OnboardFilter Update

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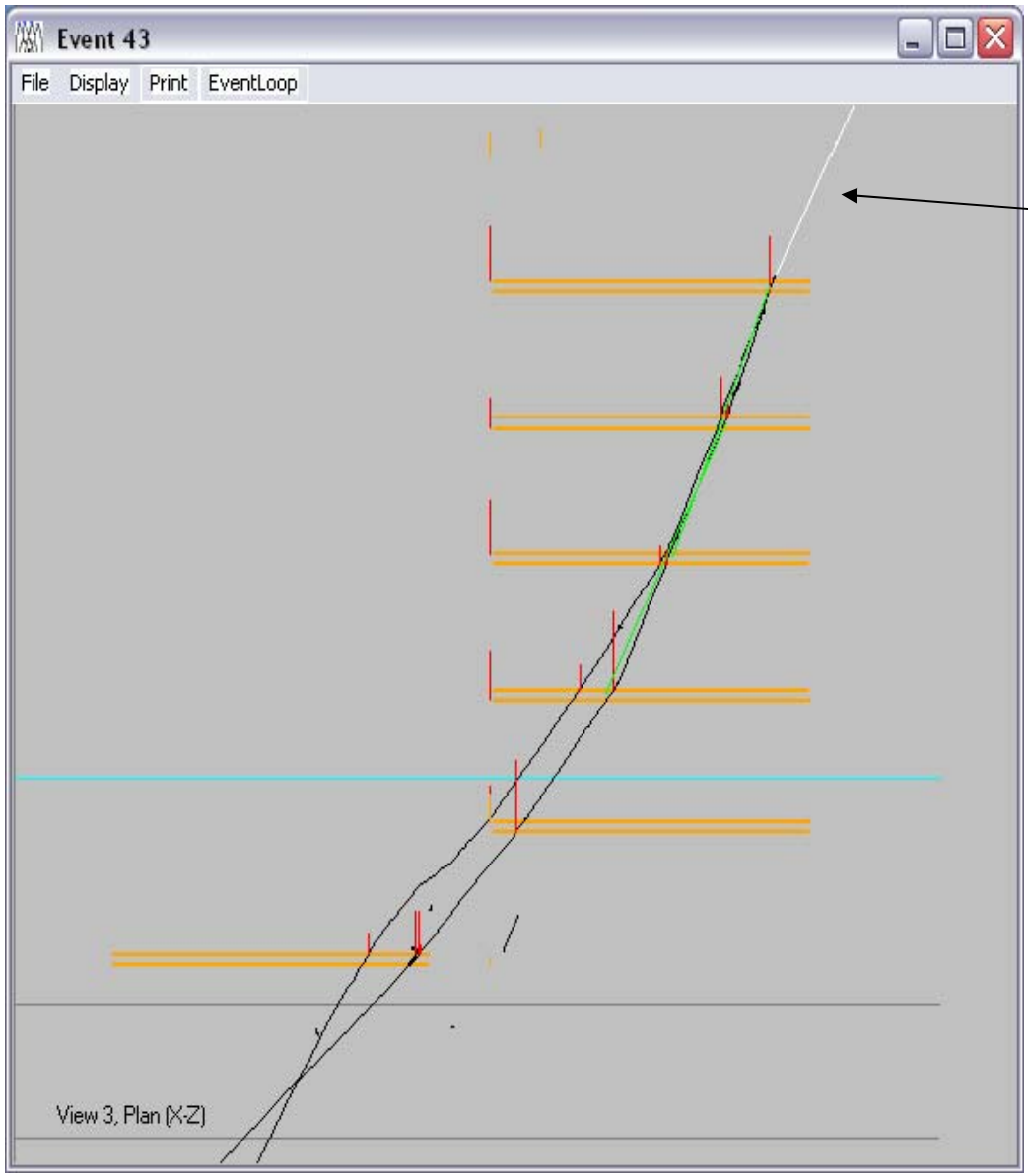
Status of Filter Work

- OnboardFilter has been integrated with GlastRelease
- OnboardFilter has been tested
  - Agrees with the Event Display & ntuple variables
- Have studied logic changes to the Filter
  - Can reduce gamma vetoes substantially
  - Performance before changes was not realistic enough for DC1
- Have calculated effective area and field of view after OnboardFilter event vetoes
- Currently studying revisions that would reduce albedo, and further improve gamma performance

Using OnboardFilter

- The Filter is called once for each triggered event
- Reconstructed Filter tracks can be drawn in the event display
  - Trigger.Members += {"FilterTracks"};
- The fundamental Filter output is in the MeritTuple in the form of two variables
  - FilterStatus_HI contains status code bits 15-31 (17 bits), which are the veto bits
  - FilterStatus_LO contains status code bits 0-14 (15 bits), which are informational bits about the event and its processing
- Filter Primitives (ACD, CAL, TKR quantities, and tracks) are in the TDS, and are being formatted for placement in an ntuple
- Filter Documented in LATDocs: LAT-TD-02979-01

Onboard Filter Tracks in Event Display



incoming gamma

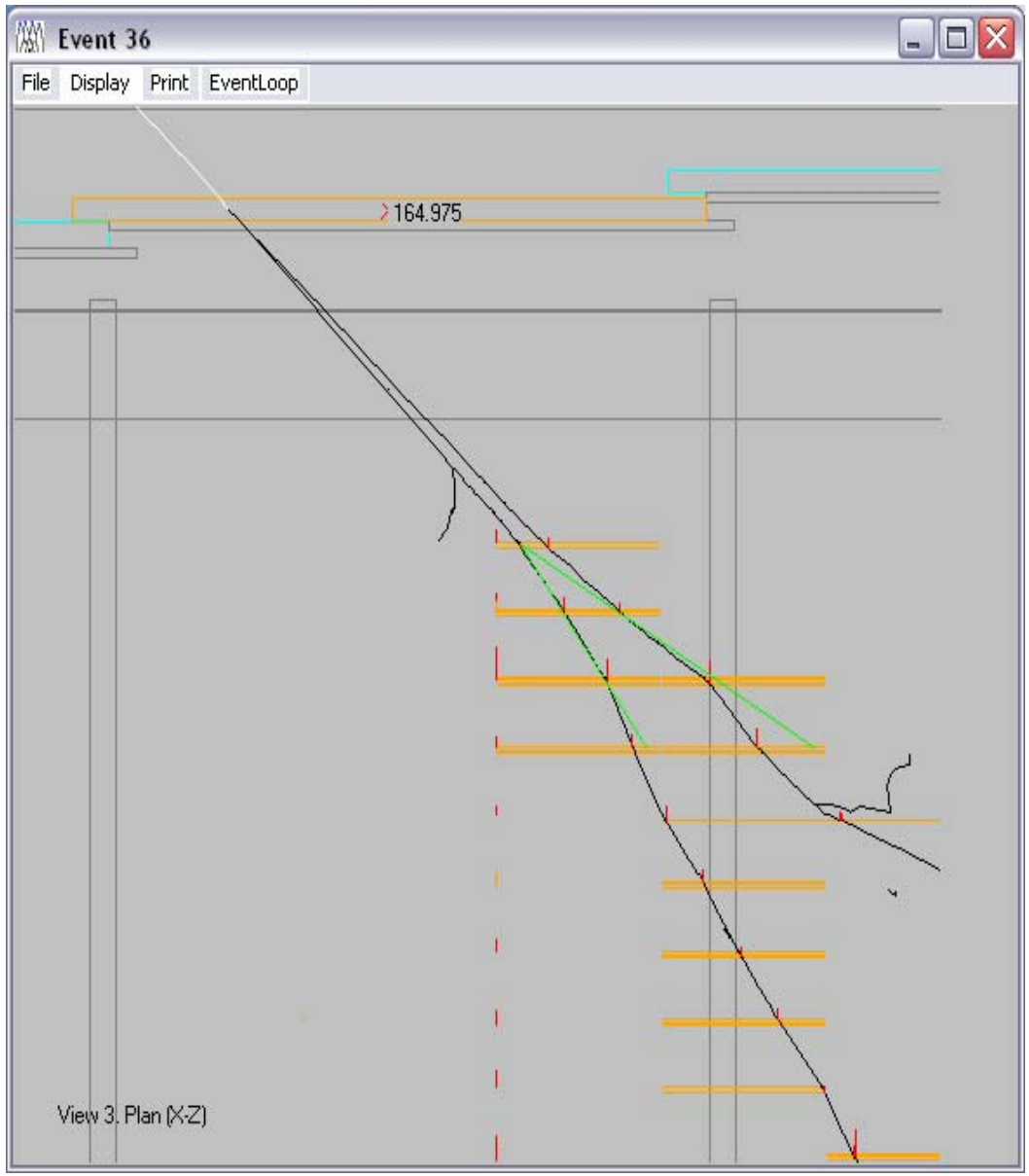
green lines are filter tracks

black lines are MC truth charged particle trajectories

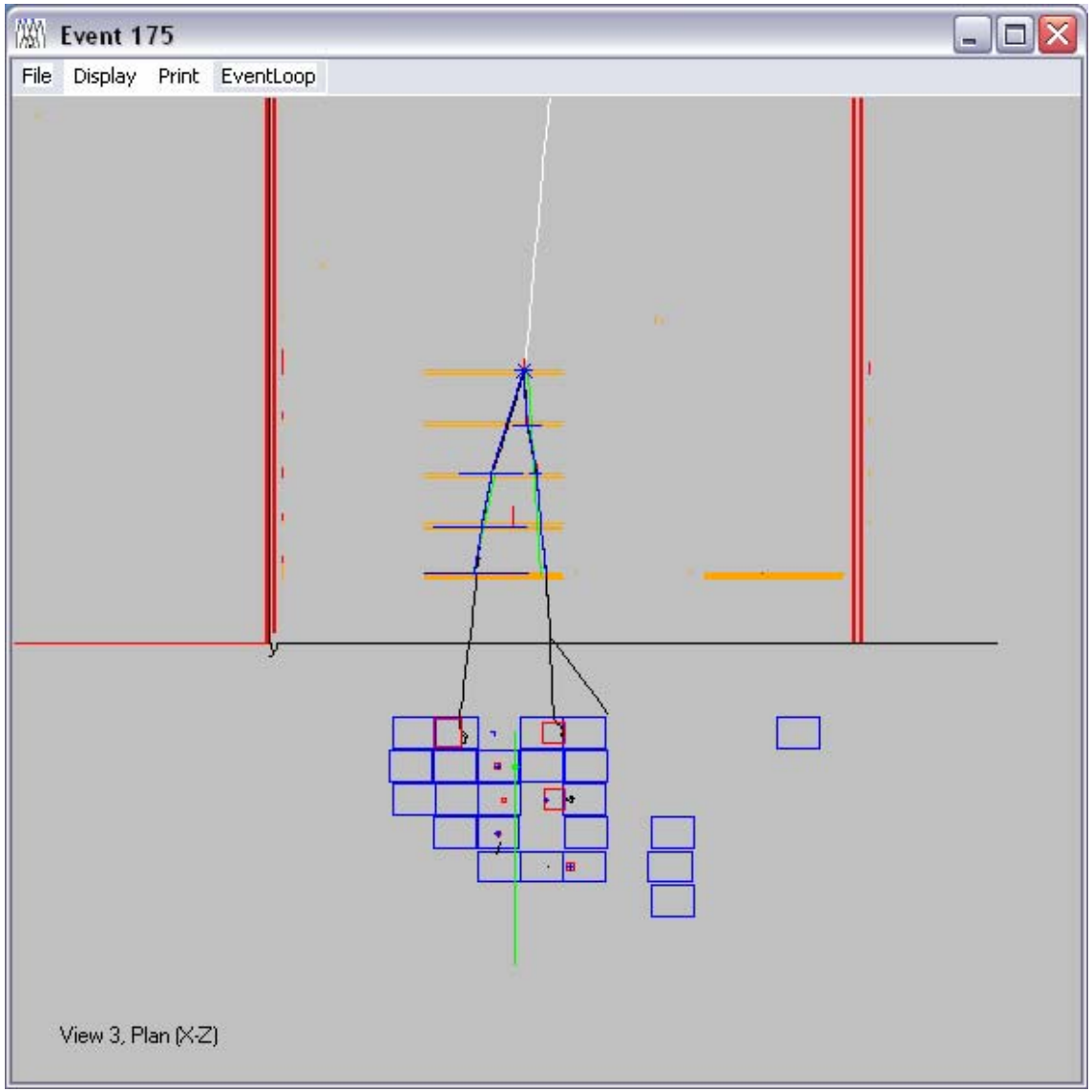
red lines are strip hits

OnboardFilter Tracks in the Event Display

(conversion in the ACD…)



OnboardFilter Tracks in the Event Display

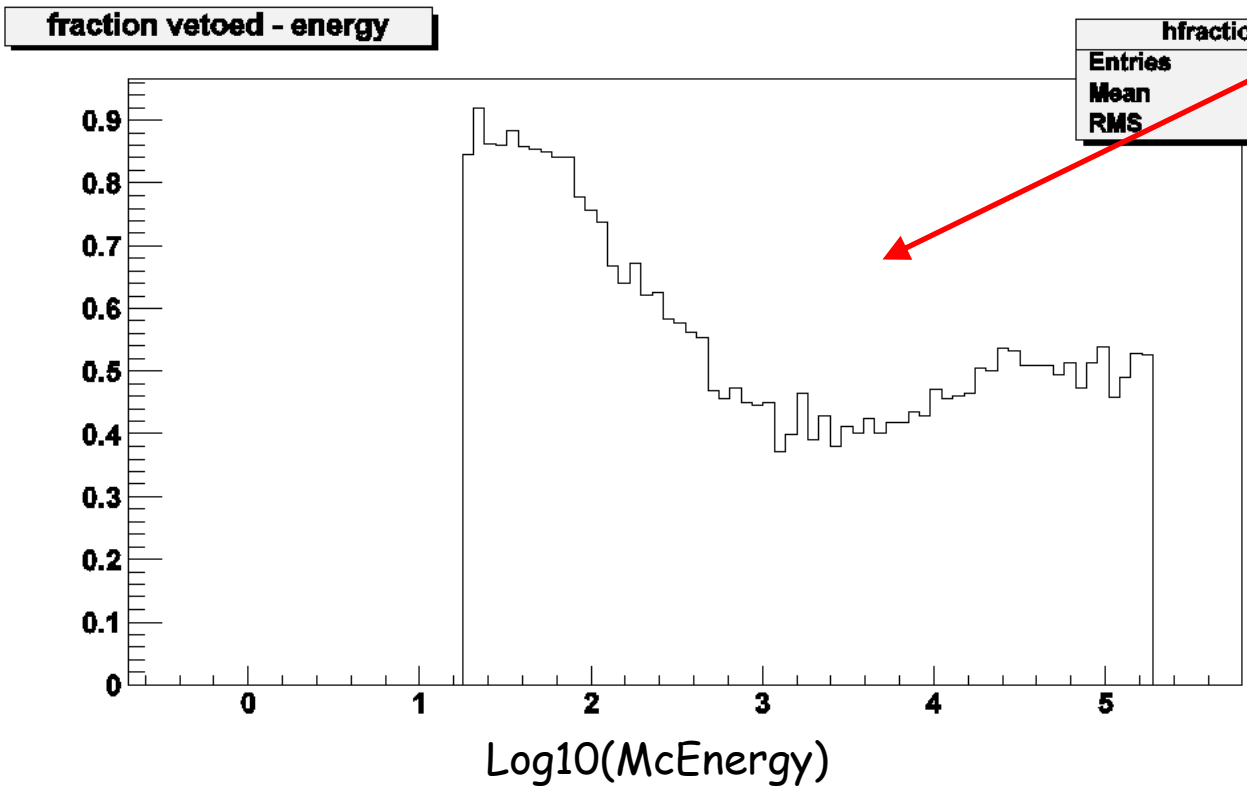


Using OnboardFilter: ROOT Analysis

- Putting Filter primitives into an easily accessible format
  - The primitives will include: ACD tiles hit; CAL energy & energy/layer; towers triggered, location of layer coincidences; projection details, but not detailed strip hit info (too much data)
  - Evaluating two options (this is Navid's department):
    - Put all info into a separate TTree in the MeritTuple
      - Could get LARGE
    - Put summary info into a separate TTree in the MeritTuple, and put projection details into digi.root
      - Would update the class dictionary, which the user would have to load at the beginning of a ROOT session

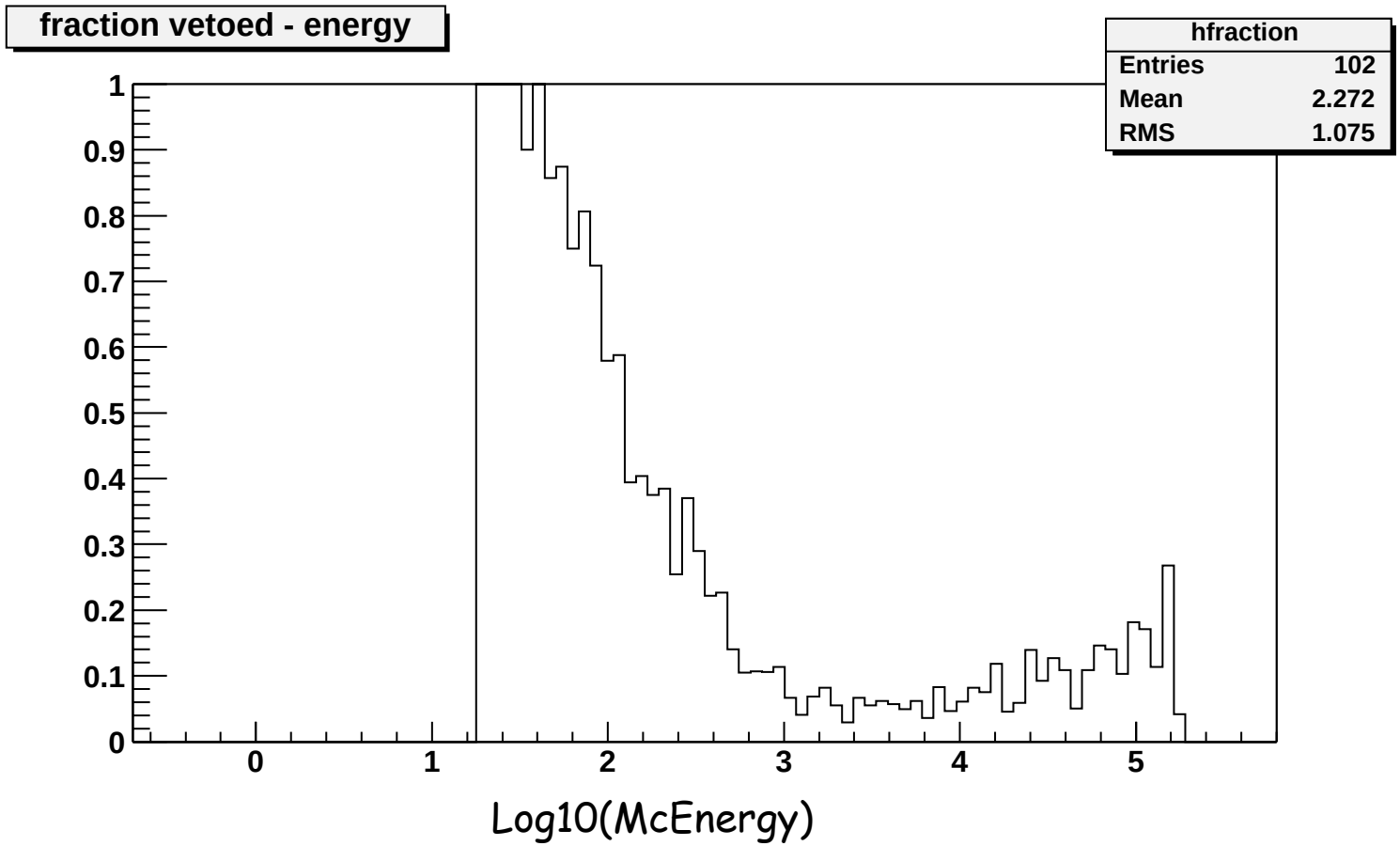
Filter Performance: Overview

- The Filter removed 95% of the backgndavgpdr source
- BUT…the filter also did substantial damage to gammas



Fraction of TKR triggered gammas vetoed with original Filter configuration. No selections on reconstruction quality or background rejection.

Even after ALL DC1 cuts (goodCal, goodPSF, zdir_cut, bk_veto, pruning), the filter still did damage

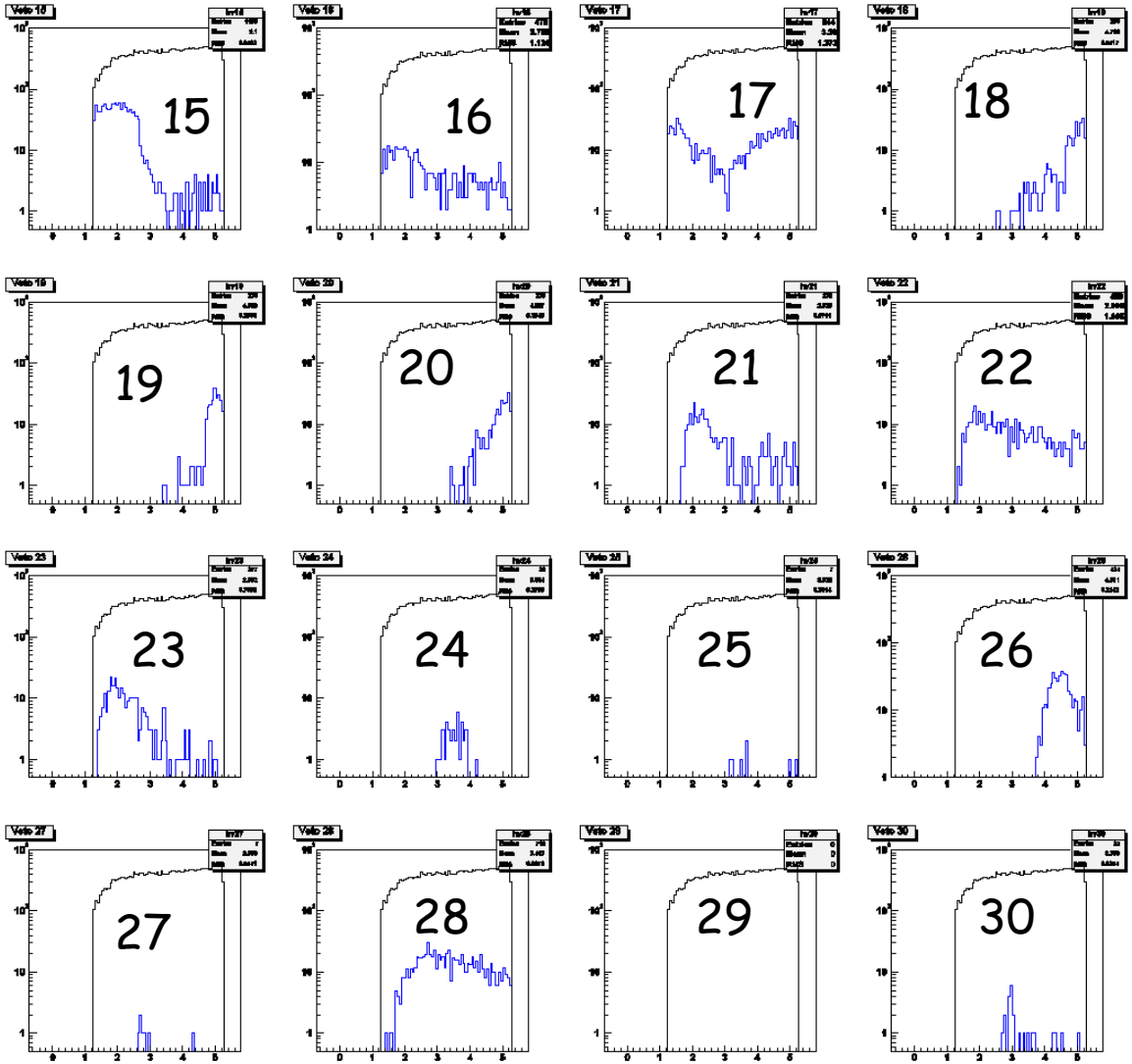


Filter Vetoes: What are the cuts?

- DFC_V_STATUS_TKR_LT_2_ELO = 15, /*!< Low energy, no 2 track evidence */
- DFC_V_STATUS_TKR_SKIRT = 16, /*!< Event into the skirt region */
- DFC_V_STATUS_TKR_EQ_0 = 17, /*!< No tracks */
- DFC_V_STATUS_TKR_ROW2 = 18, /*!< Track Row 2 match */
- DFC_V_STATUS_TKR_ROW01 = 19, /*!< Track Row 0 or 1 match */
- DFC_V_STATUS_TKR_TOP = 20, /*!< Track Top match */
- DFC_V_STATUS_ZBOTTOM = 21, /*!< No tracks into CAL with energy */
- DFC_V_STATUS_EL0_ETOT_90 = 22, /*!< E layer 0/ETOT > .90 */
- DFC_V_STATUS_EL0_ETOT_01 = 23, /*!< E layer 0/ETOT < .01 */
- DFC_V_STATUS_SIDE = 24, /*!< Event has a side face veto */
- DFC_V_STATUS_TOP = 25, /*!< Event has a top face veto */
- DFC_V_STATUS_SPLASH_1 = 26, /*!< Event has a splash veto */
- DFC_V_STATUS_E350_FILTER_TILE = 27, /*!< Event <350Mev + filter tiles */
- DFC_V_STATUS_E0_TILE = 28, /*!< Event 0 energy + tile hit */
- DFC_V_STATUS_SPLASH_0 = 29, /*!< Event has a splash veto */
- DFC_V_STATUS_NOCALLO_FILTER_TILE = 30, /*!< No CAL LO trigger + filter tile */
- DFC_V_STATUS_VETOED = 31 /*!< Any veto */

See LATDocs LAT-TD-02979-01

Which Vetoes Killed Gammas?

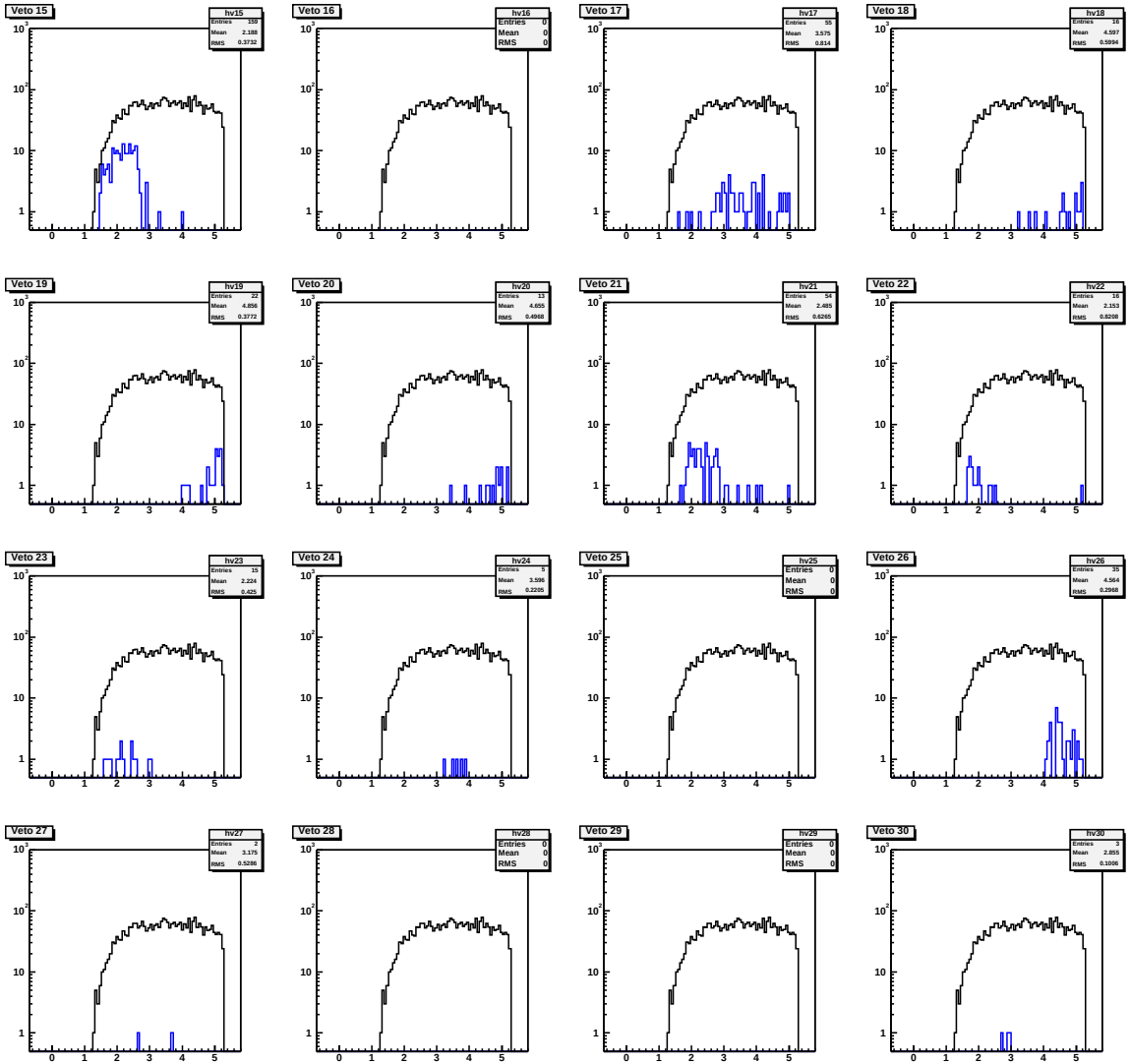


For TKR triggered gammas, there are many active vetoes

Black: TKR triggered events

Blue: TKR triggered and VETOED

Gammas killed after all standard cuts*



Log10(McEnergy)

When considering the <u>events remaining after all cuts</u>, the vetoes are fewer

Studying distributions like these, along with those of background sources, suggests changes that can be made to the filter.

*goodEvent&&background&&pruning

Altering the Filter

- Did several trials with different alterations of the filter
  - Removed some vetoes
  - Put energy cuts on a few others
  - Watched the backgndavgpdr rate as vetoes were removed

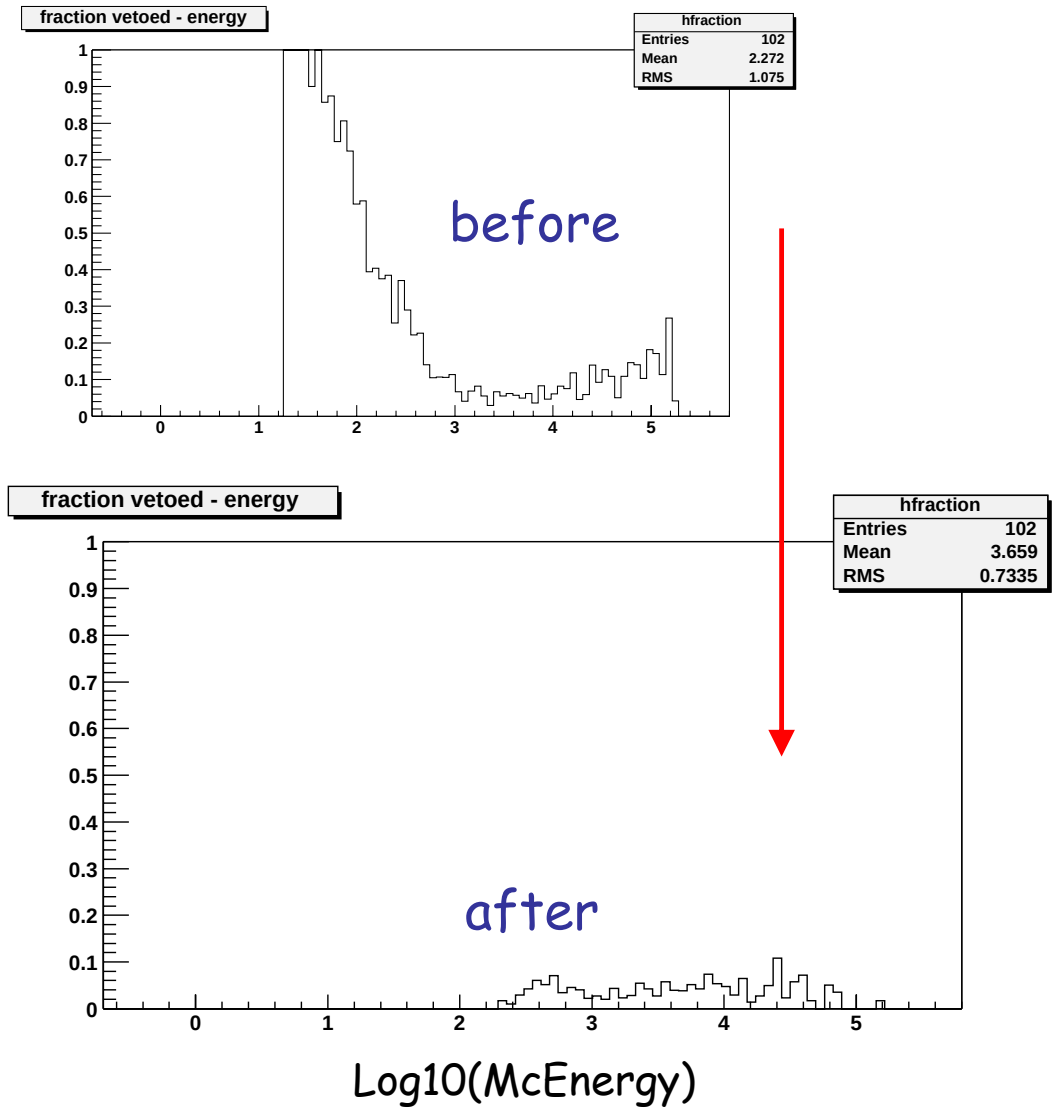
Changes:
- Veto 15 removed
- Veto 17 only executed when Energy > 250 MeV
- Veto 18 only executed when Energy < 30000 MeV
- Veto 19 only executed when Energy < 10000 MeV
- Veto 20 only executed when Energy < 30000 MeV
- Veto 21 only executed when Energy > 100 MeV
- Veto 22 removed
- Veto 23 removed
- Veto 26 removed
- Track finding tolerance is relaxed: go from ± 32 strips to ± 192 strips

Note: "Energy" corresponds to the raw cal energy that the filter sees, not McEnergy

This number is being evaluated

Filter Performance: Improvements

- After altering the Filter, the "Filter damage" decreases substantially
- These improvements were made possible when the GLAST mission office increased downlink data rate
  - Letting in more background allowed us to save MANY gammas



Effective area, field of view, and fraction of events vetoed

Cuts	Energy	0- 100 MeV	100-500 MeV	500-1000 MeV	1-10 GeV	10-180 GeV
goodEvent	Pk Aeff no Filt	1943	7957	10030	10287	9412
&& Background	FOV no Filt	2.2	2.48	2.65	2.61	2.47
&& Pruning	Pk Aeff w/ Filt	**1943**	**7782**	**9770**	**10024**	**9181**
	FOV w/ Filt	2.2	2.47	2.60	2.57	2.46
	Filt damage %	**0.0**	**2.5**	**4.1**	**4.3**	**3.2**

Pk Aeff no Filt: The peak effective area (cm^2) before applying the filter

FOV no Filt: Field of view (sr) before applying the filter

Pk Aeff w/ Filt: The peak effective area after applying the filter

FOV w/ Filt: Field of view (sr) after applying the filter

Filt damage %: Percentage of events vetoed by the filter

Falloff at high energy is not due to filter

Summary of impact on gammas and background

- Most gamma improvement is at very low and very high energy
- The overall fraction vetoed is between ~0-4%, but we know where these vetoes are happening
  - Working to reduce these vetoes
- With the altered filter, the backgndavgpdr veto rate drops from ~95% to ~90%, increasing the event rate to ~340 Hz
  - **Want more margin: we can handle ~400 Hz MAX to the ground**
  - Includes albedo_gamma limb source
- Recently added in the albedo_gamma_upwards flux
  - This causes the background rate to rise to 470 Hz at zenith-pointed orientation, so working on a solution

Current work: reducing "Filter damage"

- Reasons for Filter damage to gammas can be roughly divided into 2 groups: <1 GeV and >1 GeV
  - Altering Veto 17's implementation may reduce the damage by 44% above 1 GeV. Reduces Filter damage to <3% across all energy bins.
  - Other solutions are not obvious, so must examine vetoed events in the event display
  - These solutions are not likely to help with albedo gammas (next page)

Current work: killing albedo

- Backgndavgpdr includes albedo from the limb, but not the newer albedo_gamma_upwards source
  - The altered Filter only removes half of this unwanted flux
    - Rate is 130 Hz
- One way to kill these albedo gammas is to allow Veto 15 to execute when Filter Energy < 5 MeV
  - This has zero impact on gammas remaining after all standard cuts, because goodCal requires 5 MeV

Does it work?

Backgndavgpdr rate → 304 Hz (from 340)

Albedo_gamma_upwards → 35 Hz (from 130)

Total ~340 Hz

Disadvantages: impact on onboard science? And throwing out gammas before they reach the ground is not good if standard cuts change.

IMPORTANT NOTES:

- JJ found a geometry bug over Xmas
  - Fixing it should improve background rejection AND allow more gammas through (it did for JJ)
- Should CAL energy/layer vetoes (22 & 23) perform better? Looking into it.
- A track finding tolerance of +/- 192 strips is physically unreasonable
  - This will be reduced to a more realistic value
- Splash related vetoes (especially active above 1 GeV) need more study

Summary

- Filter performance better understood
  - Several things still need more study, but this is not unexpected
  - Good enough now for including in physics studies -> DC2!
- Possible to improve further gamma performance
  - A current version reduces "Filter damage" to <3%, and working to reduce that
- The most obvious method of killing albedo may have disadvantages, so working on alternatives
- Filter primitives have been in the TDS for several months, and will be in a more accessible format very soon
- Many options to increase post-filter data rate margin, but with some impact on A_{eff}