TDR Sims | Needed Samples and Development

○ **Reminder:** some ideas might be better suited for the physics paper rather
  - **Red =** plots critical for TDR
  - **blue =** maybe for physics paper

○ **Single particle: energy spectra** (uncalibrated vs. calibrated), and **linearity/resolution**
  - Machinery in place
  - **Needed Samples:** several different single particles @ different energies
    › Part of sim campaign output now!
  - **Needed Dev:** set-up tuple generator to run on sim campaign output **[assignee: Derek]**
    › **Maybe:** switch to using a tree structure rather than tuple

○ **Muons: reconstruction efficiency**
  - **To-Do:** ping Andrew Hurley again

○ **Event reconstruction: JB variables,** E_T^{miss}
  - **Needed Samples:** NC/CC DIS
    › Part of sim campaign!
    › Also JB kinematics calculated as part of EICrecon
  - **Needed Dev:** minimally, cross-calorimeter topo-clusters **[assignee: Tristan]**

○ **Jet reconstruction: JES/JER**
  - **Needed Samples:** High-Q^2 NC/CC DIS
    › Part of sim campaign!
 - **Needed Dev:** need to think through a little more...

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- **Single Particle:** do we meet YR requirements?
  - **Plots:** reconstructed particle energy; resolution + linearity
    - › $\pi^{\pm}$, n^0 (p^+, k_L^0?)
    - › Calibrated, uncalibrated
      - ☞ BHCal + BIC, HCal only
      - ☞ Single tile vs. multi-tile? (1, 2, 3, 4, 5 tiles?)

- **Single – Few Particles:** do we help with $\mu^{\pm}$ ID?
  - **Plots:** $\mu^{\pm}$ energy; reconstruction efficiency; non-$\mu^{\pm}$ rejection factors
   - ☞ Andrew Hurley at UMass Amherst has started looking at $\mu^{\pm}$ ID in the Barrel

- **Right:** reference plots from ECCE proposal (upper left) and sPHENIX Test Beam Paper (all others)
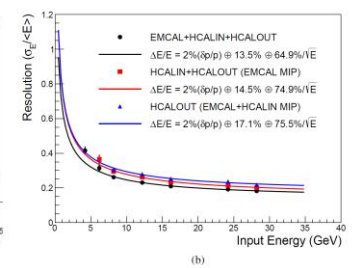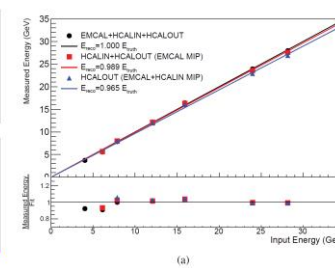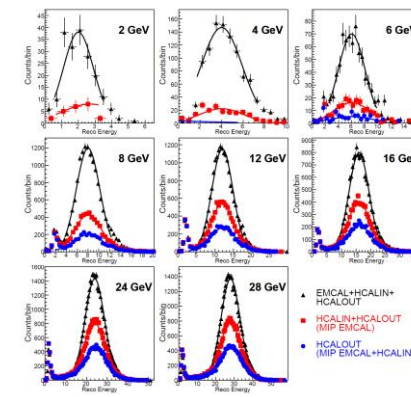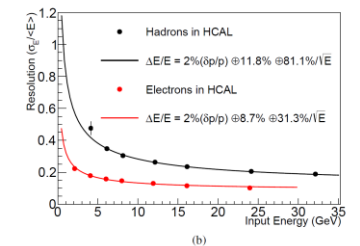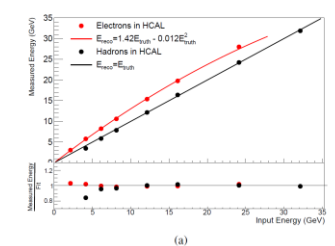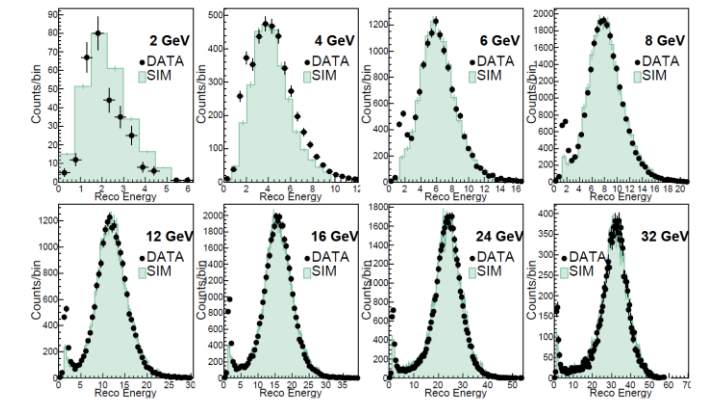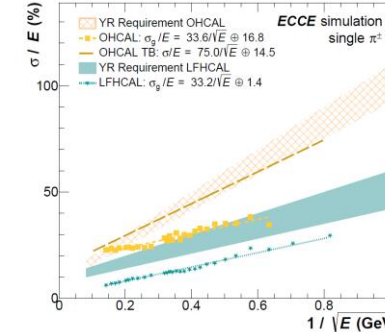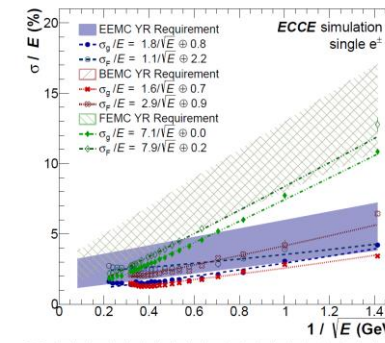
o **Event Reconstruction 1:** do we help with JB?
- **Plots:** true vs. reco. x_{JB}, y_{JB}, Q^2_{JB}
  › w/ vs. w/o BHCal?

o **Event Reconstruction 2:** do we help with CC DIS tagging?
- **Plots:** true vs. reco. E^{miss}_T
  › w/ vs. w/o BHCal?
  › NC vs. CC DIS?

o **Jet Reconstruction:** do we improve the JES/JER?
- **Plots:** JES/JER
  › w/ vs. w/o BHCal?
  › Calibrated vs. uncalibrated?

o **Right:** reference plots from EIC YR (upper 3) and sPHENIX TDR (all others)
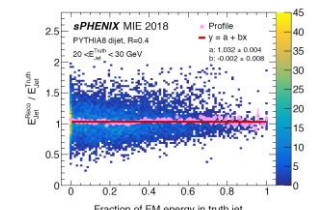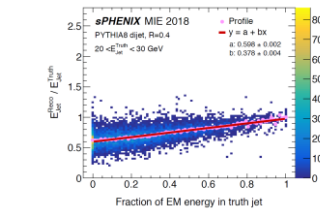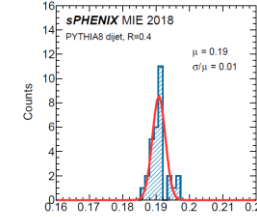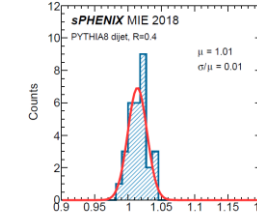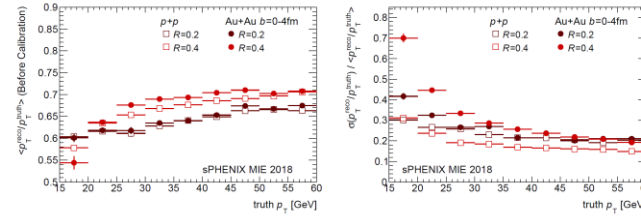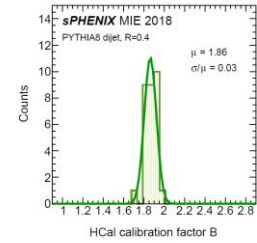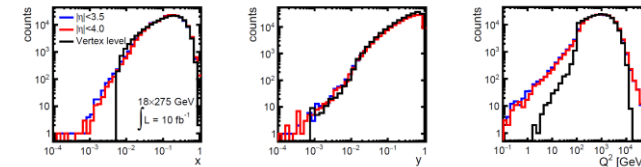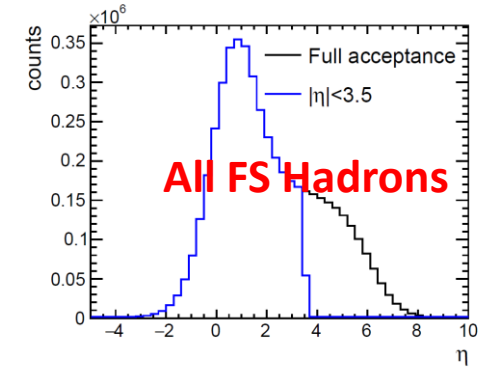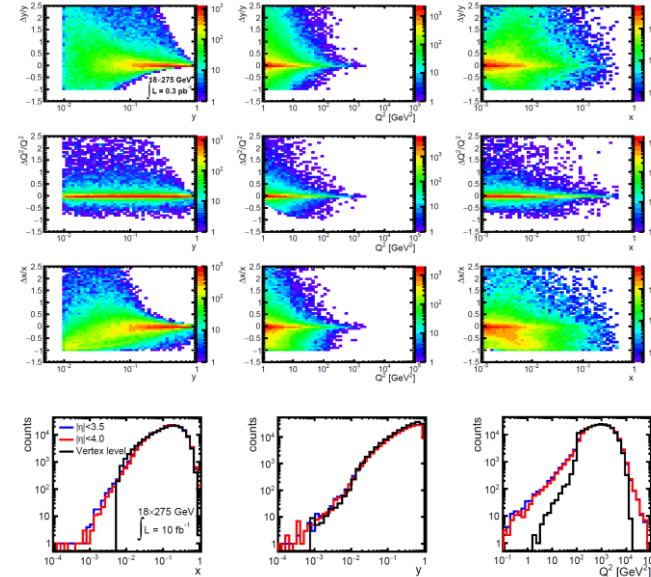
Note: "vertex level" = truth level

ePIC BHCal Meeting | Thinking Through Plots (1/2)

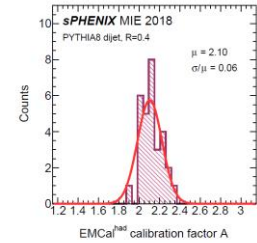o **Note:** some ideas might be better suited for the physics paper rather than the TDR
  – Also, several plots have synergy with other DSCs or PWGs
  – **Red =** plots critical for TDR, **blue =** maybe for physics paper

o **Single particle: energy spectra** (uncalibrated vs. calibrated), and **linearity/resolution**
  – Machinery in place
    › Could stand a couple improvements…
    › e.g. setting up macros to run on campaign output rather than as a plugin
  – ML part of calibration needs tuning (esp. for neutrons)

o **Single particle:** (cont.)
  – **Varying no. of tiles challenging:**
    a) Need to rerun EICrecon for each combination of tile
    b) Then would run calibration/plotting macros on output from each

o **Muons: reconstruction efficiency**
  – We should reach out to Andrew Hurley:
    ☞ He's carried out fairly extensive studies of muon ID in the barrel

- o **Jet reconstruction: JES/JER**
  - – Needs quite a bit of development, though
    - › Won't be able to use campaign output (HCal not used in jets yet)
    - › And we'll need EMCal-HCal calibration factors…
      - ☞ Could extend ML study: train on jets rather than clusters…
      - ☞ Good to have non-ML option available as well (e.g. ch. 8 of sPHENIX TDR)
  - – Possible intermediate plots:
    - 1) Jet energy vs. eta
    - 2) Fraction of EM vs. hadronic energy
      - ☞ Functionality is available to do basic track-matching
    - 3) Calibration factors

- o **Jet reconstruction:** (cont.)
    - 4) EM energy fraction vs. jet energy
    - 5) And finally, JES/JER
  - – Additional thoughts:
    - › I think the relevant scale to calibrate against would Q^2…
    - › Also would be good to explore asymmetric jet algorithm (e.g. Centauro)

- o **Event reconstruction: JB variables, E_T^{miss}**
  - – Algorithmically, very easy to calculate (sum over all hadron energies)
    - › But need to avoid double-counting…
    - › So need PF (or calibration factors?)

Backup | JB Variables & More Reference Plots

- **Jacquet-Blondel (IB) Kinematic Variables:** i.e. reconstructed event kinematics using only the hadronic final state

  - $y_{JB} = \dfrac{\sum_h (E_h - p_{z,h})}{E^e_{beam}}$

  - $Q^2_{JB} = \dfrac{(\sum_h p_{x,h})^2 + (\sum_h p_{y,h})^2}{1 - y_{JB}} = \dfrac{(E^{miss}_T)^2}{1 - y_{JB}}$

  - $x_{JB} = \dfrac{Q^2_{JB}}{s y_{JB}}$

- **Upper Right:** reference plot for generated vs. reconstructed E^{miss}_T (from arXiv:2006.1520)

- **Lower Right:** reference plot for JES/JER with vs. without HCal's (from EIC YR)