Non-photonic electron-hadron azimuthal correlation for $\sqrt{s_{NN}} = 200$ GeV AuAu collisions at STAR/RHIC

UCLA
Bertrand H.J. Biritz for the STAR Collaboration
Motivation: Heavy Quark Jet - Medium Interactions

Conical emission pattern in 2-particle correlations in AuAu

\[ 2.5 < p_T^{\text{trig}} < 4.0 \text{ GeV/c} \]
\[ 1.0 < p_T^{\text{asso}} < 2.5 \text{ GeV/c} \]

Mark Horner:

Motivation: Heavy Quark Jet - Medium Interactions

Conical emission pattern in 2-particle correlations in AuAu

B.I. Abelev, et al
arXiv:0805.0622v1

Mark Horner:

Is the same seen using e trigger?

How does B or D lose energy?
Detector, Signal and Background

**STAR Detector**

Signal are non-photonic electrons from charm and bottom decay

Background are hadronic from

- $\pi^0$ Dalitz decay
- $\eta$ Dalitz decay
- Kaon decay
- Vector meson decays
- and photonic electrons from photon conversions

Detector components used

- Time Projection Chamber (TPC) – $dE/dx$, $p$
- Barrel Electro-Magnetic Calorimeter (BEMC)
- Barrel Shower Maximum Detector (BSMD)
  
  e ID, background
# Electron Purity

<table>
<thead>
<tr>
<th>Cut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dE/dx</td>
<td>$(3.335, 4.551 \text{ keV/cm})$</td>
</tr>
<tr>
<td>Primary</td>
<td>Primary track</td>
</tr>
<tr>
<td>Charge</td>
<td>$\pm 1$</td>
</tr>
<tr>
<td>SMD Strips</td>
<td>$\geq 2$ in both eta and phi</td>
</tr>
<tr>
<td>P over E</td>
<td>$(0.3, 1.5)$</td>
</tr>
<tr>
<td>DCA Global</td>
<td>$[0, 2)$</td>
</tr>
<tr>
<td>Rcut</td>
<td>$(-0.0979, 0.0107)$ for Phi dist.</td>
</tr>
<tr>
<td></td>
<td>$(-3.564, 0.865)$ eta $&gt; 0$</td>
</tr>
<tr>
<td></td>
<td>$(-1.092, 3.169)$ eta $&lt; 0$</td>
</tr>
</tbody>
</table>
Electron Purity

98% purity

Before cuts

After cuts:
- dE/dx
- P/E

Shower Size

\( p, K, \pi, e \)

3.24
4.55

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Bertrand H.J. Biritz
The invariant masses of the O.S. and S.S. e-pairs have different distributions
- Reconstructed photonic electrons are subtracted
- Photonic electrons are reconstructed-photonic/ε
- ε is the background reconstruction efficiency calculated from simulations
Signal Extraction for e-h Correlation

All Tracks

Inclusive electron

Non-photonic electron

Photonic electron

Reco. photonic electron: Opp Sign - combinatorics

Not reco. photonic electron: \((1/\varepsilon - 1) \times (\text{reco. photonic})\)

Semi-inclusive electron

\[\Delta \Phi_{\text{non-photo}} = \Delta \Phi_{\text{semi-incl}} + \Delta \Phi_{\text{Same Sign}} - (1/\varepsilon - 1) \times (\Delta \Phi_{\text{Opp Sign}} - \Delta \Phi_{\text{Same Sign}})\]
Preliminary AuAu results

0-20% Centrality, $3 < p_T^{\text{trig}} < 6$ GeV/c and $0.15 < p_T^{\text{asso}} < 1$ GeV/c

Away side fit is from PYTHIA for p+p result

Error band due to ZYAM
Comparison with another AuAu 200GeV result

Different data set was used, lower statistics

70% photonic electron reconstruction efficiency

0-20% Centrality, $3 < p_T^{\text{trig}} < 6$ GeV/c and $0.15 < p_T^{\text{asso}} < 1$ GeV/c

(Gang Wang, QM 2008)
Comparison with CuCu 200GeV result

70% photonic electron reconstruction efficiency

0-20%, $3 < p_{T}^{\text{trig}} < 6$ GeV/c and $0.15 < p_{T}^{\text{asso}} < 1.0$ GeV/c

0-20%, $3 < p_{T}^{\text{trig}} < 6$ GeV/c and $0.15 < p_{T}^{\text{asso}} < 0.5$ GeV/c

(Gang Wang, QM 2008)
Conclusions

• Even with large error bars the e-h correlation for AuAu 200 GeV indicates there is difference from pp or dAu and is in general agreement with CuCu results

• Refining of cuts and possible combination of prior AuAu results to increase the statistics
Data Sample

• P07ie, ran with P08ib library though
  • trgsetupname = 2007Production2
  • tpc, emc and bsmd all included
  • runnumber > 8122053

• Preliminary cuts
  • Centrality > 0-60%
  • Z-vertex within 30 cm
  • TPC points >= 15
  • \( P_t > 2 \text{ GeV}/c \)
• Approximately 1M events make it
Further cuts

• 1M events which are reduced to .6M after initial cuts (0-20% centrality, Z-vertex)

• 2.5M matched tracks
  • TPC track matched to an EMC point

• Lower momentum (> 3 GeV/c) and eta (-0.7, 0.7) cut reduce it to 200k

• Electron cuts

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<th>rel. % survived</th>
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</thead>
<tbody>
<tr>
<td>dE/dx</td>
<td>$P &gt; 2, (3.335, 4.551 \text{ keV/cm})$</td>
<td>100</td>
</tr>
<tr>
<td>Primary</td>
<td>Primary track</td>
<td>100</td>
</tr>
<tr>
<td>Charge</td>
<td>±1</td>
<td>100</td>
</tr>
<tr>
<td>SMD Strips</td>
<td>≥ 2 in both eta and phi</td>
<td>34</td>
</tr>
<tr>
<td>P over E</td>
<td>$(0.3, 1.5)$</td>
<td>25</td>
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<tr>
<td>DCA Global</td>
<td>$[0, 2)$</td>
<td>99</td>
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<td>Rcut</td>
<td>$(-0.0979, 0.0107)$ for Phi dist.</td>
<td>41</td>
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SMD eta-phi check

SMD hits of hadrons

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<tbody>
<tr>
<td>Entries</td>
</tr>
<tr>
<td>Mean x</td>
</tr>
<tr>
<td>Mean y</td>
</tr>
<tr>
<td>RMS x</td>
</tr>
<tr>
<td>RMS y</td>
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SMD hits of e's

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P over E check

- Using electron cuts besides P over E (i.e. dE/dx, nstrips...)

<table>
<thead>
<tr>
<th>hpoeh</th>
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<tbody>
<tr>
<td>Entries</td>
<td>196403</td>
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<tr>
<td>Mean</td>
<td>2.288</td>
</tr>
<tr>
<td>RMS</td>
<td>1.134</td>
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</table>
P over E check

- Using electron cuts besides P over E (i.e. dE/dx, nstrips...)

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\[ P/E \text{ of } e's \]
Preliminary results

0-20% Centrality, $3 < p_T^{\text{trig}} < 6$ GeV/c and $0.15 < p_T^{\text{asso}} < 1$ GeV/c

70% electron reconstruction efficiency

60% electron reconstruction efficiency
Photonic correlation

![Graph showing photonic e-h correlation with STAR Preliminary note]
Semi + combinatorical