Measurement of semi-inclusive jet fragmentation functions in 
Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV in STAR

Poster 248. https://indico.cern.ch/event/751767/contributions/3775977/

Saehanseul Oh (LBNL) for the STAR Collaboration

Hard Probes 2020, Plenary Session – Flash Talks and Summary I
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Jet Fragmentation Functions

- Jets probe the strongly interacting QCD medium
  - Interactions between jets and the QCD medium modify the parton shower relative to that in vacuum

- Jet fragmentation function, $\frac{1}{N_{\text{jet}}} \frac{dN}{dz}$
  - Distribution of longitudinal momentum fraction of particles with respect to the jet
Jet Fragmentation Functions

Jet fragmentation function, \( \frac{1}{N_{\text{jet}}} \frac{dN}{dz} \)
- Distribution of longitudinal momentum fraction of particles with respect to the jet

\[ z = \frac{p_{T,\text{track}} \cos(r)}{p_{T,\text{jet}}} \]

Jet interactions with the QCD medium modify the parton shower relative to that in vacuum.

\[ R_{D(z)} = \frac{D(z)_{\text{PbPb}}}{D(z)_{\text{pp}}} \]
Jet Fragmentation Functions

Jet fragmentation function, $\frac{1}{N_{jet}} \frac{dN}{dz}$

- Distribution of longitudinal momentum fraction of particles with respect to the jet

How does it change in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV relative to the vacuum reference?


CMS, Phys. Rev. C 90 (2014) 024908

Jet Fragmentation Functions

Jet

Constituent Particle

$z = \frac{p_{T,\text{track}} \cos(\varphi)}{p_{T,\text{jet}}}$
Anti-$k_T$, $R = 0.4$, charged jets are used for the current analysis
Semi-inclusive jet measurement

- Jets are selected in the recoil region with respect to high momentum trigger particles (BEMC tower with $9.0 < E_T < 30.0$ GeV), $|\phi_{\text{trig}} - \phi_{\text{jet}}| > \pi - \pi/4$

- This enables us to subtract the uncorrelated background contributions
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- Semi-inclusive charged jet $p_T$ spectra in Au+Au collisions

- Combinatorial jet subtraction via a mixed-event method

Now the subtraction extended to two dimensions: $(p_{T,\text{jet}}, z)$

Semi-inclusive jet measurement - Corrections

- In the recoil region, there are **signal jets**, correlated to the trigger particle, and **background jets**, uncorrelated to the trigger particle.
- In signal jets, there are **uncorrelated particles**.
- Contributions from background jets and uncorrelated particles in signal jets are estimated via a mixed-event method, and subtracted.
Semi-inclusive jet measurement - Corrections

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Further details in the poster.

Corrected $dN/dz = \text{Black} - \text{Red} - \text{Blue}$

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Results

- Fully unfolded jet fragmentation functions for 40-60% centrality class and three $p_{T,jet}$ ranges

- PYTHIA 8 (Monash 2013, tuned to LHC) for the same $p_{T,jet}$ ranges

Au+Au, $\sqrt{s_{NN}} = 200$ GeV, 40-60%

$A_{jet} > 0.35$, $R = 0.4$, anti-$k_T$

$9.0 < E_{T,\text{trig}} < 30.0$ GeV

STAR Preliminary

$dN/dz$ jet

$1/N_{jet}$

$z$

$10^3$

$10^2$

$10^1$

$10^{-1}$

$10^{-2}$

$10^{-3}$

PYTHIA 8

- $15 \leq p_{ch,T,jet}^{ch} < 20$ GeV/c
- $20 \leq p_{ch,T,jet}^{ch} < 25$ GeV/c, $x10^{-1}$
- $25 \leq p_{ch,T,jet}^{ch} < 30$ GeV/c, $x10^{-2}$

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Results

- Ratios of jet fragmentation functions, \((\text{Au+Au } 40\text{-}60\%)/(\text{PYTHIA} 8)\)
- **The ratio remains near 1**
  - Tangential jet selection with a high-\(p_T\) trigger particle and recoil jets? Short path-length in medium or little jet-medium interactions in 40-60% centrality? …

- Fragmentation functions for \(p+p\) and **central** \(\text{Au+Au}\) events
- Semi-inclusive jet spectra in 40-60% centrality

**On their way!**