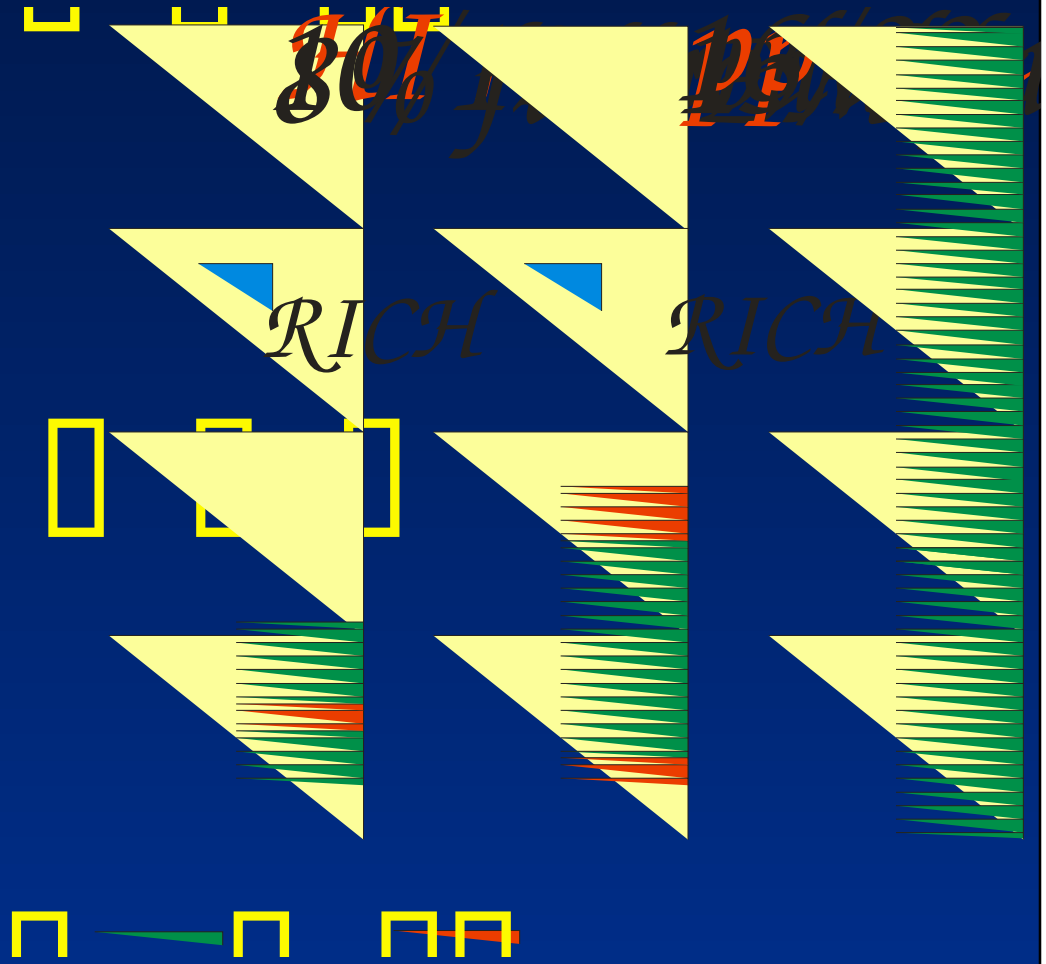
EMC Update

- Update on EMC
  - Hardware installed and current capabilities
  - Status of software
- Update on EMC analysis
  - Transverse energy
  - Electron identification
  - π^0 spectrum in pp
- First view into dAu data
  - Calibration
  - π^0
  - Electrons, etc…

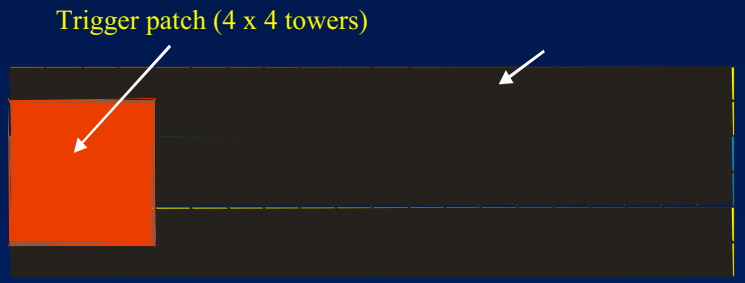
Hardware installed …

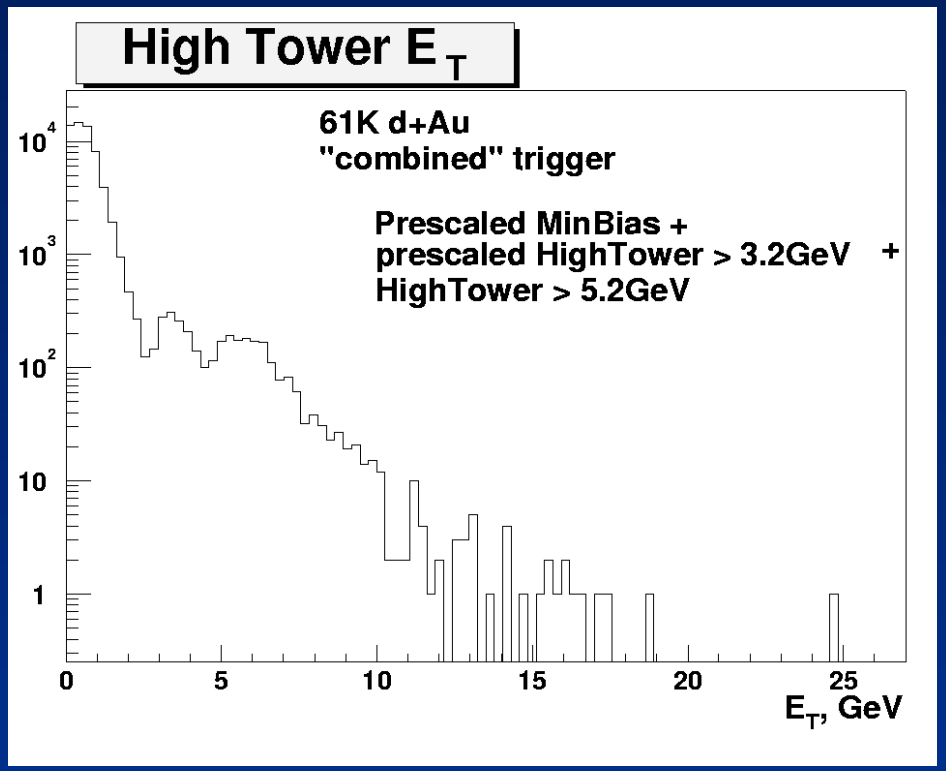
- Heavy-ion run
  - 12 modules instrumented
  - $(\Delta\eta, \Delta\phi) \sim (1.0, 1.2)$
- pp run
  - 22 modules instrumented
  - $(\Delta\eta, \Delta\phi) \sim (1.0, 2.2)$
- dAu run
  - 60 modules instrumented
  - $(\Delta\eta, \Delta\phi) \sim (1.0, 2\pi)$
  - 2400 (~2300 good) towers



EMC (L0) trigger

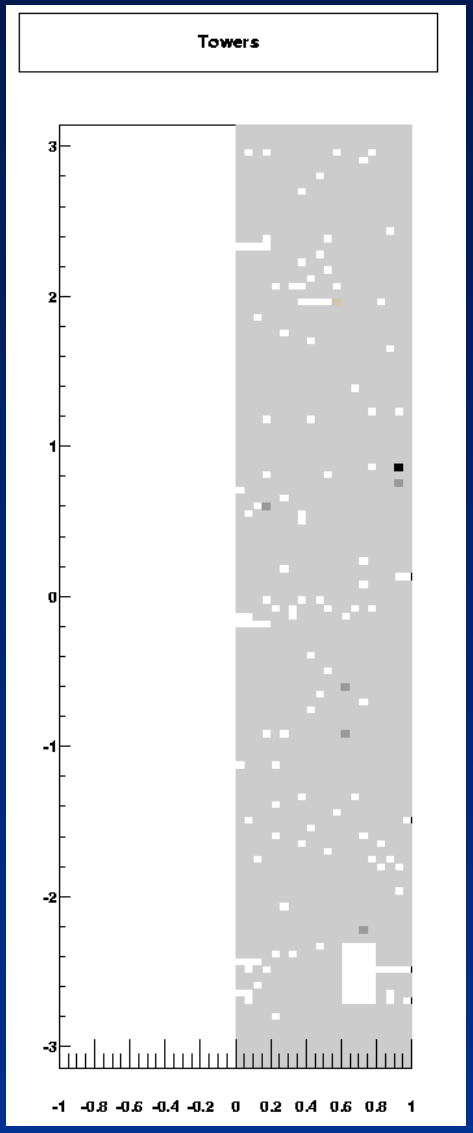
- High-p_t trigger (High Tower)
  - Photons, electrons and π^0
  - Highest tower in patch
  - 150 (145-147 good) trigger patches
    - 4 x 4 towers
    - $(\Delta\eta, \Delta\phi) \sim (0.2, 0.2)$
    - Highest tower in patch (HT)
      - 0.5 GeV energy resolution
  - About x100 enhancement at 5 GeV
- Patch sum trigger
  - Sum over 16 towers
  - 16 bits->6 bits convertion
    - Linear lookup table
      - Extremely high threshold
      - Need to replace (working on)
  - New LUT in place
    - about 2 hours to program
    - Patch trigger is being tested
- Jet trigger
  - Waiting for the patch sum

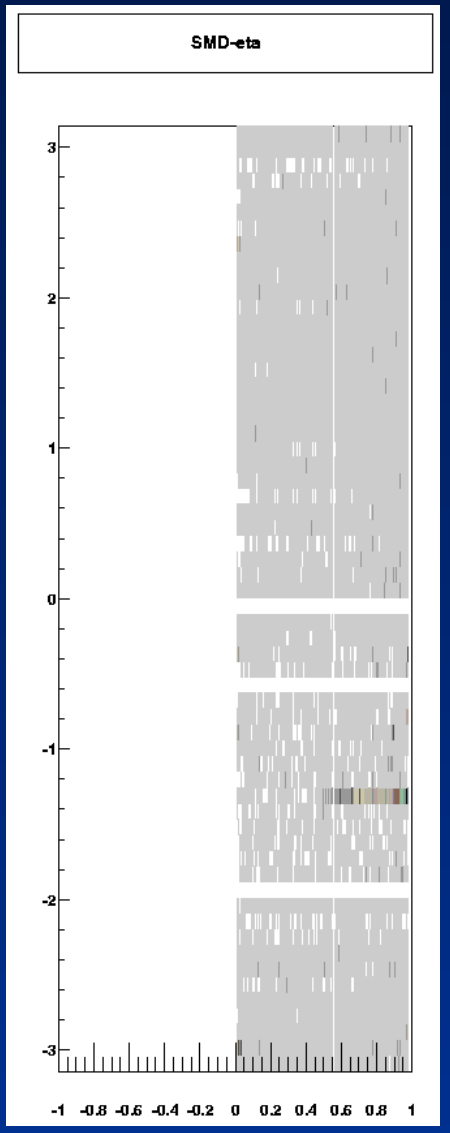




What is alive

- Towers
  - About 100(68)/2400 dead or noisy
    - 1 bad digitizer board (32) channels (replaced)
    - 68 noisy/dead channels
    - HV is set to zero for all of them
  - 3 dead crates (power supply failures)
    - Replaced during accesses
- SMD
  - 3/60 modules not working
    - 1/3 bad FEE
    - 2/3 need access inside the detector to diagnose
  - Some individual channels
    - Some we know are dead
      - Zero pedestal and no readout
    - Some are noisy





EMC software

- Many modifications since last year
  - New database scheme
    - New tables (pedestals, calibration, status)
      - Smaller than lest year
      - Reduced access time
        - » From 15 minutes -> 30 seconds
  - Online calibration and monitoring
  - Embedding and simulations
  - Emc on muDST

EMC Reconstruction flow

- Three makers
  - StEmcADCtoEMaker
    - Converts ADC to calibrated energy for all EMC sub-detectors
      - Gets calibration and pedestal tables from STAR DB
  - StPreEclMaker
    - Finds clusters in all EMC sub-detectors
  - StEpcMaker
    - Matches EMC clusters → EMC Point
- All StEvent based
  - They can run at analysis level using .event.root or muDst as input
  - This is necessary to allow clustering with different thresholds for different analysis

EMC online software

- Calibration and pedestal
  - Pedestals are calculated on the fly from real data
    - New pedestal tables are save every 6 hours (if there is data available)
  - Online MIP calibration
    - Events from event pool
    - Project L3 tracks with p > 1.2 GeV into EMC towers
    - Used to monitor gain shift on EMC
    - Need about 2 M minibias events

EMC embedding

- Embedding (2 steps)
  - TPC embedding -> .event.root and .geant.root
    - TPC embedding is necessary only for charged particles embedding (there is no need for TPC embedding if π^0, for example)
    - Need to enable reconstruction of EMC real data on chain.
  - EMC embedding
    - Clear clusters and points
    - Mixes EMC hits by adding the hits energies and ADC's from tow different input files
    - Reconstruct hits and points after mixing the hits
    - gets input from .event.root, muDst, emcMuDst, .geant.root
  - EMC association
    - Associates MC tracks with clusters and points
    - Done on the fly with the embedding
- Simulations
  - Real pedestal and gain are taken into account

EMC on muDST

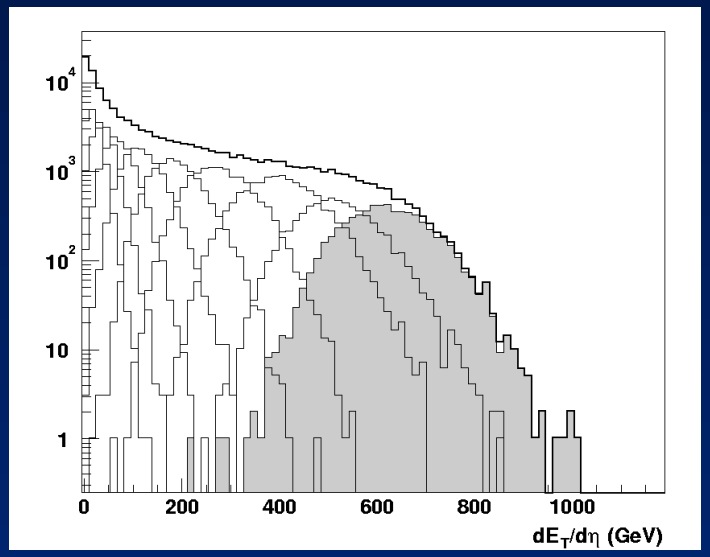
- EMC is fully implemented
  - Saves all tower ADC's
    - Just to save disk space
    - If tower energy is necessary need to run some reconstruction during analysis (very fast)
  - Saves Pre-Shower and SMD hits above some threshold
  - Saves all EMC clusters
    - Default thresholds, but can be re-reconstructed on the fly if different thresholds are necessary.
  - Saves all EMC points
    - Based on clusters thresholds but can be re-reconstructed
  - StEvent object can be re-created on the fly
    - Necessary if new clusters and points are needed

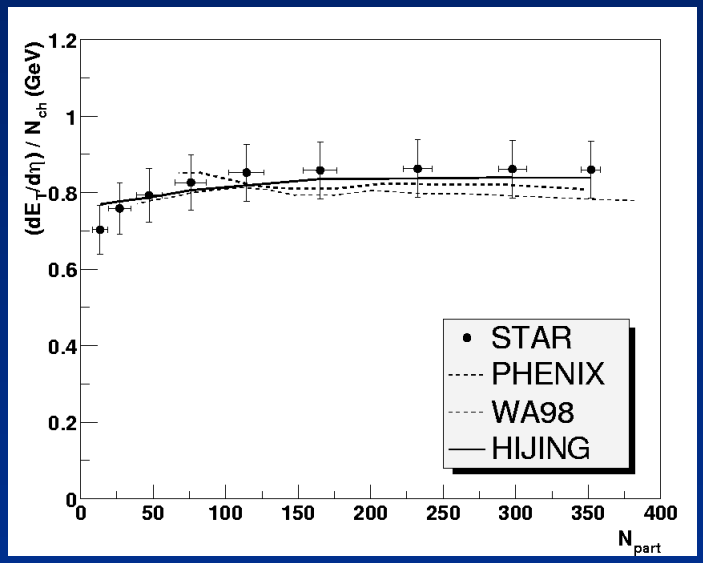
Update on EMC analysis

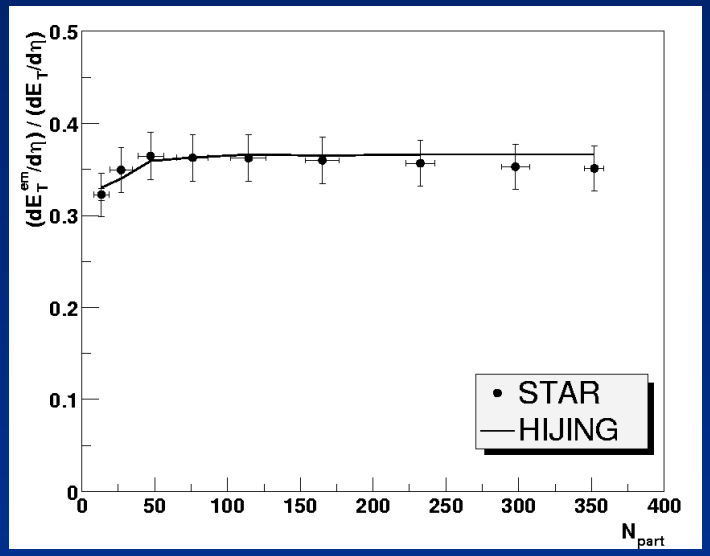
- AuAu run
  - Transverse energy measurement
    - Paper being written
  - Electron identification
- pp run
  - π^0 spectrum
  - Electron identification with SMD
- dAu run
  - First look at the data…

Physics going on… Transverse energy

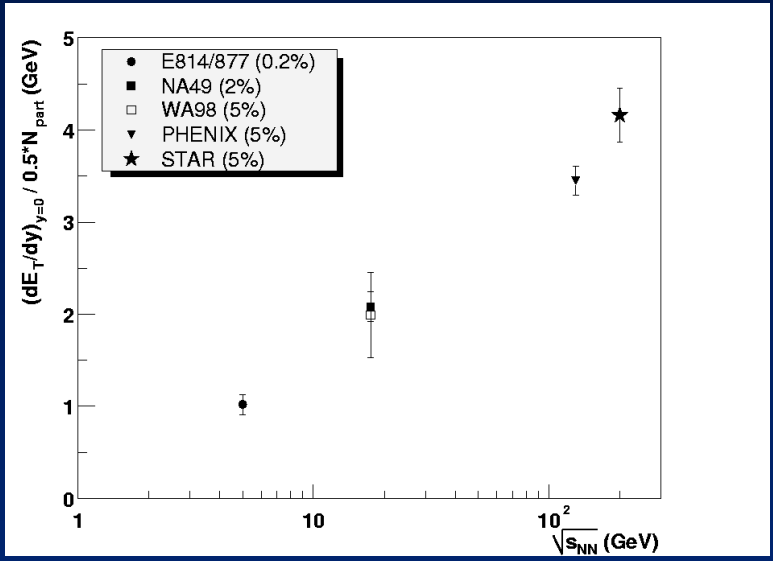
- Transverse energy analysis
  - Electromagnetic transverse energy
    - Hadronic background
      - Use TPC tracks to subtract hadronic energy deposited on EMC
      - Hadronic profile obtained from real data
      - Correction due to long lived neutral hadrons
  - Hadronic transverse energy from TPC
  - Writing a paper

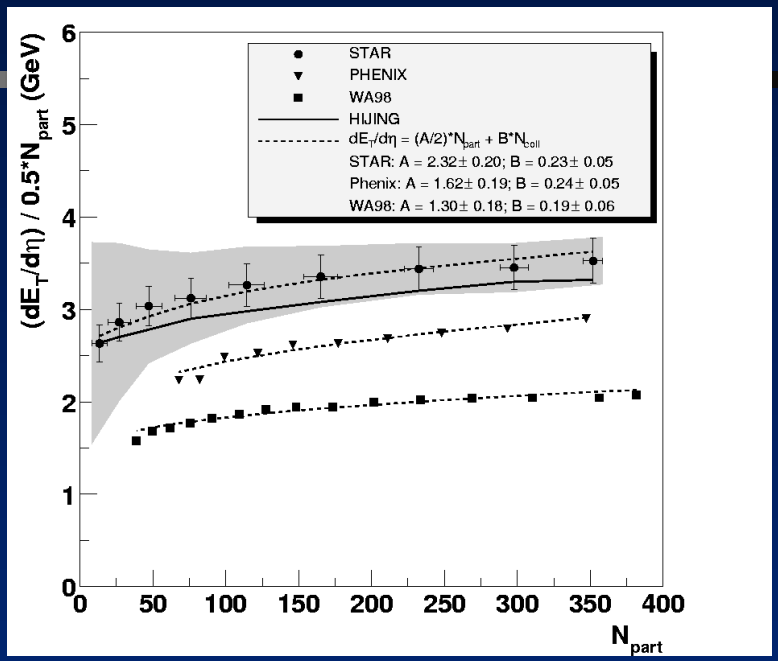


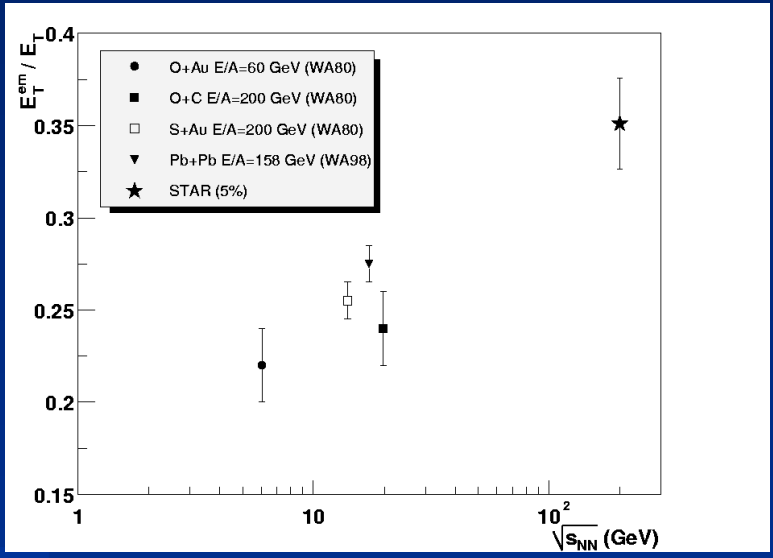


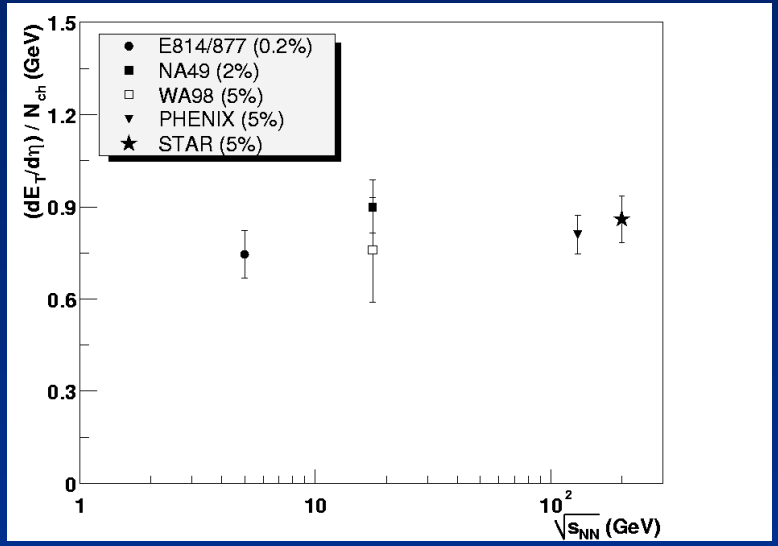


Transverse energy (cont)



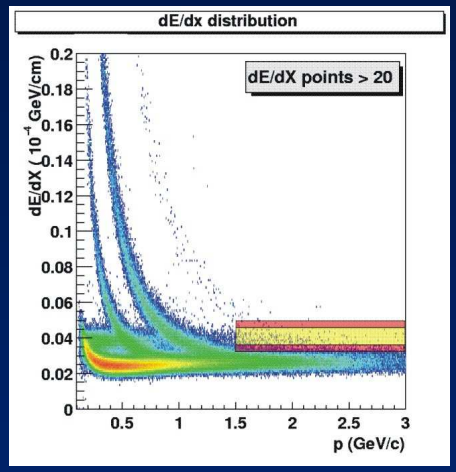


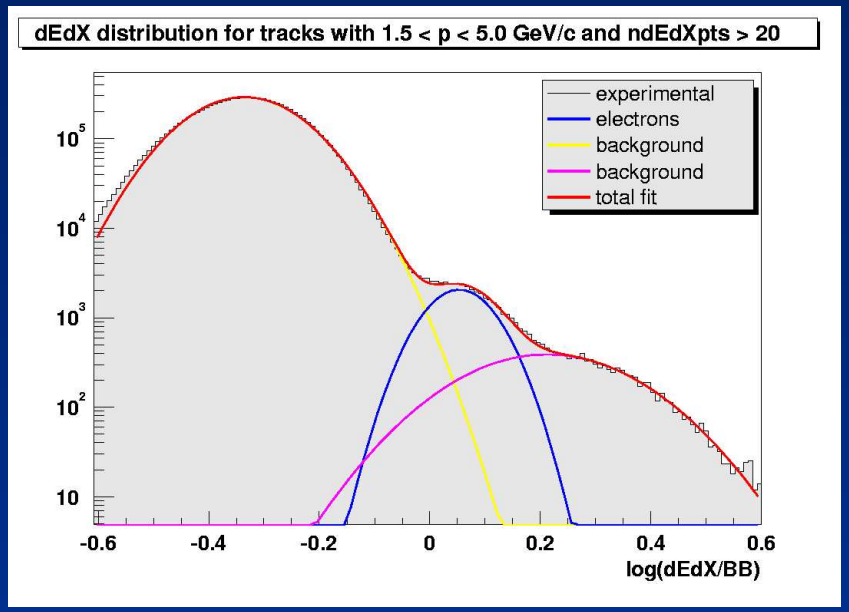




Electron identification in STAR

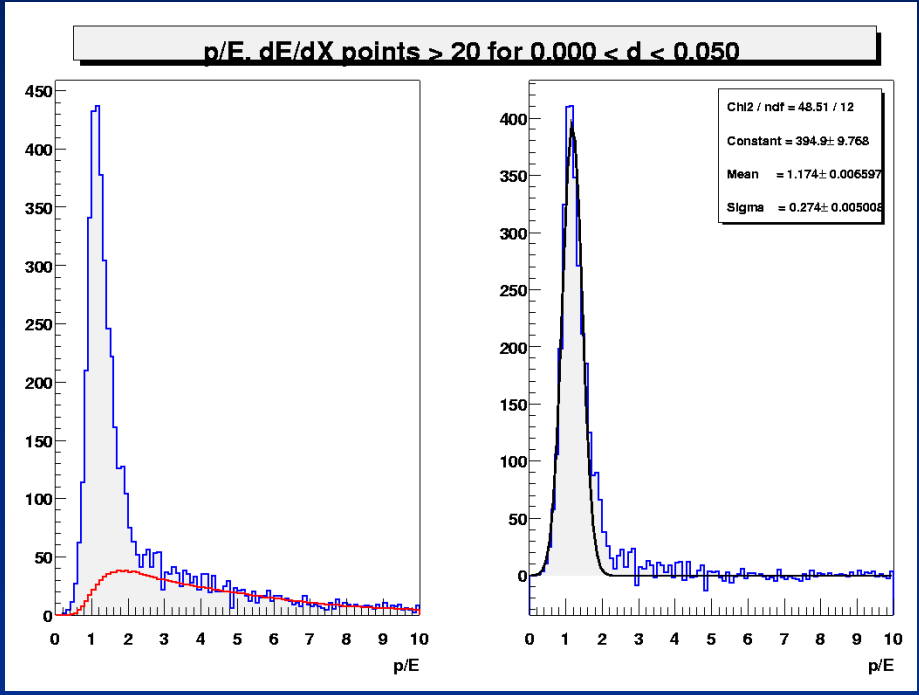
- TPC information
  - Momentum of the track
  - dE/dX
    - For electron selection
    - For hadronic background estimation
  - Number of dE/dX points
- EMC information
  - Distance from the projected track to the center of an EMC tower
  - Energy of the tower
- Dataset
  - Minimum bias AuAu
    - ~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

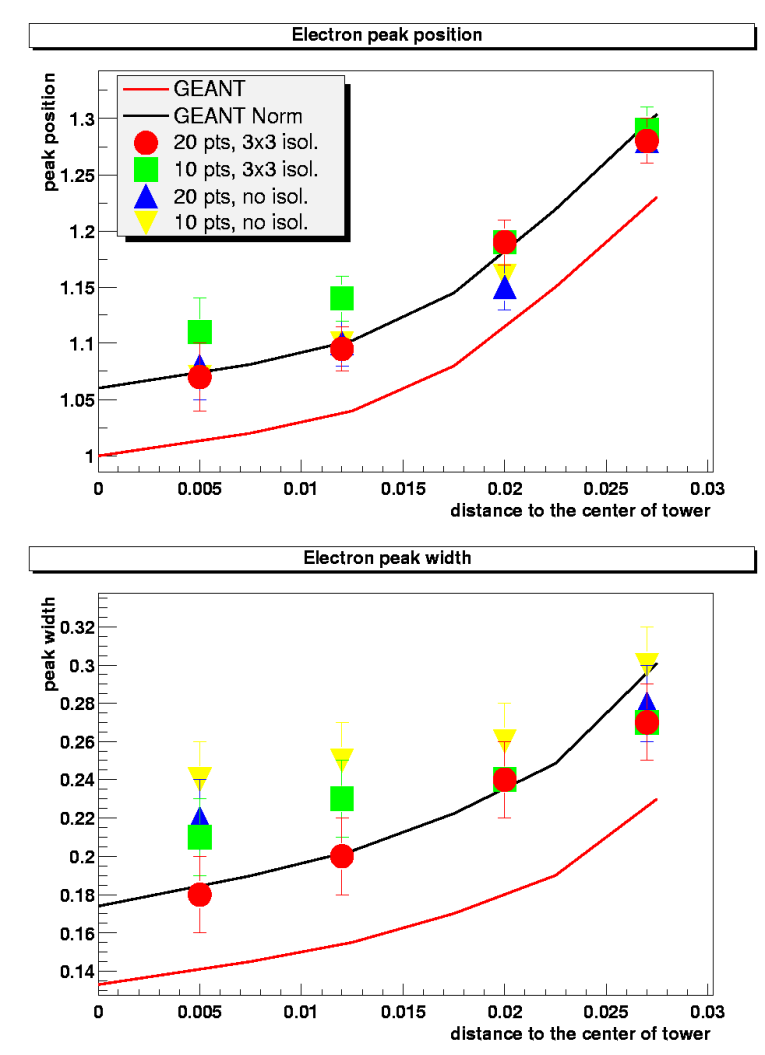




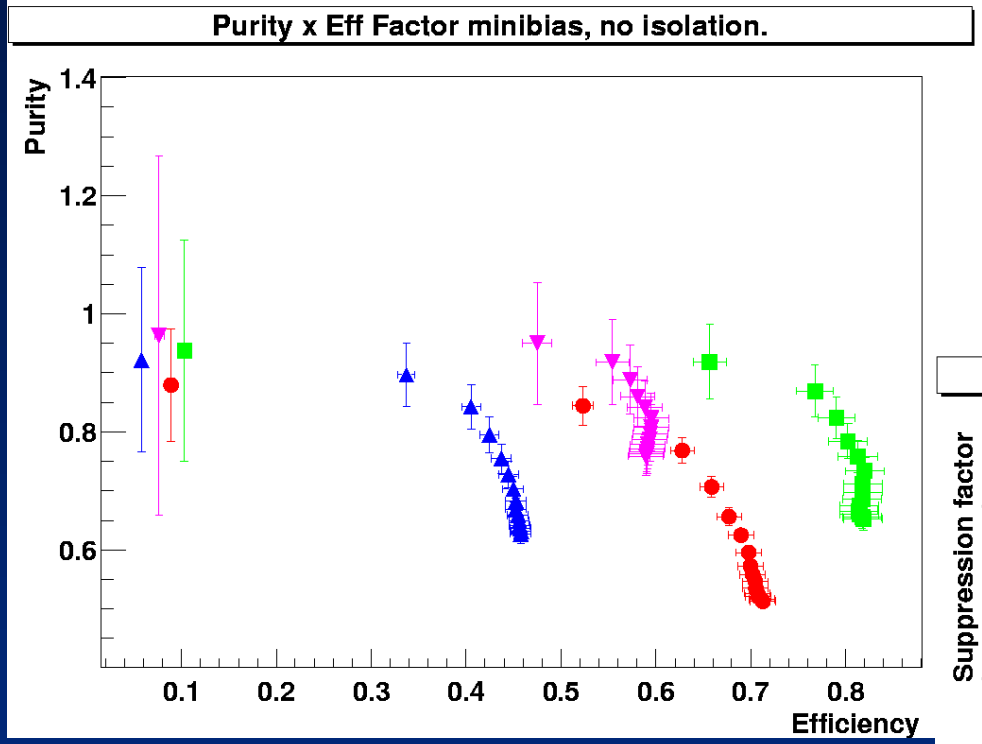
EMC information (towers only)

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



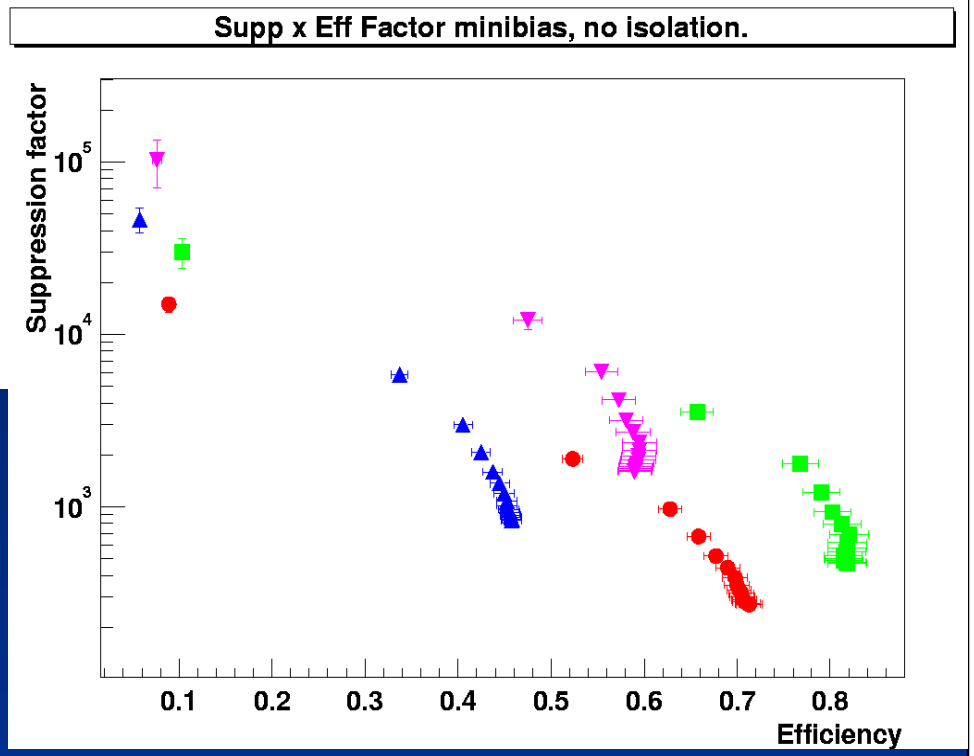


Putting all results together (TPC + EMC)



Minimum bias AuAu

- 3.6 < dE/dX < 4.5, nPoints > 10
- 3.6 < dE/dX < 4.5, nPoints > 20
- 3.8 < dE/dX < 4.3, nPoints > 10
- 3.8 < dE/dX < 4.3, nPoints > 20



π^0 reconstruction (invariant mass spectra)

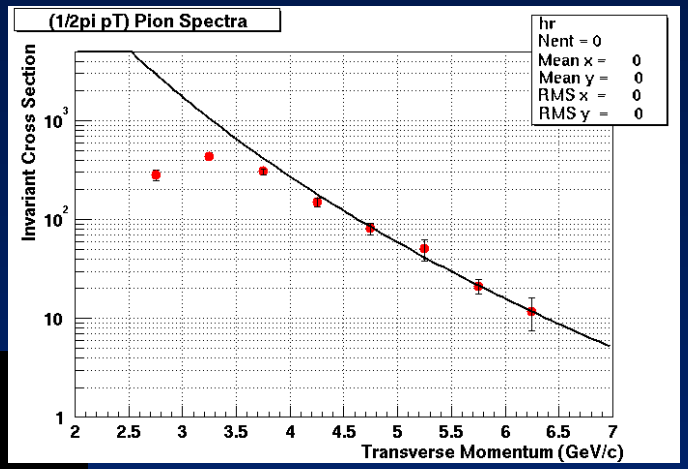
Steve Trentalange
Dylan Thein
and Alex Stolpovsky

- 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

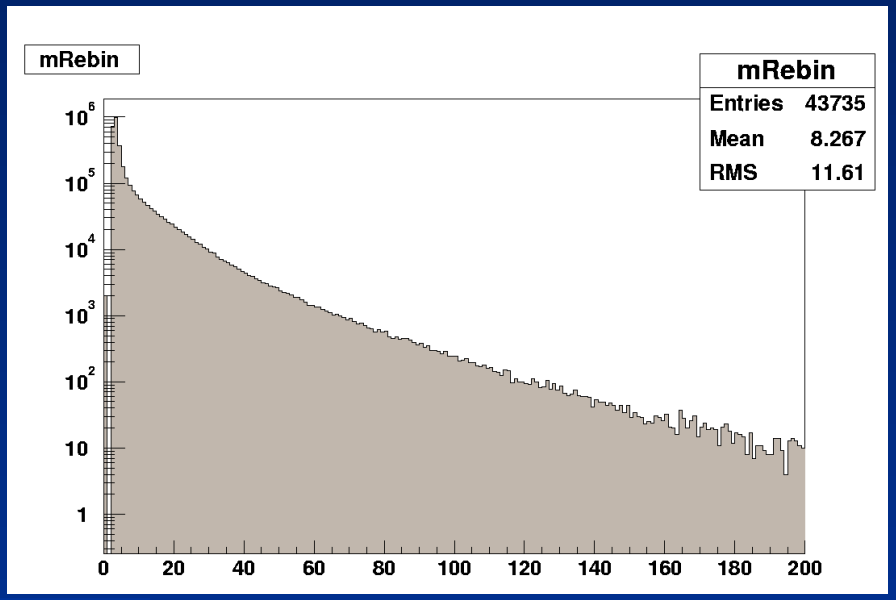
- High tower trigger
- A lot of corrections still to be done (trigger bias, efficiencies, etc)
- Only 10% of full EMC acceptance
- Corrections are still being studied

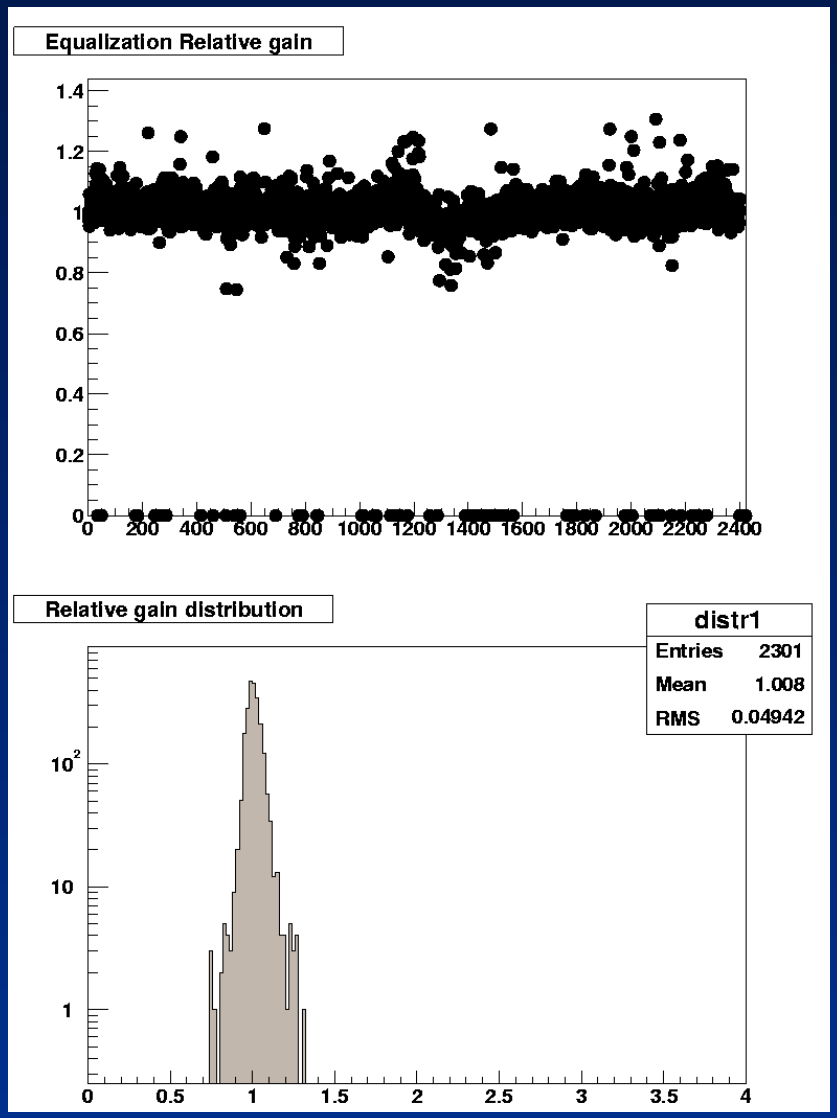


Preliminary

dAu run – Calibration (I)

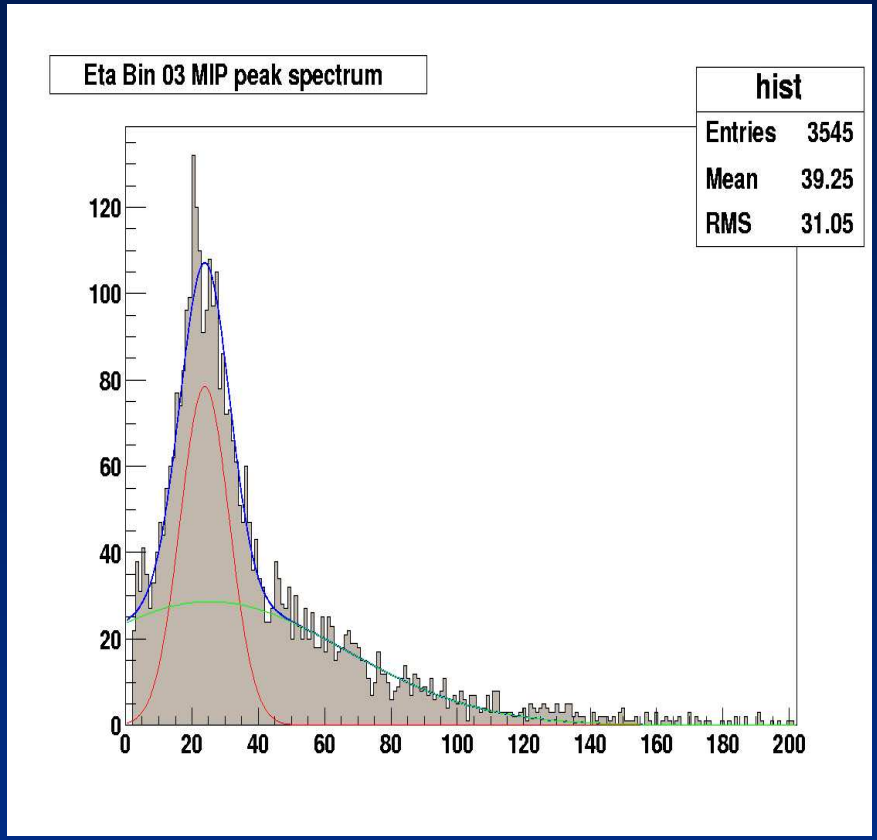
- Relative gain equalization
  - Used to adjust HV to have same gain in transverse energy
    - Important for trigger uniformity

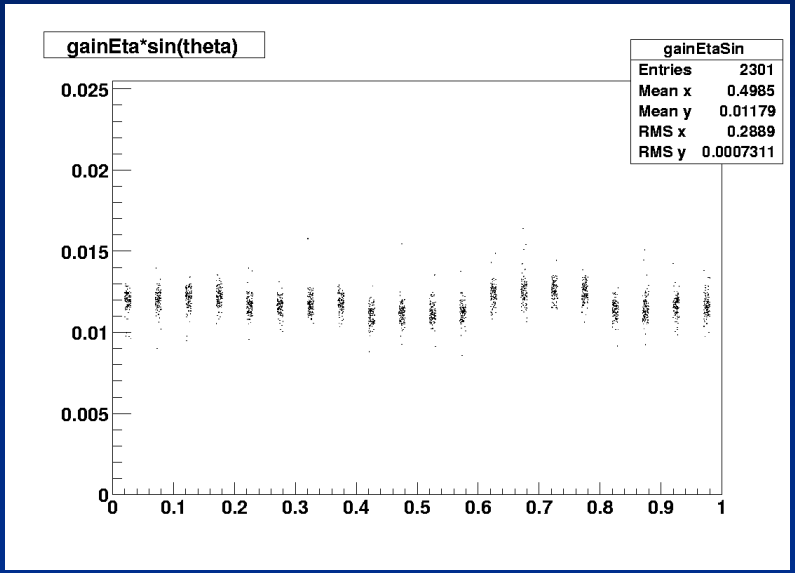




dAu – Calibration (II)

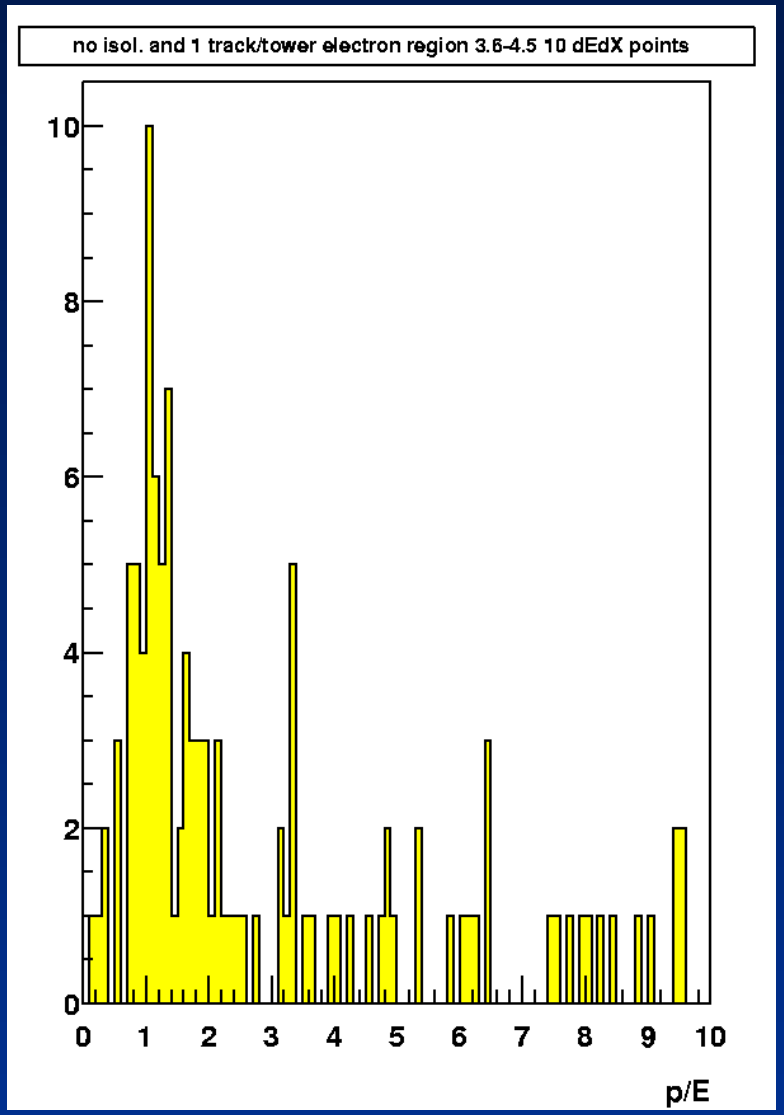
- MIP calibration
  - Project high-p tracks into EMC
    - p > 1.2 GeV/c
    - 3x3 towers isolation
  - About 1 M minimum bias events needed





dAu – Electron identification

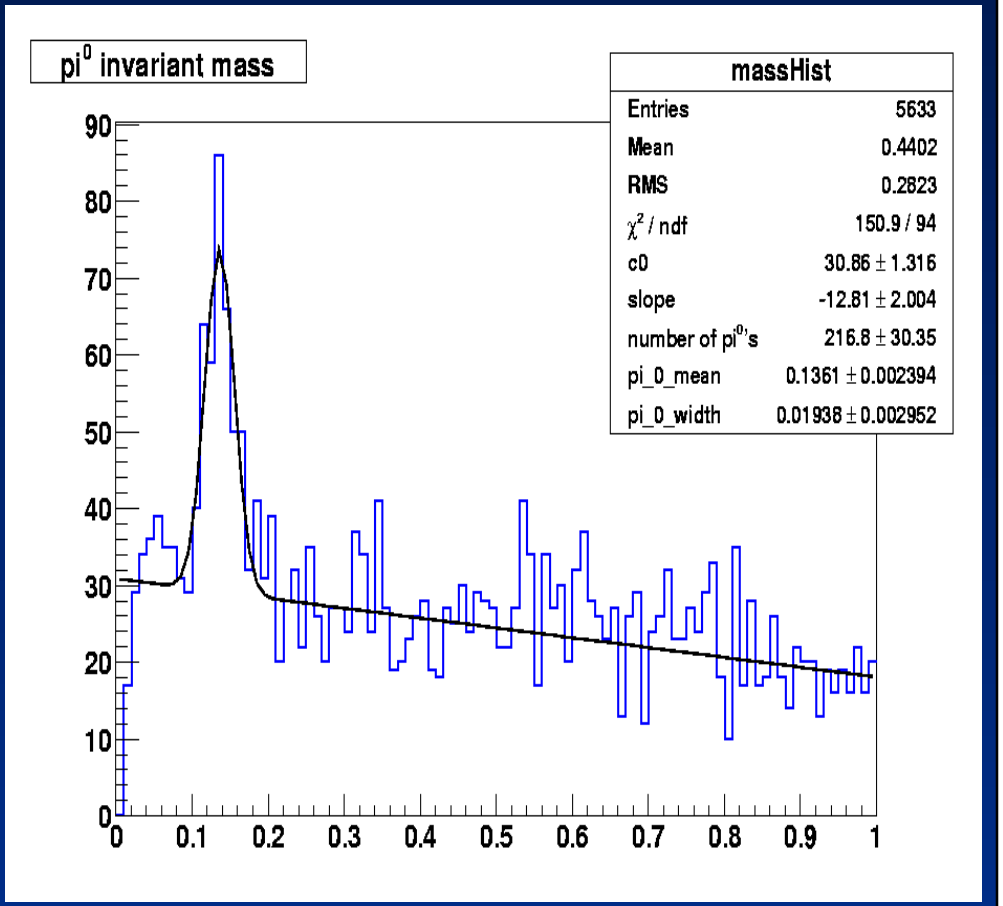
- dE/dX + Tower
  - Electron peak is visible
    - Needs more statistics for calibration
    - No track quality cuts
- dE/dX + Tower + SMD
  - Neural Net software (Julia and Dmitry)
    - Software already on repository
    - Long way to go
      - understand matching with SMD
        - » Residuals
        - » SMD efficiency



dAu – π^0 reconstruction

Alex Stolpovsky

- Invariant mass spectrum
  - pt > 1.5 GeV
  - At least one of the SMD's present
  - Vertex found (no cut)
  - No track projected to EMC point
  - Peak at the right position
  - Peak with better than last year?
    - 19 MeV
      - 27 MeV from last year pp
    - Needs more statistics
- This is just the start…



Final comments

- EMC hardware
  - ½ of the barrel is installed and running
  - High tower trigger is running
  - Patch and Jet triggers are under commissioning
- EMC software
  - Ready for full production
  - Ready for embedding
  - All necessary infra-structure in place for data analysis.
- Analysis of the data
  - Many topics
    - Et, π^0, electrons
  - First look at dAu suggests that data is promising