The semi-inclusive approach to measuring x_J^{γ}

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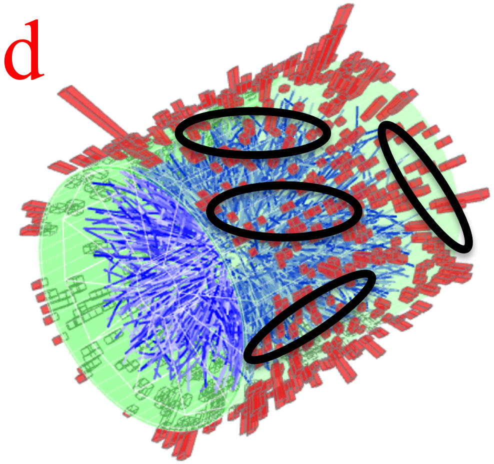
Factorizing jet signal and uncorrelated background: experiment

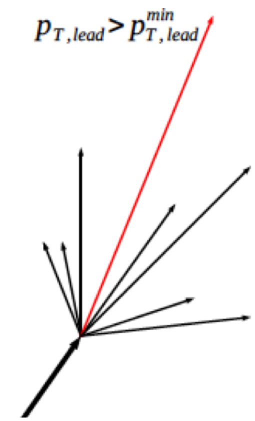


Heavy ion collisions

- Multiple hard processes generating jets
- Copious soft hadron production
- Many such processes contribute to each reconstructed jet candidate

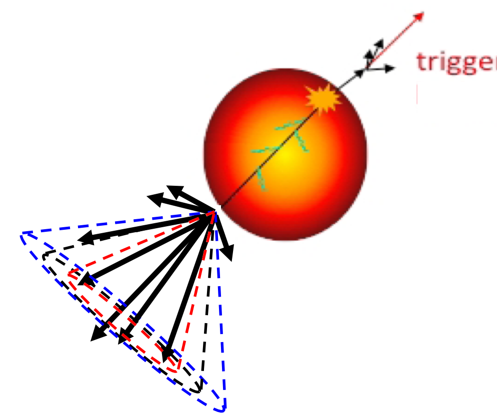
Define the signal jet population

- require linear response in bkgd environment
  $\rightarrow$ must be rare << 1/event
- can then correct for p_T-smearing via unfolding



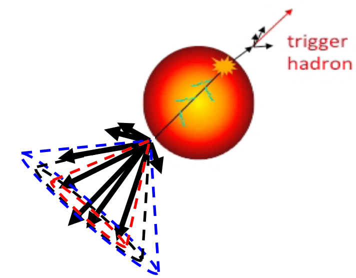
Discriminate hard jet candidates from bkgd

- Inclusive distributions:
  - hard core (high p_T hadron or cluster) - bias?
  - or high jet p_T relative to bkgd fluctuations
- Coincidence distributions:
  - Trigger on a hard process (hadron, jet, gamma, Z)
  - Measure correlated energy-momentum distribution recoiling from the trigger
- Jet substructure: grooming – bias?



Fully corrected spectrum: illustration of procedure

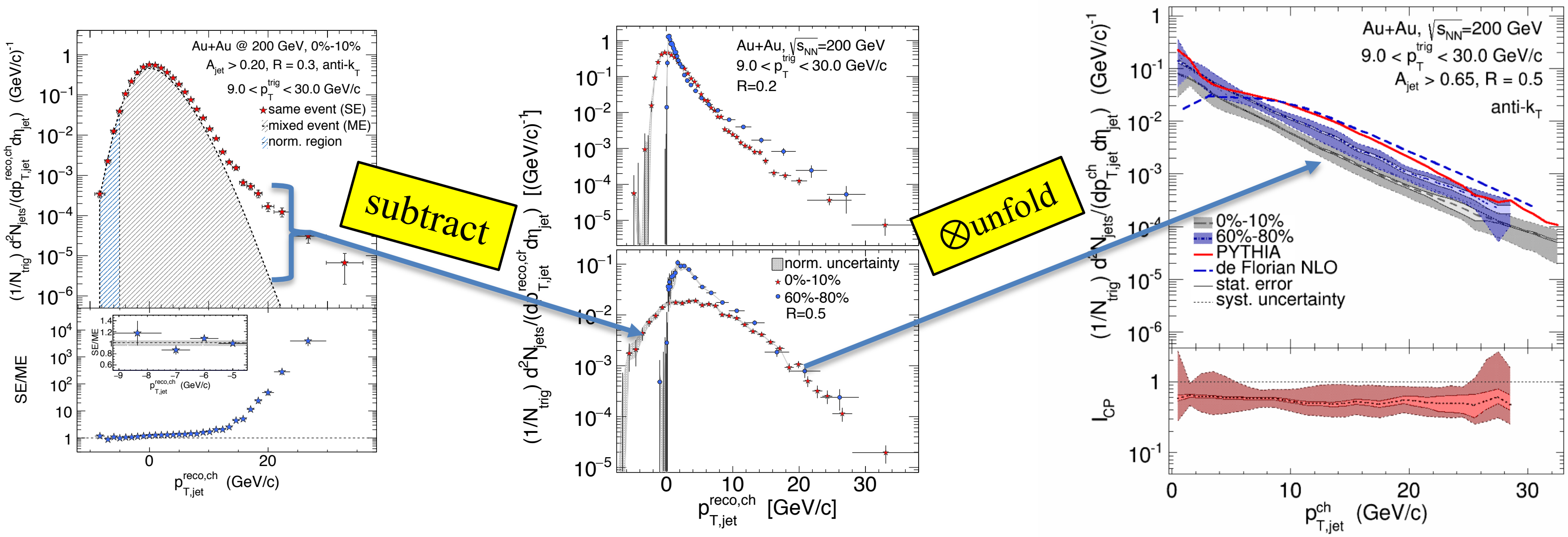
- Cannot know with certainty whether any given hadron (or hadron cluster) arises from the same high-Q^2 process as the trigger
- "uncorrelated background" strictly has meaning only for ensemble-averaged distributions



Two distinct steps for correcting bkgd:

Correct for uncorrelated yield ("vertical correction")

Correct for p_T-smearing of true jet signal ("horizontal correction")



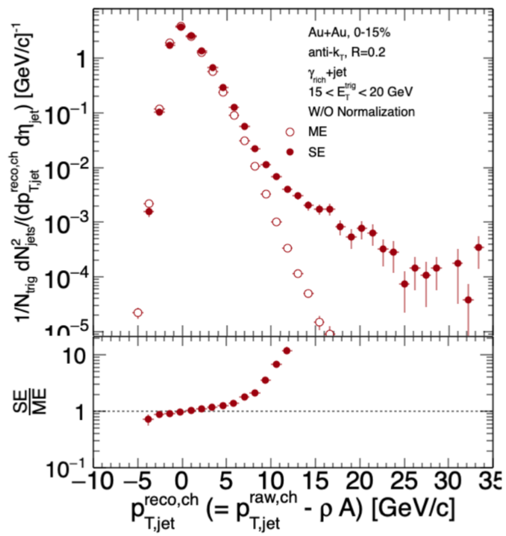
Procedure is driven by the fact that in experiment we cannot know the precise uncorrelated distribution in each event

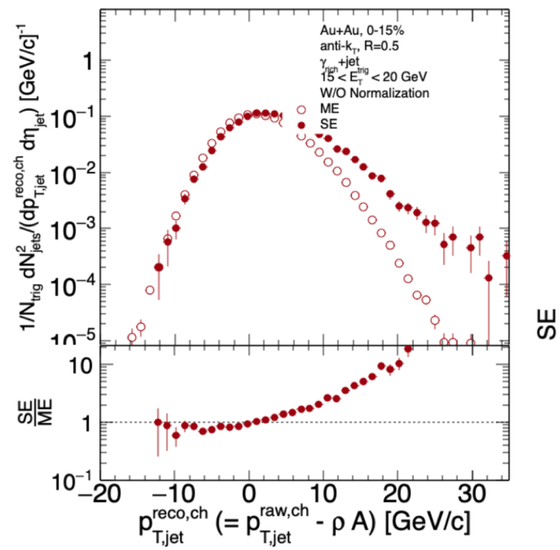
Semi-incl gamma+jet: current status

Run 14 data, 13 nb^{-1}

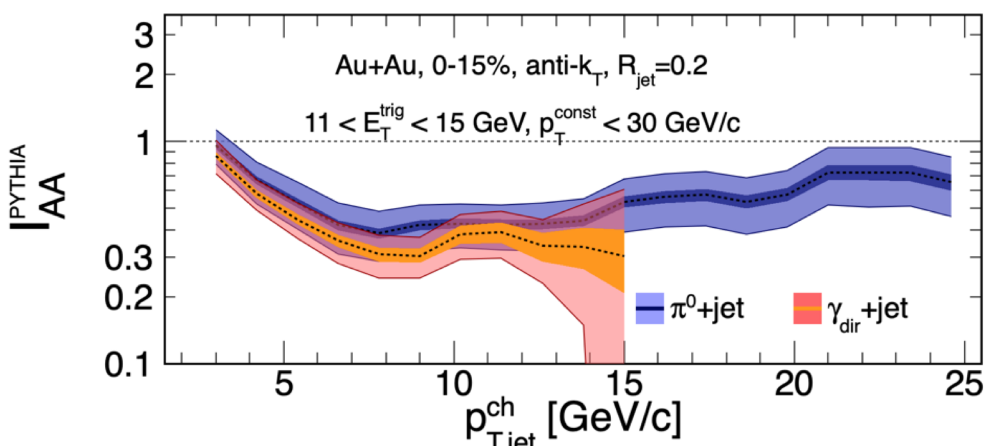
$$\frac{1}{N^{\gamma}_{trig}} \frac{dN^{recoil}_{jet}}{dp_{T,jet}} = \frac{1}{\sigma^{AA\to\gamma+X}} \frac{d\sigma^{AA\to\gamma+jet+X}}{dp_{T,jet}}$$

Raw data/ME comparison
(ME not renormalized)





I_{AA} for corrected spectra
(Nihar's talk at Collab mtg)



Semi-inclusive x_J^γ

Current measurement:

$$\frac{1}{N_{trig}^{\gamma}} \frac{dN_{jet}^{recoil}}{dp_{T,jet}} = \frac{1}{\sigma^{AA\rightarrow\gamma+X}} \frac{d\sigma^{AA\rightarrow\gamma+jet+X}}{dp_{T,jet}}$$

Scale the p_T of each recoil jet candidate by $p_{T,\gamma}$
($p_{T,\gamma}$ is measured well for each trigger)

$$x_J^\gamma = \frac{p_{T,jet}}{p_{T,\gamma}}$$

Semi-incl distribution of x_J^γ

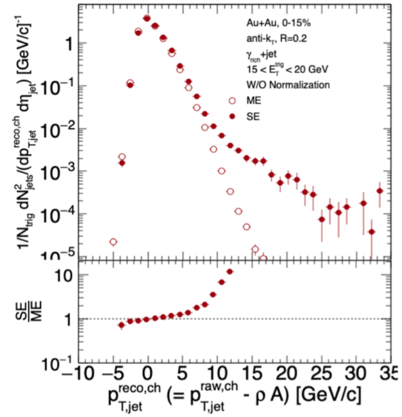
$$\frac{1}{N_{trig}^{\gamma}} \frac{dN_{jet}^{recoil}}{dx_J^\gamma} = \frac{1}{\sigma^{AA\rightarrow\gamma+X}} \frac{d\sigma^{AA\rightarrow\gamma+jet+X}}{dx_J^\gamma}$$

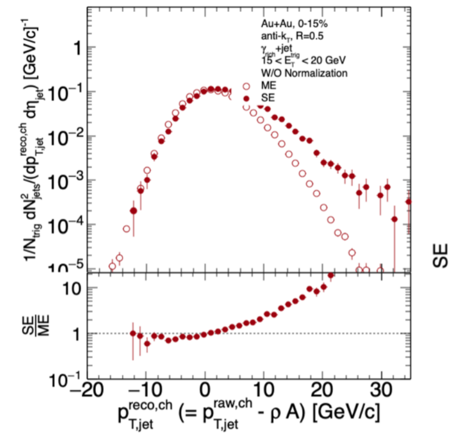
In practice: measure recoil jet distributions for γ-rich and π^0 triggers and disentangle
This is a "technical detail" ;-), above procedure still applies

$\gamma^{\rm rich}$ data in central Au+Au: SE + ME

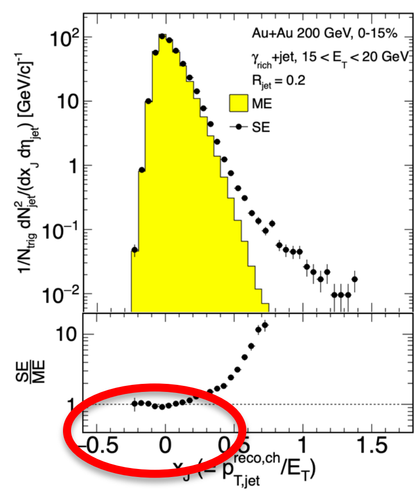
ME not renormalized in these figures

$$\frac{1}{N^{\gamma}_{trig}}\frac{dN^{recoil}_{jet}}{dp_{T,jet}} = \frac{1}{\sigma^{AA\to\gamma+X}}\frac{d\sigma^{AA\to\gamma+jet+X}}{dp_{T,jet}}$$

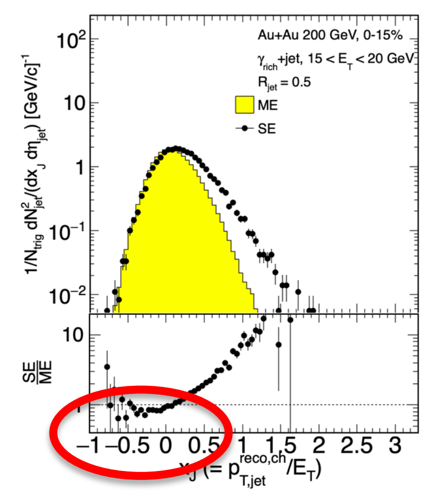




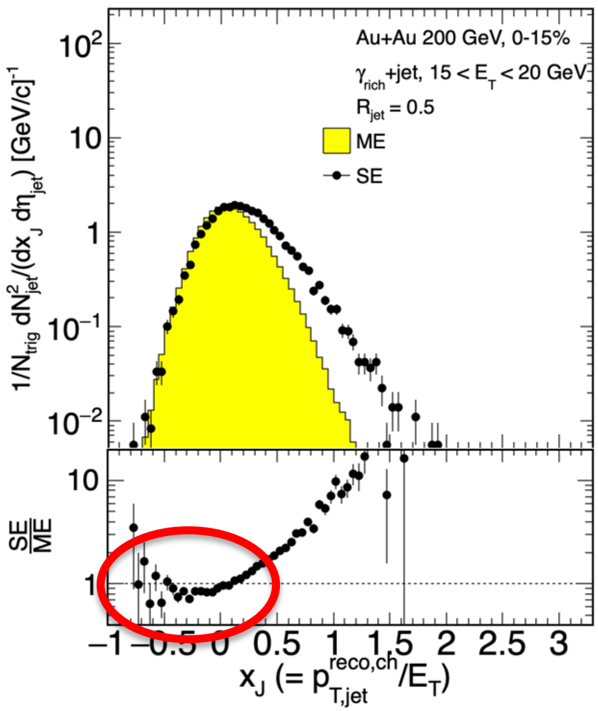
$$\frac{1}{N^{\gamma}_{trig}}\frac{dN^{recoil}_{jet}}{dx^{\gamma}_{J}} = \frac{1}{\sigma^{AA\to\gamma+X}}\frac{d\sigma^{AA\to\gamma+jet+X}}{dx^{\gamma}_{J}}$$



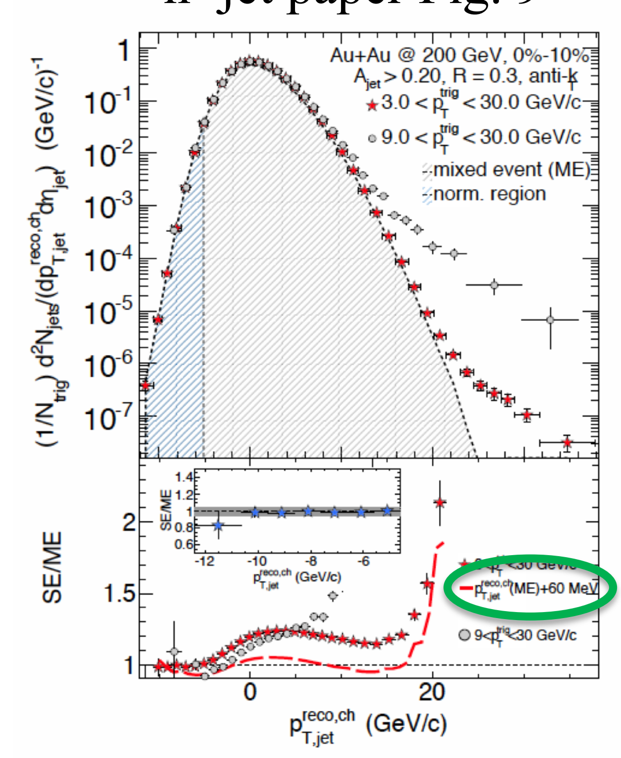
good



see next slide



h+jet paper Fig. 9



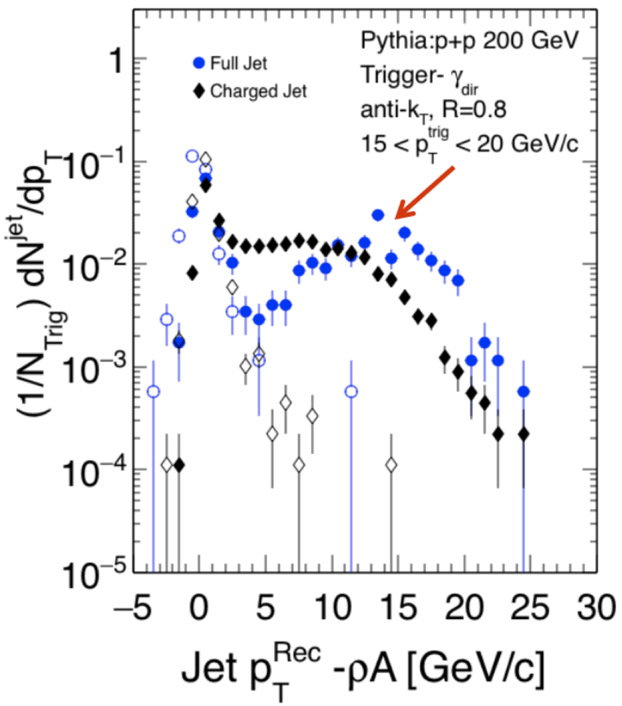
$$\rho = \text{median}\left\{\frac{p^{\text{raw,i}}_{\text{T,jet}}}{A^{\text{i}}_{\text{jet}}}\right\}$$

Jet populations are different in SE and ME

- small misalignment of ρ to be expected
- correctable with high precision

Overall: ME correction approach works well for x_J^γ; needs a bit of tuning (as expected)

Main open issue: full jet measurements w/ BEMC



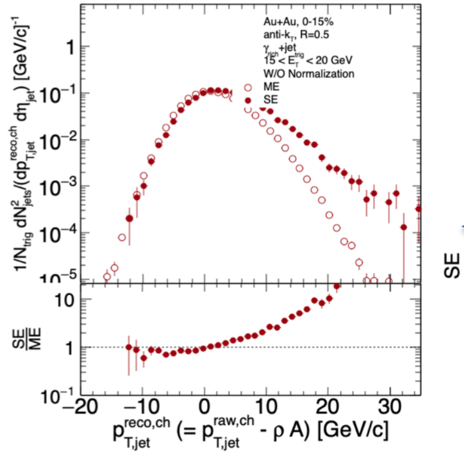
Charged vs. full recoil jet: significant difference in resolution

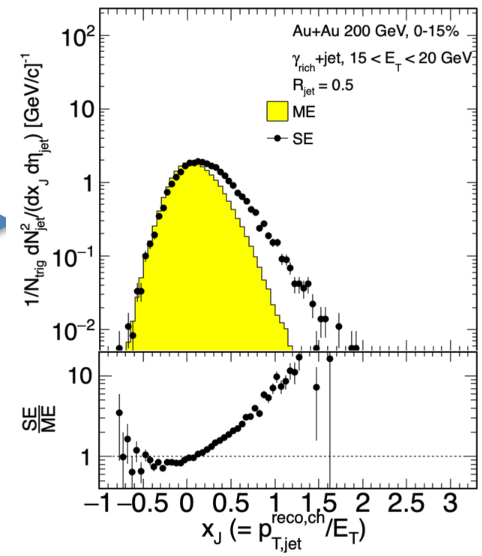
Need ME for BEMC towers

- conceptually straightforward: correct hadronic energy and then scramble
- there will no doubt be issues in practice

What do we learn from x_J^γ?

What's the difference?





All we have done is rescaled the horizontal axis by p_T^γ

- physics content is unchanged
- needs exactly the same theory calculations

We could achieve the same distribution by measuring p_T^{jet} in much narrower bins of p_T^γ

- but will sacrifice measurement precision for unfolding etc.

Essential difference is technical: resolution in scaling by p_T^γ

- Can x_J^γ be derived from the p_T^{jet} distribution using the shape of the inclusive γ spectrum?

x_J^γ certainly worth measuring but benefit is incremental