1. Why are jets interesting in Cu+Au?
Jet reconstruction in heavy ion collisions is a vital tool to explore medium effects, including energy loss and modification of parton fragmentation functions. Studying reconstructed jets in collisions of asymmetric heavy ions is crucial in understanding the interplay between collision geometry and initial and final state effects. In central Cu+Au collisions, the Cu nucleus is completely embedded within the Au nucleus. The study of Cu+Au collisions as a function of centrality can help disentangle the 'core' of the collision region, characterized by a large energy density, and the outer 'corona' region.

In this poster, we discuss two major challenges in jet reconstruction:

- Control over the effects of underlying event
- Control over the effects of mis-reconstructed high p_T conversions

We conclude that jet reconstruction in Cu+Au looks feasible and promising without an overwhelming background from underlying event or mis-reconstructed high p_T conversions.

2. PHENIX detector
PHENIX central arm (Figure 1):

- \(|\eta| < 0.35\)
- \(\Delta \phi = \pi\)

PHENIX tracking algorithm assumes that all the tracks originate from the collision vertex. Therefore, \(p_T\) of conversions (which traverse less magnetic field integral and therefore bend less) will be mis-reconstructed. Charged fraction cut is designed to minimize the contribution of these mis-reconstructed tracks to the reconstructed jet \(p_T\).

Figure 4 shows the charged fraction distribution for reconstructed jets (nc=3 and \(p_{T,reco} > 10\, \text{GeV/c}\)) in the Cu+Au dataset. The rising slope towards \(c_f\) of 1 is due to the high \(p_T\) background.

The effect of \(c_f\) cut on high \(p_T\) background can be demonstrated by examining the jet constituent spectra.

Figure 5 shows the change in the constituent spectra shape for various \(c_f\) cuts. Constituent spectra are for jets (nc=3 and \(p_{T,reco} > 10\, \text{GeV/c}\)) in the Cu+Au dataset.

The effect of \(c_f\) can be quantified by taking the ratio of charged and neutral constituent spectra.

3. Dataset
- Cu+Au @ 200 GeV, MB
  - MB trigger requires at least one hit per beam crossings in each of the two BBCs
- p+p @ 200 GeV, ERT
  - EMCal-RICH-Trigger (ERT) requires minimum energy of 1.6 GeV in 4x4 group of EMCal towers

4. Tracks and clusters selection
- Track selection criteria: \(p_T > 500\, \text{MeV/c}\) + various cuts optimized to reject high \(p_T\) background
- Cluster selection criteria: Energy > 500 MeV + require cluster to be not (and not around) hot, dead or uncalibrated towers
- Track/cluster association cut: Discard any cluster which is associated with a track

The selected tracks and clusters are used as input for Anti-k_T algorithm[1].

5. Control over the effects of underlying event
Nomenclature:
- \(\text{Number of constituents (nc)} = \sum_{\text{particle}} \times \theta(R - \sqrt{\Delta \eta^2 + \Delta \phi^2})\)

Choice of R parameter
PYTHIA[2] events (p+p @ 200 GeV) for 2+2 QCD processes were embedded in the MB HIJING[3] events. The reconstructed jets (nc=3) were ‘matched’ if the jet axis was within \(\Delta R = \sqrt{\Delta \eta^2 + \Delta \phi^2} < 0.25\) of the true (PYTHIA) jet.

Figure 2: Comparison of \(p_{T,\text{true}}\) and \(p_{T,\text{matched}}\) for different R parameters

Comparison of \(p_{T,\text{true}}\) and \(p_{T,\text{matched}}\) (Figure 2) shows that for small R parameter, the underlying event contribution is not overwhelming and will require only smaller corrections to data.

Our choice of R parameter for Cu+Au analysis is 0.2.

6. Control over the effects of mis-reconstructed high p_T conversions
Nomenclature:
- \(\text{Charged fraction (cf)} = \frac{1}{p_T^{true}} \sum_{i} n_i\), \(i = \text{Charged constituents}\)

Charged fraction cut
Figure 4: Charged fraction distribution for reconstructed jet (nc=3 and \(p_{T,reco} > 10\, \text{GeV/c}\)) in the Cu+Au dataset. The rising slope towards cf of 1 is due to the high \(p_T\) background.

Figure 6 demonstrates the power of \(c_f\) cut. For cf\(=0.2\) and cf\(=0.7\), the ratio becomes flat and stays flat up to high \(p_T\) in both Cu+Au and p+p dataset.

The effect of \(c_f\) can be quantified by taking the ratio of charged and neutral constituent spectra.

References: