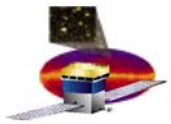


Efficiency and Bias Study

Look at trigger and recon efficiencies as a function of angle and energy.

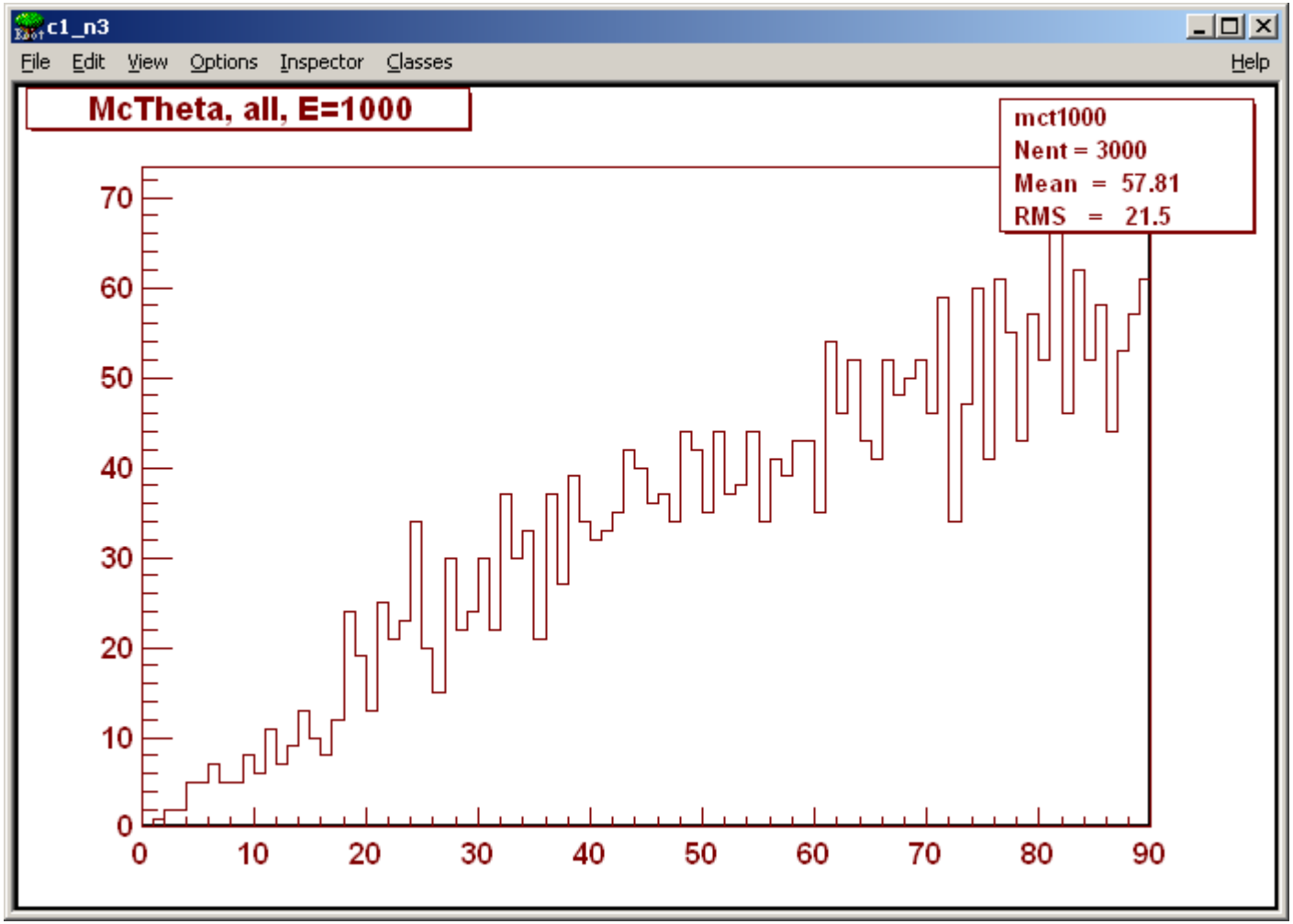
Study angle bias in the reconstruction.

Sample: Generated over a 18x18 cm^2 patch, angles from 0° to 90°, at energies between 20 MeV and 2 GeV.

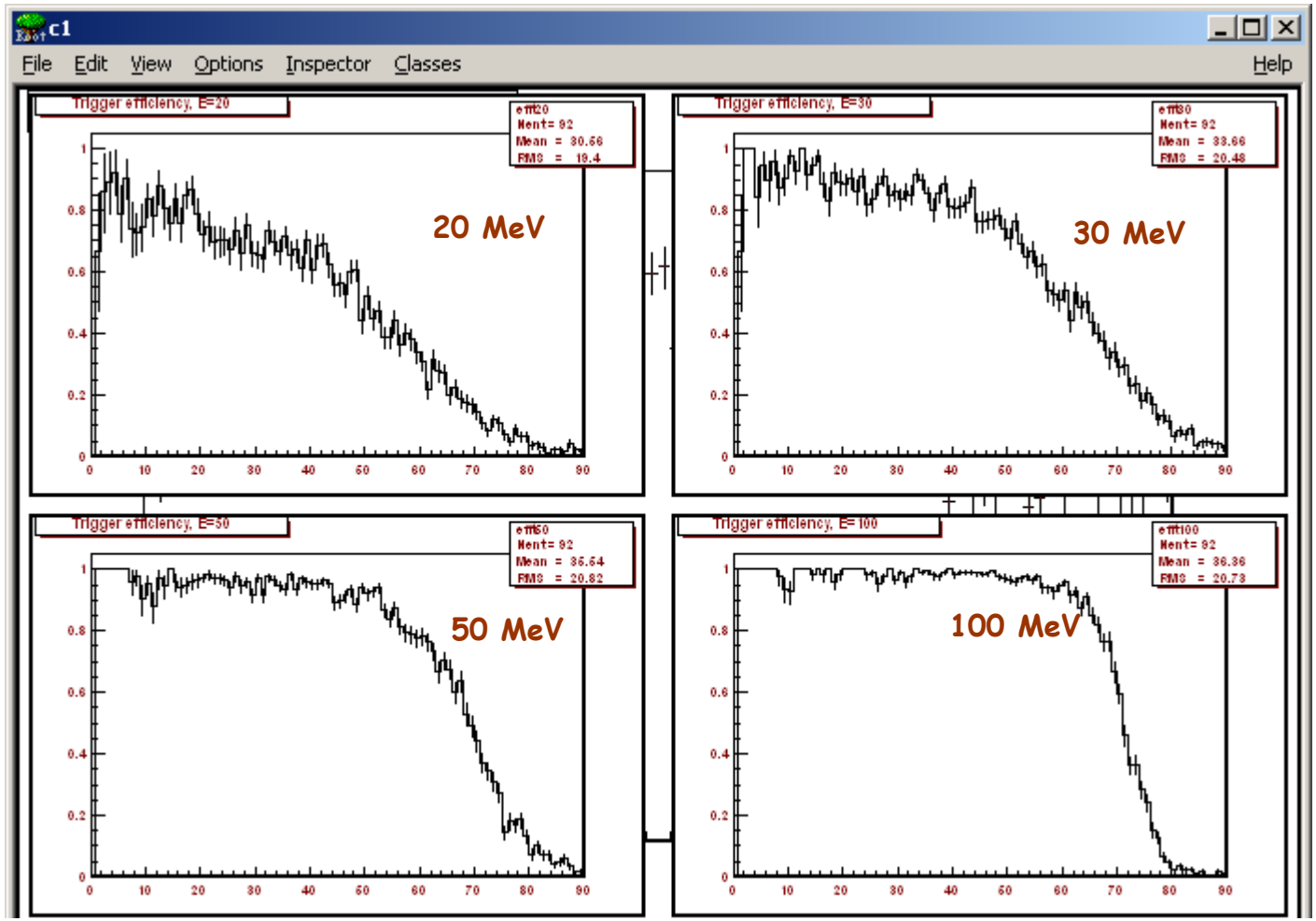
- Charged particles: electrons at lower energies, muons at higher energies
- Gammas

Plus… an excursion into energy measurement…

Distribution of MC particles

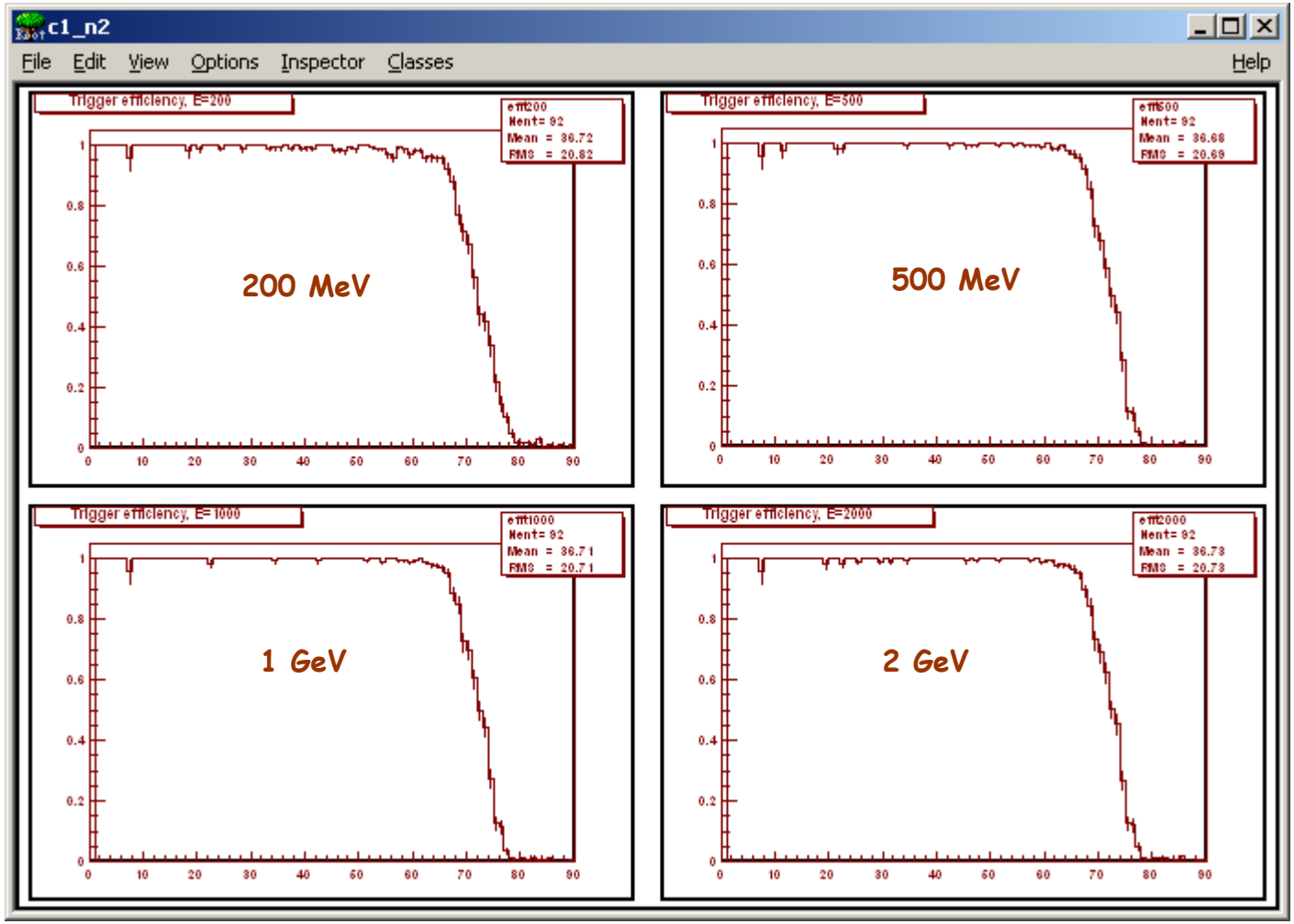


Trigger Efficiency, Charged Particles

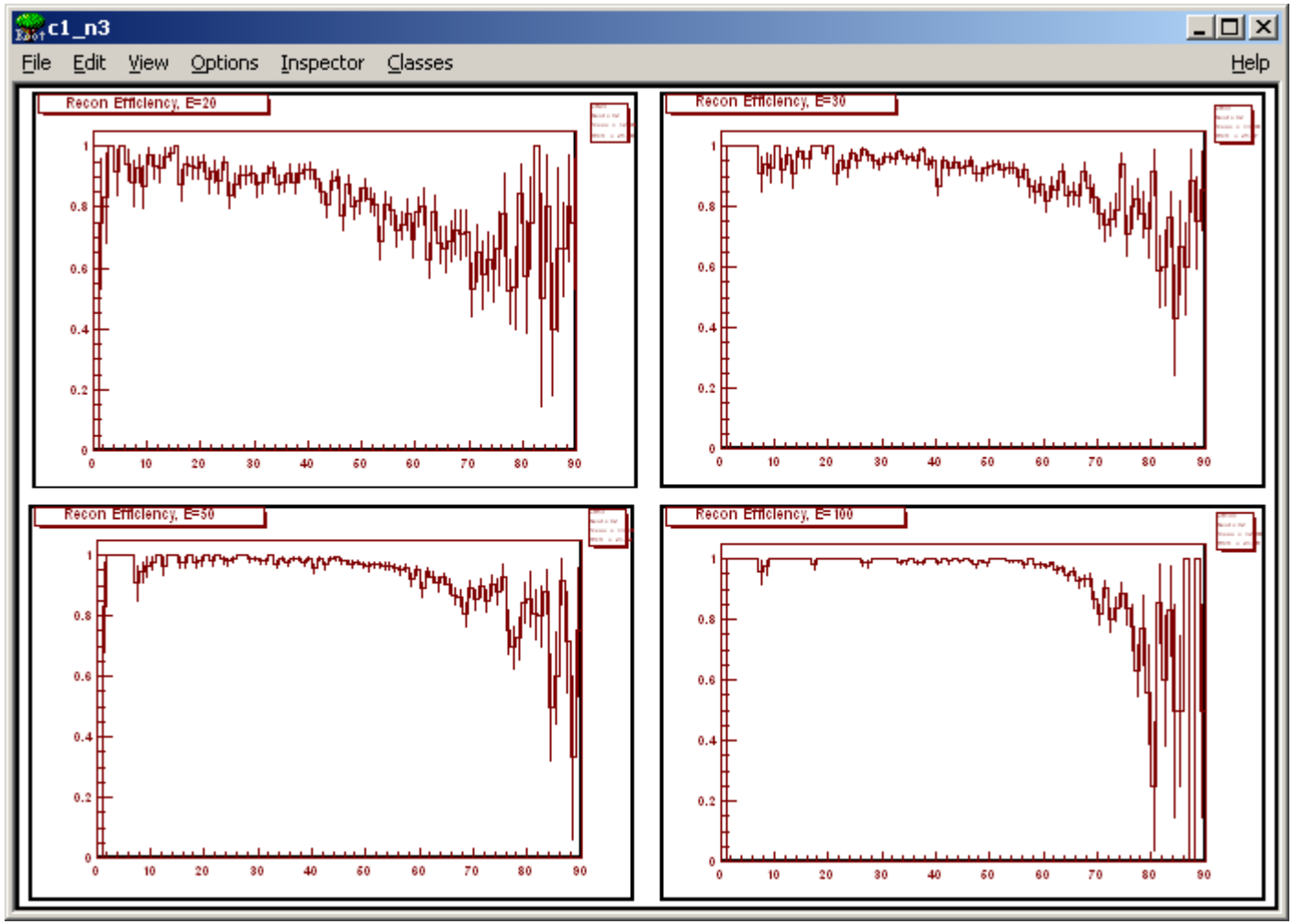


3-in-a-row trigger

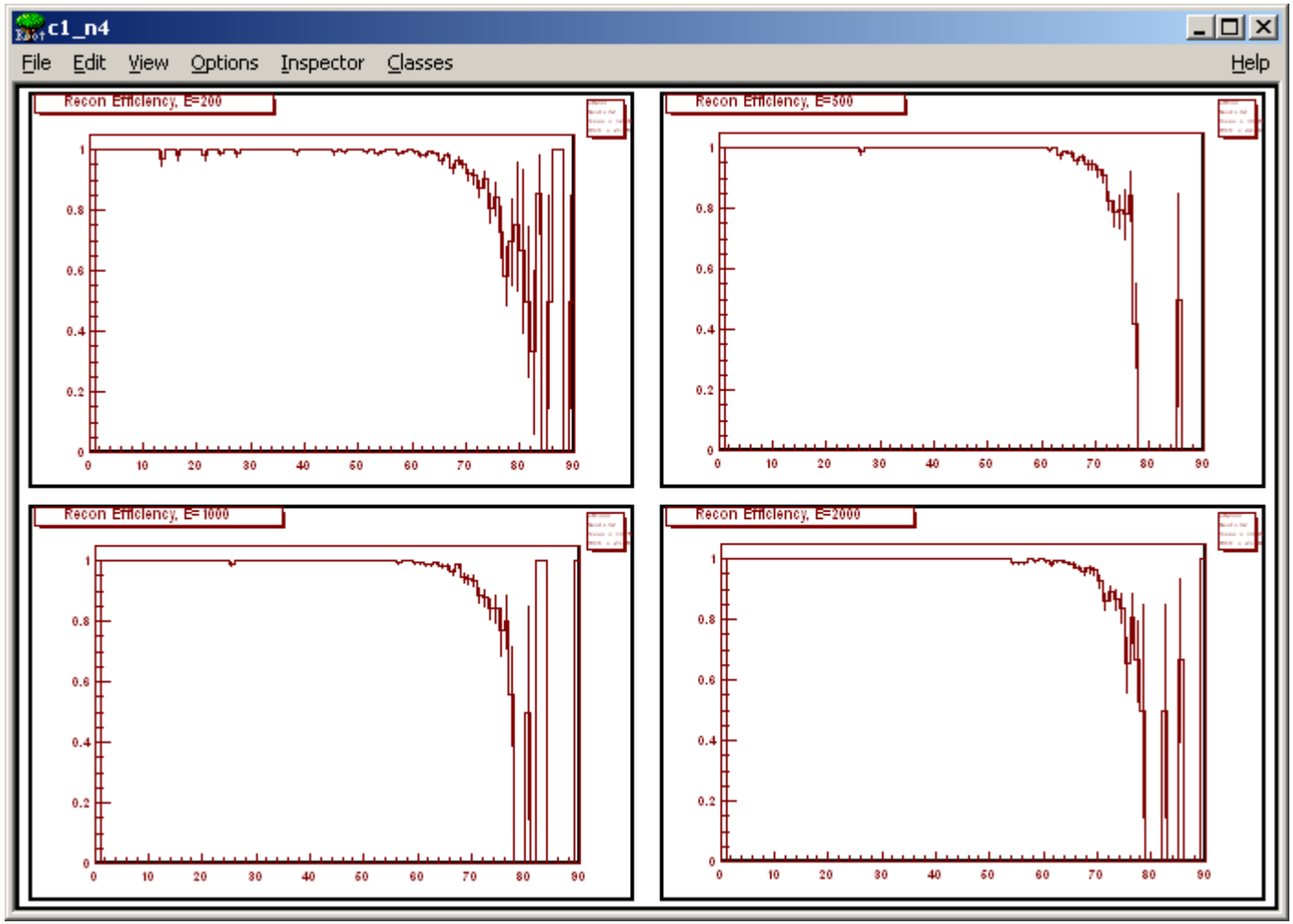
Trigger Efficiency, Continued



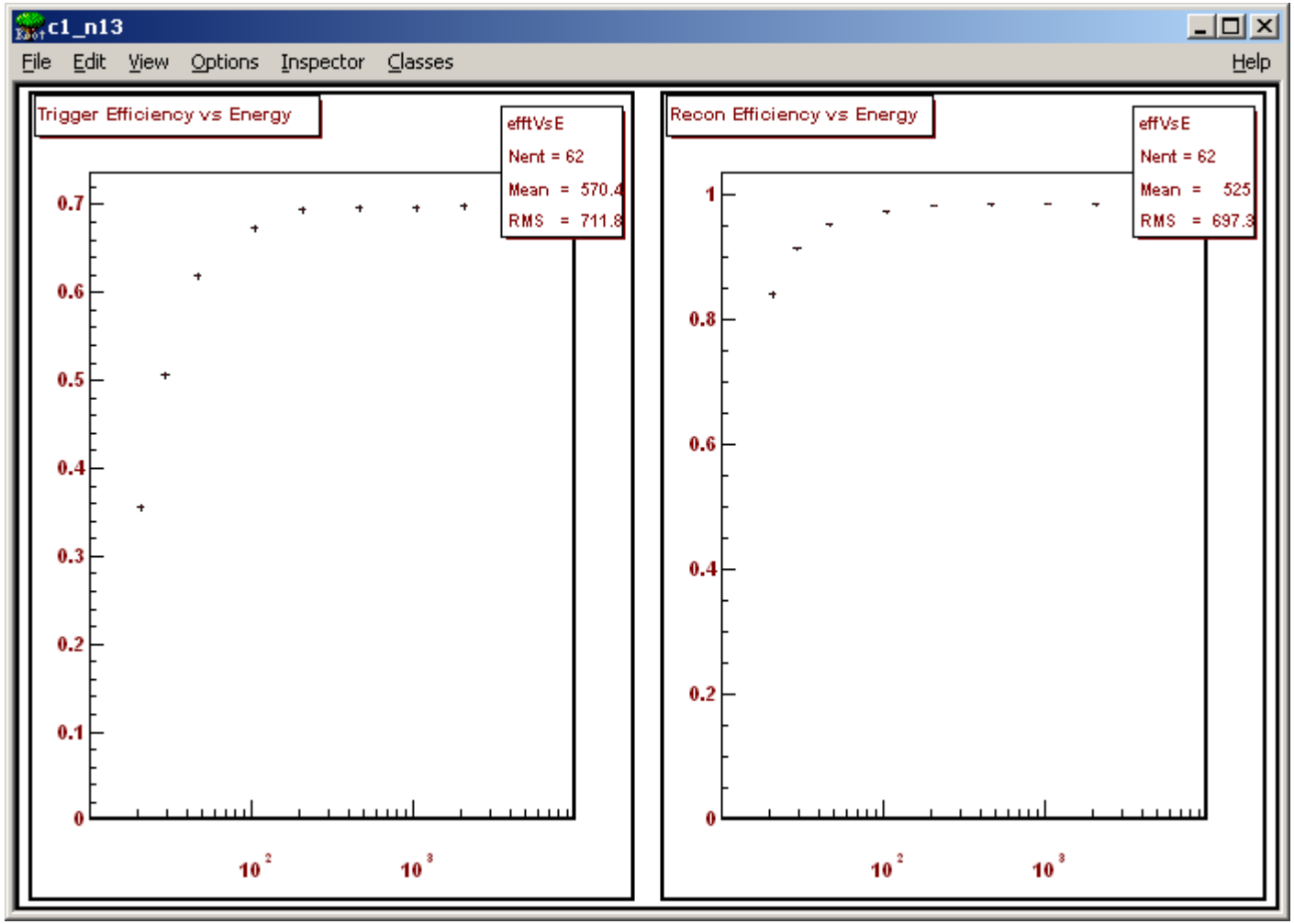
Recon Efficiency, Charged Particles



Recon Efficiency, Continued



Summary of Trigger and Recon Efficiencies



Angle Bias in the Events

Two possible sources of bias:

Reconstruction: Difference between:

- Angle as seen in detector (taken to be defined by first two hits in each plane)
- Angle as reconstructed

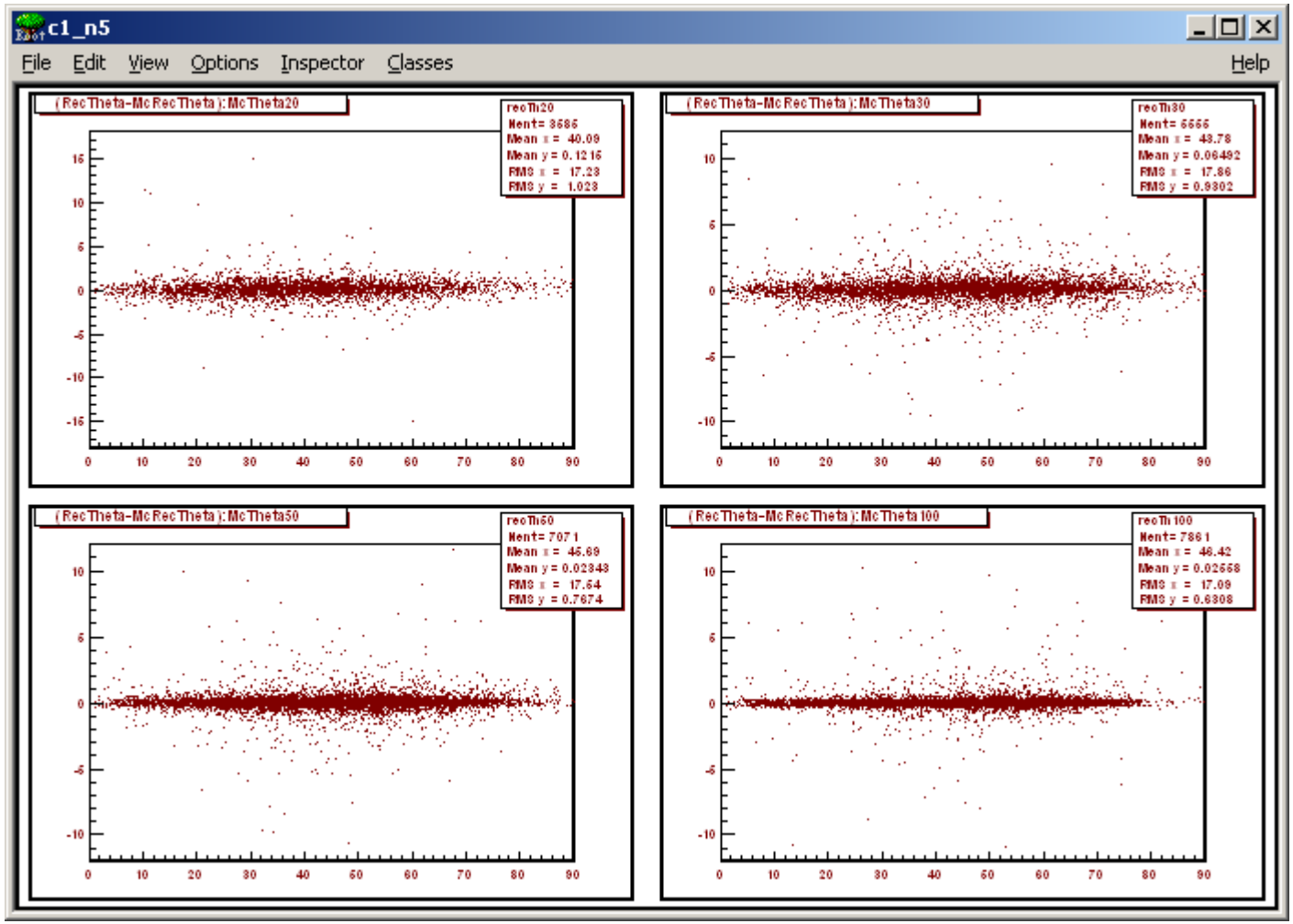
This could be due to asymmetries coming from the algorithm, notably: the multiple scattering is symmetric in θ, but the filter uses the slope, or tan(θ).

Trigger: Difference between:

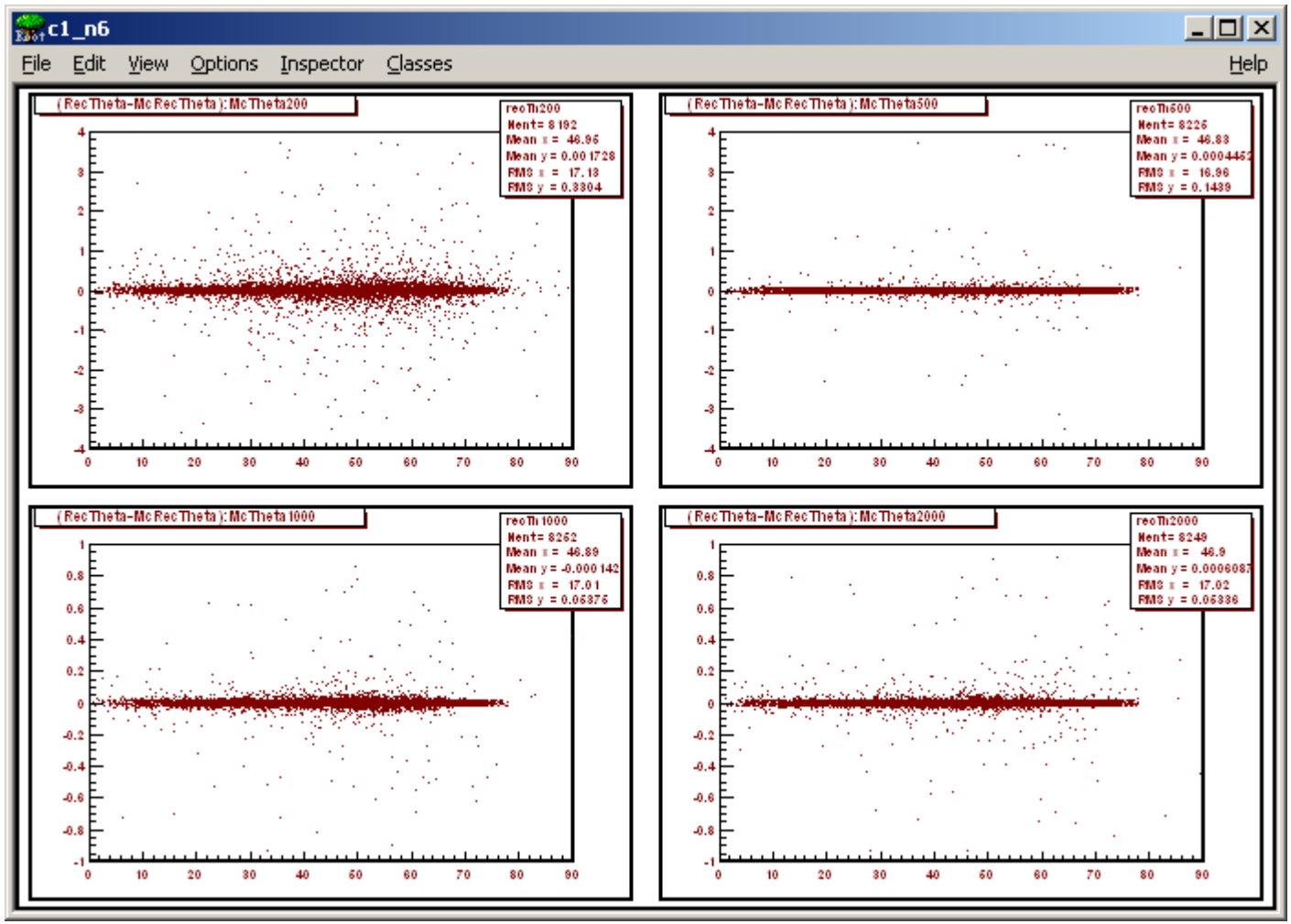
- Angle as generated
- Angle as seen in detector

This could come from asymmetries in the trigger efficiency, coupled to the multiple scattering.

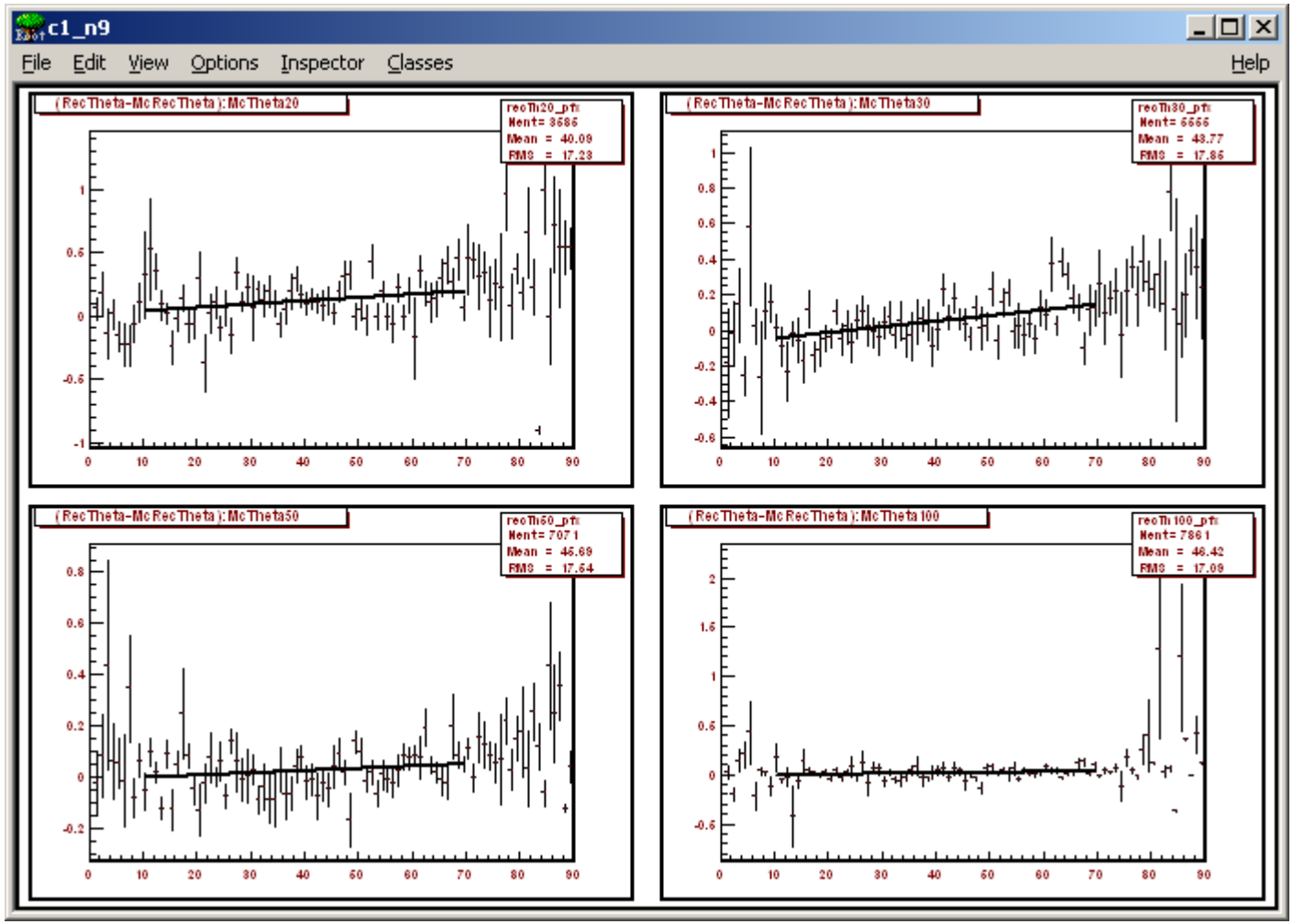
Reconstruction Bias: (delta θ vs θ)



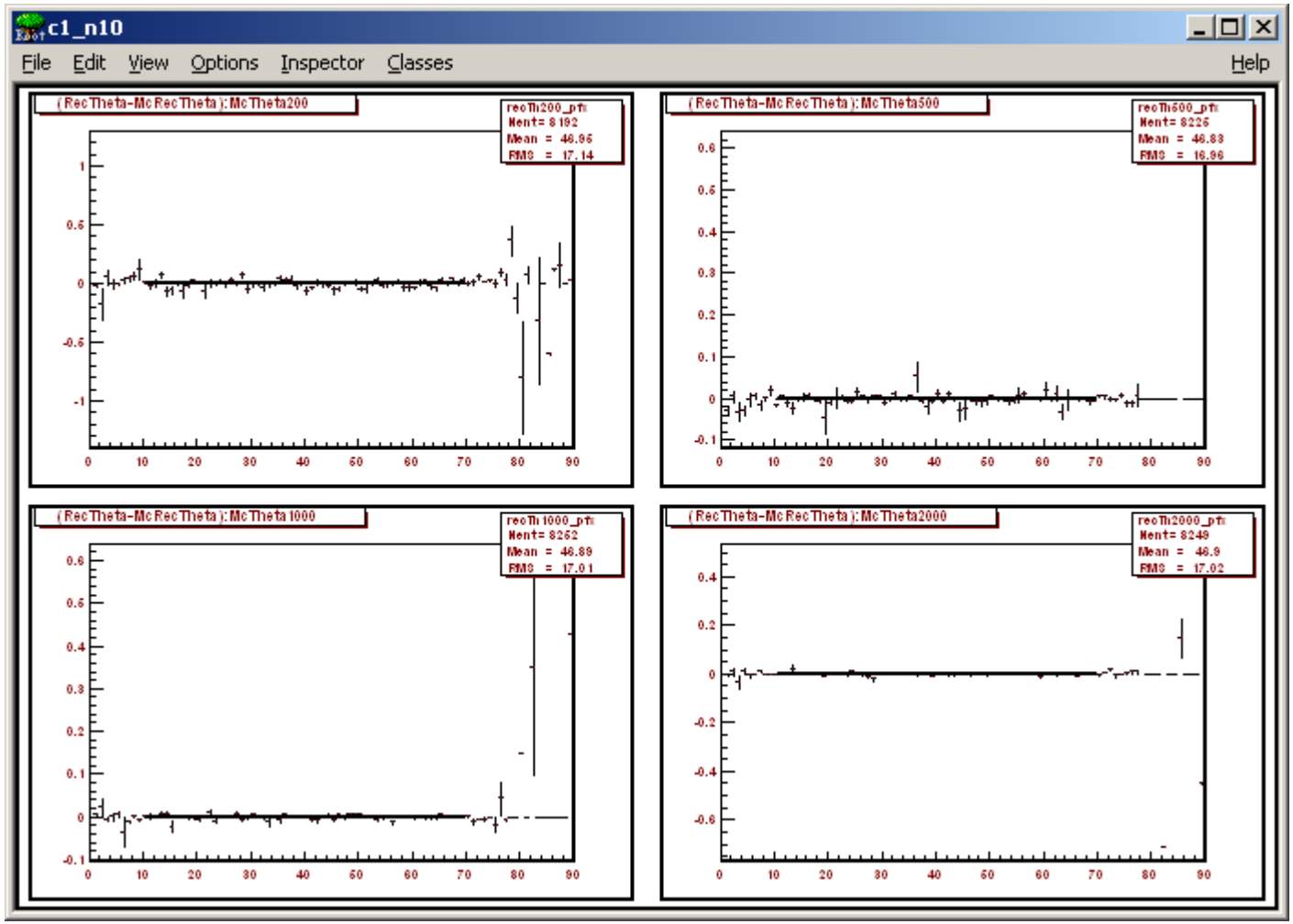
Reconstruction Bias, Continued



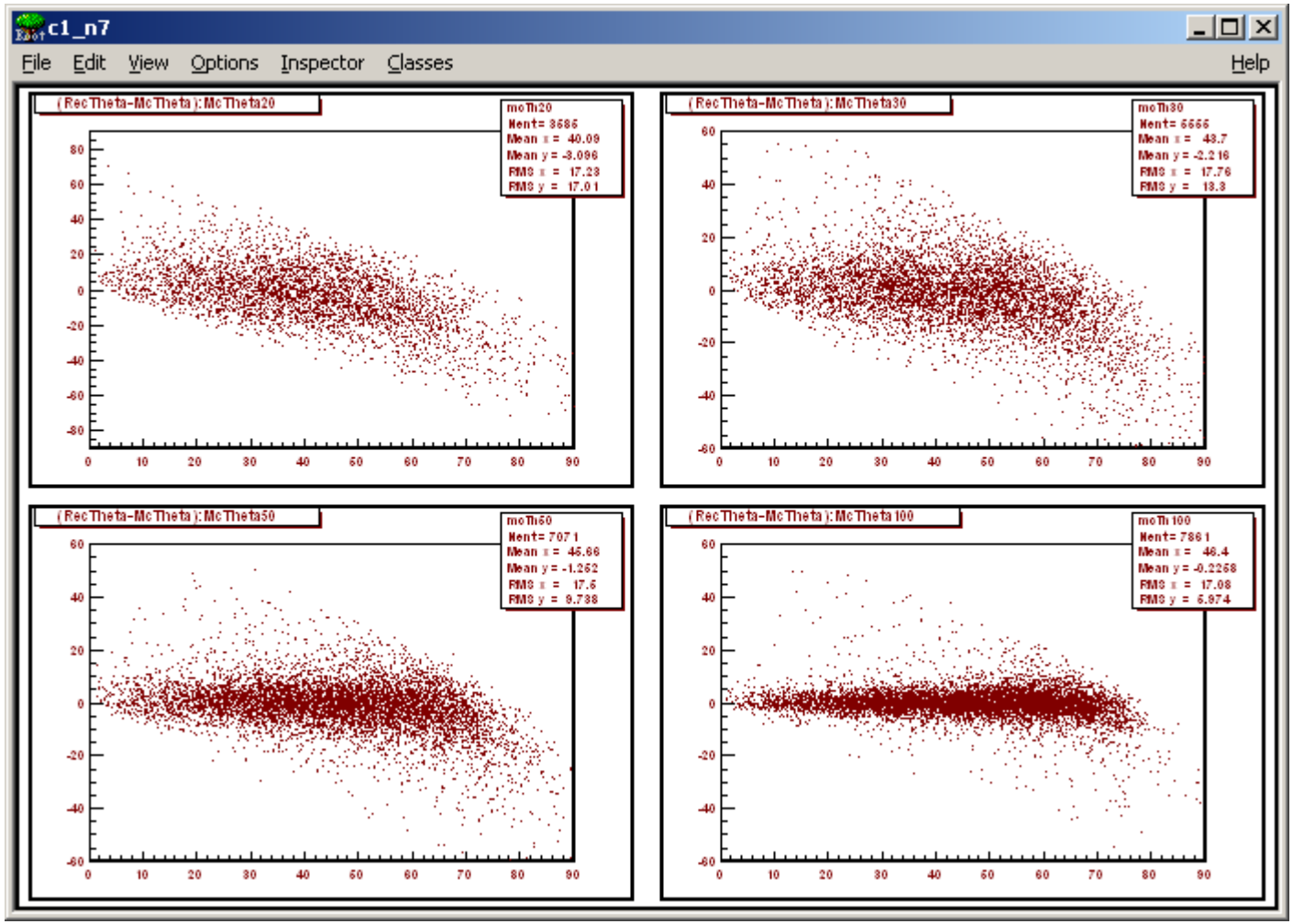
Profiles


c1_n9
File Edit View Options Inspector Classes Help
(RecTheta-McRecTheta):McTheta20
recTh20_pfx
Mean = 40.09
RMS = 17.23
(RecTheta-McRecTheta):McTheta30
recTh30_pfx
Mean = 43.77
RMS = 17.86
(RecTheta-McRecTheta):McTheta50
recTh50_pfx
Mean = 45.69
RMS = 17.54
(RecTheta-McRecTheta):McTheta100
recTh100_pfx
Mean = 46.42
RMS = 17.09

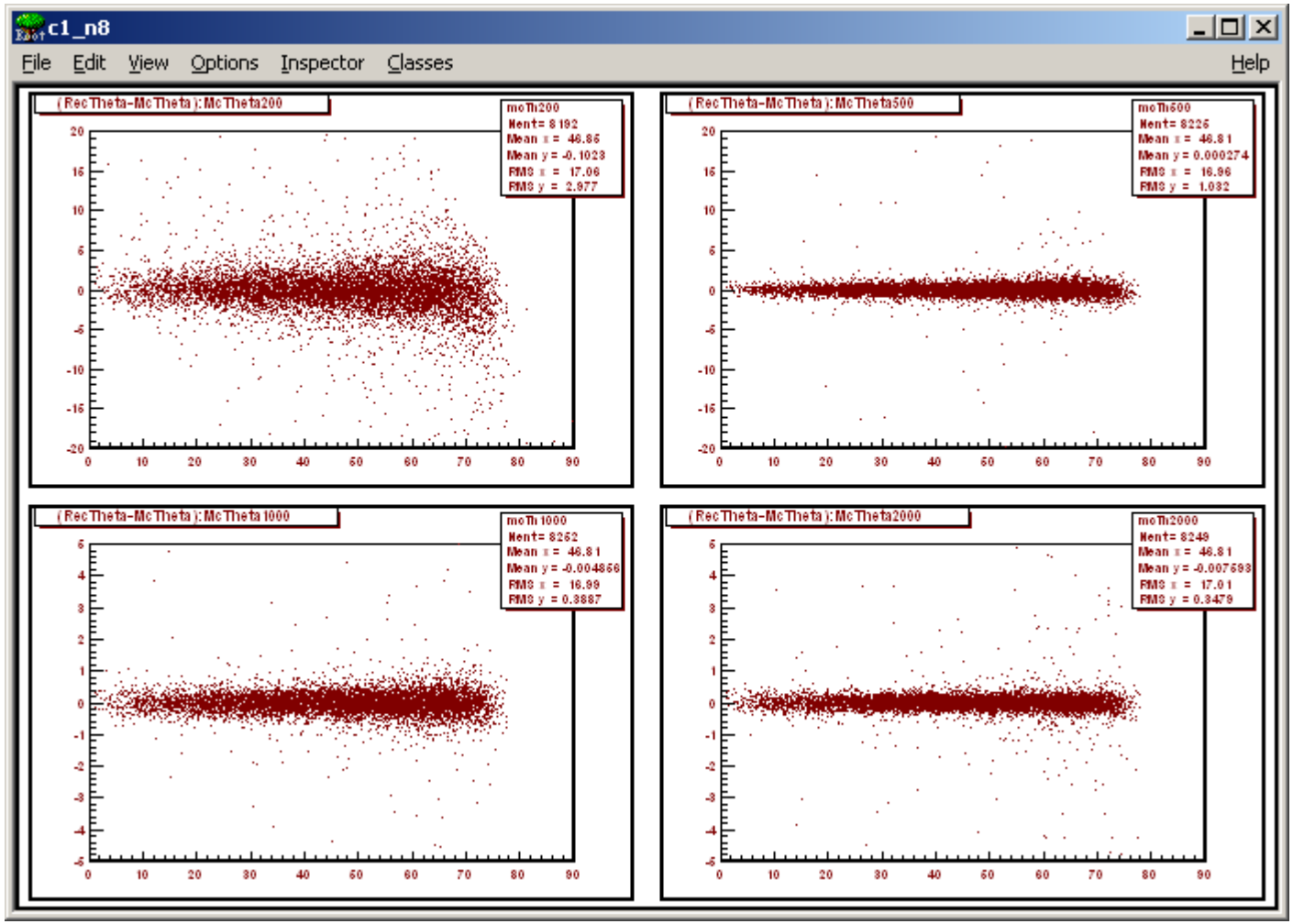
Profiles, continued



Trigger Bias : (delta θ vs θ)

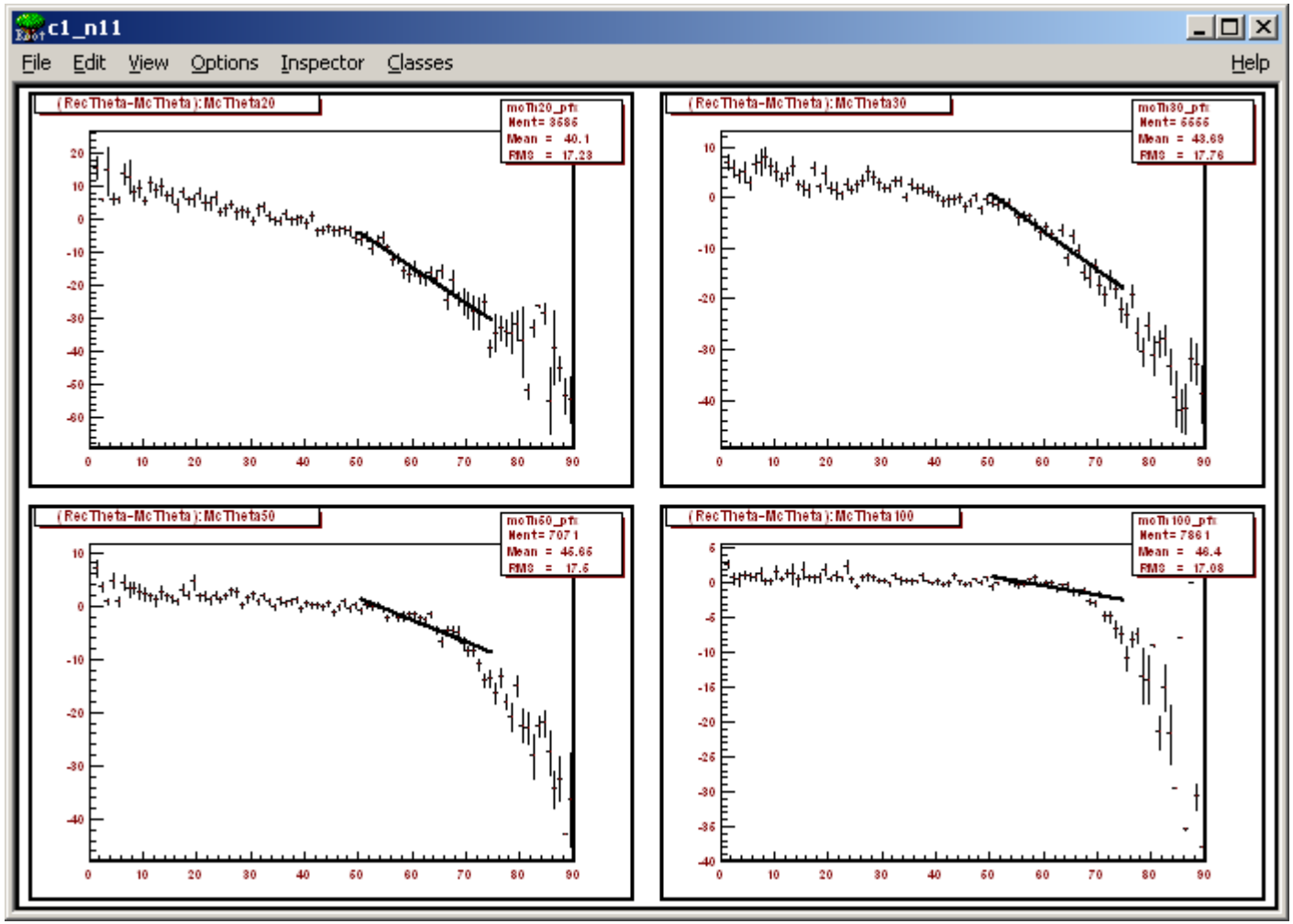


Trigger Bias, Continued



Profiles

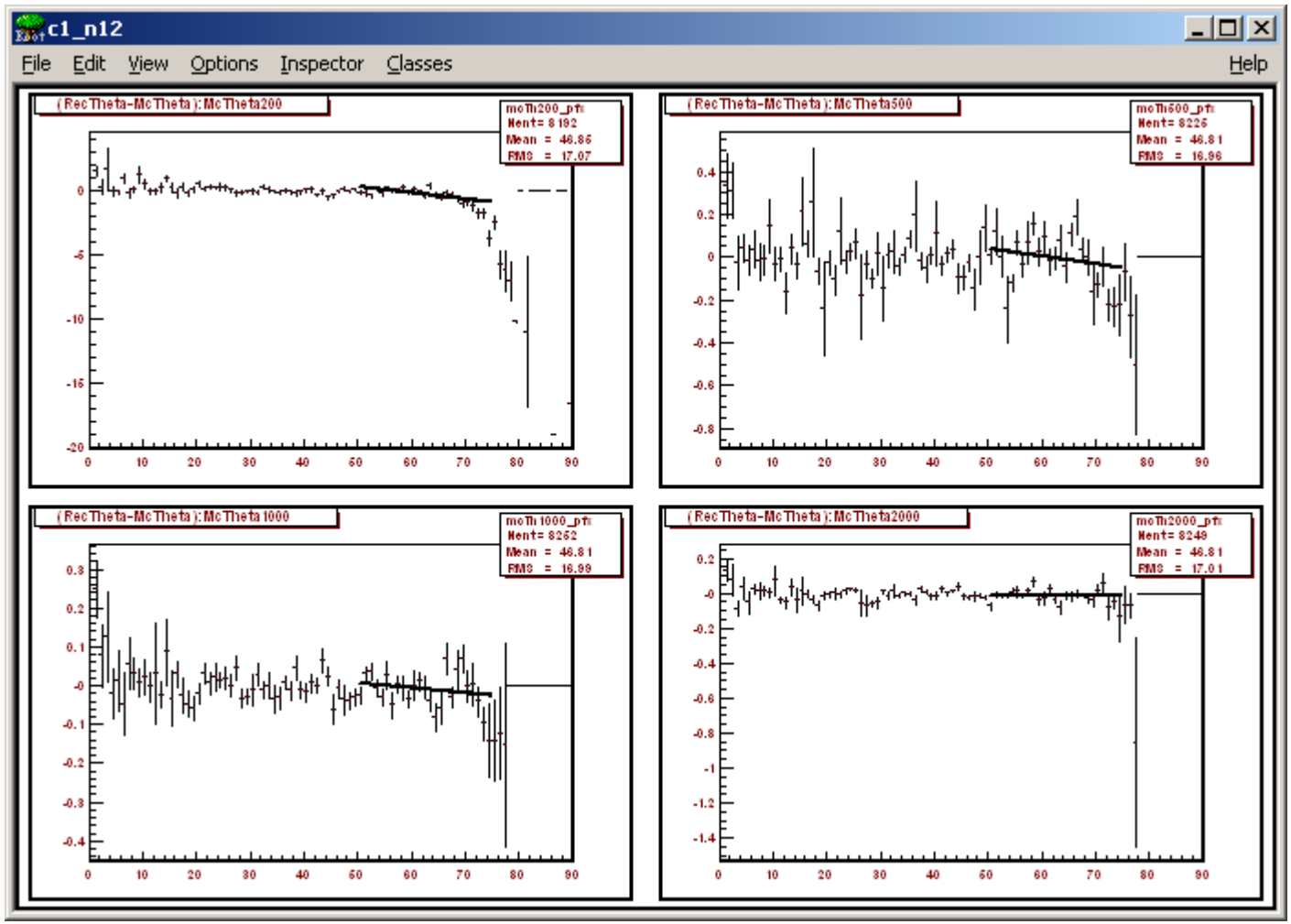
Note scale!



"Fits" are not significant, just to guide the eye…

(Effect at low angle due to choice of coordinates)

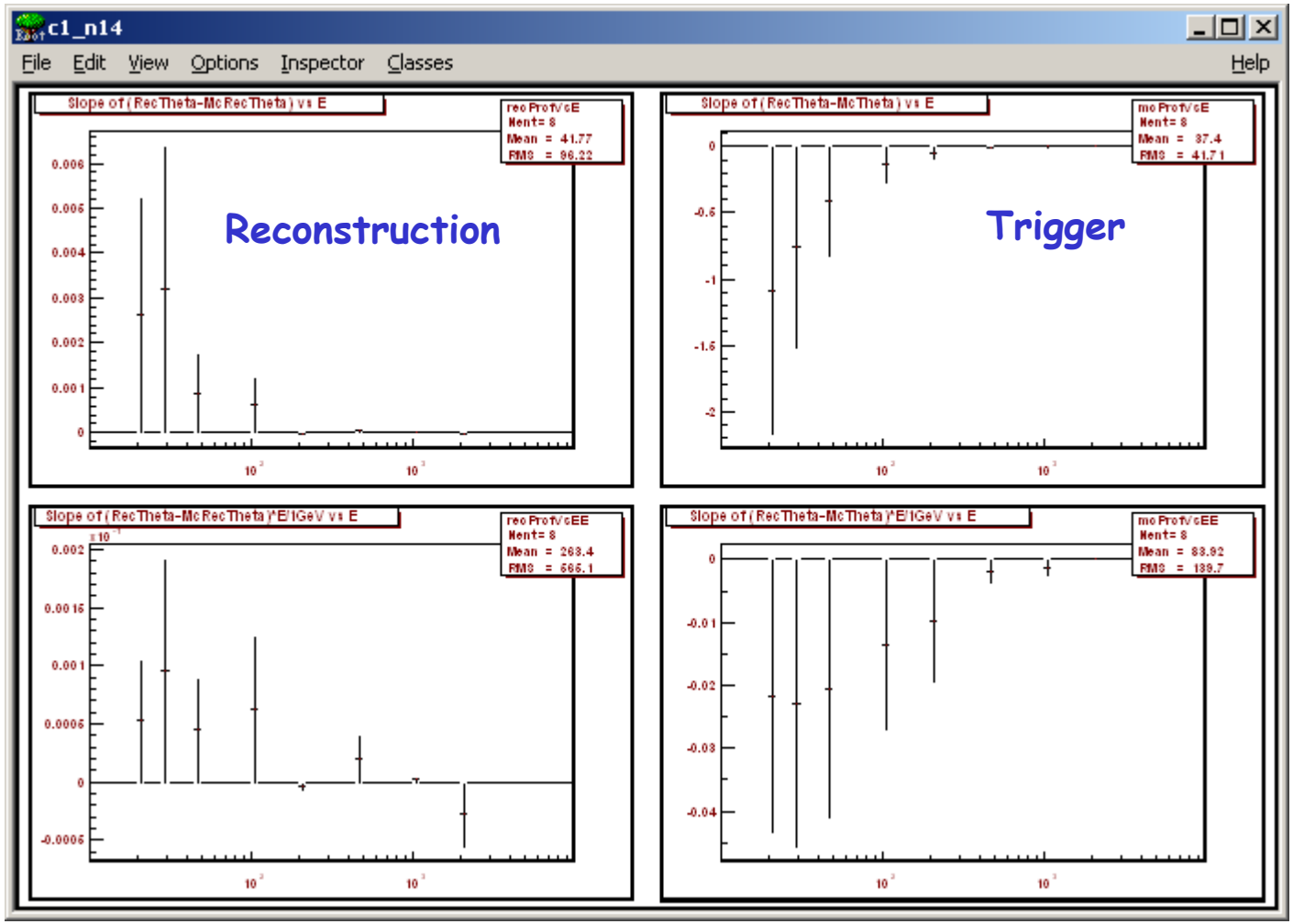
Profiles, Continued



Summary of Slopes (delta θ per incident θ)

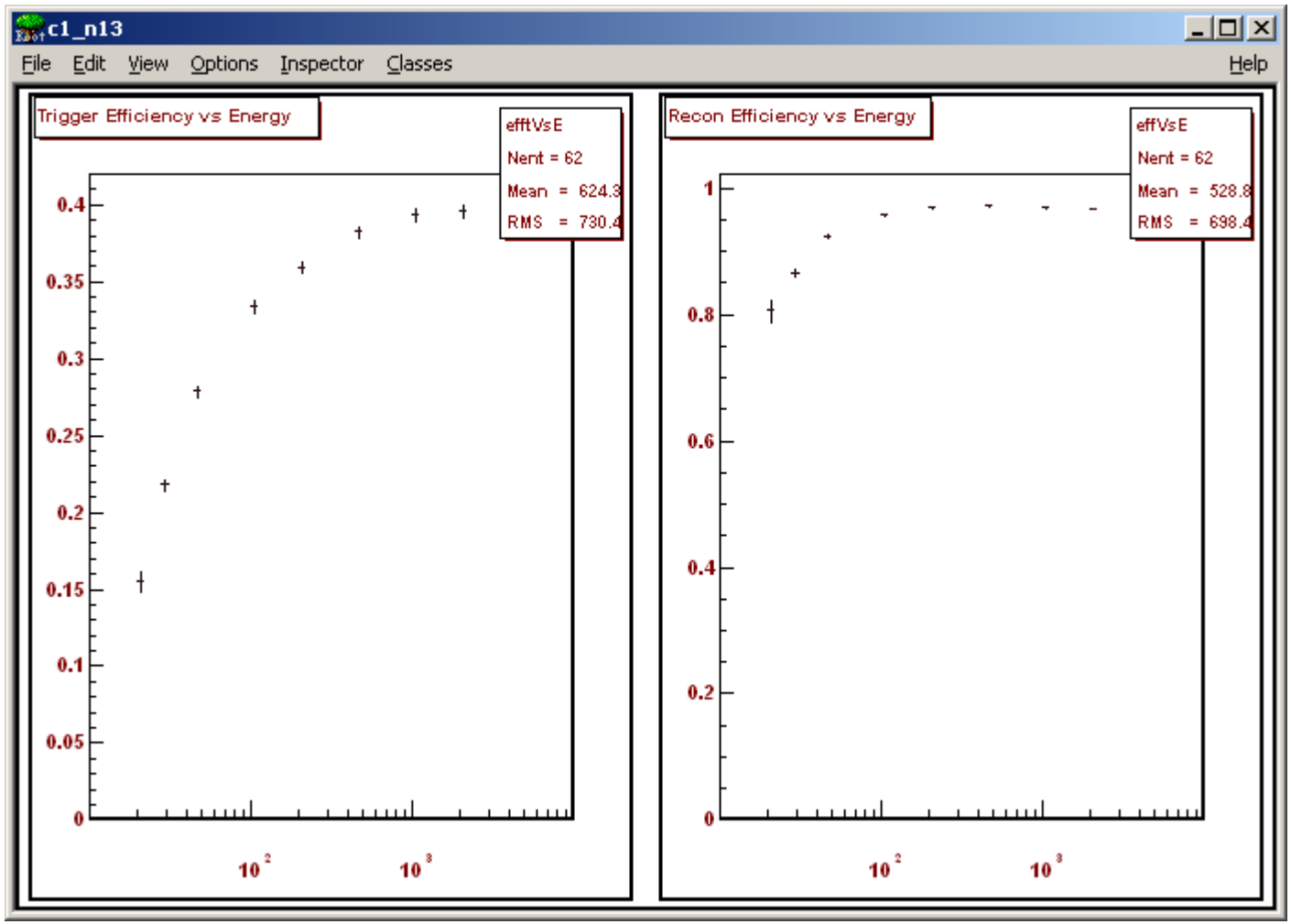
Slope

Slope*E



Same for Gammas: Efficiencies

Includes single track events



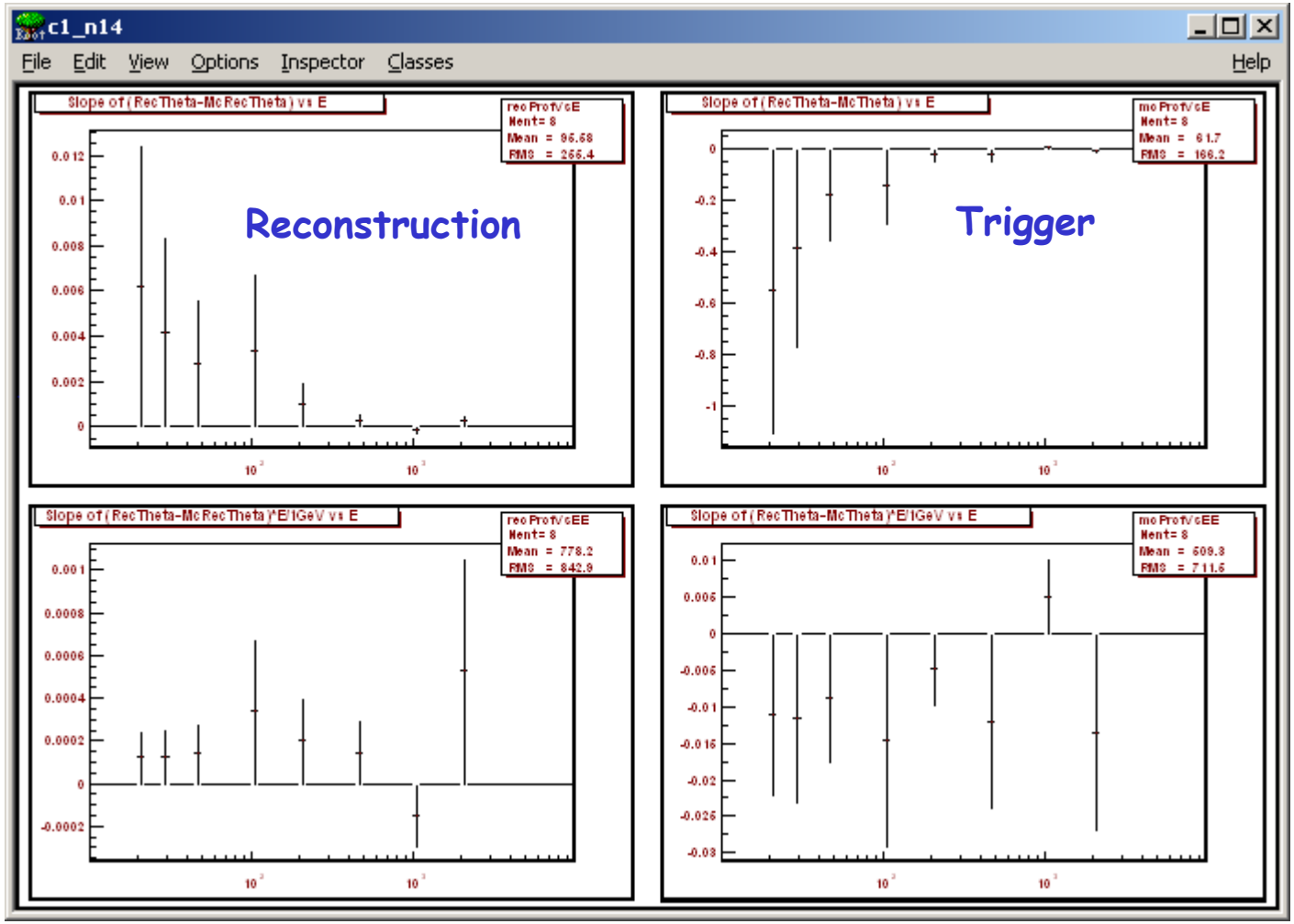
Gamma/charged trigger = 0.57; naïve expectation: 1-exp(-7/9*1.32) = 0.64

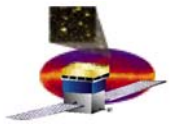
Gammas: Angle Bias

Kludge: used "best track" to determine recon angle

Slope

Slope*E

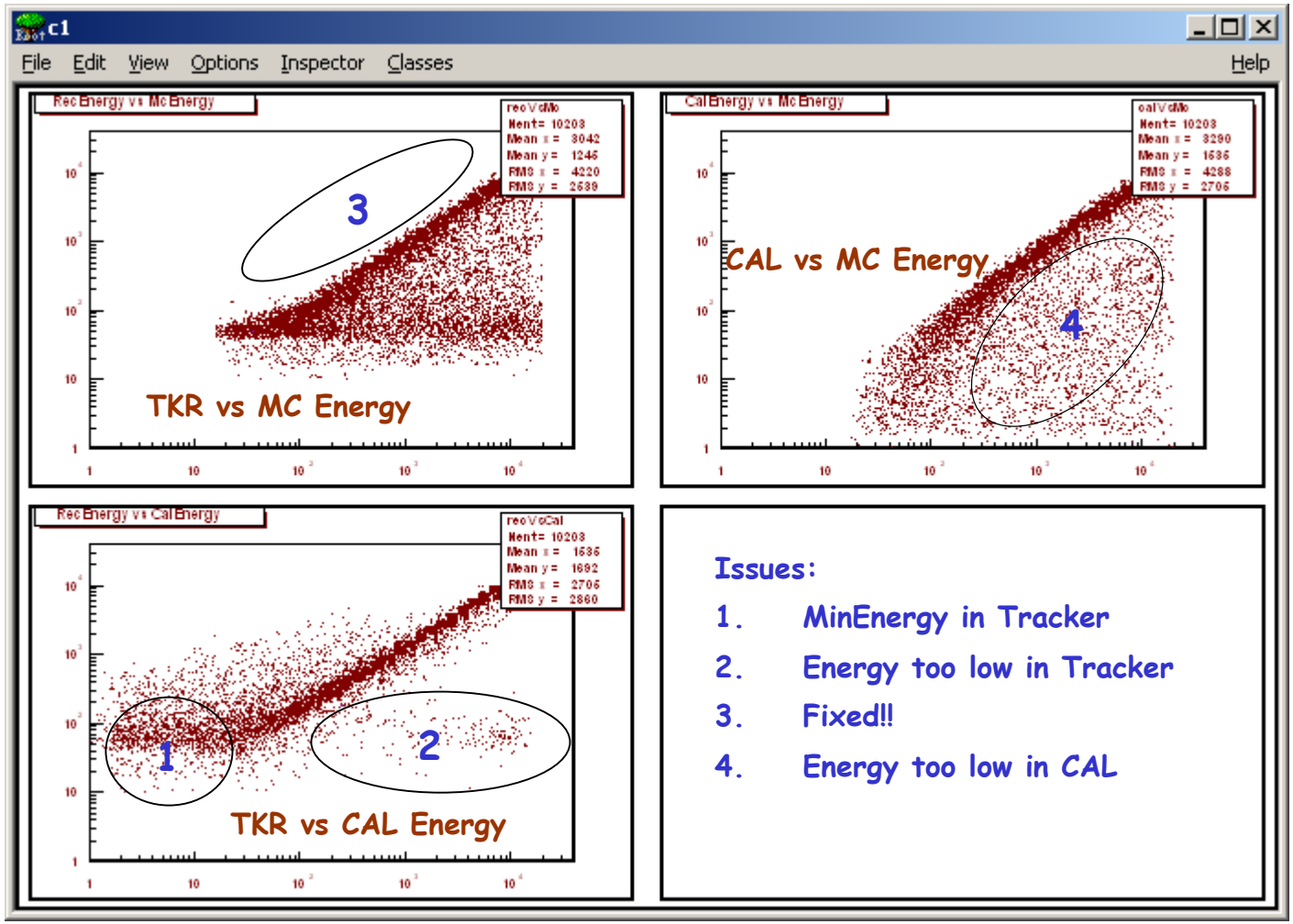




Conclusions, So Far

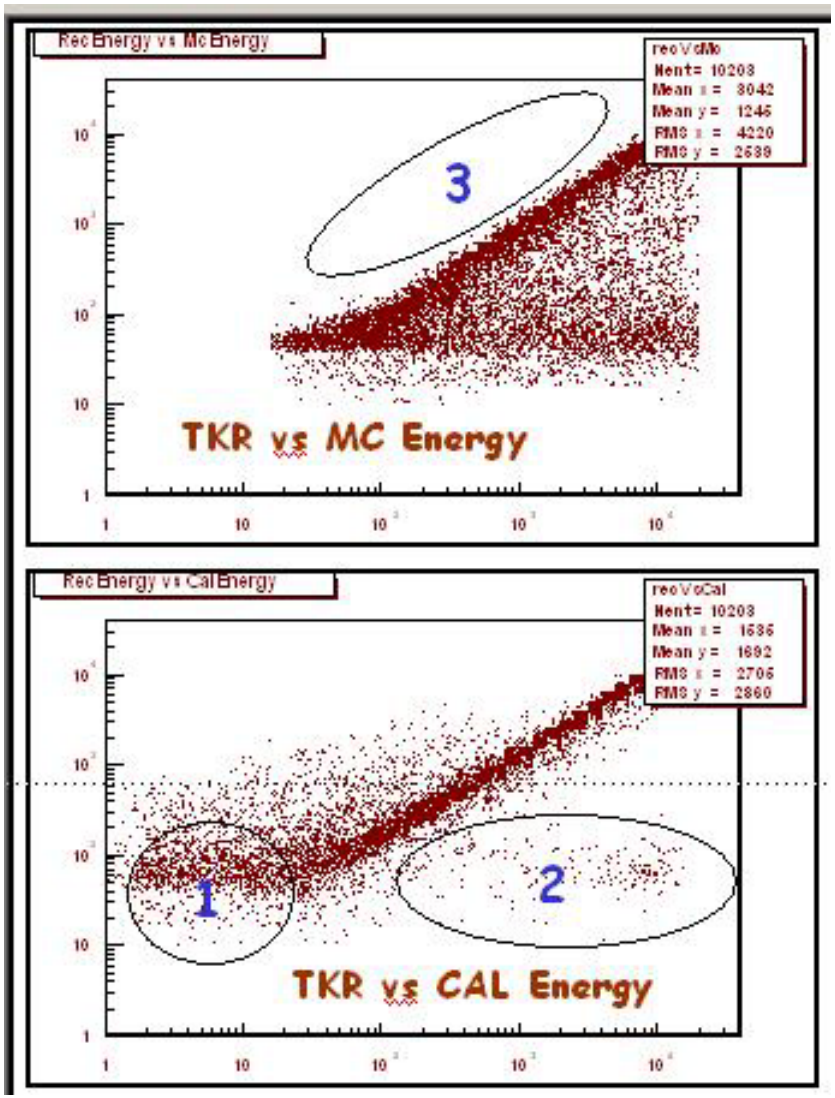
- The reconstruction of triggered tracks is faithful to the apparent angle, except for a very small positive bias, which decreases with energy and increases with incident angle.
- Tracks which scatter to smaller incident angles tend to trigger more efficiently. This introduces a substantial bias in the found angle for tracks incident at high angles and low energies
- The strategy for correcting this bias depends on knowing the energy of the track. The next slides will explore this.

Energy Measurement



~10000 all_gamma events which trigger and reconstruct at least one track

TkrRecon Energy



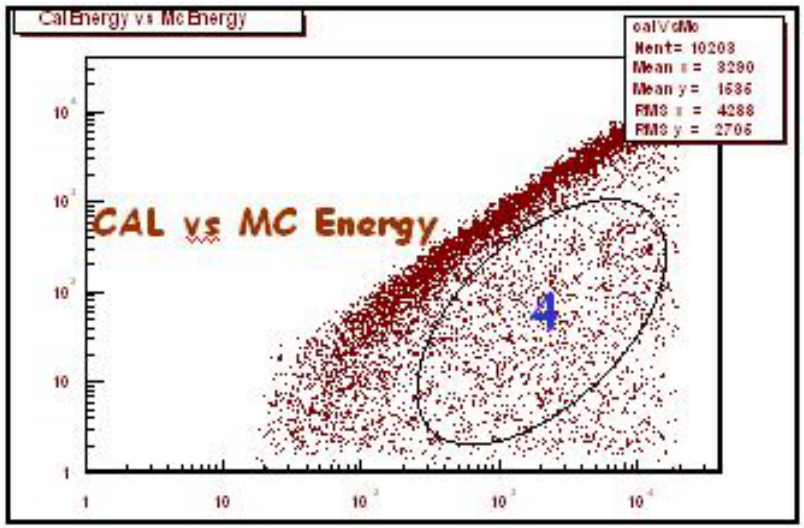
(1) Due to the minimum energy assigned to a TKR track. Class should probably be modified to store two energies: one for purposes of Kalman, which could have a minimum, and a second, which is the "real" energy. As it stands, the Tkr Energy is too high below a real energy of ~100 MeV.

(2) Gamma gets minimum energy, even though there is plenty of CAL energy around. ???

(3) I had a clever explanation for this, but it was just a bug, fixed by Bill.

Energy Measurement in the Calorimeter

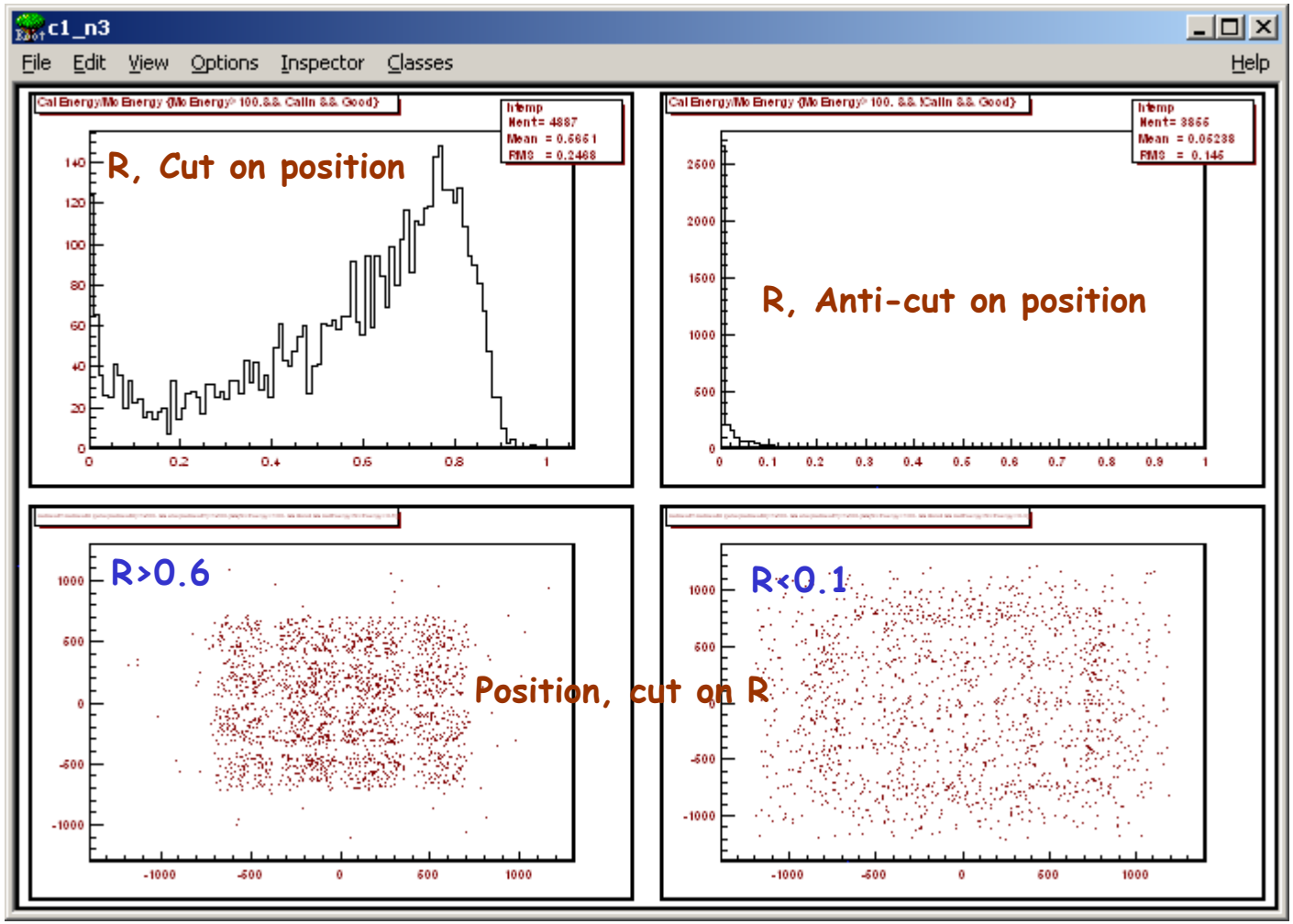
Cal Energy vs. Mc Energy



I'm going to ignore McEnergy below 100 MeV in what follows…

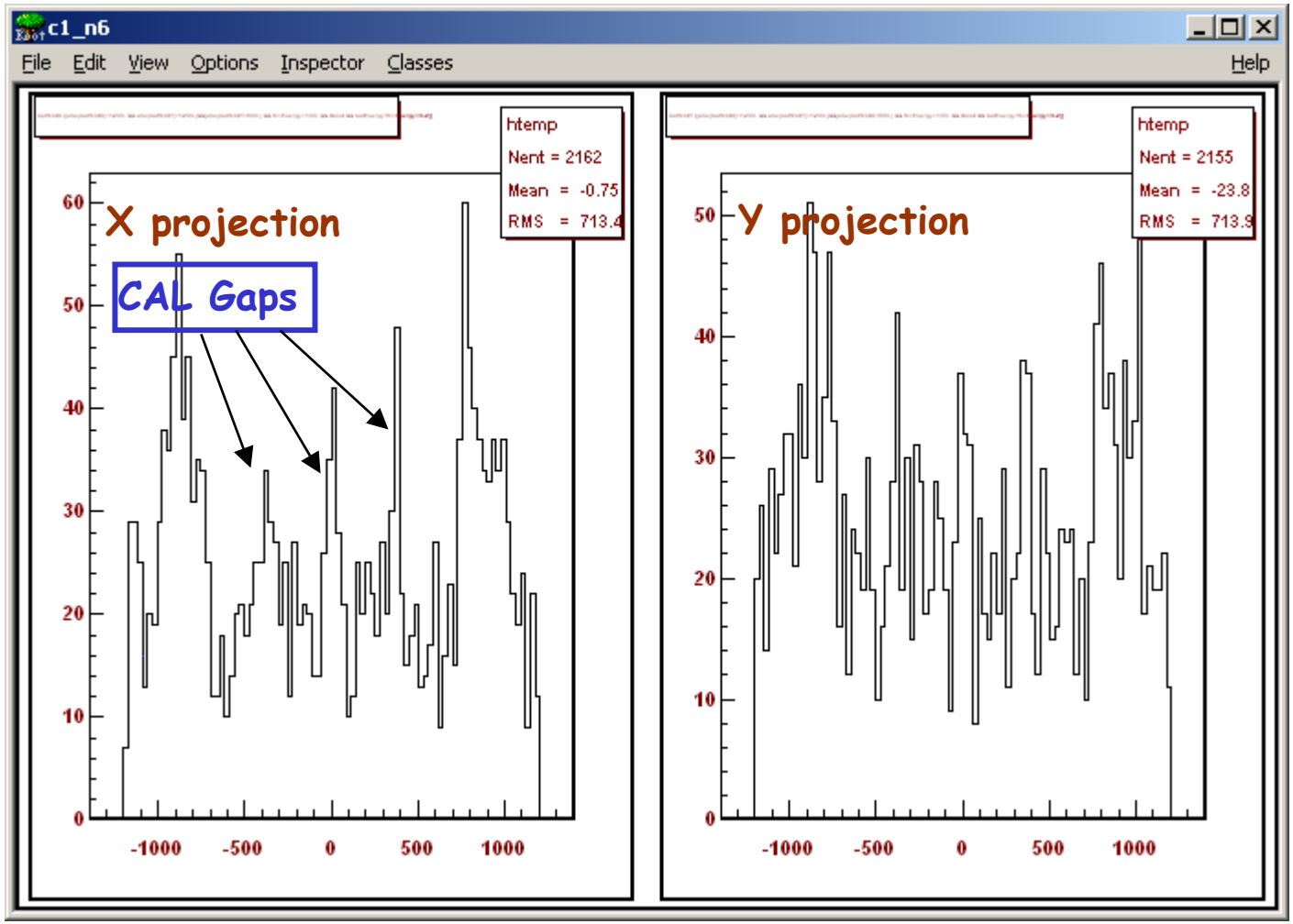
Cut on Fiducial Volume in CAL

Cut: both x and y inside 710 mm at Shower Centroid

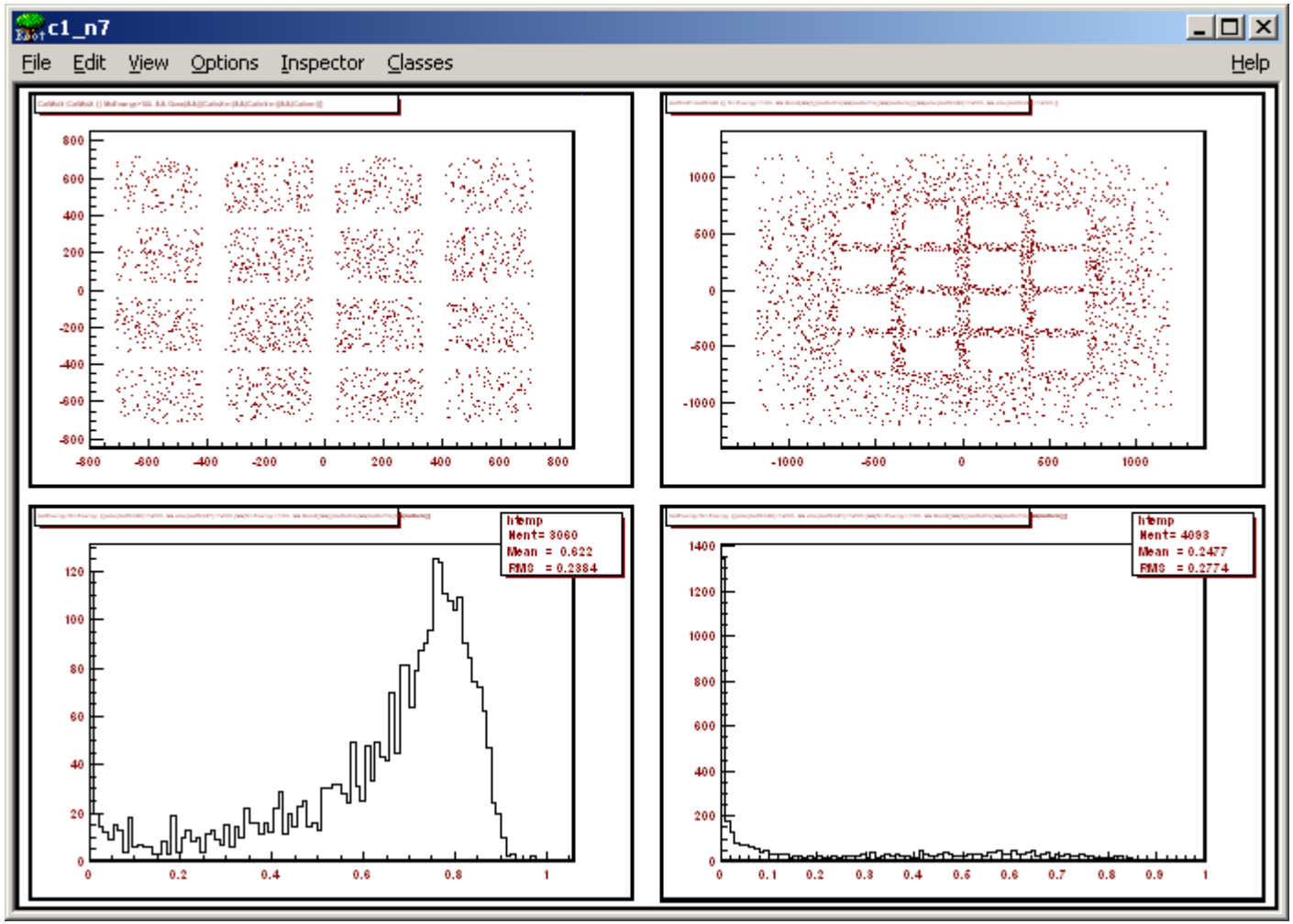


R = CalEnergy/McEnergy

Projections at Middle of CAL for R<0.3



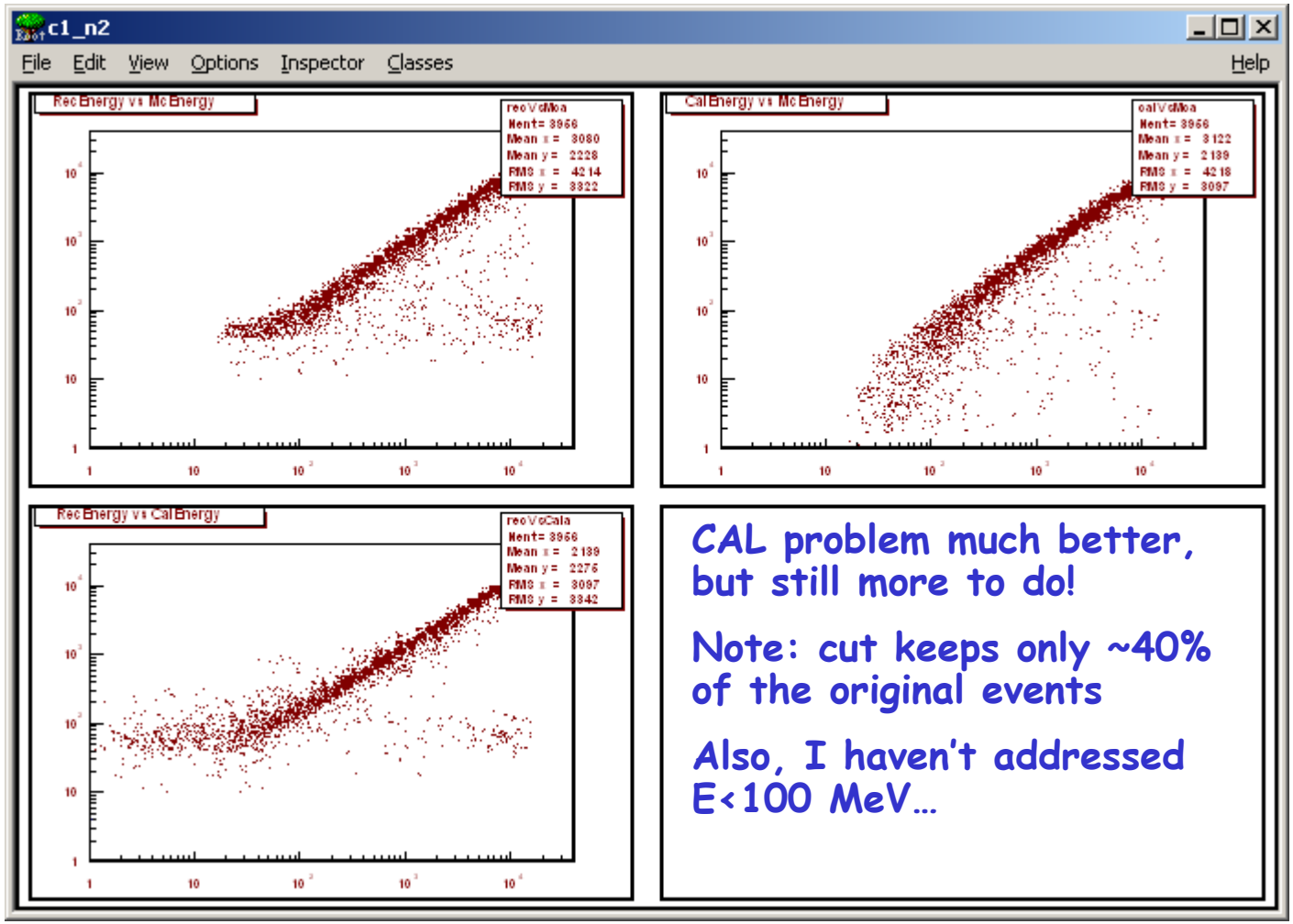
Final Cut, including 80-mm Gaps



Cut

Anti-Cut

Energy, after Cuts



Summary: Efficiency, Bias & Energy

- The tagging and recon efficiencies seem fine, except for their effect on the angle bias.
- There are pretty big angle biases for large-incident-angle events at low energies, and there is some indication that this remains a problem at higher energies, at least for gammas.
  - One fix is to cut out the entire region (>50°) for those analyses which require the best PSFs.
  - We can make an (angle,energy)-dependent correction, but especially at low energies, we don't know the energy for much of the phase space, primarily due to CAL gaps. Since we're stuck with the gaps, we need to do whatever we can to characterize these effects and to correct for them.
- There are some technical problems that are causing various TKR energy effects, over and above those coming from the CAL. There are probably some simple fixes for these. (One done already!)