CLAS12

Forward Tagger Calorimeter (FT-Cal)

Manual of operation

The CLAS12 Collaboration

Abstract

This operation manual would it be the short-cut to access the FT-Cal operations for the users. It contains all the information to operate the detector during data taking or maintenance period. An overview on the HV, LV and cooling systems is reported.

Short Manual for CLAS12 FT-Cal v2.0

December 2, 2016

Contents

1 Requirements

All users MUST have:

- a valid JLab account
- use the **clasrun** user for all instructions in this document

This manual is for users only. If you are an expert, refers to the main manual [2] or in the tdr for more information [1].

2 The EPICS main control panel

All FT detectors are controlled via EPICS from a single panel shown in Fig. 1. The FT-Cal detector is one of the FT sub-systems and all operations are accessible from the same panel.
To execute the panel, digit the following command from a terminal of the `clonpc##` workstations in the Hall-B counting house:

<div align="center">

`clas12_epics`

</div>

and select the FT-Cal panel from the FT tab in Fig. 1 to access to all services:

- **FTC Overview:** High voltage and low voltage controls, monitor of the temperature sensors and chiller temperature monitor and control
- **FTC Flasher Expert:** Management of the LED FT-Cal system for expert use only
- **FTC Flasher Novice:** Management of the LED FT-Cal system for users and normal operation
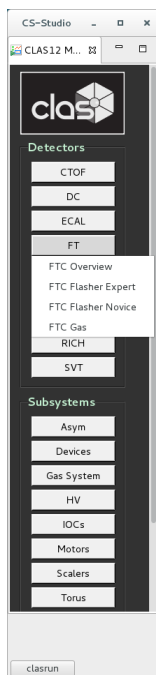- **FTC Gas** Nitrogen control system

Figure 1: View of the Hall-B EPICS main window. Menu shown gives access to all control panels.

2.1 The FTc Overview panel

The panel shows the FT-Cal overview and the user can immediately appreciate the status of the detector. The grey square buttons in the top right of each section of the main FT-Cal screen provide access to more detailed or expert screens for the corresponding subsystem.
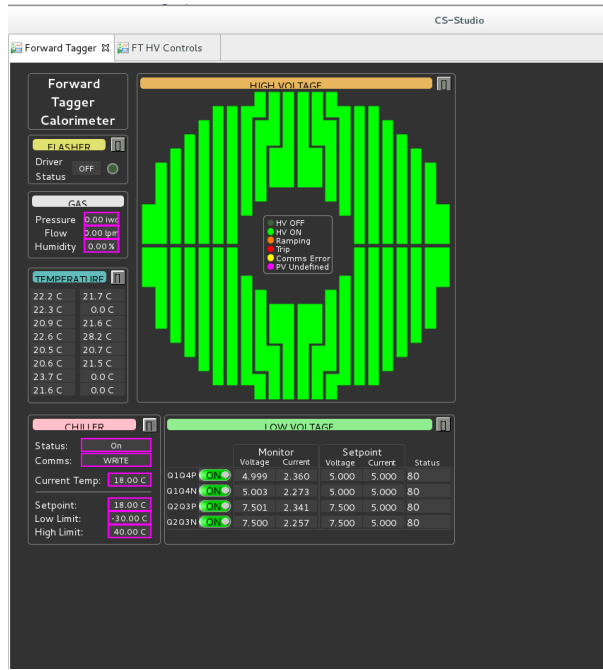
Figure 2: The primary EPICS screen needed for shift workers to monitor FT-Cal.

2.1.1 Temperature

The FT-Cal temperature should remain stable within $\pm 0.1°$ C in order to avoid gain variation in the system.

Variations of one Celsius degree ($°C$) or more during a shift should be reported to FT-Cal expert on call and noted in the log book.

- **Temperature Sensors:** There are 16 temperature sensors in the FT-Cal enclosure to be monitored. Clicking on the grey square button in the top right of the temperature section the expert panel in Fig. 3 pops up. The strip charts shown in Fig. 4 are accessible from the two buttons in the temperature section of Figure 2.

Figure 3: View of the EPICS temperature monitoring window.
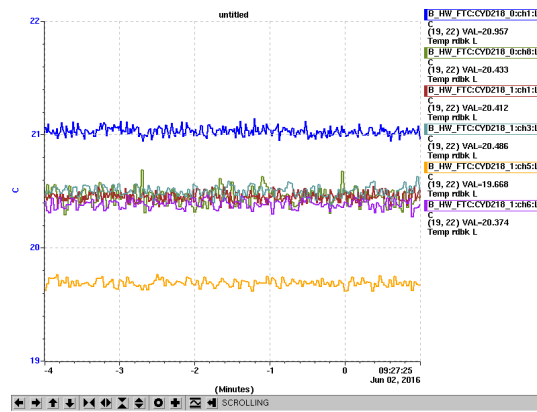
Figure 4:   Example view of what the implemented EPICS strip charts will look like

2.1.2   Chiller

The chiller MUST be ON during data taking.
It allows to keep the calorimeter at the temperature of -3 C. The chiller can be monitored through the EPICS control (Figure 5). *Shift takers should not attempt to change the chiller settings. Call FT-Cal expert in case of problem.*
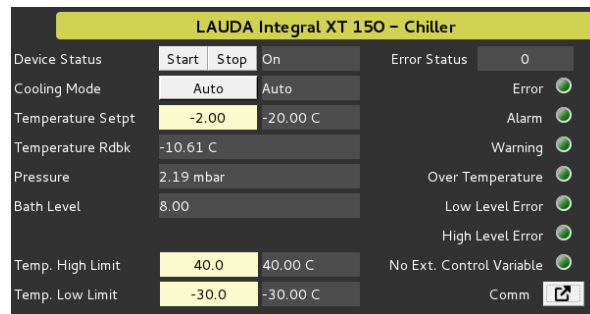
Figure 5:   View of the chiller slow control window.

2.1.3   Low Voltage

The low voltage power supply must be ON before HV is turned on.
Changing HV settings requires contact with an FT-Cal-expert.
The currents driven by the four channels should be similar. Normal current is between 2.2 and 2.4 A for all channels.
Call the FT-Cal expert if this appears not to be ON or shows an abnormal current for any of the channels.

Figure 6:   LV controls for the FTCal.

3 High Voltage

3.1 Turning ON/OFF High Voltages

HV should be turned on always after LV.
During data-taking also the chiller have to be ON.
Open the HV expert panel clicking on the grey top button of the HV panel in the FT-Cal EPICS window (Figure 2).
In the expert panel it is possible to choose :

- rump up and down the entire calorimeter
- rump up and down single channels opening a more detailed panel in Fig. 7
- monitor the HV trend using the strip chart in Fig. 8.

Jumps or drifts in current of more than 1 A should be noted in the logbook.

Figure 7: View of the EPICS FT-Cal HV control window for individual channels.

Figure 8: Example HV Current strip chart.

In case of HV trip the correspondent HV group in the main panel turns to red. HV trips will also be announced by the alarm handler. During normal operations with HV ON, there should be

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no red groups in Fig. 2 and no ECAL HV alarms.
In case of an HV trip, or a red region in Figure 2:

- try to re-enable the tripped HV group by turning it back on as described before.

- record the trip in the log book with precise indication of the group and run number concerned.

Contact the FT-CAL expert on-call in case of uncertainty.
Note, the HV can take up to 1 minute to turn back on so you should end the current run and begin a new one when the high voltage is back on.
If you cannot get a HV group to work contact the FT-Cal expert on call.
If you encounter more than two HV trips during your shift for the same group, you should notify the FT-Cal Expert.

4 Scalers

Rates seen by the FT-Cal are available in the ROOT-based GUI shown in Fig. 9.
Rates should remain constant within ~10% during stable beam operation.
A strong increase is the indication of bad beam conditions or the presence of a new source of noise in the FT-Cal system. If the latter case, please contact FT-Cal expert on call.
The Scaler Gui is stored on the jlab12daq1 machine.

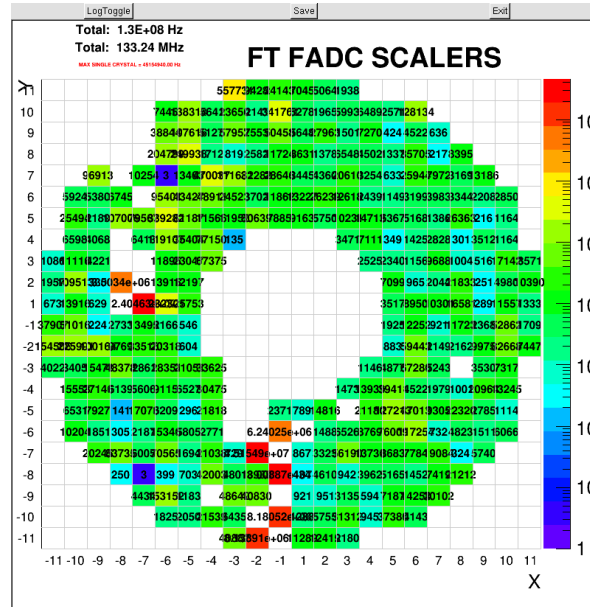Figure 9: View of the EPICS FADC scalers window (to be updated based on beam-commissioning rates.

5 Strip Charts

The most import quantities to monitor with strip charts are temperature and HV current. The StripTool from MyaViewer, shown in Figure 4, runs by executing the following scripts in a terminal (To Be Implemented):

- `mya_ftcal_all.sh`
- `mya_ftcal_temp.sh`
- `mya_ftcal_curr.sh`
- `mya_ftcal_voltage.sh`

6 How to switch ON/OFF the FT-Cal

The FT-Cal to operate requires to have the LV, HV and the chiller on.

6.0.1 Switching the FT-Cal ON

- From the CLAS12 EPICS control bring the primary FT-Cal EPICS screen ON (see Sec.2.1)
- Check temperatures (see Sec.2.1.1) and the status of the chiller (see Sec.2.1.2), if OFF, do not proceed and call the FT-Cal expert.
- Switch the LV ON (see Sec.2.1.3)
- Switch the HV ON (see Sec.3) *HV has to be switched ON AFTER LV!*

6.0.2 Switching the FT-Cal OFF

- From the CLAS12 EPICS control bring the primary FT-Cal EPICS screen ON (see Sec.2.1)
- Switch the HV OFF (see Sec.3) *HV has to be switched OFF BEFORE LV!*
- Switch the LV OFF (see Sec.2.1.3).
- Leave the chiller ON (see Sec.2.1.2)

7 The FT-Cal data monitor

The application used to monitor on-line and off-line data provides plots to assess detector performance.
To start the monitoring app, in a terminal run:

```
clas12-module
```

- choose from the menu the monitoring application you are interested in
- click the "Et" button to connect to the ET ring
- click the ">>" to start the event processing
- at the start of every run, clear the histograms via the "Clear Histograms"

After a few minutes of beam, the tabs should be cycled through and their plots compared to the reference. Once sufficient statistics are accumulated, snapshot of the relevant panel should be taken and uploaded to the logbook.

8 The LED run

The LED system is operated through an EPICS GUI accessible from the main CLAS12 EPICS menu, through FT, then FTC-Flasher Novice (see Figure 10).
Shift takers are requested to operate the system in "Sequence mode" only.
The sequence:

- click on "Initialize Flasher"
- verify the TOP frequency is 8000 Hz (if necessary adjust it trough the proper drop-down menu)
- click on "Start"

During such a run the DSC scaler screen and the monitoring app allows to check the proper functioning of the channels.

8.1 Taking a LED sequence run

This involves setting the DAQ, starting the LED sequence run, and configure the monitoring app to monitor the data. At the end of the run, the user can upload the relevant information to the CLAS12 conditions database, as well as post a log-entry to the HallB electronic logbook.
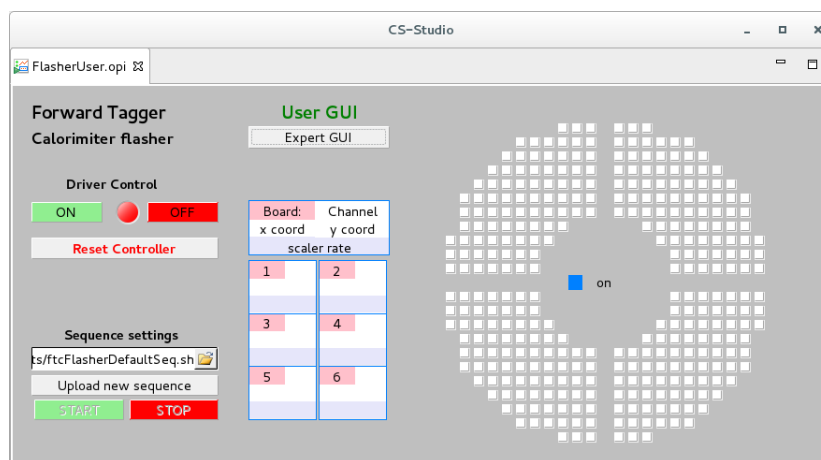
Figure 10: The FT-CAL Led monitoring system EPICS GUI.

8.1.1 Setup

It is critical they are followed in the **exact** order as they are here reporter.

1. **Start the DAQ system:**
   - Identify the machine where the DAQ RunControl is running.
     - If the DAQ system is not available, it has to be initialized from scratch. *Refer to the CLAS12 DAQ manual, or contact the DAQ expert.*
   - Depending on the DAQ state, different buttons may be visible in the "Transition" area. If the "Configure" button is not visible, click on "Reset", then on "OK".
   - Click on "Configure" to properly set up the run. A "Run Type Configuration" dialog will show up.
     There are two active FT configurations available:
     - FT: this is the standard configuration; all CODA modules are up, FT data are collected and written on disk.
     - FT_NOER: CODA ER module is off, data are collected for on-line analysis but they are not saved on disk.
   - Click on "Download" button. A file-chooser menu will show up.
     Select: clasdev.trg.
     Click on "OK" to close the file-choose menu.
   - Click on "Prestart". Wait until the "GO" button appears, but **do not click on it yet.**

2. **Start the monitoring app:** Use the command clas12-module on a terminal to start the monitoring app and select the FTCalViewerModule.
   Do this after the run-control shows the "GO" button.
   When the monitoring gui window shows up, click on the *Et* button to connect to the ET ring and on the ">>" button to start the event processing.

3. **Initialize the LED monitoring sequence:** In the EPICS gui, click on "Initialise Flasher", "Start Flasher", then on "!Stop All Seq" (to ensure there are no previous sequences running).

8.1.2 Run start, data taking, and run stop

To start data taking follow these instructions, in the exact order they are reported here.

1. In the RunControl GUI, click on the "GO" button. Wait 10 s, until the message "transition go succeeded" is displayed in the log window and the "END" button displays.

2. In the EPICS LED GUI, click on "Start".

3. To stop the run when the sequence is ended click on "END".

While the LED sequence is running, you can look at the monitoring application to check data being recorded.
The event display will show 6 crystals at time with a signal and a full sequence will take $\simeq$ 50 minutes to complete.

Use the EPICS gui to periodically check the sequence status, looking at the Sequence Control section (RED is OFF, GREEN is ON).
The DAQ system is not set up to end the run when the LED sequence is completed.
When the sequence is complete:

- The LED system automatically turns off. As a direct consequence of this, no further triggers are sent to the DAQ system

- The data-taking run is **not** ended. This means the DAQ will stay in RUN mode, but no events will be recorded, since there are no triggers.

The user can confirm the sequence has actually ended by looking at the FT-Cal Event display: no crystals have signal when the sequence is off.

When the sequence is OFF, first turn OFF the controller (LED ON/OFF, click on OFF), then use the DAQ run control to END the run, by clicking on the "End" button.

8.1.3   Analysis of the LED run

When the run ends, loop through the different tabs of the monitoring application to check the histograms were correctly filled.
Check in particular that no calorimeter channel in this map is shown as grey that would indicate the channel is dead or the sequence was not complete. In that case contact the FT-Cal expert on call.
Close and restart the monitoring application and analyze the recorded EVIO file by selecting it via the "File" button.

Once the analysis is completed, loop again through the different tabs to verify histograms an calorimeter maps. Check the values reported on the "Charge" tab: the average channel response should be in the range $\simeq 20 \div 30$. Make an entry in the e-logbook , reporting the run number and including a snapshot of the "Charge" tab and the LED calibration result file. The path to the latter will be indicated on the terminal from which the monitoring application was started.

9   Noise Run

A quick check of the calorimeter channels functionality can be obtained with a quick LED run. We simply use the LED sync trigger to have data recorded without performing a full LED sequence and check the noise levels recorded for each channels.
A channel is operating normally if the noise RMS is within 0.75 and 1.1 mV. Noise below this range may indicate the channel is dead. If this is the case reports on the logbook.
In order to perform this check, set the sequence:

1. **Start the DAQ system:**

   - Identify the machine where the DAQ RunControl is running. If you can't find it anywhere, it is possible the DAQ system has to be initialized from scratch. To do so, refer to the CLAS12 DAQ manual, or contact the DAQ expert.
   - Depending on the DAQ state, different buttons may be visible in the "Transition" area. If the "Configure" button is not visible, click on "Reset", then on "OK".
   - Click on "Configure" to properly set up the run. A "Run Type Configuration" dialog will show up. Use the scroll-down menu to select as RunType: FT. This configuration will also save any data on tape. Use instead: FT_NOER to not save data on tape.
     Default is to save data to the tape
   - Click on "Download" button. A file-chooser menu will show up.
     Select: clasdev.trg.
     Click on "OK" to close the file-choose menu.
   - Click on "Prestart". Wait until the "GO" button appears.
   - In the RunControl GUI, click on the "GO" button. Wait 10 s, until the message "transition go succeded" is displayed in the log window and the "END" button displays.

2. **Initialize the LED monitoring sequence:**In the EPICS gui, click on "Initialise Flasher", then on "!Stop All Seq" (to ensure there are no previous sequences running) and finally on "Start".

3. **Start the monitoring app:**

- Use the command outlined in the previous section to start the monitoring app. When the monitoring gui window shows up, click on the "Et" button to connect to the ET ring and on the ">>" button to start the event processing.
- Accumulate events for 2 minutes.
- Go to the "Noise" 11 tab and check the detector view map on the left panel: noise levels are within range if they show in green.
- Compare the color map with previous ones to verify the presence of new "dead" (blue) or "noisy" channels (orange). Take a snapshot of the panel and make an e-logbook entry with the appropriate comments.
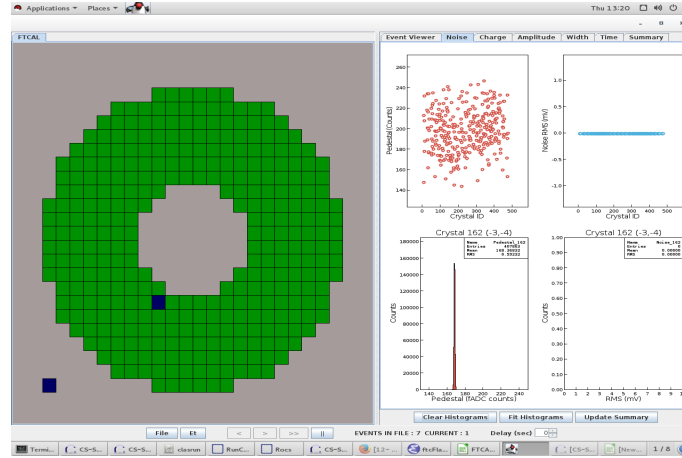

Figure 11: Example Noise map within the LED monitoring Gui. The color of the heat map is determined by the RMS of the mean of the noise of a given channel.

- ***If new problematic channels are found, contact the FT-Cal expert on call.***

4. **Stop the DAQ:** click on "End Run".

5. **Stop the LED controller:** end the sequence by clicking on "Stop" and turn off the drivers by clicking on "OFF".

10   Taking a Cosmic Calibration Run

1. **Start the DAQ system:**
   - Identify the machine where the DAQ RunControl is running. If you can't find it anywhere, it is possible the DAQ system has to be initialized from scratch. To do so, refer to the CLAS12 DAQ manual, or contact the DAQ expert.
   - Depending on the DAQ state, different buttons may be visible in the "Transition" area. If the "Configure" button is not visible, click on "Reset", then on "OK".
   - Click on "Configure" to properly set up the run. A "Run Type Configuration" dialog will show up. Use the scroll-down menu to select as RunType: FT. This configuration will also save any data on tape. Use instead: FT_NOER to not save data on tape. 12 *Default is to save data to the tape*
   - Click on "Download" button. A file-chooser menu will show up. On the Left pane of the popup window select .../parms/trigger/FT Once within the aforementioned directory Select ft_selftrigger.trg in the Right pane
   Click on "OK" to close the file-choose menu. 13
   - Click on "Prestart". Wait until the "GO" button appears.
   - In the RunControl GUI, click on the "GO" button. Wait 10 s, until the message "transition go succeded" is displayed in the log window and the "END" button displays.

2. **Start the monitoring app:**
   - Use the command outlined in the previous section to start the monitoring app. When the monitoring gui window shows up, click on the "Et" button to connect to the ET ring and on the ">>" button to start the event processing.
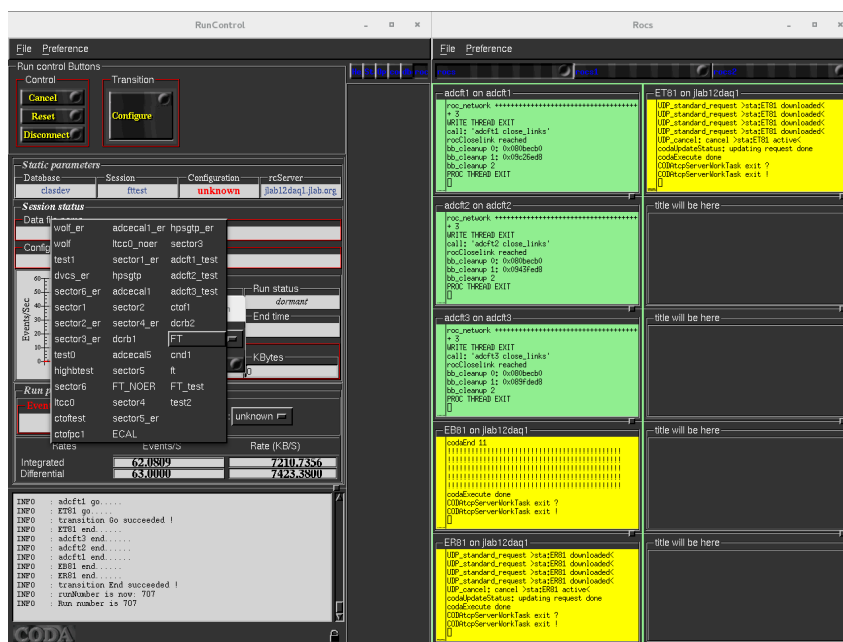
Figure 12: Depending on whether the user would like to record or only view live data, there are two configuration options to choose from. The FT option records data, and the FT_NOER option only shows live events.

- Once connected to the ET ring the user will see live events on the Left pane of the monitoring app14, as well as the waveform and tabs to provide further analysis on the Right.

References

[1] CLAS collaboration,"Forward Tagger (FT), Techical Design Report ", (2012)

[2] https://userweb.jlab.org/ battagli/FT-Manual.pdf

Figure 13: Once the configuration has been chosen, the user will then download the corresponding trigger file. In the case of the Forward Tager, this file is accessed by clicking the download button and navigating to .../parms/trigger/FT/ in the left window of the popup, and selecting the file called ft_selftrigger.trg in the right window.
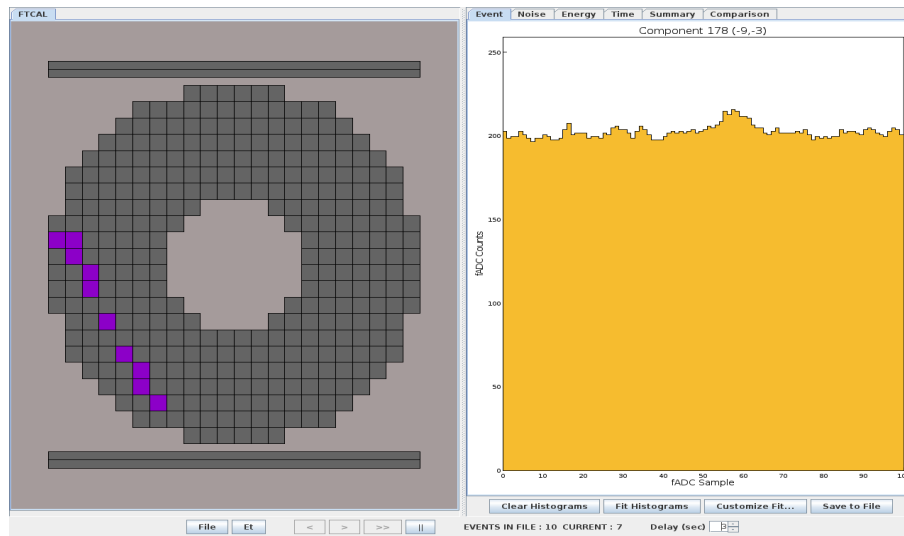
Figure 14: Sample cosmic event showing the channels being activated, as well as a histogram for a selected channel, which shows read waveform.