FCAL pi0 shift

Susan Schadmand, 29 Sep 2021

Long term items

1. FCAL: [orphan item] It has been noticed that the pi0 mass shifts when the LED pulser runs at high rate. This is still not understood. See Log Entry 3595928 and references. Several runs have been taken in raw mode. These runs exhibit the shift in pi0 mass with LED running at 1 kHz. There is a need to analyze these to try to determine the cause. Susan will undertake this task.
   1. 50634 - FCAL Green LED: 1kHz, 29 V, Livetime is 9%, 1.7 M events
   2. 50635 - FCAL Violet LED: 1kHz, 22 V, Livetime is 9%, 1.4 M events
   3. 50636 - FCAL Blue LED: 1kHz, 15 V, Livetime is 9%, 1.5 M events

Sep 20, 2018 Calorimeter meeting

Calibrations

[FCAL Pedestals and LED Rate](#) (Matt)

- ○ FCAL monitoring of spring 2018 data showed the pi0 mass shift for some runs. The runs (around ~42221) were found to correspond to an (accidentally) high pulsing of the LEDs, up to 1kHz where 10 Hz is nominal.
- ○ The causality of pi0 mass shift due to pedestals is not established.
- ○ Colin, Mark and Elton will take a look at pulses on the scope and see how the baseline shifts. Note added: No baseline shifts were found, but at high rates LED pulser rates it was noted that the HV on some pmts was sagging. See [Log Entry 3595928](#).
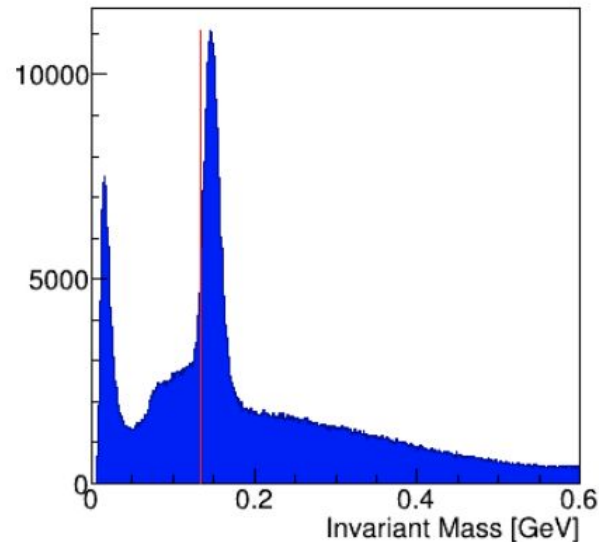

Run 42221

FCAL 2 Cluster Invariant Mass E > 1 GeV
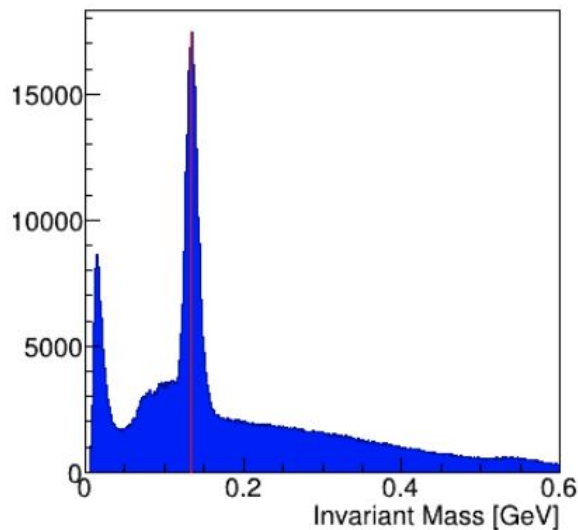
Violet Only/Nominal Rate

Run 42236

FCAL 2 Cluster Invariant Mass E > 1 GeV

Three Colors (maybe)/High Rate

Random Comments

- FCAL uses fixed pedestal for analysis: simplest solution and has been sufficient for our needs

- Pedestals measured during data taking runs tend to be biased high due to out of time signals and readout threshold

- At some point (after 1/16/2018) we started removing LED events from online monitoring

- Intensity of LED is strongest at edges and pedestal appears to fluctuate with distance from edge

- Even at 1 kHz one would nominally think overlap of LED and physics is small: how does $\pi 0$ mass shift?

- Need to understand mechanism - may be degrading data quality during nominal conditions

  - Examine a variety of channels with scope: trigger on LED pulsed and look at time structure of response.

  - Does 1 LED flash produce many pulses? Does the PMT/base take time to stabilize after bright LED flash?

Day shift summary

[...]
8:13 Called MCC since we saw beam was steady at 180 nA. They confirmed that it should be ok for a while.
8:14 Started **Run 50634. FCAL Green LED. 1kHz, 29 V** readback voltage on LED. Livetime is 9%. We ran for 5 min according to plan in counting house. 1.7 M events.
8:15 HALO counter trips from time to time: BEAM:HALO:hv:g:tag:b,l
8:22 The beam went off so that Hall C can go to Power permit.
8:23 Switched over to the Violet LED but beam is off.
8:45 Beam still unstable and around 50 nA.
8:55 Beam back at 180 nA.
9:00 Started **Run 50635 Violet LED, 1kHz, 22 V** bias. Livetime 9%. Beam 180 nA but after 4.5 min it dropped, came back, unsteady, 1.4M events. Stopped run.
9:20 MCC called. They see that the convergence is not ok (we don't have details on this); this is probably related to the HALO counter tripping.. They have a "quicker" fix (maybe one hour) adjusting a dipole, or a more complicated fix that could take half a shift. Eugene agreed that it made sense to make such an investment, and be able to work under stable conditions.
9:27 Started **Run 50636 Blue LED, 1kHz, 15 V** bias. Livetime 9%. When beam goes off livetime drops to 0% for blue; did not see this for violet or green. Beam 180 nA but unsteady. Run stopped: 1.5 M events.
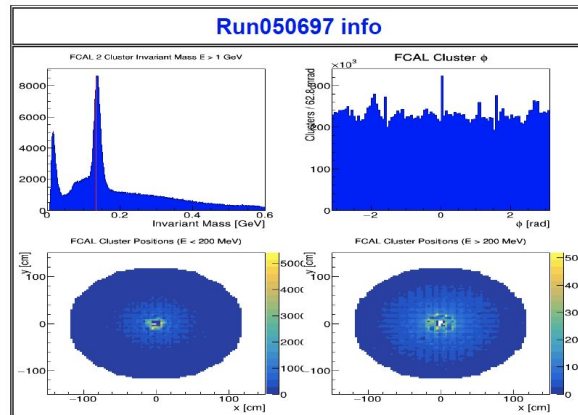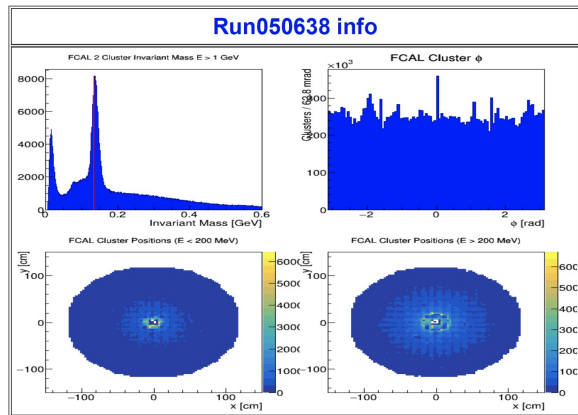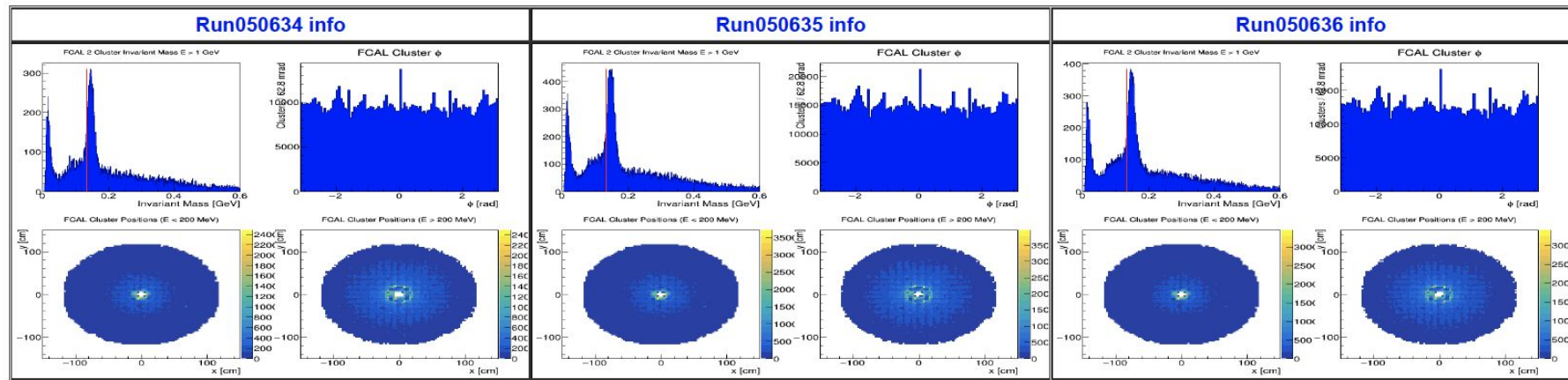9:38 Finished the FCAL LED runs. [...]

Run Period [RunPeriod-2018-08 ⌄]   Version [Incoming Data ver01 ⌄]   (5-52640)

Plot to Display [FCAL Clusters 2 (pi0 peak) ⌄]   Toggle plot order   columns [3 ⌄]

Run Range: [50634] [⌄] [50636] [⌄]   Max #plots [100] [⌄]

[   ] [query]

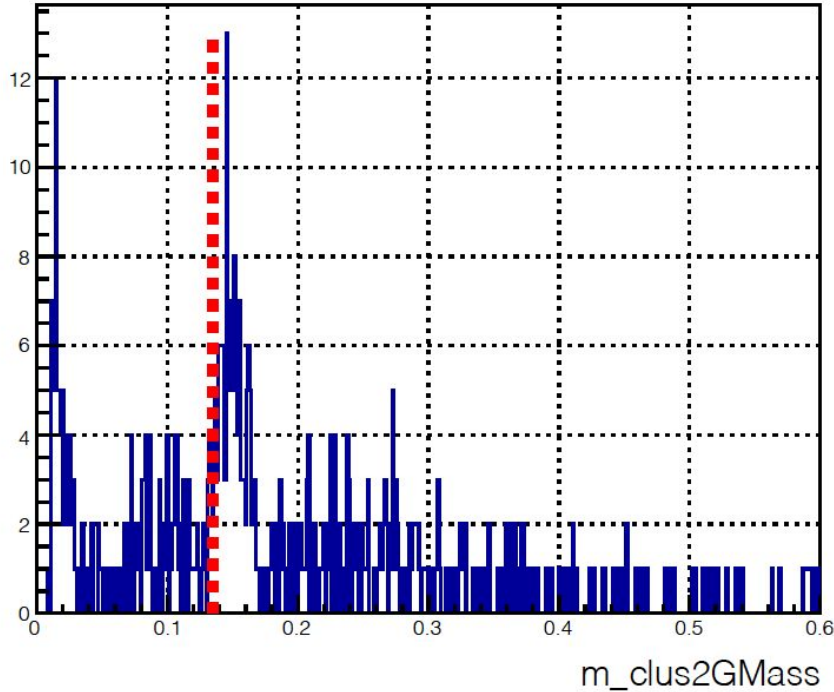FCAL LED 1kHz runs: pi0 position shift

50638
first run of LED
efficiency study

50677
first run of full REST
production

first comparison of normal and high LED rate runs

Run050634 Green LED, 1kHz, 29 V

Run050634 Green LED, 1kHz, 29 V