Analysis Update: EM Jet A_N using FMS and EEMC

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June 3, 2020

Outline

1. **EM Jets in FMS and EEMC**
2. **EM Jet A_N Extraction from Run 15**

EM Jet A_N with FMS and EEMC

Reminder From Last Time:

- This is a continuation of the analysis that Chong was working on (see talk here).
- Feedback from last PWG meeting:
  - Finer hot channel list
  - Apply hot channel masking before reconstruction.
  - Lower FMS tower energy threshold (3 GeV $\rightarrow$ 0.2 GeV)
  - Investigate statistics concern at higher energy bins.
  - Fix/investigate sign in raw asymmetry calculation for yellow beam.
  - Follow more systematic and detailed approach for the analysis.
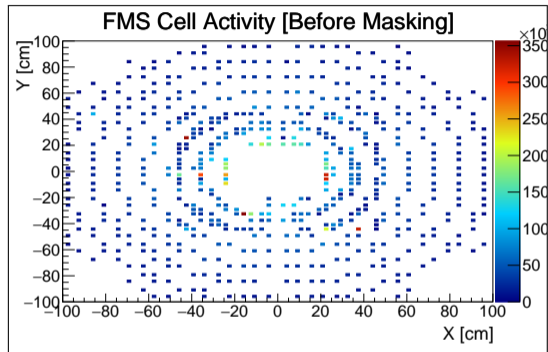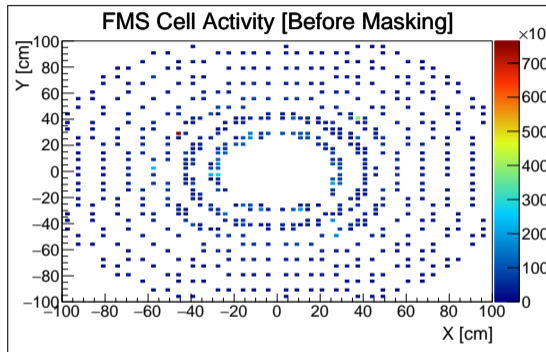
Update Since Last Time:

- Incorporated all feedback from last PWG presenation.
- Included EEMC EM jets.
- Increased statistics.

EM Jet A_N using FMS and EEMC

- **Dataset: Run 15** pp transverse 200 GeV.
- **FMS EM Jet:** FMS-stream with FMS JP, Small BS, Large BS triggers.
- **EEMC Jet:** Physics-stream with EHT0, JP1, JP2 and MB triggers.
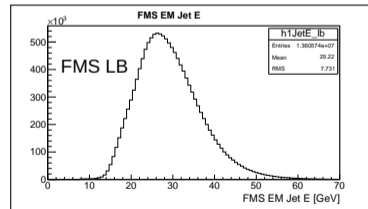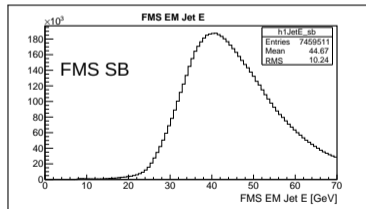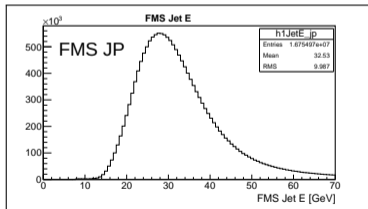
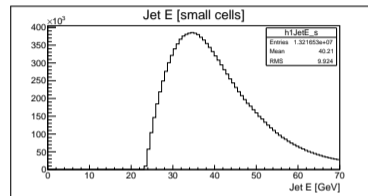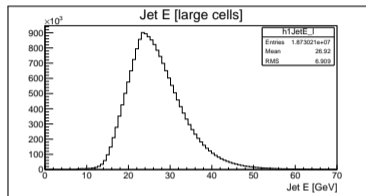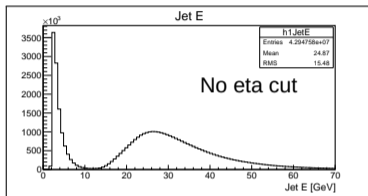**FMS Hot Channel Masking**

- Compare cells within same radial bin to determine if a cell is hot.
- Left plot shows FMS cells with odd number of radial bins. Right plot shows FMS cells with even number of radial bins.
- Find hot channels on a fill-by-fill basis.
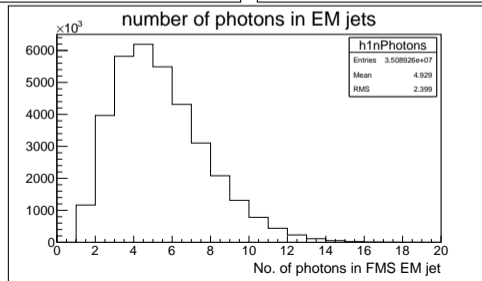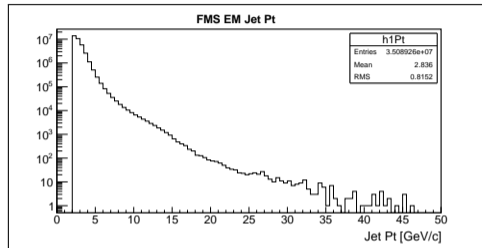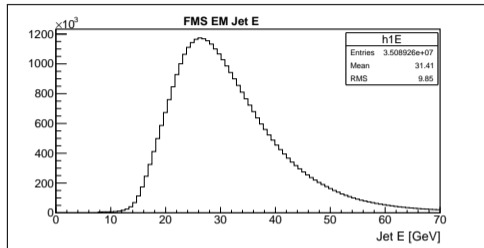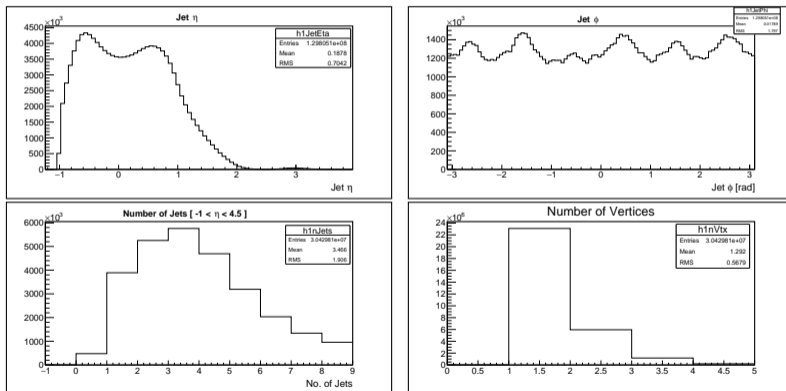- Exclude highly bit-shifted channels.

FMS EM Jet QA Plots
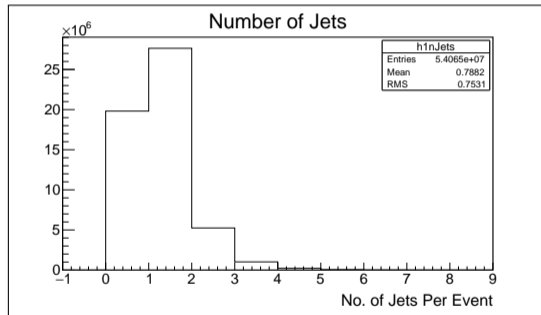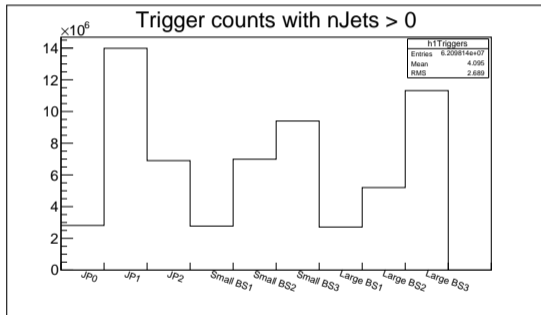
FMS EM Jet QA Plots
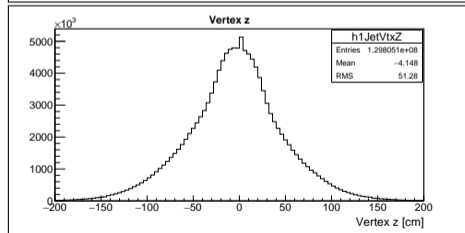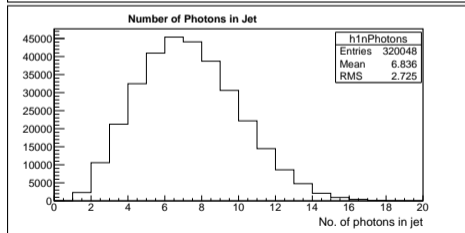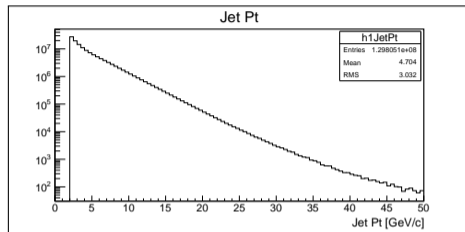
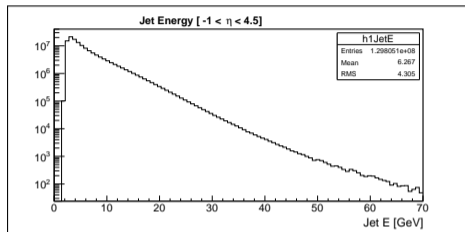# FMS Jet E, Pt, Phonton Multiplicity

EM Jet in EEMC

- Run 15 pp trans 200 GeV, physics stream
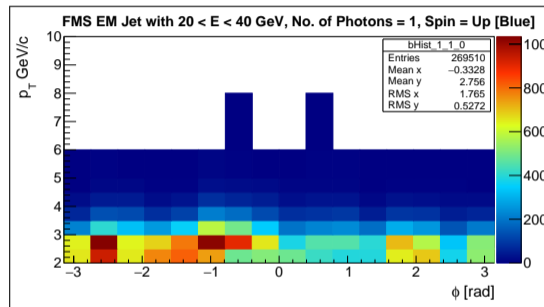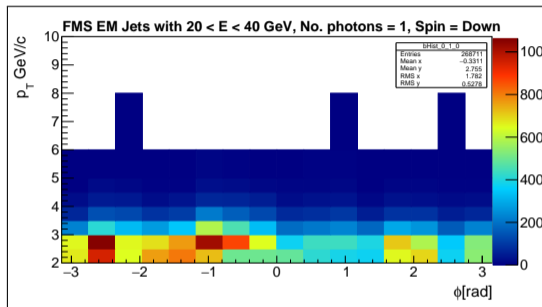- Triggers: EHT0, JP1, JP2 and all MB

- The above plots have jets from all detectors (charged and neutral).

EM Jet in EEMC

- The above plots have jets from all detectors (charged and neutral).

Sorting jets in phi, energy, Pt and photon multiplicity bins

- TH2D histograms [#spins][#Eng bins][#phi bins][#Photons]
- Fill custom p_T bins along y and and 16 ϕ bins along x-axis.
- Separately for blue and yellow beams.

EM Jet A_N Calculations
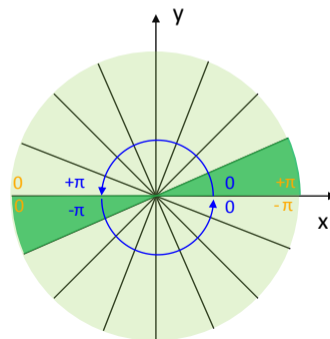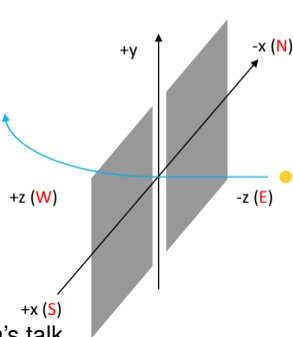
● Use Cross-ratio formula to calculate A_N.

$$\epsilon = A_N \times P \times \cos(\phi)$$

$$\epsilon \approx \frac{\sqrt{N_\phi^\uparrow N_{\phi+\pi}^\downarrow} - \sqrt{N_{\phi+\pi}^\uparrow N_\phi^\downarrow}}{\sqrt{N_\phi^\uparrow N_{\phi+\pi}^\downarrow} + \sqrt{N_{\phi+\pi}^\uparrow N_\phi^\downarrow}}$$

For yellow beam:
$\phi_y = \pi - \phi$ (if $\phi >= 0$)
$\phi_y = -\pi - \phi$ (if $\phi < 0$)

*Diagrams from C. Kim's talk

Error Propagation for ϵ

with

$$y = \sqrt{N_R^\uparrow N_L^\downarrow} - \sqrt{N_L^\uparrow N_R^\downarrow}$$

and

$$x = \sqrt{N_R^\uparrow N_L^\downarrow} + \sqrt{N_L^\uparrow N_R^\downarrow}$$
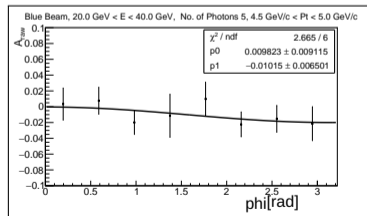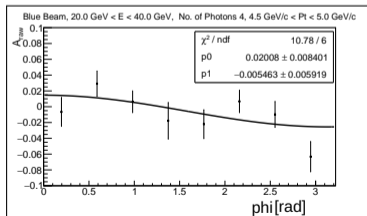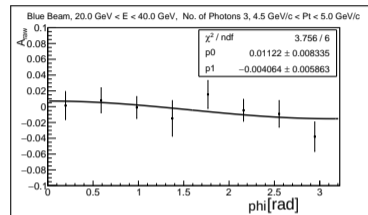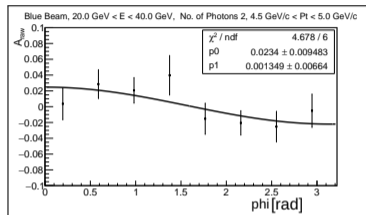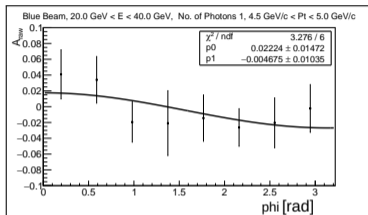
$$\epsilon = \frac{y}{x}$$

$$\boxed{(\Delta\epsilon)^2 = \epsilon^2 \left[\frac{(\Delta x)^2}{x^2} + \frac{(\Delta y)^2}{y^2} \right]}$$

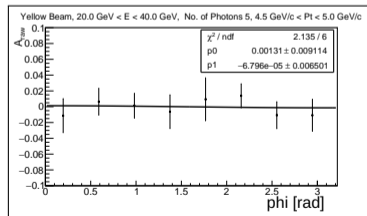using $\Delta N_R^\uparrow = \sqrt{N_R^\uparrow}$ ... ... etc, since they follow Poisson's distributions,
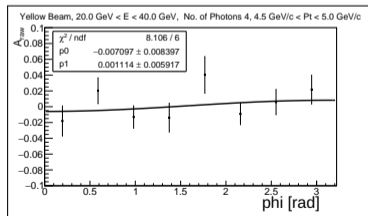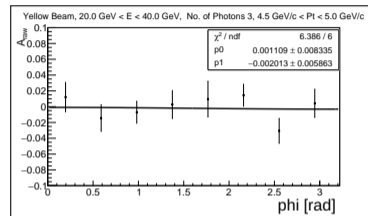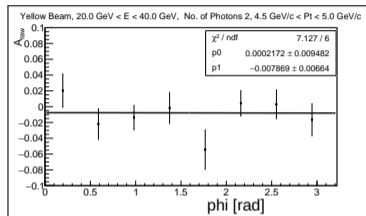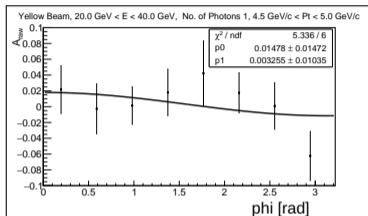
$$(\Delta x)^2 = \frac{1}{4}(N_L^\downarrow + N_R^\uparrow + N_L^\uparrow + N_R^\downarrow)$$

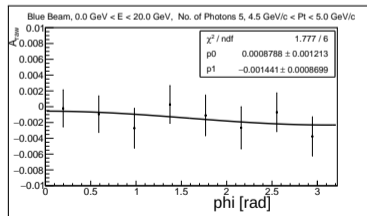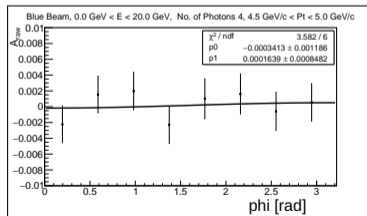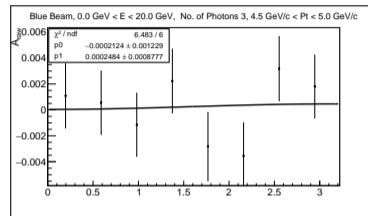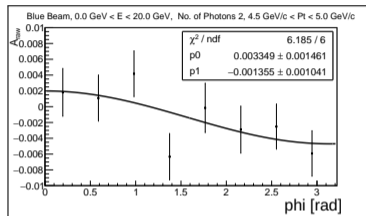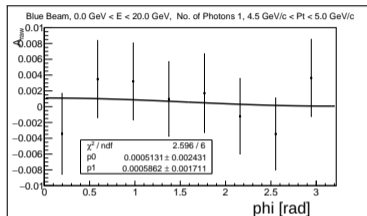$$(\Delta y)^2 = \frac{1}{4}(N_L^\downarrow + N_R^\uparrow + N_L^\uparrow + N_R^\downarrow)$$

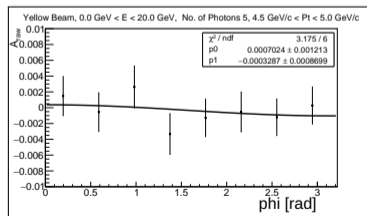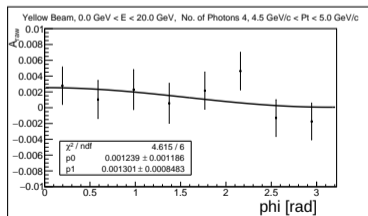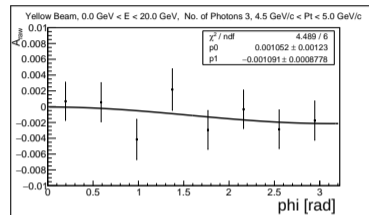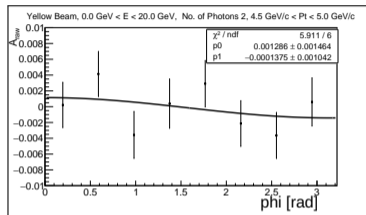**Measured Asymmetry Fits in FMS [Blue Beam]: 20 < E < 40 GeV, 4.5 < p_T < 5.0**

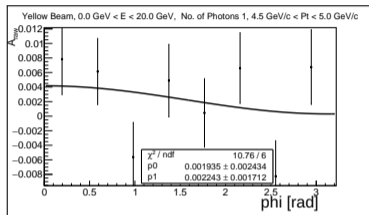**Measured Asymmetry Fits in FMS [Yellow Beam]: 20 < E < 40 GeV, 4.5 < p_T < 5.0**

Measured Asymmetry Fits in EEMC [Blue Beam]: 0 < E < 20 GeV, 4.5 < p_T < 5.0
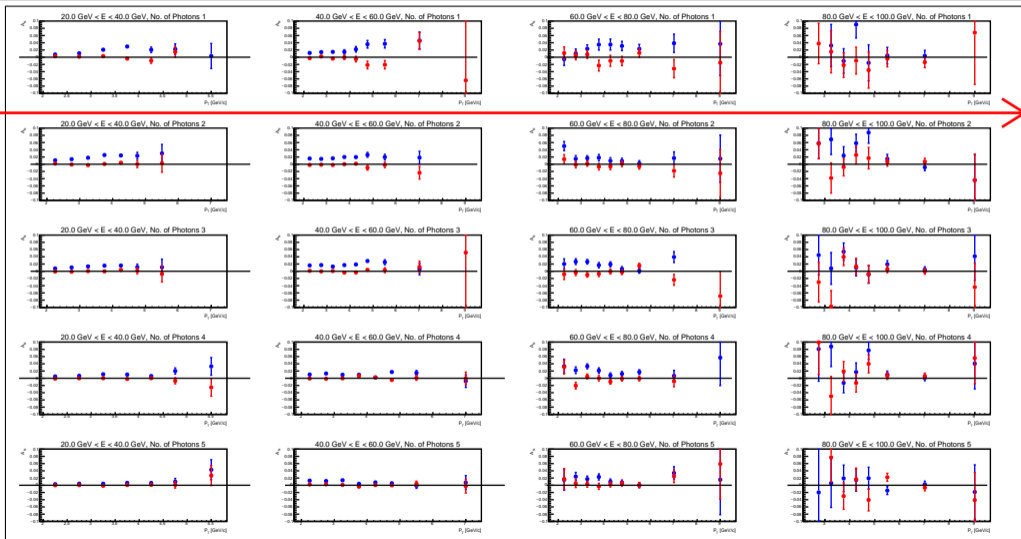
Measured Asymmetry Fits in EEMC [Yellow Beam]: 0 < E < 20 GeV, 4.5 < p_T < 5.0

FMS EM Jet A_N: Blue for blue beam, Red for yellow beam

EEMC Jet A_N: Blue for blue beam, Red for yellow beam
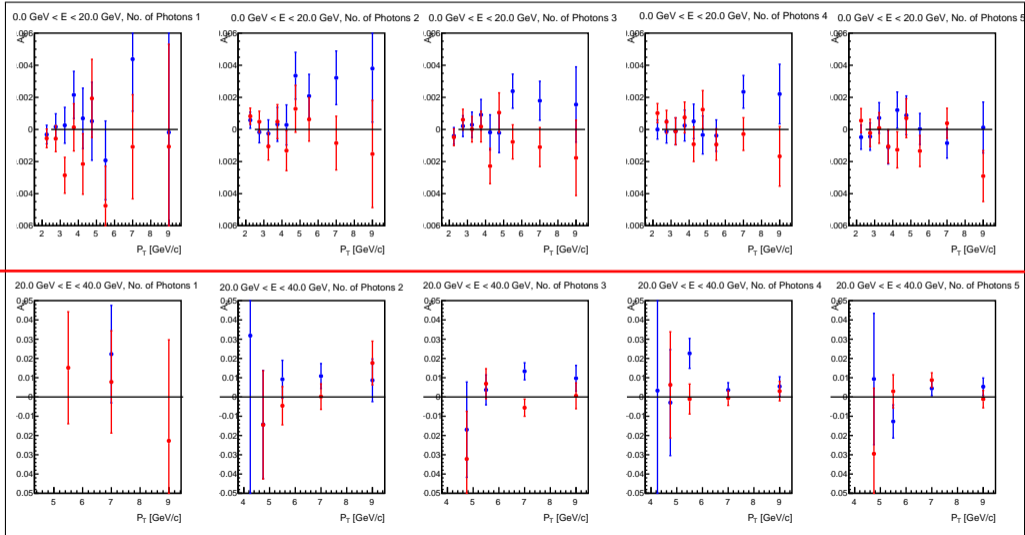
Conclusion

- Extracted A_N for FMS and EEMC EM Jet for different photon multiplicity, p_T and jet energy bins.
- Result seems consistent with previous measurement.

To be done:

- Include remaining dataset.
- Include correction for polarization.
- Work on unfolding and simulation.