Toward understanding relativistic heavy-ion collisions with the STAR detector at RHIC

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The hard production of a direct photon back-to-back with a jet (γ-jet) is a probe of the parton energy loss in heavy-ion collisions [1]. In the "γ-jet" coincidence measurement, the measured energy of the trigger particle (the photon) serves as a calibrated baseline for the total energy of the jet particles on the recoil side (i.e. opposite in azimuth) of the trigger. The mean-free path of the γ in the medium is large enough so that its momentum is preserved, regardless of the position of the initial scattering vertex. Thus it does not suffer from the geometric biases, i.e. the non-uniform spatial sampling of hadron triggers due to energy loss in the medium, of *e.g.* π^0 triggers.

As the dominant background to direct photons are π^0 (decaying to two photons), the Barrel Shower Maximum Detector (BSMD) has provided the capability of distinguishing direct photons from neutral pions via the transverse shower shape. Our group has used this method in the measurement of direct photon+hadron correlations [2]. The γ-hadron correlation studies can be extended to studies of γ-triggered jet reconstruction measurements (as has been done at the LHC [3, 4]). The away-side jet will then be reconstructed in coincidence with triggers selected as direct photon candidates or (for p_T<20 GeV using the shower shape with the BSMD) identified π^0 triggers. The advantage of this is the ability to reach lower energy fragments in the jet to study jet-shape modification and possible redistribution of energy.

Two papers on charged recoil jets relative to γ/π^0 triggers are in the final stages of collaboration review and should be submitted to PRL and PRC for publication within this fiscal year. Charged-jet reconstruction is performed using the anti-k_T algorithm from the Fastjet package [5]. In this analysis, charged particles with transverse momentum $0.2 < p_T < 30$ GeV/c are included as constituents. A fiducial cut is made on the pseudorapidity of the jet axis, $|\eta_{jet}| < 1-R$, where R is the jet resolution parameter associated with the radial size of the jet.

A key finding of the measurements in medium (Au+Au collisions) vs. vacuum (p+p collisions) is that the suppression of R=0.2 jets on the recoil side of both γ and π^0 triggers is largely restored when reconstructing larger jets of R=0.5. One selective figure from the upcoming papers is shown in Fig. 1.

Fig. 1 shows the ratio of charged recoil-jet yields for R-0.2 to R=0.5, $\Re^{0.2/0.5}$ for π^0 triggers measured with transverse energy E_T=9-11 GeV and 11-15 GeV, and γ triggers with 15-20 GeV. The Au+Au results are in blue and red. Also shown in these figures are the corresponding measurements in p+p collisions, in green. The comparison of the measurements in Au+Au to p+p collisions is a demonstration of in-medium jet broadening.

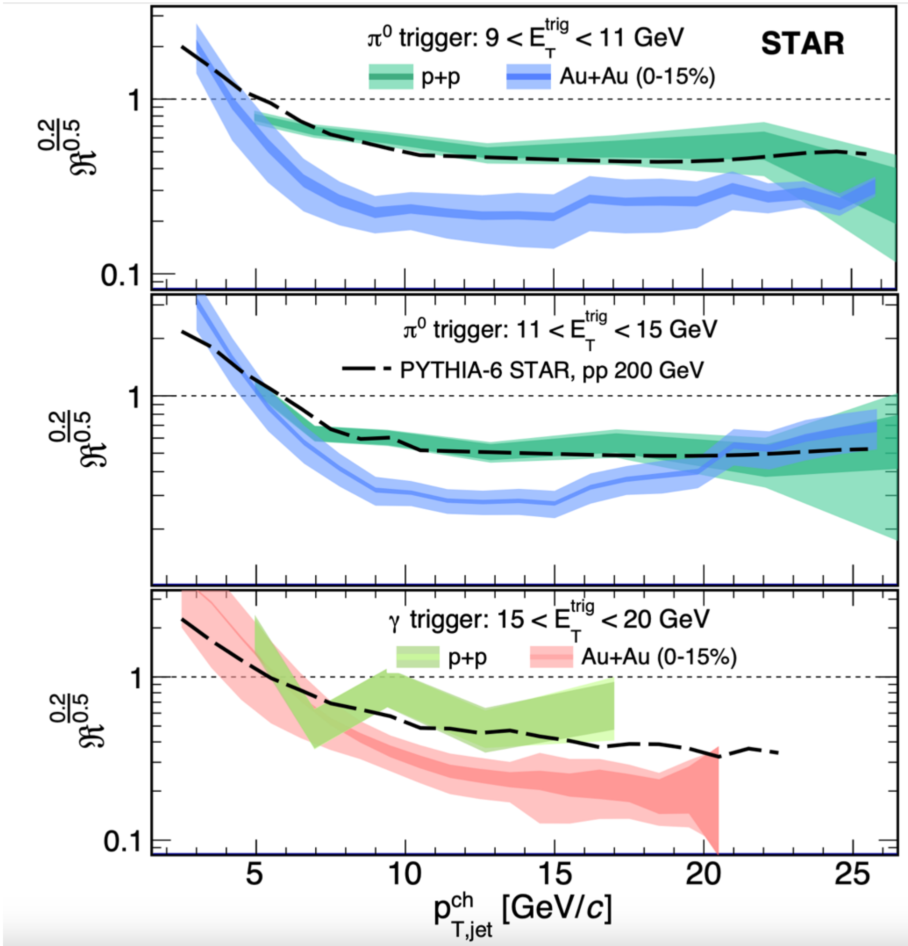

Fig. 1. Yield ratio $\Re^{0.2/0.5}$ for R = 0.2 and 0.5 measured in p+p and Au+Au collisions. Top panel: π^0 trigger, 9 < E_T^{trig} < 11 GeV; middle panel: π^0 trigger, 11 < E_T^{trig} < 15 GeV; bottom panel: γ_{dir} trigger, 15 < E_T^{trig} < 20 GeV. Dark bands are statistical errors; light bands are systematic uncertainty. Also shown are the same distributions calculated using PYTHIA-6 STAR tune for p + p collisions.

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