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

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Quark Matter 2025

Abstract

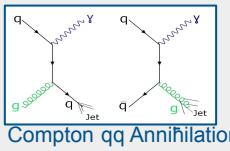
We report the semi-inclusive distribution of fully-reconstructed jets recoiling from a direct photon trigger in pp and central Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. This observable provides an incisive probe of the Quark-Gluon Plasma generated in high-energy nuclear collisions. Direct photons 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

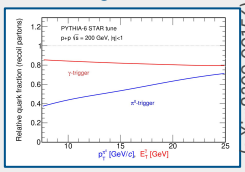
In Au+Au

- γ+jet→reference scale for jet quenching
- π^0+jet→ path length and quark vs. gluon dependence on energy loss
- Recent publication by STAR only includes charged particles in jet reconstruction

(arXiv:2309.00156)



Compton qq Annihilation Scattering



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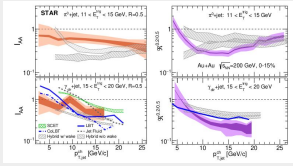
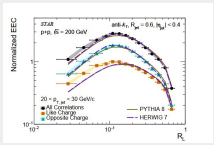
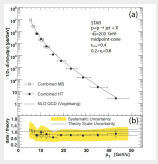


Fully Reconstructed Jets Measured by STAR

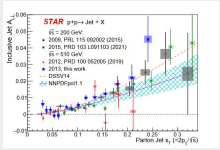
- STAR has done full jet reconstruction for p+p at √s= 200 GeV previously



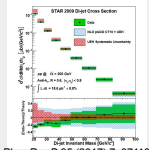
Phys.Rev.D 105 (2022) 9, 092011



Phys.Rev.Lett 97 (2006) 252001



arxiv.org/2502.15925(2025)

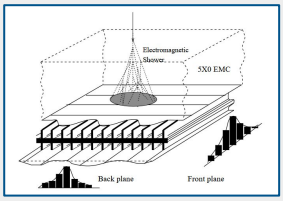


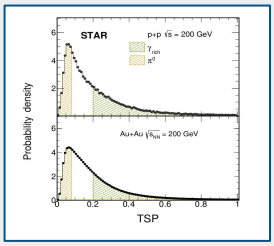
Phys.Rev.D 95 (2017) 7, 071103

π^0/γ discrimination

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

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

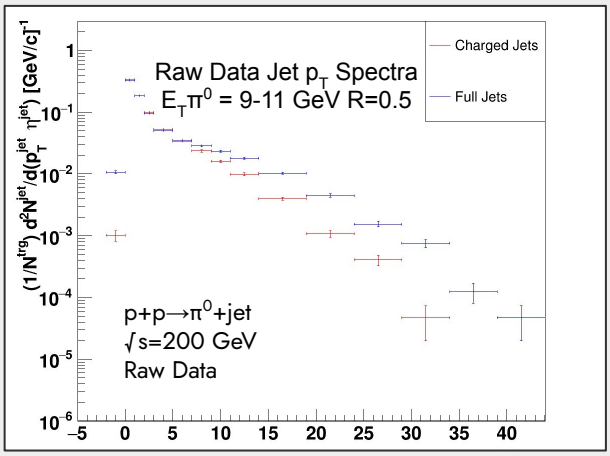




(arXiv:2309.00156)

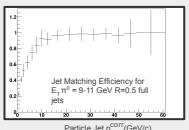
Jet Reconstruction

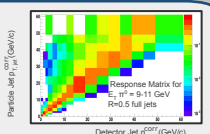
- Full reconstruction (including neutral particles from BEMC) using anti-k_T, R=0.2, 0.5
- Jet axis within $\pi \pm \frac{\pi}{4}$ relative to π^0 or γ trigger



Corrections

- Corrections from Embedding will be used in unfolding





Conclusion and Prospects

- in p+p, unfolding with full systematics studies underway
- in Au+Au, corrections for heavy ion background will include event mixing

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

The STAR Collaboration