DC1 Instrument Response

Agenda

- Where are we?
- V3R3P7 Classification Trees
- Covariance Scaled PSF
- Pair Energies
- Backgrounds

A Brief History of Resolution & Rejection

Preparing for DC1 is a LARGE TASK

- Not likely to get right the 1st, or the 2nd, or the 3rd, or.... time!

1st Time: April-May
Discover Mult-scattering in G4 "too good to believe!"
Took till end of June to fix!

2nd Time: July (SAS Workshop)
OOPS! The ACD geometry!

3rd Time: July-August
Where did all the Run Numbers go?

4th Time: August
Will Bill never stop changing variables - well at least
he shouldn't make so many coding errors! Steve's variables added.

5th Time: August-September
Data of the day! But it's certainly not "The rest of the story!"

6th Time: .... IS A CHARM!

A Brief History Continues!

6th Time: NOT CHARMED! September:

ToT's found to be effective at removing range-outs! Code added to explore this handle on Backgrounds

7th Time: October- November

ACD ribbons added to seal up ACD cracks. Code added to analyze Ribbons. 5M All-Gammas produced over [18 MeV, 180 GeV] & 2π str.

8th Time: November-December

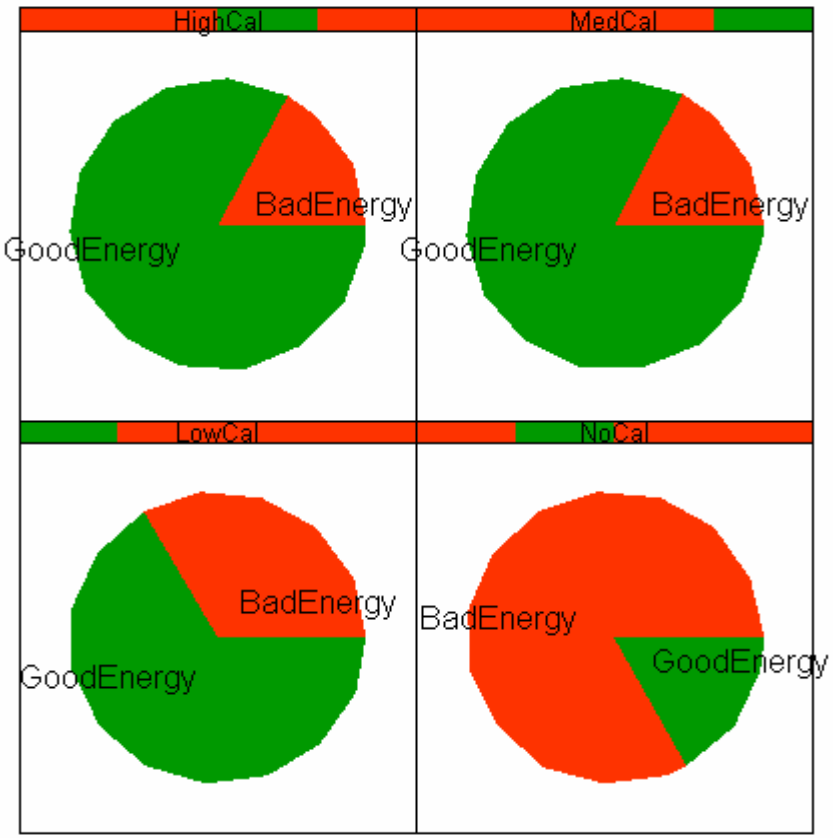
Ribbon & Tile Geometry discoveries!

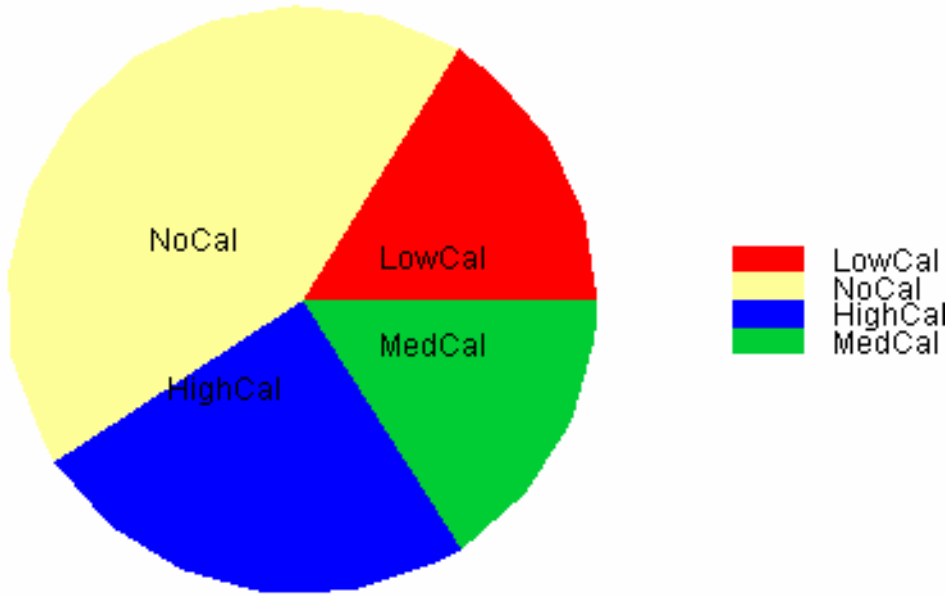
9th Time: December 3

Background Data delivery: 160M$^+$ BGEs. Note: just the BGEs have been run. All-Gammas awaiting. Credit goes to Heather and Berrie. THANK YOU!

Energy CTs

NoCal: < 2 r.l. or < 5 MeV
LowCal: < 350 MeV
MedCal: < 3500 MeV
HighCal: > 3500 MeV



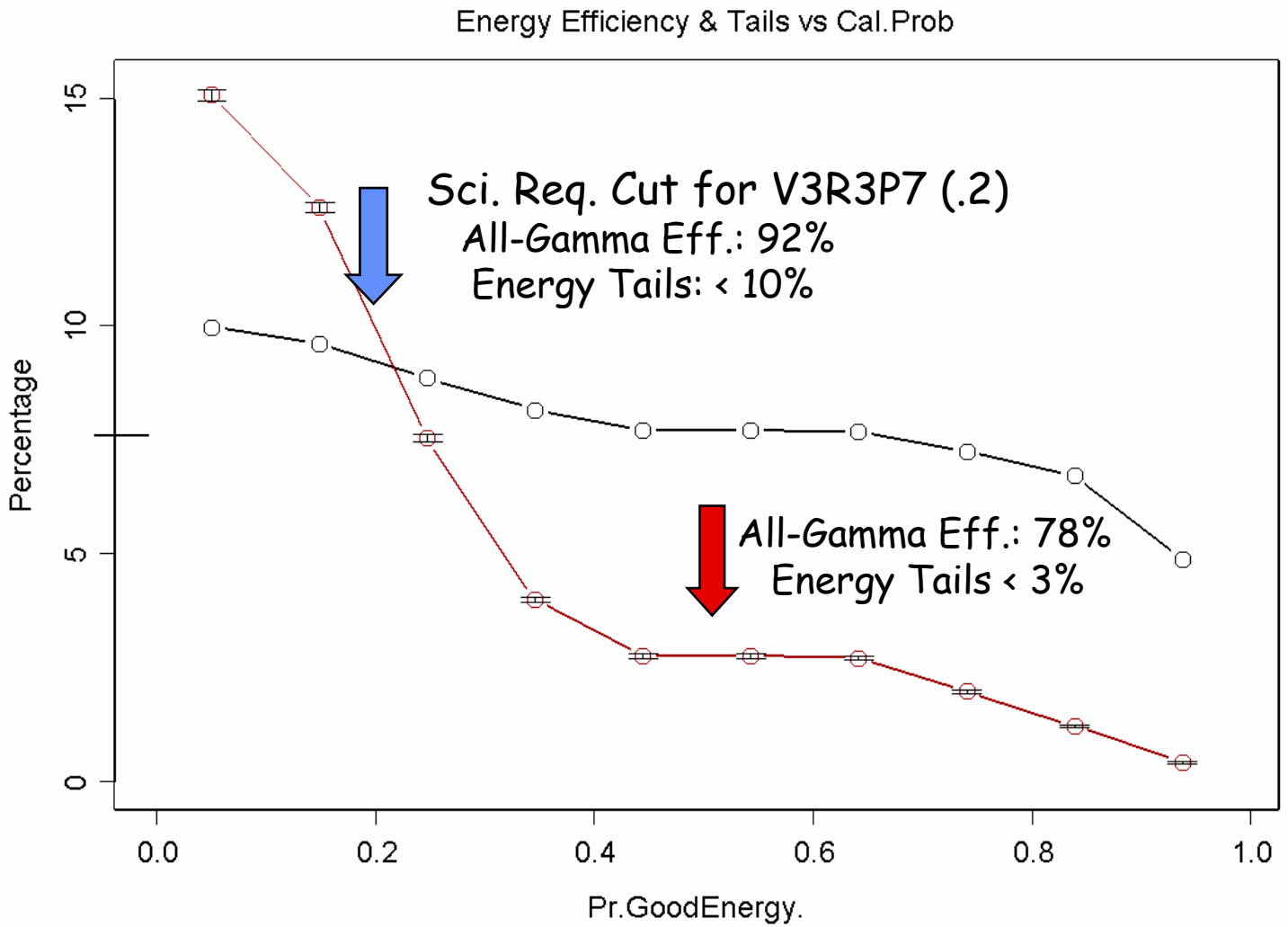


CAL Energy Def's and Good/Bad Breakdown

Recall:

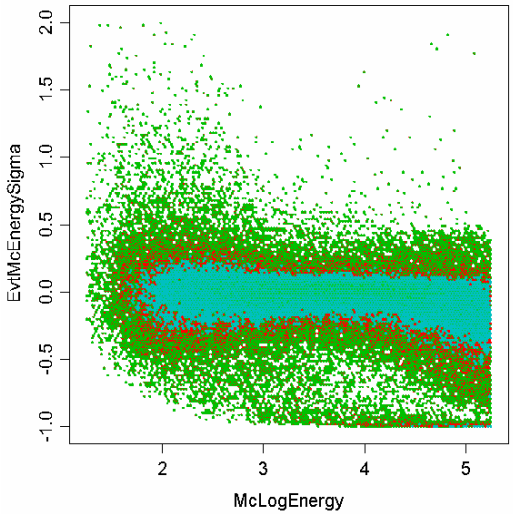
"Good": $\frac{\Delta E}{E} < .35$

Energy CT's Probability Evaluation

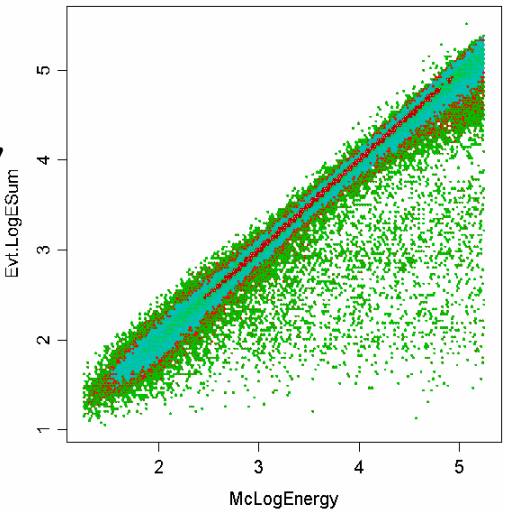


DC1 Energy Post Good-Energy Cut: IMgoodCalProb > .2

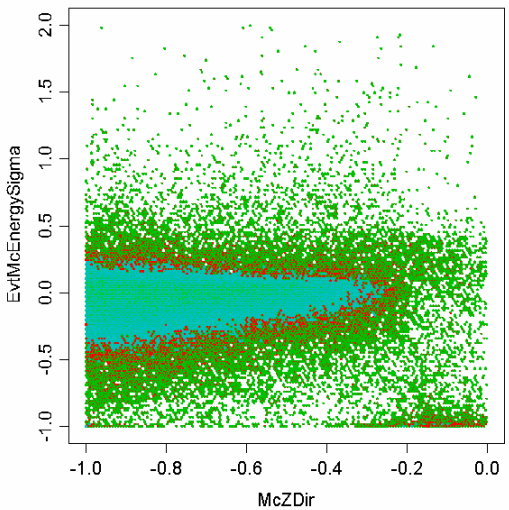
Energy σ vs Energy



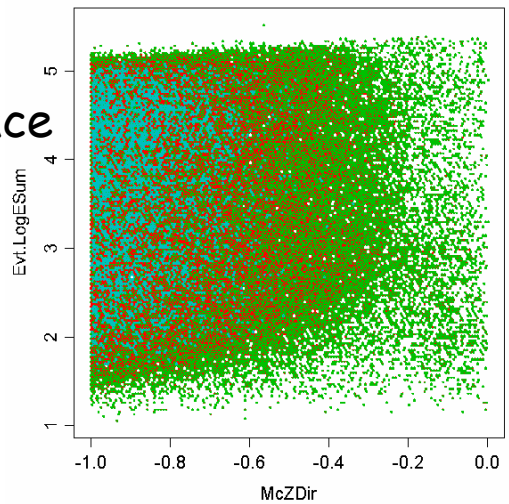
Meas. Energy vs M.C. Energy



Energy σ vs cos(θ)

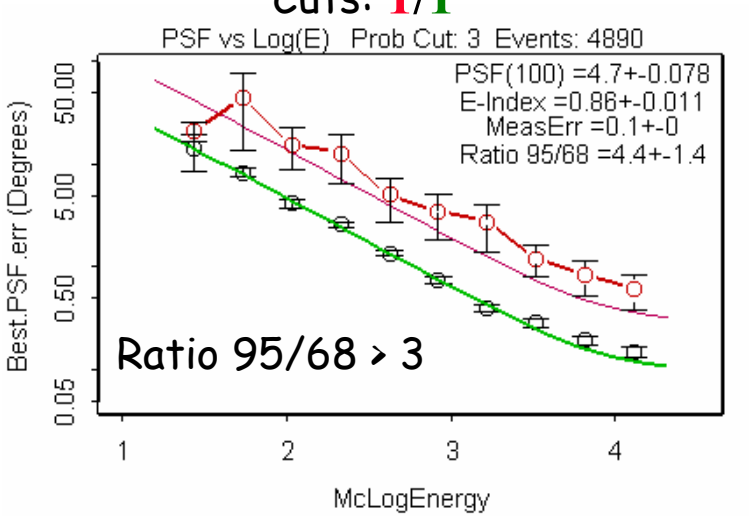


Meas. Phase Space Energy vs cos(θ)

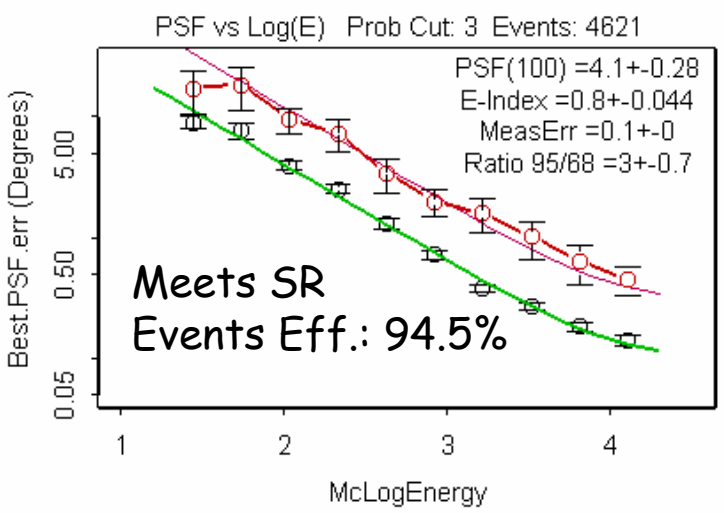


Rome: Thin PSF's - Integrated over FoV
4 Combinations of Cuts *(CORE/Pred)*

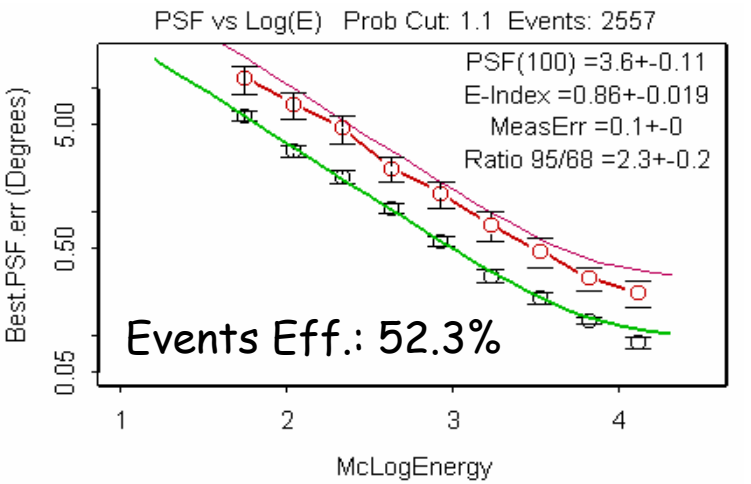
Cuts: 1/1



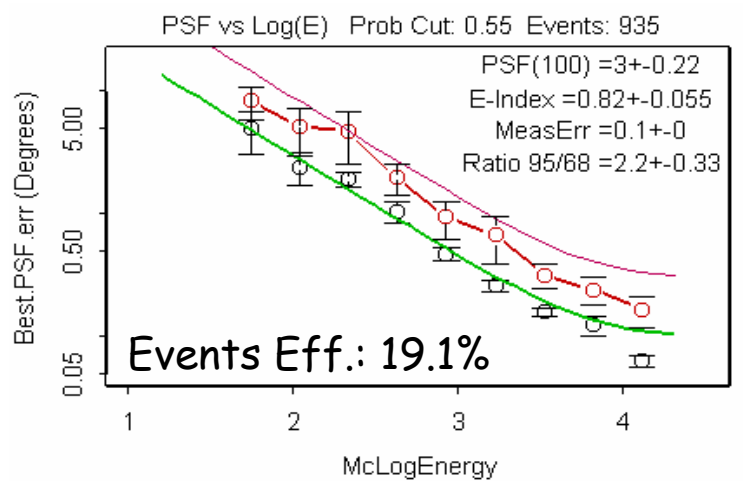
Cuts: 2/1



Cuts: 3/2

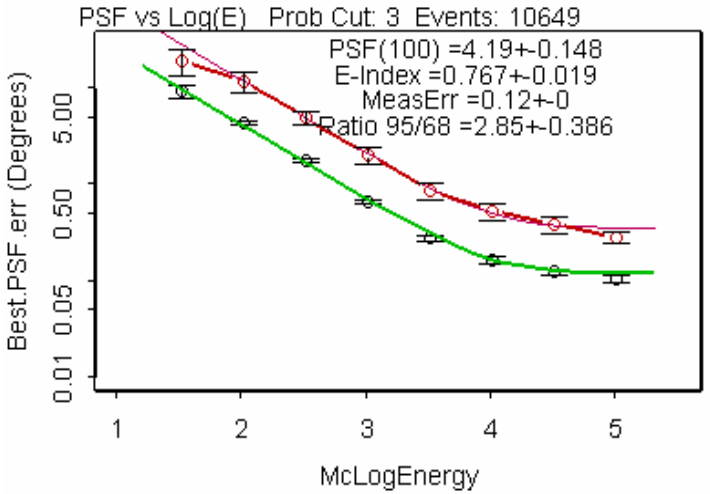


Cuts: 3/4

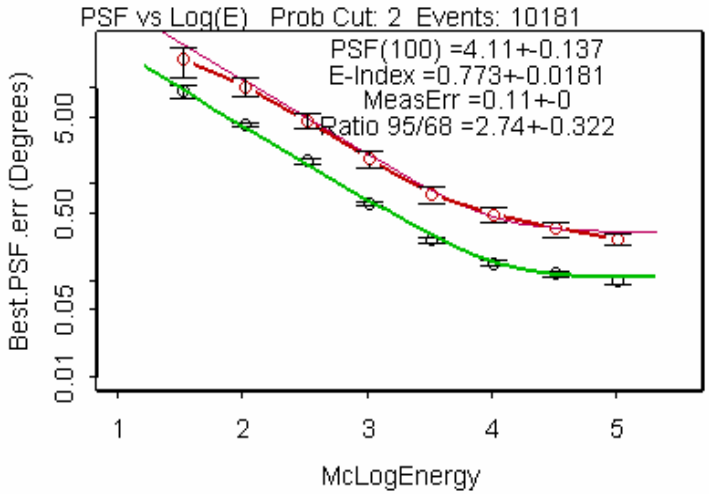


DC1: Thin PSF's - Integrated over FoV
4 Combinations of Cuts *(1-CORE/4-Pred)*

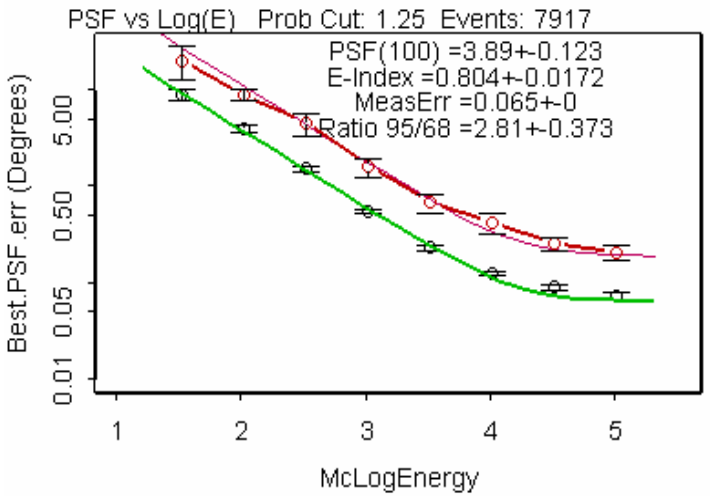
Cuts: 2/1



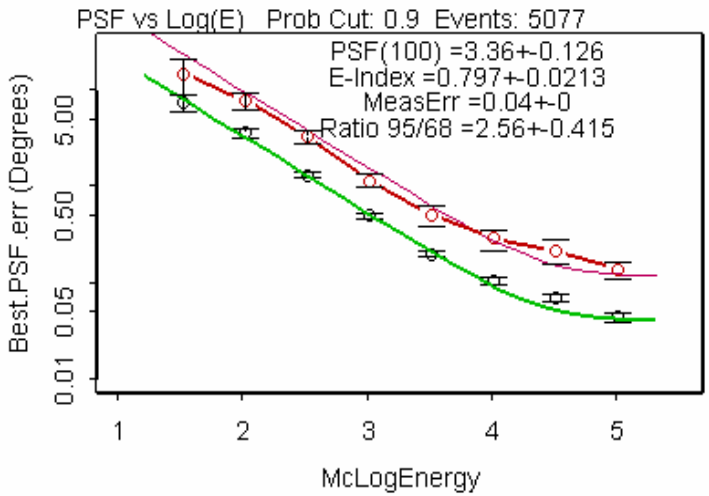
Cuts: 2/2



Cuts: 2/3



Cuts: 2/4



Covariance Scaled PSF's

(from Covariance.ppt presentation to Analysis Group, July, 2003)

A bit of math then shows that:

$$\sigma_\theta^2 = \cos^4(\theta)\left(\cos^2(\phi)C_{xx} + 2\sin(\phi)\cos(\phi)C_{xy} + \sin^2(\phi)C_{yy}\right)$$

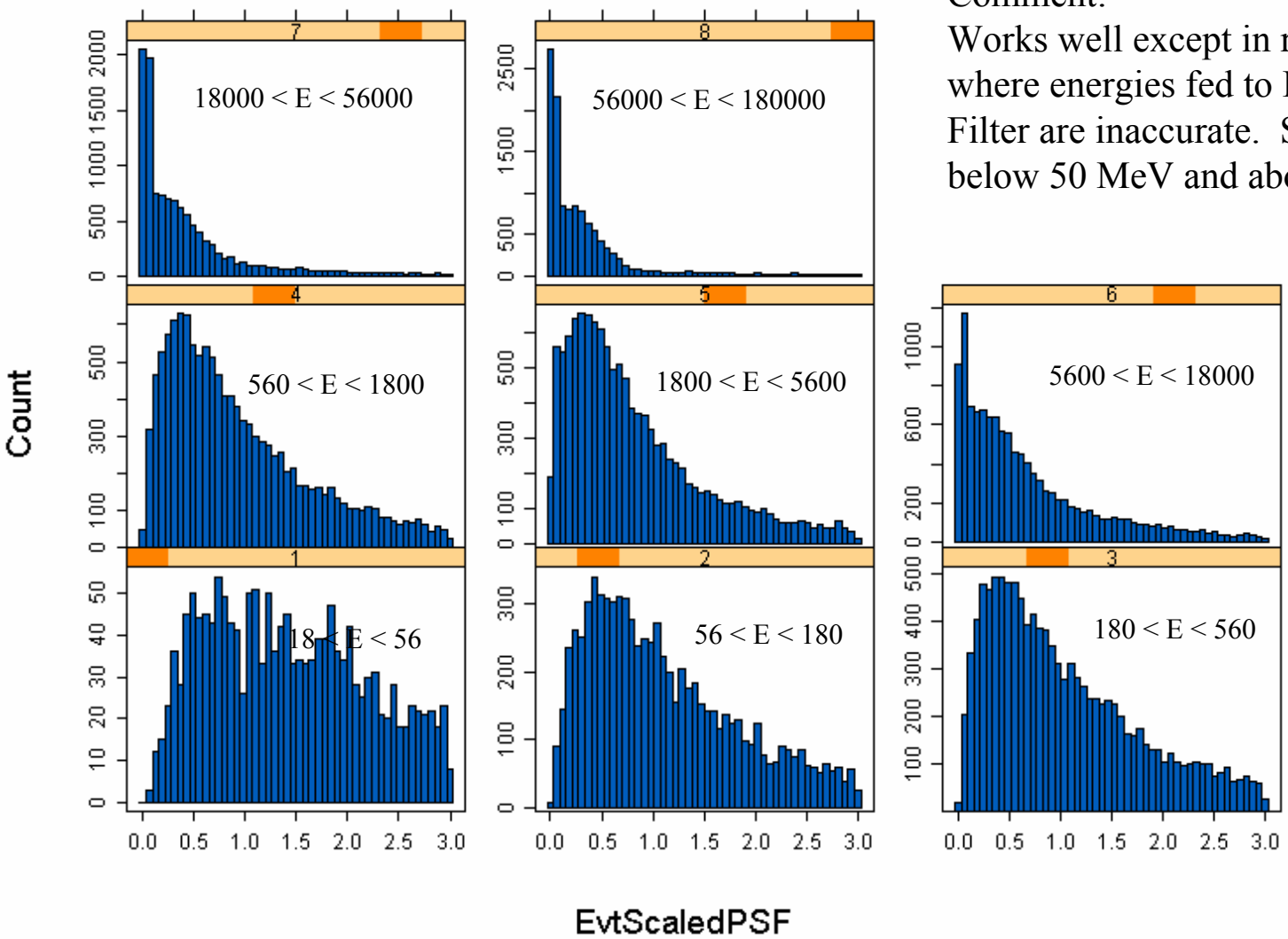
and

$$\sigma_\phi^2 = \frac{1}{\tan^2(\theta)}\left(\sin^2(\phi)C_{xx} + 2\sin(\phi)\cos(\phi)C_{xy} + \cos^2(\phi)C_{yy}\right)$$

Definitions: $$\text{EvtScaledPSF} \equiv \frac{\text{McDirErr}}{\sqrt{\text{Tkr1ThetaErr}^2 + \text{Tkr1PhiErr}^2}}$$

Where all the variables come from the Merit-ntuple.
(See my covariance ppt for details on Tkr1ThetaErr and Tkr1PhiErr - these are derived from the covariance matrix elements, event-by-event)

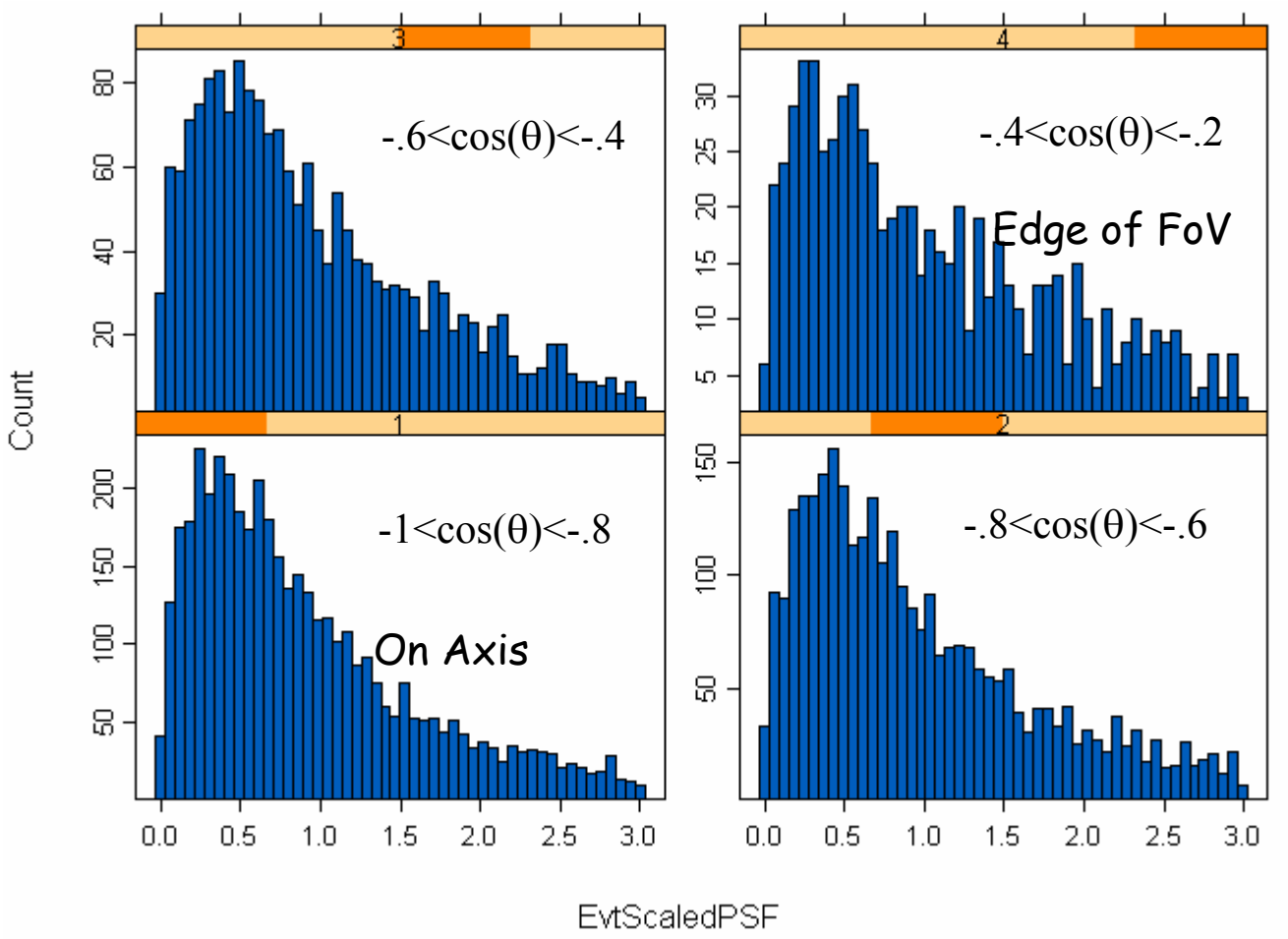
Scaled PSFs: Energy Dependence



Comment:
Works well except in regions where energies fed to Kalman Filter are inaccurate. Specifically below 50 MeV and above 10 GeV

Scaled PSFs: Angle Dependence

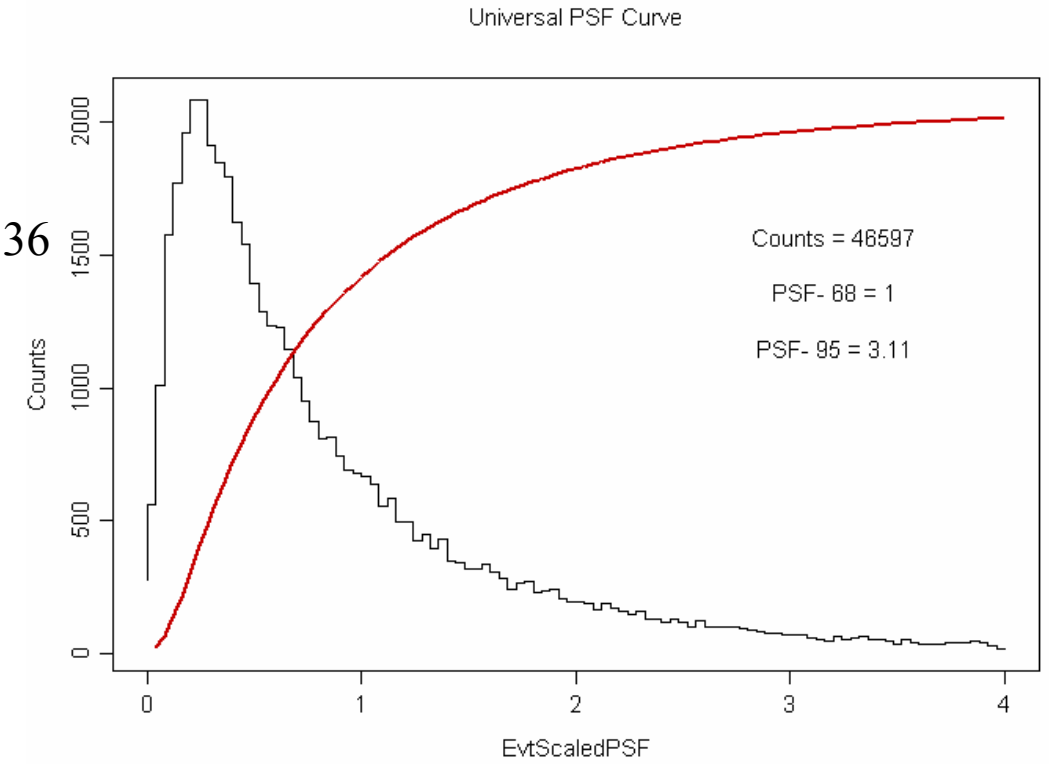
McEnergy < 10000 MeV



Universal PSF Curve???

1) Scale Factors adj. to 2.38 & 3.36
Thin /Thick respectively

2) IMcoreProb > .2 &
IMpsfErrPred < 3.
(SR cuts)



3) Energy cut: .5 <Tkr1ConEne/EvtEnergySumOpt < 1.

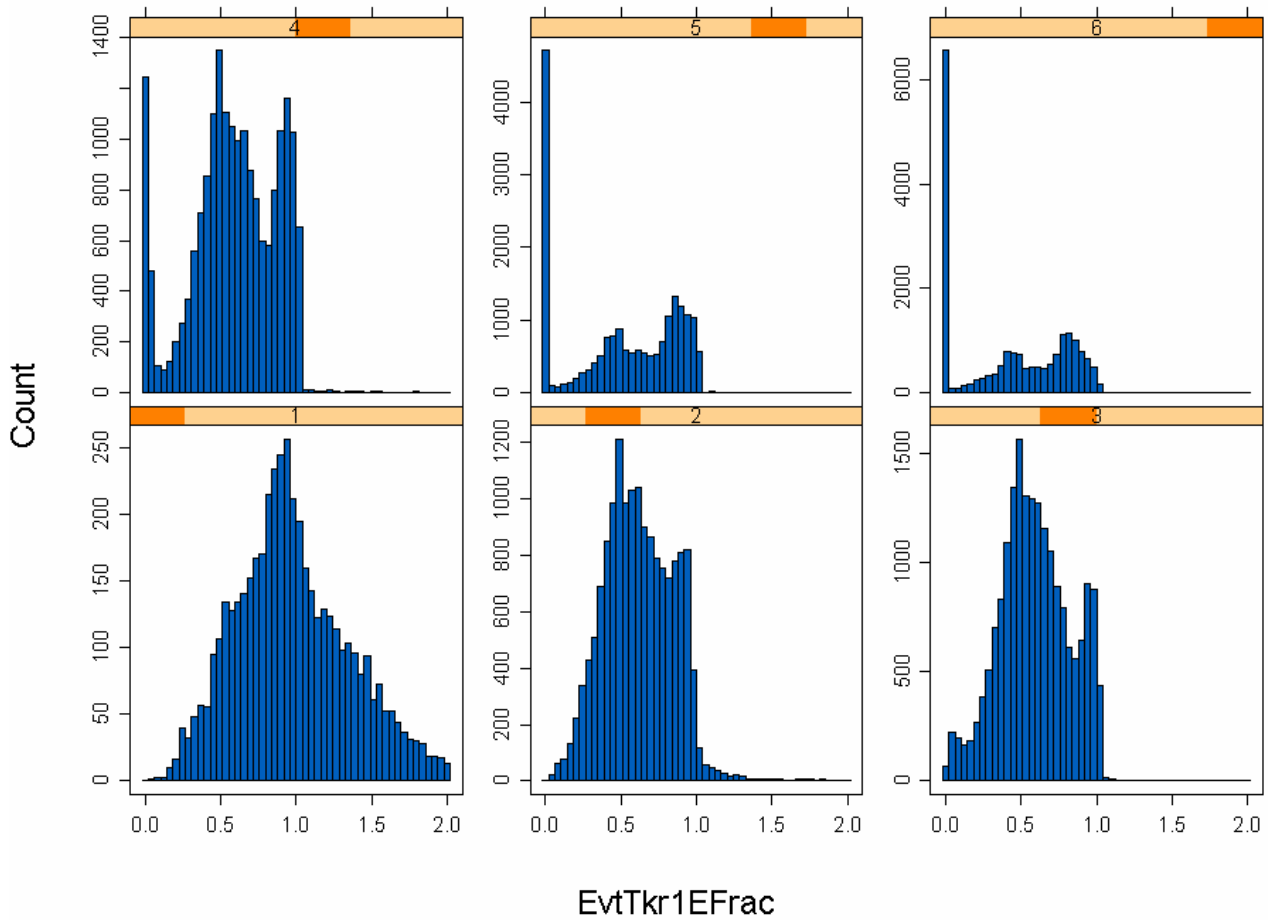
Note: This cuts out almost 1/2 the data !!!! (44.4%)

Pair Energies: The Missing Half

Optimization done using:

$$\sigma_E \approx \frac{1}{\sqrt{N_{Kinks}}}$$

Only Valid Region: [.5, 1.)



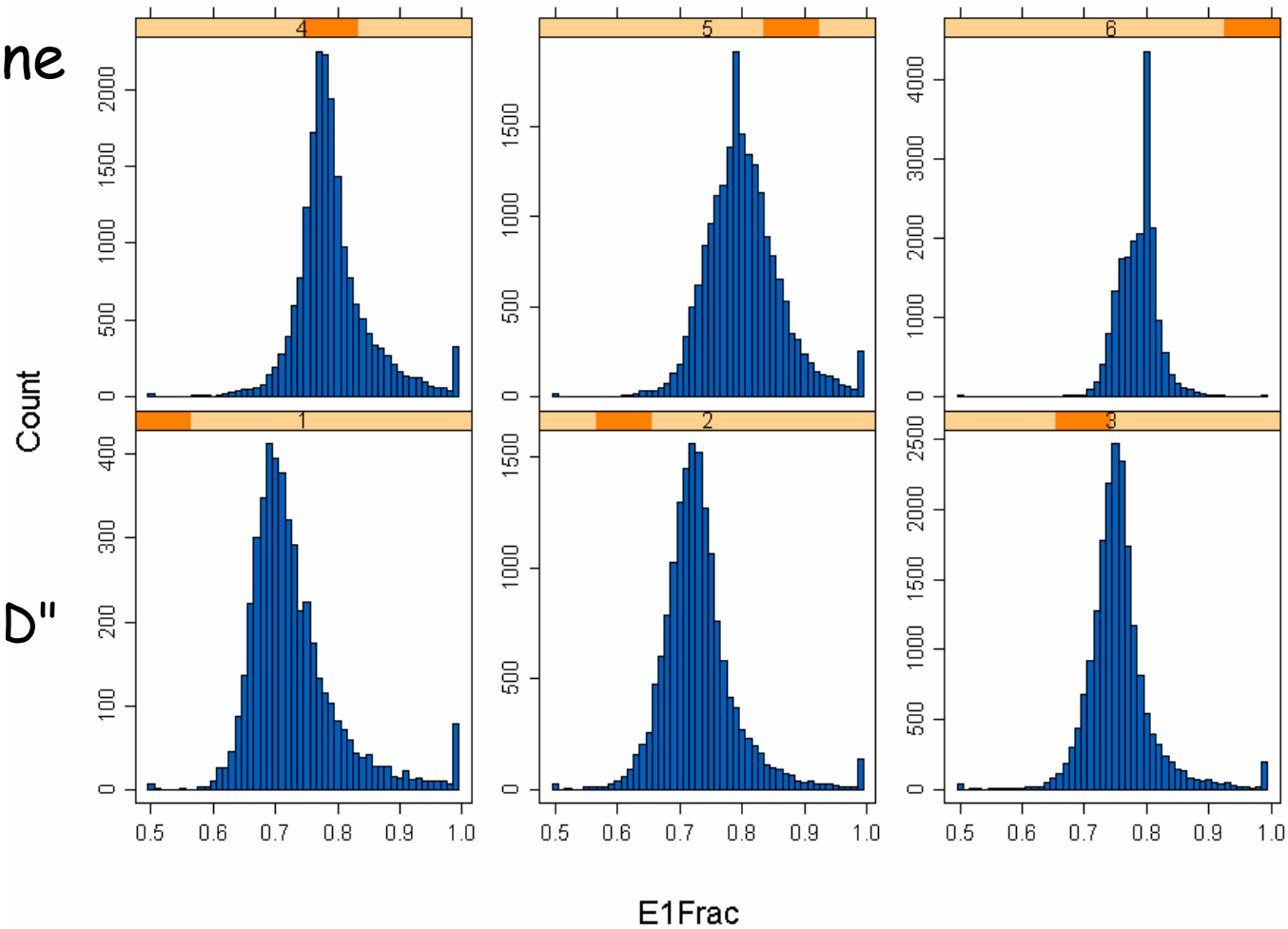
Pair Energies: The Missing Half (2)

Optimization done using

$$\sigma_{1/E} \approx \frac{1}{\sqrt{N_{Kinks}}}$$

&

Consraint to "QED"



Backgrounds: A First Look

Input: - 27 BGE Events Files
- pruned
- 168 MB/File 4.5 GB Total
- 161.5 M BGE Generated

Prune Step: AcdActiveDist < -20 & AcdRibbonActDist < 20
OR
Tkr1SSDVeto > 2

Reduces BGE sample by 3.7X.
This used SSD Tracking layers as "back-up" Vetos.

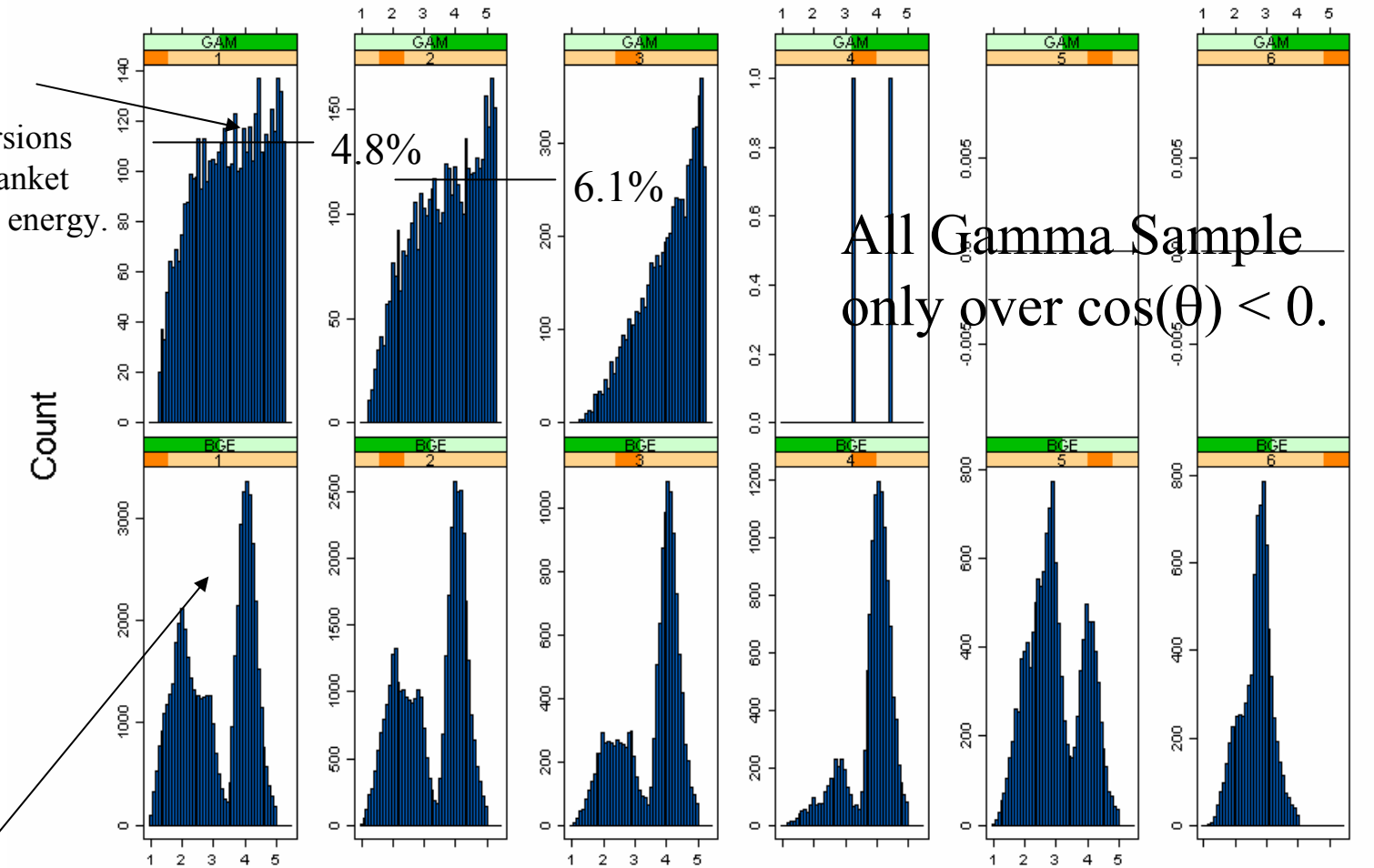
Tkr1SSDVeto Definition: # of live SSD back along trajectory from start of First Track to ACD.

Adding Trk1SSDVeto saves 1/2 the killed γ's allowing ~ +15% BGEs.

Events lost due to Global Veto Cut
7.6% AG's Lost & 73% BGE's

Yellow/Orange Bins: Cos(Mc-Theta) -1 to 1.

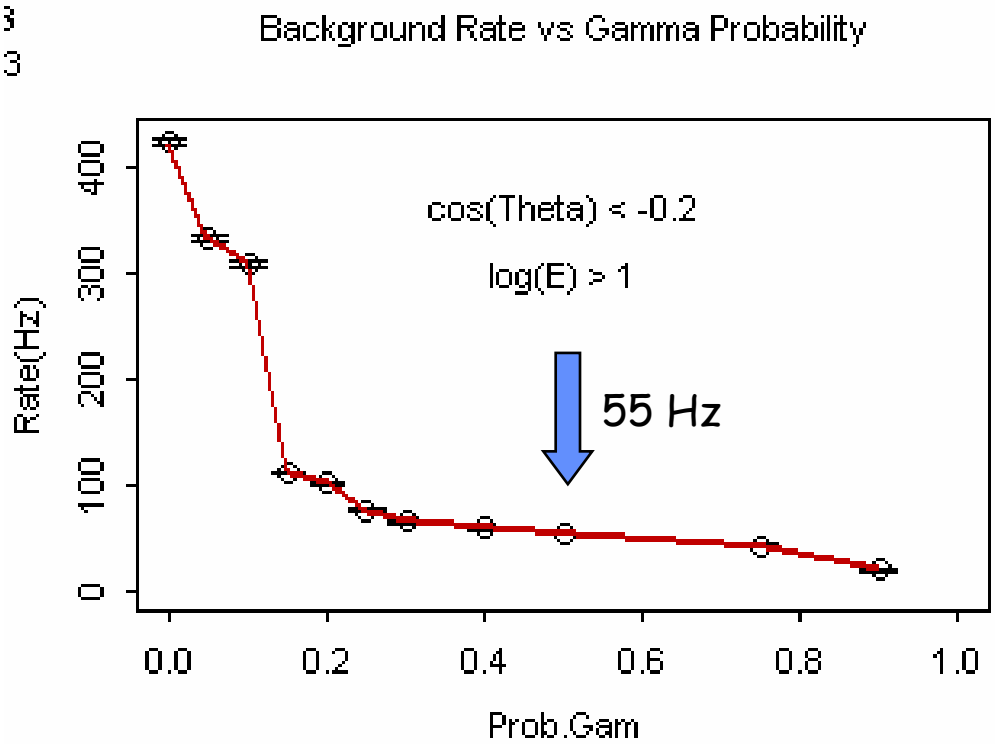
This is close to the irreducible limit from conversions in the ACD & Blanket AND it's ~ flat in energy.

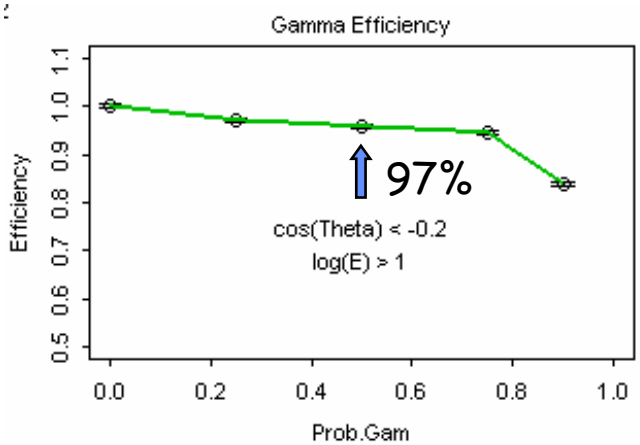


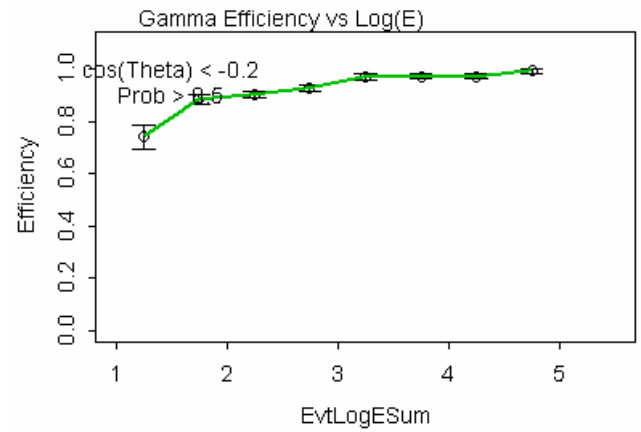
~ 78% BGE's get killed on axis

CT Pruner Step

Event Sample much too large (410 Hz Orbit Average Rate)
First allow only !NoCal Events: 3.7x BGE Reduction (107 Hz)
Apply a CT based secondary pruner build on Reconstruction Primatives.



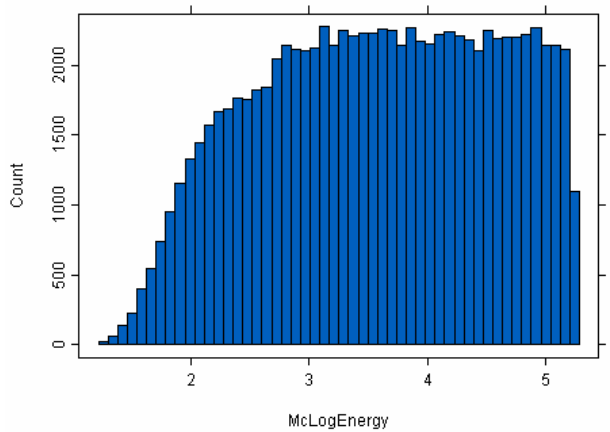




Good Cal Energy & Minimal PSF Cut

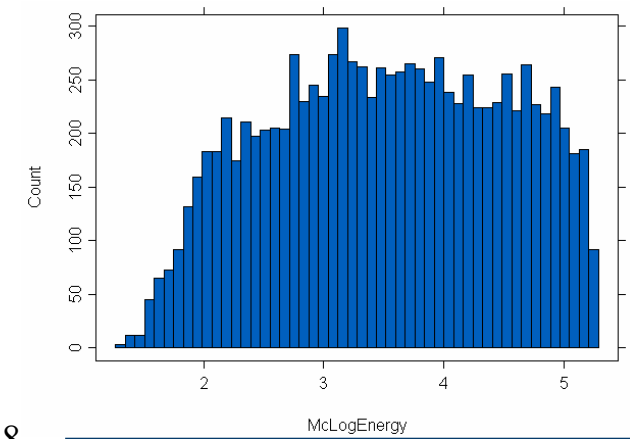
Good Cal Energy (Prob.GoodCal > .2): Remaining Rate: 23 Hz
All-Gamma Efficiency: 91.5% (Total so far: 82%)

Efficiency vs Energy



Cutting on PSF(CORE) (Kills PSF Tails - Prob. > .2): Remaining 13.2 Hz
All-Gamma Efficiency: 88% (Total so far: 73%) - 2.2 m^2 - str.

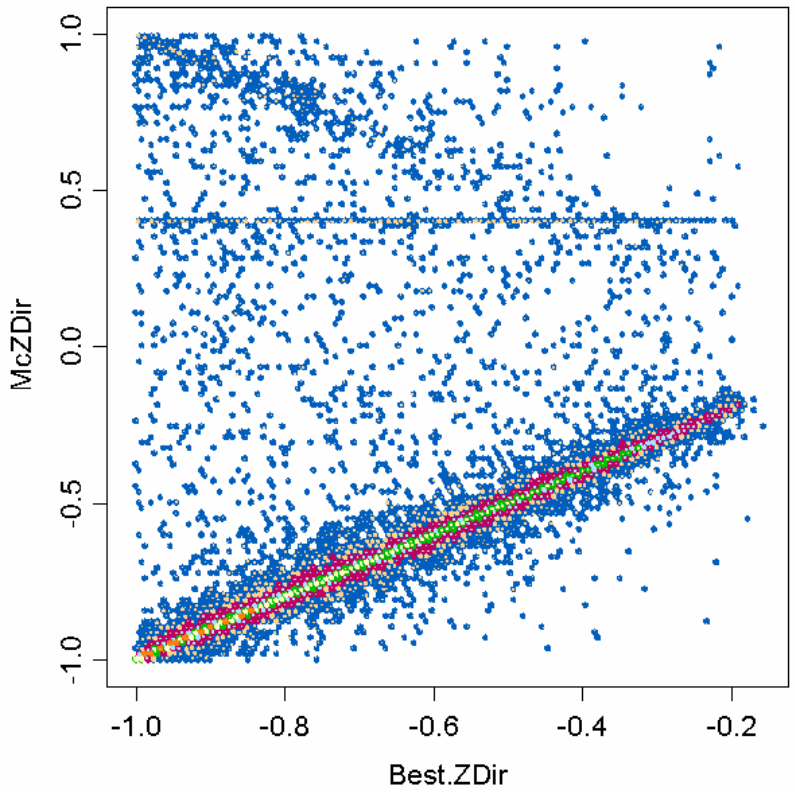
Efficiency vs Energy



Final CT Background Tree Processing

Good Cal Energy (Prob.GoodGam > .5): Remaining Rate: 1.3 Hz
All-Gamma Efficiency: 87.4% (Total so far: 63.4%) - 1.93 m^2 - str.

Now the 3 Problem classes are clear!



Conclusions and Future Work

1) We're NOT THERE YET! Stay tuned - *for the Rest of the Story.*

2) V3R3P7 CTs are in production version of GLAST Sim

3) An event-by-event PSF analysis seems to be achievable
PROVIDED....

4) We straighten out the energies used in the Kalman Fit.

5) Backgrounds - First look at statistically useable event samples.
- Need to back the filtering up-stream to better manage local resources!

GOAL: To have a Background Analysis in hand by DC1 Close-Out