Central Calorimeter E/p Tuning

UC CDF Group meeting
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with
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Introduction

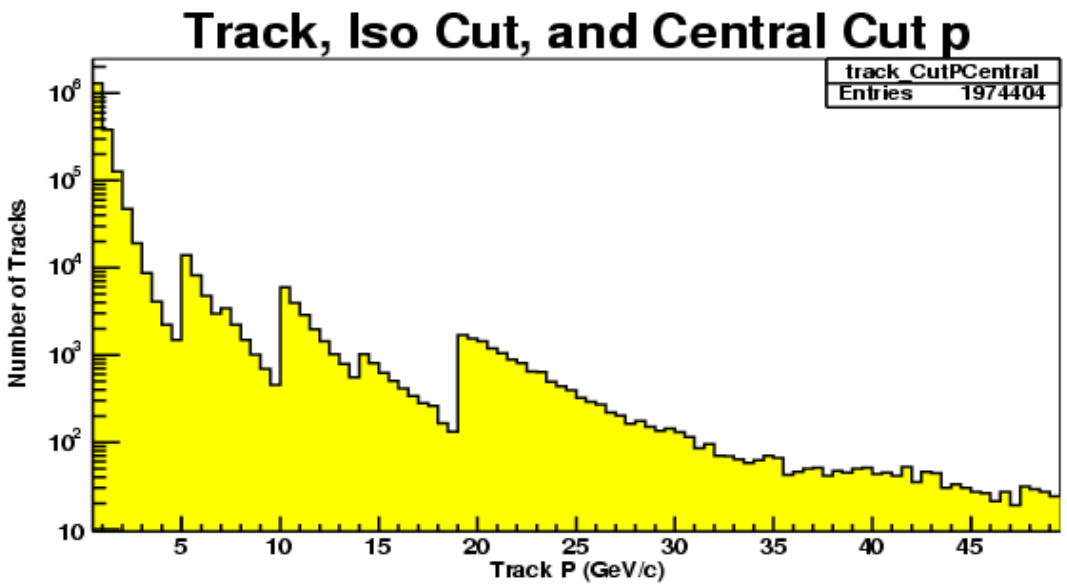
- Over the past couple of months we have taken a step back to tune the “big picture,” the full momentum spectrum from 0 to 30 GeV/c.
- Review of the datasets we used.
- Details of the analysis, including the changes we have made to accommodate the full momentum spectrum.
- Different Monte Carlos (MCs) generated.
- Comparison between data and MC.

Full Spectrum Datasets

- I compared the MC to four different datasets.
  - gjtc0h_stt15 15 GeV Single Track Trigger (15 STT)
  - gjtc0h_stt10 10 GeV Single Track Trigger (10 STT)
  - gjtc0d + gjtc01 Jet Calibration Data
  - gmbs0d Minimum Bias Data
- Isolated tracks are extracted from this dataset
  - No tracks within a 7x7 block around the target track.
  - No CES clusters within the same 7x7 block, excluding a small $\Delta R=0.03$ cone around the target track.
- For each isolated tracks plot the:
  - EM (2x2), Hadron (3x3),
  - MIP (EM < 670 MeV), and Total (EM+Hadron) energy over momentum of the track.
  - Tracks are separated into 1 GeV/c momentum bins starting from 0.5 to 39.5 GeV/c
  - It is from these individual histograms that the E/p data points are extracted.

Combined Dataset

- Combined all data into one large dataset.
- In doing so, introduced logic to select tracks away from the trigger thresholds in order to reduce trigger bias.
  - e.g. for the 10 GeV/c trigger threshold we demanded the target tracks had greater than 14 GeV/c.
  - Although this lowers our total statistics it helps create a “cleaner” sample of good data for the full range of momentum, 0 to 38 GeV/c.

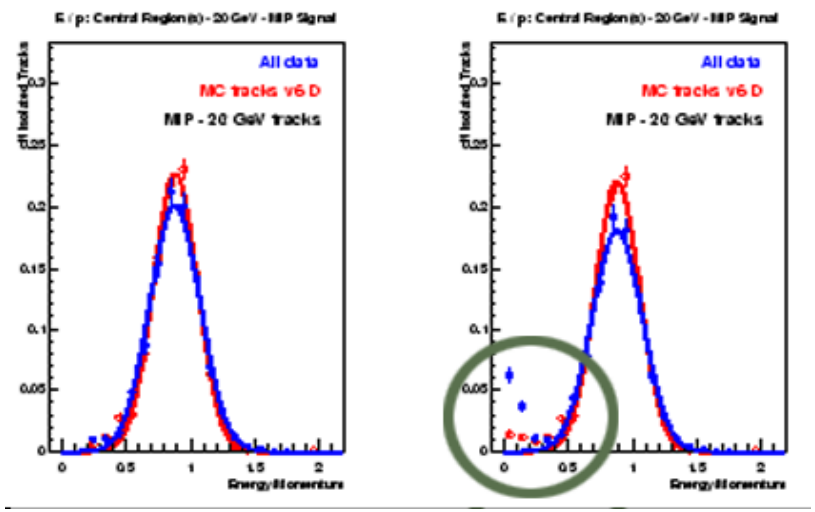


Analysis Details

- In addition to track isolation we demand that the tracks satisfy the "contour" cut.
  - Track must hit within the central 81% of the tower.
- MC is weighted at low momentum because the falling spectrum may bias our results.
  - This momentum weighting is applied from 0 to 7.5 GeV/c.
  - I will show the effects later in this talk.
- The muon and electron vetoes that we had used previously were adjusted.
  - The muon veto, Total Energy > 5 GeV, would would negate our sample at low momentum. As such it was removed.
  - The electron veto is HAD/EM > 0.056. It has been kept.
  - We processed the data and MC with and without the electron veto. Both comparisons will be shown.

Analysis Details (cont.)

- To compensate for the muon and electron vetoes, we use "converging" Gaussian fits at high momentum in order to remove the tails of the E/p signal.
  - Fit range is 3σ around the previous Gaussian until the fit converges.
- How the mean E/p is extracted:
  - For all the signals (EM, HAD, etc.) the default method of extracting the mean E/p is to use the mean of the histograms that are filled.
  - Only for the Total above 7.5 GeV and MIP above 5.5 GeV do we use the Converging Gaussian technique described above.



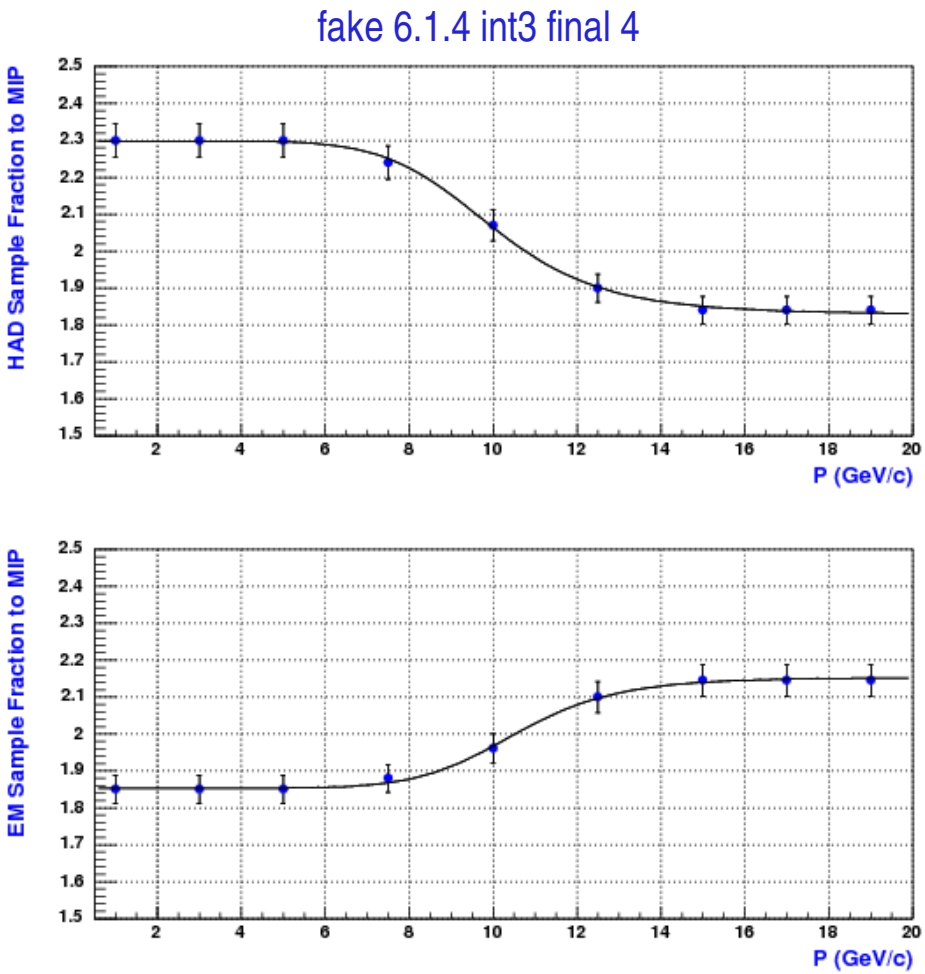
Left: Muon Veto
Right: No Muon Veto

Monte Carlos Generated–History of Gflash Tuning

- fake_614 : plain vanilla 6.1.4
- fake_614_newl : 6.1.4 with Pedro's final lateral tune
- fake_614int3 : 6.1.4int3 with Pedro's final lateral tune
  - This became our new baseline for the following adjustments.
- fake_614int3_pbymip3
  - Removed the p dependence from the EM sampling introduced for the MinBias analysis (with old lateral tune), affects E/p below p<10 GeV/c.
  - Adjusted the fraction of deposited energy, affecting the total energy response, above p>20 GeV/c.
- fake_614int3_pbymip34
  - Removed the p dependence from the HAD sampling, affects E/p below p<5 GeV/c.
  - Adjusted fraction of deposited energy above p>10GeV/c.

Monte Carlos Generated–History of Gflash Tuning

- fake_614int3_f1
  - Adjusted the fraction of deposited energy for 0<p<30 GeV/c.
- fake_614int3_f2
  - Add +2% for the EM sampling to the MIP
  - Subtract -4% for the HAD sampling to the MIP
- fake_614int3_f3
  - Increased EM sampling to +6%
  - Decreased HAD sampling to -10%
- fake_614int3_f4
  - EM sampling is +16%
  - HAD sampling is -20%
  - Current iteration shown in this talk



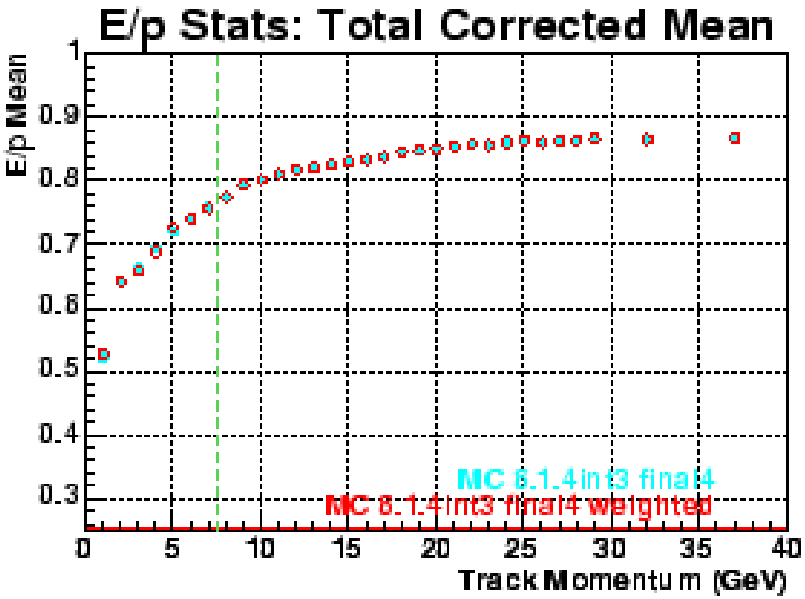
Comparisons (being shown here)

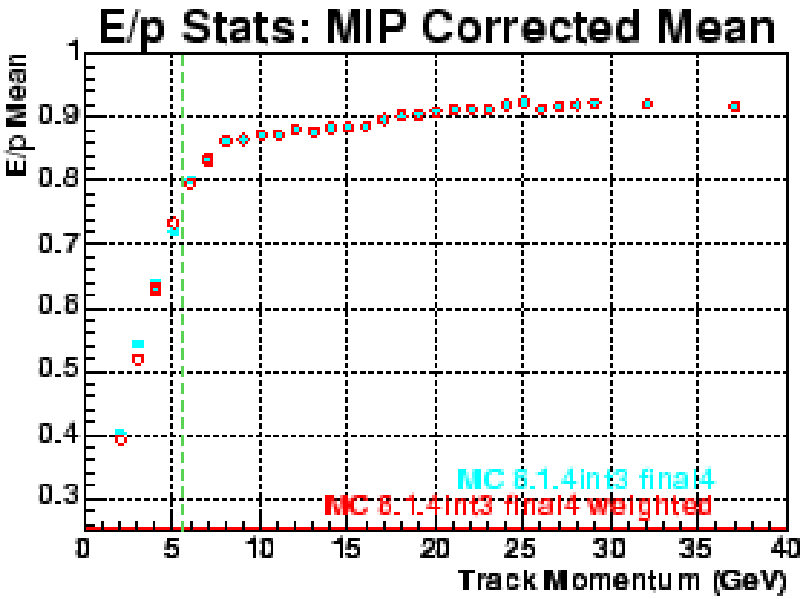
- Show the corrected E/p vs. p results for the Total and MIP.
- Corrected is defined as: Signal(NxN) – Background(1xN) strip
  - Where N is 2 for EM and 3 for HAD.
- Green dashed line indicates where Gaussian fits are used to determine the mean.

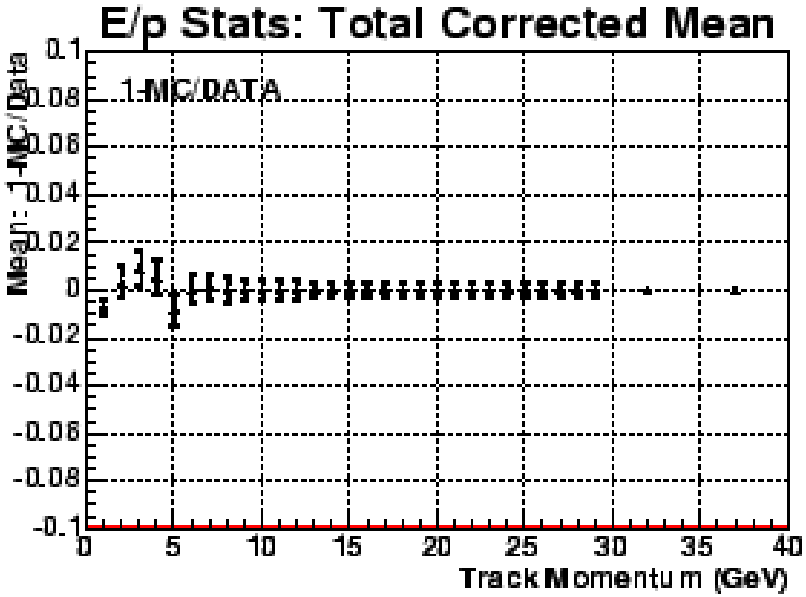
Three sets of comparisons:

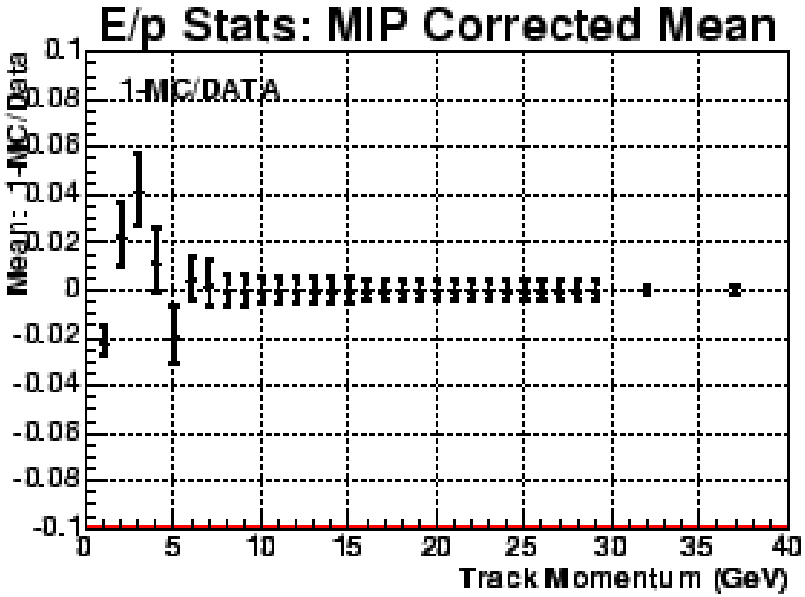
1. MC vs. MC with weighting, both w/ No lepton veto
2. Data w/ No lepton veto vs. Weighted MC w/ No lepton veto
3. Data w/ both lepton vetoes vs. Weighted MC w/ Electron veto

Weighted MC vs. Unweighted MC

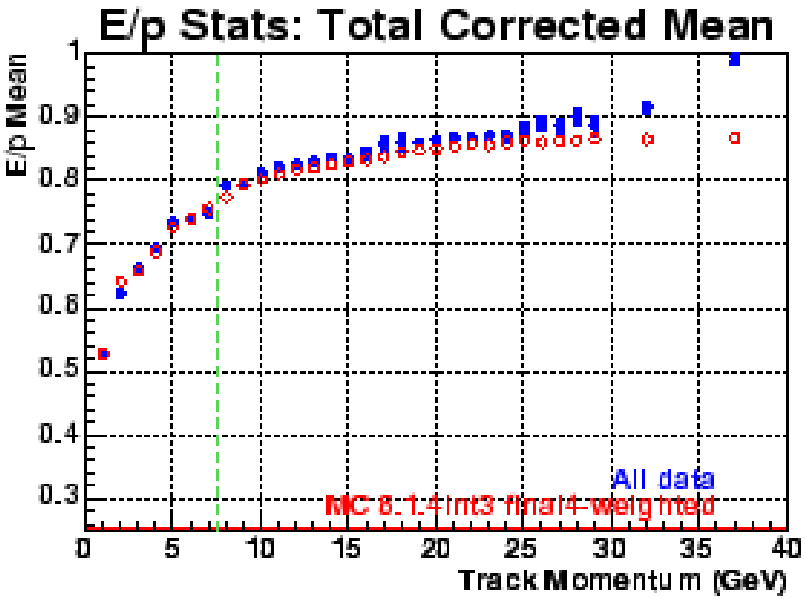


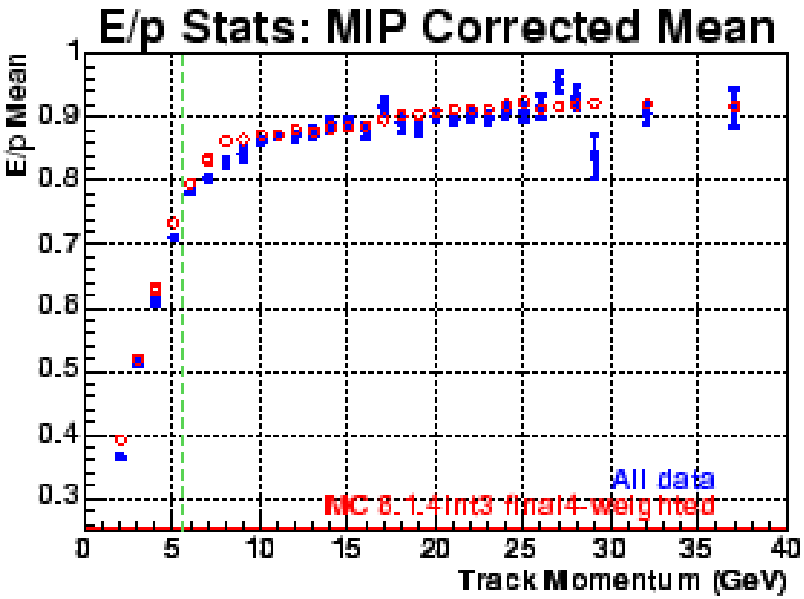


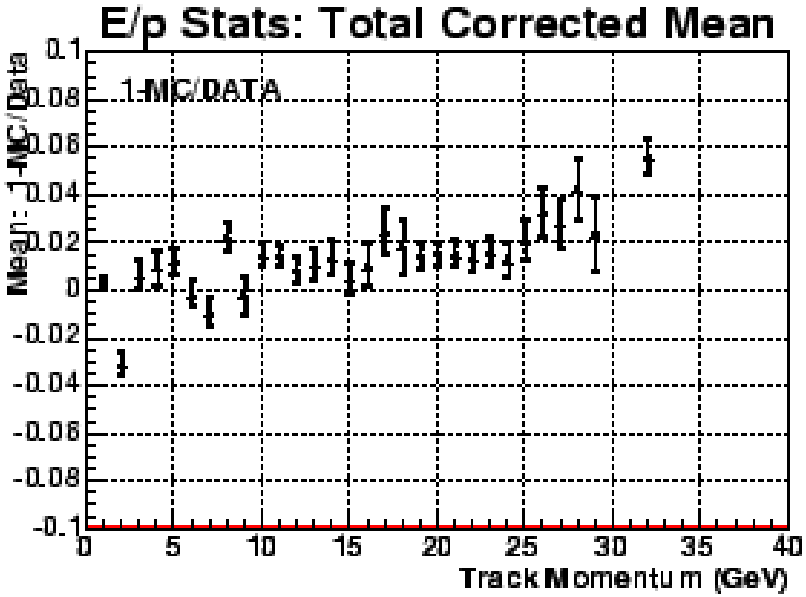


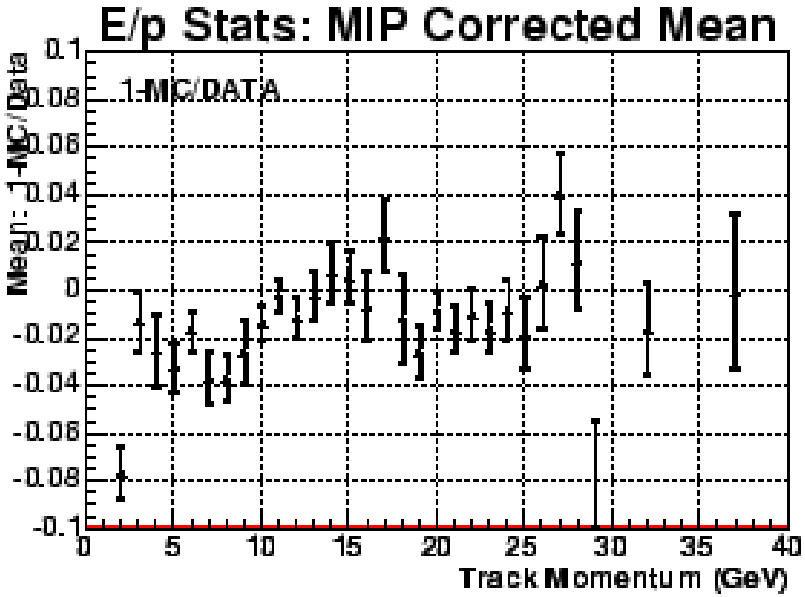


All data vs. MC both without electron veto

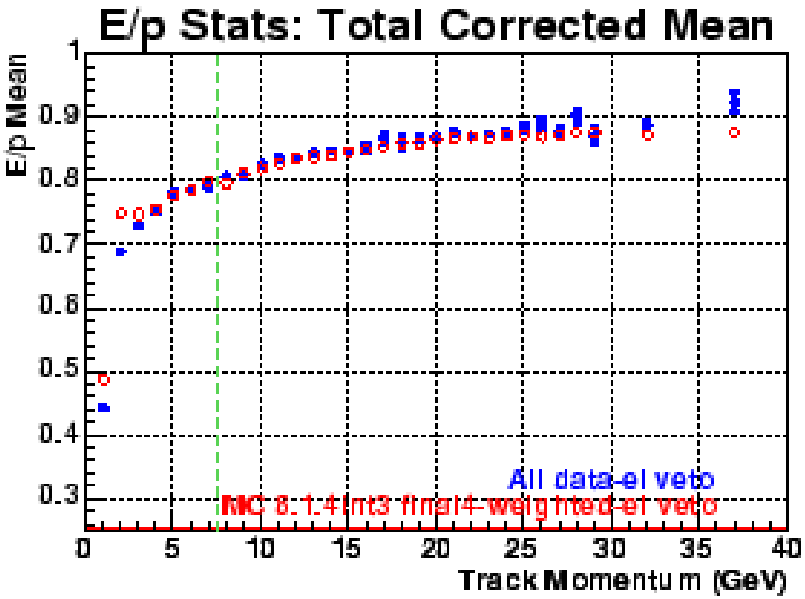


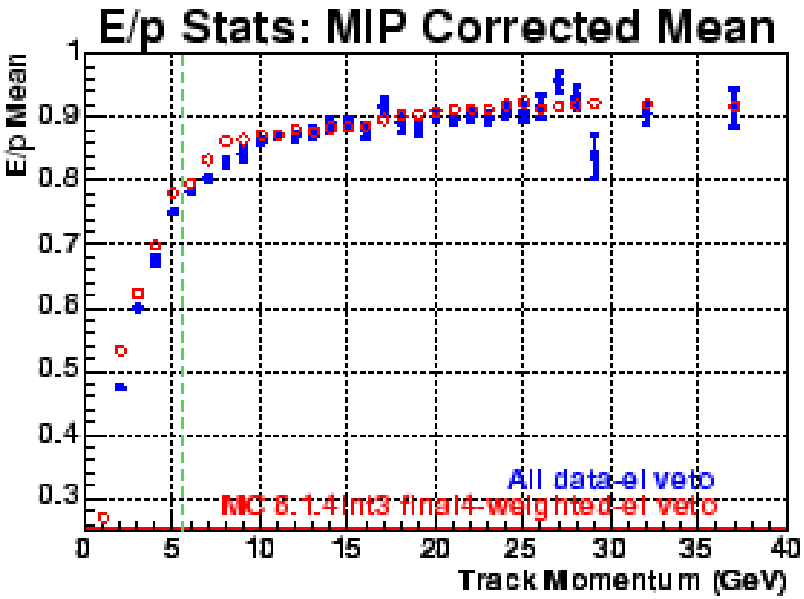


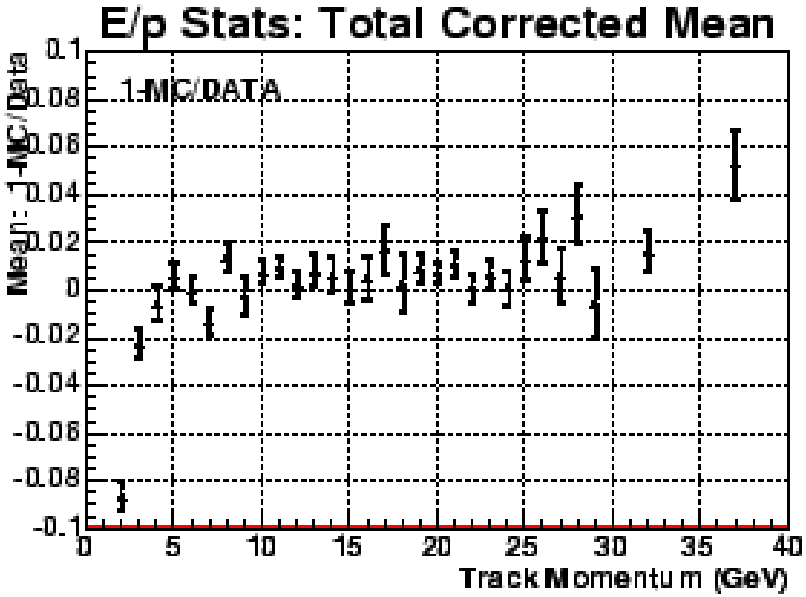


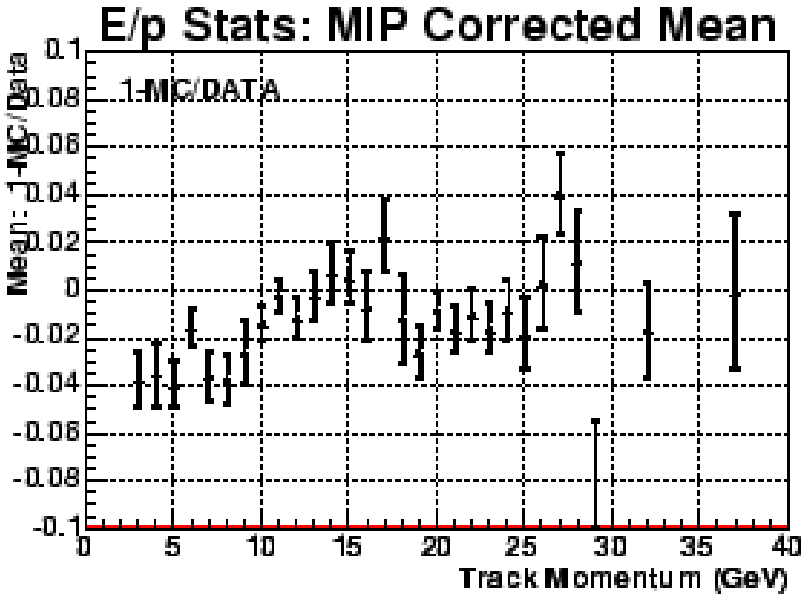


All data vs. MC both with an electron veto









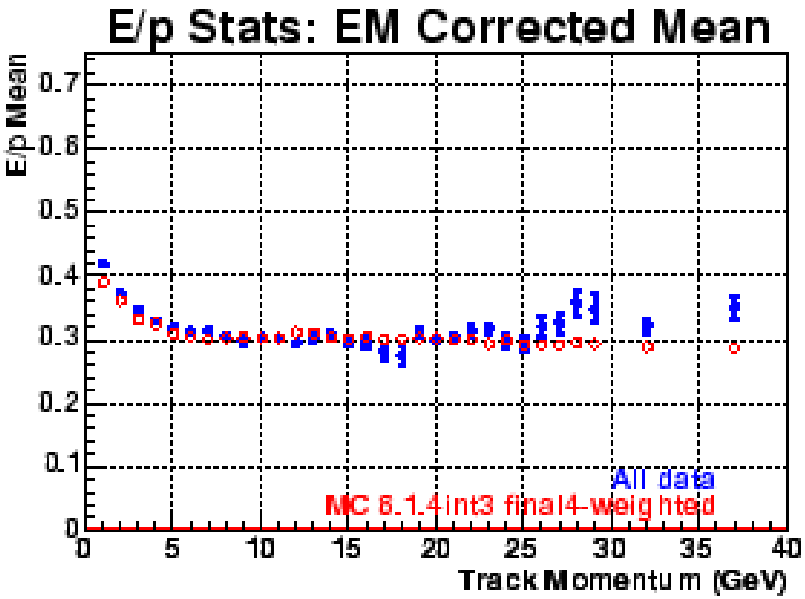
Conclusions

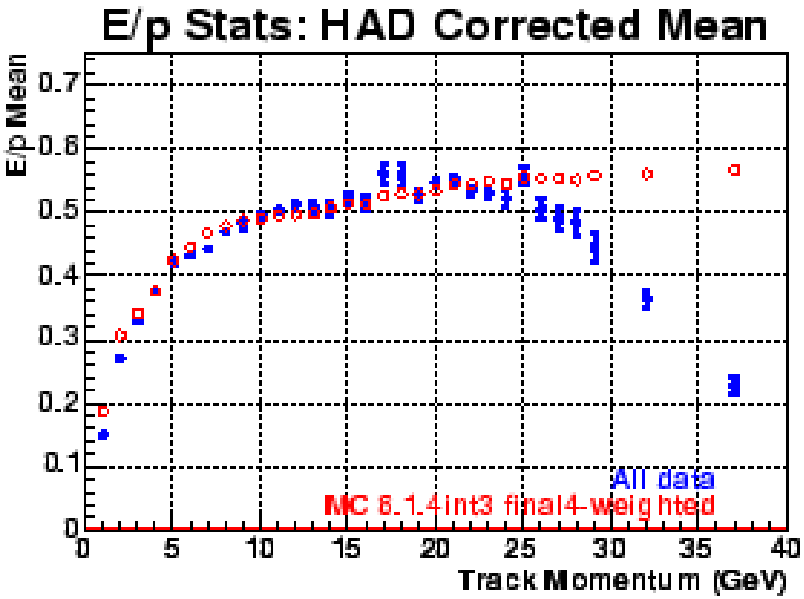
- This f4 tune shows good agreement between the data and the MC.
- Discrepancies are now at the 1%-2% level.
  - We believe that a 1% difference is the best we can accomplish using the analysis presented here.
- Make sure that this Gflash parameterization also agrees with the 57 GeV test beam data.

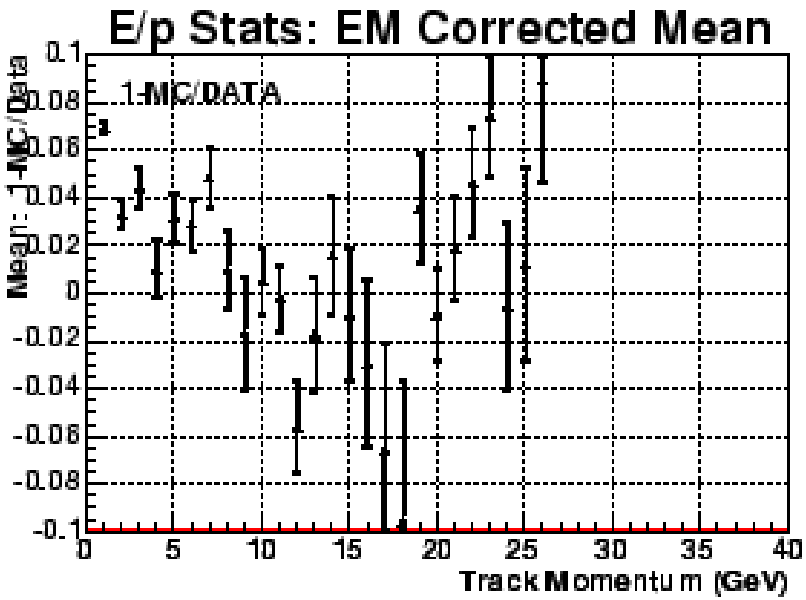
Backup Slides

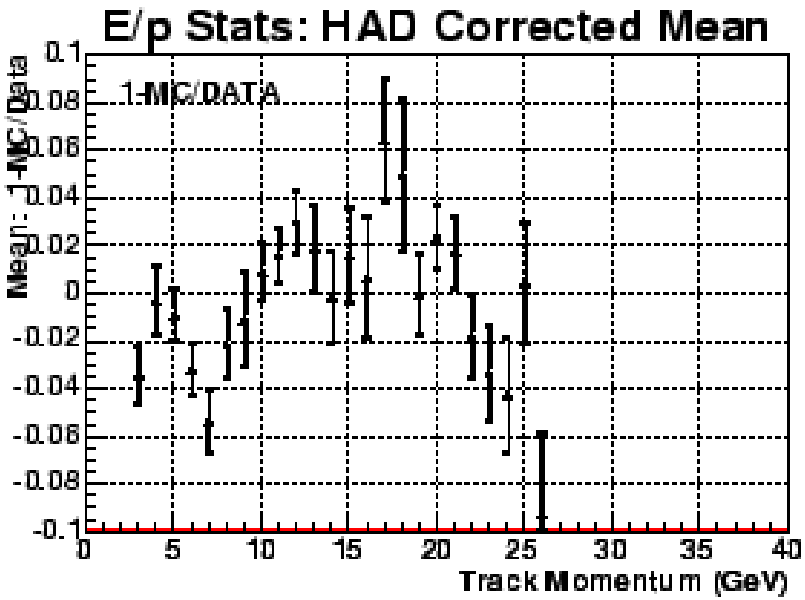
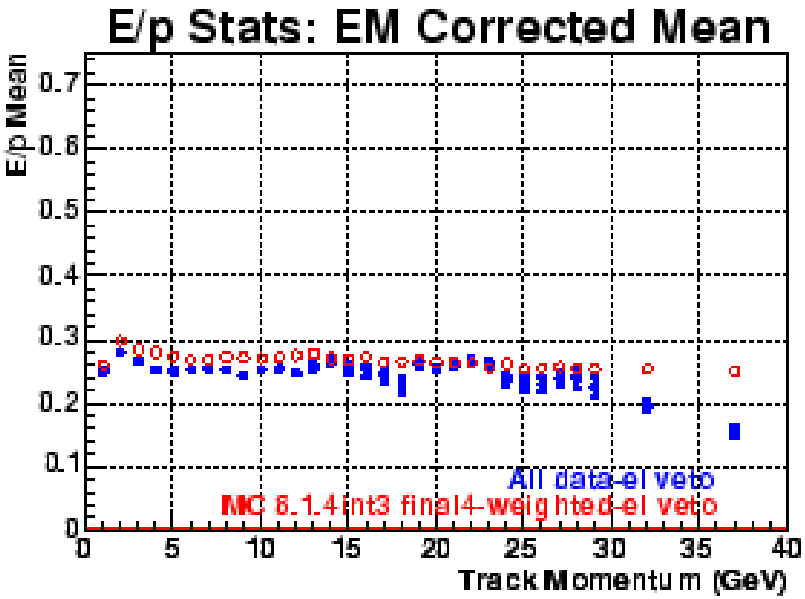
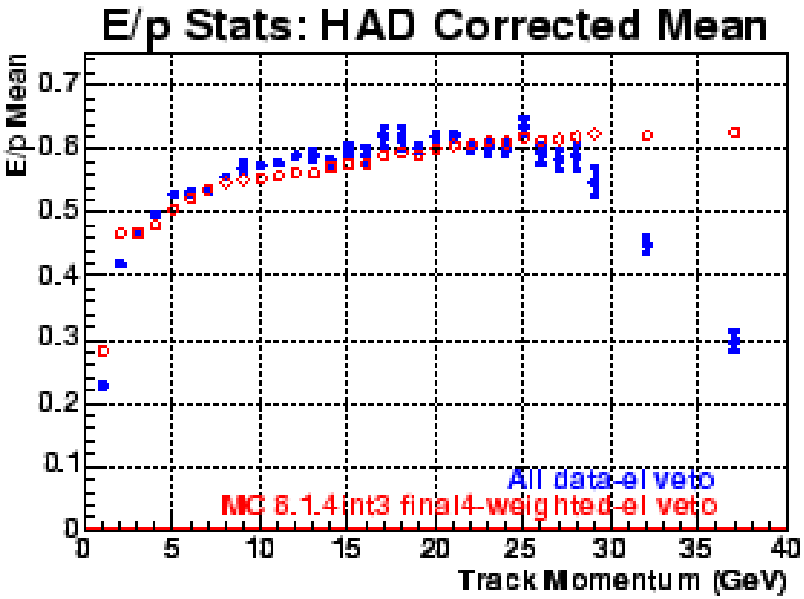
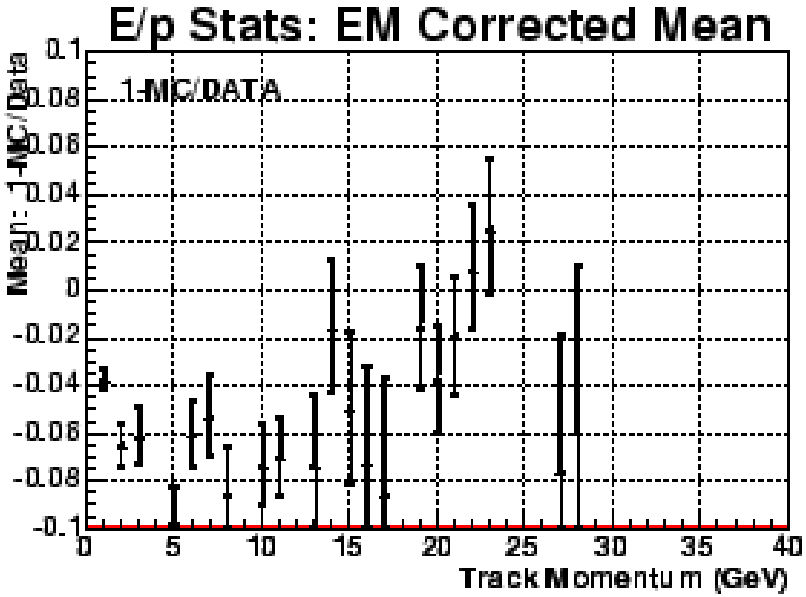
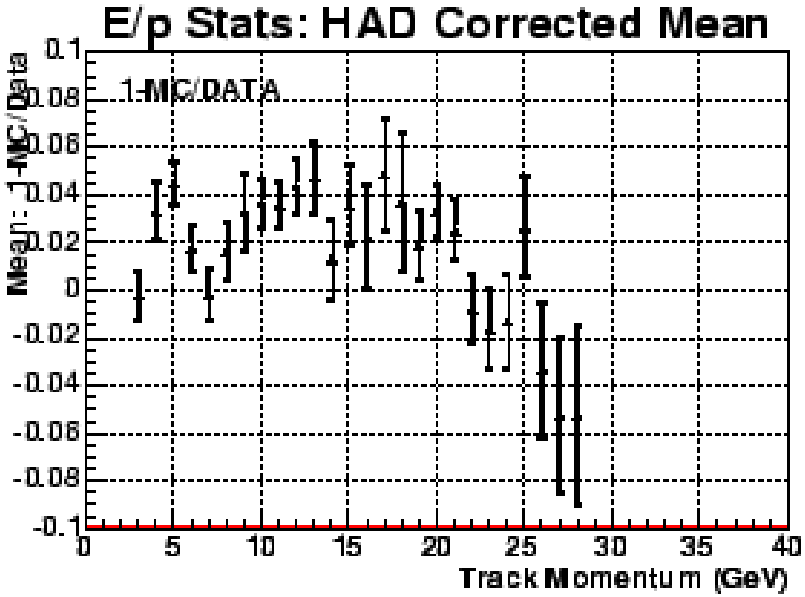
- Backup slides have the EM and HAD response vs. p for the (last) two data vs. MC comparisons in the previous slides.
- Reminder: All EM and HAD E/p data are simple means of the E/p response histogram, not converging Gaussian fits.

All data vs. MC both without electron veto









All data vs. MC both with an electron veto