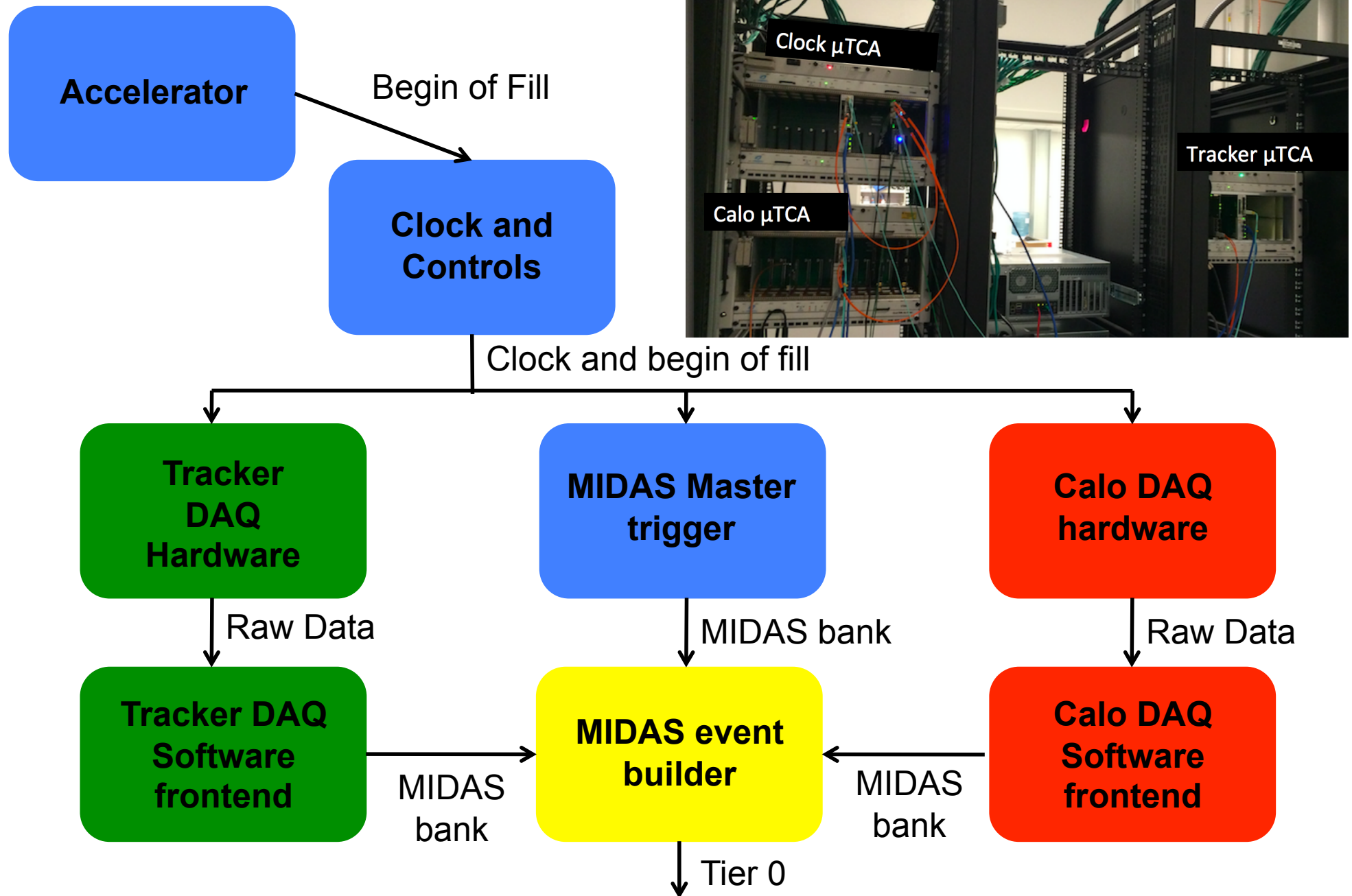


G-2 tracker DAQ

Becky Chislett

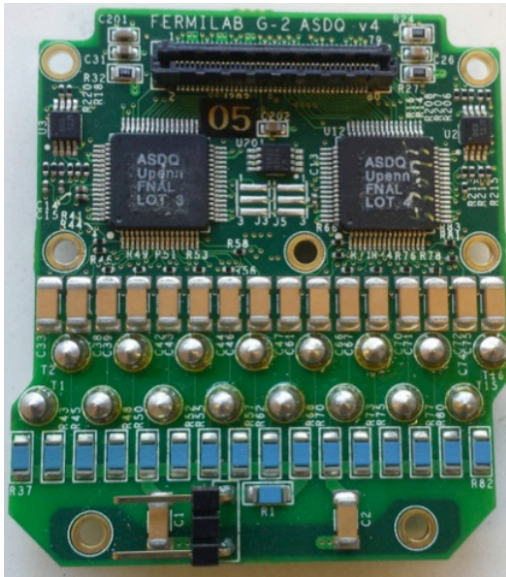
MUSE General Meeting
29th September 2016

Introduction



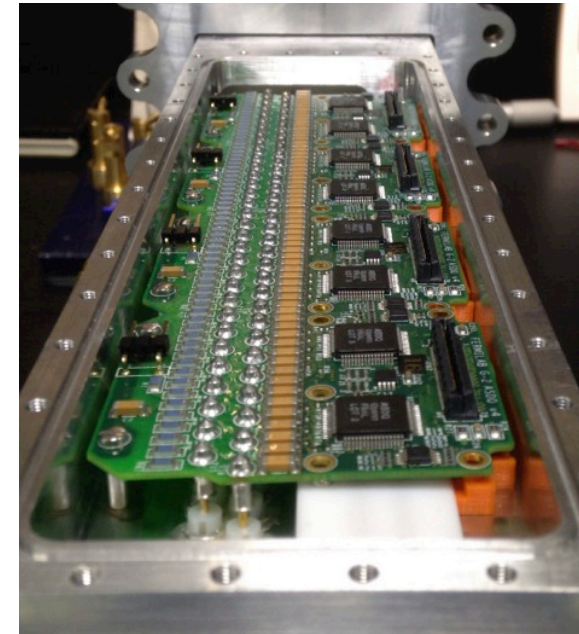
Tracker Frontend Readout

The tracker readout hardware consists of ASDQs, TDCs, Logic boards, FC7s and an AMC13



Straw Ends

Non-readout pin cover

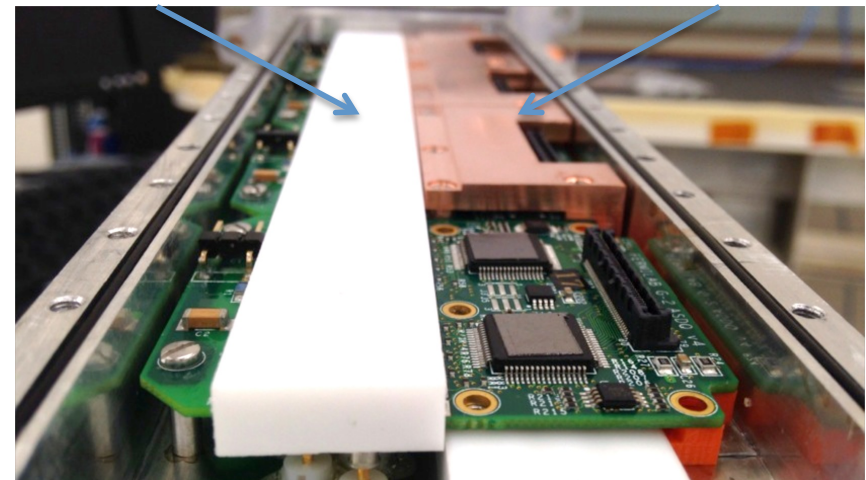


Socket cover

Cooling bar

The ASDQs plug onto the end of the straws :

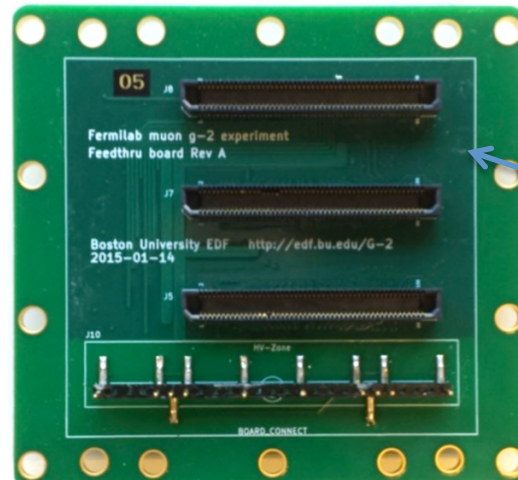
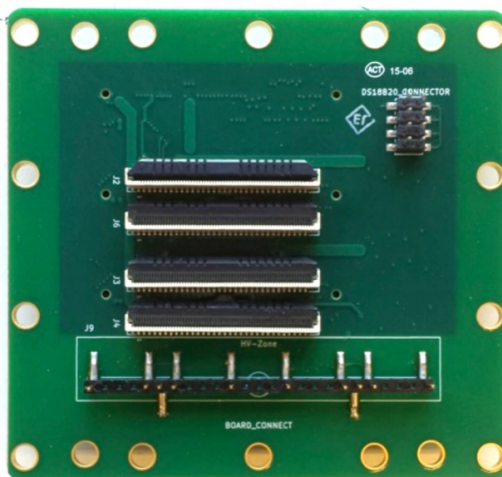
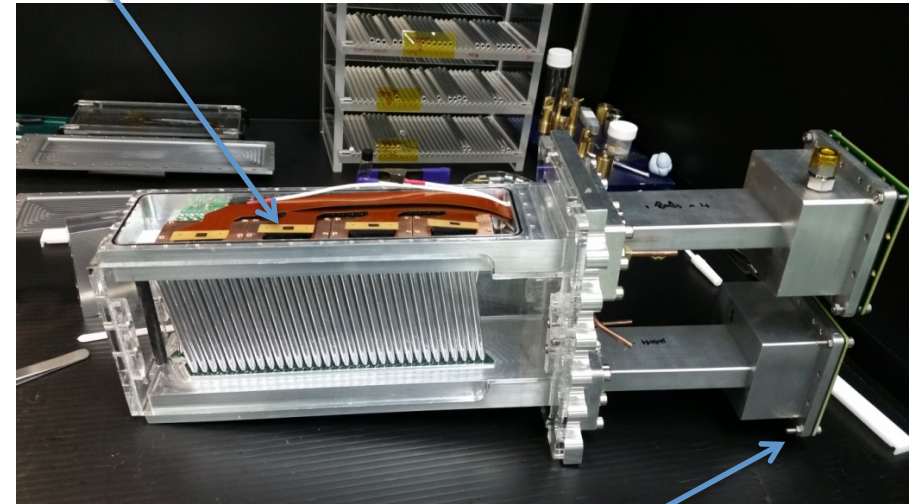
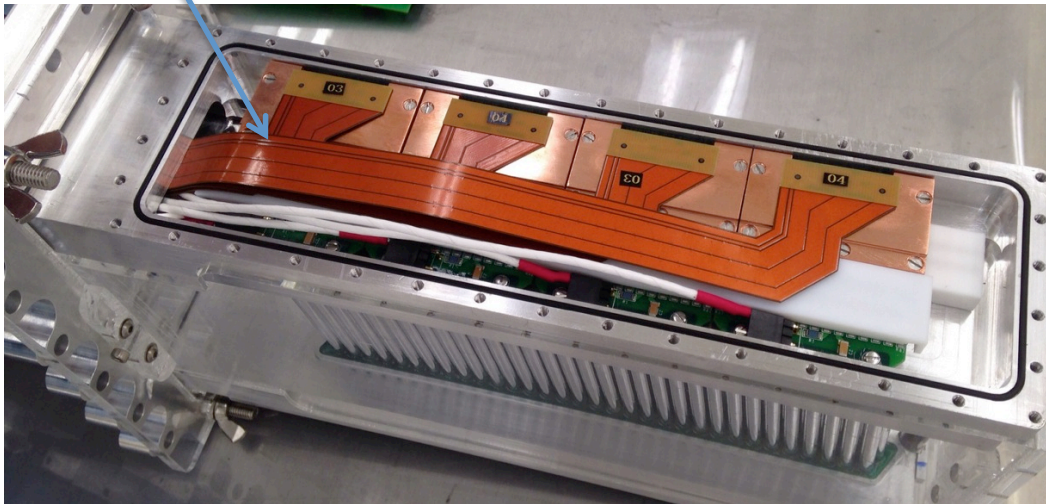
- 8 ASDQs per manifold (4 boards)
- Take care of pulse shaping, baseline restoration and discrimination
- Produce a digital output



Tracker Frontend Readout

The flexi cables plug onto the ASDQs :

- Provide power and reference voltages
- Carry the signal from the ASDQs



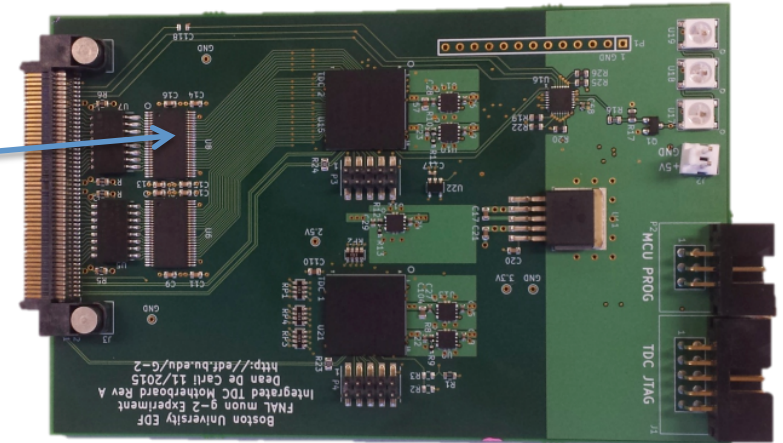
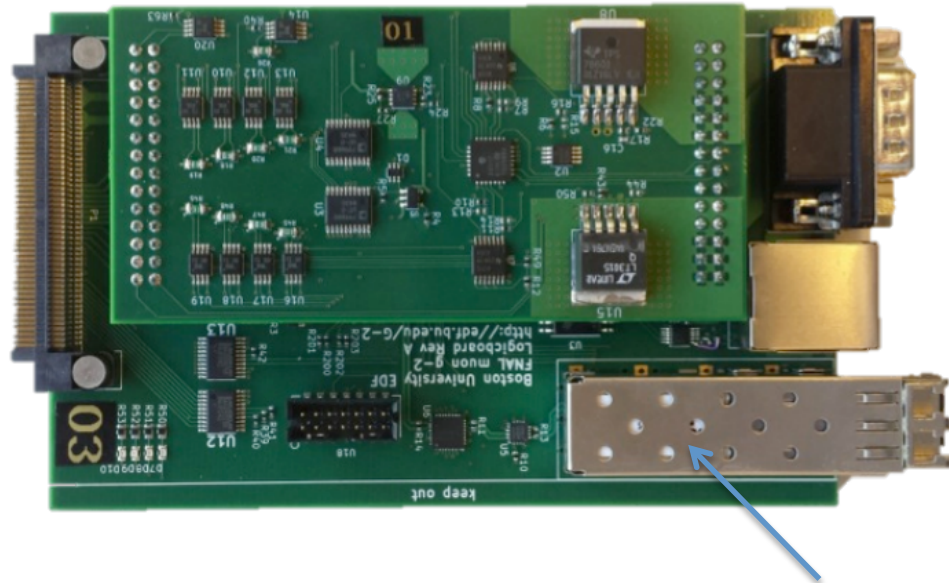
The flexi cables connect to the feedthrough board :

- Forms the gas seal
- Acts as a backplane for the boards

Tracker Frontend Readout

The data is passed to the TDCs :

- 2 TDC boards per manifold each with 2, 16 channel FPGAs
- Convert the digital signals from the ASDQs



The TDCs pass the data onto the logic boards :

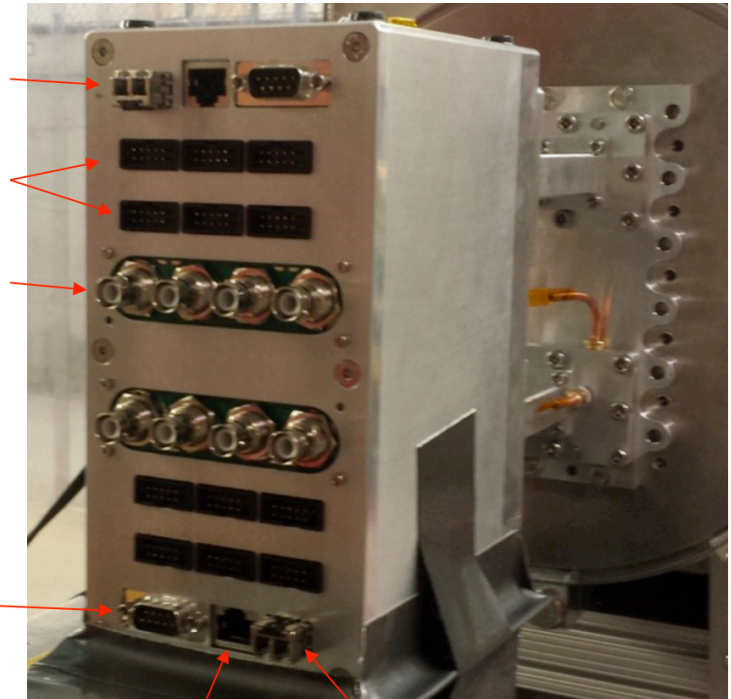
- Buffers and sends out the data from the TDCs
- Slow Control connection for programming settings and loading firmware
- Regulates voltages from $\pm 5V$ Low voltage input

Logic Board

TDC Board

HV Board

Power



Slow Control

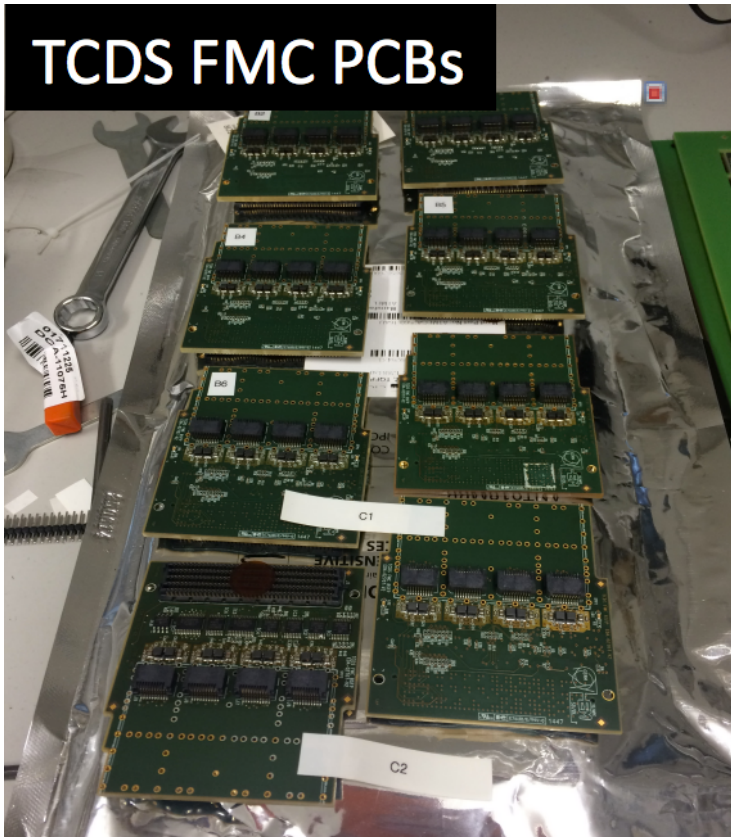
CLK/Data

Tracker Backend Readout

The data from the logic board is sent over fibre to the FC7 :

- Takes 16 fibre inputs (1 whole tracker station per FC7)
- Collects the data from all 16 Logic boards and sends it out
- Provides the clock to the logic board

TCDS FMC PCBs



The FC7 sends the data on to the AMC13 :

- Forms the connection to the PC via 10Gb ethernet
- Data send out over fibre to a PCIe card in the PC

The g-2 DAQ software uses MIDAS

Event builder, combines the events from the different frontends

Master GM2 stores the trigger information (begin of fill)

Straws frontend collects the straws data into a MIDAS bank

Slow Controls frontend records monitoring data (currents, temperatures etc.)

The screenshot shows the MIDAS interface with the following sections:

- Run Status:** Run 562 Running, Start: Wed Aug 31 23:30:15 2016, Running time: 6h54m21s, Data dir: /home/scratch/midas, Experiment Name: gm2. A log entry shows "23:30:34 [mhttpd,INFO] Run #562 started".
- Equipment:** A table listing equipment and their status.
- Logging Channels:** A table showing logging channels and their disk levels.
- Clients:** A list of active clients.

Equipment	Status	Events	Events[s]	Data[MB/s]
EB	Ebuilder@gm2straw6.fnal.gov	1.430M	57.7	0.087
MasterGM2	MasterGM2@gm2straw6.fnal.gov	0	0.0	0.000
StrawTrackerDAQ	StrawTrackerDAQ@gm2straw6.fnal.gov	1.430M	57.6	0.087
LVandSC01	LVandSC01@gm2straw6.fnal.gov	0	0.0	0.000

Channel	Events	MB written	Compr.	Disk level
#0: run00562.mid	1429639	2181.248	N/A	33.5 %

Clients		
mhttpd [gm2straw6.fnal.gov]	Logger [gm2straw6.fnal.gov]	MasterGM2 [gm2straw6.fnal.gov]
Ebuilder [gm2straw6.fnal.gov]	LVandSC01 [gm2straw6.fnal.gov]	StrawTrackerDAQ [gm2straw6.fnal.gov]

Ran stably for more than 7 hours at 50Hz rate

Tracker DAQ



Custom web pages have been written for easy straws control for variables that need changing often

Enabled and present values for each piece of hardware

Button to change thresholds of all boards at the same time

Threshold for the ASDQs

Channel mask – used to mask off any channels behaving badly

The screenshot shows a web browser window titled "Straw Settings - Mozilla Firefox" with several tabs open. The main content area is titled "Tracker-0 Settings" and contains a navigation menu with buttons for Status, Programs, ODB, Messages, Alarms, History, Sequencer, Chat, Config, and Help. Below the menu is a "FC7-0 Settings" section with a table:

ID	Enabled	Present	Number Of LBs
0	y	y	3

To the right of this table is a button labeled "change TDC thresholds". Below this are three "LB Settings" sections (LB-0, LB-1, LB-2), each with a table of parameters:

LB-0 Settings	
Parameter	Value
ID	0
Present	y
Enabled	y
Number of TDCs	4
LV channel	4
LV output	0

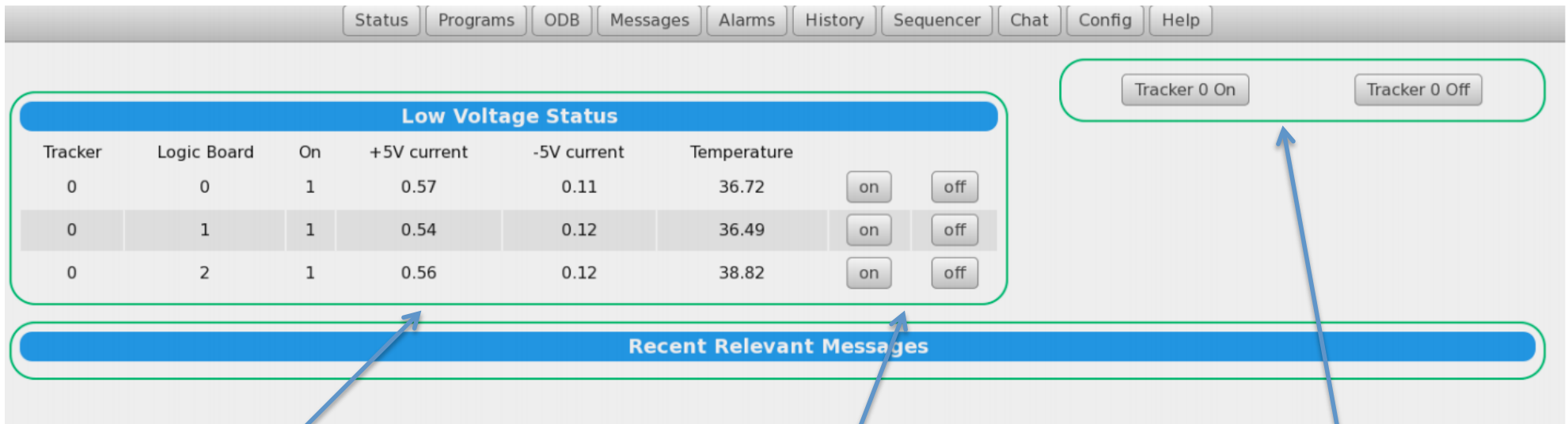
Similar tables are shown for LB-1 and LB-2. Below the LB settings are 12 "TDC Settings" sections (TDC-0 to TDC-3 for each LB), each with a table of parameters:

TDC-0	
Parameter	Value
ID	0
Present	y
Enabled	y
DTHR threshold	400
Channel mask	65535

Similar tables are shown for TDC-1, TDC-2, and TDC-3 for each LB. The "Channel mask" values are 65535 for most TDCs, except for TDC-0 in LB-2 which is 3.

Tracker DAQ

A custom web page for Low Voltage monitoring and control is also available



The screenshot shows a web interface with a navigation menu at the top containing: Status, Programs, ODB, Messages, Alarms, History, Sequencer, Chat, Config, and Help. Below the menu is a 'Low Voltage Status' section with a table and two buttons: 'Tracker 0 On' and 'Tracker 0 Off'. The table has columns for Tracker, Logic Board, On, +5V current, -5V current, and Temperature. Each row also has 'on' and 'off' buttons. Below the table is a 'Recent Relevant Messages' section.

Tracker	Logic Board	On	+5V current	-5V current	Temperature		
0	0	1	0.57	0.11	36.72	on	off
0	1	1	0.54	0.12	36.49	on	off
0	2	1	0.56	0.12	38.82	on	off

Easy view of the currents and temperatures and which boards are on

Buttons to turn the boards on and off individually

Option to turn a whole tracker on or off

Recent error messages are also displayed on the page so it will inform you if the press of the button was unsuccessful

Calo-Tracker DAQ Integration

The DAQ systems for the calo and the tracker were integrated along with the clock and controls system

Tracker DAQ/Calorimeter DAQ comparison

- Same top-level hardware (AMC13)
- Common clock, triggers, event builder
- Different frontend electronics
(ASDQ/TDC vs Rider)
- Tracker records hit times, calorimeter records waveforms
- Lower data volume in tracker
→ no need for GPUs
- Common protocol for board register read/write (IPbus)

Run Status

Run 73 Running

Start: Fri Apr 1 09:56:30 2016 Running time: 0h00m42s
Alarms: On Restart: No Data dir: /home/gohn/exp.RIDER/
Experiment Name: RIDER

09:56:30 [mhttpd,INFO] Run #73 started

Equipment

Equipment	Status	Events	Events[/s]	Data[MB/s]
MasterGM2	MasterGM2@g2be1.fnal.gov	34	1.0	0.000
AMC1301	AMC1301@g2calo0708.fnal.gov	34	1.0	10.675
AMC1302	AMC1302@g2calo0708.fnal.gov	0	0.0	0.000
EB	Ebuilder@g2be1.fnal.gov	35	1.0	10.603
StrawTrackerDAQ	StrawTrackerDAQ@g2calo0102.fnal.gov	35	1.0	0.002

Logging Channels

Channel	Events	MB written	Compr.	Disk level
#0: run00073.mid	37	384.857	N/A	82.1 %

Clients

mhttpd [g2be1.fnal.gov]	MasterGM2 [g2be1.fnal.gov]	Logger [g2be1.fnal.gov]
AMC1302 [g2calo0708-priv]	StrawTrackerDAQ [g2calo0102-priv]	Ebuilder [g2be1.fnal.gov]
AMC1301 [g2calo0708-priv]		

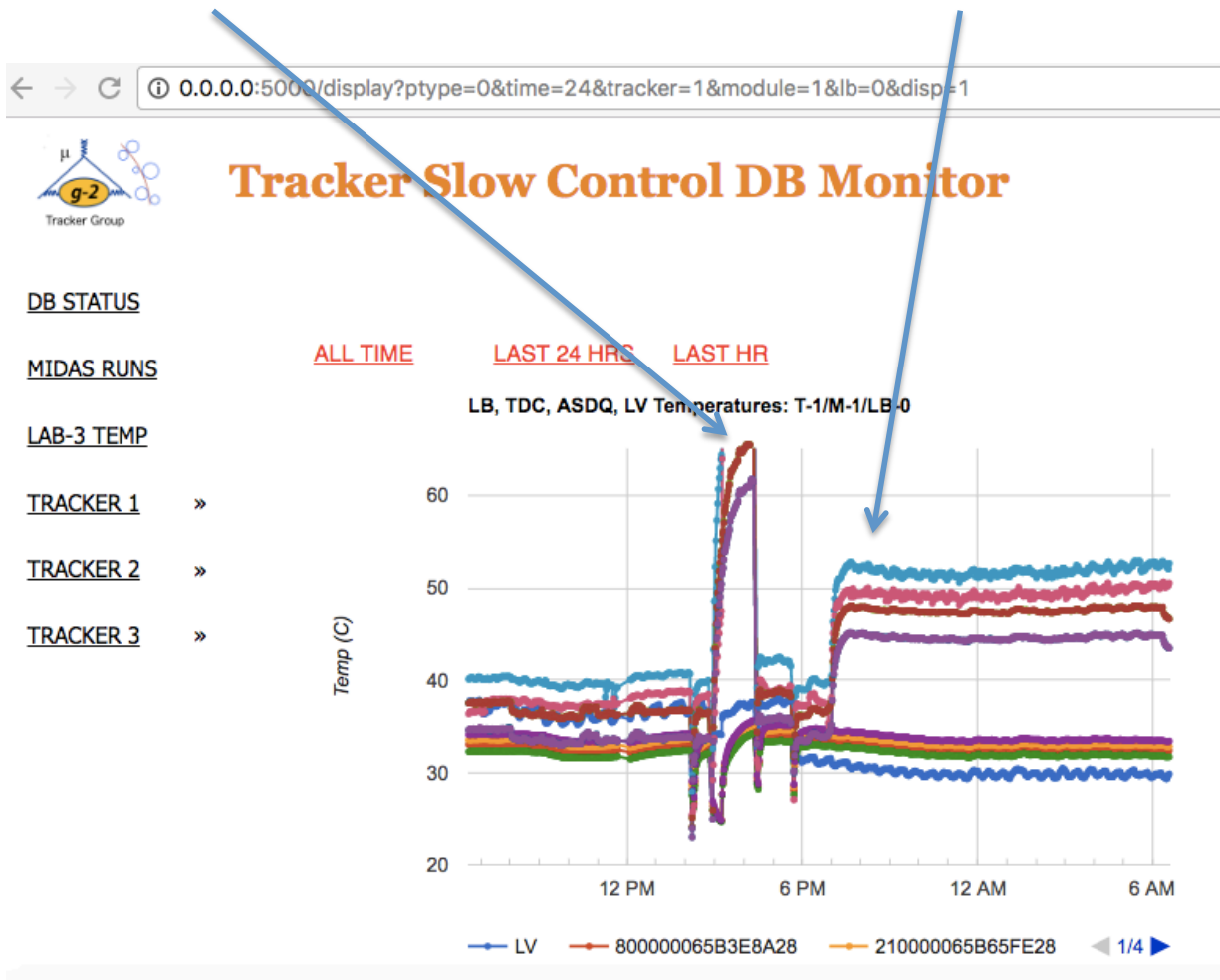


Tracker Slow Controls

The Low Voltage and Slow Controls frontend reads temperatures, currents, voltages etc. from the electronics boards and stores them in the ODB and an sql database

Forgot to plug fan back in

Fan fell off



The information put into the database is displayed on a webpage which auto updates once a minute

Displays :

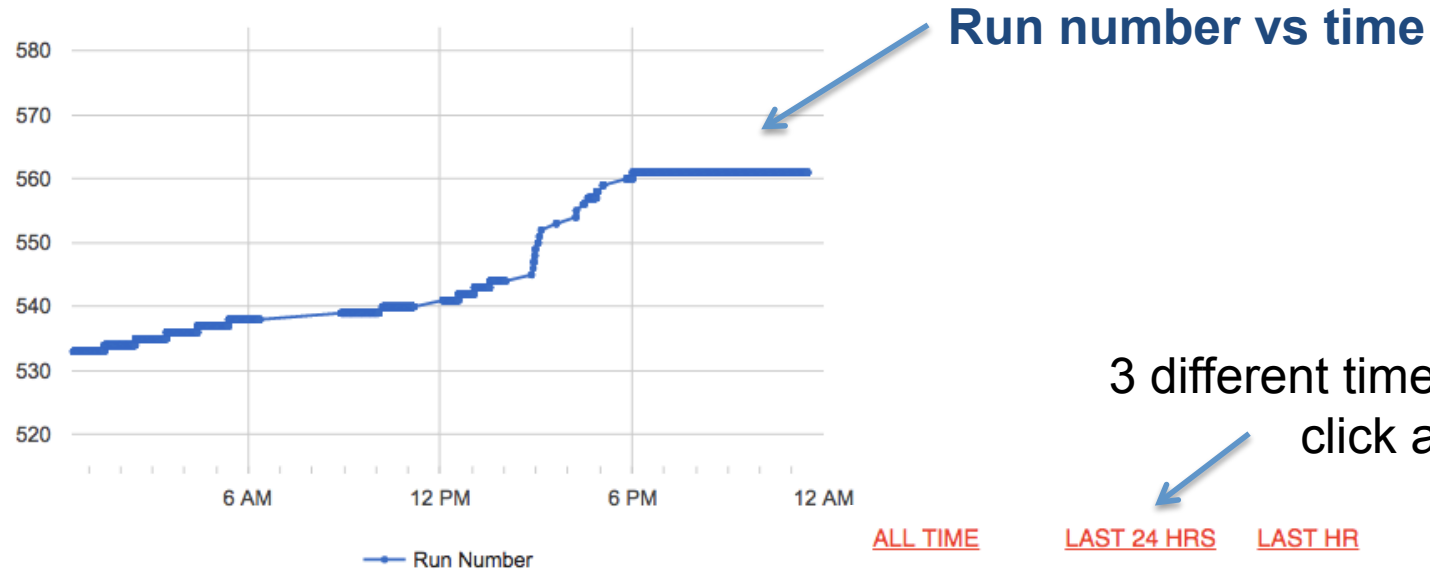
- Temperatures
- Currents
- Voltages
- DAQ errors
- MIDAS runs

The DAQ throws an warning/error if these values get too large

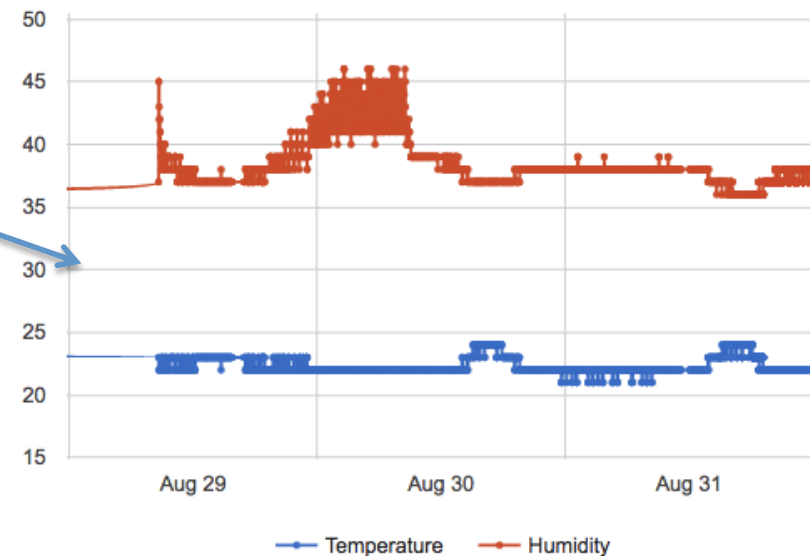
Tracker Slow Controls



ALL TIME LAST 24 HRS LAST HR

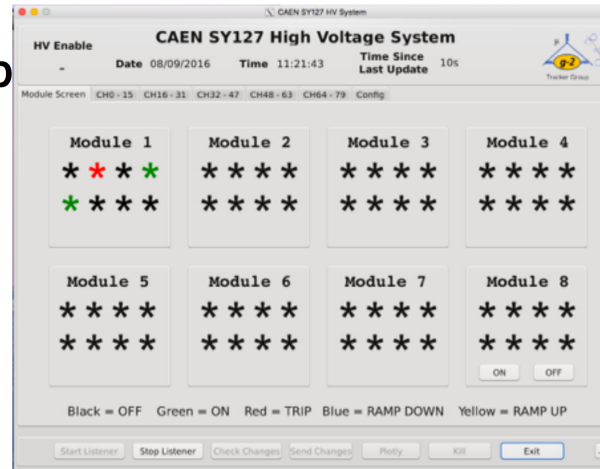
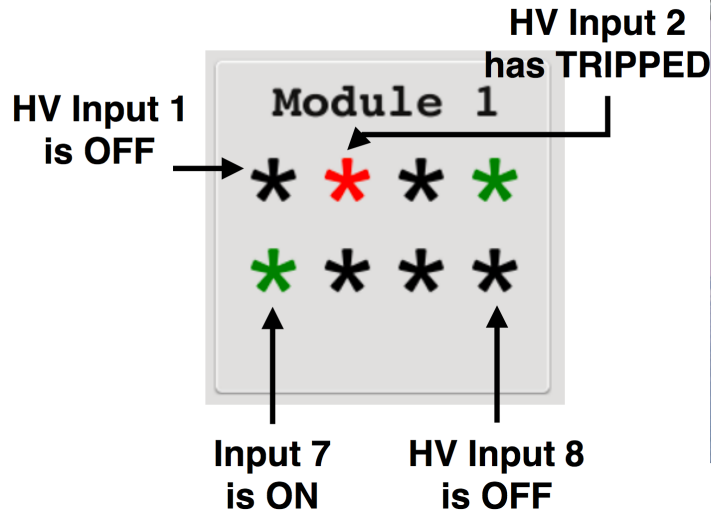


Lab temperature and humidity



High Voltage control

An HV GUI is available for HV control and monitoring



An easy display to see which HV channel are on or have tripped

There is also a page which allows the user to turn channels on/off and change the voltages

Screenshot of the CAEN SY127 High Voltage System GUI showing a detailed table of channel parameters. The table includes columns for CH #, Power, VMon (V), IMon (uA), V0 (V), I0 (uA), RUP (V/s), RDW (V/s), Trip (ms), Status, and Ramp Status. The table is currently displaying data for channels 0 through 15.

CH #	Power	VMon (V)	IMon (uA)	V0 (V)	I0 (uA)	RUP (V/s)	RDW (V/s)	Trip (ms)	Status	Ramp Status
0	<input type="checkbox"/>	0	0	1	1	3	4	0	OFF	-
1	<input type="checkbox"/>	0	0	50	1	3	4	0	TRIP	-
2	<input type="checkbox"/>	0	0	1	1	3	4	0	OFF	-
3	<input checked="" type="checkbox"/>	0	0	0	1	3	4	0	ON	-
4	<input checked="" type="checkbox"/>	0	0	1	1	3	4	0	ON	-
5	<input type="checkbox"/>	0	0	1	1	3	4	0	OFF	-
6	<input type="checkbox"/>	0	0	1	1	3	4	0	OFF	-
7	<input type="checkbox"/>	0	0	0	1	10	20	0	OFF	-
8	<input type="checkbox"/>	0	0	0	1	10	20	0	OFF	-
9	<input type="checkbox"/>	0	0	0	1	10	20	0	OFF	-
10	<input type="checkbox"/>	0	0	0	1	10	20	0	OFF	-
11	<input type="checkbox"/>	0	0	0	1	10	20	0	OFF	-
12	<input type="checkbox"/>	-	-						-	-
13	<input type="checkbox"/>	-	-						-	-
14	<input type="checkbox"/>	-	-						-	-
15	<input type="checkbox"/>	-	-						-	-

High Voltage control

The information from the HV GUI is read by the HV frontend and displayed in the Slow Control Monitoring pages

The screenshot shows the HV GUI interface with the following sections:

- Run Status:** Run 719 Stopped. Start: Wed Sep 14 03:43:13 2016. Stop: Wed Sep 14 04:41:38 2016. Alarms: On. Restart: Yes. Experiment Name: gm2. Data dir: /home/scratch/midas.
- Equipment Table:**

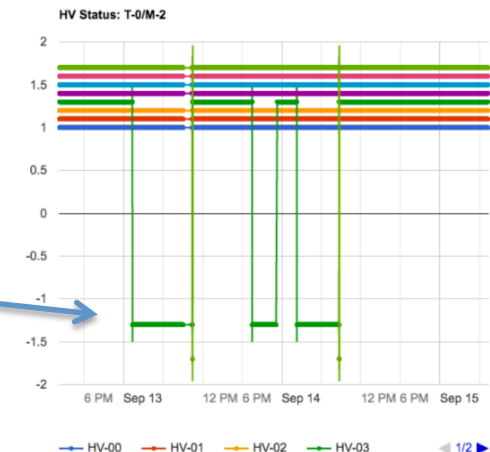
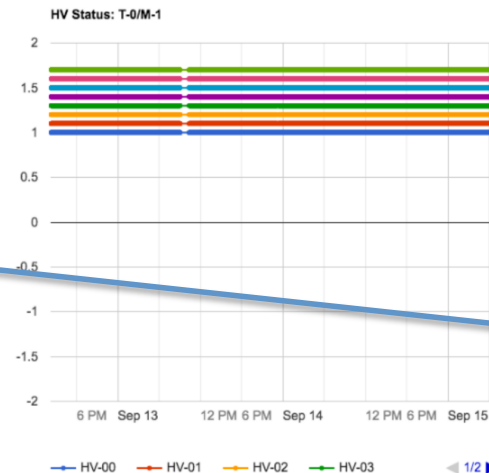
Equipment	Status	Events	Events[/s]	Data[MB/s]
EB	Ebuilder@gm2straw6.fnai.gov	200079	0.0	0.000
MasterGM2	MasterGM2@gm2straw6.fnai.gov	0	0.0	0.000
StrawTrackerDAQ	StrawTrackerDAQ@gm2straw6.fnai.gov	200079	0.0	0.000
LVandSC01	LVandSC01@gm2straw6.fnai.gov	0	0.0	0.000
StrawTrackerHV	StrawTrackerHV@gm2straw6.fnai.gov	0	0.0	0.000

- Logging Channels Table:**

Channel	Events	MiB written	Compr.	Disk level
#0: run00719.mid.gz	200081	55.264	N/A	47.7 %

HV frontend throws an error to MIDAS if the HV trips to alert the user

The Slow Control monitoring allows you to see when the HV tripped – good to know when analysing the data!



Straw Tracker DQM

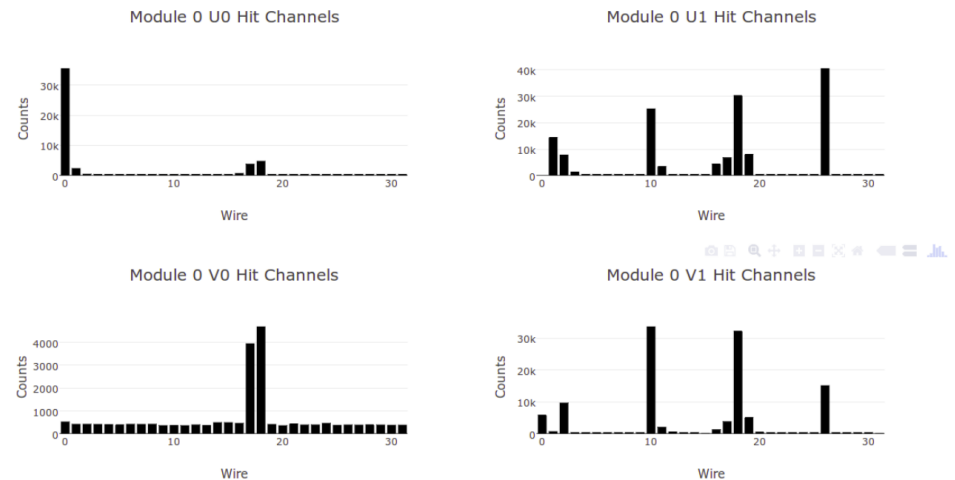


The DQM for the experiment will use MIDAS-to-art online which is sent to a node web client

[CONNECTED home channels](#)

Tracker Test Stand Hit Channels

RUN 610 EVENT 54242

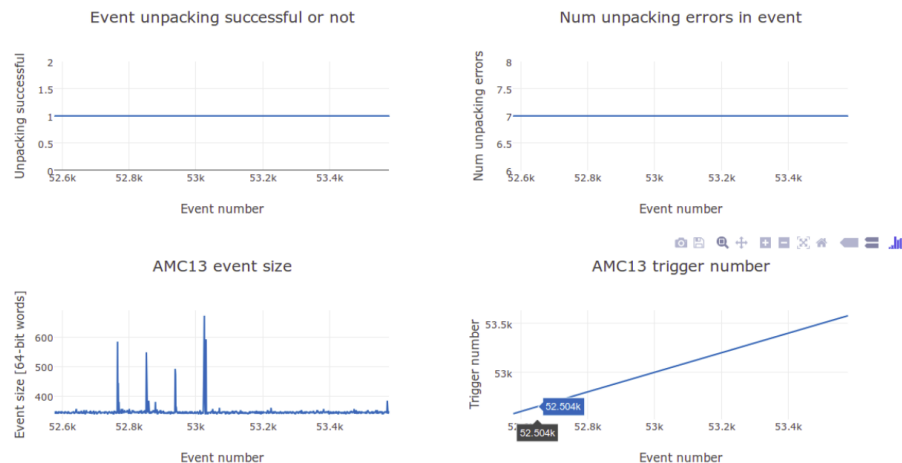


Uses the same software that is used for the offline analysis to make simple DQM plots – can use some of the same tools

[CONNECTED home channels](#)

Tracker Test Stand Summary

RUN 610 EVENT 53577



Have some basic useful plots in there currently but work is ongoing – need to decide on the exact plot combination

Summary

The Straw Tracker DAQ system is generally running well and is being well tested at FNAL and Liverpool

- The g-2 DAQ system uses **MIDAS with μ TCA hardware communicating via IPBus**
- There are many **tools available for monitoring** of SCs, LV, HV and the data
- The tracker DAQ has been **integrated with the calorimeter DAQ and clock and controls systems**
 - Further and longer tests of this will be performed
- A system with **2 tracker modules** is currently running well
 - Allowed for testing using 2 different FC7s successfully
- Continuing data taking is allowing **infrequent errors to be picked up** and solved and for **small improvements for increased usability**
- The system has **proved to be robust**, running over night for runs of up to 12 hours without error