Status of Jet Reconstruction in Cu+Au collisions at 200 GeV from PHENIX

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Abstract

Measurement of the centrality dependence of jet production in 200 GeV copper-gold (Cu+Au) collisions are presented. Jets are reconstructed as function of centrality for spectra measured over the kinematic range of jet transverse momentum 12 < p_T < 42 GeV/c and within a pseudorapidity acceptance of |eta| < 0.3. The nuclear modification factor, R_{AA}, is evaluated and jets are found to be suppressed by approximately a factor of two in central collisions compared to p+p collisions. The R_{AA} shows no significant dependence in p_T.

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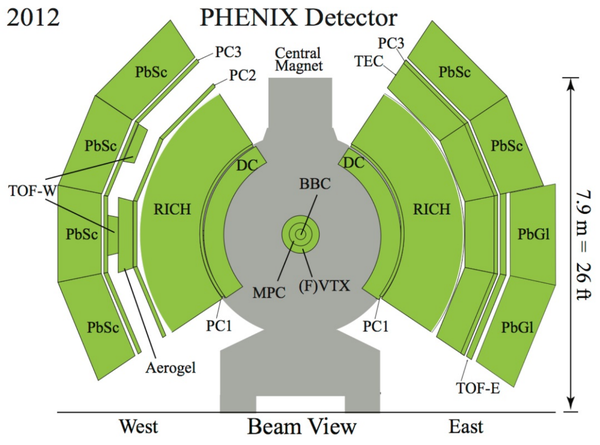


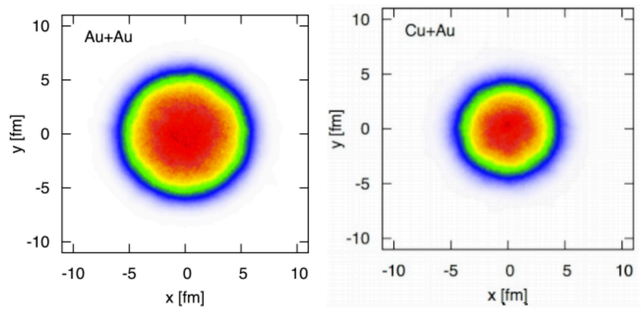
Figure 1: 2012 PHENIX detector configuration

PHENIX central arm

- $|\eta| < 0.35$
- $\Delta\phi = \pi$

PHENIX detector

- Charged particle tracks are reconstructed using the Drift Chamber (DC), the Pad Chamber (PC) and the collision point.
- Neutral clusters are measured in the Electromagnetic Calorimeter (EMCal). EMCal measures π^0, γ, and some hadrons (with lower efficiency).
- The Beam Beam Counters (BBCs) are used as the minimum bias (MB) trigger and for determining the collision vertex (z) position.



Average initial energy density distributions (in arbitrary units, increasing density from blue to red) in the transverse plane for zero impact parameter (b = 0) in Au+Au and Cu+Au collisions from arXiv:1403.2232 [nucl-th]. For Cu+Au collisions the system size is dominated by the smaller size of the Cu nucleus.

Jet reconstruction

- Track selection criteria: p_T > 500 MeV/c + various cuts optimized to reject high p_T background
- Cluster selection criteria: Energy > 500 MeV + require cluster to be not (and not around) hot, dead or uncalibrated towers
- Track/cluster association cut: Discard any cluster which is associated with a track

Jets are reconstructed using the anti-k_t algorithm with R = 0.2.

Fake jet subtraction

Data driven method of statistically subtracting fake jet contribution is implemented as:

- For events in which jet is not reconstructed, the position (η, ϕ) of tracks and the position (η, ϕ) of clusters are randomly swapped. Positions of tracks and clusters are swapped independently to insure that tracks/clusters don't fall in the dead/inefficient areas during the swapping process. Also, the random swapping is performed for east and west arm separately.
- Jet reconstruction is performed in these swapped tracks and clusters and then all the jet-level cuts are applied to the reconstructed jets.
- The resulting yield is "fake" jets.

Figure 2 demonstrates the fake jet subtraction procedure. Black points are the raw yield, blue points are the estimated fake jet yield, and the red points are resulting yield after statistically subtracting estimated fake jet yield from the raw yield.

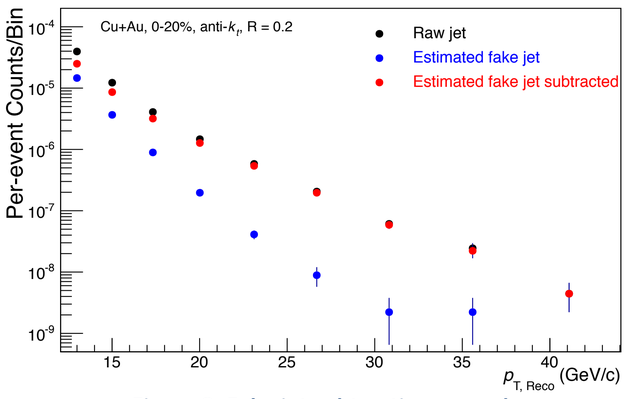


Figure 2: Fake jet subtraction procedure.

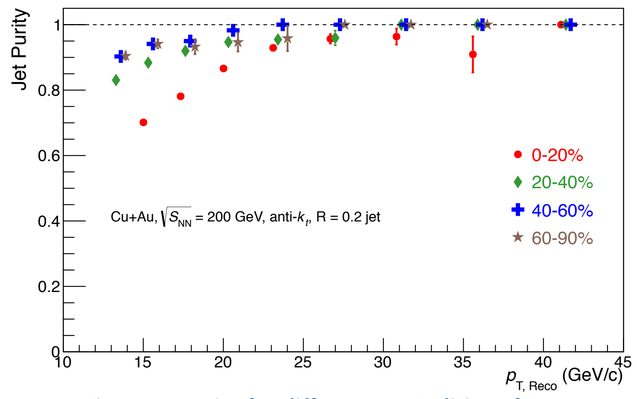


Figure 3: Purity for different centralities of Cu+Au.

Figure 3 shows the jet purity for different centralities of Cu+Au collisions. As expected, fake jet contribution is both $p_{T,\,Reco}$ and centrality dependent; the contribution being largest for central collisions and at low p_T.

Results

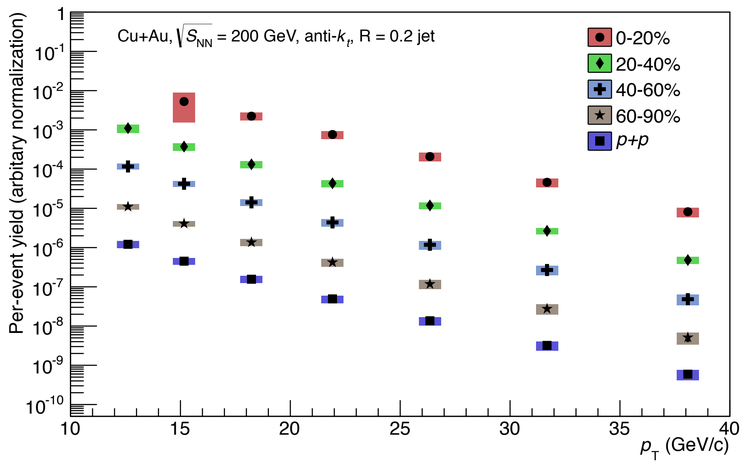


Figure 4: Measured per-event jet yield in p+p and Cu+Au collisions.

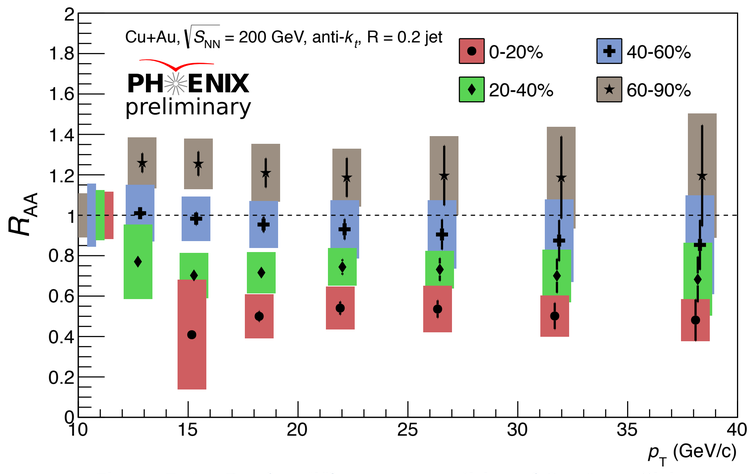


Figure 5: Jet R_{AA} for different centralities of Cu+Au collisions.

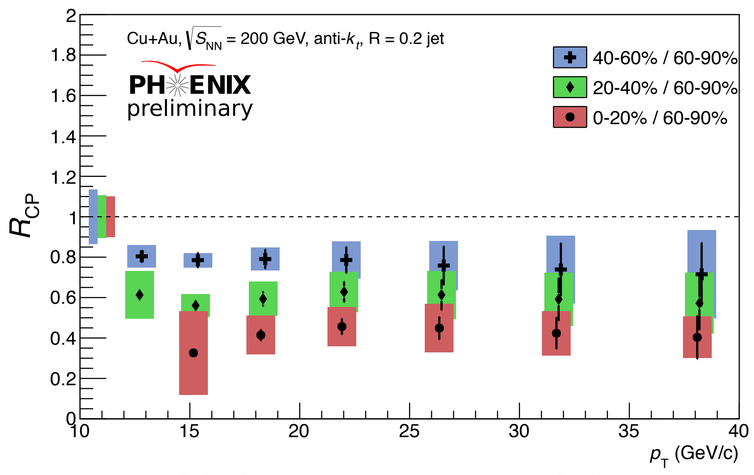


Figure 6: Jet R_{CP} for different centralities of Cu+Au collisions

Figure 4 shows the measured per-event yield in p+p different centralities of Cu+Au collisions. The yields are arbitrarily normalized. The vertical bars indicate the statistical uncertainties and the shaded bands indicated the systematic uncertainties. Figure 5 and Figure 6 show the measured je R_{AA} and R_{CP} for different centrality classes, respectively. The vertical bars indicate the statistical uncertainties and the shaded bands indicate the systematic uncertainties. The overall normalization uncertainties are shown as vertical band on the left side at Y = 1 mark.

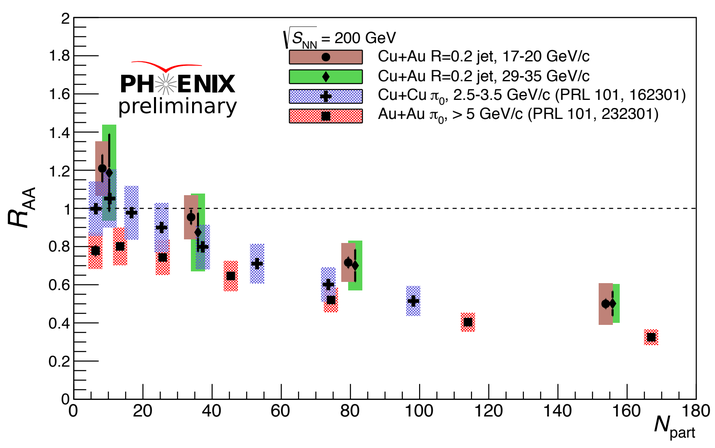


Figure7: Cu+Au jet R_{AA} compared with Cu+Cu and Au+Au π^0 R_{AA}.

Figure 7 shows Cu+Au jet R_{AA} compared with the average π^0 R_{AA} in the interval 2.5 < p_T < 3.5 GeV/c for Cu+Cu collisions and integrated π^0 R_{AA} for p_T > 5 GeV/c for Au+Au collisions. In all cases, the vertical bars indicate the statistical uncertainties and the shaded bands indicate the systematic uncertainties, except for the Cu+Cu data. In the latter case, the shaded bands indicate total (statistical + systematic) uncertainties. The overall normalization uncertainties are not shown.

Conclusion

The ratios of jet spectra from different centrality selections of Cu+Au collisions show a strong modification of jet production at all p_T; as a result, jets are found to be suppressed by approximately a factor of two in Cu+Au collisions as compared to p+p collisions. The dependence of Cu+Au jet R_{AA} on N_{part} is higher than π^0 R_{AA} for both Cu+Cu and Au+Au collisions at the same collision energy.

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