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Long-range correlation in p-Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV with the ALICE detector

Y. Sekiguchi,[*1,*2] H. Hamagaki,[*2] and T. Gunji[*2]

Measuring of the correlations in particle production in the azimuthal angular space and rapidity space is very useful for investigating the underlying mechanism and dynamics of particle production in high-energy nucleus-nucleus collisions. The long-range correlations in the rapidity space in near-side angular pairs in dihadron correlations was first observed in Au-Au collisions at $\sqrt{s_{NN}}$= 200 GeV at RHIC.[1,2] This long-range correlation was derived from the collective expansion of the initial geometry fluctuations. Unexpectedly, a similar structure has also been observed in high-multiplicity p-p collisions at $\sqrt{s}$=7 TeV with the LHC-CMS experiment.[3] The high-density gluon fields in a small x of nucleus and the collision of two high-density gluon sheets can explain the long-range correlation.[4] It is very interesting to study the correlation in p-Pb collisions since the initial gluon density and magnitude of the collective expansion are very different from those in other collision systems (pp and Pb-Pb).

A Large Ion Collider Experiment (ALICE) is dedicated to understand the state of matter as it existed shortly after the Big Bang, called Quark Gluon Plasma (QGP). The main subsystems in the ALICE for the study are the inner tracking system (ITS), time projection chamber (TPC), and time of flight (TOF). The ITS consists of 6 layers of silicon detectors for vertex finding and tracking. The TPC is the main tracking detector and is used for particle identification by measuring the specific energy loss dE/dx. The TOF is used to identify particles by measuring the time of flight. They have a common acceptance $|\eta|$ <0.9.

The correlation function as a function of $\Delta\eta$ and $\Delta\phi$ between two charged particles is defined as:

$$\frac{1}{N_{trig}}\frac{d^2N_{asso}}{d\Delta\eta d\Delta\phi} = \frac{S(\Delta\eta,\Delta\phi)}{B(\Delta\eta,\Delta\phi)} \qquad (1)$$

where this correlation function is studied for different p_T intervals and different event classes according to the event multiplicity, and N_{trig} is the total number of triggered particles in the event class and $p_{T,trig}$ interval. The signal distribution $S(\Delta\eta,\Delta\phi) = 1/N_{trig}d^2N_{same}/d\Delta\eta d\Delta\phi$ is the associated yield per trigger particle for particle pairs from the same event. The background distribution $B(\Delta\eta,\Delta\phi) = \alpha 1/N_{trig}d^2N_{mixed}/d\Delta\eta d\Delta\phi$ corrects for pair acceptance, pair efficiency, and uncorrelated pairs. It is constructed by correlating the trigger particle in one event with the associated particles from other events in the same event multiplicity class. The α factor is chosen so that it is unity for pairs at $(\Delta\eta,\Delta\phi) = (0,0)$. The correlation function in peripheral collisions (low-multiplicity event class) is subtracted from that in central collisions (high-multiplicity event class) to remove the auto-correlations from jets. Figure 1 shows the associated yield per trigger particle in 0-20% event class subtracted by 60-100% event class with 1<$p_{T,trig}$, $p_{T,asso}$ <2 GeV. The projection onto $\Delta\phi$ averaged over 0.8< $|\Delta\eta|$ <1.6 on the near side and $|\eta|$ <1.6 on the away side is shown in Fig. 2. The double ridge structure is observed.

Measurements of the correlation functions by tagging identified hadrons and strange baryons are ongoing to evaluate the collectivity in p-Pb collisions and the initial state effects.

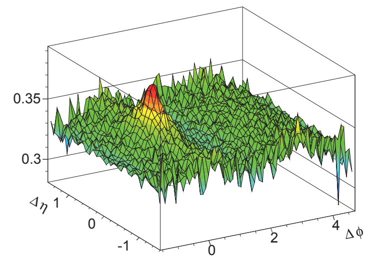

Fig. 1. Associated yield per trigger partile in 0-20% event class subtracted by 60-100% event class with 1<$p_{T,trig}$, $p_{T,asso}$ <2 GeV

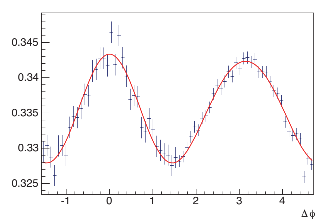

Fig. 2. Projection onto $\Delta\eta$ averaged over 0.8< $|\eta|$ <1.6 on the near side and $|\eta|$ < 1.6 on the away side

References
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*1 RIKEN Nishina Center
*2 Center for Nuclear Study, the University of Tokyo