Dihadron Δη correlation in Au+Au collision at 200 GeV : the Ridge

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arxiv:0801.4545 [nucl-ex]

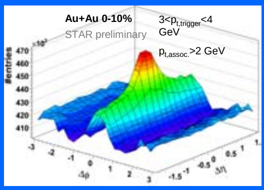
Intro & method

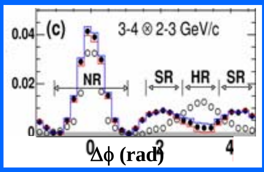
•STAR showed a long range correlation in Δη that persists after elliptic flow background subtraction.

•This component is responsible for the enhancement of near-side per-trigger Δϕ distribution.
- This enhancement is even more pronounced if we believe the triggers contains soft contribution which already dilute the near-side per-trigger yield

• Possible physics mechanisms include:
- •Jet interaction with a longitudinal flowing medium
- •Position-momentum correlations induced by radial flow
- •Correlation between radial flow boosted beam jet and medium suppressed transverse jet
- •Correlation induced by plasma instability
- •Back splash caused by quenched jets.

• However this ridge may be related to the away-side "Cone" like shoulder yield.
- For instance, the pair of hadrons maybe associated with the "Cone" generated by the quenched jet.
- In this case, there is no surface bias. (since this correlation is among the hadrons carrying medium response to original jets)





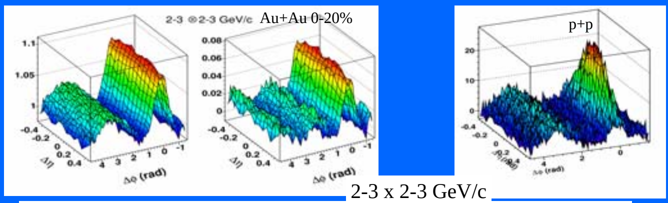
PHENIX has a small Δη acceptance |Δη|<0.7, a typical jet width is 0.3 radian. So there should be room to see the ridge component underneath the jet signal

- We build a 2D correlation function
- using ZYAM method to subtract the background, assuming v2 and ZYAM background is constant in PHENIX h acceptance.
- •The background subtracted distribution shows a very broad distribution along Dh, whereas pp show a peaked structure, indicating a long range correlation.

Jet pair ratio=Ratio of jetpairs/combinatoric pairs

$$\mathrm{JPR}(\Delta\phi) \equiv \frac{\mathrm{Jet\_pairs}(\Delta\phi)}{N^{\mathrm{mixed}}(\Delta\phi)} = \frac{N^{\mathrm{same}}(\Delta\phi)}{N^{\mathrm{mixed}}(\Delta\phi)} - \xi(1+2v_2^a v_2^b\cos 2\Delta\phi)$$

Correlation function — Jet pair ratio — Jet pair ratio

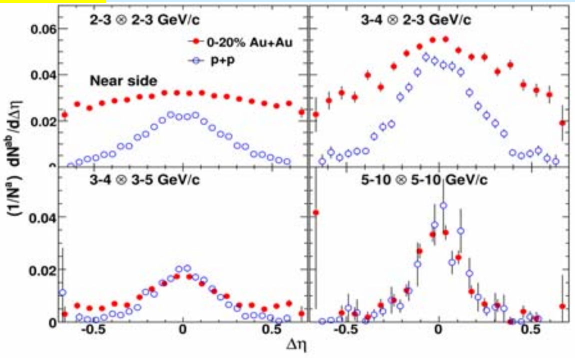


2-3 x 2-3 GeV/c

Focus on Δη×Δη ∈[-0.7,0.7]x[-0.7,0.7] and look at their projections

Results

Compare the jet shape between Au+Au and p+p



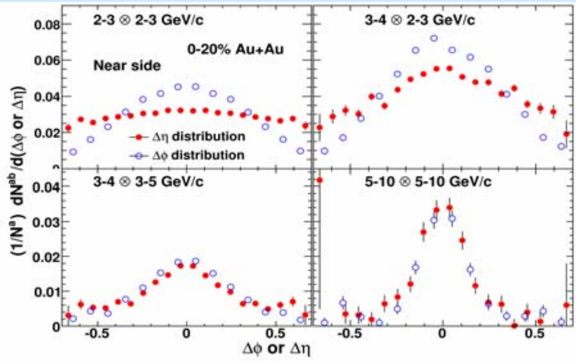
For low p_T region (2-3x2-3 GeV/c)
- AuAu shape is broader than pp shape
- Shape in Δη is broader than shape in Δϕ.
- Au+Au yield is enhanced, especially at large Δη.

For high p_T region
- Au+Au shape is similar to pp shape
- Shape in Shape in Δη and Δϕ become similar

•The ridge component is important up to 4 GeV/c

•At high p_T either the ridge is gone or it is Overwhelmed by jet fragmentation.

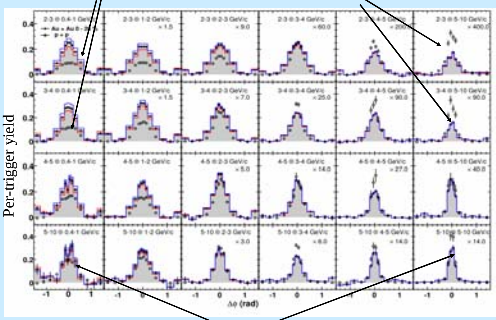
Compare the jet shape in Δη and Δϕ



Impact of the ridge via indirect studies

Enhancement at low p_T

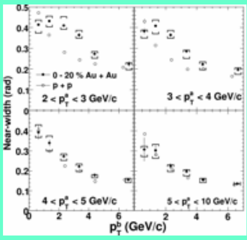
Suppression for low p_T triggers and high p_T partners
Due to dilution effects of non-jet triggers

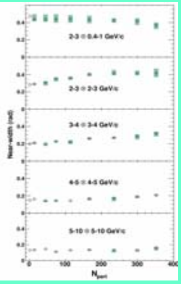


Unmodified/weakly modified for large p_T triggers and all p_T partners

Δϕ distribution is broadened at low p_T

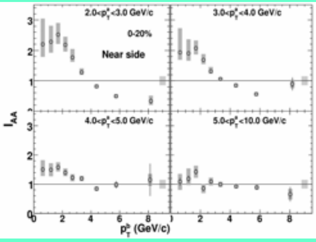
- The width of jet component narrows towards high p_T
- The width of ridge component seems to be constant around 0.4 rad So width saturates vs Npart at low p_T.





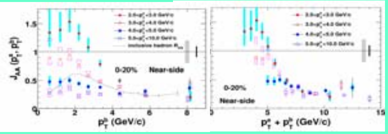
Jet per-trigger yield is enhanced at low p_T

- Quantified by I_{AA}
- However, per-trigger yield is suppressed for trigger p_T<4 GeV/c
- This suppression is due to a dilution effects of soft triggers which has weak jet correlation.
- So the true per-trigger yield for jet triggers should be factor of 2 higher.



Jet-induced hadron-pair yield

- •Quantified by J_{AA}
- •Does not affects by dilution effects
- •Scales with sum of their momentum values
- The pair yield scales faster than Ncoll at low $p_T^a+p_T^b$ (energy conservation effect)



PHENIX Detector and future prospect

•Event mixing method to correct for the Δϕ acceptance $C(\Delta\phi) \equiv \frac{N^{\mathrm{same}}(\Delta\phi)}{N^{\mathrm{mixed}}(\Delta\phi)}$

•Zero yield at minimum (ZYAM) method used for background subtraction

$$Y_{\mathrm{jet\_ind}}(\Delta\phi) = \frac{\int d\Delta\phi N^{\mathrm{mixed}}(\Delta\phi)}{2\pi N^a \varepsilon^b} \times \left[\frac{N^{\mathrm{same}}(\Delta\phi)}{N^{\mathrm{mixed}}(\Delta\phi)} - \xi(1+2v_2^a v_2^b\cos 2\Delta\phi)\right]$$

•Jet bias to BBC reaction plane v2 was studied and found to be negligible.

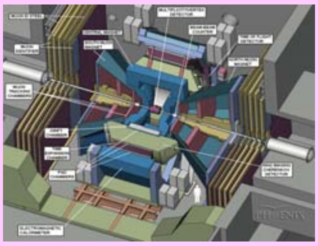
•Correlation between hadrons in muon arm and central arm: Extend the rapidity range to |Δη|<2.6 This study has been performed in dAu and pp (Phys. Rev. Lett. 96, 222301 (2006))

•Can study the RP dependence of the ridge with the Reaction-Plane detector in RUN7

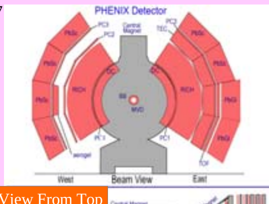
Central Arms
Coverage (E&W)
-0.35< y < 0.35
30° <|ϕ |< 120°

Muon Arms
Coverage (N&S)
1.2< |y| <2.3
-180° < ϕ < 180°

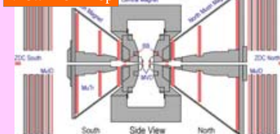
A complex apparatus to measure: Hadrons, Muons, Electrons, Photons



View From Beam



View From Top



Discussion

The evolution of the enhancement and broadening with the p_T^{ab} reflects the competition between contributions from the medium response and jet fragmentation. The former is important at p_T^{ab} < 4 GeV/*c* and manifests itself as an enhanced and broadened distribution in Δη and Δϕ. The latter dominates at higher p_T, reflected by I_{AA} ~1 and a near-side width similar to *p* + *p*.

Connections between near- and away-side: The fact that both near- and away-side distributions are enhanced and broadened at low p_T and that the modifications limited to p_T^{ab} < 4 GeV/*c*, above which the jet characteristics qualitatively approach jet fragmentation, may suggest that the modifications mechanisms for the near- and away-side are related.