



Pi0-hadron Correlations in Small and Large Systems with PHENIX Veronica Canoa Roman

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Jet modification in QGP



 High momentum partons lose energy when they transverse the QGP medium-> jet is modified:



broadening energy loss

Two particle correlations



- Two particles correlations from same jet : near side ($\Delta \phi \sim 0$)
- Two particles correlations from each dijet: away side ($\Delta \phi \sim \pi$)

PHENIX detector

- Two central arms: cover φ~π and |η|<0.35
- Electromagnetic calorimeter (EMCal): measure photon,
 πo→ γ +γ
- Drift Chamber (DC) and Pad Chamber (PC): charge particle tracking
- Beam-Bream counters (BBC) and Zero-Degree Calorimeters (ZDC) measures collision centrality



Two particle correlation p+p



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Hard scattering kinematics



$$p_{\rm out} = |\mathbf{p}_T^{\rm assoc}|\sin\Delta\phi$$

momentum component of the associated hadron perpendicular to the trigger hadron



Iongitudinal momentum fraction of the associated hadron with respect to the trigger hadron (proxy for the momentum fraction z)

Pout for away side jet

arXiv:1805.02450v2

as a function of PT trigger



- Pout allows to separate non-perturbative (Gaussian) and perturbative process (not Gaussian tail)
- Tails deviate from Gaussian:hard radiation
- Gaussian width increases with PT trigger

Pout for away side jet

arXiv:1805.02450v2

as a function of XE



Gaussian width increases with XE

Gaussian width for different energies

arXiv:1805.02450v2



- •No significant center of mass energy dependance
- Gaussian width increases with P⊤ trigger and XE

-> similar qualitative behavior to Drell-Yan and semi-inclusive DIS interactions (*Phys. Rev. D 81(2010), Phys. Rev. D 89 (2014)*)



Correlation in p+Au

Away side





- Near side: $|\Delta \phi| < \pi/2$
- Away side: $2\pi/3 < \Delta \phi < 4\pi/3$
- Tails deviate from Gaussian:hard radiation
- Intra jet correlation, pi0 and hadron fragment from the same hard parton ->narrower than the away side

arXiv:1809.09045v1

Broadening in p+A



Near side shows no Pout broadening-> intrajet radiation effects are small

Away side shows Pout broadening only in p+Au

Broadening in p+A (away side)

arXiv:1809.09045v1

- Pout broadening shows Ncoll dependance-> suggests a path length dependance
- Possible effects that may contribute:
 - v2 and v3 systematically ruled out as contributor (1%)
 - multiple scattering of partons inside a nuclear medium ("Croning effect region")
 - Additional KT (initial transverse momentum) for parton in the nucleus respect to p+p
 Path length dependance->hard scattered partonic energy loss

Correlation in Au+Au

 $\cos(4\Delta\phi)$

New results with better handle on v2, v3 ,v4 background wrt our earlier PRL 104 252301 (2010)

• Flow background due to initial condition of collision BG flow = $b_0 [1 + 2\sum v_n^{\pi^0} v_n^H \cos(n \cdot \Delta \phi)]$

Correlation in Au+Au

- Au+Au away side broadening in low associate P⊤ region
- Au+Au results converge to p+p results in high trigger P⊤ bins
- No significant centrality dependence within uncertainty

Summary

p+p

- Multi-Differential analysis with hard scales that are sensitive to small transverse momentum
- Non-perturbative momentum width increases with the hard scale

->suggest QCD factorization breaking effects due to QCD's non-Abelian nature (have been seen also in DY processes)

p+A

- Away-side Pout broadening in p+Au with respect to p+p (not in p+AI!)
- Away-side Pout broadening increases with Ncoll
- -> Potentially provide information about cold nuclear matter effect: energy

loss, PDFs, multiple scattering, additional KT, etc.

Au+Au

- Away side angular broadening in low associate pT
- The differences with respect to p+p tends to disappear when the trigger pT increases