Semi-inclusive hadron+jet measurement in Ru+Ru and Zr+Zr collisions at $\sqrt{s_{\mathrm{NN}}} = 200$ GeV with STAR

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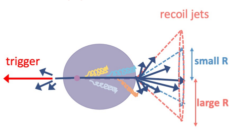
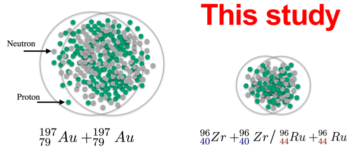
Motivation

- ☐ Jet: a collimated spray of particles
- ☐ Parton-QGP interaction → Jet quenching → Probe QGP properties
- ☐ h+jet study in intermediate-size collision systems

Jet recoiling from a high-p_T trigger hadron

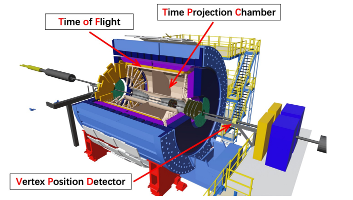


This study



- ➢ **Jet energy loss**
  Yield suppression
- ➢ **Jet substructure modification**
  Yield dependence on jet R

STAR detector



- ☐ Time Projection Chamber (TPC):
  charged particles: $|\eta| < 1.0, 0 \leq \phi \leq 2\pi$
- ☐ Year 2018 data taking for Ru+Ru and Zr+Zr at $\sqrt{s_{\mathrm{NN}}} = 200$ GeV

Analysis procedure

$0.2 < p^{ch}_{T,trk} < 25$ GeV/c, $7 < p_{T,trig} < 25$ GeV/c
Charged-particle jets with R = 0.2 to 0.5
$3\pi/4 < |\phi_{\mathrm{jet}} - \phi_{\mathrm{trig}}| < 5\pi/4$
Anti-k_T algorithm

High p_T hadron triggered recoil jets → Uncorrelated background subtraction → Correction for efficiency + Unfolding of jet energy → Fully corrected results

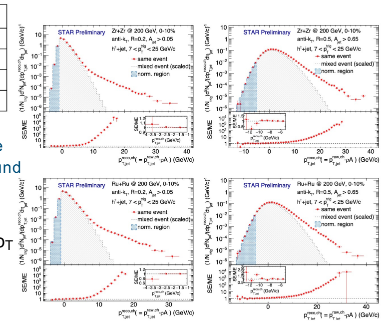
Mixed-Event (ME) approach

jet yield = Same Event - f^{ME} * Mixed Event
(f^{ME}: normalization factor extracted from data)

0-10%	R	f^{ME}
Zr+Zr	0.2	0.92
	0.5	0.79
Ru+Ru	0.2	0.92
	0.5	0.77

All ME tracks are fully uncorrelated to estimate combinatorial jet background

SE and ME are in good agreement at negative p_T → ME works well on background description

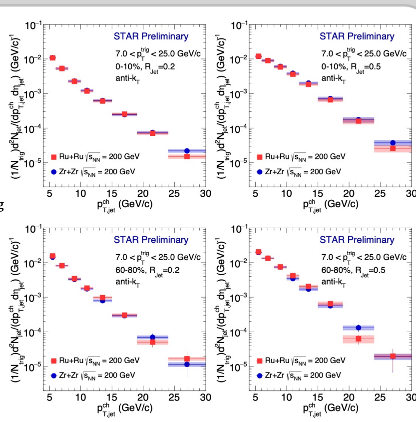


h+jet yield

Trigger-normalized yield

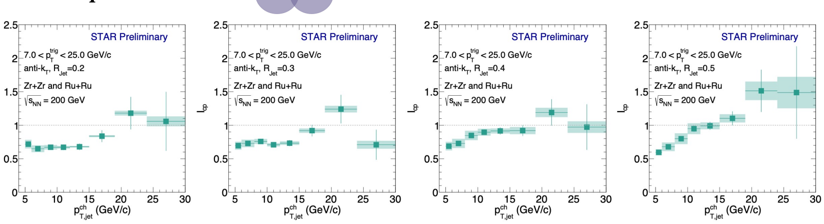
$$Y(p^{\mathrm{ch}}_{\mathrm{T,jet}}) = \frac{1}{N^{AA}_{trig}} \cdot \frac{d^3 N^{\mathrm{AA}}_{\mathrm{jet}}}{dp^{\mathrm{ch}}_{\mathrm{T,jet}} d\Delta\phi d\eta_{\mathrm{jet}}}\Bigg|_{p_{\mathrm{T,trig}}}$$

h+jet spectra from the two systems are consistent within uncertainties, allowing the data to be combined



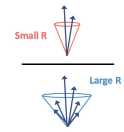
h+jet yield ratio (I_{cp})

$$I_{cp} = \frac{Y^{0-10\%}}{Y^{60-80\%}}$$

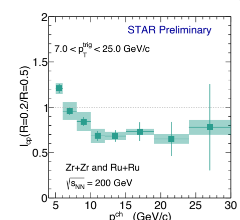


- Similar trends across different jet R: I_{cp} increases with jet p_T
- $I_{cp} < 1$ at low p_T (~ 5 - 15 GeV/c) is indicative of jet quenching
- $I_{cp} > 1$ at high p_T (> ~ 15 GeV/c) may suggest an interplay between trigger and jet energy loss [1]

Jet R dependence



$$\frac{I^{R=0.2}_{cp}}{I^{R=0.5}_{cp}}$$



Small R jets are more suppressed
→ in-medium broadening of jet shower

Summary

- ☐ Fully corrected recoil jet spectra and I_{cp} have been measured in Zr+Zr and Ru+Ru collisions
- ☐ A rising trend of I_{cp} with jet p_T is observed; $I_{cp} < 1$ in lower p_T range is indicative of jet quenching
- ☐ Ratio of I_{cp} (R = 0.2 / R = 0.5) < 1 at high p_T, indicating medium-induced jet broadening

Reference

1. Y. He, M. Nie, S. Cao, R. Ma, L. Yi, H. Caines, Phys. Lett. B 854 (2024) 138739

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