Measurement of photon-jet correlations in p+p and central Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV by STAR

Jace Tyler (jacer98@tamu.edu)
for the STAR Collaboration
Texas A&M University

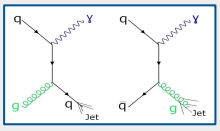
Quark Matter 2025

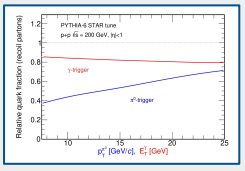
Abstract

We report the semi-inclusive distribution of fully-reconstructed jets recoiling from a direct photon trigger in pp and central Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. This observable provides an incisive probe of the Quark-Gluon Plasma generated in high-energy nuclear collisions. Direct photons are measured using the STAR Barrel Electromagnetic Calorimeter (BEMC). Jet reconstruction is carried out by the anti-k_T algorithm with jet resolution parameters R = 0.2 and R = 0.5, utilizing neutral energy measured in the BEMC and charged-particle tracks measured in the Time Projection Chamber (TPC). This measurement extends a recently reported STAR measurement of the same observable, which used charged-particle jets, to fully-reconstructed recoil jets. The status of the analysis will be reported, and its physics prospects will be discussed.

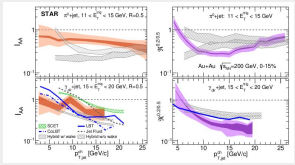
Motivation

- γ+jet→reference scale for jet quenching; dominated by quark jets
- π^0+jet→ path length and quark vs. gluon dependence on energy loss
- Full jets provide higher fidelity reconstruction of parton energy (cf. recent publication by STAR only includes charged particles in reconstruction)





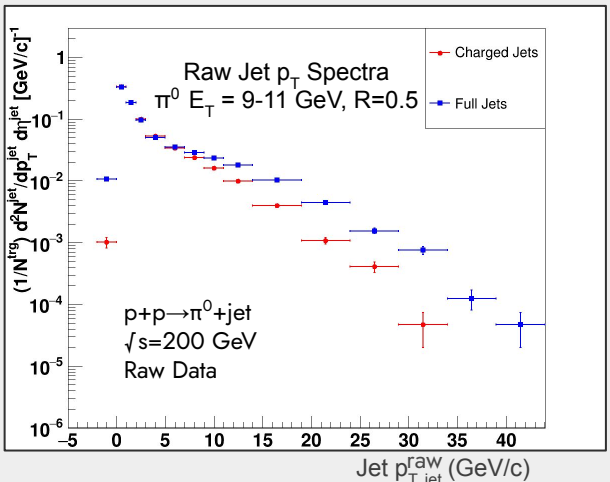
(arXiv:2309.00156)



(arXiv:2309.00156)

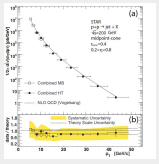
Jet Reconstruction

- Full reconstruction (neutral and charged particles) using anti-k_T, R = 0.2, 0.5
- Jet axis within $\pi \pm \frac{\pi}{4}$ relative to π^0 or γ trigger

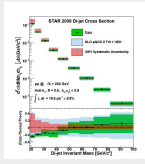


Fully Reconstructed Jets Measured by STAR

- STAR has done full jet reconstruction for p+p at √s= 200 GeV previously



Phys.Rev.Lett 97 (2006) 252001



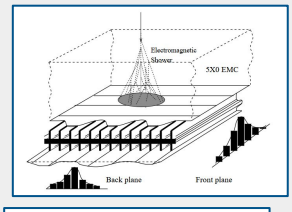
Phys.Rev.D 95 (2017) 7, 071103

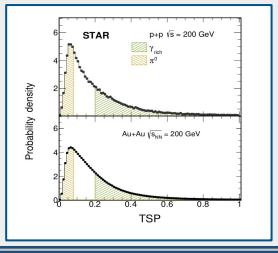
π^0/γ discrimination

- BSMD measures shower shape for distinguishing γ/π^0triggers
- π^0 decays into two photons decreasing Transverse Shower Profile (TSP)

$$TSP = \frac{E_{Tower}}{\sum_i e_i \, r_i^{1.5}}$$

E_{Tower} = trigger tower energy
e_i = strip energy
r_i = distance from strip to center

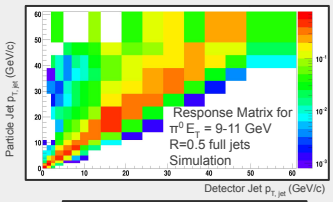


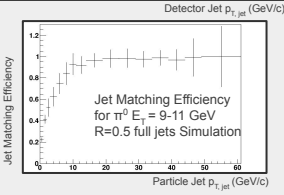


(arXiv:2309.00156)

Corrections

- Response matrix from detector simulation will be used in unfolding
- In Au+Au, corrections for heavy ion background will employ event mixing technique





Prospects

- Full correction and systematic uncertainty evaluation
- Comparisons with theoretical models will help infer QGP properties

Supported in part by the U.S. DEPARTMENT OF ENERGY Office of Science

The STAR Collaboration