

A pilot experiment for collective flow in heavy-ion collisions

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Asymmetric emissions of various particles in semi-central heavy-ion collisions are expected to be sensitive probe for the equation of state (EOS) of high-density nuclear matter.¹⁾ A pilot experiment was conducted by impinging 400 MeV/nucleon ^{132}Xe on a CsI target (500 mg/cm²) at beam intensities of 10^5 – 10^6 particles/spill at the HIMAC SB2 beam line at NIRS. Our primary goal is to confirm asymmetric angular correlation of proton and neutrons at target rapidity with respect to the reaction plane determined by charged particles in forward rapidity.

A forward counter FC, 90 plastic scintillation detectors mounted in 3 rings centered along the beam axis, was developed to determine the reaction plane of heavy-ion collisions on an event by event basis. A cubic-shape plastic scintillator ($25 \times 25 \times 25$ cm³) was coupled with a photomultiplier tube (Hamamatsu R3478S; used for the CERN-NA44 experiment). Figure 1 shows the experimental setup, where left detectors correspond to the NiGIRI²⁾ to measure the particles at target rapidity region. The FC is installed at a distance of 43 cm, 46 cm, and 48 cm downstream from a target for inner-, middle-, and outer-rings, respectively. The signals of NiGIRI, FC, and beam counters are recorded using fast digitizers (CAEN V1730B, V1740) together with the TDC module (CAEN V1190A), where newly developed RCDAQ

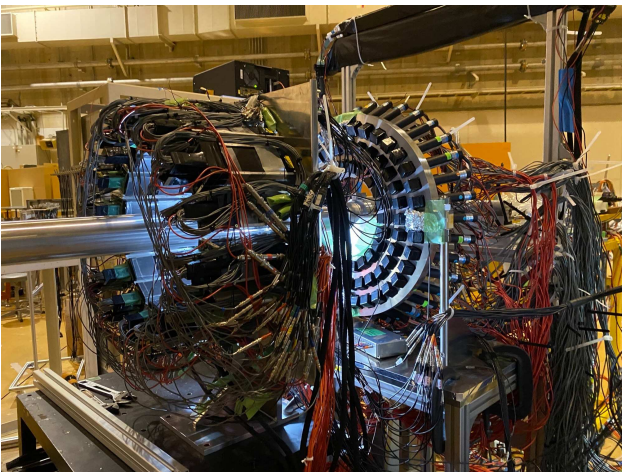


Fig. 1. Experimental setup for H447. Xe-beam is coming from left to right. CsI target is located at NiGIRI in left. The FC is installed after the target.

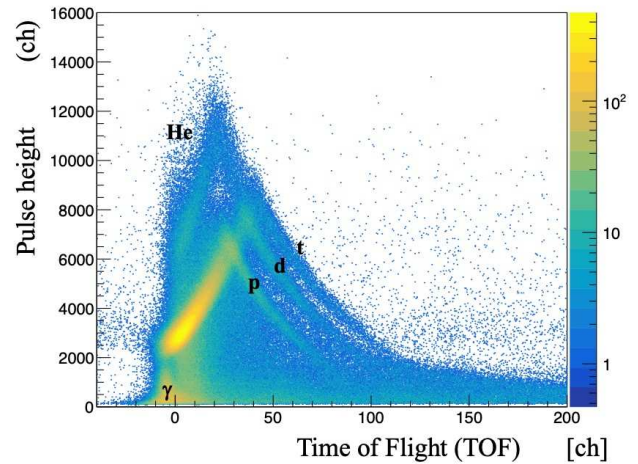


Fig. 2. Particle identification in FC. A plastic scintillator BC1 in the beam line is used for start timing of the FC. Charged particles (p , d , t , and He) are selected for reaction plane determination.

was employed to recode the waveform of signals at trigger rate of up to 1 kHz with buffering mode.³⁾ A plastic scintillator BC1 is installed as a start counter in the beam line.

Figure 2 shows a particle identification spectrum obtained by the FC, where the horizontal and vertical axes are the time-of-flight and the energy loss ΔE , respectively. The charged particles (p , d , t , He) in forward rapidity were identified from the background γ -rays. The collective flow of protons and neutrons was confirmed successfully as a function of the transverse momentum using the NiGIRI at target rapidity, where the reaction plane was determined by the FC using a sub-event sampling method.⁴⁾

In future, our experimental technique will be applied using the higher energy Xe-beam and high intensity radioactive beam at HIMAC and RIBF, respectively.

References

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