter.[2,3)] This report describes particle identification (PID) in TPC based on the last report[5)] and the preliminary spectra of protons and deuterons in ^{132}Sn+^{124}Sn reactions.

The PID in TPC relies on two measured observables, namely, the magnetic rigidity and energy deposit per unit length (dE/dx). The truncated-mean method was applied for the dE/dx measurement, which was found to depend on the emission angles. To calibrate the angle dependence of dE/dx, tracks were classified by their pitch (Θ^{Pitch}) and yaw (Θ^{Yaw}) angles, and their origins are set to the beam-axis direction. Figure 1 shows dE/dx vs magnetic rigidity plots in two different angular regions of pitch and yaw angles. The loci of protons, deuterons, and tritons were simultaneously fitted by the simplified Bethe-Bloch formula[4)] for each region. As explained in Ref. 5), the mass was calculated from given dE/dx and rigidity values with fitting parameters. Then, the angle-calibrated observable is obtained.

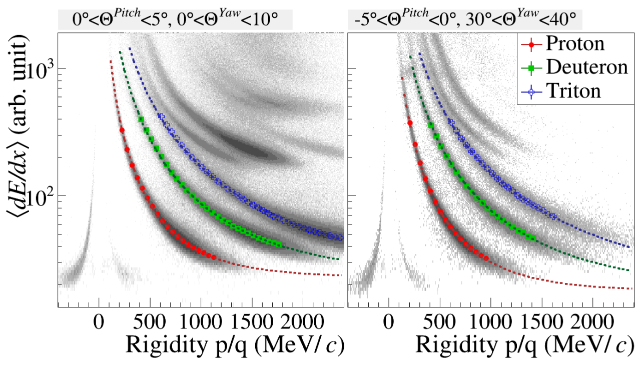

Fig. 1. Particle identification spectra for different emission angles. Overdrawn markers and dotted lines are the Gaussian-fitted mean dE/dx values in each 50 MeV/c rigidity bin and the results of a simultaneous fit, respectively.

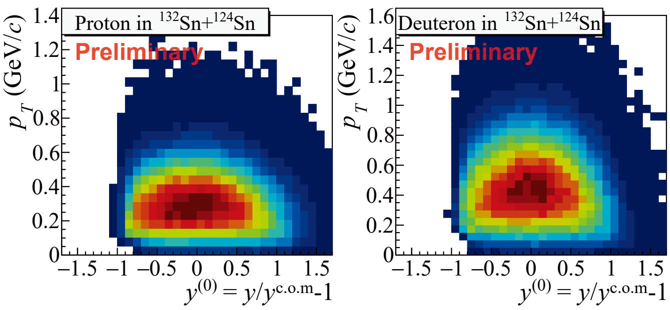

Fig. 2. Transverse momentum and normalized rapidity spectra of protons and deuterons in central ^{132}Sn+^{124}Sn reactions without efficiency corrections.

Figure 2 presents preliminary spectra of the transverse momentum p_T vs normalized rapidity $y^{(0)}$ without detection-efficiency corrections for protons and deuterons in ^{132}Sn+^{124}Sn reactions. The rapidity was normalized by the center-of-mass rapidity of the reaction system ($y^{\mathrm{c.o.m}}$) and shifted by -1. A higher track multipliticy cut, $M_{\mathrm{TPC}} \geq 55$, was applied for selecting central collisions. Protons and deuterons were identified using the angle-dependent mass described above. The value $y^{(0)} = -1$ corresponds to the perpendicular emissions, and it is close to the acceptance limit of the TPC. At $y^{(0)} \geq -0.5$, approximately symmetric distributions centered at the mid-rapidity, $y^{(0)} = 0$, were obtained, which is reasonable as the kinematics of heavy-ion reactions. To extract physics information and to compare with model predictions, efficiency correction is necessary, which is currently being evaluated by Monte Carlo simulations.

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