

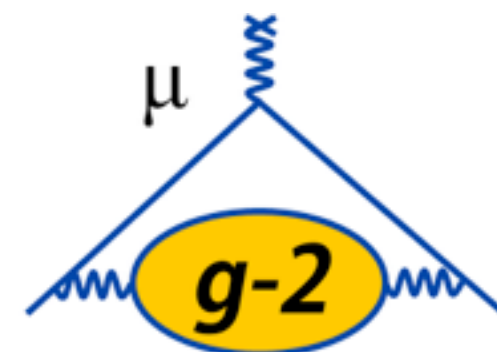


Muon $g-2$ Experiment Monitoring

Wesley Gohn

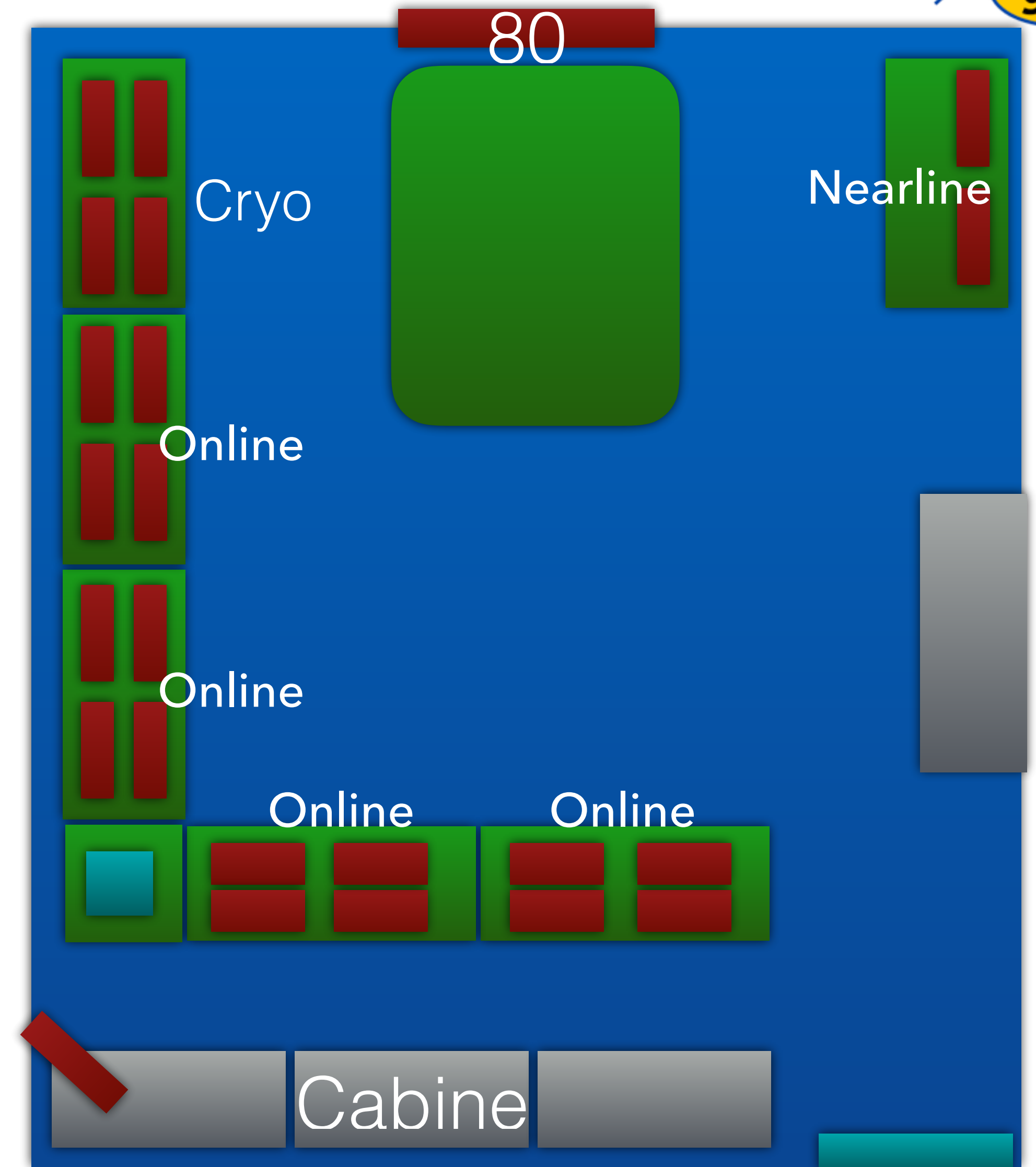
University of Kentucky

8 November 2016



Control Room Layout

- ▶ 2 computers installed with 8 monitors have been installed
- ▶ 3rd computer for field monitoring is currently being set up.
- ▶ Still need to add one more for full online monitoring.
- ▶ Need a machine that can run the event display for the 80" screen.
- ▶ Plan to add videoconferencing.





Monitoring Screens



Required displays:

- MIDAS for detectors
- MIDAS for field
- DQM for detectors
- DQM for field
- Run log

- Trend plots
- Laser monitor
- Rider monitor
- Kicker monitor
- CTAG display

- Logbook
- Video feed
- MIDAS History
- High Voltage control
- Nearline monitor

- Run status
- DAQ status
- SiPM Monitor
- FTS Display
- Accelerator status

+Paraview on 80" screen



MIDAS Web Control



Status ODB Messages Chat ELog Alarms Programs History MSCB Sequencer Config Help

ChanMap Enabled

Run Status

Run 5132 Running Start: Mon Jul 18 16:26:49 2016 Running time: 0h00m56s

Alarms: On Restart: Yes Data dir: /data/wes

Experiment Name: WES

16:26:50 [mhttpd,INFO] Run #5132 started

Equipment				
Equipment +	Status	Events	Events[/s]	Data[MB/s]
EB	Ebuilder@g2be1.fnal.gov	634	13.0	70.611
AMC1301	AMC1301@g2calo0102.fnal.gov	652	12.0	2.478
MasterGM2	MasterGM2@g2be1.fnal.gov	640	12.0	0.001
AMC1305	AMC1305@g2calo0506.fnal.gov	635	12.0	2.923
AMC1306	AMC1306@g2calo0506.fnal.gov	654	12.0	2.530
AMC1302	AMC1302@g2calo0102.fnal.gov	628	12.0	2.590
AMC1307	AMC1307@g2calo0708.fnal.gov	637	12.0	2.537
AMC1308	AMC1308@g2calo0708.fnal.gov	635	12.0	2.431
AMC1303	AMC1303@g2calo0304.fnal.gov	652	12.0	2.844
AMC1304	AMC1304@g2calo0304.fnal.gov	627	12.0	2.594
AMC1309	AMC1309@g2calo0910.fnal.gov	635	12.0	2.768
AMC1310	AMC1310@g2calo0910.fnal.gov	644	12.0	2.430
AMC1311	AMC1311@g2calo1112.fnal.gov	637	12.0	2.948
AMC1312	AMC1312@g2calo1112.fnal.gov	636	12.3	2.864
AMC1313	AMC1313@g2calo1314.fnal.gov	635	12.0	2.596
AMC1314	AMC1314@g2calo1314.fnal.gov	620	12.0	2.396
AMC1315	AMC1315@g2calo1516.fnal.gov	652	12.0	2.858
AMC1316	AMC1316@g2calo1516.fnal.gov	630	12.3	2.937
AMC1317	AMC1317@g2calo1718.fnal.gov	620	12.0	2.915
AMC1318	AMC1318@g2calo1718.fnal.gov	653	12.3	2.590
AMC1319	AMC1319@g2calo1920.fnal.gov	625	12.0	2.727
AMC1320	AMC1320@g2calo1920.fnal.gov	632	12.0	2.928
AMC1321	AMC1321@g2calo2122.fnal.gov	620	12.0	2.693
AMC1322	AMC1322@g2calo2122.fnal.gov	653	12.0	3.046
AMC1323	AMC1323@g2calo2324.fnal.gov	621	12.0	2.694
AMC1324	AMC1324@g2calo2324.fnal.gov	643	12.0	2.850

Logging Channels

Channel	Events	MB written	Compr.	Disk level
#0: run05132.mid	634	3449.517	N/A	2.6 %

- Midas web server used for experiment monitoring and control.
- Includes control of hardware/software settings via editing the Midas Online Database.
- Alarm system provides visual and audible warnings and alerts.

Online Database Browser

Find Create Delete Create Elog from this page

/ Equipment / AMC1301 / Settings / Rider01 /

Key	Value	+
rider_enabled	1 (0x1)	
sample_length	256 (0x100)	
pre_delay	56 (0x38)	

MIDAS Control with Javascript



We are creating custom pages with JS that interact with the MIDAS ODB to improve control over the experiment.

Frontend Enable												
Frontend	Enable	Send to EB	Repeat First Event	TQ on	Raw data	Raw prescale	Raw prescale offset	Histogram data	Histogram data flush	Histogram flush offset	Waveform Length	GPU WaveformLength
AMC1301	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	2	0	<input type="checkbox"/>	10	0		560000
AMC1302	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	10	0	<input type="checkbox"/>	10	0		560000
AMC13Simulator02	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>								560000	
AMC13Simulator01	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>								560000	
AMC13Simulator03	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>								64	

Include	
Equipment	Include in FE Enable
AMC1301	<input checked="" type="checkbox"/>
EB	<input type="checkbox"/>
AMC1302	<input checked="" type="checkbox"/>
MasterGM2	<input type="checkbox"/>
AMC13Simulator02	<input checked="" type="checkbox"/>
AMC13Simulator01	<input checked="" type="checkbox"/>
AMC13Simulator03	<input checked="" type="checkbox"/>
AMC1303	<input type="checkbox"/>

Being implemented by Z. Helton (UKY Undergraduate) and R. Chislett (UCL)

The screenshot shows the 'Straws Settings' web interface. At the top, there are navigation tabs for 'Status', 'Programs', 'ODB', 'Messages', 'Alarms', 'History', 'Sequencer', 'Chat', 'Config', and 'Help'. The main content area is titled 'Tracker-0 Settings' and contains a table for 'FC7-0 Settings' with columns for ID, Enabled, Present, and Number Of LBs. Below this are three main sections for 'LB-0 Settings', 'LB-1 Settings', and 'LB-2 Settings'. Each LB section contains a table of parameters (ID, Present, Enabled, Number of TDCs, LV channel, LV output) and four sub-panels for 'TDC-0', 'TDC-1', 'TDC-2', and 'TDC-3'. Each TDC sub-panel has its own table with parameters (ID, Present, Enabled, DTNR threshold, Channel mask).

FTS Monitor



FTS status for gm2-fts-gm2samgpvm01

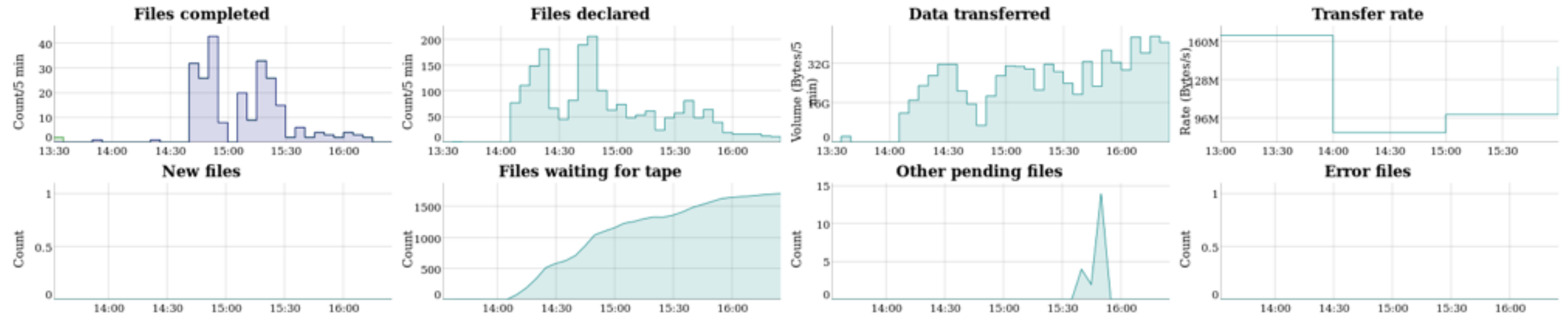
Generated at 2016-06-24 16:27:04 CDT [\(update\)](#)

Summary

FTS: OK SAM: OK

Completed files:	244
Failed transfers:	0
All error files:	0
Waiting on tape:	1719
Other pending files:	0
New files:	0

- An FTS server is running on g2be2 to copy data from our local RAID to the Fermilab dCache.
- The server provides monitoring plots so we can track the data transfer and easily see the quantity of data left on disk.



Monitoring Webpage



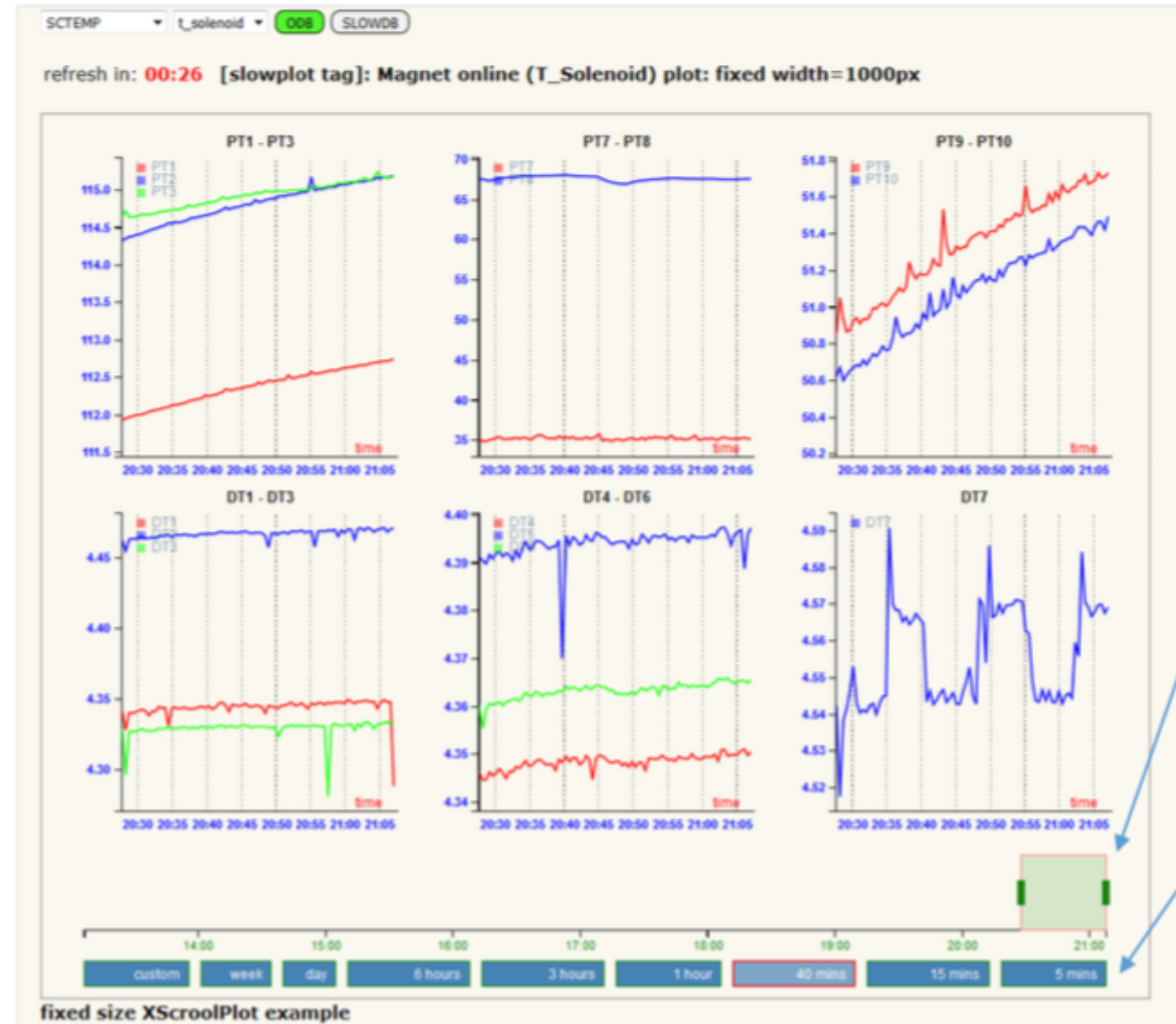
- Webpage for experiment monitoring is being written using Django, a python-based web framework.
- Allows for web 2.0 technologies such as AJAX, vector graphics, and JQuery plugins.
- Modular and extendable
- Being developed by Novosibirsk (I. Logoschenko, A. Anisenkov)

Many sensors on one plot

Everything is clickable

Automatic refresh for real-time data

The same interface for real-time or historical data



Common time scale for all plots on a page

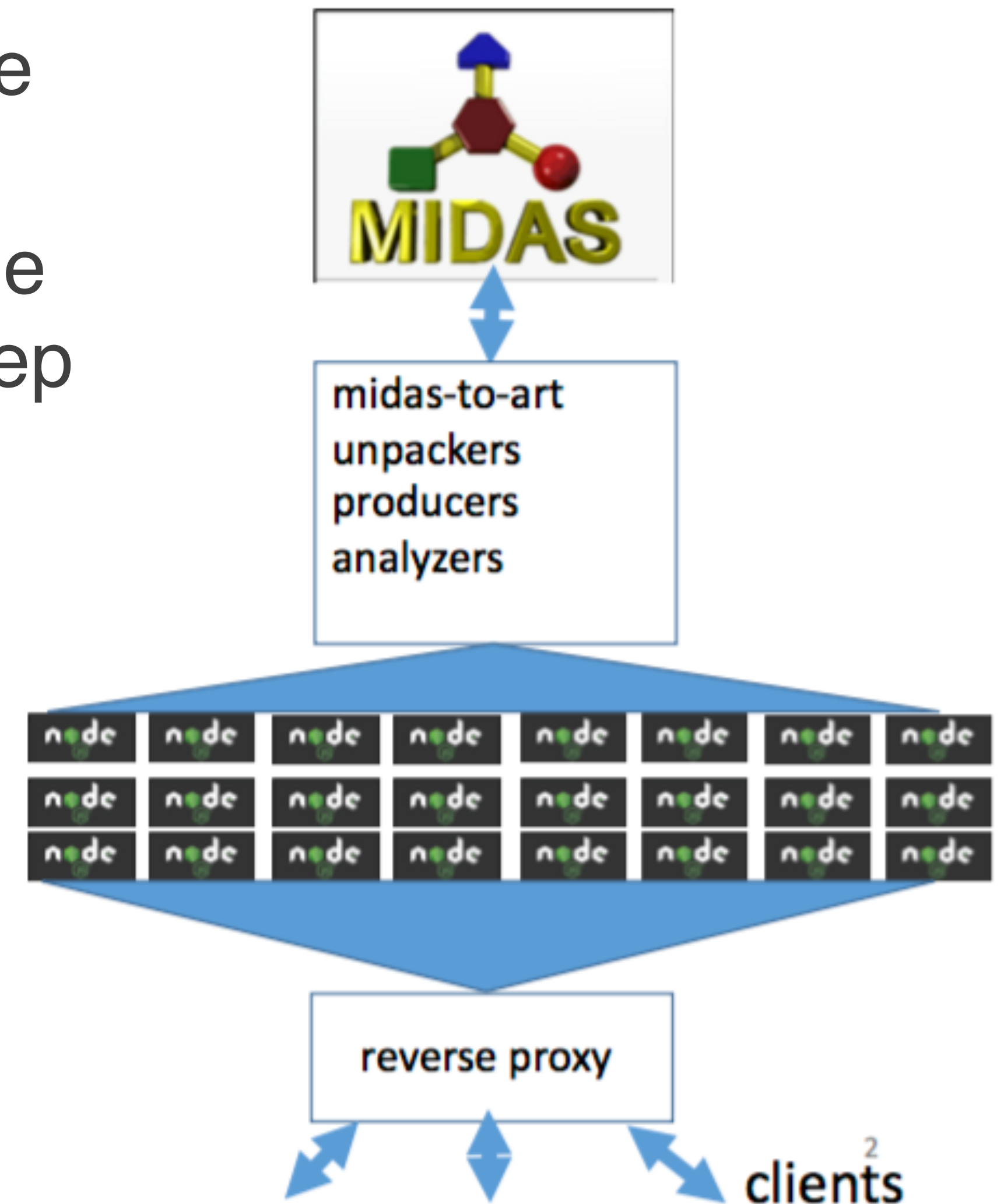
Standard time windows

See talk by M. Eads for more details.

DQM with *art/JS*

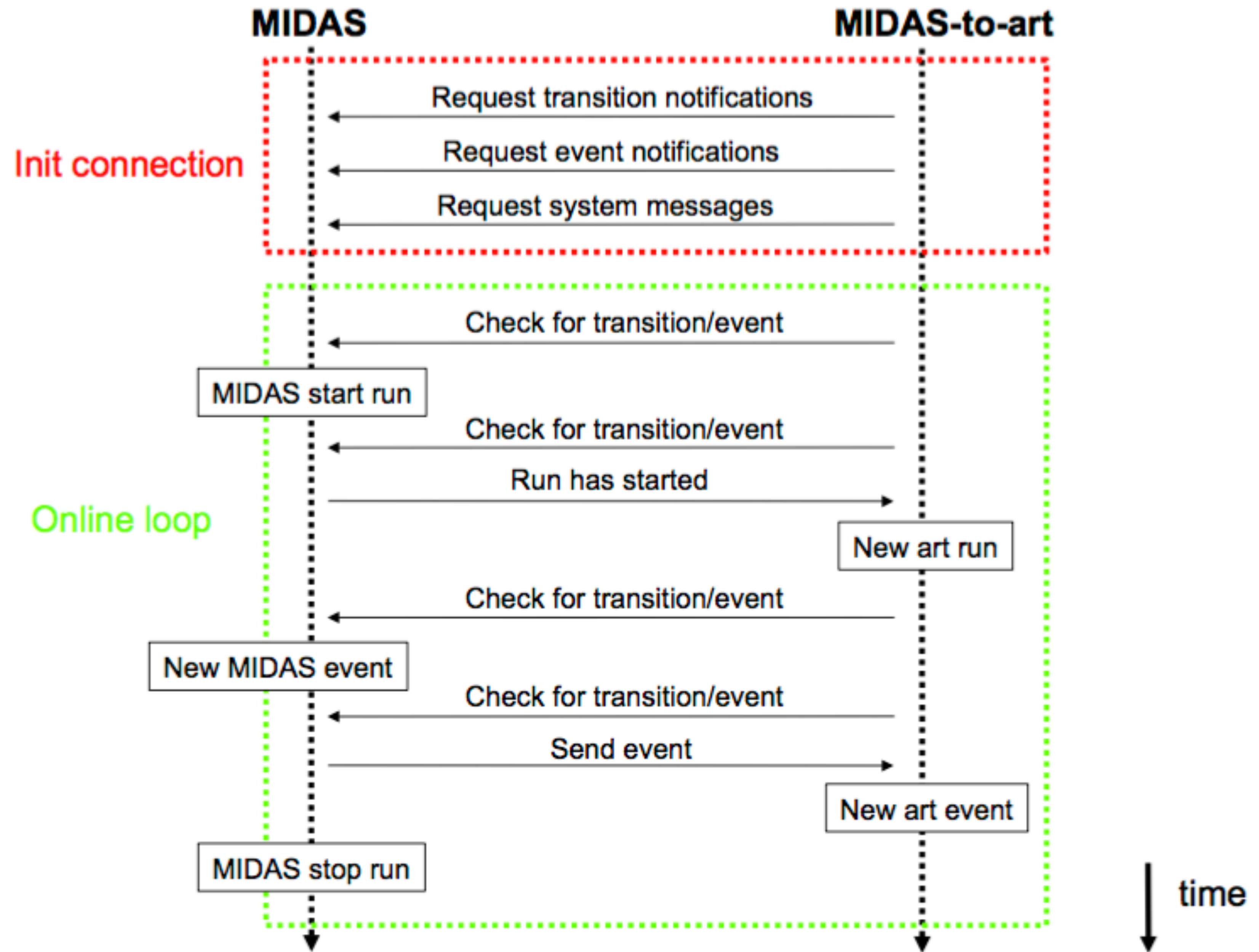
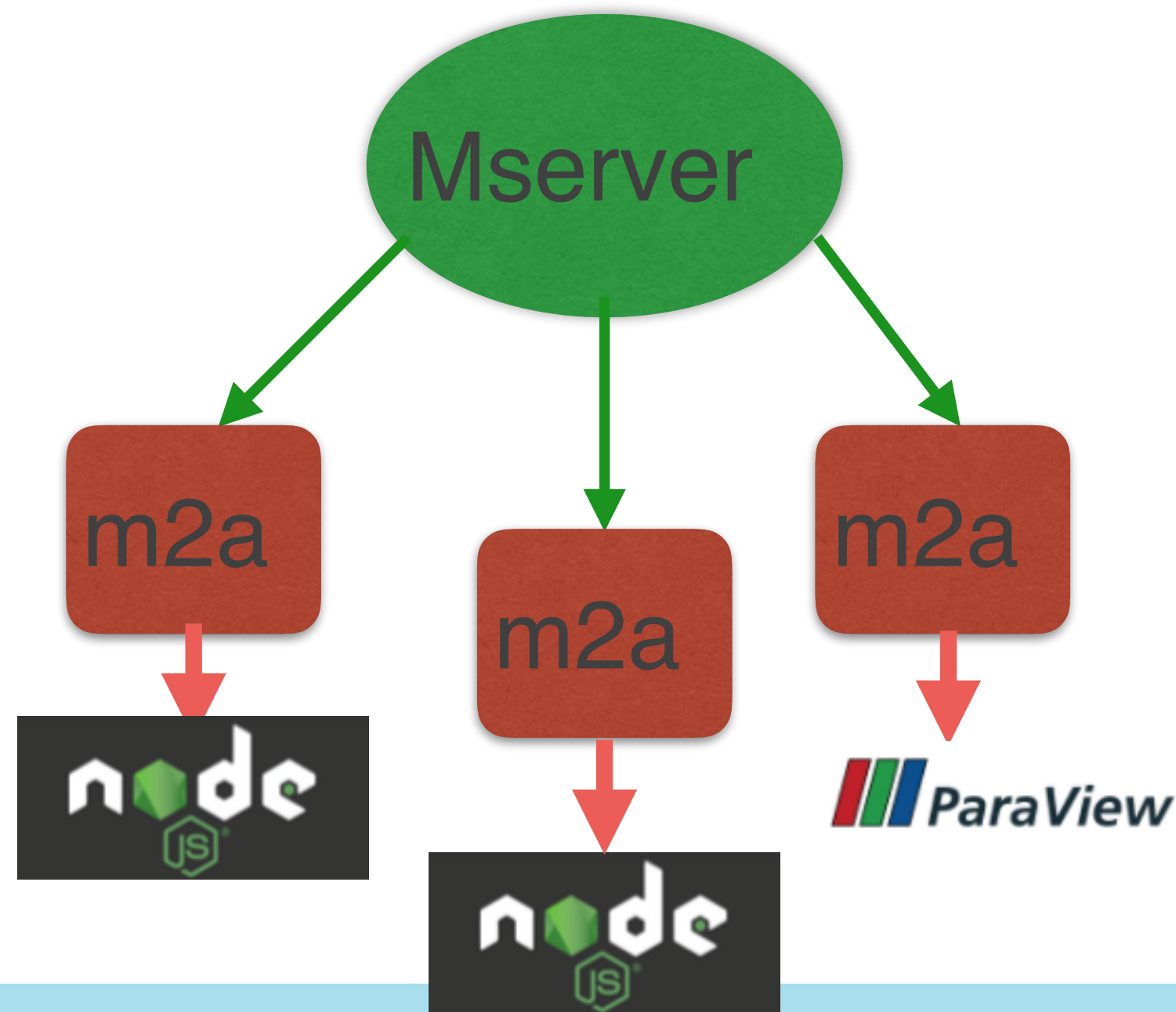


- We have enabled our midas2art utility to run online and read data from the Midas mserver.
- We can then attach our art analyzer modules to the process to perform any analysis tasks that can keep up with the data acquisition.
- A web server using ZeroMQ with node.js then provides the data to a web gui where plots are displayed.
- Plots created using plotly.
- Need HTML development.
- Current development is being performed by A.Fienberg (U. Washington), R. Fatemi and L. Kelton (U. Kentucky).



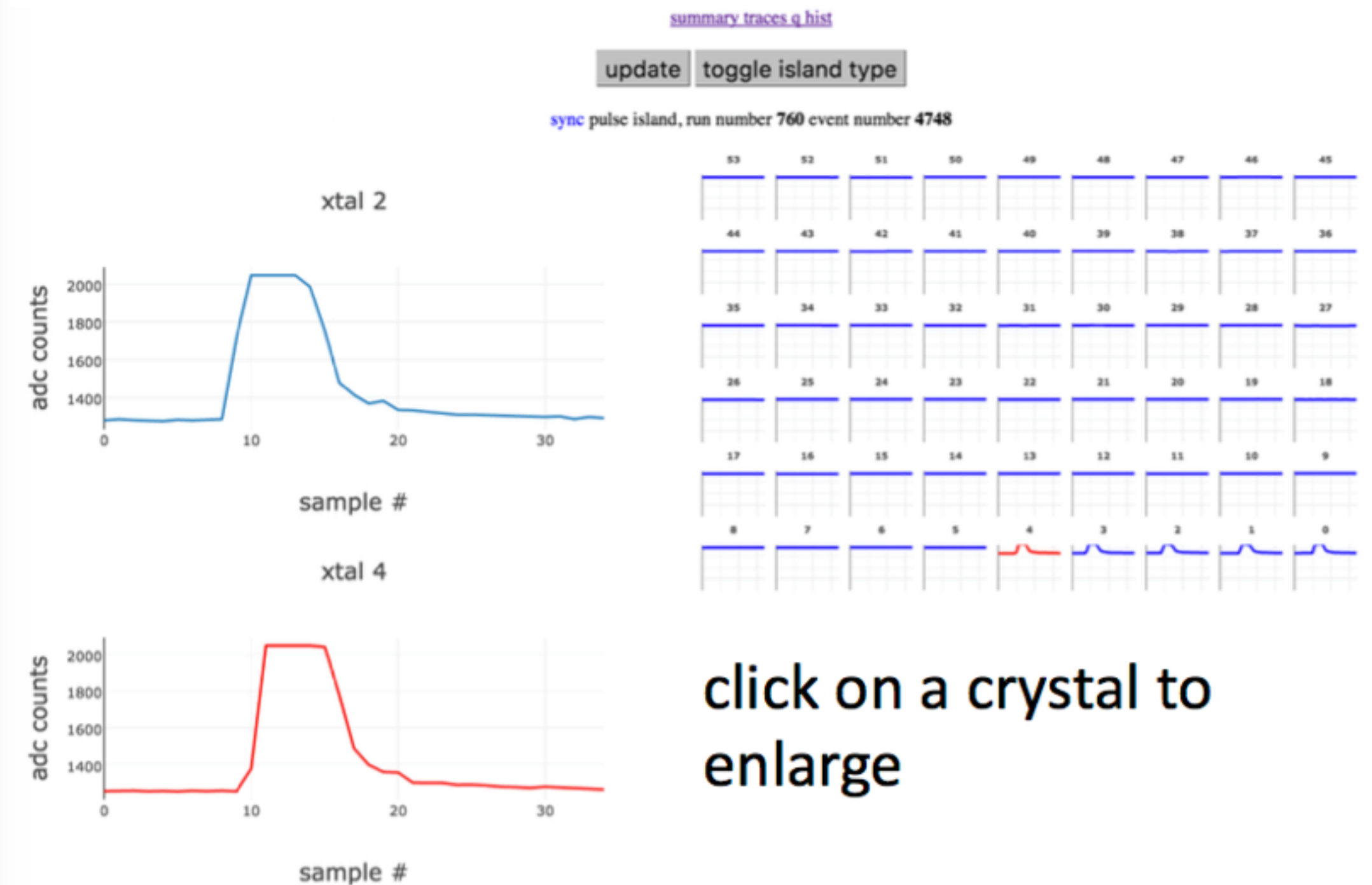
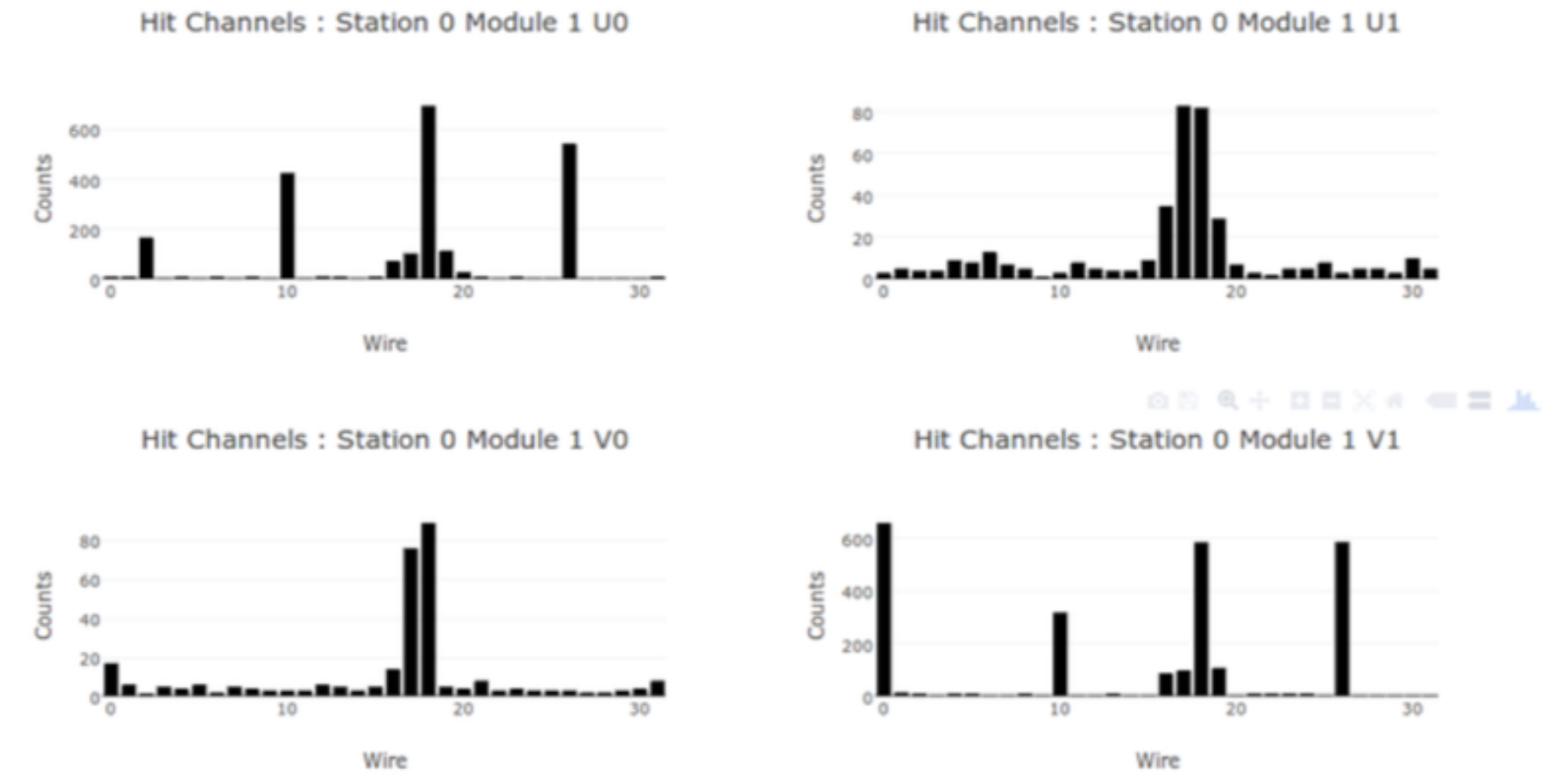
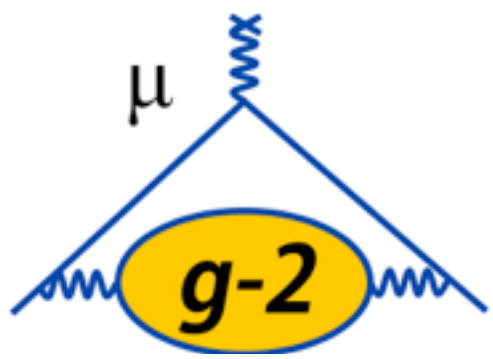
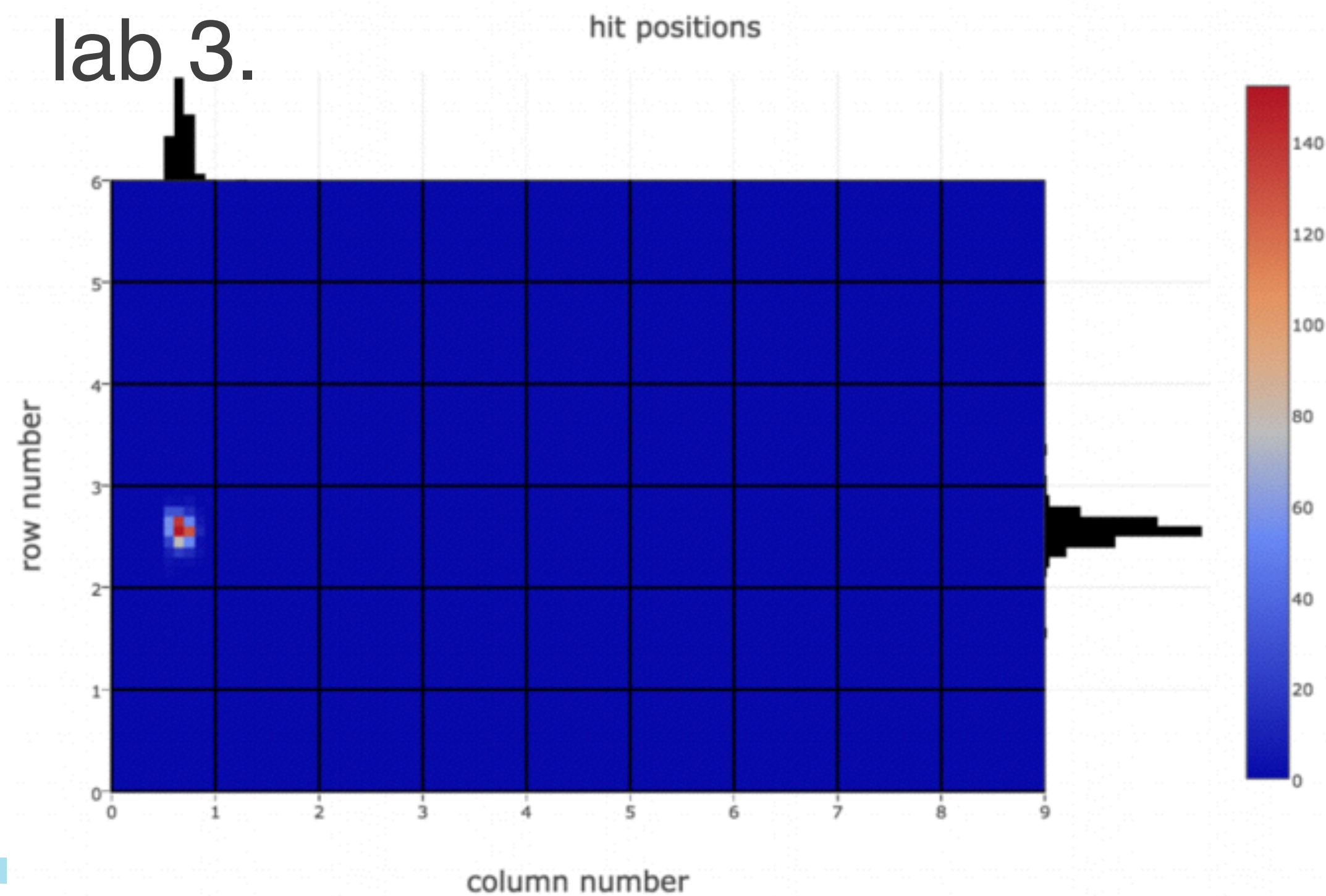
Midas2art online

- Connects directly to mserver.
- Non-blocking
- Based on NOvA DQM model

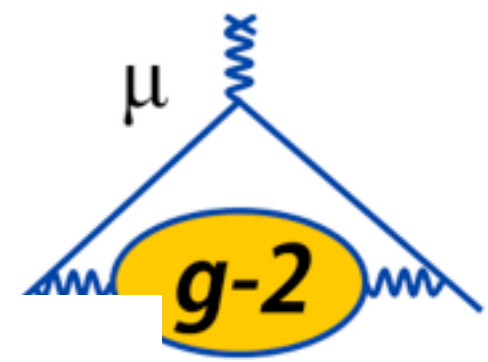


Test Implementations

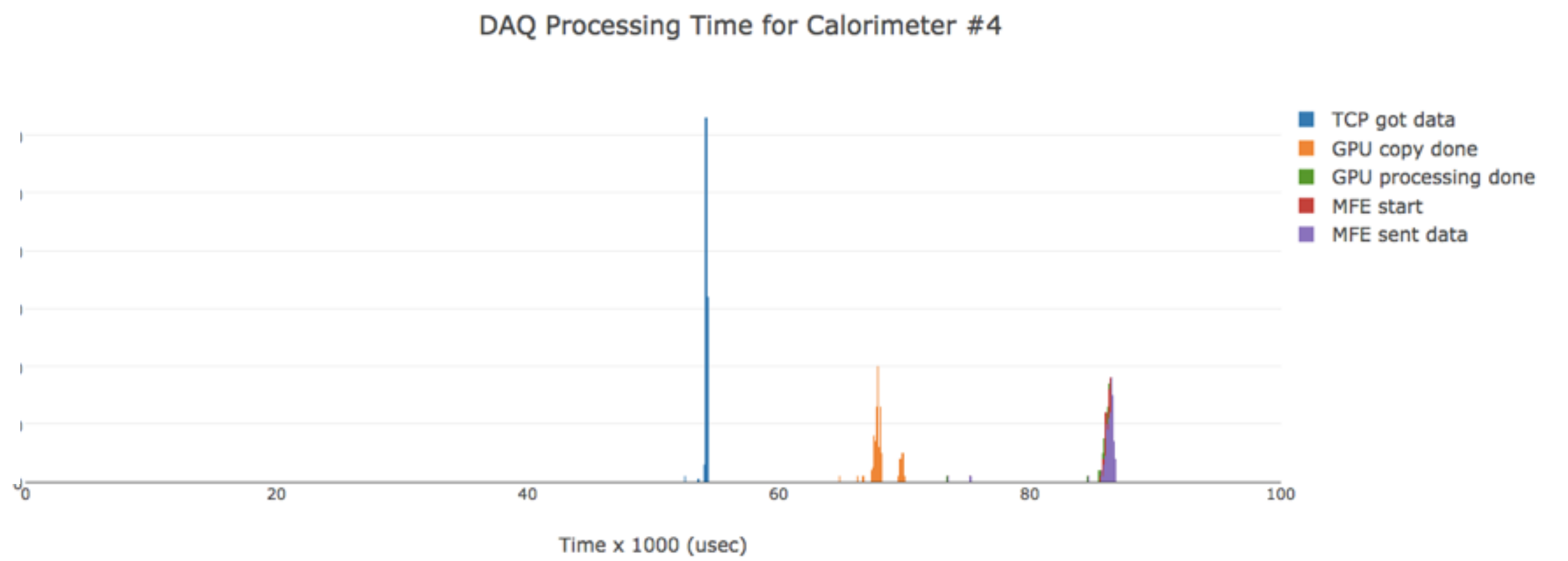
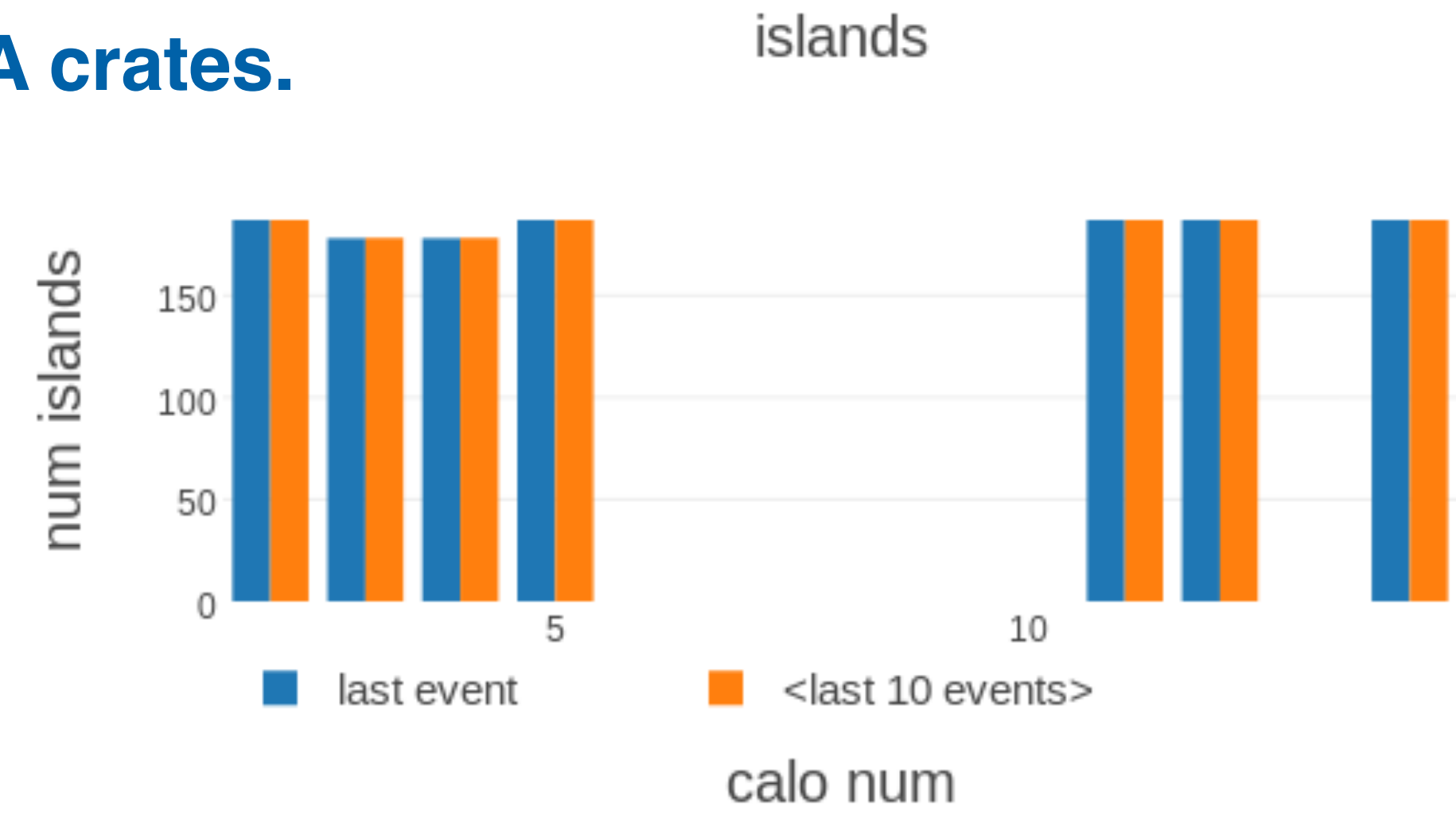
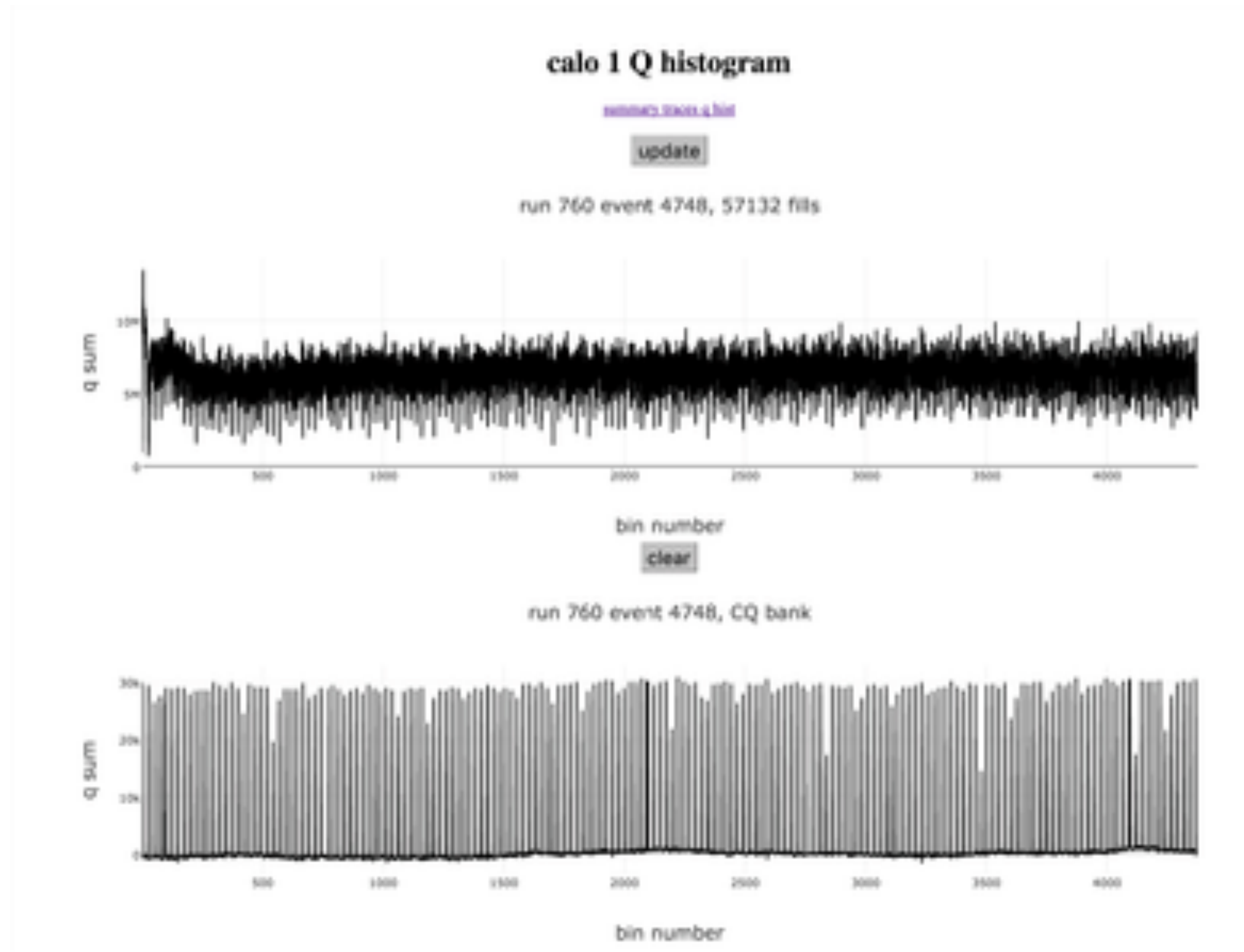
- Tested with calorimeter emulator for 24 calorimeters.
- Used to display data from 420 Rider channels (7 crates) in test setup.
- Monitored tracker cosmic test-stand at lab 3.



DQM with *art/JS*

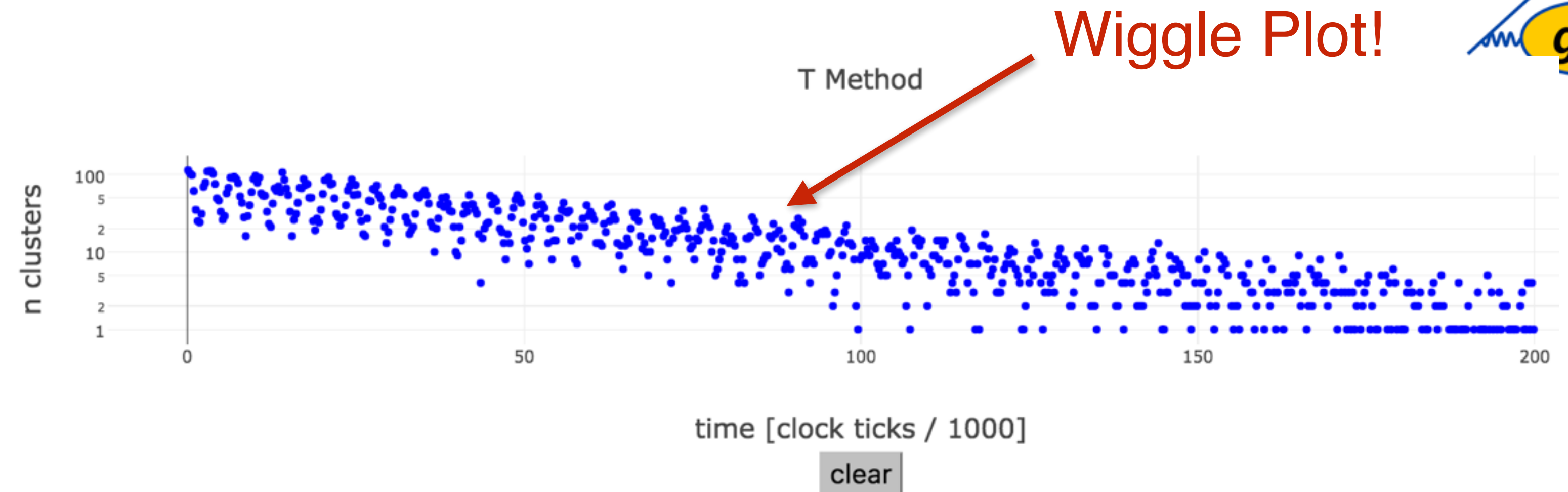
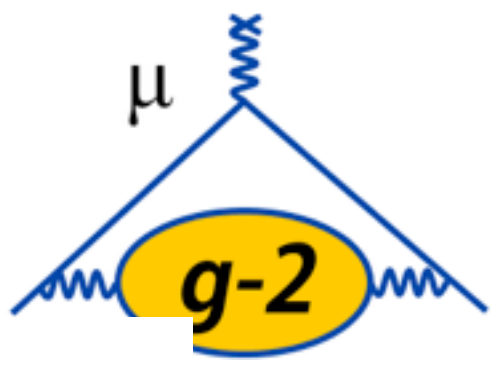


DQM is running to monitor our test setup with 7 uTCA crates.

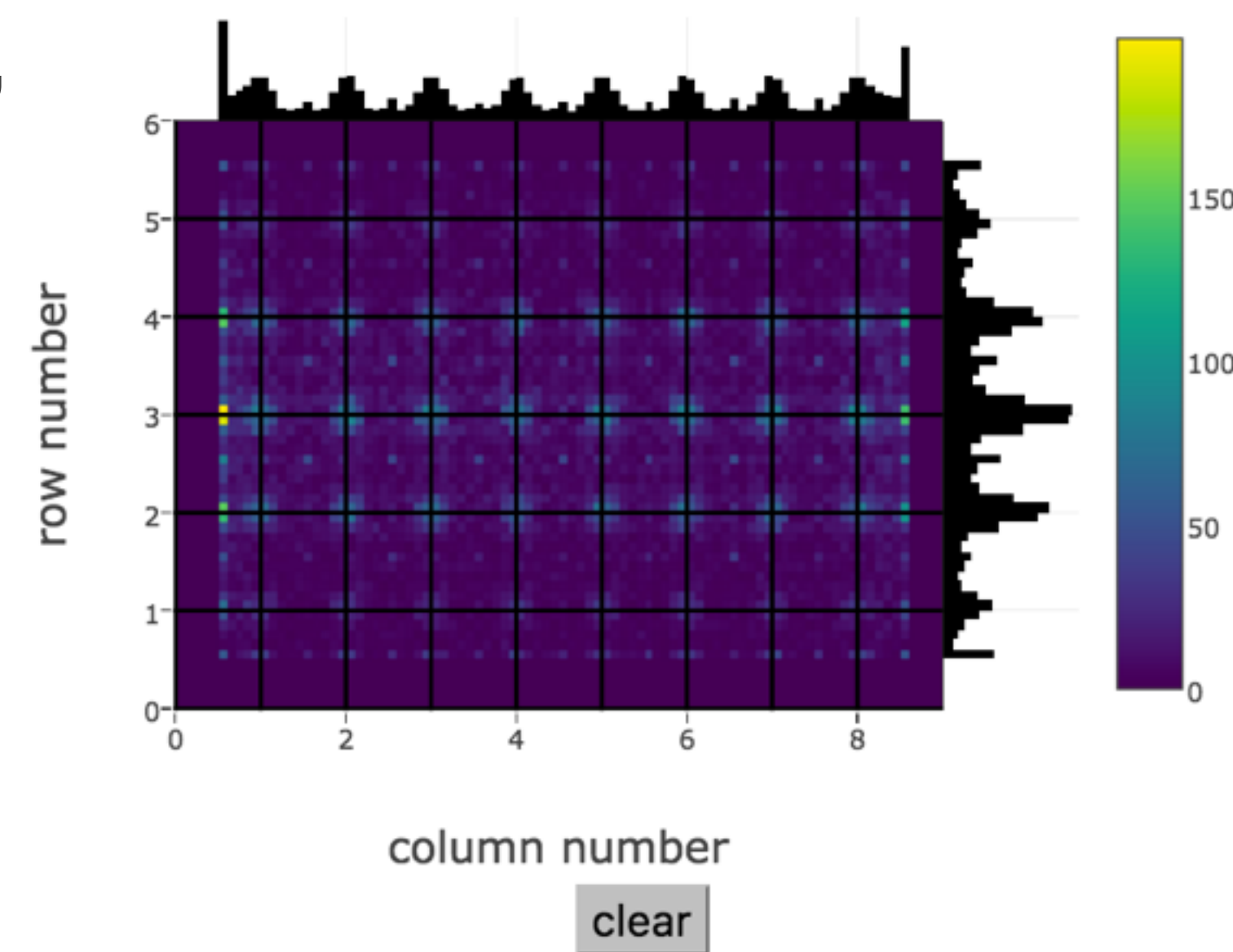


GPU Pulse fitting

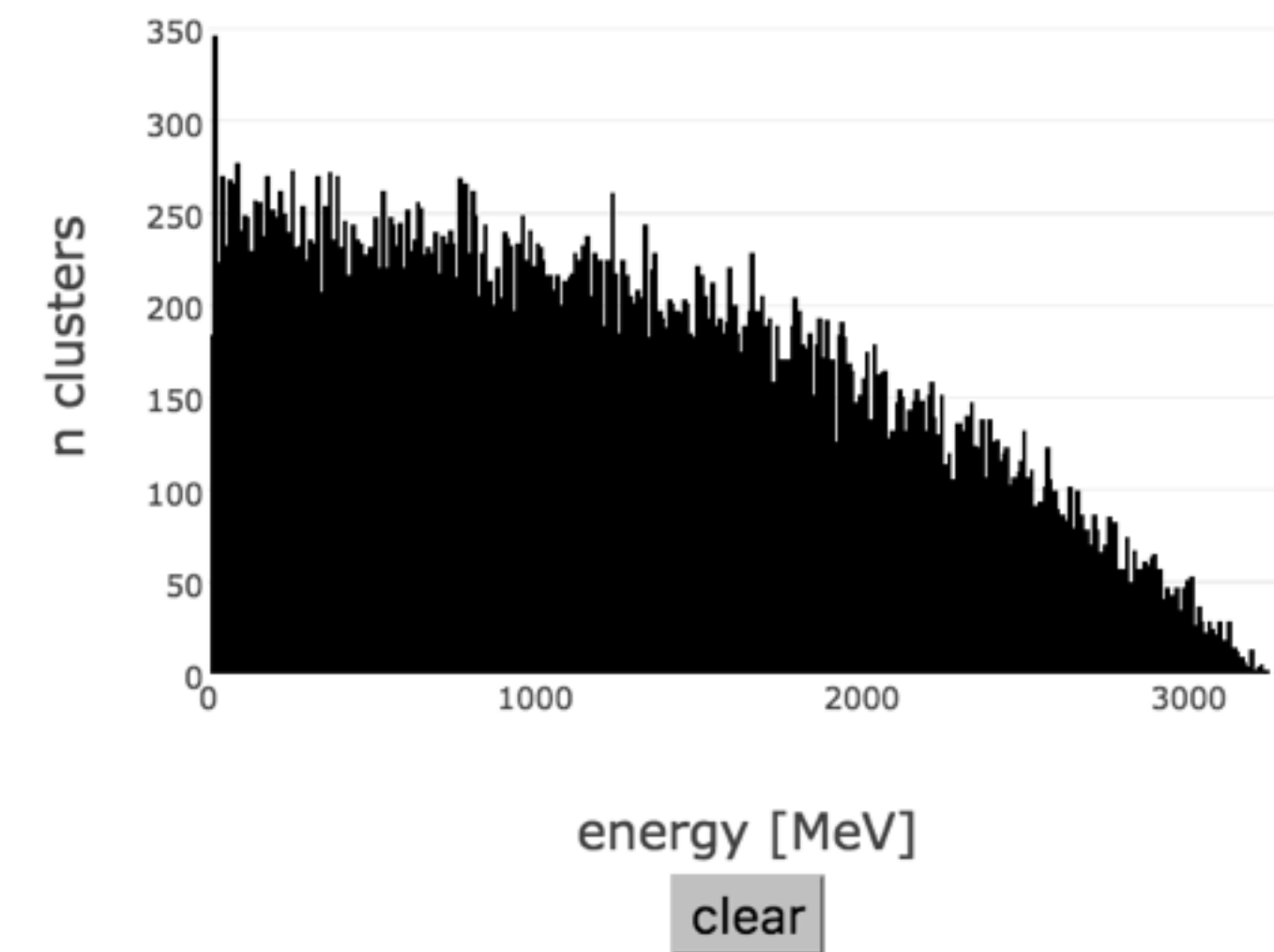
- We have implemented a GPU-based pulse fitting algorithm in our online system, that saves fit parameters for each pulse, which allows for fast reconstruction of positron decays in the online system.



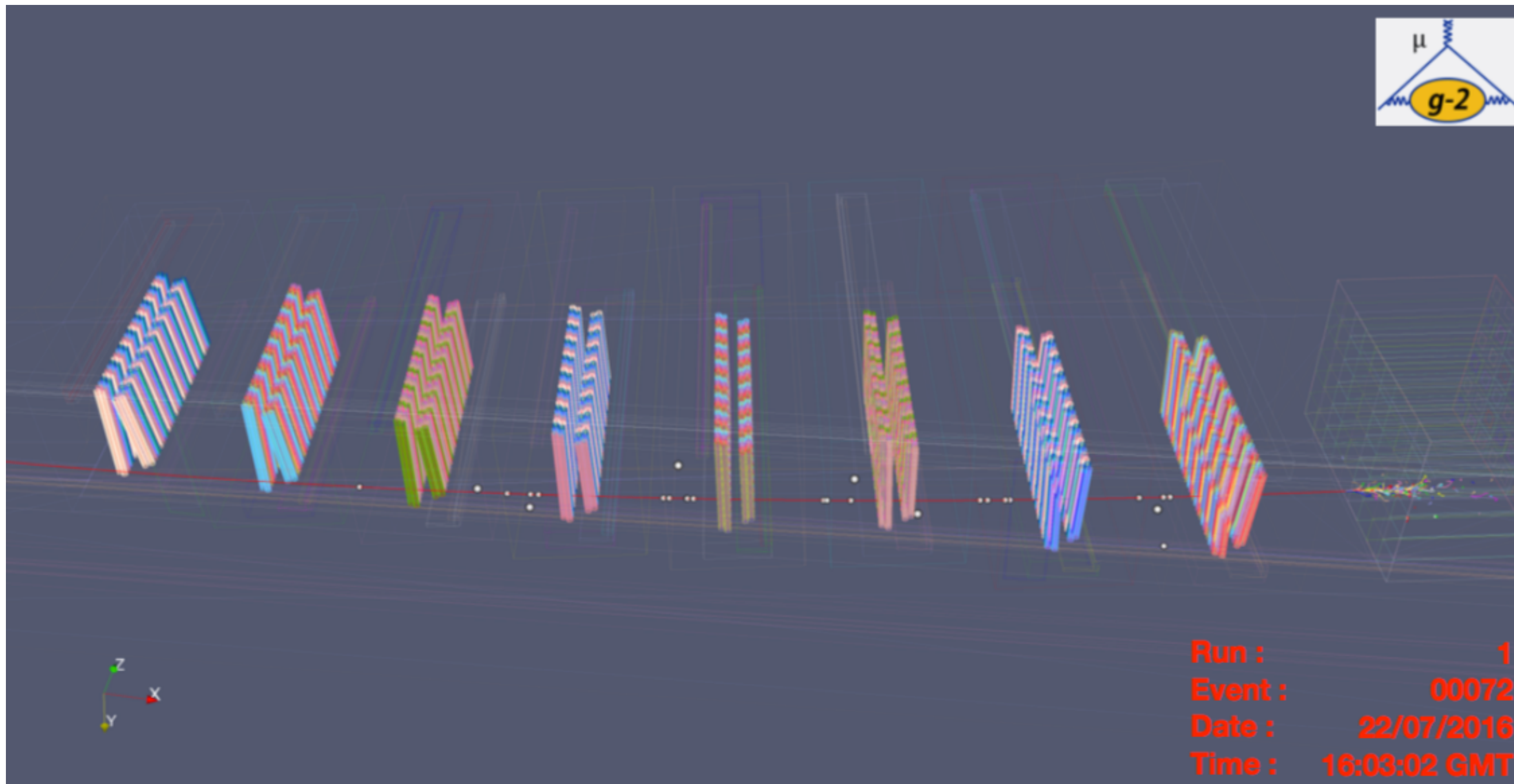
cluster positions, 49175 clusters



cluster energies



Paraview Event Display

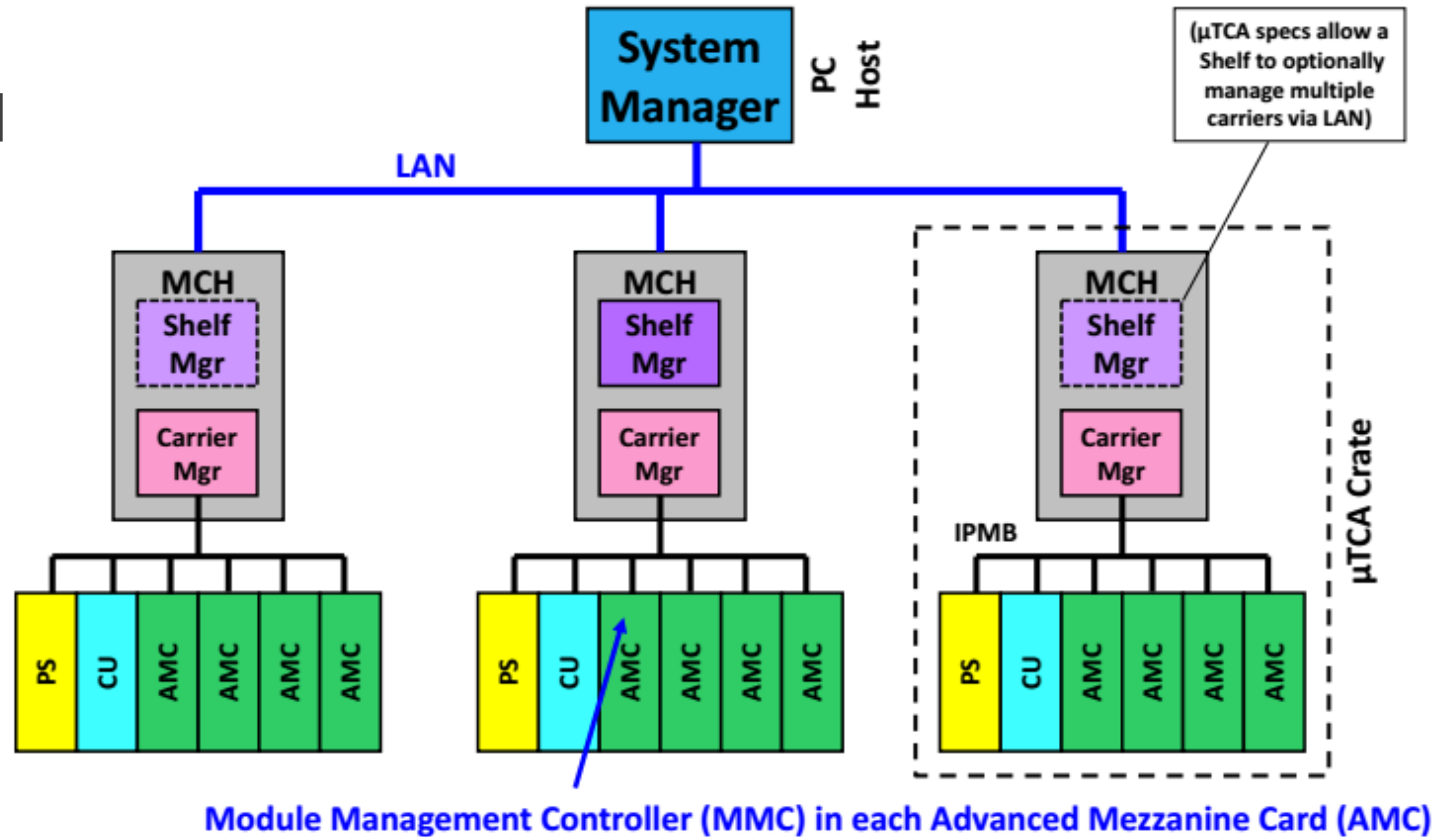


- Event display will run as an *art*-online process that connects to mserver using midas2art, with module that outputs vtk object for Paraview visualization.
- Development is underway.
 - Dubna: N. Khomutov, V. Krylov
 - Liverpool: W. Turner

uTCA Monitoring



- Will provide “slow control” information such as temperatures, fan speeds, and voltages from each module in every uTCA crate.
- Will communicate with Midas via a dedicated interface.
- Based on design for CMS that has been developed at U. Wisconsin.
- Being adapted to our g-2 system by A. Chapelain (Cornell U).



Rider/FC7 monitoring



- A python-based web interface will communicate with each mezzanine card (Rider or FC7) via IPMI commands to determine the current status of each.
- The web interface displays a summary of all uTCA crates, and you can click through to get details of each individual module.
- Being developed by D. Sweigart (Cornell U).

A screenshot of a web browser showing the 'Backend Electronics Status' page. The browser address bar shows '192.168.1.100:4000'. The page title is 'Backend Electronics Status'. Below the title, there is a section for 'Calorimeter Crate' with 'Reset' and 'Recover' buttons. The main content is a table of 11 riders, each with a status indicator and a triggers readout value.

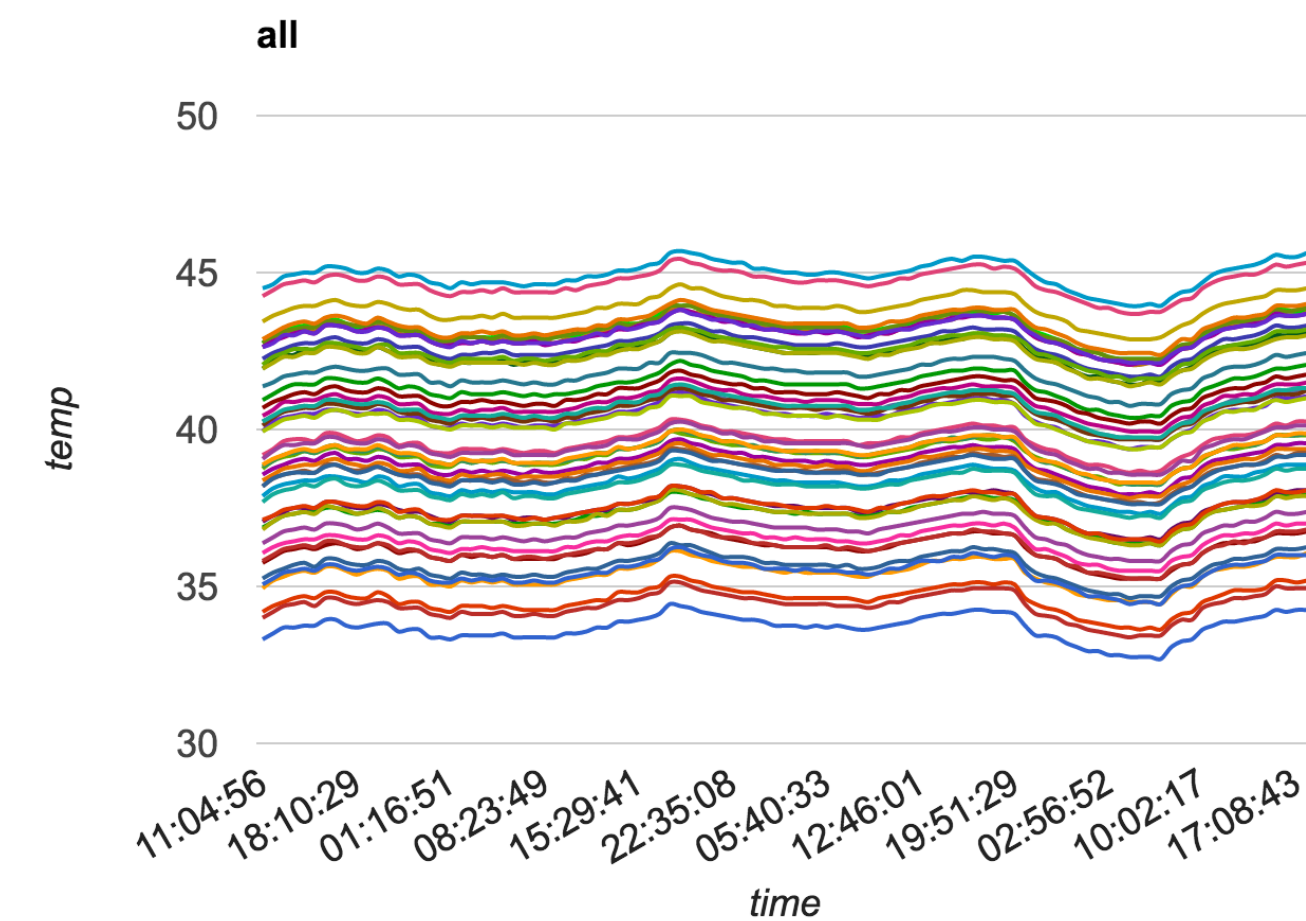
Rider	Status	Triggers Readout
Rider 1	Ready	350027
Rider 2	Ready	350027
Rider 3	Ready	350027
Rider 4	Paused Readout	350028
Rider 5	Ready	350028
Rider 7	Paused Readout	350028
Rider 8	Paused Readout	350028
Rider 9	Paused Readout	350028
Rider 10	Paused Readout	350028
Rider 11	Paused Readout	350028

Above: A prototype of our Rider monitor in use during the SLAC test beam last June.

SiPM Monitoring



- Python-based web gui used at SLAC.
- Displays temperatures, controls bias voltages, and programs gain amplifiers.
- Saves current settings and can reload old settings from file (or database).
- Written and maintained by A. Fienberg (U. Washington)
- Will be integrated into main slow control system (see talk by M. Eads)



Alarm system



- Baseline is to use the included MIDAS Alarm system.
 - Two alarm levels (warning or alert).
 - Visual and audible alarms.
 - Can configure alarms to stop the run.
 - Alarms based on ODB parameters -> very easy to set alarms on any slow control parameters.
 - Can post to Slack (or other medium).
- Drawbacks
 - Only works while DAQ is running.
 - We would like an alarm if the DAQ crashes (catch 22)
 - Interfacing with non-MIDAS sources is cumbersome, but possible.
- Would like to see what is used by other experiments.

Operations



- Expect 7 shifters to be “on” in a 24 hour period. Six regular shifters on 8-hour shifts + 1 Nearline analysis expert.
- When running smoothly, might reduce to one night-shifter in Roc-West and add remote operations.
- Will form DAQ operations group to maintain additional on-call experts to diagnose and resolve DAQ problems.
- We will hold training sessions to bring collaborators up to speed.
- A DAQ instruction manual has been written, and will be kept up to date.

Summary

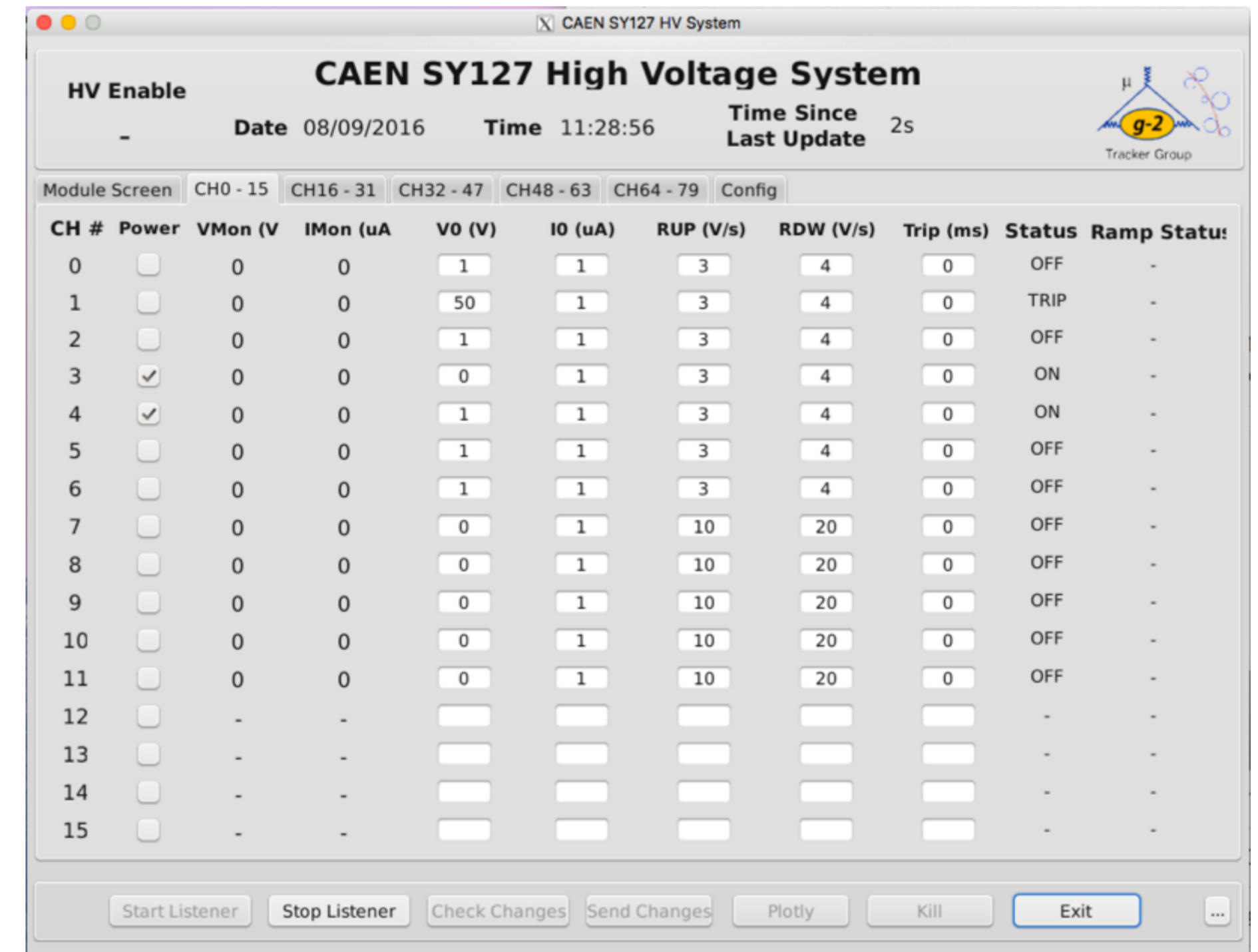
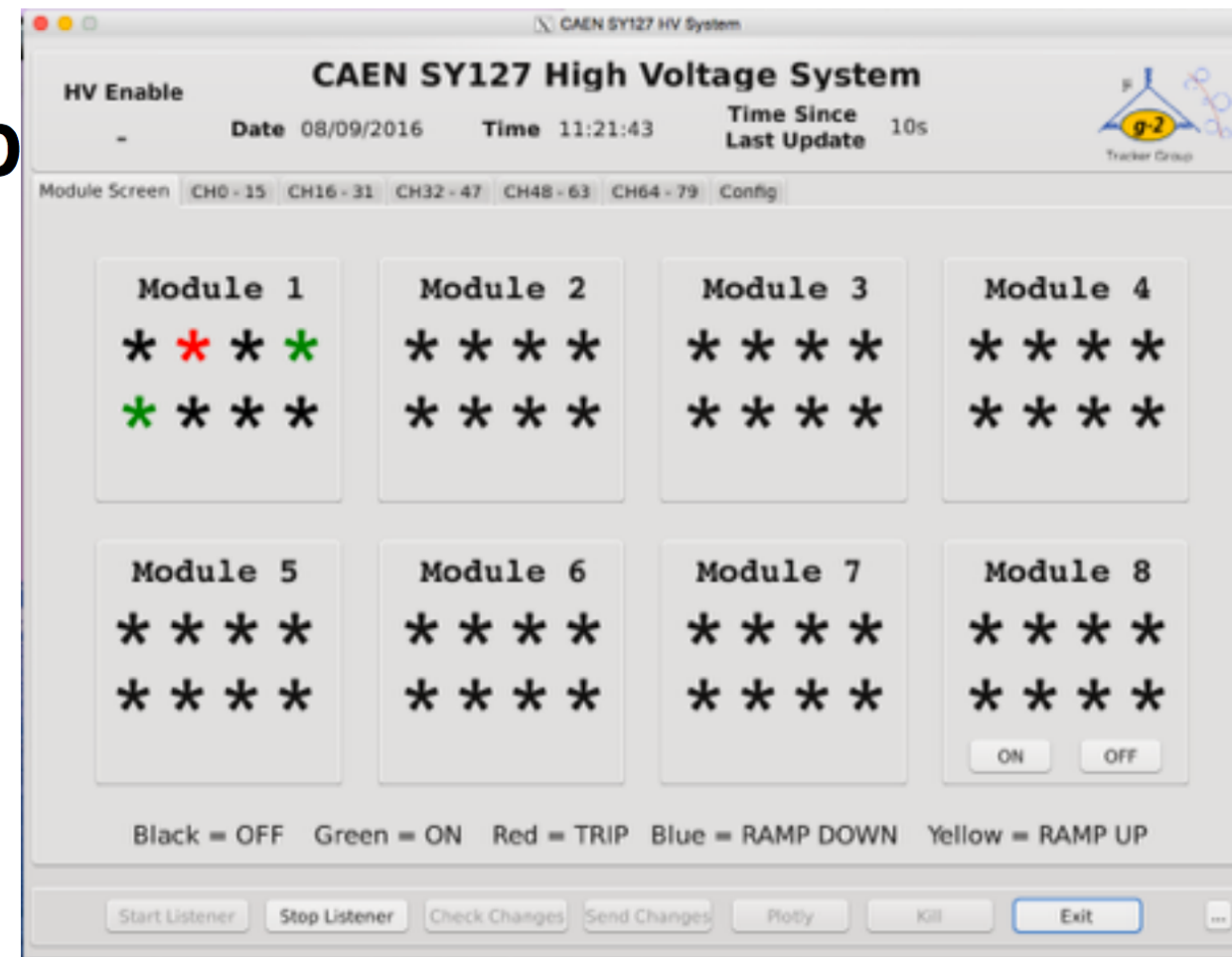
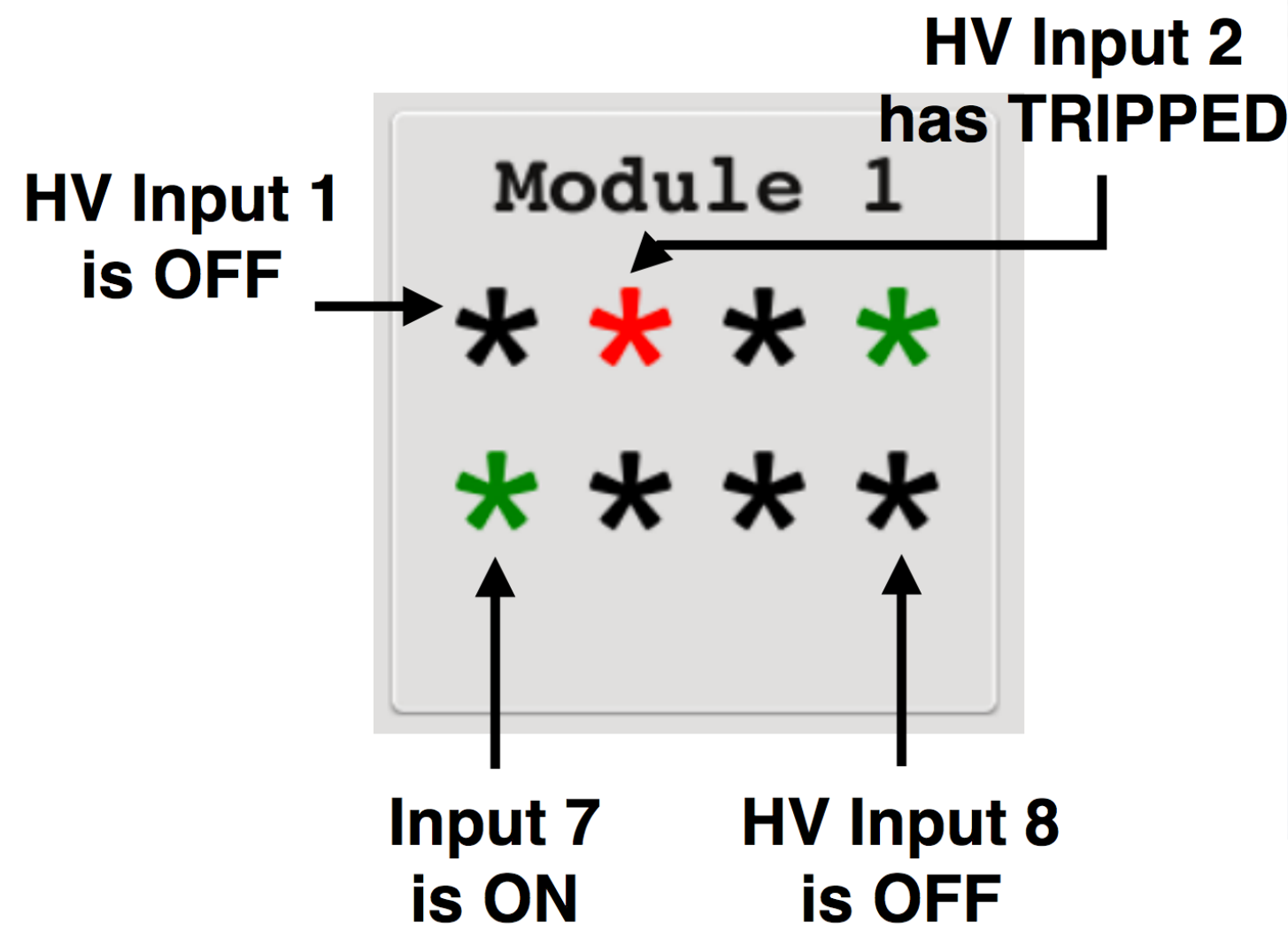


- Many monitoring systems are already in very sophisticated states, but some are yet to be developed.
- Require more information on interfacing with ACNET.
- Need more development on Kicker, Quad, Laser, and IBMS monitoring and Paraview event display.
- Hardware is about 50% there. Exploring additional funding options to complete control room.
- Roc West is also available for light shifts, though screen-space is limited.

Backup



HV Monitoring and Control



- GUI to provide channel-by-channel control over tracking detector HV.
- Three dedicated servers to read HV status via serial DB9 connection.
- Developed and maintained by UCL.