Investigating the QGP with three particle jet correlations in the PHENIX Detector

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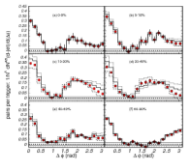
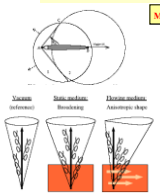


PRL 97, 052301 (2006)

200 GeV Au+Au
1<pT<2.5
vs
2.5<pT<4.0

Two particle jet correlations have given ample evidence of strong away side modification

Possible Modifications of Jet Topology



Mach Cone,Wake Effect or "sonic boom"

Stoecker nucl-th/0406018
Muller,Rupport Hep-ph/0503158
Casalderrey-Solana, Shuryak, Teaney, arXiv hep-ph/0411315 (2004)

The away side modification can be either due to a Mach Cone formation or due to bending of the away side jet due to the flow field

Two-particle correlations are unable to distinguish between the two scenarios. To determine which scenario is the correct one it is necessary to study three particle jet correlations

Armesto,Salgado,Wiedemann hep-ph/0411341

Flow induced Deflection

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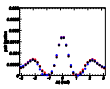
Procedure adopted for 3particle Jet Correlation Extraction :

a) Tune simulations to reproduce observed 2-particle jet correlations



Bent:Red Data:Black Cone:Blue

b) Obtain total 3-particle correlations in data

c) Remove flow from total 3p correlations to get total 3p jet correlations using ZYAM method

d) Construct (2+1) jet correlations using 2 event mixing

e) Remove (2+1) jet correlations from total 3p jet correlations

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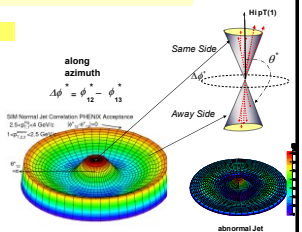
3 Particle Correlations in High pT Framework (*)

Polar plot



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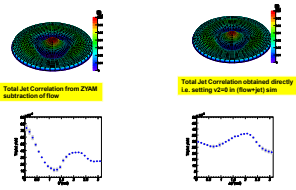
Demonstration of 2d ZYAM Method

Jet Correlation = Total Correlation – a0*(Harmonic Correlation)

"a0" is adjusted till Jet Correlation surface goes to zero at its minimum (ZYAM)

Ajitanand et.al. Phys. Rev. C 72, 011902 (2005)



Total Jet Correlation from ZYAM subtraction of flow

Total Jet Correlation obtained directly i.e. setting v2=0 in (flow+jet) sim

Grey bands indicate extent of difference between correlations obtained from ZYAM subtraction and correlations obtained directly

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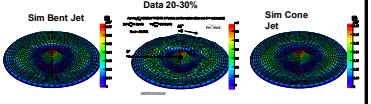
Data 20-30% corrected for flow and (2+1)

Data 20-30%

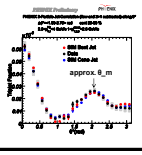


The relationship between Mach Cone Angle wrt leading jet axis (θ_m) and speed of sound c_s is given by :

θ_m = π - arccos(c_s/c)

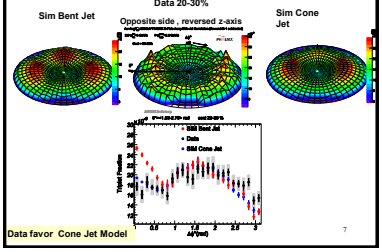
For θ_m ~ 2.1 rad (see arrow in projection plot) this would give

c_s ~ 0.5 (in units of c = 1)



Data 20-30% corrected for flow and (2+1)

Data 20-30%



Data favor Cone Jet Model

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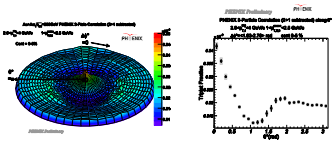
Data 0-5% corrected for (2+1) but not for flow



Away side peaks below Pi implying abnormal jet shape

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Conclusions

3-particle jet correlations obtained for 200 GeV Au+Au

3-particle correlation without harmonic removal for most central case shows abnormal jet topology

True 3-particle jet correlations validate presence of Mach Cone jets but do not rule out small contributions from other topologies.

The approximate implied Mach Cone angle yields a speed of sound ~ 0.5 c

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