



DC1 Back Ground Analysis

Strategy: Break events into categories in energy and topology

- Energy Bins:
 - 0 - 350 MeV (CalLow)
 - 350 - 3500 MeV (CalMed)
 - 3500 - Limit (CalHi) } CalEnergySum

These were the break points in energy used in the CT Pruner.

- Topology Bins: VTX - Recon found a pair - this is the super-set of events used in PSF def.
For this purpose a different Recon Alg. might be better

Number of Classes: 3 (Energy) x 2 (Topology) = 6 Analysis Classes

Procedure for each branch - throw-out events with single cuts until the photon eff. falls below 90%. Finish with a CT. Use CT's to point to next best variable.

Background Rejection (Events downloaded on Dec. 4 - 27 blocks)

Input: 119.6M orbit ave background events. (~ 4880 sec. - 2 sec/Run * 122 Runs/Block x 20 Blocks)

1.33M All-Gammas (200/750 * 5M Total)

Two stages of pruning:

1) (AcidActiveDist < -20 & AcidRibbonActDist < -20) | Trk1SSDVeto > 2

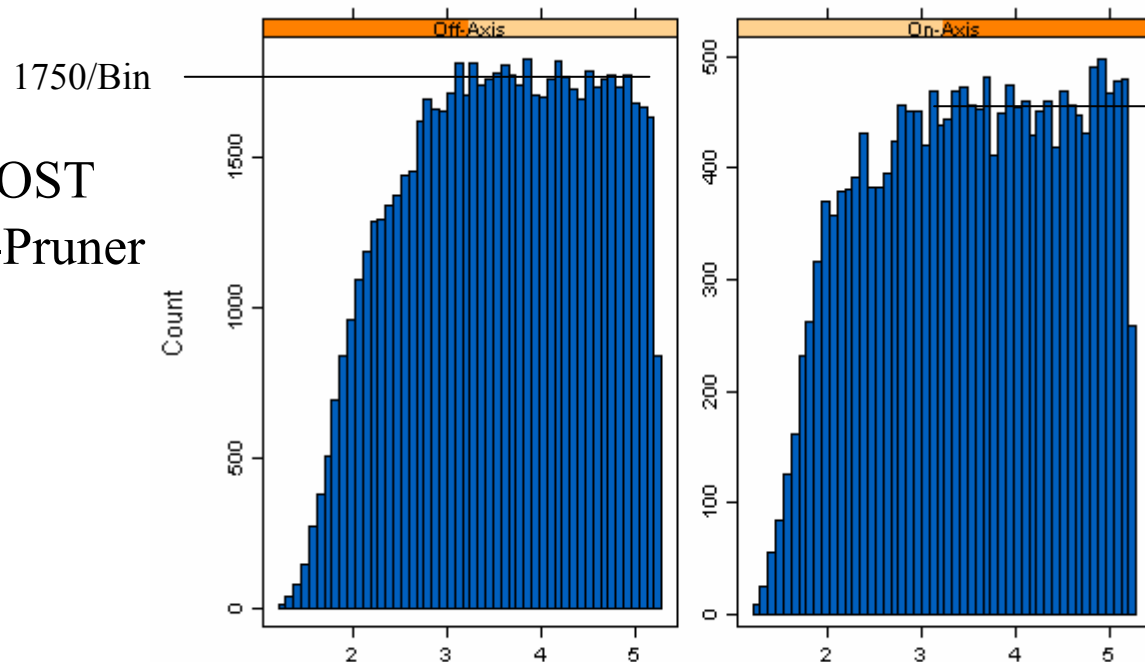
Also by default TrkNumTracks > 0 & GltWord > 3

Reduction: factor of 10 in rate.

2) CT Pruner -

a) !NoCal: Reduction - 4.6

b) CT based pruner: Reduction - 1.63 leaves 97% γ 's; Rate = 55 Hz
(113282 BGEs / 88075 γ 's)



$$A_{\text{eff}} (\text{On-Axis}) = 1.00 \text{ m}^2$$

$$445 \times 50\text{bins} / 1.33 \times 10^5 * 6\text{m}^2$$

$$\text{Total: } 445 + 1750 = 2195$$

$$A_{\text{eff}} \times \Delta\Omega = 3.11 \text{ m}^2\text{-str}$$

$$2195 \times 50\text{bins} / 1.33 \times 10^6 * 37.7 \text{ m}^2\text{-str}$$

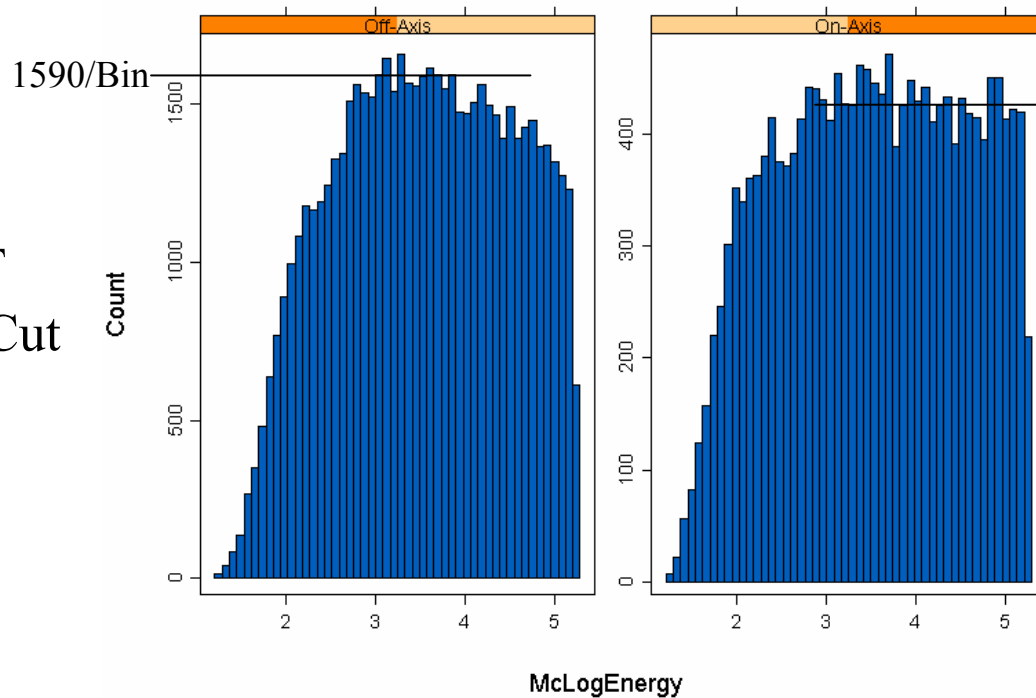
Final stage: Basic PSF & Energy CT Cuts -

1) Pr(GoodEnergy) > .2

2) Pr(CORE) > .2

reduction - 1.76 ➔ Rate = 13.2 Hz (64473 BGEs/ 78250 γ 's)

POST
Above Cut



$$A_{\text{eff}} (\text{On-Axis}) = .960 \text{ m}^2$$

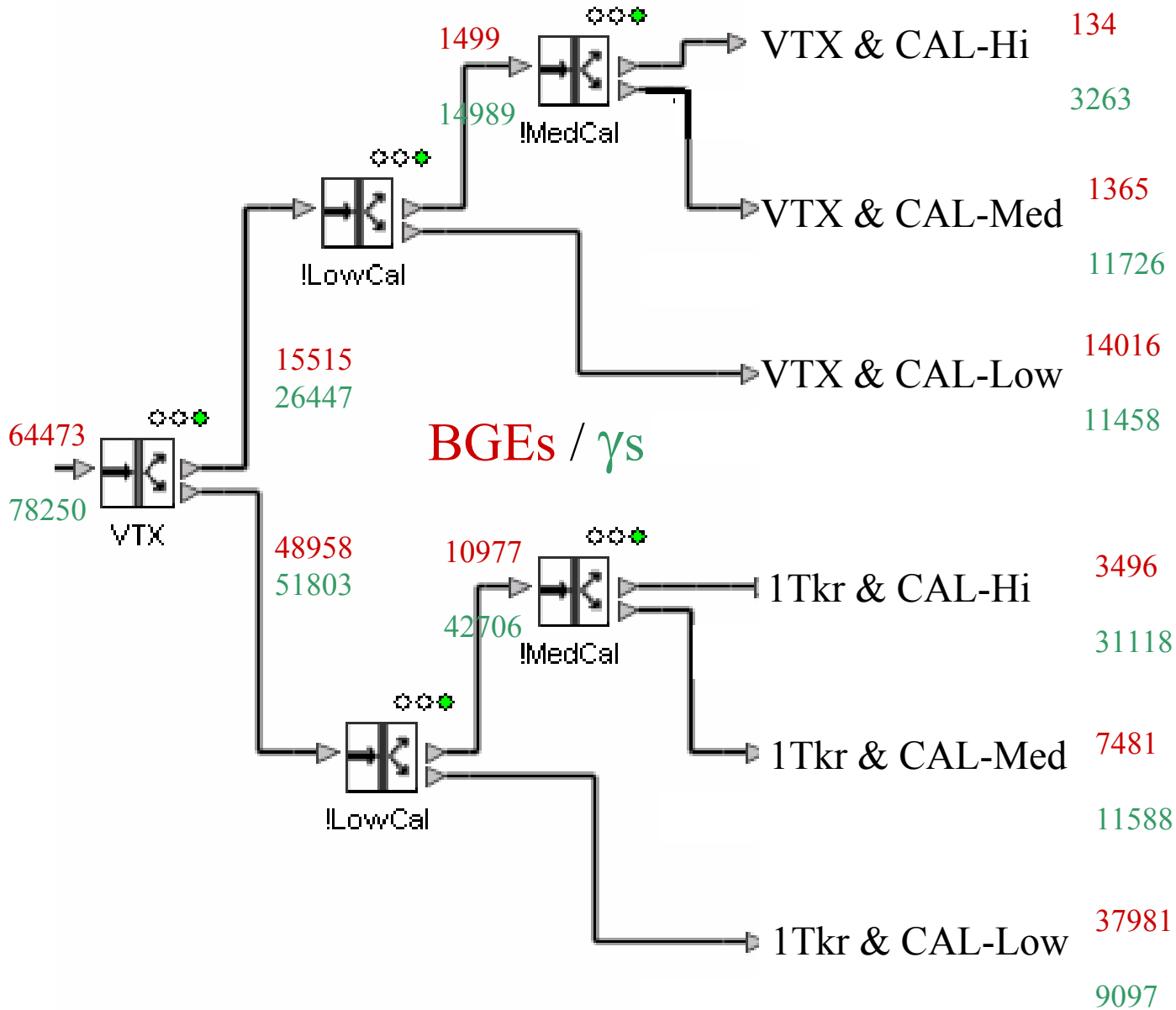
$$430 \times 50\text{bins} / 1.33 \times 10^5 * 6\text{m}^2$$

$$\text{Total: } 430 + 1590 = 2020$$

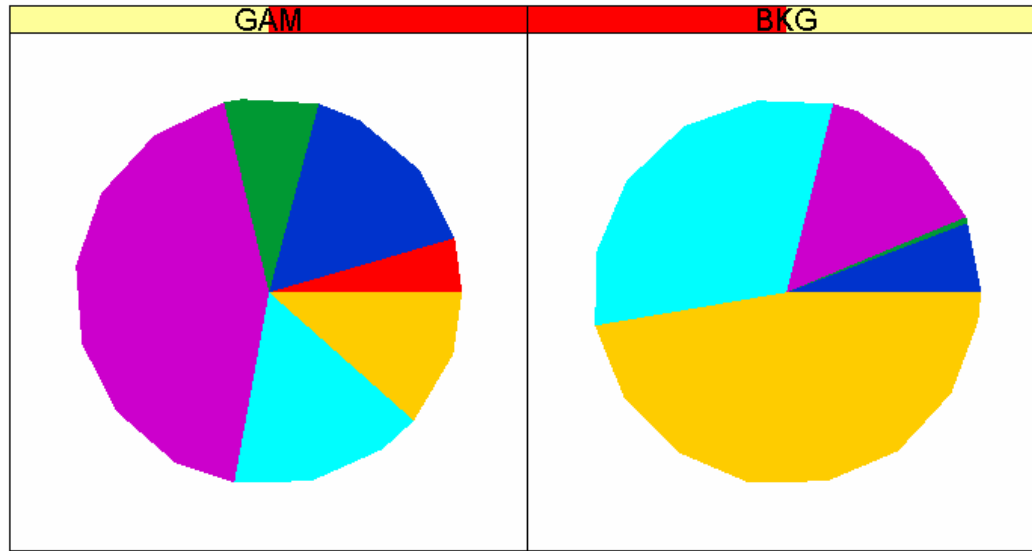
$$A_{\text{eff}} \times \Delta\Omega = 2.86 \text{ m}^2\text{-str}$$

$$2020 \times 50\text{bins} / 1.33 \times 10^6 * 37.7 \text{ m}^2\text{-str}$$

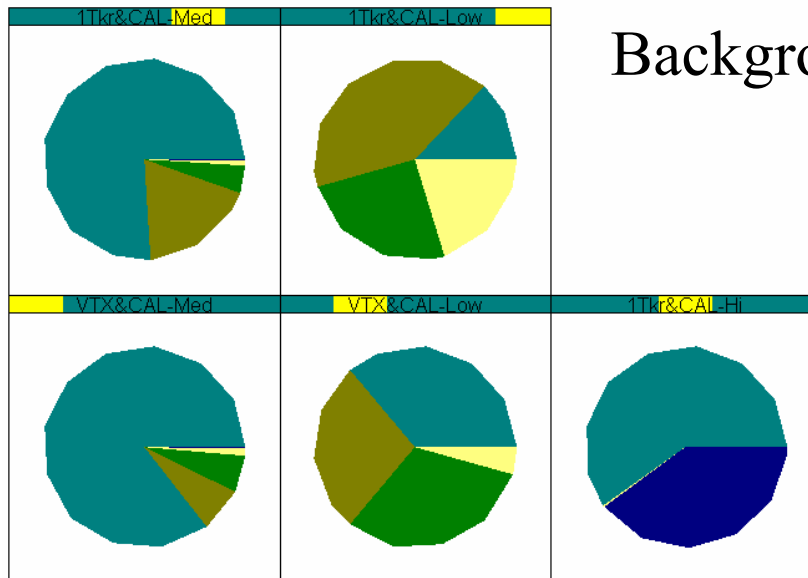
Event Break-down by Class



Signal & Noise breakdown by analysis class



Background source breakdown by analysis class

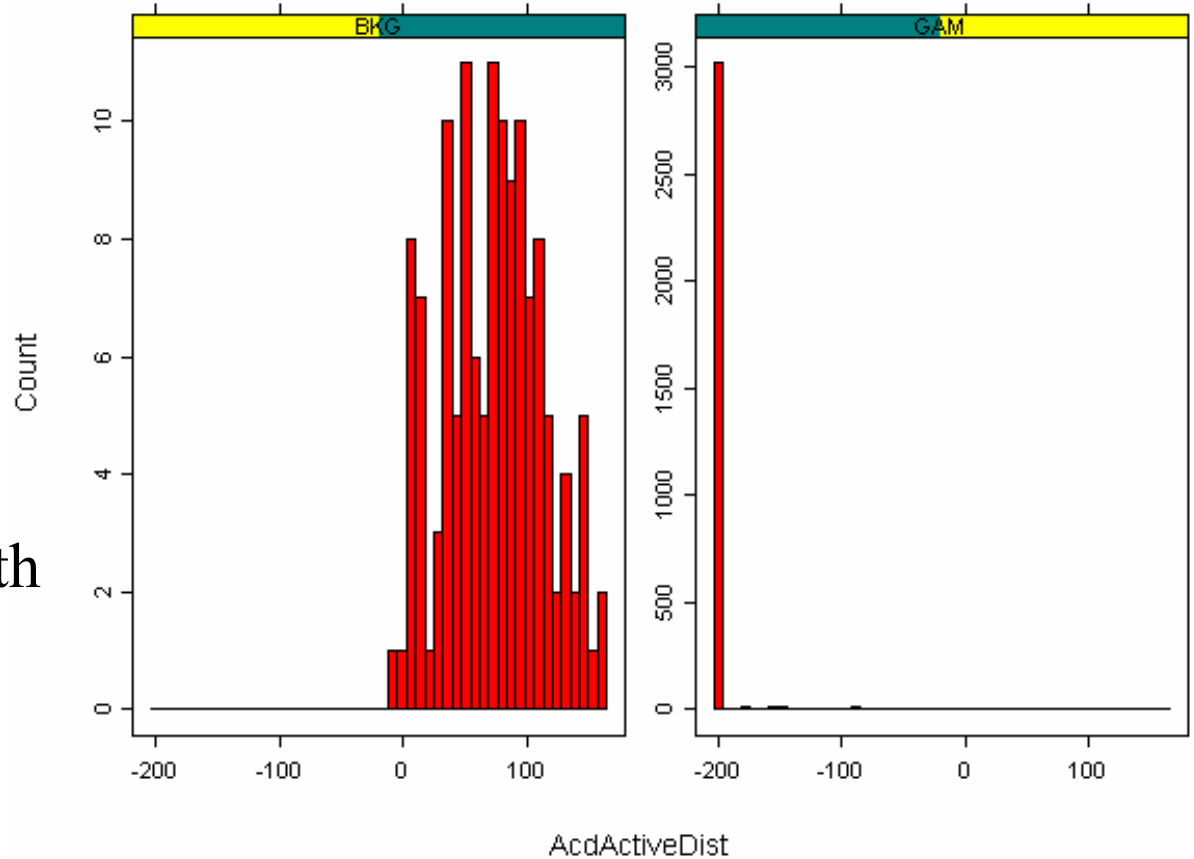


VTX & CAL-Hi

(Easiest Class)

γ s : BGEs = 3263 : 134

All BGE eliminated with
 $\text{AcdActiveDist} < -30$



Remaining γ s : BGEs = 3151:0 (Efficiencies: 96.6% : 0%)

No Events left to build a CT

VTX & CAL-Low

(Moderately Difficult)

γ s : BGEs = 11458 : 14016

Most BGEs killed by

$\text{AcdActiveDist} > -190$

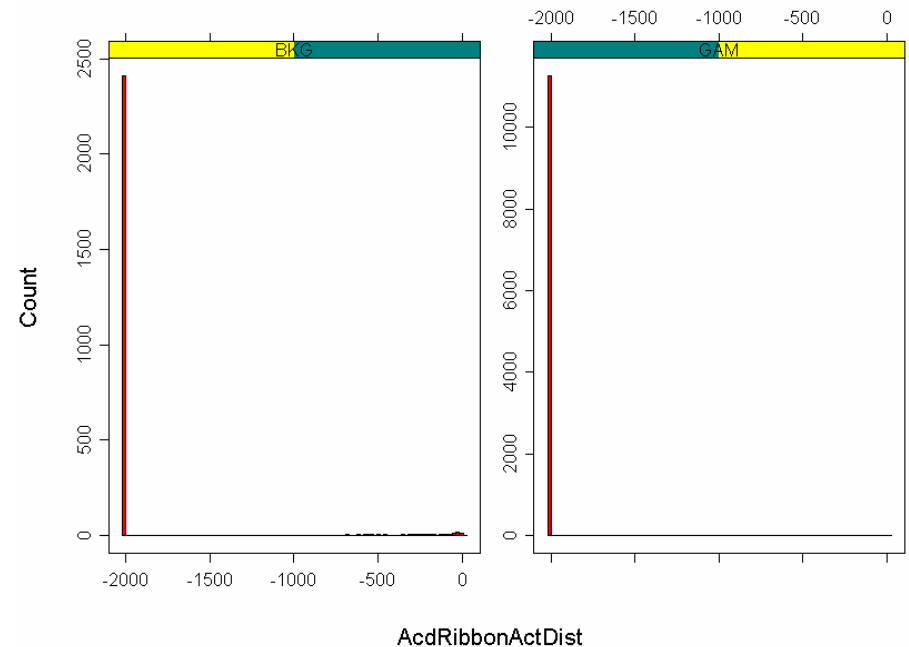
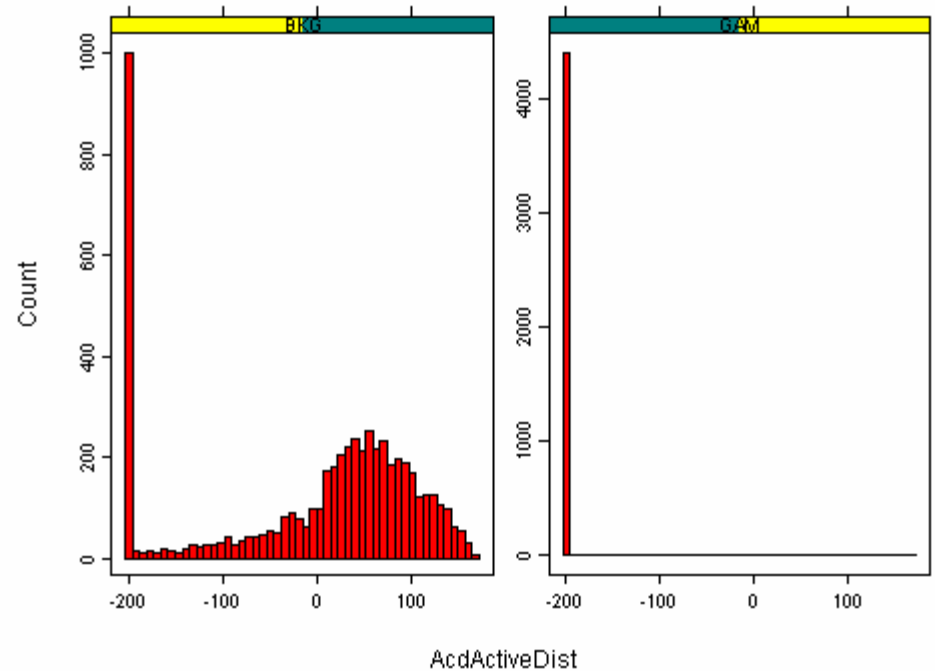
γ s : BGEs = 11318 : 2563

(98.8% : 18.3%)

$\text{AcdRibbonActDist} > -800$

γ s : BGEs = 11270 : 2420

(98.4% : 17.3%)

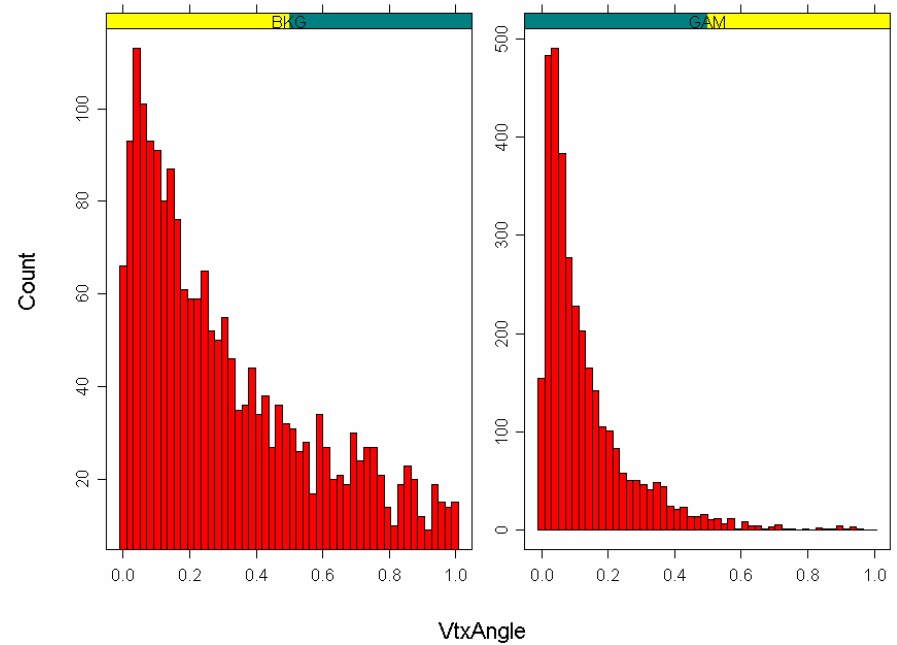


VTX & CAL-Low

Continued

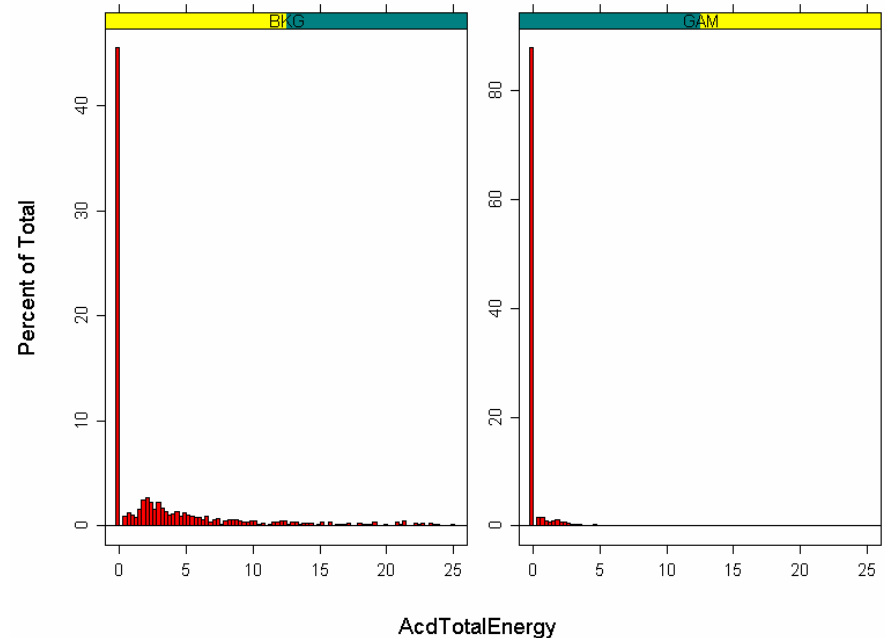
$V_{tx}Angle > .3$

γ_s : BGEs = 10887 : 1530
(95.0% : 10.9%)



$AcidTotalEnergy > 2.5$

γ_s : BGEs = 10504 : 900
(91.7% : 6.4%)

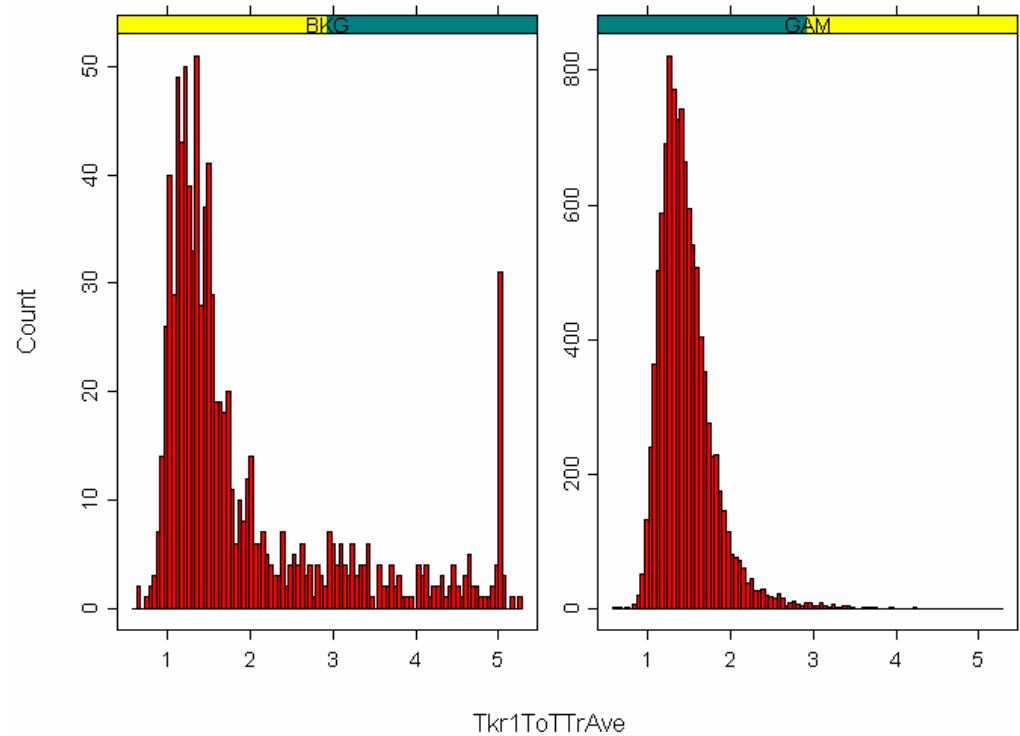


VTX & CAL-Low

Continued

$T_{kr1ToTTrAve} > 2.5$

$\gamma_s : \text{BGEs} = 10363 : 708$
(90.4% : 5.1%)



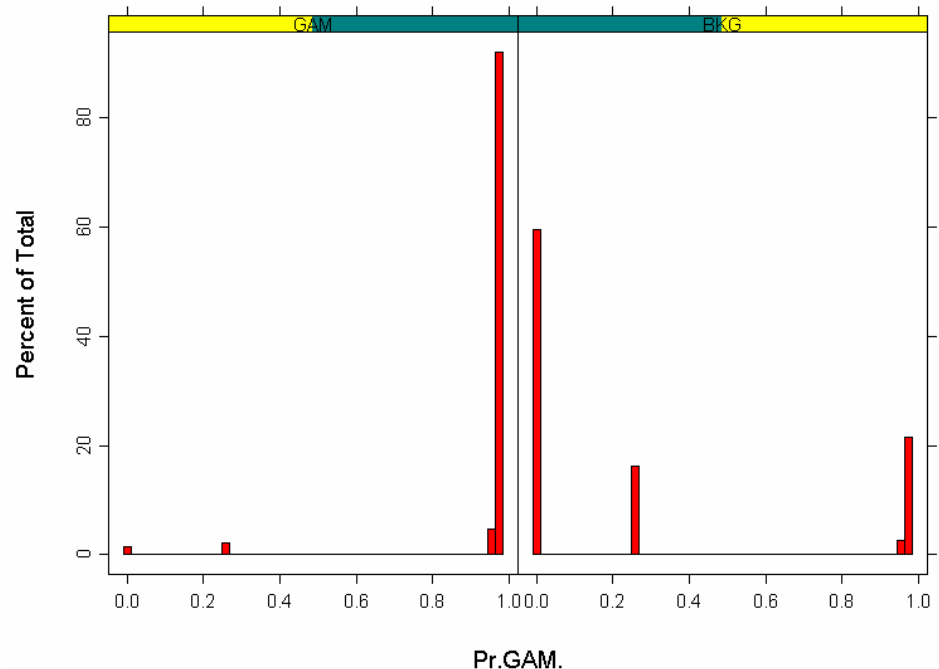
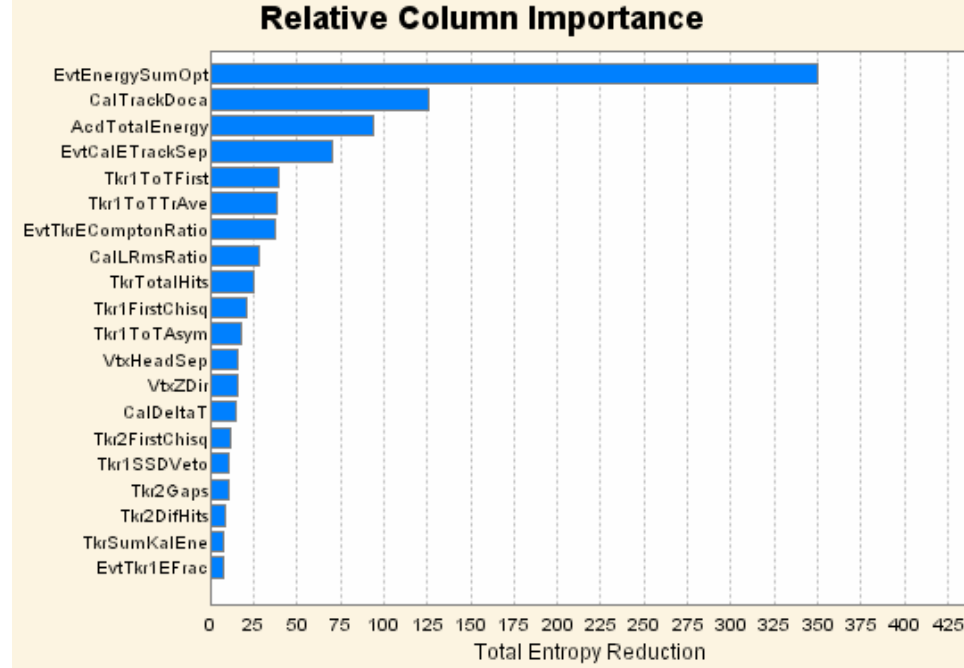
VTX & CAL-Low Continued

Prob.Cut > .5 Kills all
but 124 BGEs while
leaving 8182 γ s
(71.4% : .9%)

Input Node - VTX CT				
		Predicted		Totals
		BKG	GAM	
Observed	BKG	382	124	506
	GAM	45	935	980
Totals		427	1059	1486

	Observed		Overall
	BKG	GAM	
% Agree	75.5%	95.4%	88.6%

Positive Category - GAM		
Recall	Precision	F-Measure
95.4%	88.3%	91.7%



1Tkr & CAL-Low

(Hardest Class)

γ s : BGEs = 9097 : 37981

AcdTileCount == 0

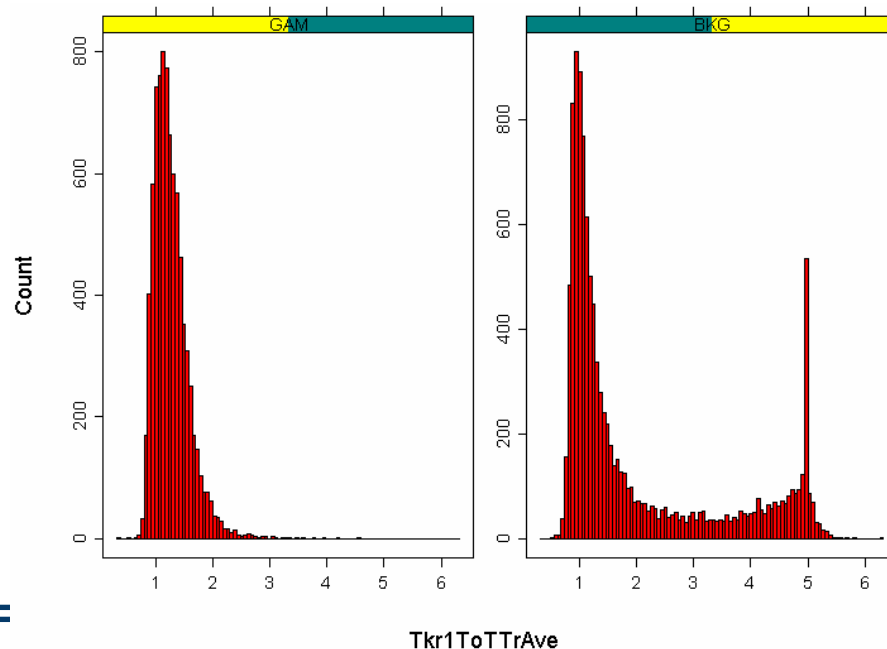
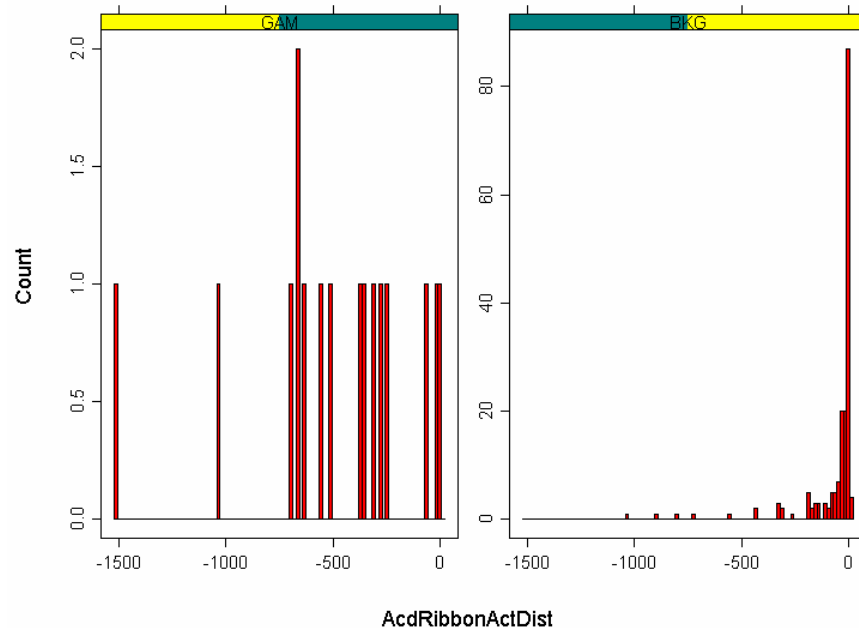
γ s : BGEs = 8320 : 11340
(91.5% : 29.9%)

AcdRibbonActDist > -500

γ s : BGEs = 8312 : 11166
(91.4% : 29.4%)

Trk1ToTTrAve < 2.5

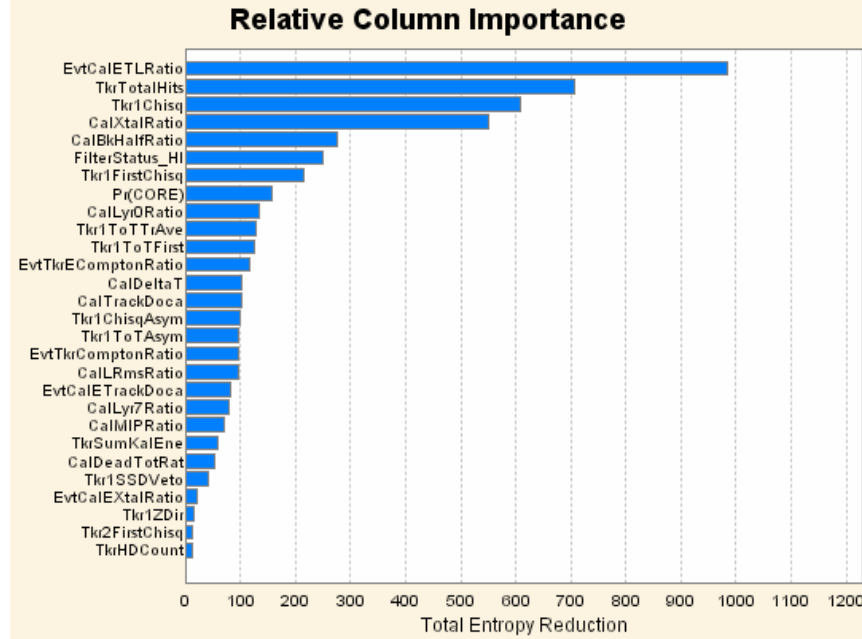
γ s : BGEs = 8264 : 8226
(90.8% : 21.7%)



1Tkr & CAL-Low

Continued

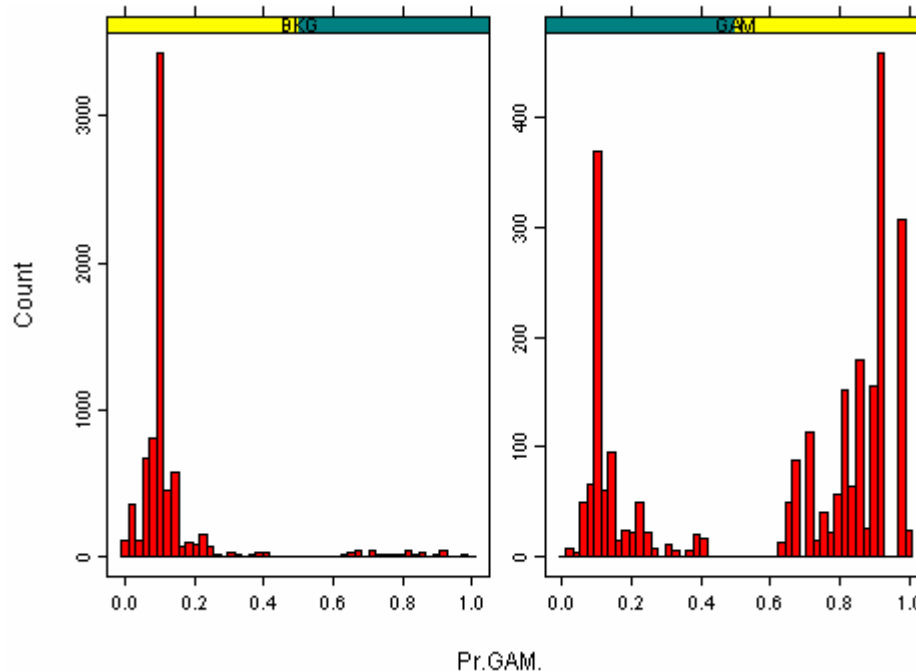
Prob.Cut > .5 Kills all
but 343 BGEs while
leaving 4920 γ s
(54.1% : .9%)



Input Node - 1Tkr CT				
		Predicted		Totals
		BKG	GAM	
Observed	BKG	7883	343	8226
	GAM	936	1957	2893
Totals		8819	2300	11119

	Observed		Overall
	BKG	GAM	
% Agree	95.8%	67.6%	88.5%

Positive Category - GAM		
Recall	Precision	F-Measure
67.6%	85.1%	75.4%

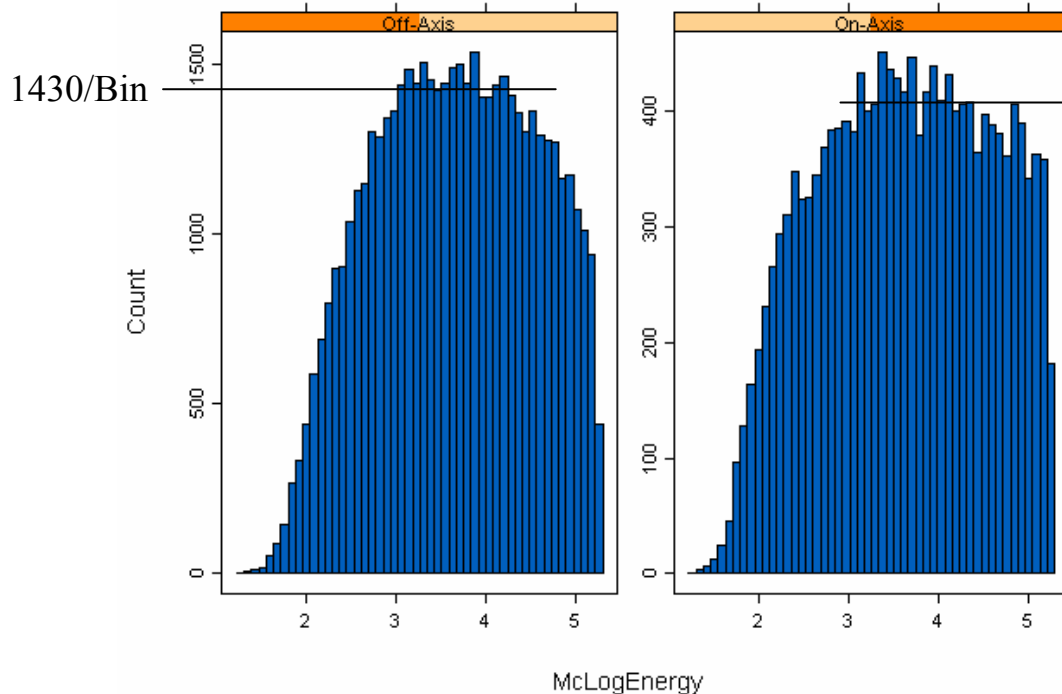
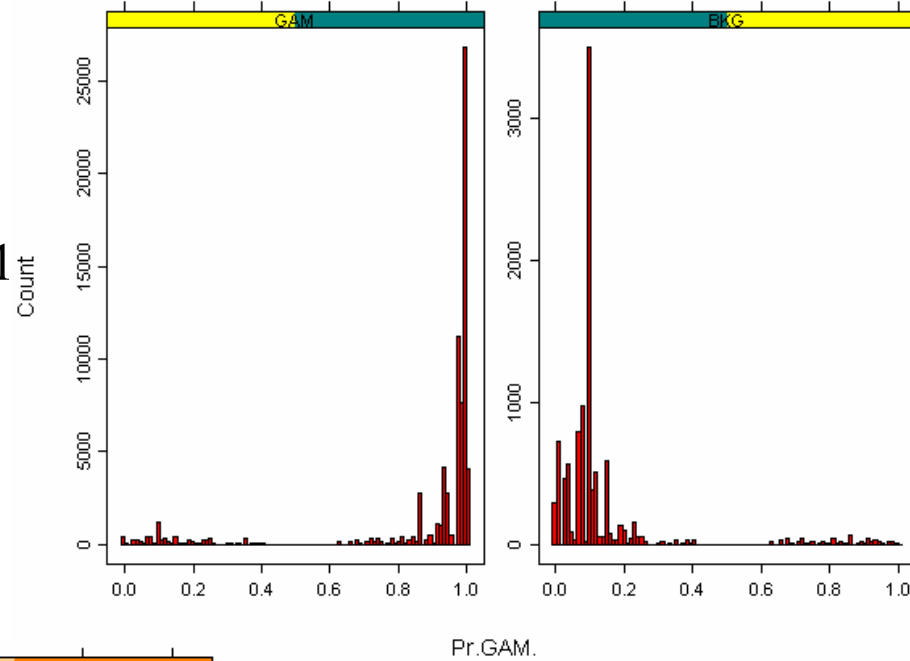


Post Pre-Filter/CT Assessment

γ s : BGEs = 78250 : 64473

Pre-filter Stage: γ s : BGEs = 71740 : 10381
(91.7% : 16.1%)

Prob.GAM > .5
 γ s : BGEs = 65899 : 547
(84.2% : .8%)



$$A_{\text{eff}} (\text{On-Axis}) = .925 \text{ m}^2$$

$$410 \times 50\text{bins} / 1.33 \times 10^5 * 6\text{m}^2$$

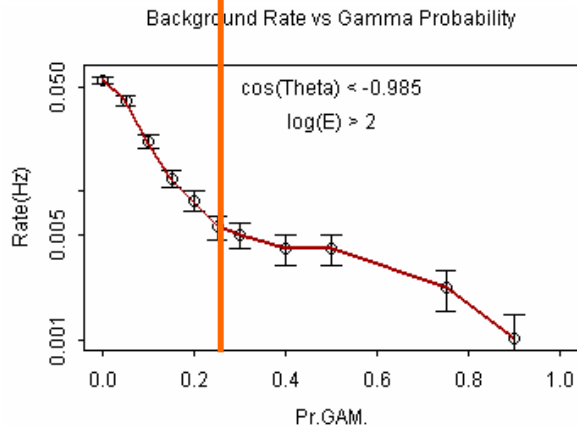
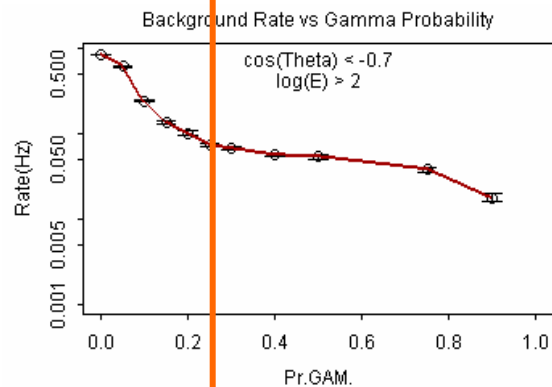
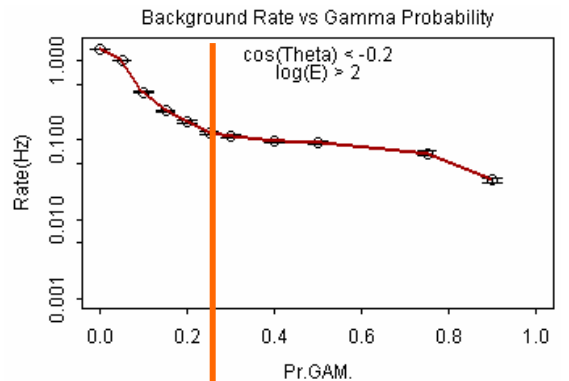
$$\text{Total: } 410 + 1430 = 1840$$

$$A_{\text{eff}} \times \Delta\Omega = 2.61 \text{ m}^2\text{-str}$$

$$1840 \times 50\text{bins} / 1.33 \times 10^6 * 37.7 \text{ m}^2\text{-str}$$

Residual BGE Rate
.11 Hz

Background Rates



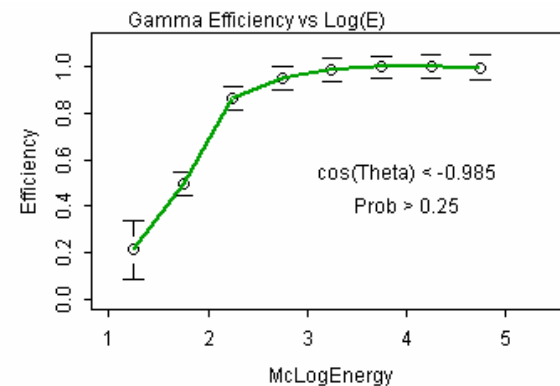
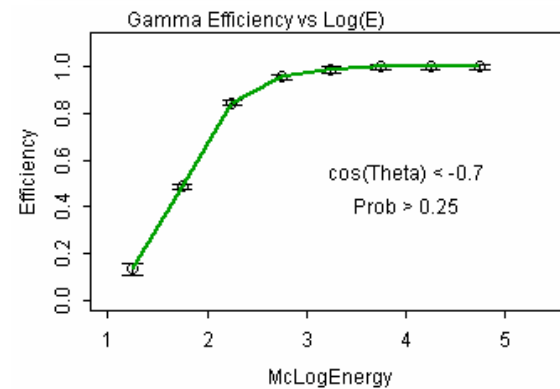
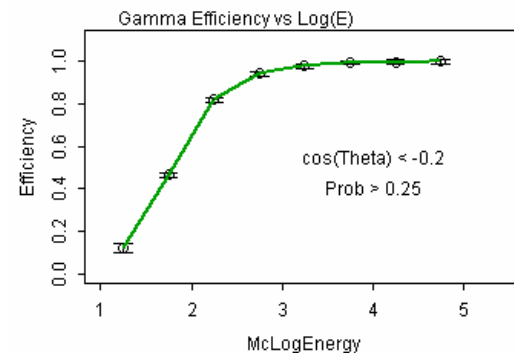
Full FoV

Central 45°

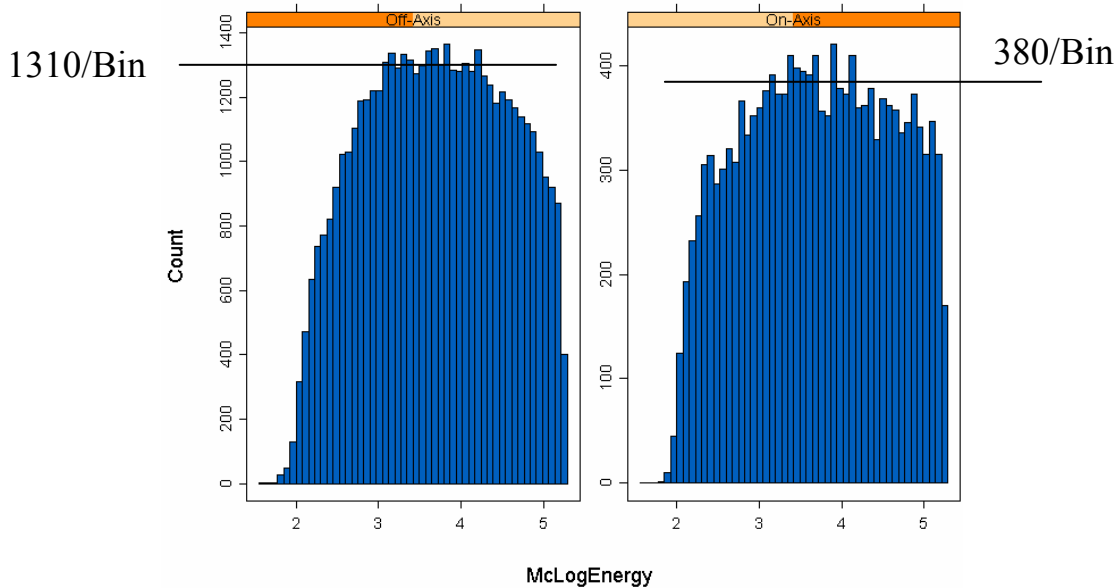
Central 10°

Gamma Efficiency

Prob > .25



Restrict Energy & FoV: Best.ZDir < -.3 & EvtEnergySumOpt > 100



$$\gamma_s : \text{BGEs} = 63258 : 344$$

$$(71.8\% : .070 \text{ Hz})$$

$$A_{\text{eff}} (\text{On-Axis}) = .857 \text{ m}^2$$

$$380 \times 50\text{bins} / 1.33 \times 10^5 * 6\text{m}^2$$

$$\text{Total: } 380 + 1310 = 1690$$

$$A_{\text{eff}} \times \Delta\Omega = 2.40 \text{ m}^2\text{-str}$$

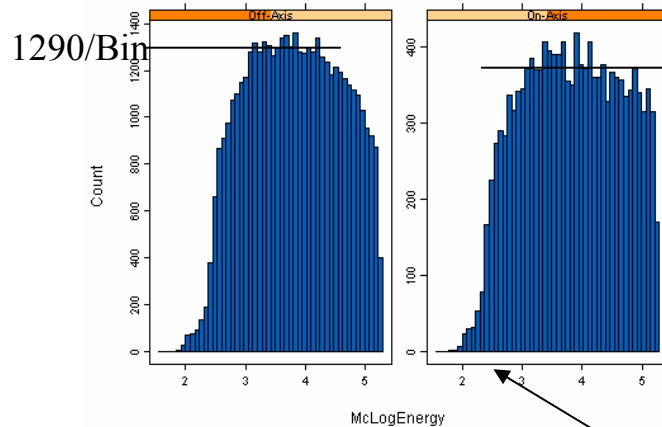
$$1690 \times 50\text{bins} / 1.33 \times 10^6 * 37.7 \text{ m}^2\text{-str}$$

Using only Pr(GAM) & EvtEnergySumOpt > 100 MeV & Best.ZDir < -.3:

Pr(GAM) > .9

γ s : BGEs = 58037 : 138
(66% : .028 Hz)

$R_{\text{Diffuse}} = .36 \text{ Hz}$



380/Bin

$A_{\text{eff}} (\text{On-Axis}) = .857 \text{ m}^2$

$380 \times 50\text{bins} / 1.33 \times 10^5 * 6\text{m}^2$

Total: $380 + 1290 = 1670$

$A_{\text{eff}} \times \Delta\Omega = 2.37 \text{ m}^2\text{-str}$

$1670 \times 50\text{bins} / 1.33 \times 10^6 * 37.7 \text{ m}^2\text{-str}$

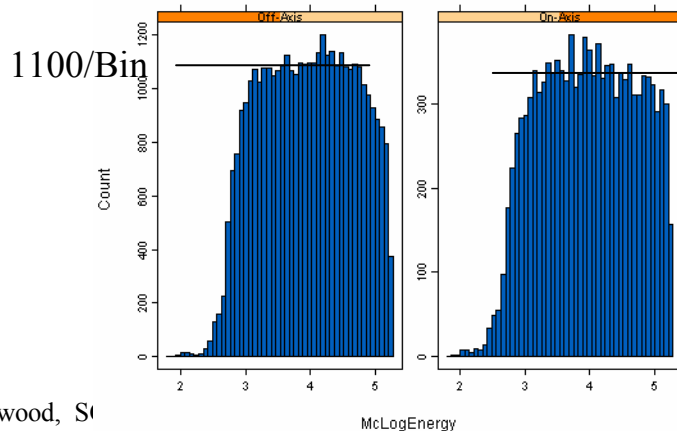
S/N = 13 : 1

Note low efficiency at 100 MeV

Pr(GAM) > .95

γ s : BGEs = 49534 : 50
(56% : .01 Hz)

$R_{\text{Diffuse}} = .31 \text{ Hz}$



340/Bin

$A_{\text{eff}} (\text{On-Axis}) = .767 \text{ m}^2$

$340 \times 50\text{bins} / 1.33 \times 10^5 * 6\text{m}^2$

Total: $340 + 1100 = 1460$

$A_{\text{eff}} \times \Delta\Omega = 2.07 \text{ m}^2\text{-str}$

$1460 \times 50\text{bins} / 1.33 \times 10^6 * 37.7 \text{ m}^2\text{-str}$

S/N = 31 : 1

What's Left?

344 Events

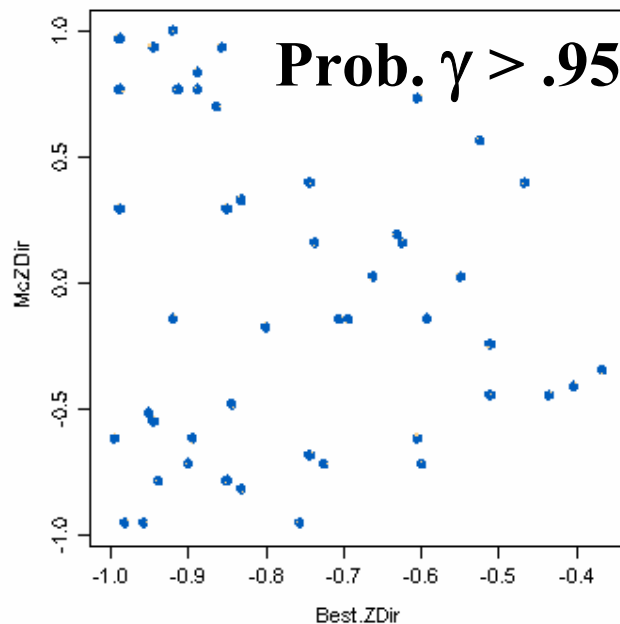
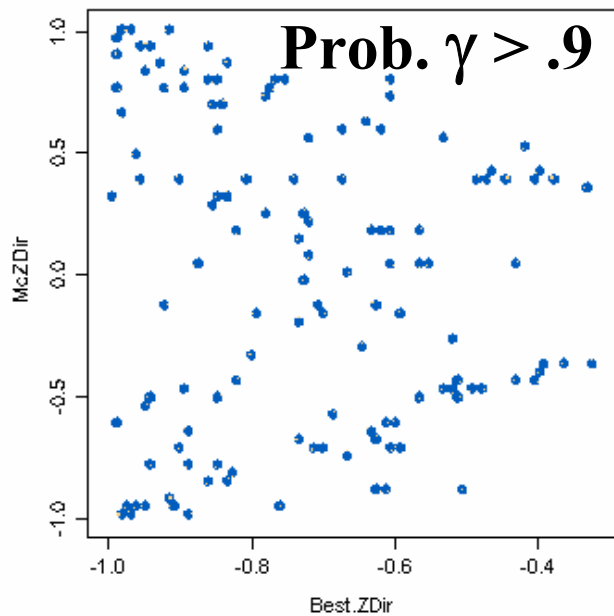
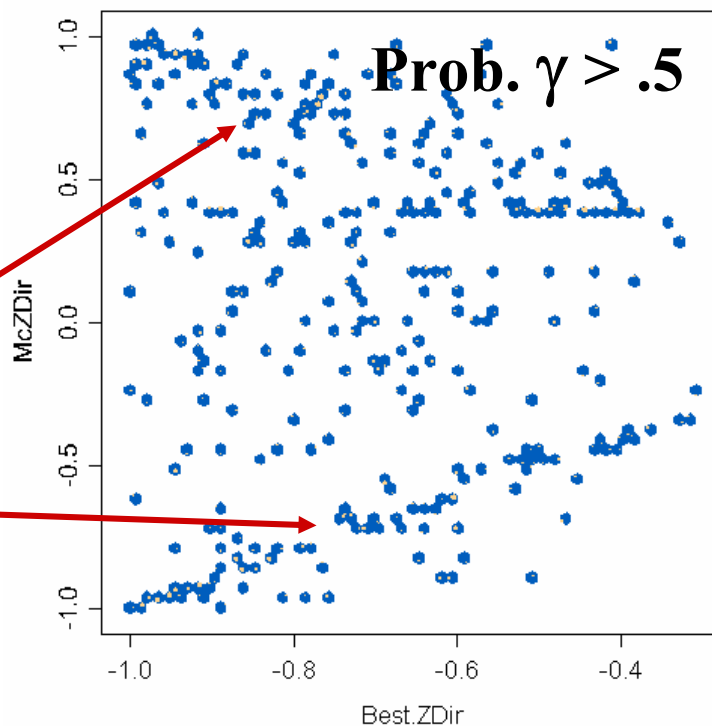
Downward moving events

More Geometry Errors?

Upward moving events

ToT not enough

CAL MIP Finder



Where Do We Go From Here?

1) Use Better Energy Estimate in Kalman Fits

Presently $\sim 1/2$ of the events at high energy fit with less than 50% of the correct energy!

2) Fix Bugs

- Even - Odd Effect
- Missing Co-ordinate in Measured Hits

3) Improvements in Tracker measurement utilization

4) Improve Calorimeter Analysis

- Cluster Finding
- MIP Finding
- Improve Leakage & Edge Corrections

5) Separate Topological Event Classification from gamma Reconstruction

7) Repeat Analysis utilizing a "by-hand" approach

8) Run $\sim 500\text{M}$ Background Events