Detector Matrix and Jet Substructure

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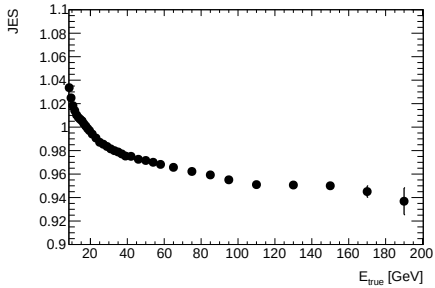
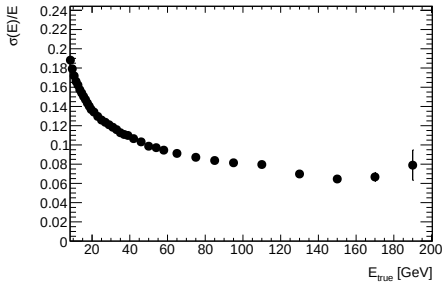
Jet Substructure Limitations

- Jet substructure observables considered during YR process
  - Single hadron in jet ((n)TMDs)
  - Soft drop z_g, R_g (QCD splitting, nuclear modification, etc.)
- Substructure observables generally limited by jet resolution
- Limiting factor towards resolution generally hadrons measured in HCal
- Current JER/JES in EICSmear shown here, with 100% assumed PID and essentially perfect angular resolution

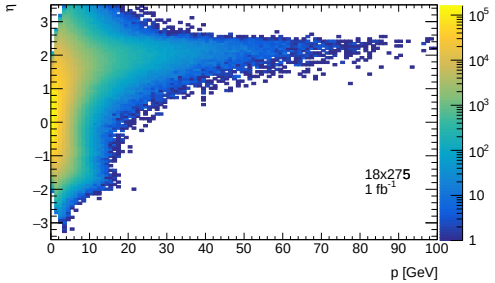


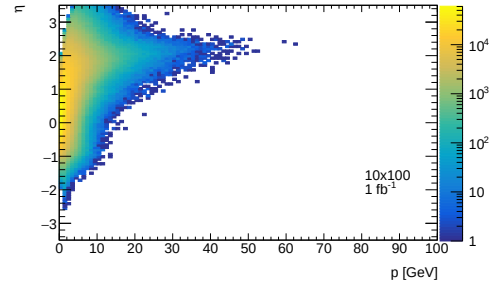


Important Detector Considerations

- Plots show jet constituent eta vs. p
- Tracking resolution for FFs at high z
  - Current tracking resolution sufficient - at worst $\sim$7% at 50 GeV

η	Res
-1-1	σp/p 0.05%p+0.5%
1-2.5	σp/p 0.05%p+1.0%
2.5-3.5	σp/p 0.1%p+2.0%

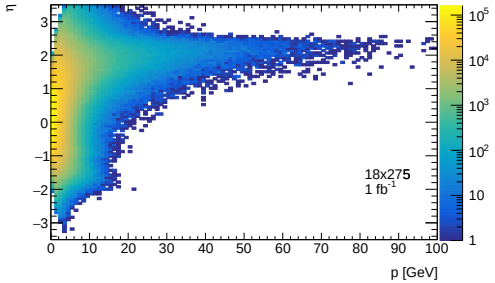




Important Detector Considerations

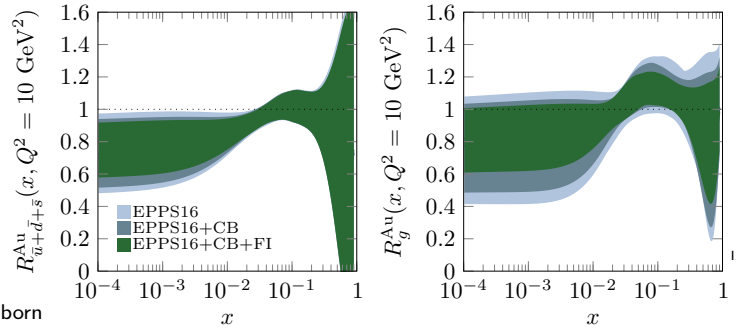
- Plots show jet constituent eta vs. p
- PID capabilities will be important for identified FFs
  - Current parametrizations would be insufficient for accessing the highest z in the highest momentum jets at 18x275
  - Would be sufficient for measurements in 10x100

η	$> 3\sigma$ separation
-1-1	< 5 GeV
1-1.5	< 25 GeV
1.5-2	$< 40 - 50$ GeV
2-3	< 20 GeV
3-3.5	< 45 GeV



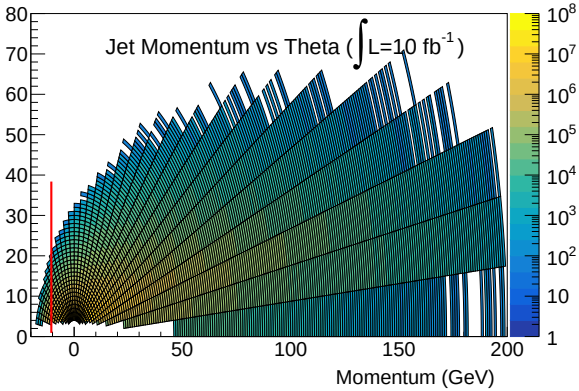
Important Detector Considerations

- Calorimeters as implemented in EICSmear don't give the full picture
  - e.g. for a robust evaluation would want non-perfect angular resolution, real particle flow implementation
- Nonetheless calorimeter performance seems suitable for jet substructure measurements
  - Barrel calorimetry similar to what is used in sPHENIX
  - Forward calorimetry similar to that studied in R&D and phenomenology for forward jet measurements at RHIC (e.g. PRD 100, 014004 (2019))



I. Helenius, J. Lajoie, JO, P Paakkinen, H Paukkunen (2019)

Backwards HCal



- One question - how important is HCal coverage from $-3.5 < \eta < -1$?
- If we are looking for cost savings (maybe too early to be thinking about this), this would be an area that could be studied in greater depth
- If we cut on $p \sim$10 GeV, there is little in the backwards direction remaining

Final Thoughts

- Current detector matrix elements are sufficient for jet substructure measurements
- The one insufficient piece (that stands out to me) is limited PID at high z in 18x275
  - Given this will be the $\sqrt{s}$ with the highest jet cross section, we will be missing the PID for the highest momentum particles in the highest momentum jets
- Conveners requested something along the lines of "If detector requirements are loosened, how does that affect observables?"
  - For jet substructure, the biggest loss would be in tracking resolution for high momentum
  - Would affect measurements at high z, low z_g since the highest momentum particles would be smeared out more
  - This is something that could be quantitatively studied in EICSmear