Tower A: A First Look.

The First Data Runs made with Tower A
Are examined with regards to finding
Gamma Rays and Clean MIPs

The Data

Run 1338 Feb. 23, 2005
105524 Events
Duration ~ 1 Hour

At Least 1 Track Found
102118 Events

At Least 10 MeV in Cal
26954 Events

Topology Classes
Vtx: 2549 Events
1 Trk: 24405

Monte Carlo

All Gamma
SAS GR v6r2p1 ++
5×10^6 Events
37.7 m^2-str
18 MeV - 18 GeV

At Least 1 Track Found
38745 Events

At Least 10 MeV in Cal
11941 Events

Topology Classes
Vtx: 4925 Events
1 Trk: 7016

Similarly for a sample of Surface Muons

Note: Not the latest MC Runs – these are "Perfect Tower" Runs

Gamma Ray Finder by Classification Trees

First attempt:

Use real data as "Background" & "MC All Gammas"

Failed due to differences between MC and Data

CT's quickly found the differences!

Second Attempt:

Train CT's on pure Monte Carlo: Surface Muons and All Gammas

(This is the usual HEP approach)

First Cuts: (Use Tracker in self Veto Mode to replace ACD)

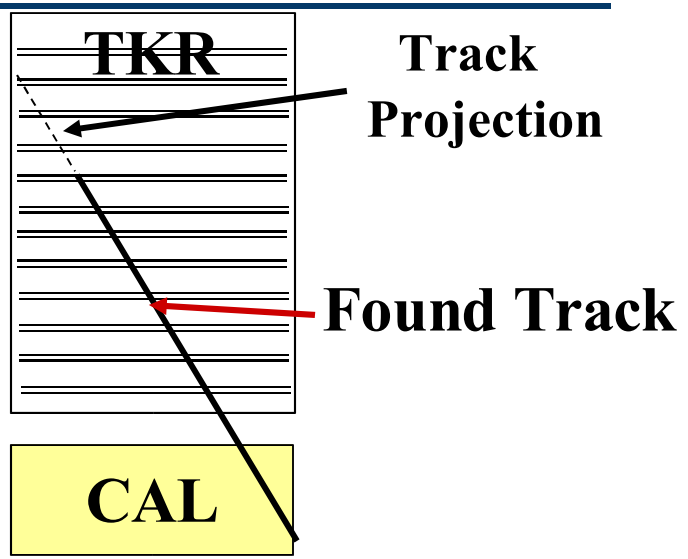
1 Trk Topology: Tkr1SSDVeto > 3

Vtx Topology: Tkr1SSDVeto > 1

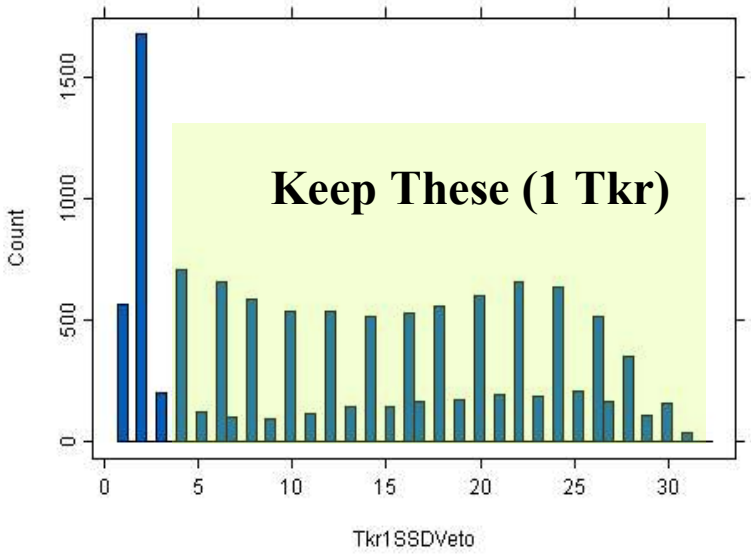
Tkr1SSDVeto

This variable is a count of the number of silicon planes the projected track crosses

Allows using the SSDs in the tracker as an ACD



Require: Tkr1SSDVeto > 1 (Vtx)
& Tkr1SSDVeto > 3 (1 Tkr)



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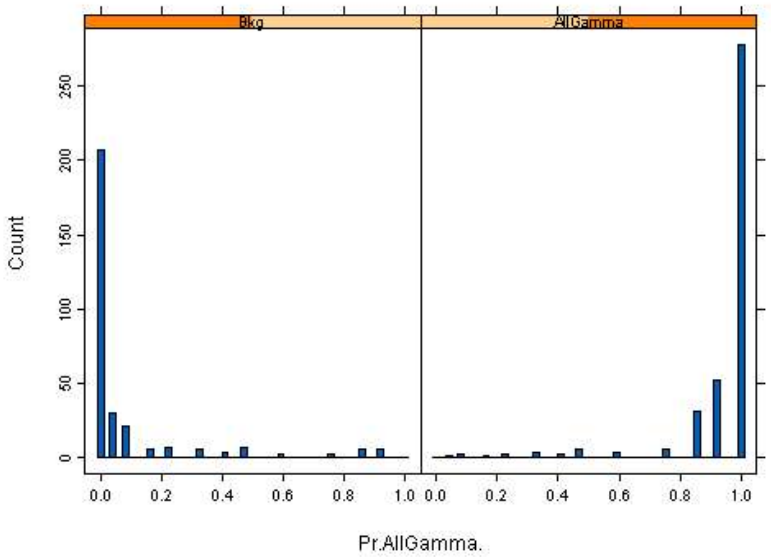
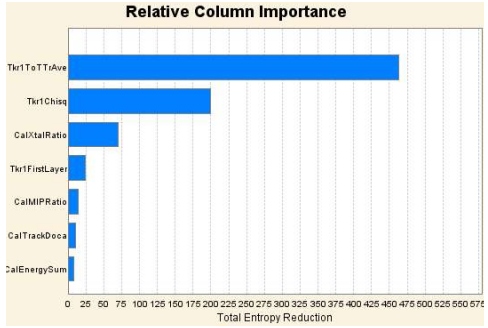
CT Details

1 Tkr





Input Node - 1 Tkr Gammas

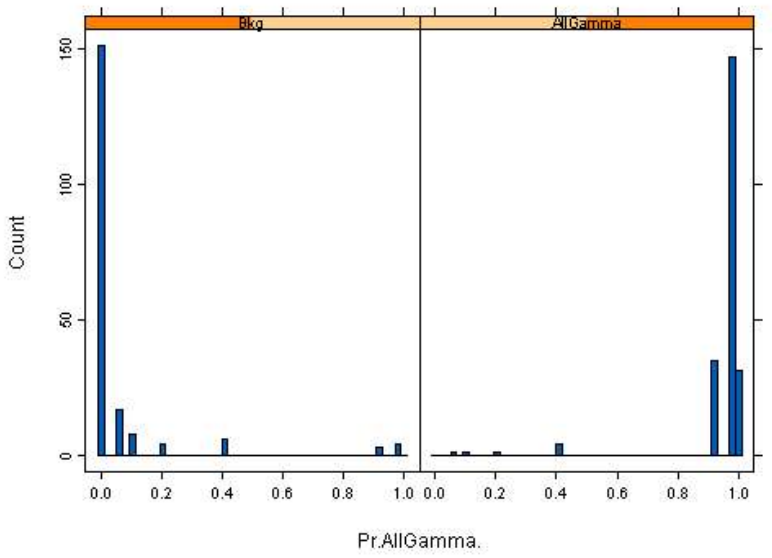
		Predicted		Totals
		Bkg	AllGamma	
Observed	Bkg	286	14	300
	AllGamma	17	370	387
Totals		303	384	687

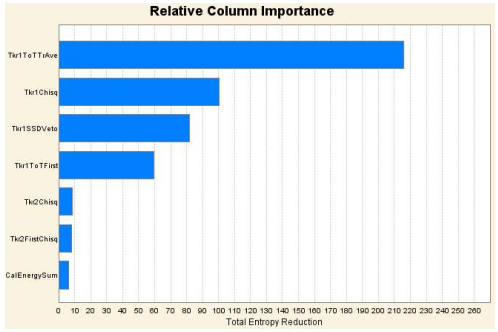
	Observed		Overall
	Bkg	AllGamma	
% Agree	95.3%	95.6%	95.5%

Positive Category - AllGamma

Recall	Precision	F-Measure
95.6%	96.4%	96.0%

Vtx





Input Node - Vtx Gammas

		Predicted		Totals
		Bkg	AllGamma	
Observed	Bkg	186	7	193
	AllGamma	7	213	220
Totals		193	220	413

	Observed		Overall
	Bkg	AllGamma	
% Agree	96.4%	96.8%	96.6%

Positive Category - AllGamma

Recall	Precision	F-Measure
96.8%	96.8%	96.8%

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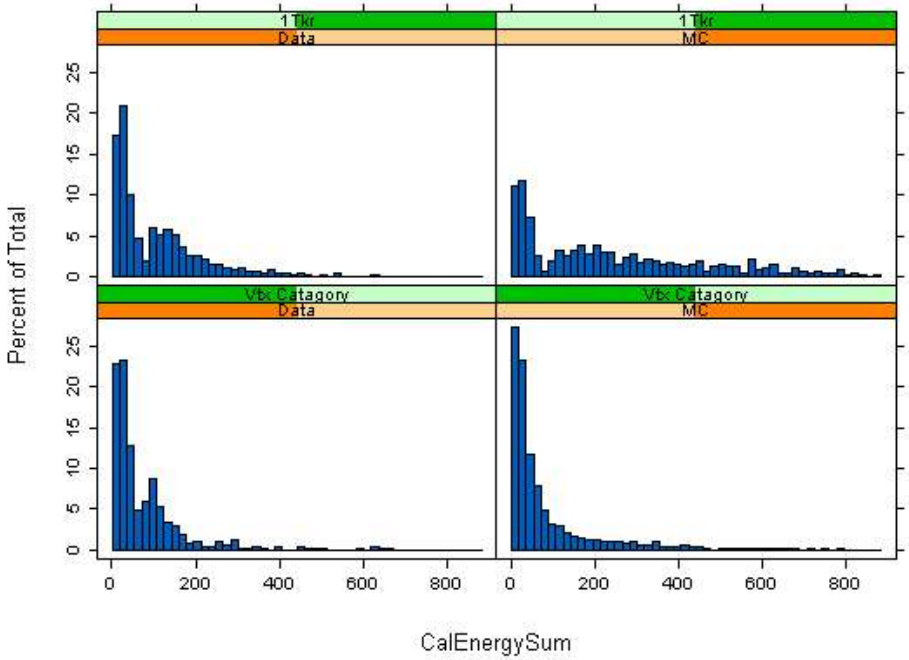
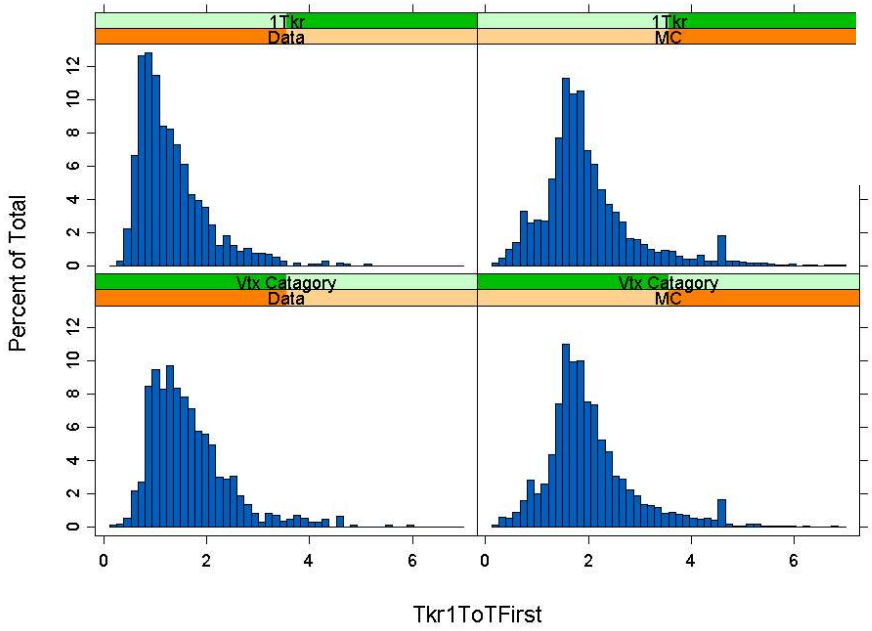
First Results

Demand Gamma.Prob > .90 (Vtx) &
> .98 (1 Tkr)

Use CalEnergySum as one of several Background Monitors

Clear presents of MIP like Energies





Trk1ToTFirst – will use this to clean-up

Cut: Tkr1ToTFirst > 1. (Vtx) and 1.5 (1Tkr)

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Better Results

Monte Carlo

All-Gammas surviving: 4827 Events → $A_{eff} \times \Delta\Omega = 364$ cm^2-str

Surface Muons surving: 4

$A_{Geom} = 1211$ cm^2 & Conversion Prob. ~ .5

A_{eff} (On Axis) ~ 600 cm^2

FoV ($\Delta\Omega$) ~ .6 str

Data

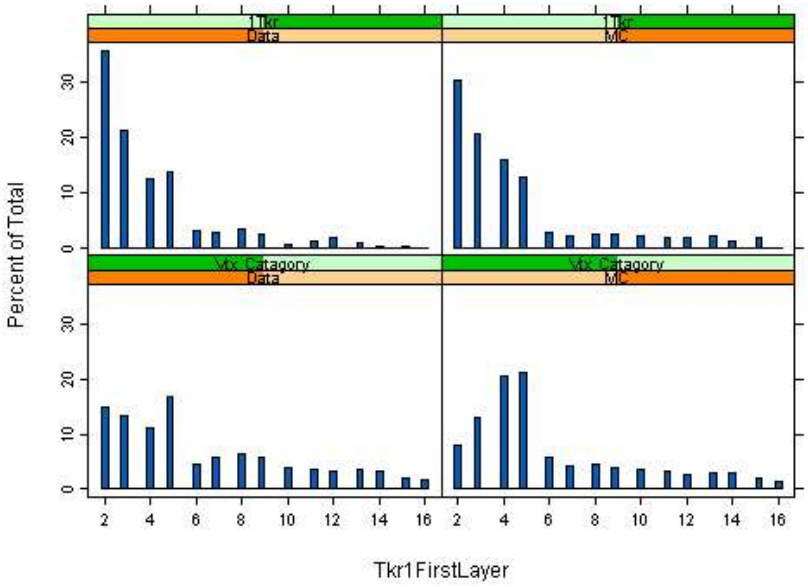
1 Trk: 353

Vtx: 912

Total: 1265 → Rate: ~ .35 Hz & Flux ~ 10^{-3}/cm^2-str-sec

Conversion Location by Track Layer

Note: (again) this MC run did not have dead strips...



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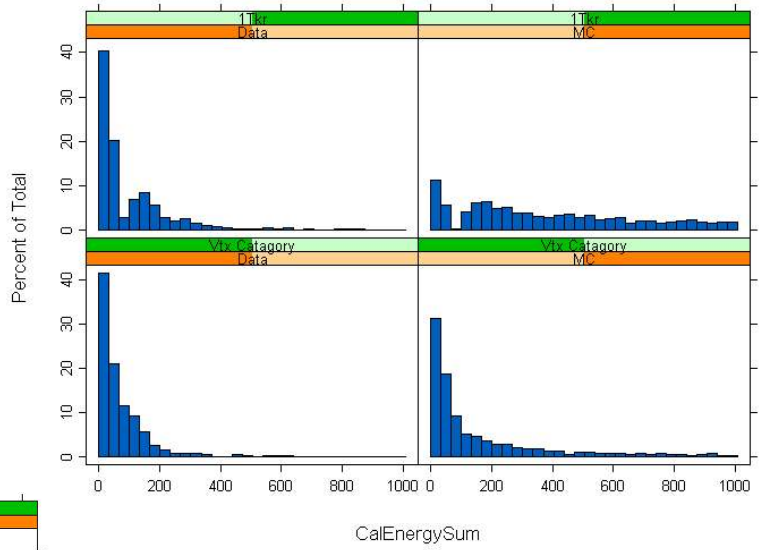
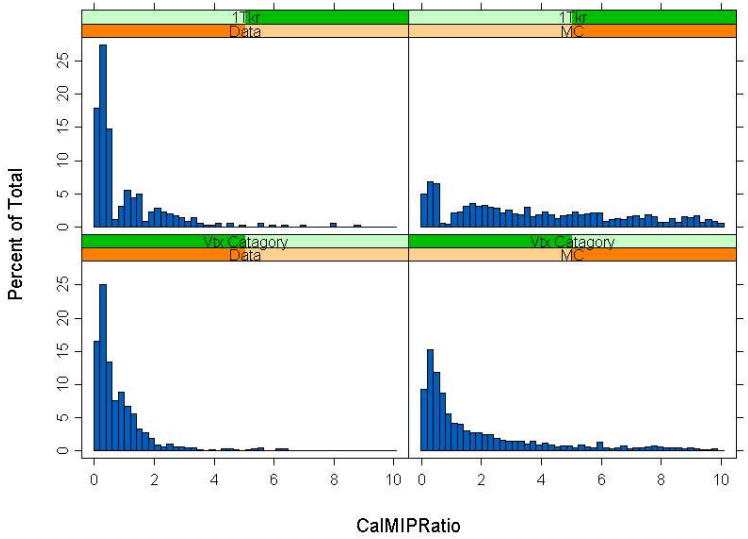
Gamma Candidate Plots

Background Monitors
Indicate Residual Bkg

CalEnergySum





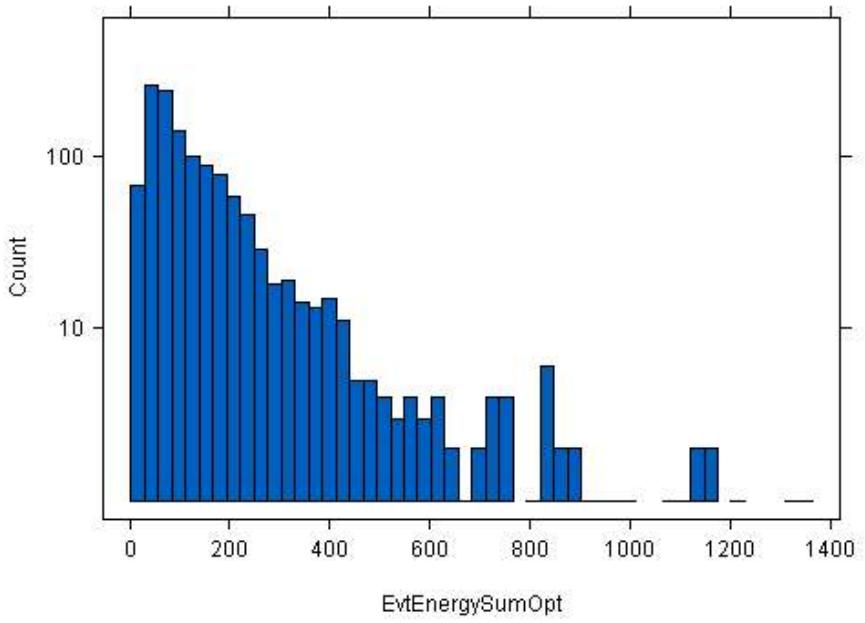
CalMIPRatio

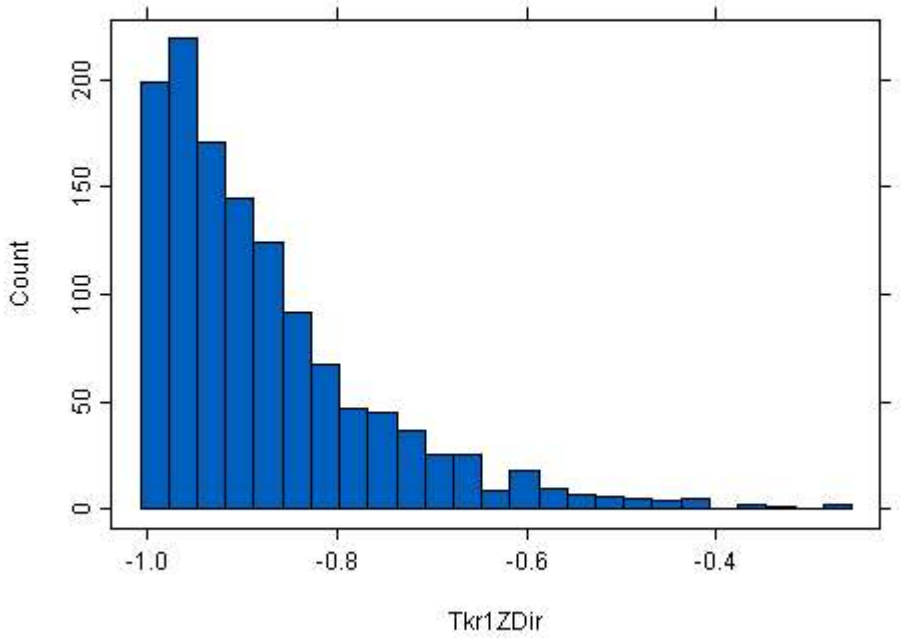
Indicates still some background but at a low level.

Gamma Candidate Distributions

Energy Spectrum of
Gamma Candidates

Is the "bump" at
600 – 1000 MeV due to
π^0 production in Bldg 33?



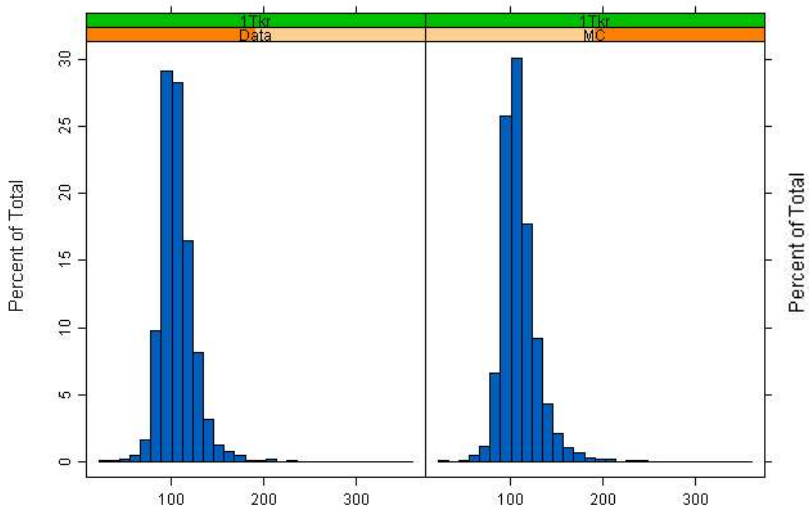


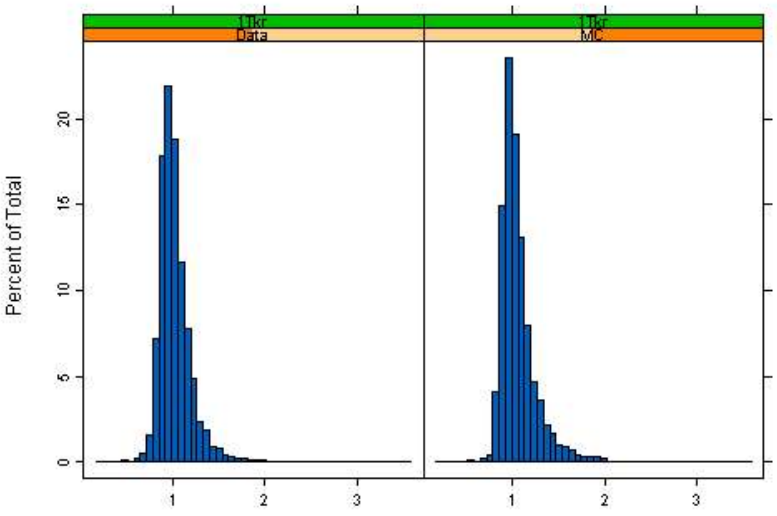
Angular Distribution
Small FoV due to Track + Cal Info.

MIPs & Cal Energies

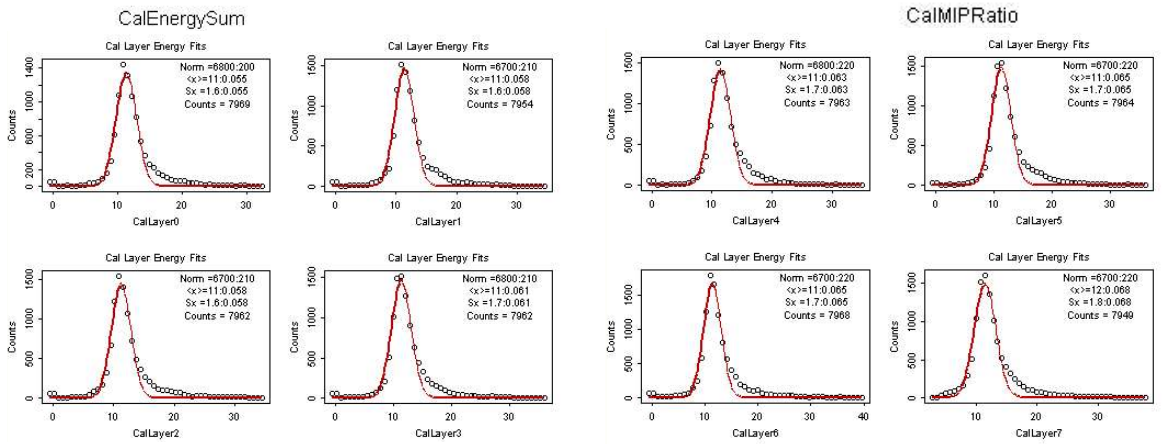
We can turn the cuts around: demand CT Probs. < .1, only 1 track and 8-10 Xtals

Results: 6627 Events





Layer by Layer



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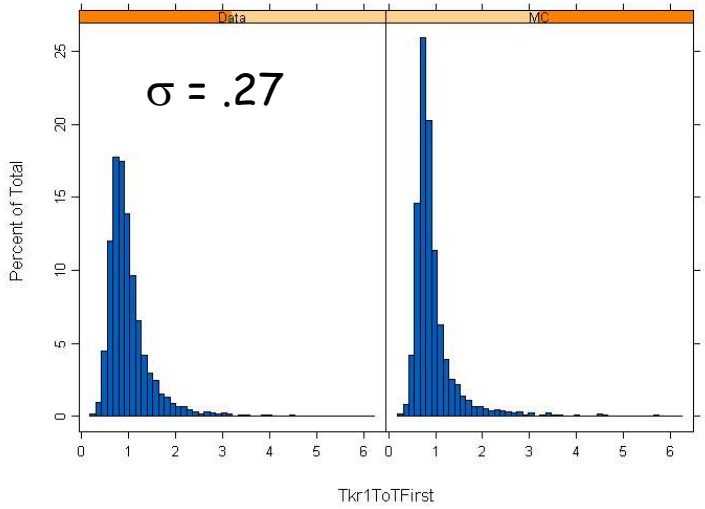
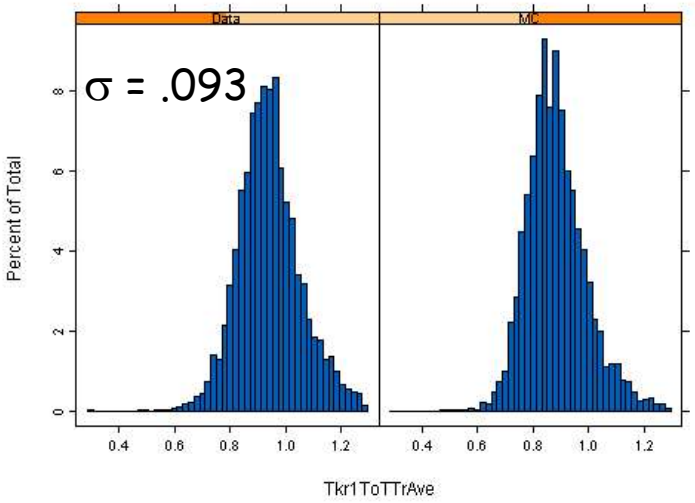
ToT for MIPs

ToT for first hit on First (Best) Track



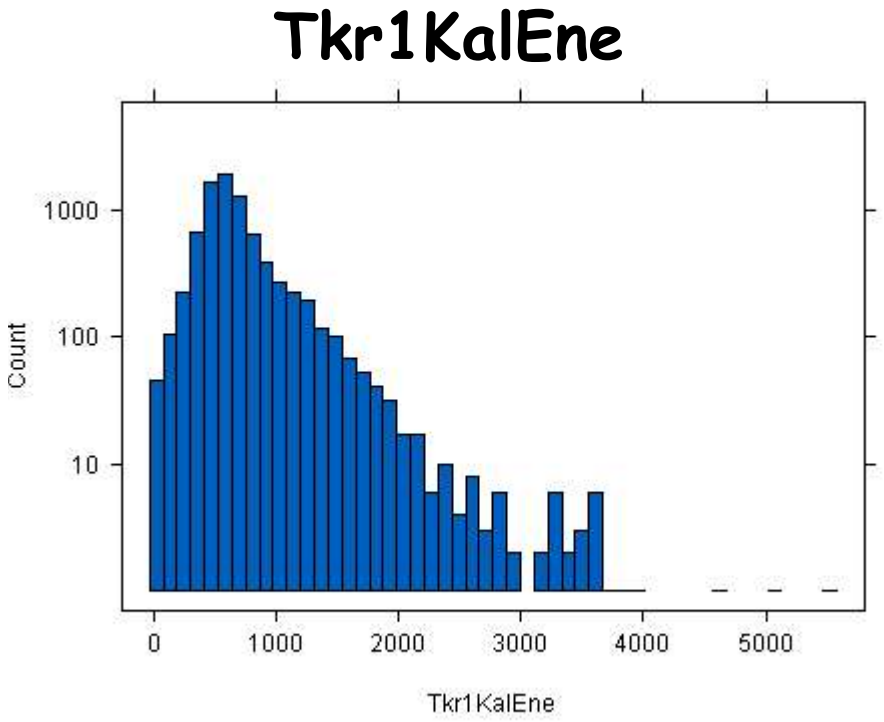
Time-over-Threshold is measured once per Tracker read control (usually 2 per plane)

Truncated <ToT> for First (Best) Track



And – the MIP Energy Spectrum

The Track energy can be estimated form the amount of Multiple Scattering observed on each track



What to do now?

- MIP sample can be used for calibrations and monitoring

- Found Gamma Sample can be used as a monitor for Condition Scans, trending, etc.
  - approximation to on-orbit issues of background and signal
  - sensitive to small (subtle) changes in performance

- A Bit of Physics & Challenge: Can we find the π^0 in the surface Cosmic Rays?