Update on EM-Jet A_N Using FMS and EEMC

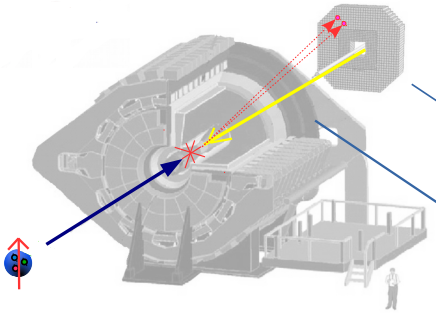
For Run 15 Dataset

Latif Kabir

February 17, 2021

Reminder: EM-Jet A_N Using FMS and EEMC

- $p^{\uparrow} + p \rightarrow$ EM-jet + X
- Extract A_N as a function of EM-jet p_T, energy and photon multiplicity.
- EM-jet in FMS and EEMC
- **Dataset:**
  Run 15(200 GeV pp trans)
- **Data-stream:**
  -FMS-stream (For FMS EM-jet)
  - Physics-stream (For EEMC EM-jet)



- **Triggers:**
  - Small BS, Large BS and FMS-JP Triggers (For FMS EM-jet)
  - EHT0, JP and MB triggers (For EEMC EM-jet)
  - Veto on LED and abort gap

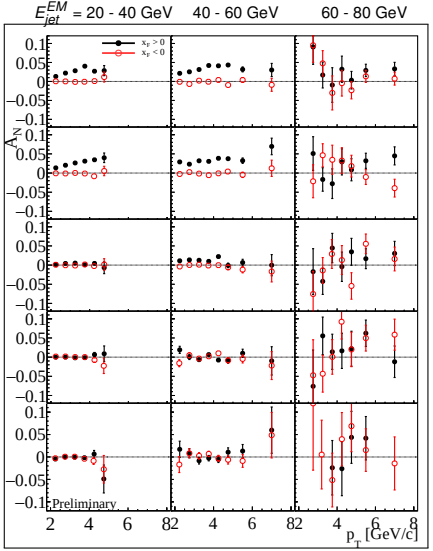
Reminder: FMS and EEMC EM-Jet A_N

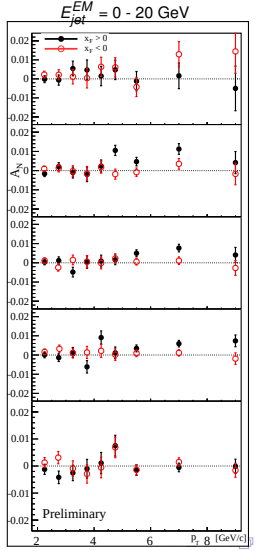
	Status / Value
1. Trigger:	
1.1. FMS Data	FMS BS and JP Triggers
1.2. EEMC Data	EHT0, JP and MB
2. Jet Reconstruction:	
2.1. FMS hot channel masking before reconstruction	Yes
2.2. Exclude highly bit-shifted channel	Yes
2.3. Fill-by-fill hot/bad channel masking	Yes
2.4(a). FMS points as input for Anti-k_T	Yes
2.4(b). FMS Point: Try 1 photon fit (default in yes)	Yes
2.4(c). FMS point: Scale shower shape to 0.8 for large and 0.6 for small cells (default)	Yes
2.5. R for Anti-k_T	0.7
2.6. Photon energy cut	E_γ > 2.0 GeV
2.7. Jet p_T	Jet p_T > 2.0 GeV/c
2.8. Vertex z priority according to TPC, VPD, BBC	Yes
2.9. BBC slewing correction	Yes
2.10. Jet Finder Class	`StJetMaker2015`

3. Event Selection Cuts:	**Status / Value**
3.1(a). Veto on LED	Yes
3.1(b). Veto on abort gap	Yes
3.2(a). Eta (η) range covered (FMS)	2.8 - 3.8
3.2(b). Eta (η) range covered (EEMC)	1.0 - 2.0
3.3. Vertex z cut	-80 cm < V_z < 80 cm
3.4. Trigger dependept p_T cut	Yes
3.5. Exclude bad spin status	Yes
3.6. Ring of fire cut: BBC and TOF	No
3.7. Ring of fire cut: Exclude Sm-bs3 trigger	Yes
3.8. Exclude fills with wrong spin pattern	Yes
3.9. Exclude events with x_F > 1 or E_{jet} > 100 GeV	Yes
4. Corrections:	
4.1. Photon energy correction	No
4.2. Jet energy correction	No
4.3. Jet Pt correction	No
4.4. Underlying event correction	No
4.5. Time dependent correction	No
5. A_N Extraction:	
5.1. Extraction method	Cross-Ratio Formula
5.2. Phi binning	16

Reminder: FMS and EEMC EM-Jet A_N

FMS ⇒





⇐ EEMC

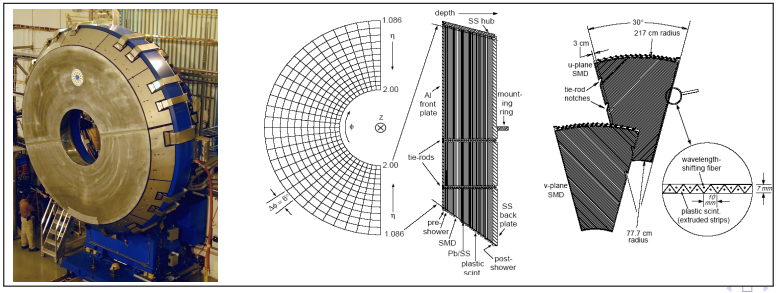
Update To EEMC EM-jet

Earlier version:

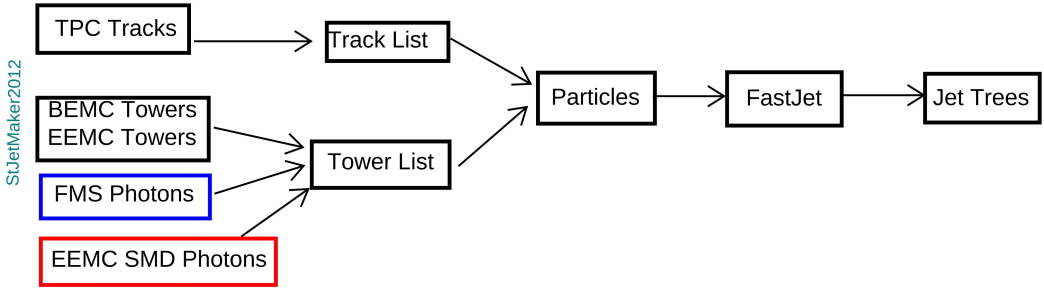
- Used EEMC tower + TPC tracks as input for jet finder
- EEMC tower size has eta dependence

Current version:

- Repeated the calculation with following modifications:
  - Used photon candidates made out of SMD + EEMC towers
  - Removed TPC tracks and kept only photon candidates
  - **Photon energy cut: 2.0 GeV**

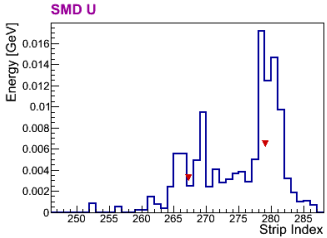


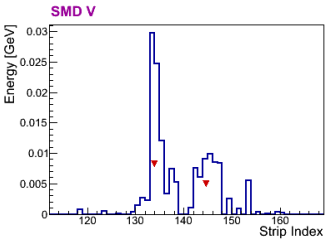
Update To EEMC EM-jet



Photon Reconstruction in EEMC/SMD: Same as used for 2006 EEMC Paper by S. Gliske, J. Webb et al.

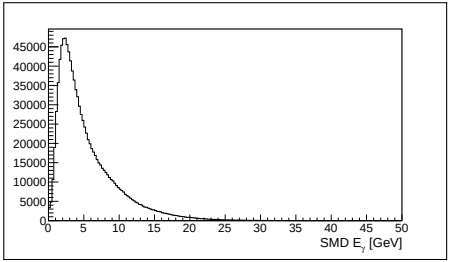
- EM Particle Reconstruction Procedure
  - Identify clusters in the u and v strips
  - Determine which u and v clusters to associate with incident particles
  - Compute energy of incident particles (e.g. photons) from the towers
  - Compute momentum from the vertex and SMD cluster positions
- SMD response (right) in π^0 candidate event from data
  - Blue histograms show energy response per strip
  - Red triangles represent clusters drawn at mean strip position, and 10% of the cluster energy
- SMD clusters are found by
  - Smoothing the histogram using the method of J. Tukey
  - Identifying clusters as a strip above an energy threshold, with +-3 adjacent strips with monotonically decreasing energy
  - Setting cluster position to energy-weighted mean position of strips
- EM particle candidates built from pairs of u-v clusters
  - Clusters matched by energy of u and v strips
  - Required to have associated tower energy above threshold
  - Often have e.g. two photons from one π^0 deposited in one tower
- Reconstruction difficulties include
  - Upstream passive material: π^0 opening angle on the same order as photon conversions
  - Single particles sometimes look like two particles, and vice versa

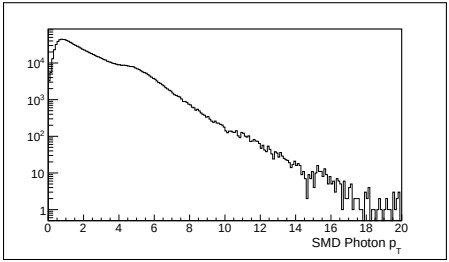


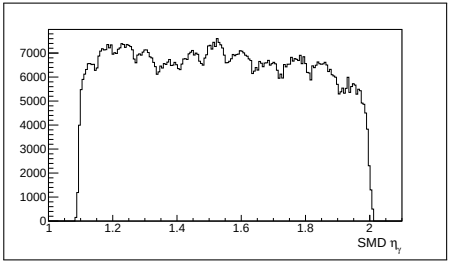


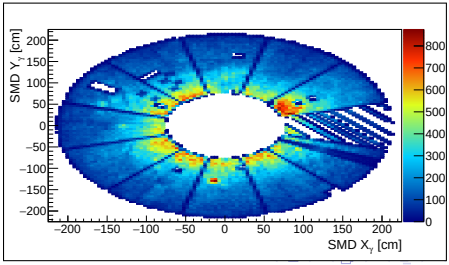
*Slide taken from A. Gibson's talk

EEMC SMD Photon Samples

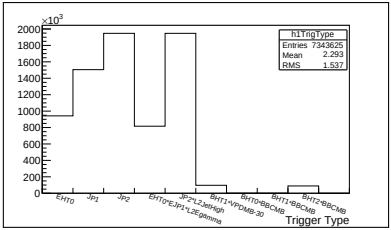


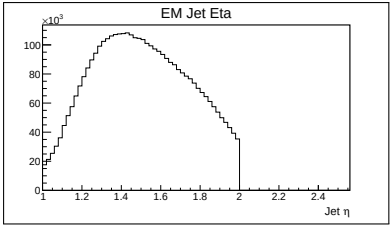


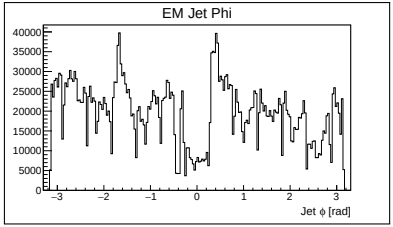


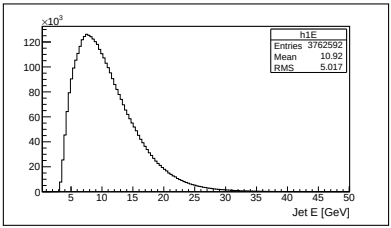


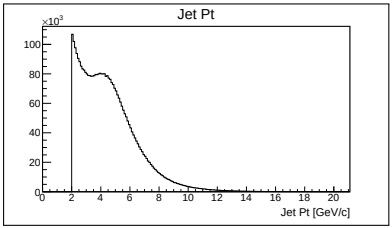
EM-jet With EEMC SMD

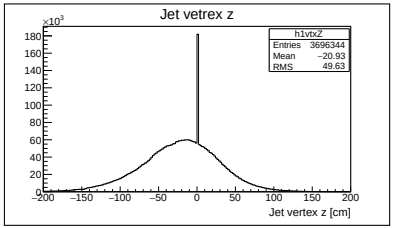




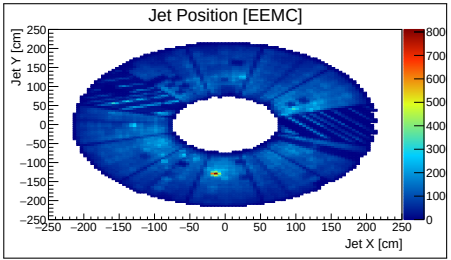


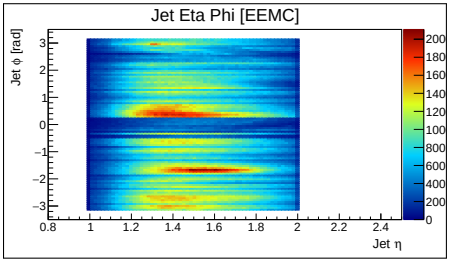


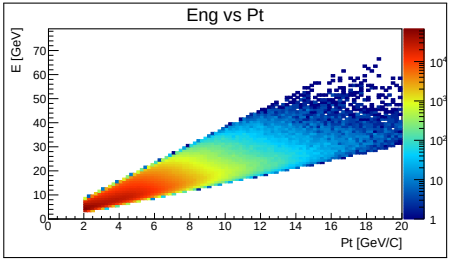


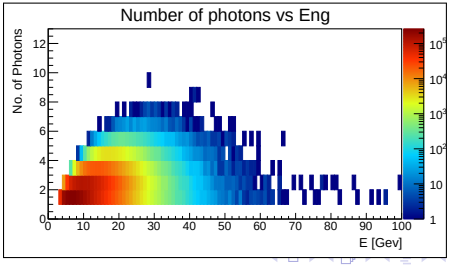


EM-jet With EEMC SMD

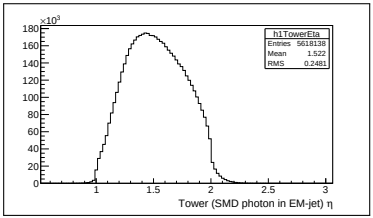


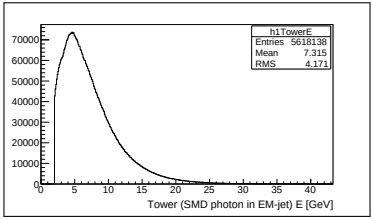


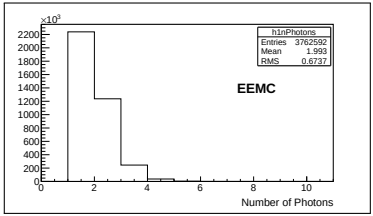




EM-jet With EEMC SMD: Photons Inside EM-jet



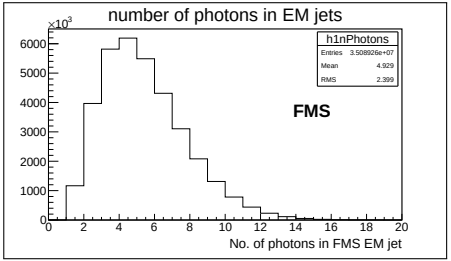


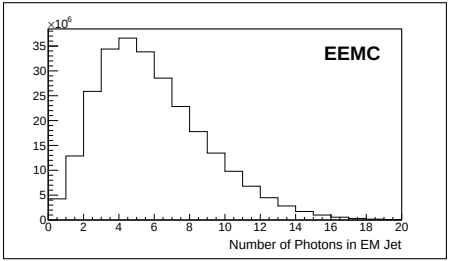


- Note: $E_\gamma > 2.0$ GeV

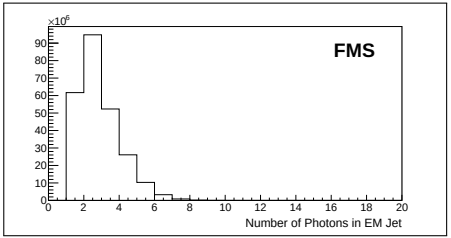
Effect of Photon Energy Threshold Cut: 0.2 GeV vs 2.0 GeV

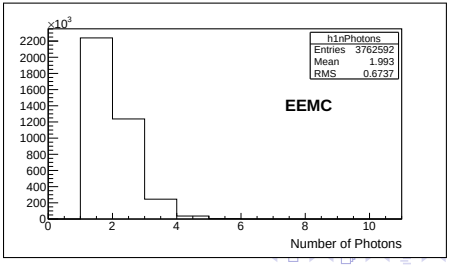
0.2 GeV ⇒





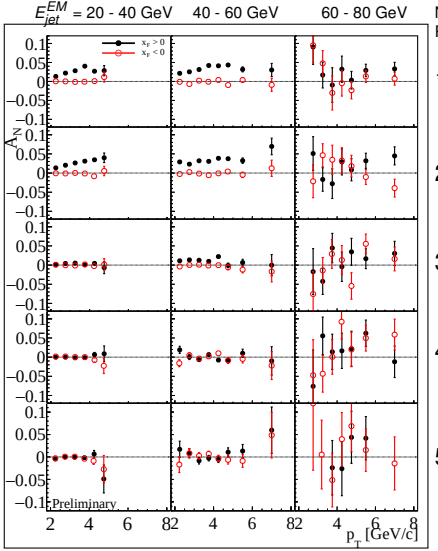
2.0 GeV ⇒

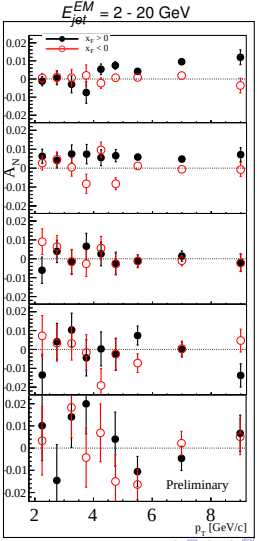




FMS and EEMC (Updated) EM-Jet A_N: 2 GeV Photon Energy Cut

FMS ⇒





⇐ EEMC

EM-jet A_N Systematic Uncertainties

A_N Uncertainties:

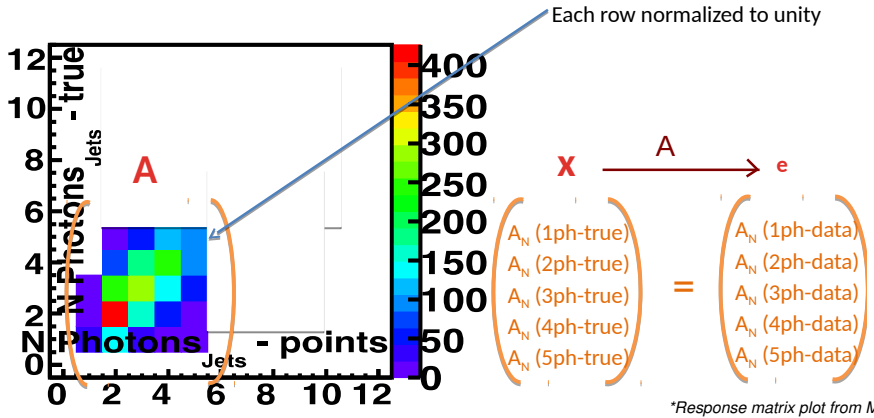
- Event Misidentification:
  - Misidentification of 1, 2 etc photons as other types (2, 1, etc)
- Background Uncertainty
  - Pile up, Abort gap, Ring of fire
  - Underlying events
- Polarization Error

Energy or p_T Uncertainties:

- Calibration uncertainty
- Energy correction
- Uncertainty due to radiation damage
- Positional uncertainties
- Vertex uncertainty

Unfolding Procedure??

- Solve a set of five linear equation with five variables for each energy and p_T bin
- Decompose A_N as a linear composition of number of photons n_i or corresponding A_N^i ??



*Response matrix plot from Mriganka's slide

Summary

- Updated EEMC EM-jet A_N by replacing EEMC towers by SMD photon candidates
- Work on systematic uncertainties is in progress.
- Need to decide on unfolding procedure (if required)