# Background Rejection: Pass4 & Handoff Review

Bill Atwood & Friends

# Pass 4 Punch List (from 30-Jan-2006 C&A VRVS Meeting)

1) Change event axis in CalValsCorrTool to Tkr1 definition (thanks – P. Bruel)

2) New ACD Variable (addition to AcdValsTool)

Distance of closest approach to an ACD Ribbon

(whether not Ribbon fired)

Suggested Alg.:

a) determine if trajectory goes out top (0) or which of the 4 sides (1-4).

b) depending on entering surface – loop over all ribbon segments

c) keep and report smallest value.

This avoids having to check the POCA for each DOCA calc. and limits the sampled ribbon segments to only those on the entering surface.

Suggested nTuple Var. name: AcdTkrRibbonDoca

3) New Tkr. Vars. (Additions to TkrValsTool)

TkrLATEdge = 742 – max(abs(Tkr1X0), abs(Tkr1Y0))

(presently this appears as CTBTrkLATEdge in the nTuple)

Track Dispersion: Mean-square distance between track start locations relative to Tkr1

$$TkrDispersion = \frac{1}{(N_{Tkrs}-1)} \sum_{2}^{N_{Tkrs}} \Delta\vec{X}_i \text{ if } \hat{t}_i \cdot (\Delta\vec{X}_i) > 0 \text{ else } \left|\Delta\vec{X}_i\right|^2 - (\hat{t}_1 * \Delta\vec{X}_i)^2$$

where $\Delta\vec{X}_i = (\vec{X}_i - \vec{X}_1)$

If $N_{Tkrs} < 2$ TrkDispersion = 0.

4) New Trk-Cal Variables – Where to put them? – Historically these have gone into CalValsTool.

CalTkrXtalDispersion: Dispersion of Cal. Xtals about Tkr1 Tracjectory weighted by energy (?)

$$CalTkrXtalDispersion = \frac{1}{E_{CalRaw}} \cdot \sum_{i=1}^{N_{Xtals}} ((\vec{X}_i - \vec{X}_{Tkr1})^2 - ((\vec{X}_i - \vec{X}_{Tkr1}) \cdot \hat{t}_{Tkr1})^2) \cdot E_i$$

CalTkrXtalDispTrunc: Same as above after throughing out 10% furthest (Not largest contributors) tracks

## Data Reprocessing Requirements

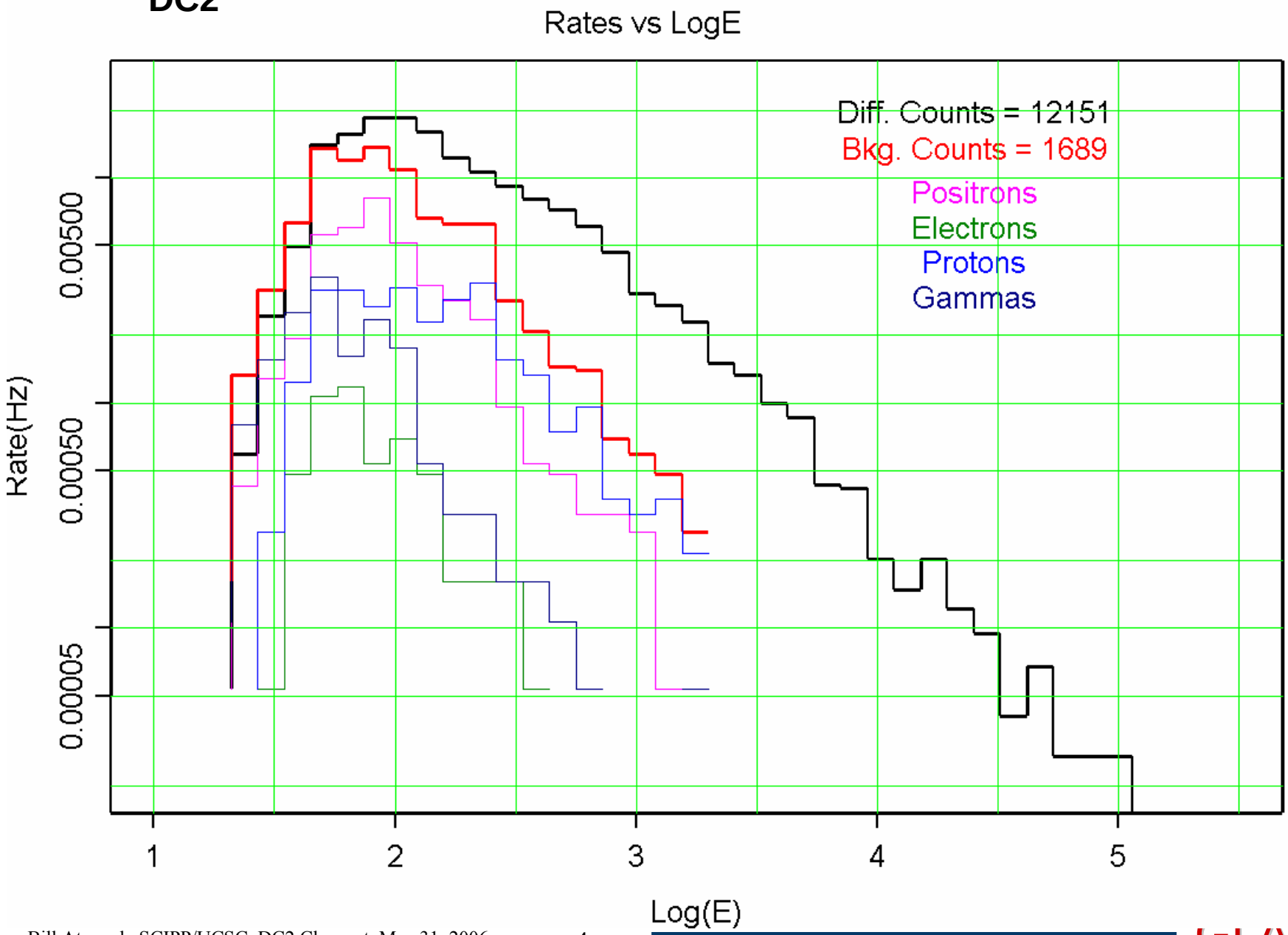
Data: the All Gamma Run (V7r3p4 which is a repo of v7r3p1) – need 2M

Background: the 5B run using v7r3p5

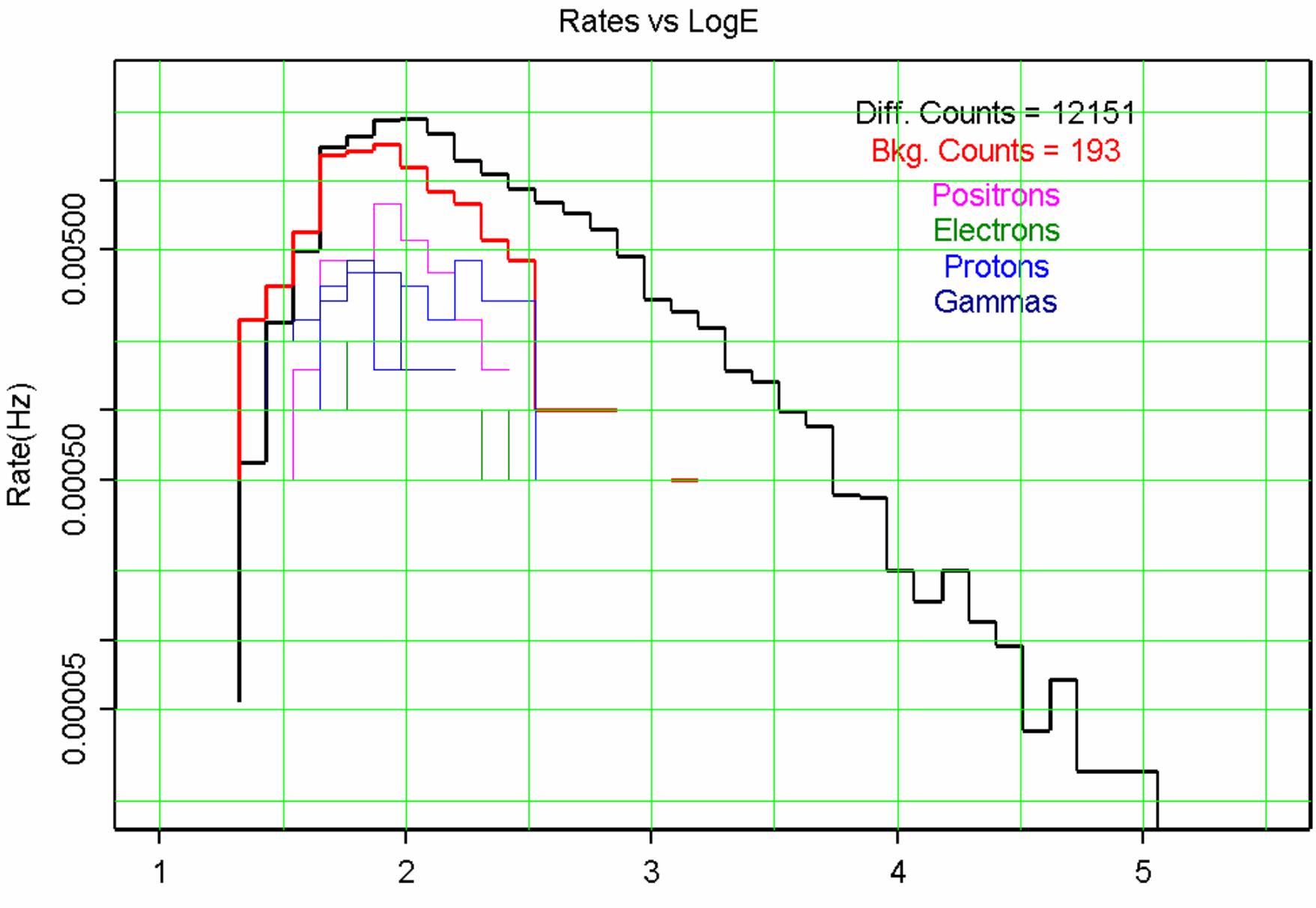
Diffuse: the 1 day using v7r3p5

**NOW v9r6**

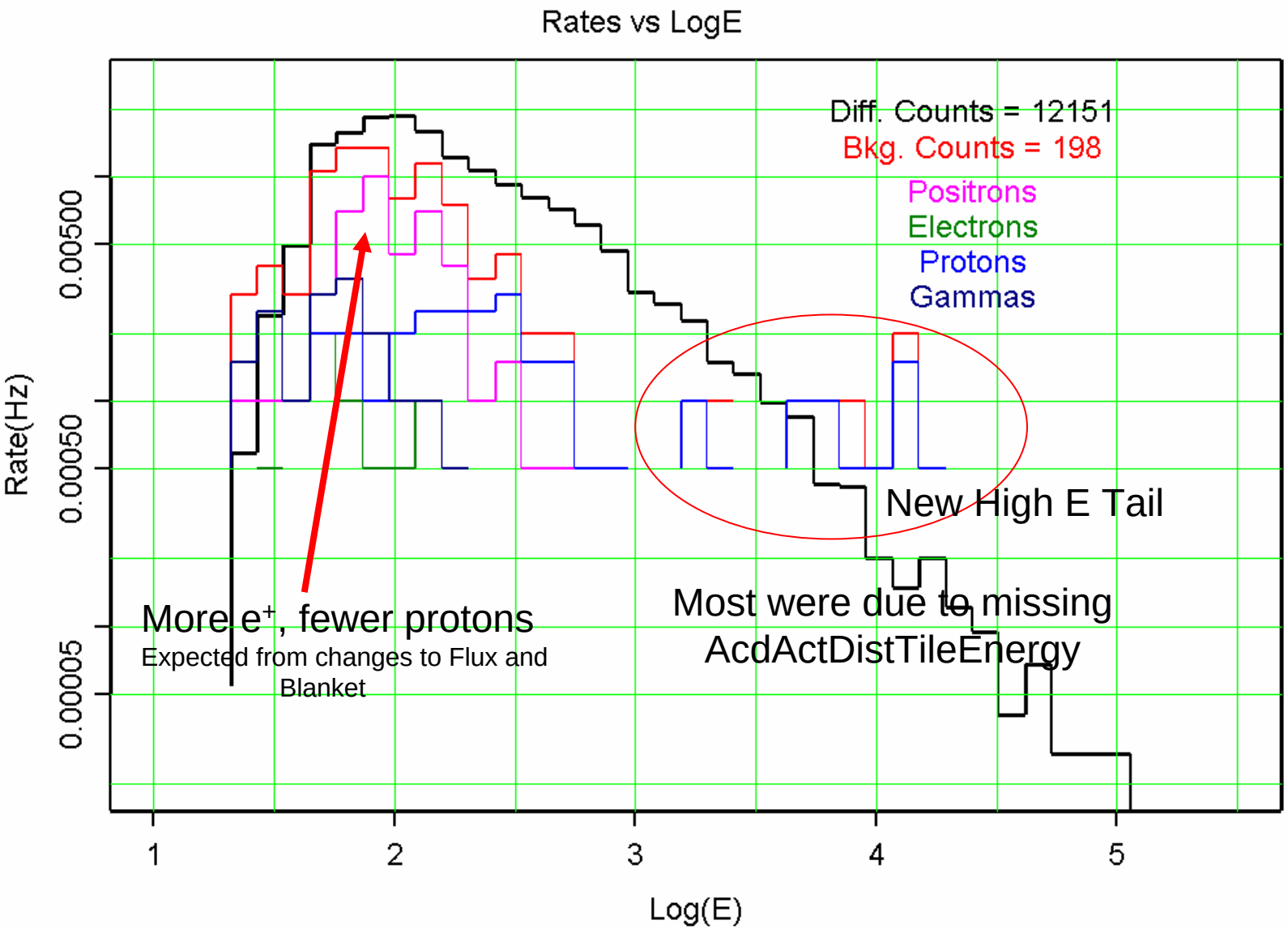
# DC2


Rates vs LogE
Diff. Counts = 12151
Bkg. Counts = 1689
Positrons
Electrons
Protons
Gammas
Rate(Hz)
0.00500
0.00050
0.00005
1
2
3
4
5
Log(E)

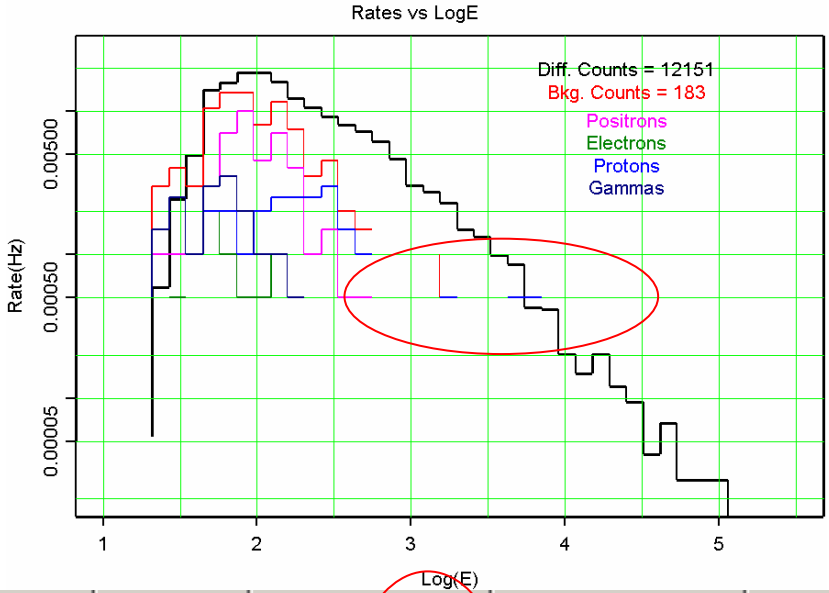
# V9r3 – First Verification of G4, Gaudi, and Root Updates



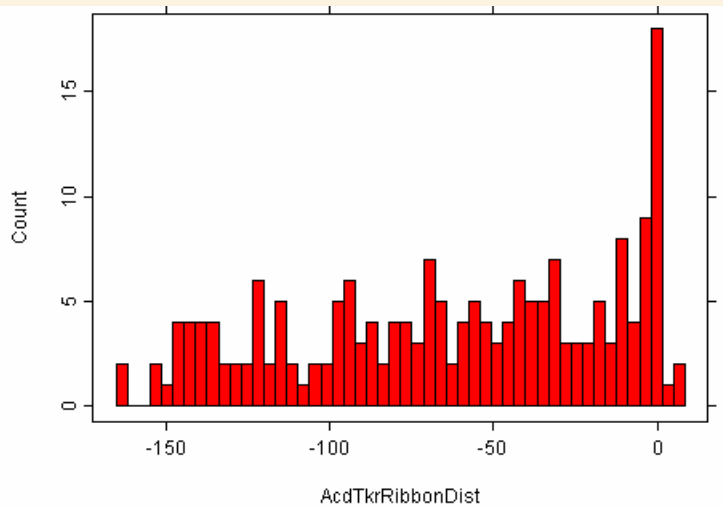
# V9r4: Add the new ACD Geometry & Variables



# V9r6: Have we arrived?




| | McSourceId | McCharge | McEnergy | McZDir | AcdTkrRibbonDist | AcdTkr1RibbonDist | CTBBestZDir | CTBBestEnergy | McSource.Type |
|---|---|---|---|---|---|---|---|---|---|
| | continuous | continuous | continuous | continuous | continuous | continuous | continuous | continuous | categorical |
| 1 | 1,000.00 | 1.00 | 8,147.99 | 0.41 | -49.38 | -2,000.00 | -0.50 | 4,551.47 | P Primary |
| 2 | 1,000.00 | 1.00 | 24,583.60 | -0.96 | -43.24 | -43.24 | -0.96 | 6,747.66 | P Primary |
| 3 | 1,000.00 | 1.00 | 230,293.00 | -0.91 | -118.03 | -118.03 | -0.94 | 54,891.50 | P Primary |
| 4 | 1,000.00 | 1.00 | 29,614.30 | -0.96 | 1.21 | 1.21 | -0.96 | 17,389.20 | P Primary |
| 5 | 1,000.00 | 1.00 | 6,534.49 | -0.91 | -136.54 | -142.16 | -0.89 | 3,956.76 | P Primary |
| 6 | 1,000.00 | 1.00 | 17,111.60 | -0.75 | -3.36 | -54.62 | -0.80 | 6,172.06 | P Primary |
| 7 | 1,000.00 | 1.00 | 874,999.00 | -0.88 | 0.78 | 0.78 | -0.88 | 198,213.00 | P Primary |
| 8 | 1,000.00 | 1.00 | 16,249.60 | -0.90 | -33.49 | -33.49 | -0.91 | 7,503.34 | P Primary |

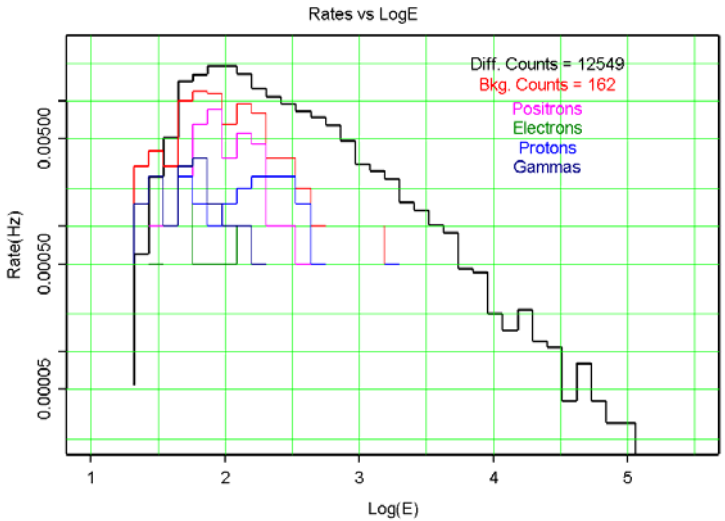


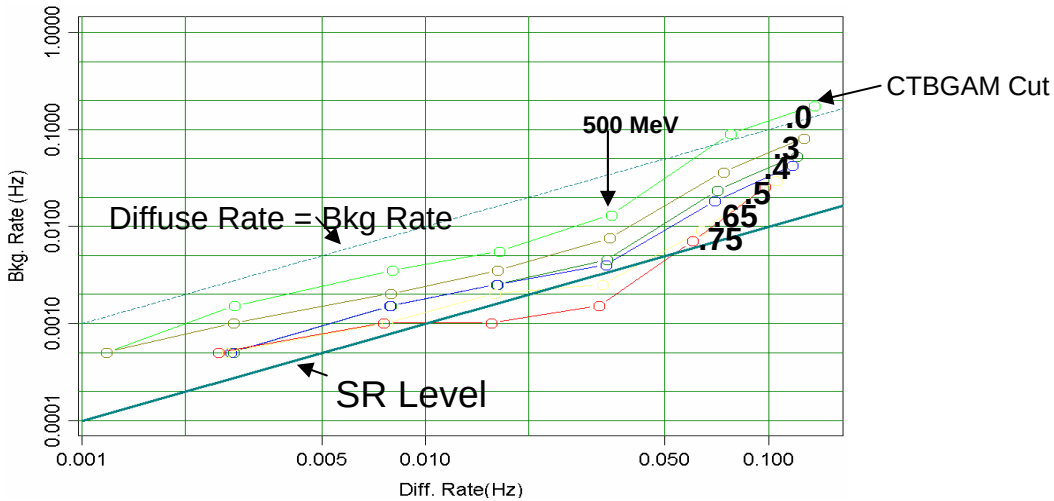

DC2 Analysis had X – Y swapped.

Eric to the rescue!

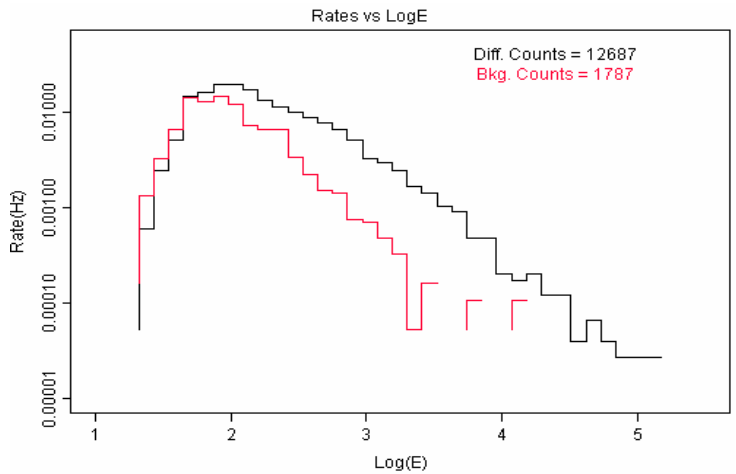
Cutting on AcdTrkRibbonDist kills most of the high energy tail

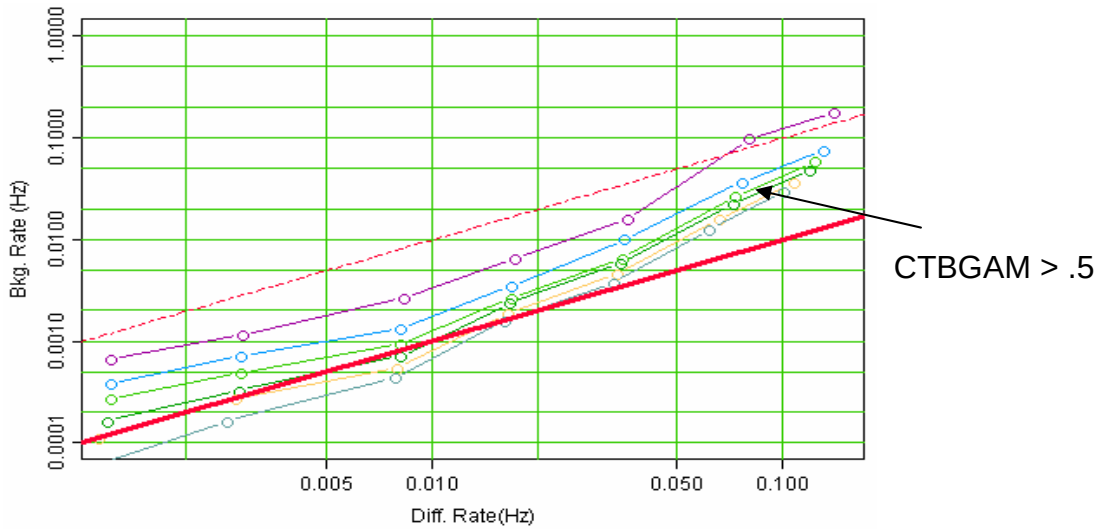
# **YES!** This is where Pass 4 starts!



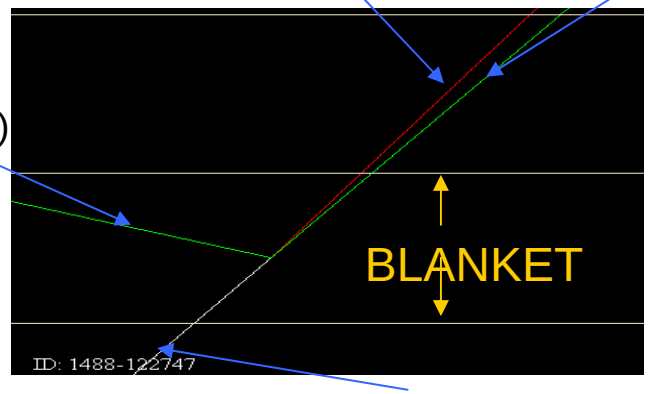

## **DC2 Base Class 3** – Post-Processing Filters & CTBGAM Boost at Low Energy



**Irreducible Backgrounds**: Proton interactions in the Blanket

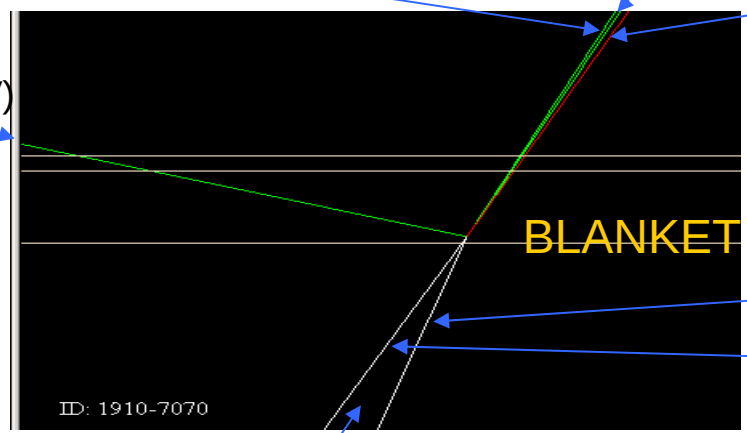
Event 1488 - 122747




Charge Conservation?

2 γs from $\pi^0$ decay (7.2 GeV) +
neutron (not shown – 8.9 GeV)

Event 1910 - 7070

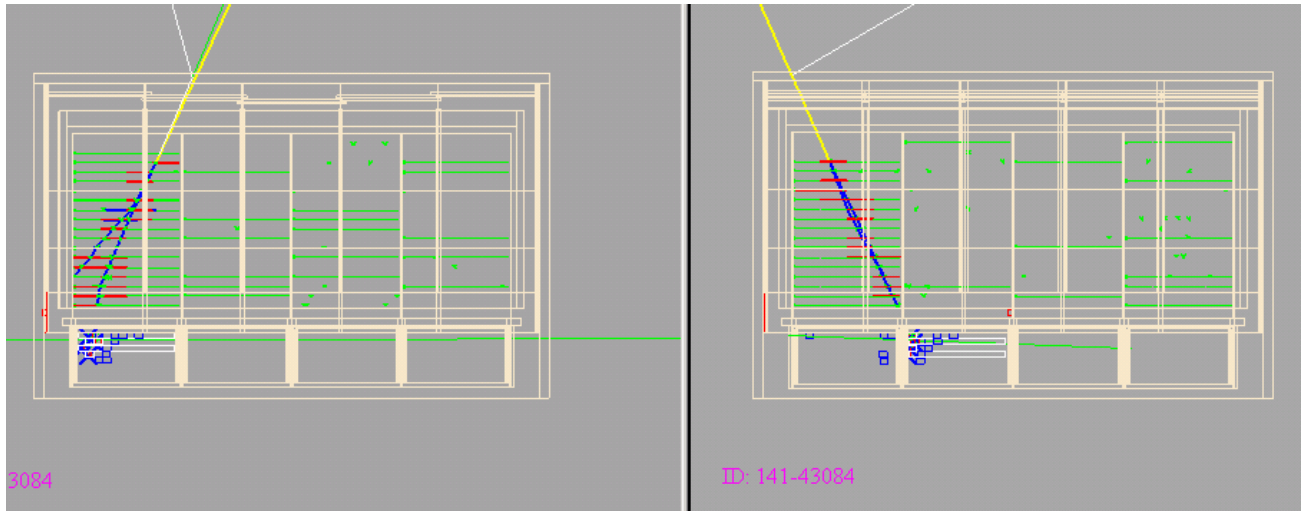



$\pi^0$ -> 2γ *not shown* (6.1 GeV)

**Irreducible Backgrounds**: Positron Annihilation in the Blanket

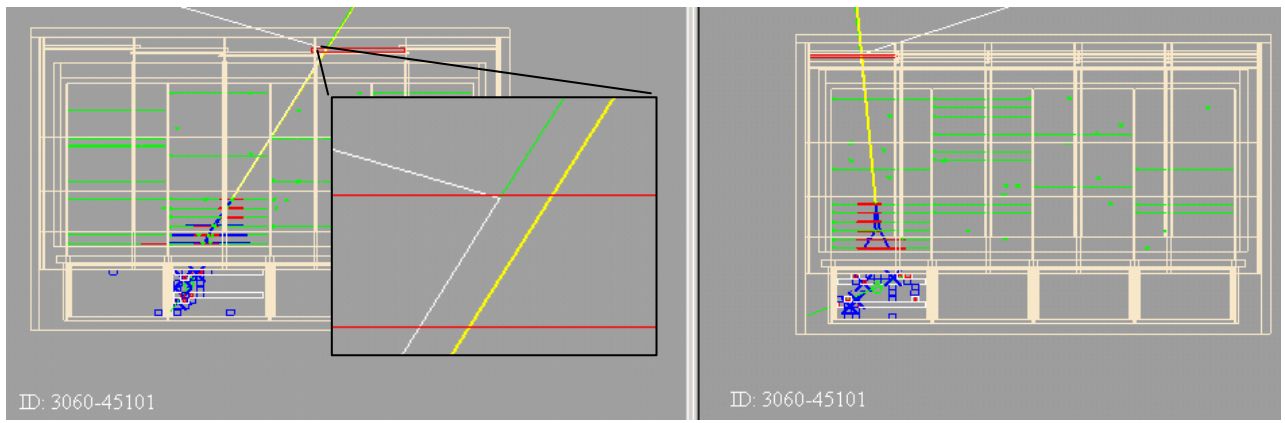
e+ Blanket conversion
$E_{e+}$= 288 MeV

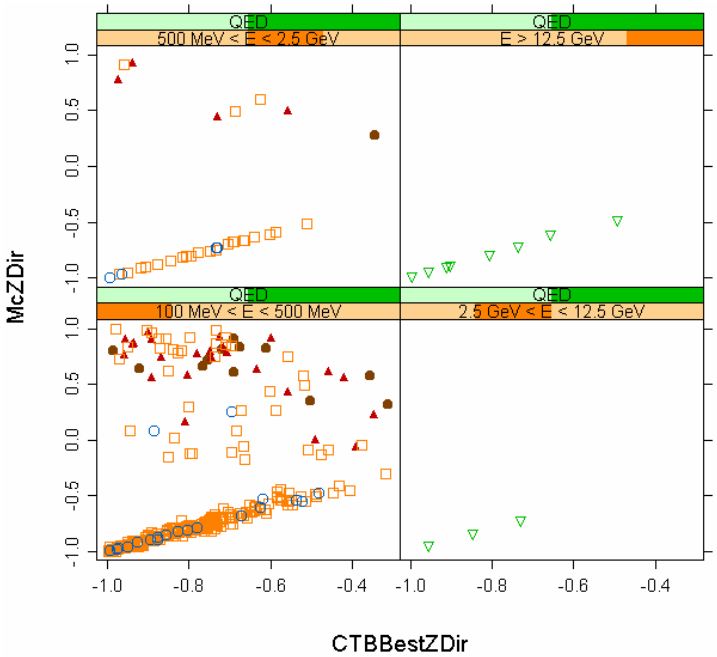
74 of these



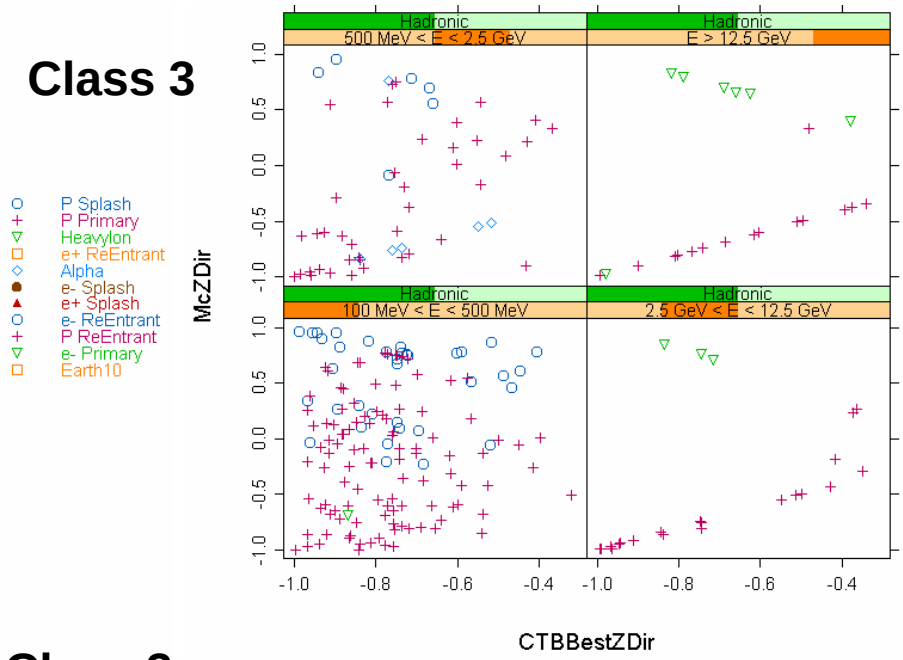

e+ Tile Conversion
134 MeV

a few of these –
counted as Blanket
conversions

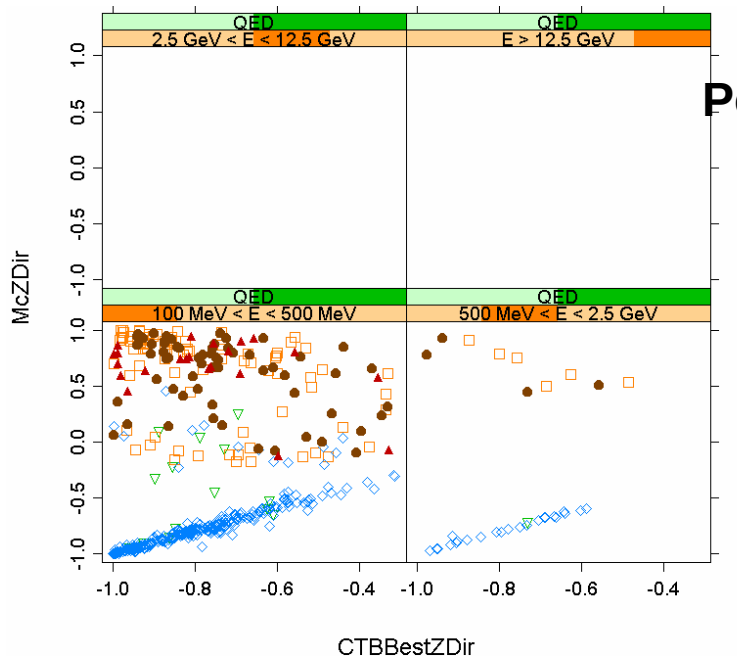


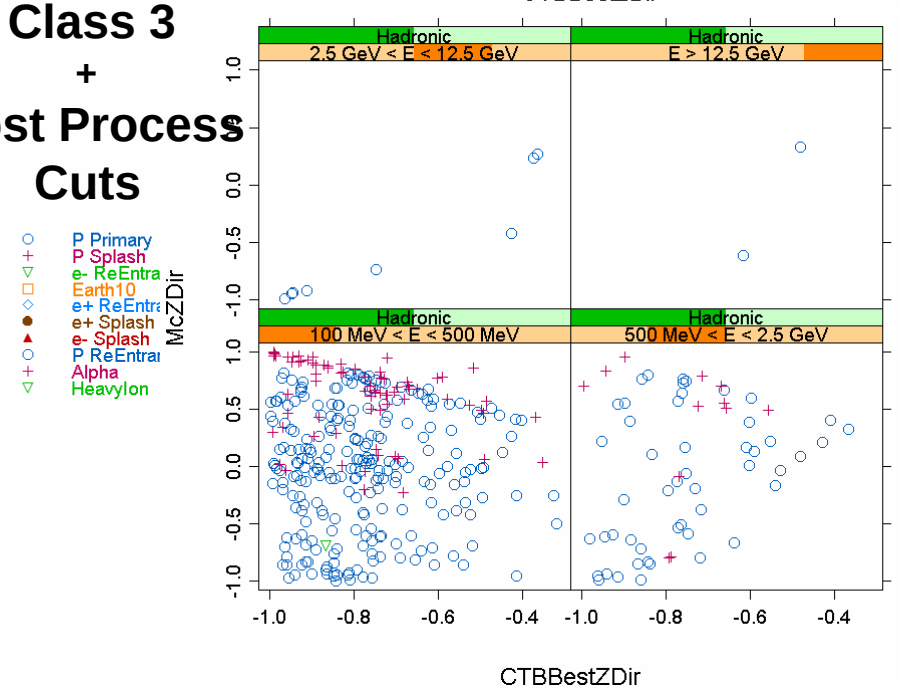



## Class 3



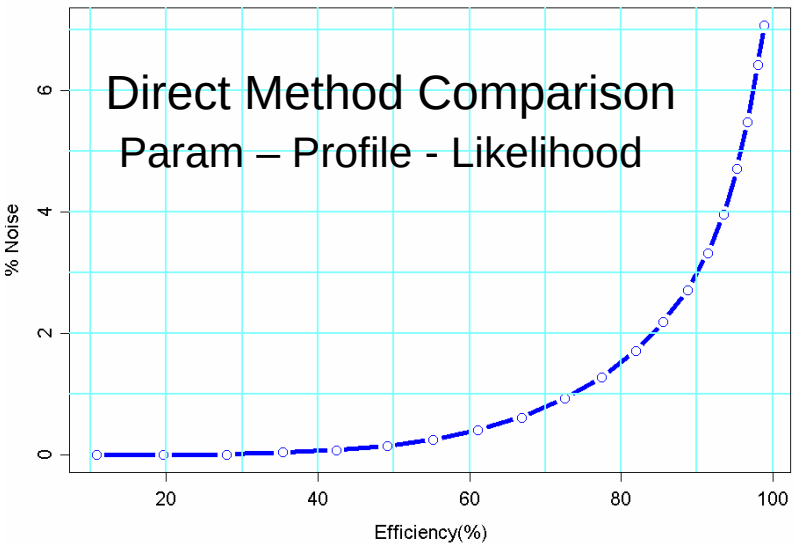

## Class 3 + Post Process Cuts

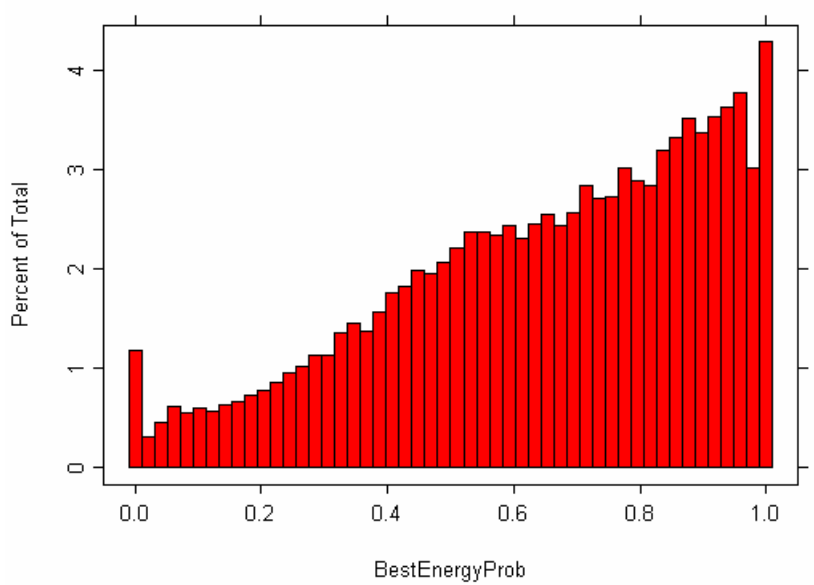


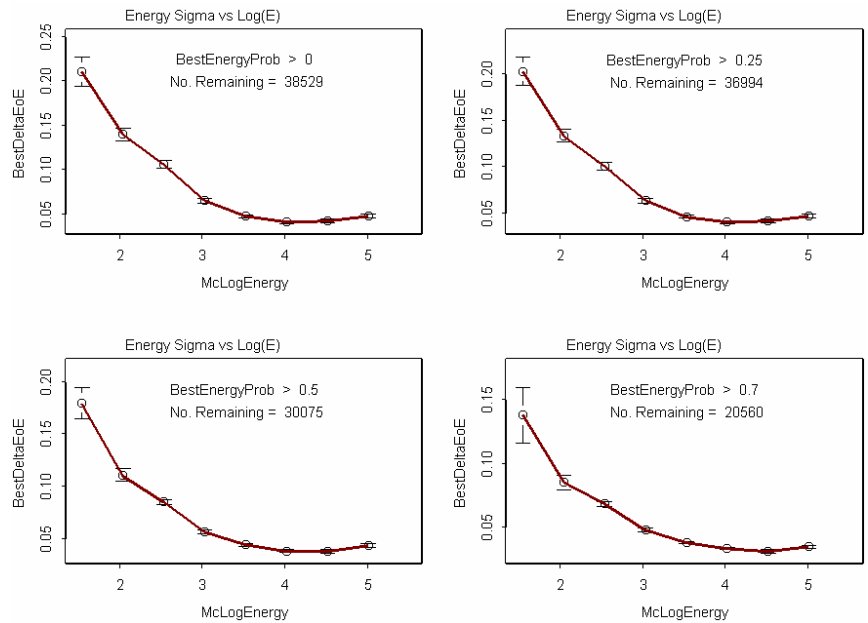



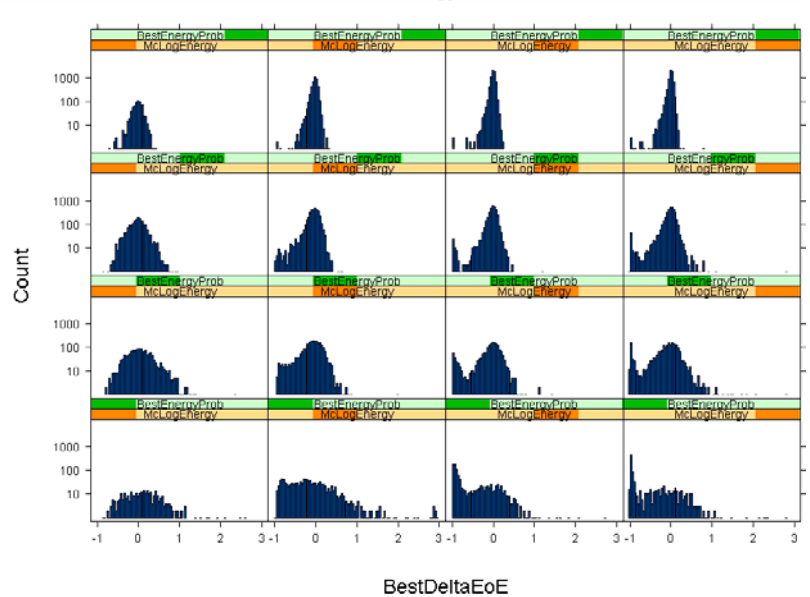

Careful: Order of Plots different Top to Bottom

# Pass 4 Energy Analysis Plots – New analysis due to new Likelihood Energy Alg.

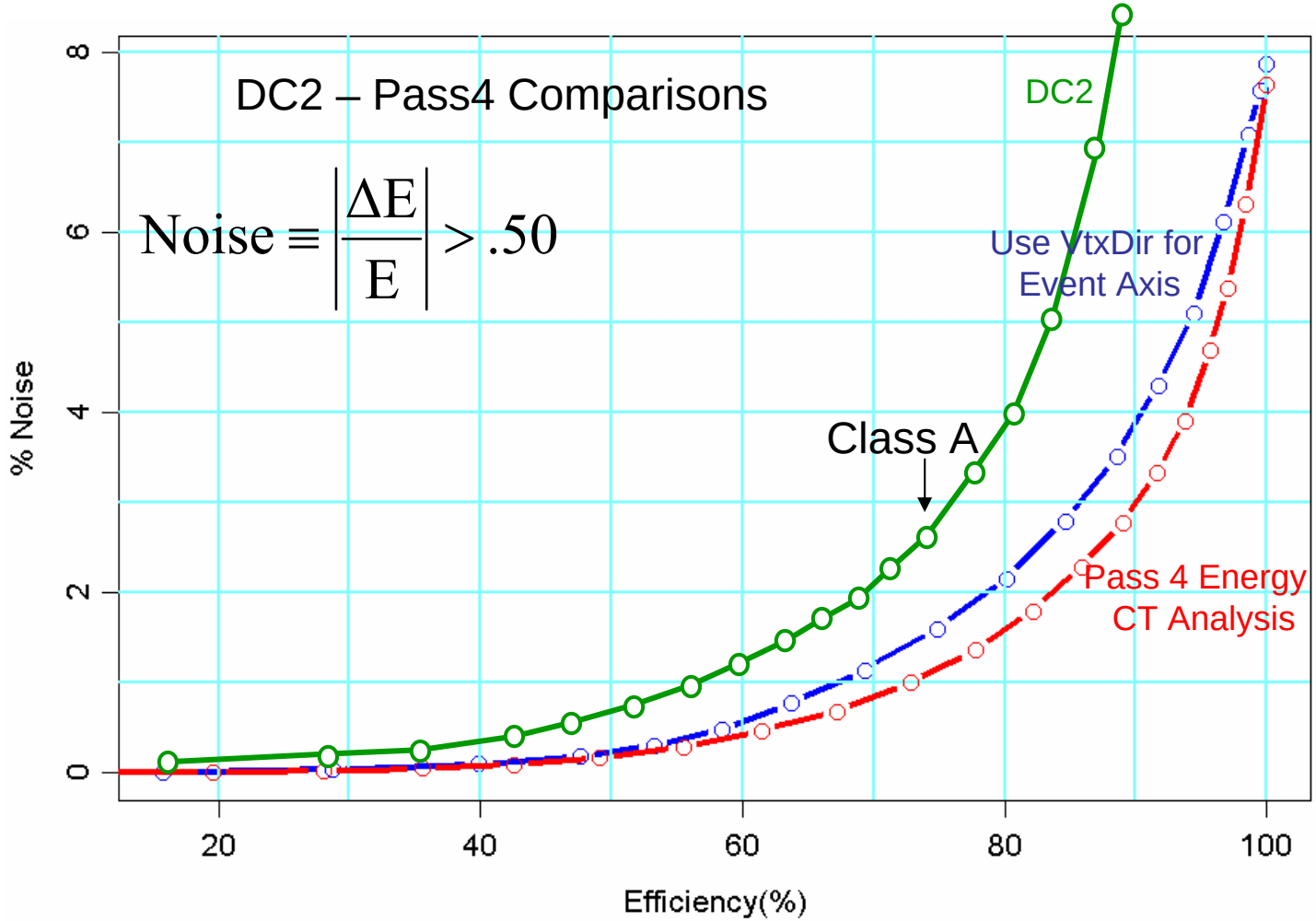


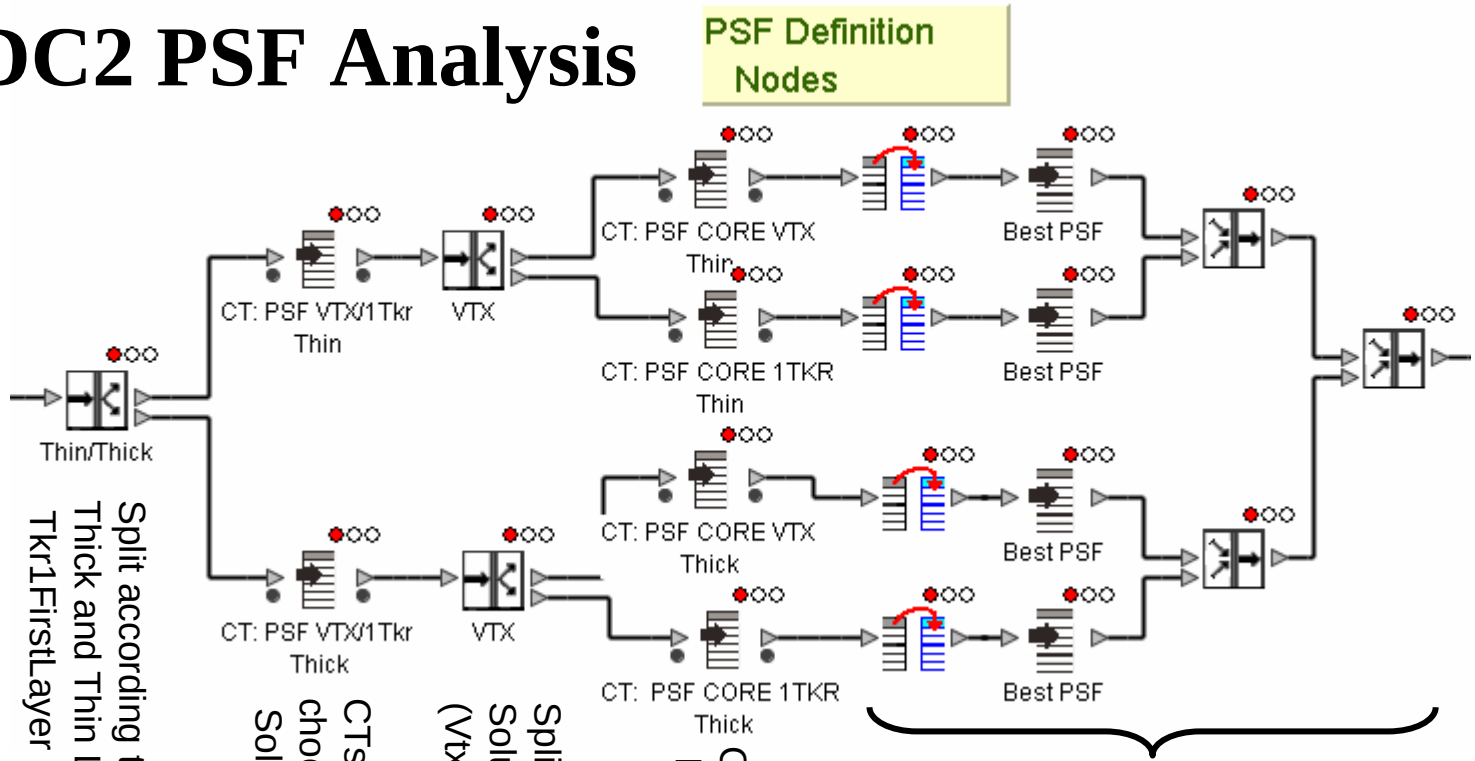



## Improvement over DC2



# DC2 PSF Analysis




Split according to Thick and Thin Layers: Tkr1FirstLayer 2-5 (Thick) or 6-17 (Thin)

CTs: Of Events with Valid VTX choose to use 1Tkr or VTX Solution: CTBVTX

Split according to VTX Solution (VtxAngle > 0 && CTBVTX > .5

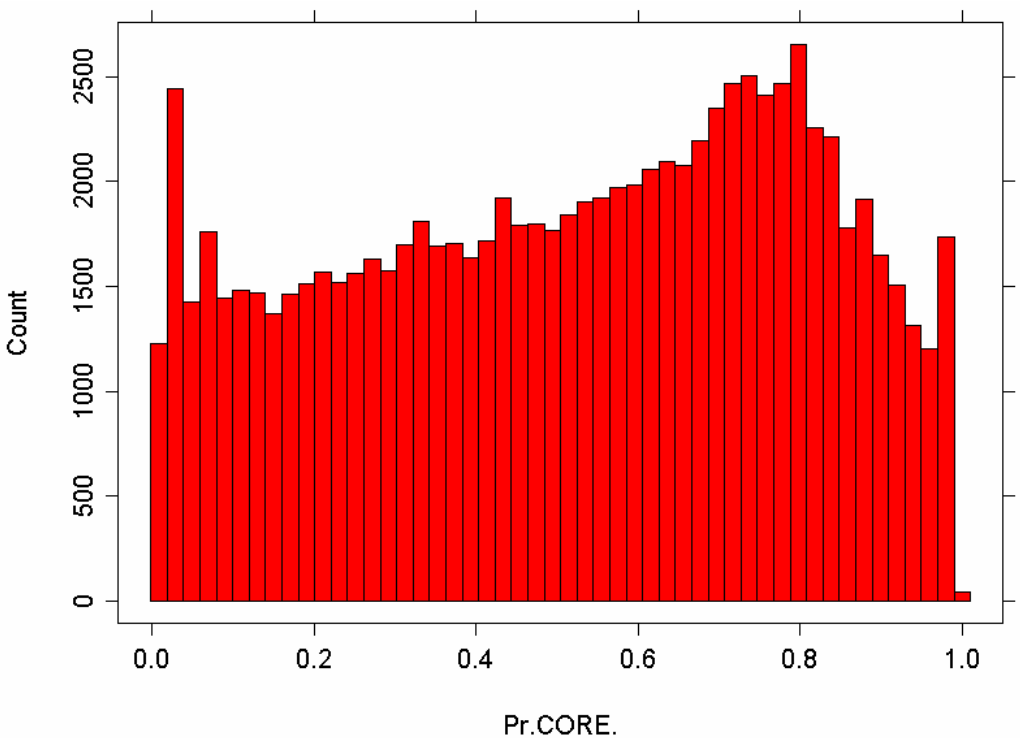
CTs: PSF Image Sharpening Produces CTBCORE Variable

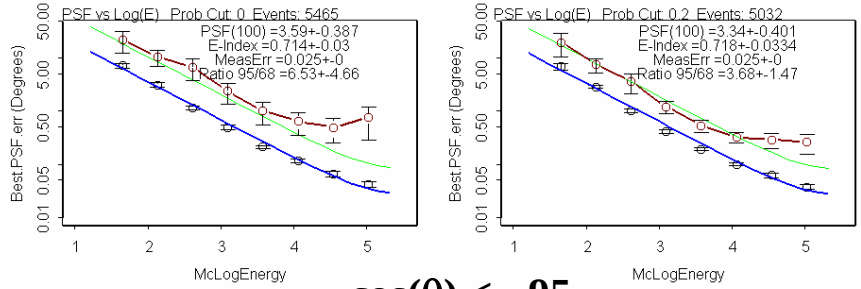
IM "glue" to put events back together and produce CTBBestXDir,YDir,ZDir and CTBCORE (the "good" PSF probability variable)

# DC2 PSF Analysis Results

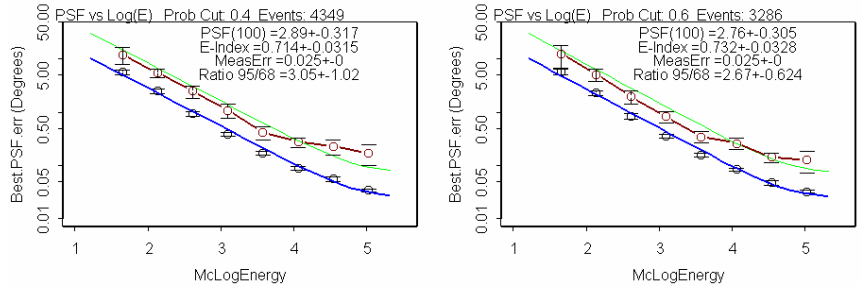
## What CTBCOR Does

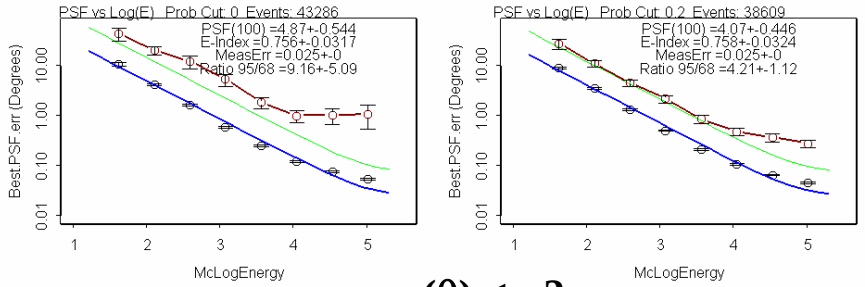
- On Axis can vary PSF by ~ 30%
  (at the expense of $A_{eff}$)
- The 95/68 Ratio improves significantly



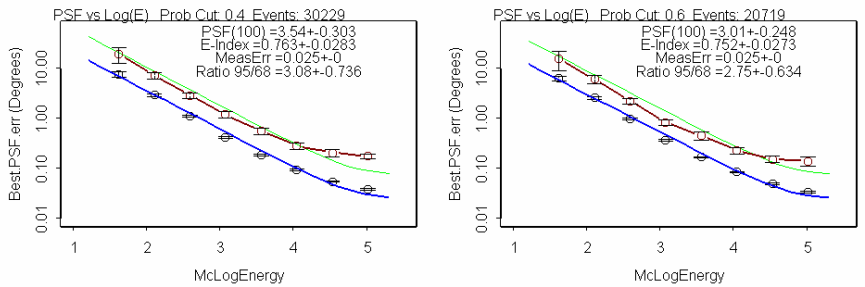




$\cos(\theta) < -.95$



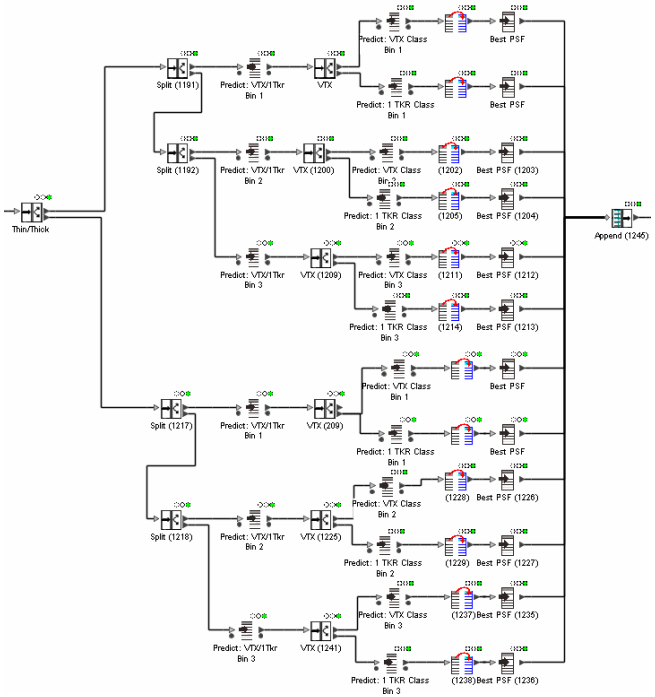

$\cos(\theta) < -.2$

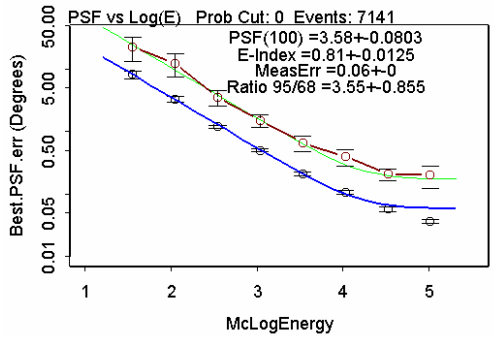


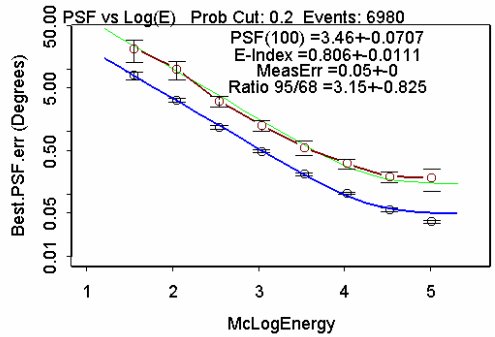
# Pass 4 PSF Analysis

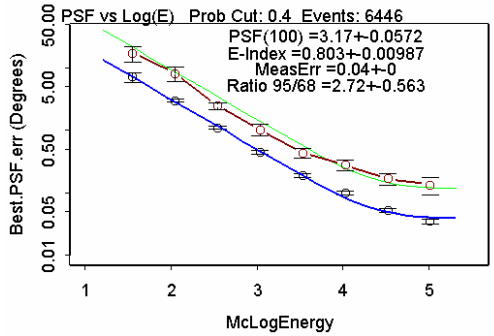
Break energy range into 3 bins:
< 350 MeV, 350-3500 MeV, > 3500 MeV

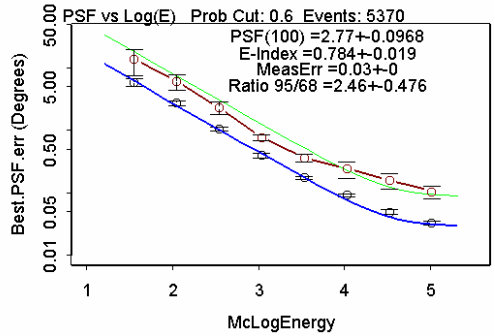
Increases No. of CT's by 3X

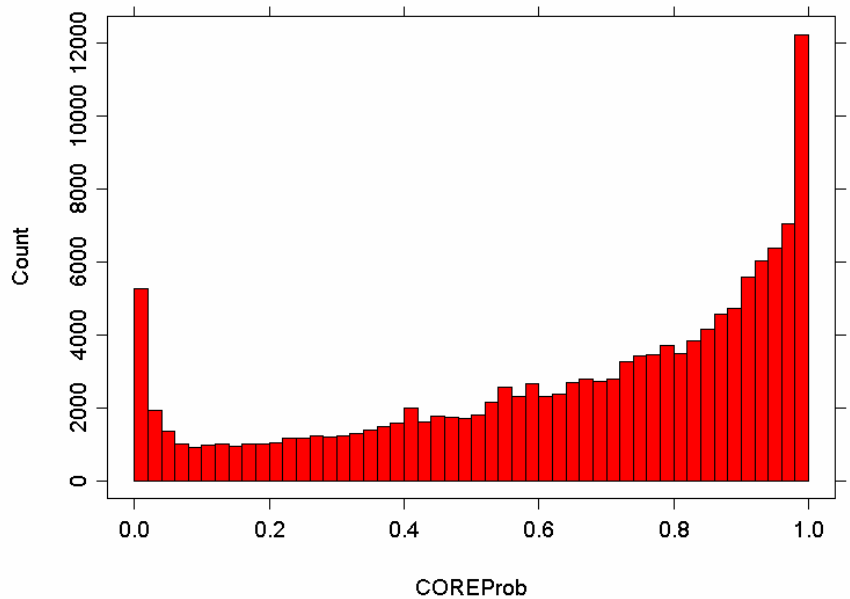



Results:
Core remains the same, but…
Ratio 95/68 improved by 11-14%

# Next Steps

**Redo Full Background rejection for PSR to Spectrum-Astro** (13-Sept-2006)

**Run increased statistics over DC2 in all catagories**

- All Gamma (IRFs)
- Background (to search for remaining “hot-spots” in phase space)
- Diffuse (for PSR)
- All Sky *a la DC2* (a years worth to continue and extend the work of DC2)

**Beam Test** (Starts at CERN in July!!!!!!!)

- Validate G4 Physics for rare processes now known to
- result in LAT irreducible backgrounds
- Verify energy reconstruction at > 100 GeV
- Validate G4 QED Shower back-splash into ACD
- Demonstrate PSF in Flight Hardware