FCAL bad channels GlueX data

Susan Schadmand, 25.Nov.2020

introduction

- FCAL bad channel maps needed for efficiency from simulations
  - main issue: HV stability

- NIM paper:
  - four acrylic panes each covering the upstream end of one quadrant
  - each pane is illuminated by forty LEDs, ten violet, ten blue, and twenty green
  - the different colors are used to study the wavelength dependence of the transmission
  - transmission of blue is sensitive to radiation damage which causes brownish color of lead glass

- WIKI:
  - during production running the FCAL LEDs are cycled through 6 configurations, each 10 minutes long and tied to the wall clock

    Violet 12 V (00 to 09 minutes)
    Blue 10 V (10 to 19 minutes)
    Green 29 V (20 to 29 minutes)
    Violet 22 V (30 to 39 minutes)
    Blue 15 V (40 to 49 minutes)
    No pulsing (50 to 59 minutes)

- goal: “efficiencies” per run per detector channel, based on Blue 15 V
  - with respect to HV status only

analysis of LED skims

- plugin for histograms (hd_root file) containing ADC integrals per detector channel
  - */u/home/susansch/GlueX/halld_my/plugins/fcalbadchannels*

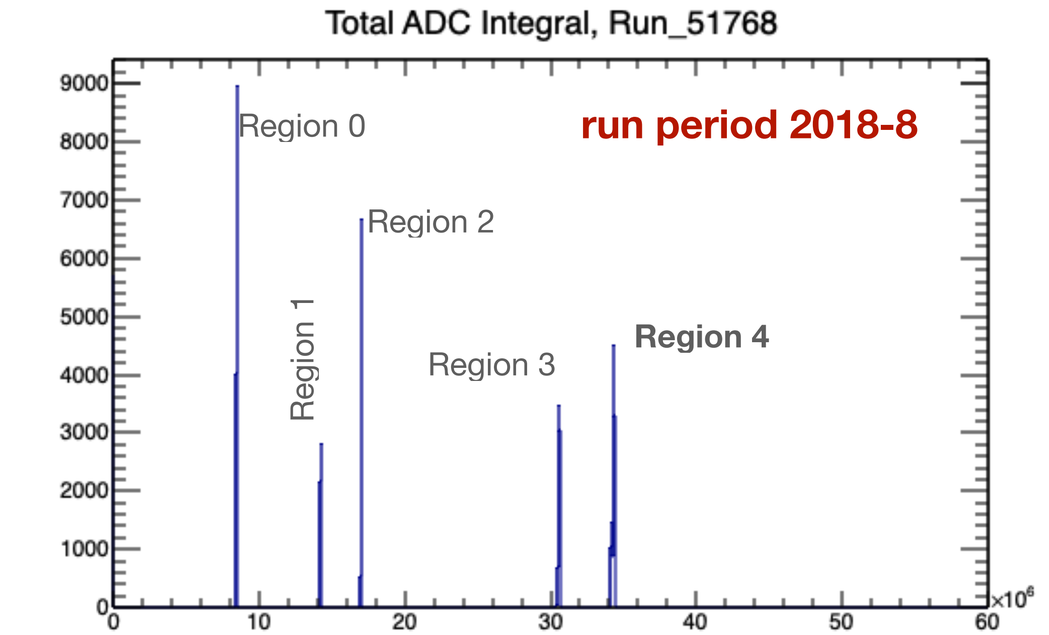
- scripts for analysis and hand over all sub-runs per run
  - */u/home/susansch/GlueX/FCAL/badchannels/scripts*

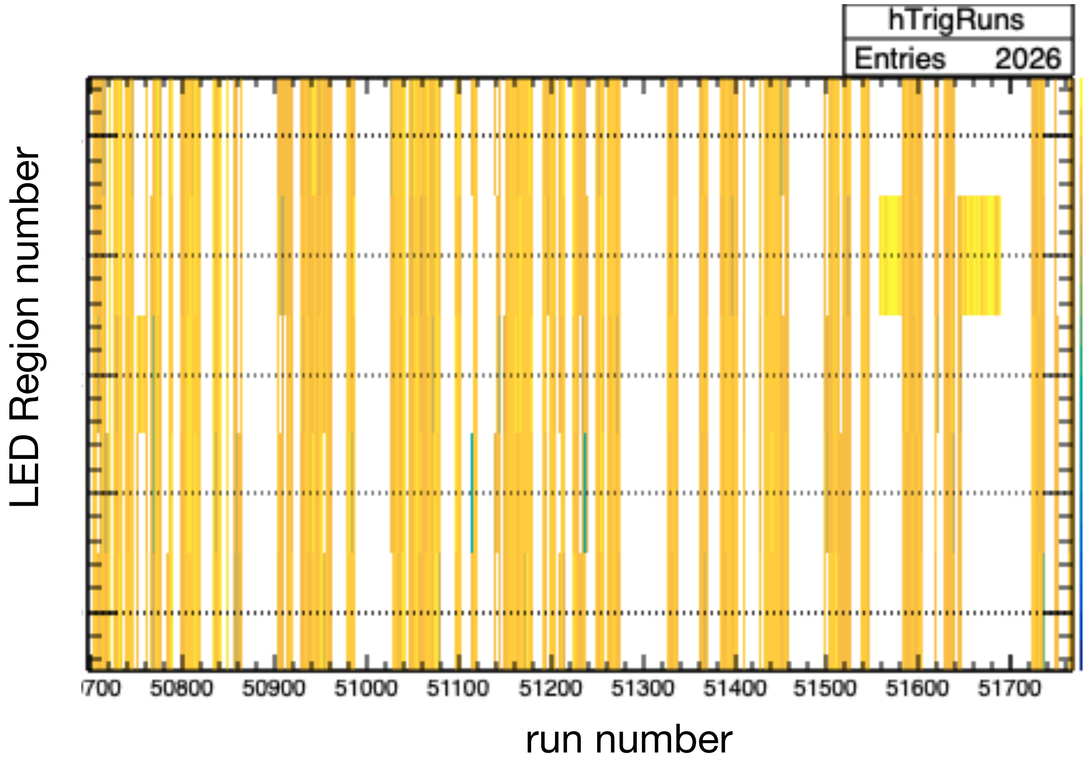
- sum over ADC integrals shows distinct peaks for the different “LED Regions”
  - *Regions 0-4, Region 4 is ‘most intense color’*

- LEDs are cycled, LED trigger sometimes off (by choice)

see 2D plot:
Entries in LED Regions
as a function of LED Region and run number

RunPeriod 2018-08 physics runs: 050697 - 051768





evaluation of histograms

- scripts for running the macro
  - */u/home/susansch/GlueX/FCAL/badchannels/macros/ChannelStatusGlueX.C*

- Entries: entries of histograms, ADC integrals per detector channel, normalized via entries in LED Region
  - just entries, no regard to number or quality of peaks in histograms

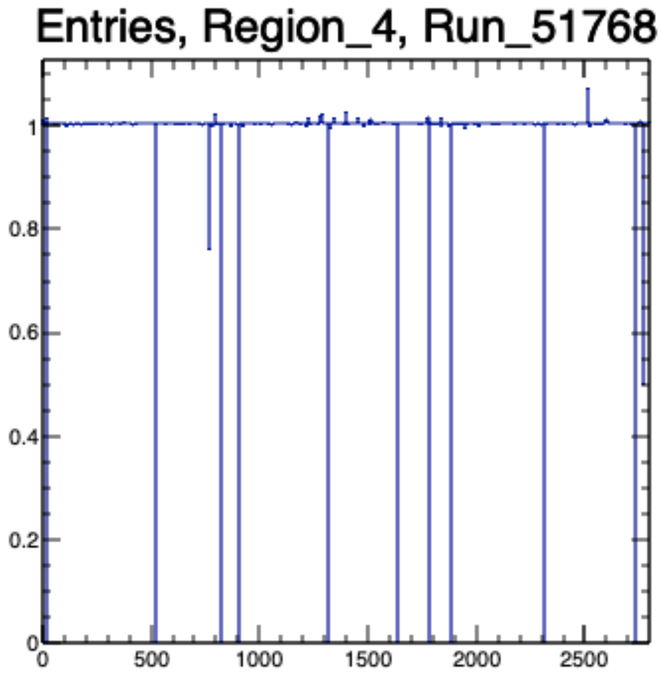
- txt output file: Entries>1 are set to 1 —> “**efficiency”** (with respect to HV status)

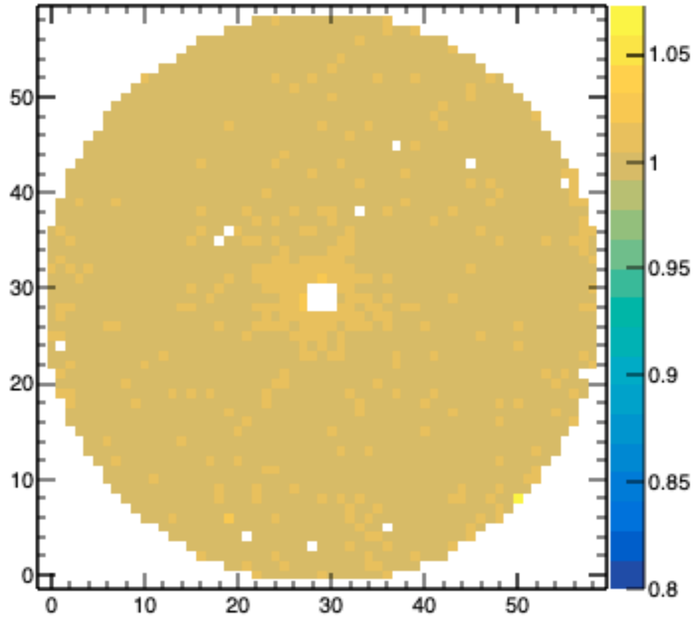
- Entries plot is using the translation
  int channel =
  fcalGeom.channel(digihit->row,digihit->column);

- 2D plot is the occupancy
  hRowColOcc_[ireg]->Fill(digihit->row,digihit->column);

  normalized to the Entries plot

(Run_051768 is last physics production run)





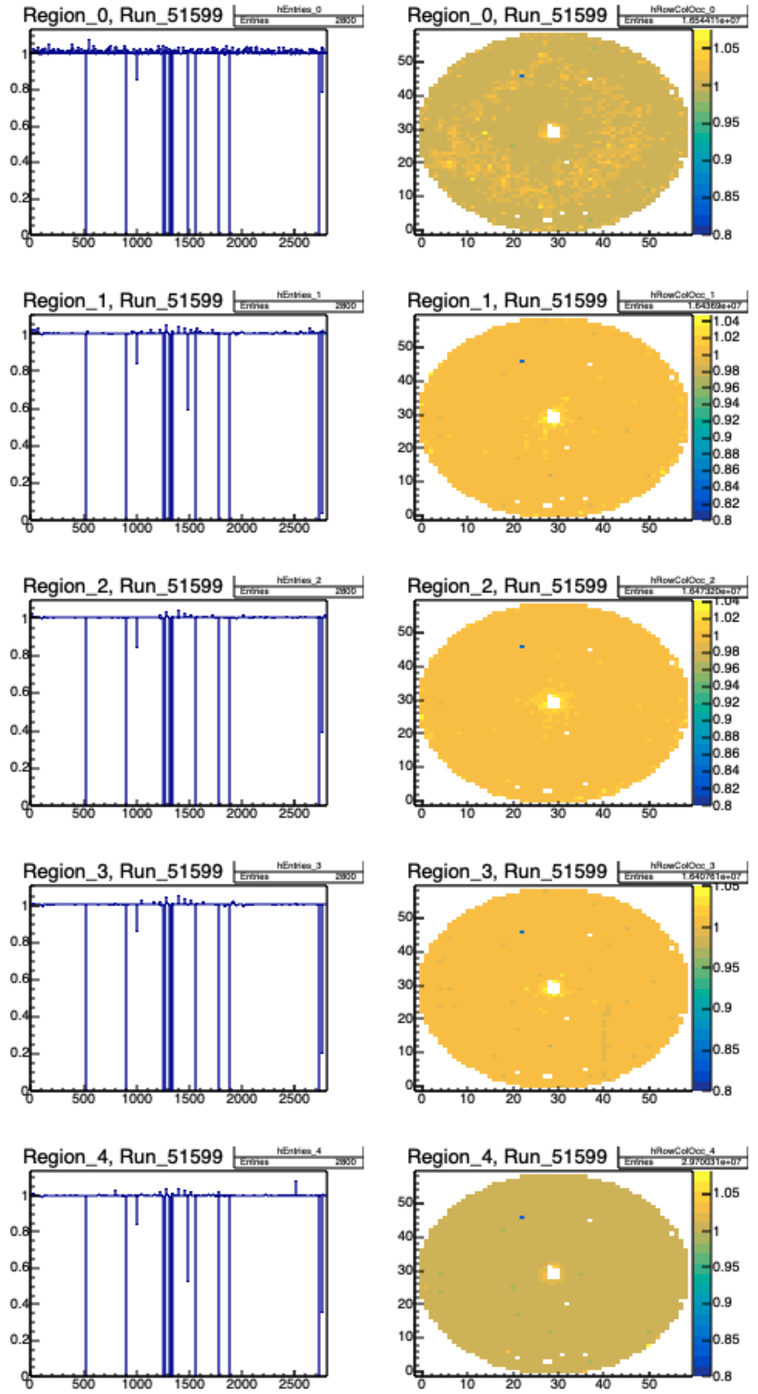
output files for data base

- a root file with entry and occupancy plots

- txt files: “efficiencies”
  - with respect to HV status only
  - per run and per LED Region,
  - each file <u>2800 lines, 1 column</u>

/w/halld-scifs17exp/home/susansch/FCALbadchannels

```
Run_051599_Entries_plot.root
Run_051599_Region0_Eff.txt
Run_051599_Region1_Eff.txt
Run_051599_Region2_Eff.txt
Run_051599_Region3_Eff.txt
Run_051599_Region4_Eff.txt
```



FCAL bad channels GlueX data

Susan Schadmand, 11.Nov.2020

bad channel maps needed for efficiency from simulations

known issues:

FCAL Base Manual (JonZ)

- sudden HV failure
- loss of communication
- hot channels

method adapted from Chandra Akondi
(fcalbadchannels05aug2020presentation.pdf, see previous calorimeter meetings)

- LEDs are used to check the status of detector channels

- analyze **FCAL-LED event skims**

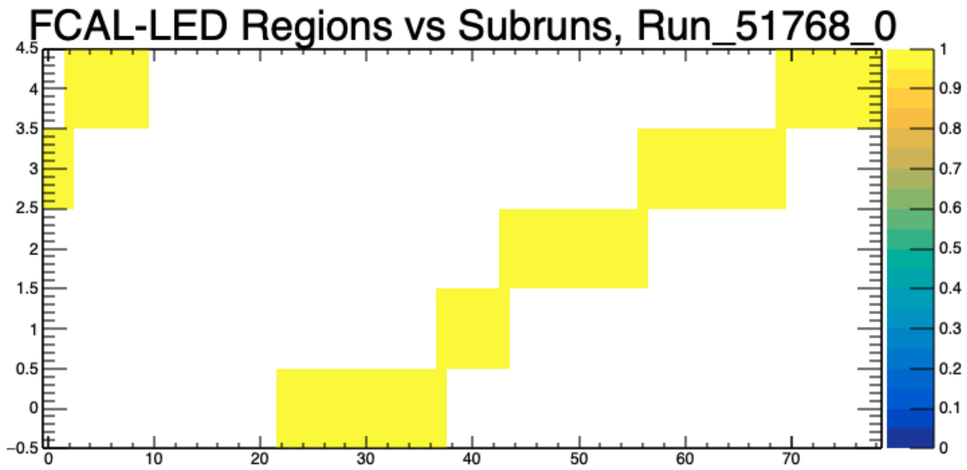
plugin for histograms (hd_root file) records ADC integrals per detector channel

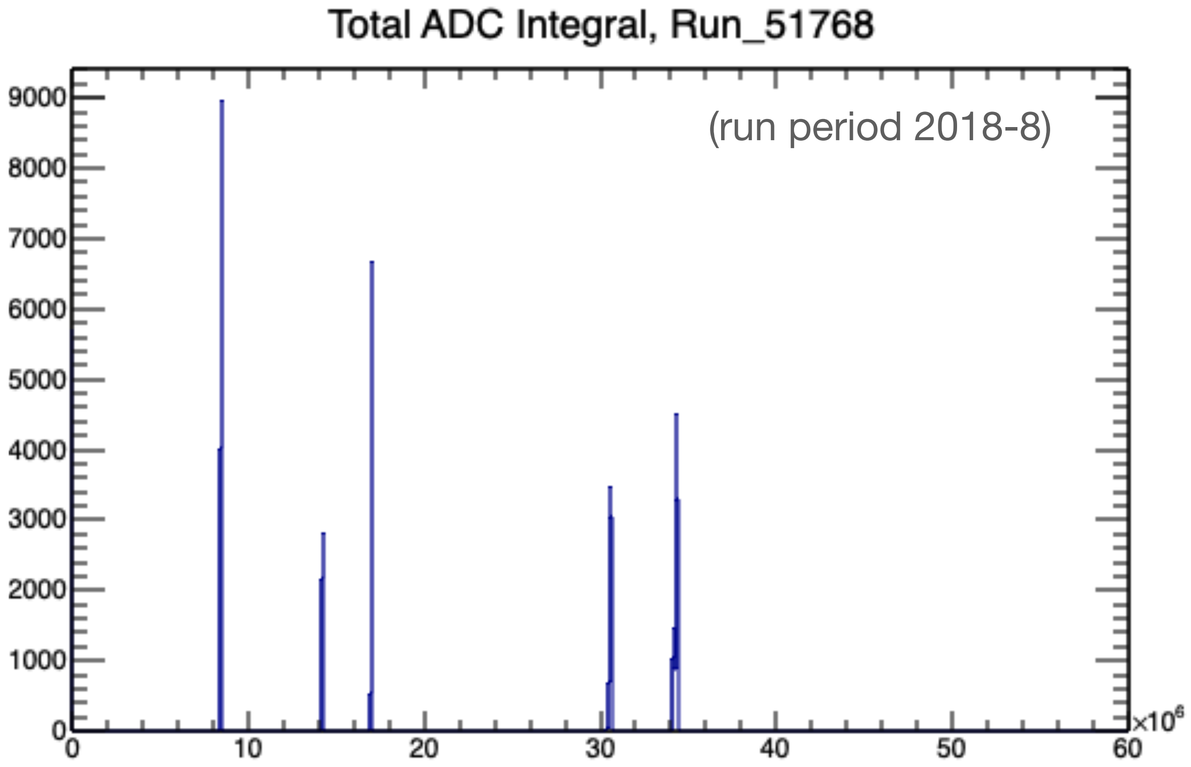
```
ADCintegral per detector channel
 = (digihit->pulse_integral)
   - (((double)digihit->pedestal/digihit->nsamples_pedestal) * digihit->nsamples_integral);
```

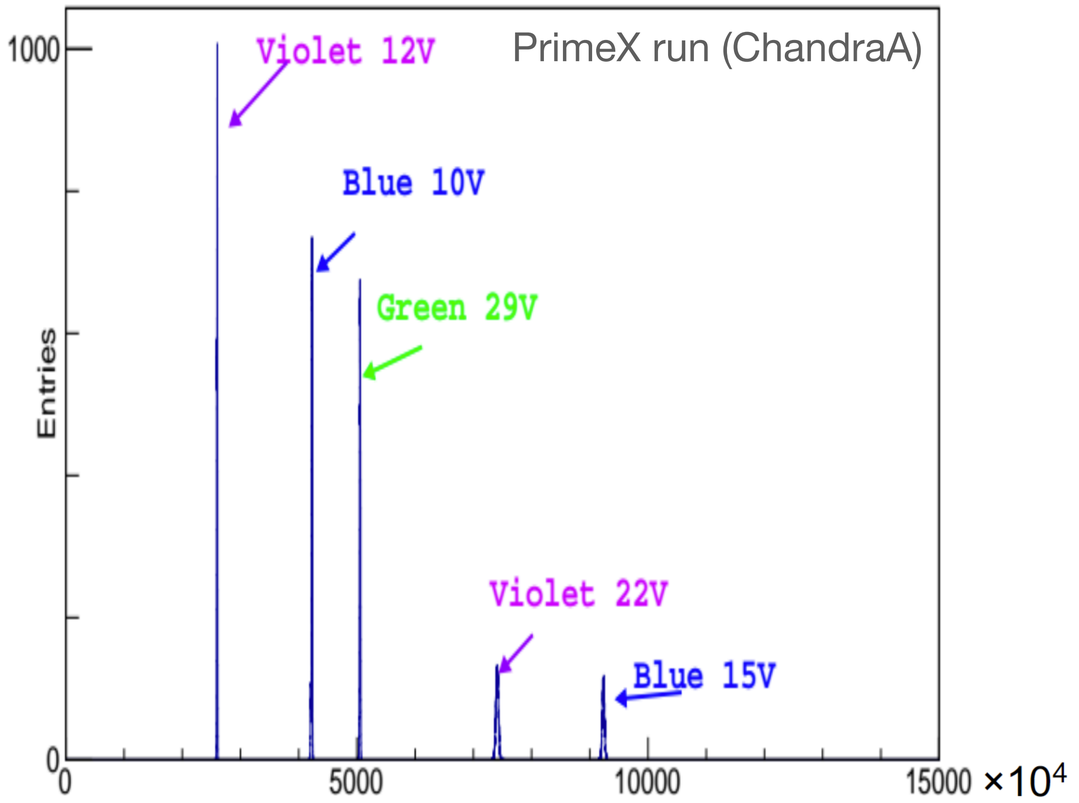
- 3 LED colors, run with different voltages, periodically switching voltages -> seen in ADC integrals

★ **sub-runs without LED events**
★ sub-runs with more than one LED region

- **sum over ADC integrals shows distinct peaks for the different "LED Regions"**





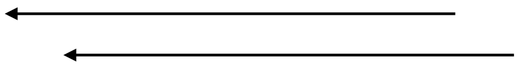


finding bad channels:

look at ADC integrals, per run and per region

status is bad if

- number of peaks in histogram > 2 (there may be a pedestal peak ??)
- or Gauß fit to the peak returns the status 4
- or averaged* histogram entries < 0.9
- or the averaged* area under the Gauß is < 0.9



these two types of spectra do not seem to have the same features

the overall bad status of the detector channels has to be a logic OR over the regions

the Gauß area seems more sensitive to inefficiencies?

or simply preferable because it does not count additional peaks like pedestals?

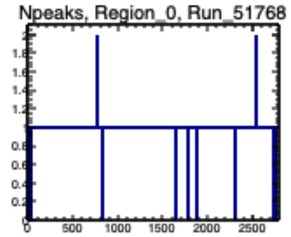
for the data base, need a txt file with numbers for the 2800 channels

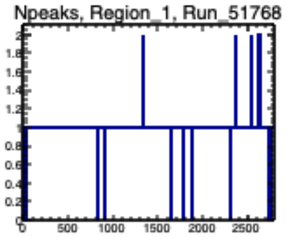
- 1 for good ; 0 for bad

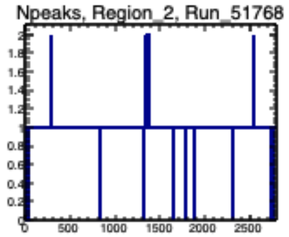
- or an efficiency

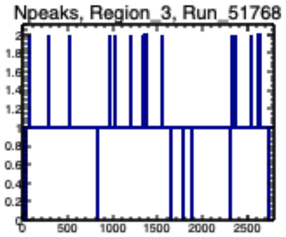
(see next page)

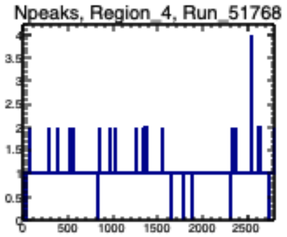
* averaged to 1 over the channel numbers





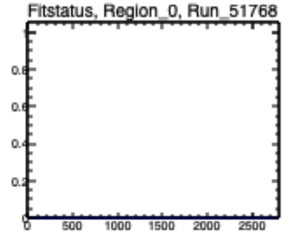


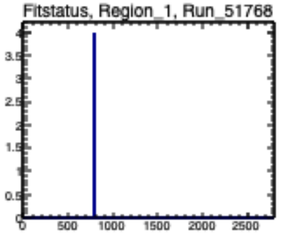


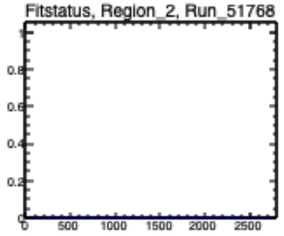


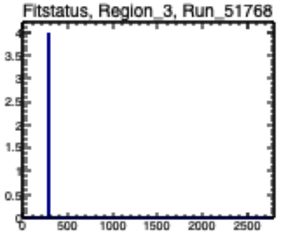
for example:

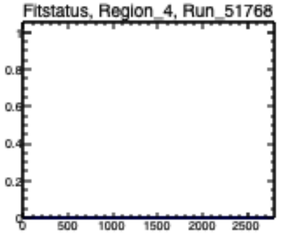
there is >=2 peaks in the ADC integral histograms



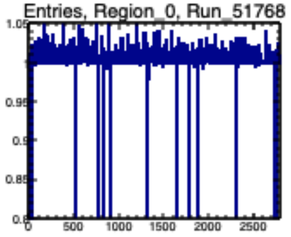


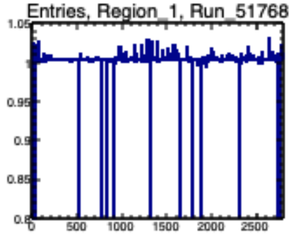


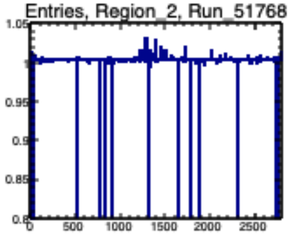


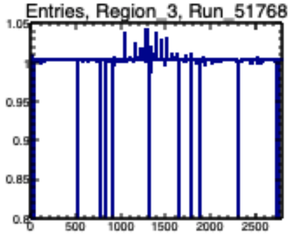


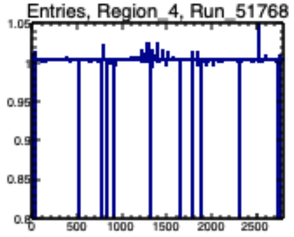
Gaussian fitstatus is good (=0), the peak with the highest x-position is fitted.



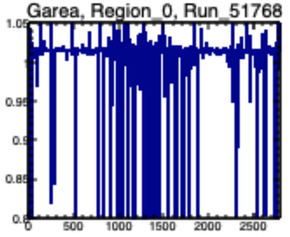


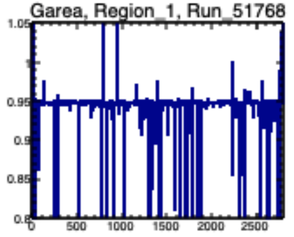


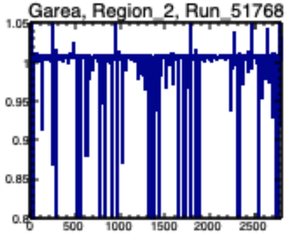


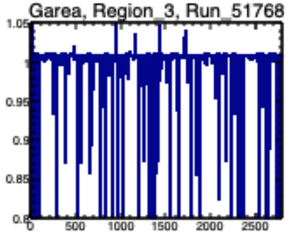


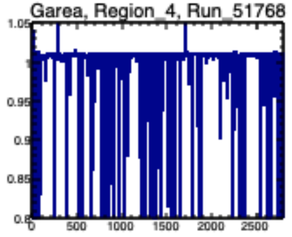
there is hot channels in the middle of the detector (beam).



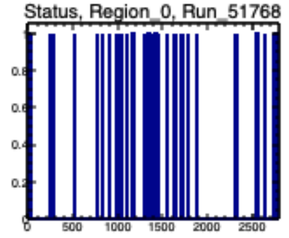


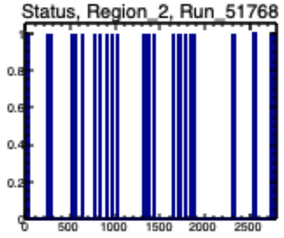


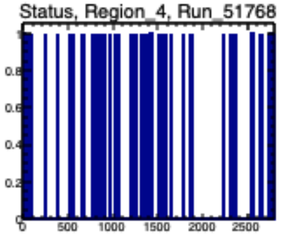




this is not seen as extremely in the averaged Gauß areas … because of counting in only one peak, the one with the highest x-position.
but **the Gauß area seems more sensitive to inefficiencies?**

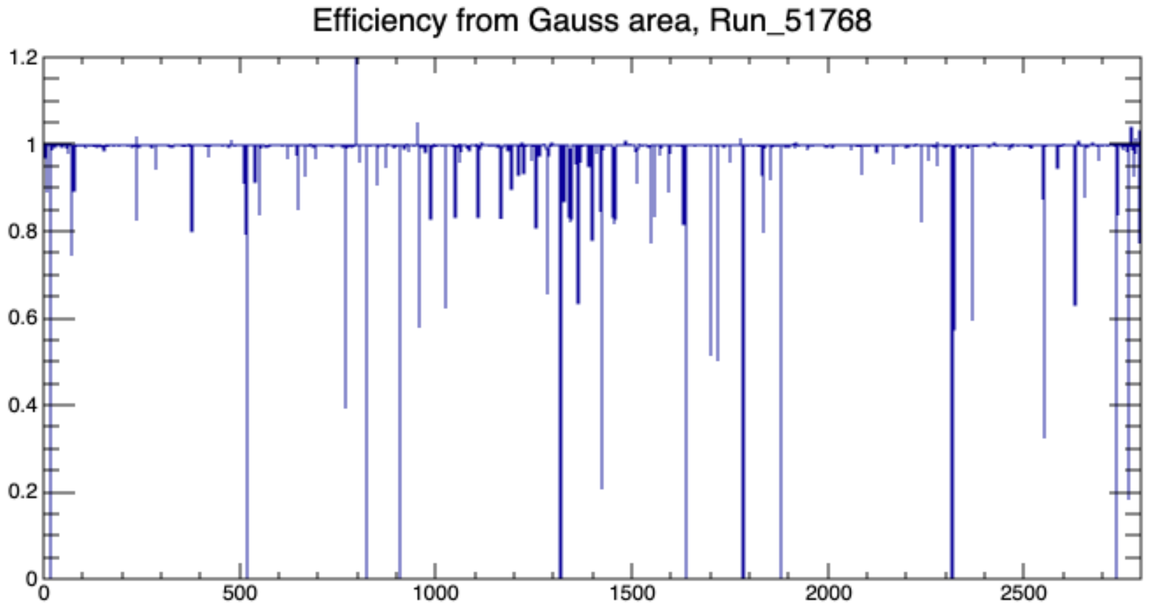


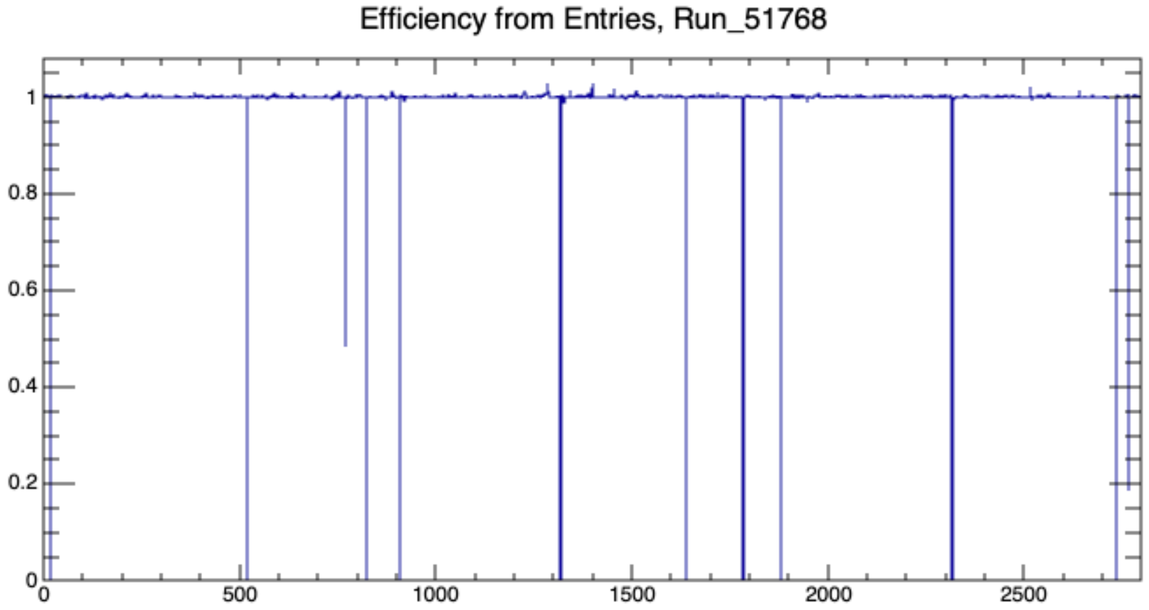




here, the bad channels (status=1) are based on the Gauß areas.

in total 57 channels would be bad





efficiencies

- ignoring LED Regions
- integrated over Run
  - including sub-runs without LED events
- normalized with FCAL-LED trigger count
- consider as inefficiency (set efficiency>1 to 1)
- **suggestion**:
  - **<u>provide per-run files with inefficiencies</u>**
  - **from which**, Gauss areas or Entries or both**?**
  - by applying a **cut on the inefficiencies** this could easily be turned into a 0/1 decision