Measuring the groomed shared momentum fraction ($z_g$) in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV at STAR using a semi-inclusive approach

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Abstract: This poster presents an ongoing analysis of measuring the jet substructure observable $z_g$, which probes the physics of the first hard splitting of a hard-scattered parton, in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. This analysis employs a semi-inclusive approach, selecting candidate jets found within the recoil region of high transverse momentum trigger particles. Contributions from combinatorial jets due to the large fluctuating background is subtracted at the ensemble level using a mixed-event technique.

Groomed Shared Momentum Fraction $z_g$

- $z_g$ is the momentum fraction of the subleading jet groomed using SoftDrop [1] (defined here with $\alpha_s = 0.1, \beta = 0$)

$$z_g = \frac{\text{Min}(p_T^1, p_T^2)}{p_T^1 + p_T^2} > 0.1$$

- Previously measured in STAR for Au+Au collisions [2] using a HardCore selection of dijets to eliminate combinatorial jets
  - No modification of $z_g$ found compared to $p_T$-smeared Au+Au
  - Requiring a high-$p_T$ particle in jets can induce surface bias
  - Is there a different selection of jets in Au+Au collisions at RHIC energies in which $z_g$ is modified?

Using Mixed Events to Remove Combinatorial Jets

- Same Events (SE) require a BEMC tower with $p_T > 9$ GeV

- Mixed Events (ME) are minimum-bias (MB) events with charged tracks mixed such that particle correlations are destroyed

- Events binned and sampled in classes of event vertex position along the beam direction, luminosity, event-plane angle and charged track multiplicity

- Event mixing and combinatorial jet subtraction independently done for 0-10% and 10-20% centrality

- Unlike SE, no jets excluded when calculating ME $p_T$, the event-wise background density

SE and ME $z_g$ Distributions

- Both event classes are background subtracted using Constituent Subtraction [4] at the jet-level
- Zero bin filled by jets which do not pass the SoftDrop criterion
- SE and ME $z_g$ have distinct shapes, especially important at low $p_T$ where combinatorial jet contribution is significant

Combinatorial-subtracted $z_g$

- Combined 0-20% centrality detector level jets with $20 < p_T^{\text{jett}} < 25$ GeV/$c$

- Insensitive to details of combinatorial subtraction in this $p_T$ range (~5% combinatorial jets in SE for 0-10% central, less for 10-20% central)

- Comparison to smeared PYTHIA-6 embedded into MB 0-20% Au+Au events

- No significant modification found in this $p_T$ region compared to PYTHIA-6

Summary and Outlook

- Measured $z_g$ for 0-20% central events within $20 < p_T^{\text{jett}} < 25$ GeV/$c$ bin which is insensitive to details of combinatorial subtraction
- No clear $z_g$ modification observed for $20 < p_T^{\text{jett}} < 25$ GeV/$c$ compared to smeared PYTHIA-6 baseline embedded into Au+Au events
- Plan to utilize this semi-inclusive approach to measure $z_g$ down to lower jet $p_T$ without inducing a strong surface or fragmentation bias

References


The STAR Collaboration

https://drupal.star.bnl.gov/STAR/presentations