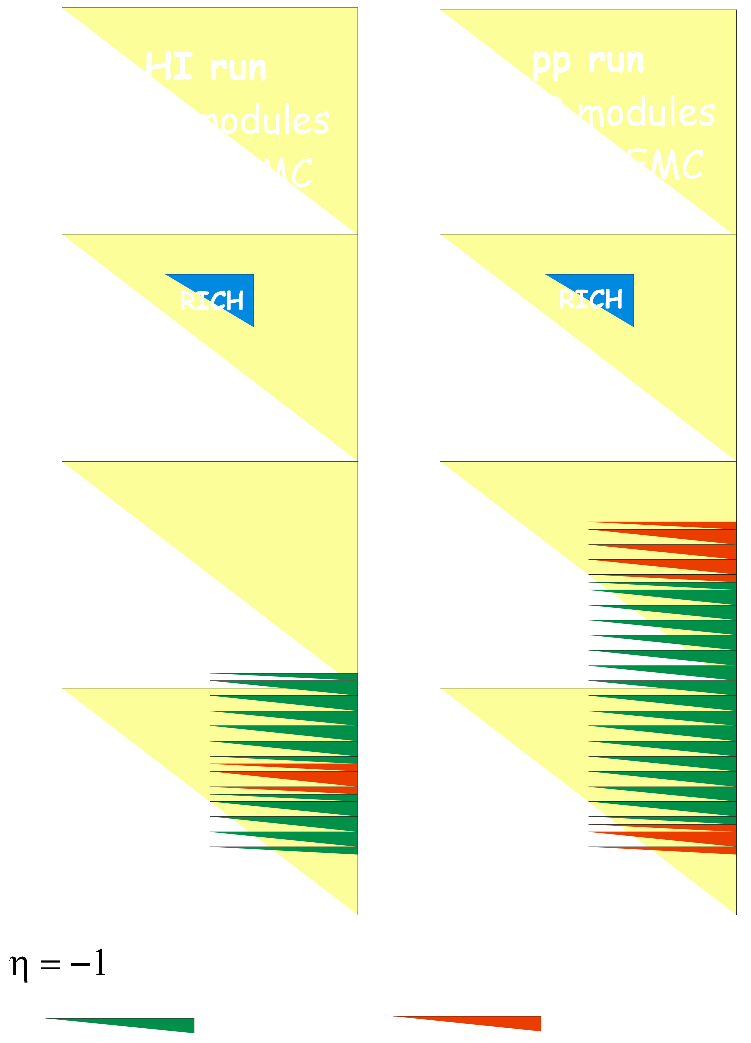
EMC update

- Status of EMC analysis
  - Calibration
  - Transverse energy
  - Electron identification
  - π^0 spectrum in pp
- Plans for the next run
  - Online monitoring and calibration
  - EMC simulations
  - EMC on common μDST

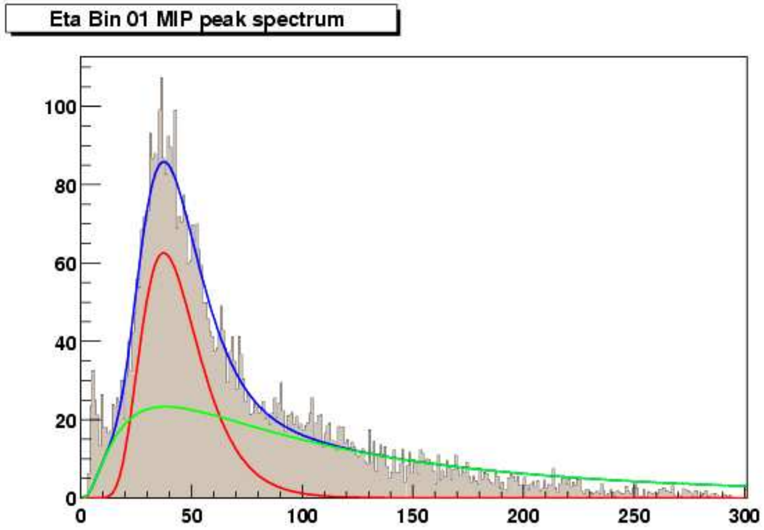
Just to remember …

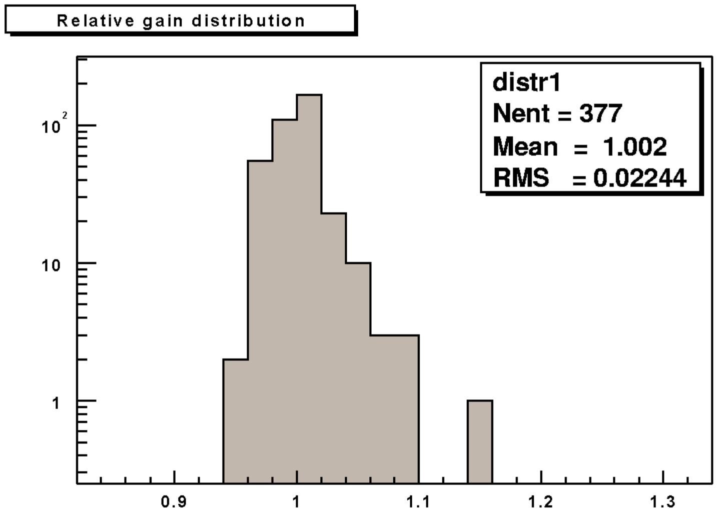
- Heavy-ion run
  - 12 (10) modules instrumented
  - 480 (~400) towers
    - $(\Delta\eta, \Delta\phi) \sim (1.0, 1.2)$
  - No SMD most of time
    - Last week of HI only
- pp run
  - 22 (16) modules instrumented
  - 880 (~640) towers
    - $(\Delta\eta, \Delta\phi) \sim (1.0, 2.2)$
  - SMD
  - High-tower trigger

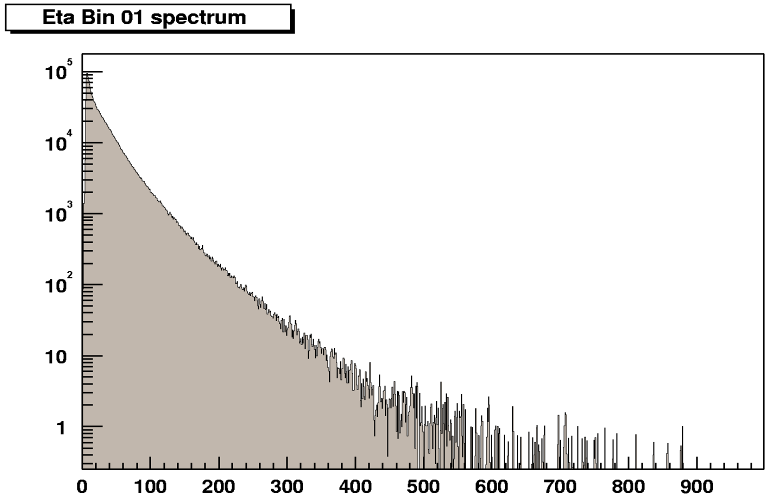


AuAu pre-calibration using MIP's

- AuAu data
  - Towers equalized within 5%
  - 200 k minibias data
- MIP candidates
  - p>1.5 GeV/c
  - Track isolated in a 3x3 patch







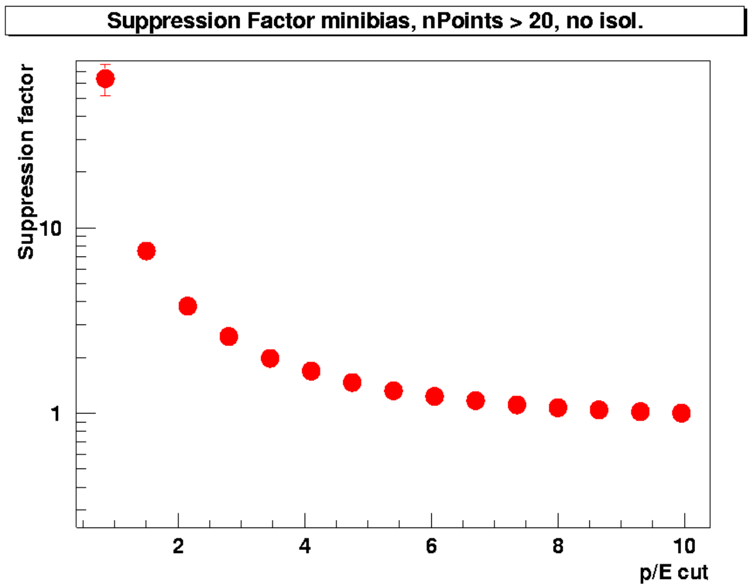
500 ADC ~ 4 GeV

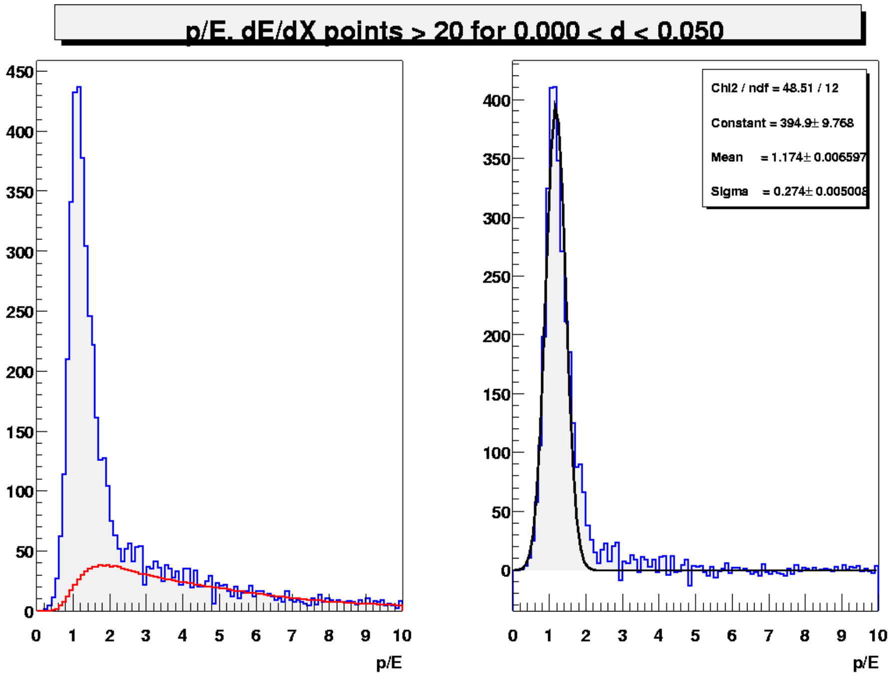
Electron identification in STAR

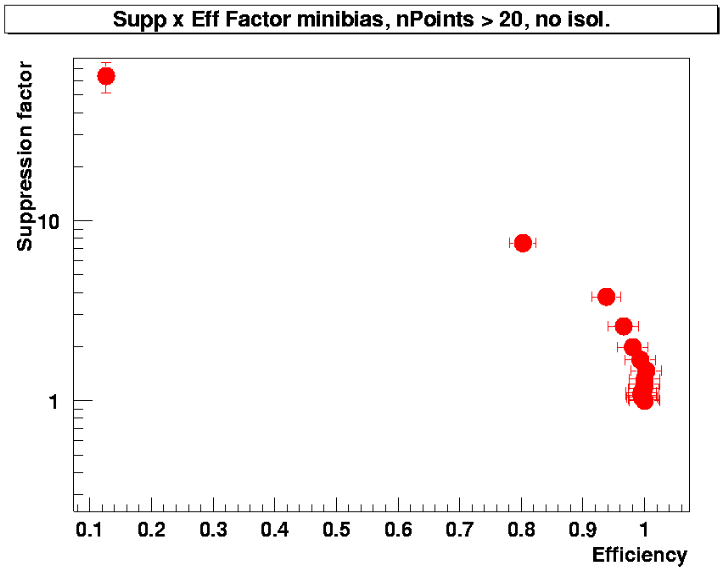
- TPC information
  - Momentum of the track
  - dE/dX
    - For electron selection
    - For hadronic background estimation
  - Number of dE/dX points
- EMC information
  - Distance from the projected track to the center of an EMC tower
  - Energy of the tower
- Dataset
  - Minimum bias AuAu
    - ~ 2 M events
  - Central AuAu
    - ~ 150 k events
  - $|z_{vertex}| < 20$ cm

EMC information (towers only)

- p/E cut
- distance to the center of the tower cut
- Hadronic background estimation
- Hadronic suppression factor ~ 20 for efficiency ~ 0.5

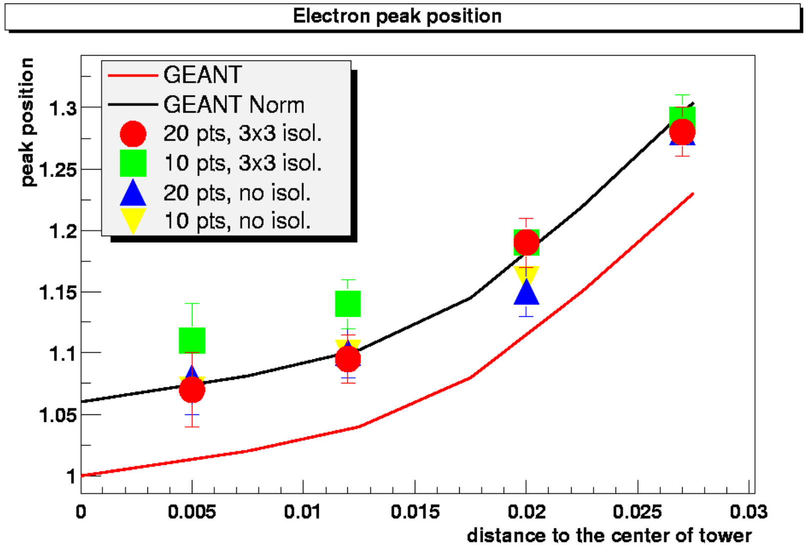


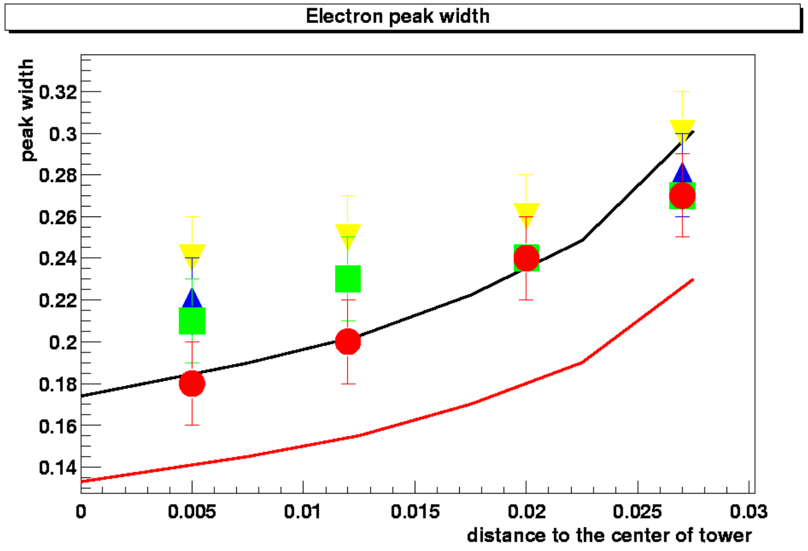




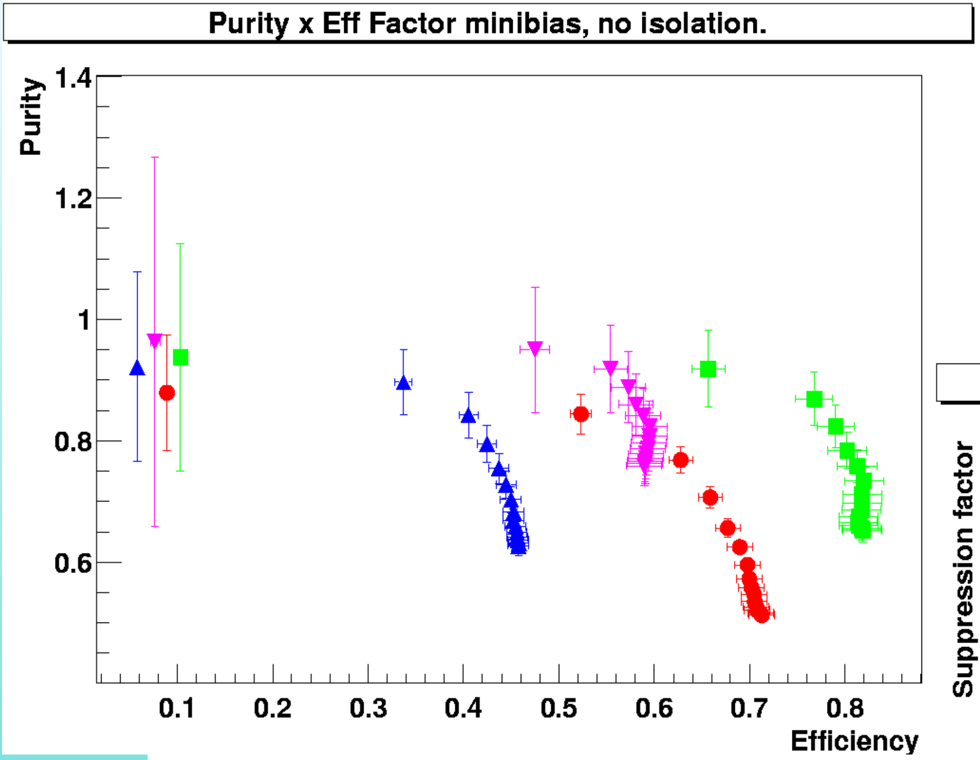
Electron calibration

- Initial calibration done with MIP
  - ~10% systematic errors
  - low energy (~300 MeV)
- Electron calibration
  - Higher energy (1.5 – 5 GeV)
  - Reduce systematic errors to 2-3%
  - EMC global energy resolution
    - ~17%/sqrt(E)



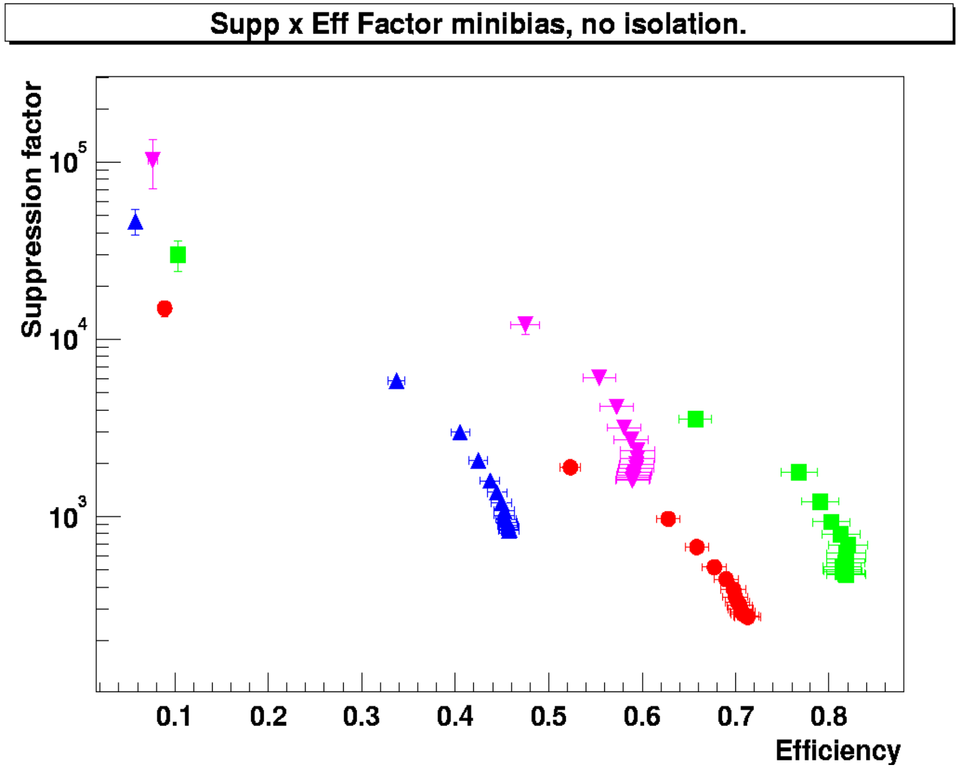


Putting all results together (TPC + EMC)



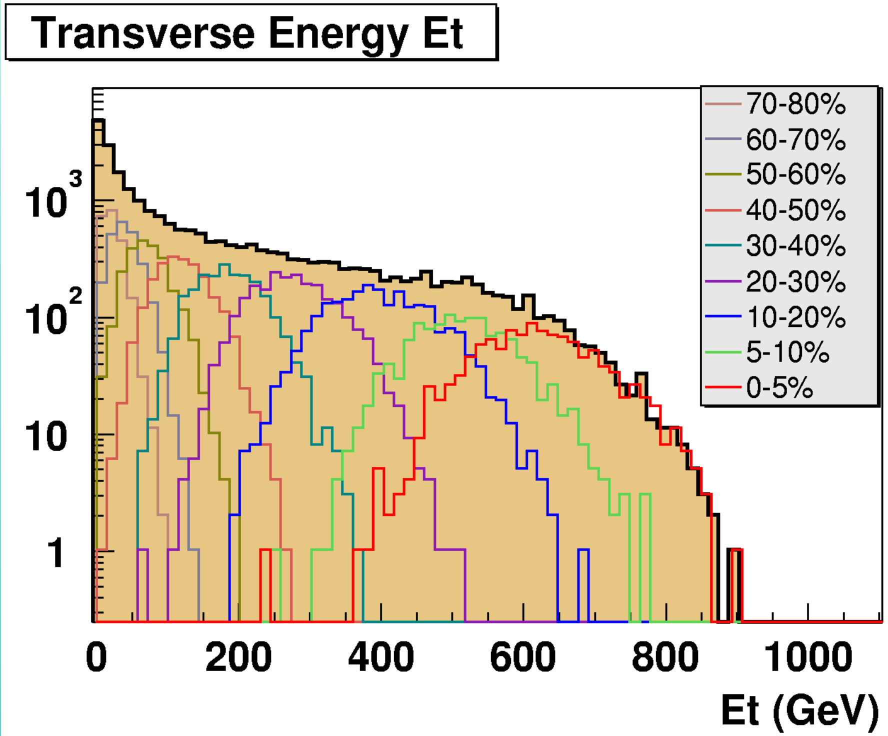
Minimum bias AuAu

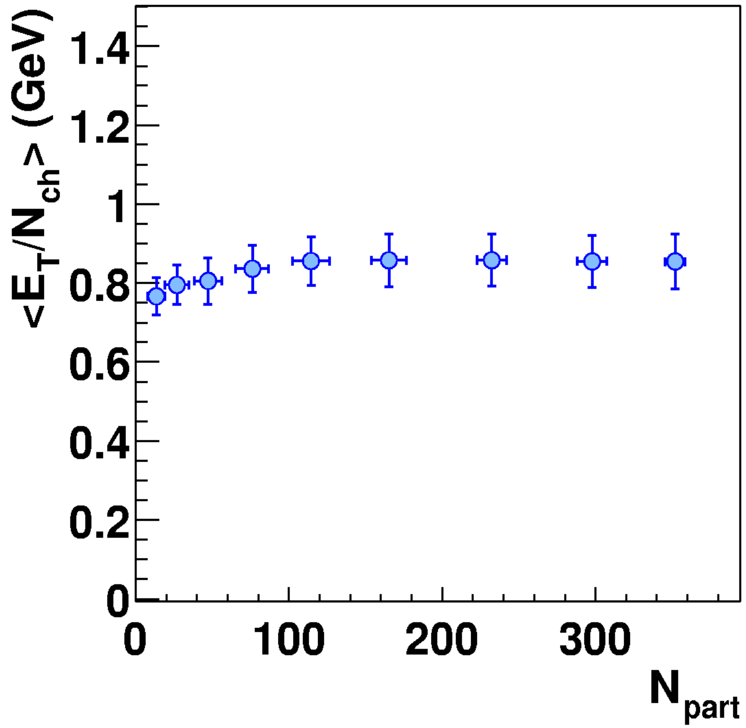
● (red)	3.6 < dE/dX < 4.5, nPoints > 10
■ (green)	3.6 < dE/dX < 4.5, nPoints > 20
▲ (blue)	3.8 < dE/dX < 4.3, nPoints > 10
▼ (magenta)	3.8 < dE/dX < 4.3, nPoints > 20



Physics going on… Transverse energy

- Transverse energy analysis
  - Electromagnetic transverse energy
    - Use TPC tracks to subtract hadronic energy deposited on EMC
  - Hadronic transverse energy from TPC
  - Finalizing systematic errors





π^0 reconstruction (invariant mass spectra)

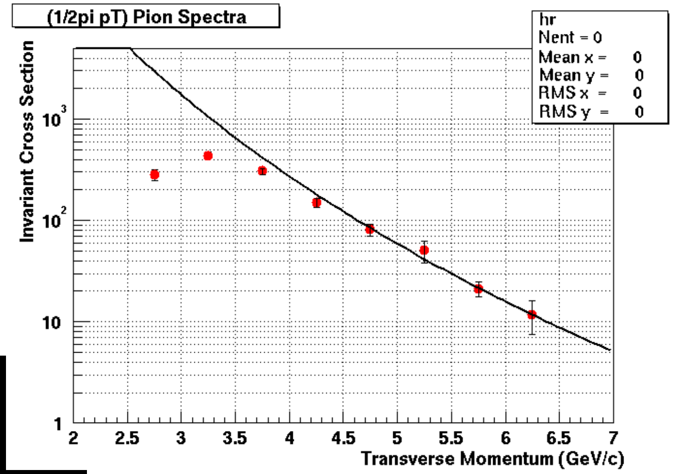
Steve Trentalange
Dylan Thein
and Alex Stolpovsky

- π^0 reconstruction with pp data
  - SMD present
    - Still needs better understanding of uniformity and gain
  - High tower trigger
    - Improve statistics
  - Low EMC occupancy
    - Smaller background

π^0 spectrum

Steve Trentalange
Dylan Thein
and Alex Stolpovsky

- High tower trigger
- A lot of corrections still to be done (trigger bias, efficiencies, etc)
- Only 10% of full EMC acceptance
- Corrections are still being studied



EMC for the next run - online

- Online Calibration and QA
  - Pedestals
    - Towers pedestal will be calculated on the fly from the data
      - No special run is required
      - Auto update to STAR DB for offline reconstruction
    - SMD pedestal subtraction at DAQ?
      - No zero suppression
  - Gain equalization and gain monitoring
    - Auto update to offline DB with gain variations
  - MIP and electron calibration
    - Get events from event pool
      - Need L3 tracks
    - Fit of MIP and electron peaks will be done offline
    - Estimated time to have first calibration – 2 weeks after beam starts
- QA histograms
  - Global histograms to single tower spectrum are available

EMC Simulations

- EMC slow simulator in place
  - It is ready for real simulation
    - calibration
    - pedestals and noise
    - dead channels
  - Only issue is database timestamp
    - Now -> one timestamp for all STAR ????
      - Works fine with real data because event time is the same
      - What to do in plain simulations? Which timestamp?
        - » Different detectors -> diff configuration -> diff timestamps
- Embedding
  - Just to merge hits (add ADCs) and run EMC reco again
    - Can be done at analysis level.
    - Does not need special chain

EMC on common μDST

- What do we need to save?
  - All tower hits (ENERGY and ADC)
  - SMD hits above threshold (ENERGY and ADC)
  - Clusters and points
- Current EMC micro DST
  - 9 bytes/hit
    - 42 k (towers) (FIXED) + ~ 2 k (SMD)
  - 20 bytes/cluster
    - ~ 0.7 k/event
  - 24 bytes/point
    - ~ 0.4 k/event
- Some features we want to keep
  - Re-creation of StEvent (limited version)
    - What do we need?
      - Basic event structure (trigger, vertex, etc)
      - Basic tracks (Geometry, dE/dX, etc)
      - StEmcCollection
    - And, why do we need?
      - EMC clustering and point thresholds depend on physics
        - » Cluster finder and point maker are StEvent compatible
        - » Reconstruction of clusters and points at analysis level for more sophisticated analysis

EMC on common μDST

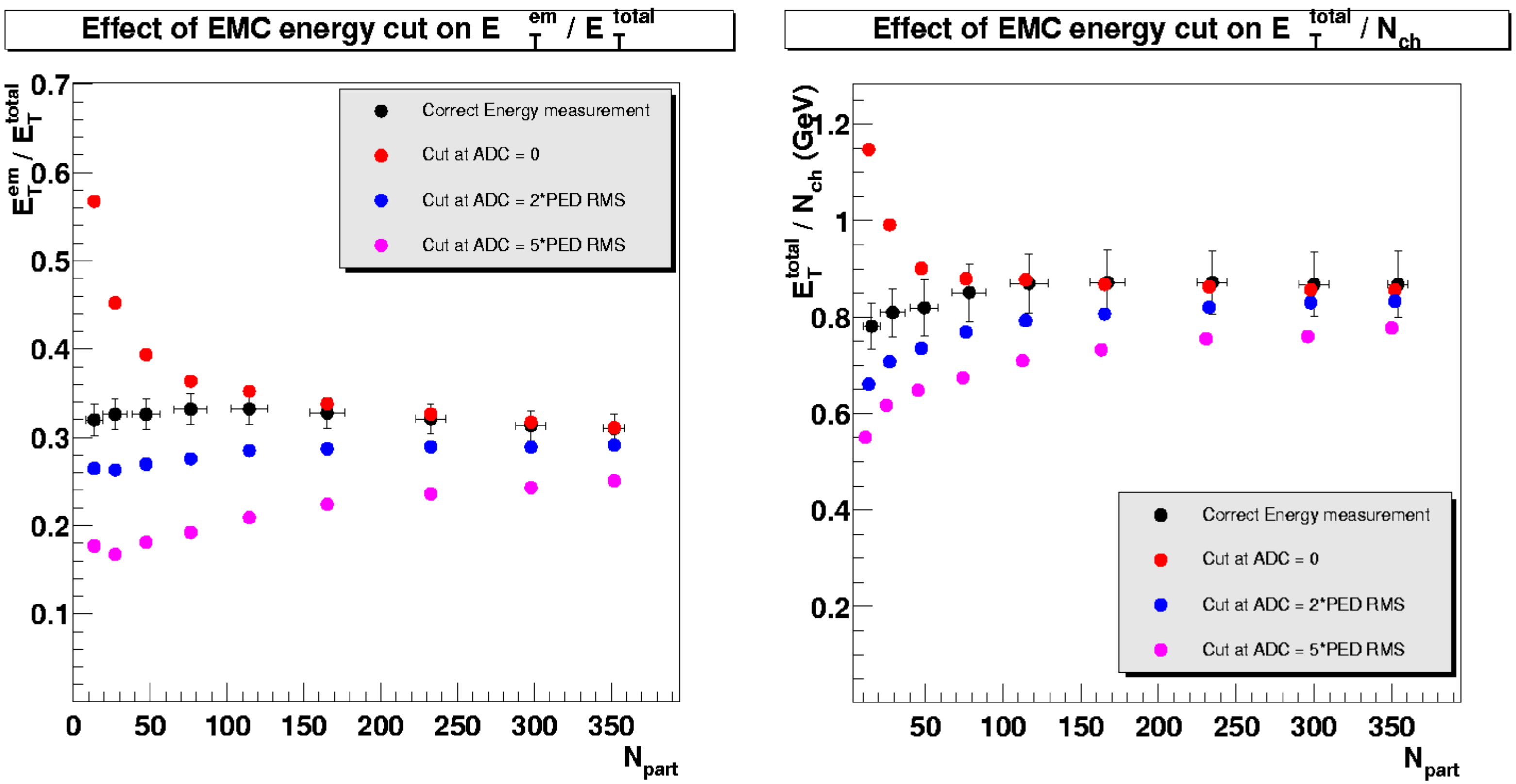
- Thinking a little bit WITHOUT cutting the data
  - Can change hit definition for tower
    - TObject* -> Float_t (ENERGY) and Short_t (ADC) arrays
      - 42 k/event -> 28 k/event
    - TObject* -> char[10200] for energy and char[7200] for ADC
      - Pack energy in a 17 bits value
        - » Energy measurement from 0 to 131 GeV with resolution of 1 MeV
      - Pack ADC's in a 12 bits value
        - » Same resolution as DAQ
      - 42 k/event -> 17 k/event
      - Not the best solution for last year data because patch was small
  - Keep the old hit definition for SMD
    - 9 bytes/hit

Do we need to save all tower hits?

- EMC is a calorimeter, not a tracking detector
  - Proper energy measurement is fundamental
    - Electron, photon reconstruction
    - Jet reconstruction
    - Et, etc
- What happens if we cut tower hits bellow some threshold?
  - Total energy measurement (Et) is biased
  - Shift on mass and momentum of reconstructed electromagnetic particles
  - Wrong jet energy

Just one example: Transverse energy

- Et is calculated assuming different energy cuts and compared to full energy measurement
- Stronger BIAS in the low multiplicity region.
  - This is the region where the size makes difference and we completely screw up the EMC measurement



Final comments

- EMC Analysis
  - Transverse energy just coming out
  - Electrons and π^0's can be identified
    - π^0 spectrum up to ~6.5 GeV/c for pp?
- EMC for the next run
  - Online QA and Calibrations
  - EMC simulator
    - Ready for real detector simulation
    - Embedding is not an issue
    - Need to learn how to deal with timestamp
  - EMC on micro DST
    - Very important for next year
    - Event size seems to be an issue now.
    - Need to save all tower hits