Contribution from fluid-jet interaction towards ridge in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV

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Introduction

Two-particle angular correlation measurements in p-Pb, pp and d-Au collisions have revealed existence of azimuthal correlations extended to large pseudorapidity separation $|\Delta\eta|$ popularly known as "ridge". It has been argued that angular-correlations in small systems are dominated by jet-like processes. However, the emergence of the near side ridge in high-multiplicity event classes of small collision systems (pp and p-Pb) still lacks unambiguous understanding. Hydro model like EPOS reasonably explains the ridge like structure in the highest multiplicity classes of p-Pb collisions[1]. Our work shows that in the context of EPOS 3, ridge in the higher multiplicity classes of p-Pb collisions has non zero contribution from the fluid-jet interaction.

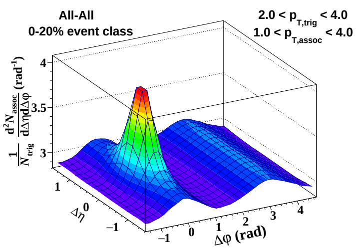

FIG. 1: Multiplicity dependence of: (**top**) near side jetlike yields and (**bottom**) ratio of yields from EPOS. For details refer to text.

EPOS 3 is a 3+1D event by event hydro model based on flux tube initial conditions [2]. The basis of this model is multiple scatterings where each scattering consists of a hard elementary scattering plus initial state radiation - commonly referred as a parton ladder or pomeron. After initial scatterings, the produced flux tubes/strings initially form a "matter" which eventually constitute both bulk and jets based on the energy loss by them. As mentioned in [3] three possibilities can occur:

a) String segments without sufficient energy to escape the matter will evolve hydrodynamically and finally hadronize to produce the bulk (core).

b) High energetic string segments will escape the matter and hadronize following Schwinger mechanism producing jet hadrons or corona.

c) Some string segments are produced inside the matter or at the surface but have enough energy to escape. These segments may pick up quark, antiquark, diquark or antidiquark needed for the flux tube breaking from the fluid (bulk) with properties (momentum, flavor) determined by the fluid [3] rather than the Schwinger mechanism. The produced jet hadrons are composed of a high p_T string segment originating from the initial hard process and di(quarks) from the fluid carrying fluid properties including transverse fluid velocity. The jet hadrons carrying fluid properties are expected to be correlated with the bulk part of the system. Therefore except from core-core , core-corona and corona-core correlations are expeceted. Also, it would be interesting to look at the corona-corona correlations at higher multiplicity event class where a larger fraction of corona particles are affected by fluid-jet interaction compared to the lower multiplicity event classes.

1. Analysis Method

Two dimensional (2D) $\Delta\eta - \Delta\phi$ correlation function is calculated by pairing charged particles in the trigger and associated p_T ranges

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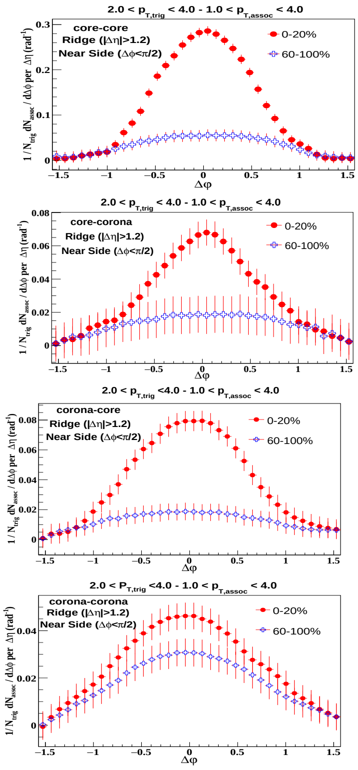

FIG. 2: p/π to ratio: (**left**) AMPT and, (**right**) EPOS.

of $2 < p_{T,trig} < 4$ GeV/c and $1 < p_{T,asso} < 4$ GeV/c, respectively and it is shown in Fig 1. The correlation function C($\Delta\eta, \Delta\phi$) is defined as:

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

where $S(\Delta\eta, \Delta\phi)$ represents the number of same event pairs, constructed by pairing the trigger and associated particles from same event. The mixed event distribution $B(\Delta\eta, \Delta\phi)$ that corrects for the effects due to limited acceptance is constructed by pairing trigger and associated particles from different events, but of similar multiplicities. This analysis concentrates only on the near side ($|\Delta\phi| < \pi/2$) of the correlation function. The particles from jet fragmentation are expected to be confined in a small angular region- so the ridge is estimated from large $|\Delta\eta|$ ($|\Delta\eta| \geq 1.2$).

2. Results and Discussions

In this analysis the trigger ($2.0 < p_T < 4.0$ GeV/c) and associated ($1.0 < p_T < 4.0$ GeV/c) particles are selected from intermediate p_T range where particles from both hard (origin: corona) and soft (origin: core) processes are present [2]. The ridge structures obtained from core-core correlation in 0-20% and 60-100% event classes are compared in Fig 1(a) and it originates from hydrodynamical evolution of the system. The ridge structure is also observed in core-corona and corona-core correlations and shown in Fig.1(b) and Fig 1(c). The origin of ridge in these two cases is the fluid-jet interaction. The jet hadrons (corona) produced inside or at the surface of the bulk via flux tube breaking using partons from the bulk (core) [3] carry fluid information and eventually correlated with the bulk part of the system - creating the correlation between core and corona which increases with multiplicity. The corona-corona correlation is also affected by the fluid-jet interaction as shown in Fig 1(d) as more jet hadrons carry fluid information in the higher multiplicity class where the ridge is found to be slightly enhanced compared to the lowest multiplicity class. It is clear that though the hydrodynamical evolution of the system (core-core correlation) contributes maximum to the ridge, a non zero contribution from the fluid-jet interaction is also present.

References

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[3] K. Werner, Phys. Rev. Lett. 109, 129903 (2012)