

# DAQ system and its software

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On behalf of PRad Collaboration

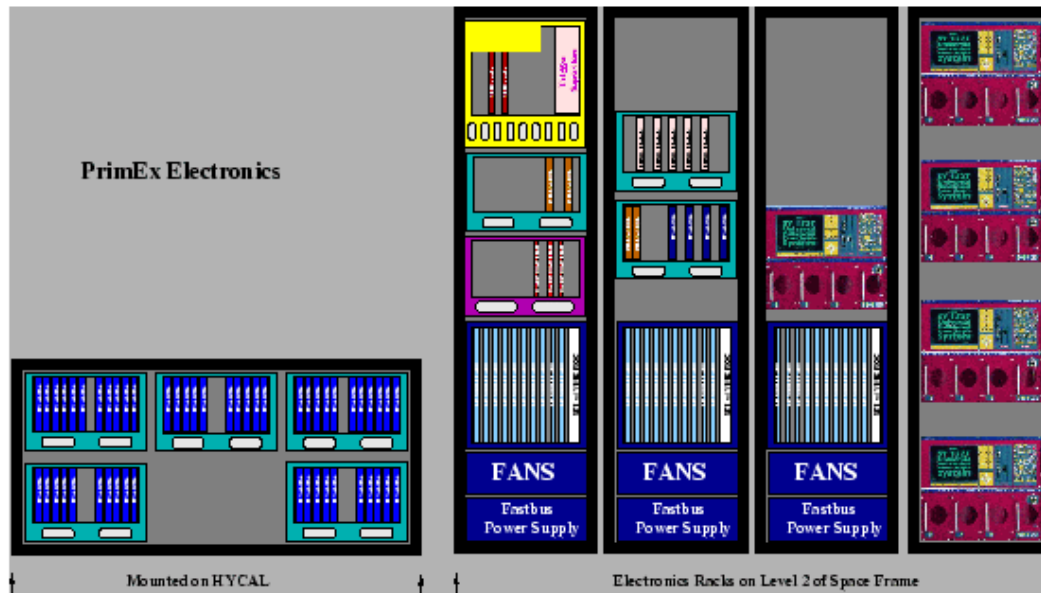
11/12/2015

# Outline

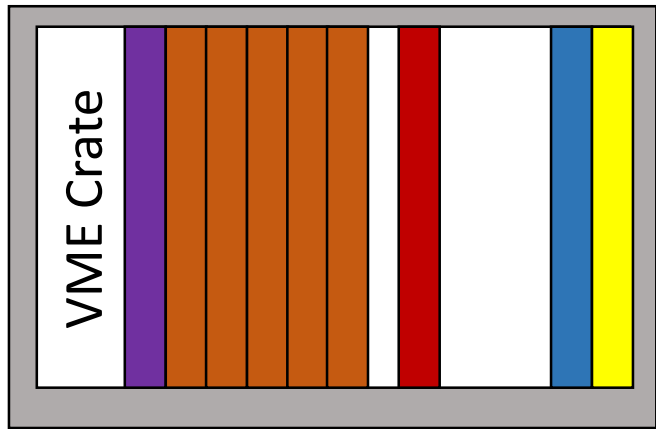
- DAQ system
  - Subsystem for HyCal
  - Subsystem for GEM
- Software
  - Online software
  - Offline software
- Cosmic tests
- Summary

# DAQ System – HyCal Part

- Based on previous PrimEx electronics
- 3 Fastbus crates with 30 ADC modules will read the 1728 channels from HyCal
- Total sum of energy as the physics trigger, a total of 52 UVA120A modules for the linear sum of dynode signal as the trigger
- Light monitoring system to monitor the gain for each channel

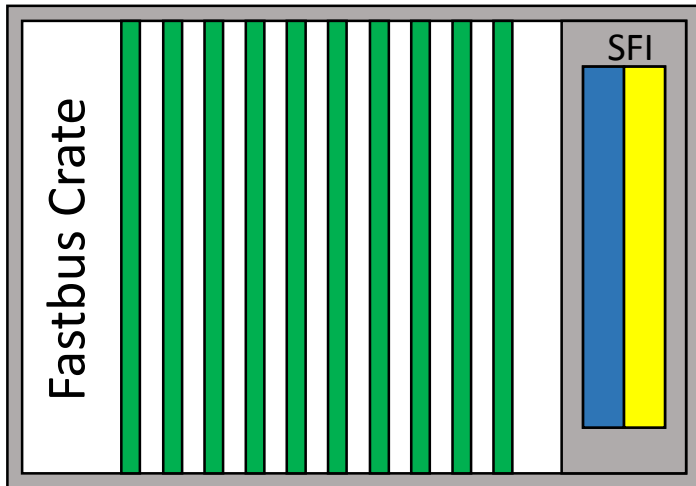


# DAQ System – HyCal Part



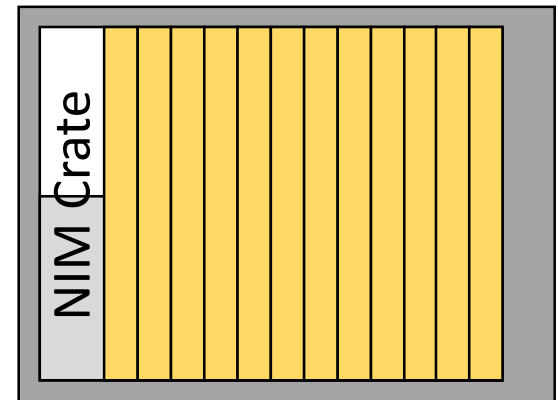
## TDC/Trigger Crate

- 1x v1190 TDC
- 1x MVME 2436 ROC
- 1x JLAB TI (MASTER)
- 5x JLAB DISCRIMINATORS



## 3x ADC Crates

- 10x LRS1881M ADCs
- 1x MVME 5100 ROC
- 1x JLAB TI (SLAVE)

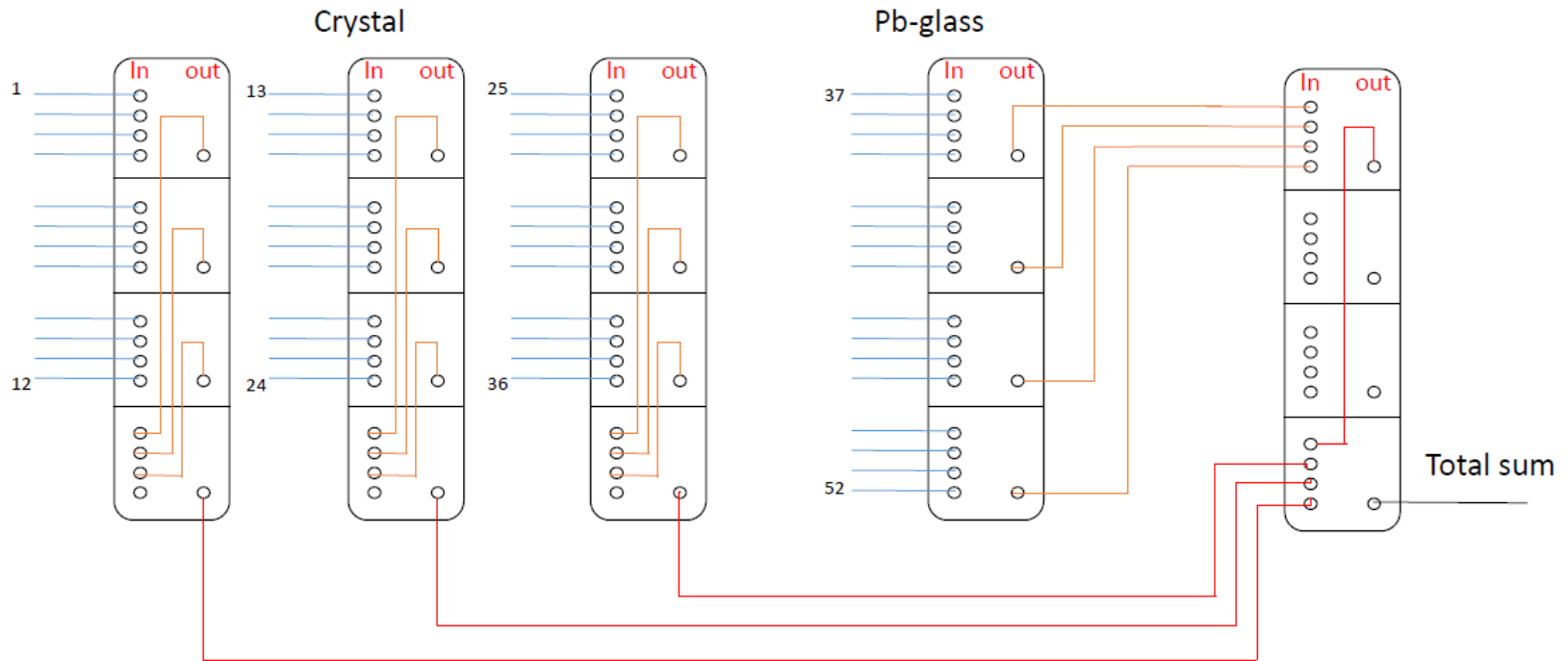


## 5x Linear Sum Crates

- 8x ~ 12x UVA 120A
- (52 output groups in total)
- Linear sum modules
- Mounted on HyCal box

# DAQ System – HyCal Part

- 2 more NIM crates for the logic and translation (from NIM to ECL) modules
- Total sum of all the channels as the trigger

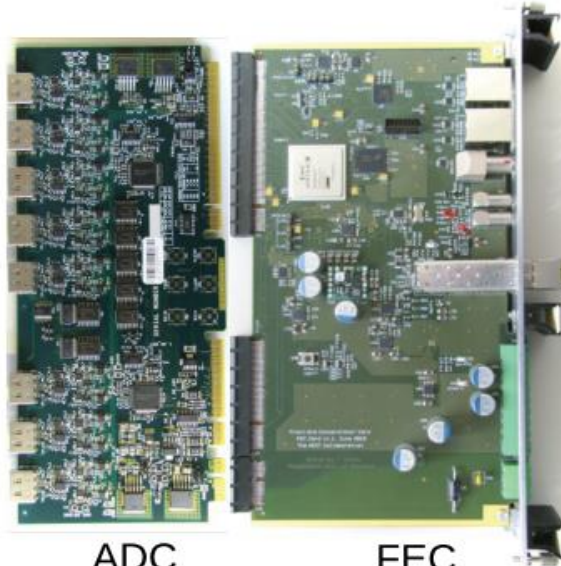


# DAQ System – GEM Part



APV25  
Hybrid

HDMI →



ADC

FEC

Gb Ethernet →



DAQ  
Computer

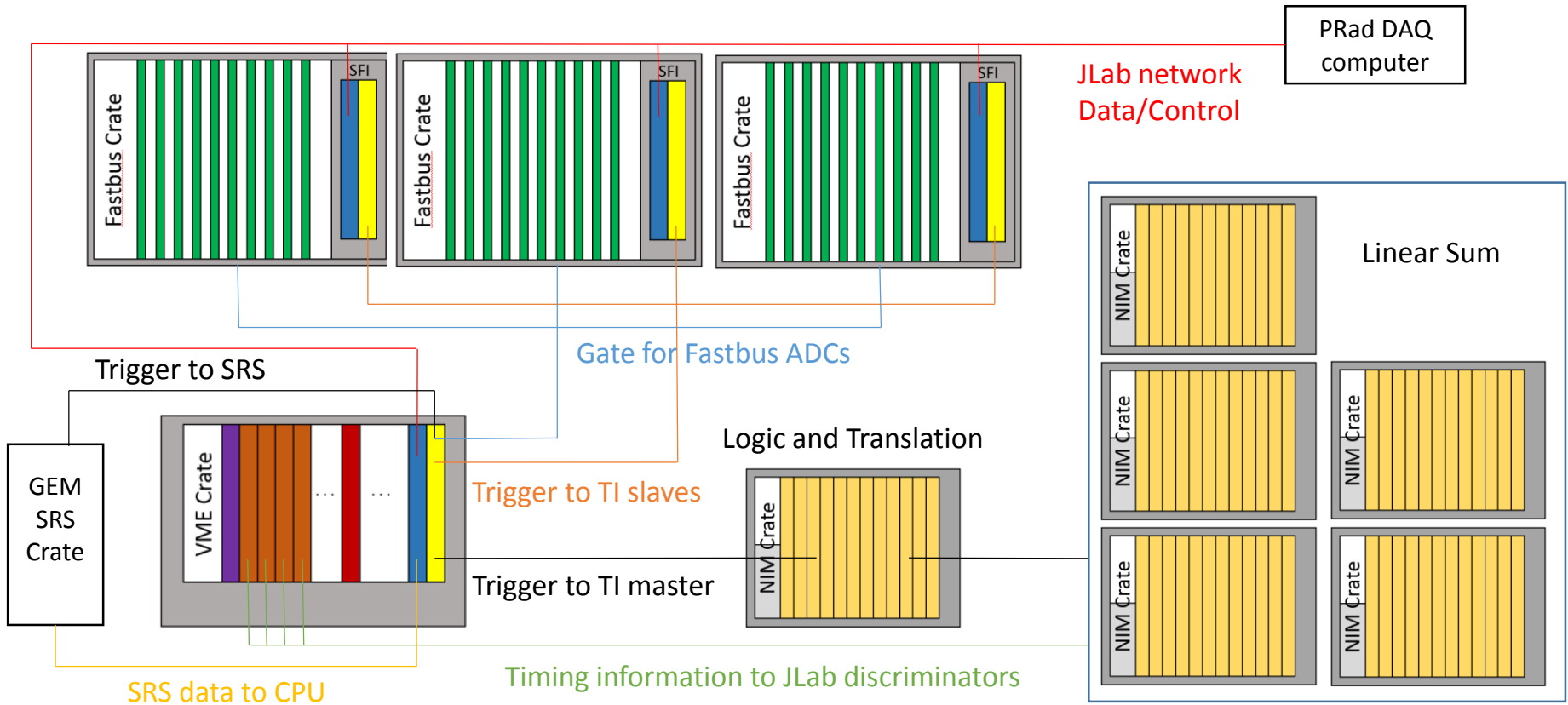
- 128 channel APV25 chip
- 192-deep analog sampling memory
- Master/slave configuration
- Diode protection against discharge
- RD51 standard 130-pin Panasonic connector interfaces to detector
- Mini HDMI (type C) connector

- 2 × 12-Bit Octal ADC
- 8 × HDMI input channels (16 APV hybrids)
- Virtex LX50T FPGA
- SFP/Gb Ethernet/DTC interface
- NIM/LVDS GPIO (trigger, clock synch, etc.)

- Data Acquisition using CODA (JLab)
- Data transfer via UDP
- Slow control via ethernet

Developed by RD51 collaboration at CERN

# DAQ System Overview



# DAQ Software

- Standard CODA 2.6.2
- Modified readout list from previous PrimEx (since it was for HallB CODA, and configuration changed)

The screenshot shows the Run Control rcGui-21 interface. The top bar includes 'Platform', 'Sessions', 'Configurations', 'Options', 'Expert', and 'Help'. The main area is divided into several sections:

- Run Parameters:** Expid (PRAD), Session (PRAD01), Configuration (TTest), Output File (/home/pradrun/coda/data/T1\_test217.dat).
- Run Status:** Run Number (217), Run State (booted), Event Limit (0), Total Events (302), Data Limit (0.0), Client Data (ER6).
- Table:** A table with columns: Name, State, EvtRate, DataRate, In-EvtRate, In-DataRt.
- Graph:** A line graph showing Event Rate vs Time (15:10:20).
- Log:** A table with columns: Name, Message, Time, Severity.

Name	State	EvtRate	DataRate	In-EvtRate	In-DataRt
ER6	downloaded	0.0	0.0	13.7	3.3
EB6	configured	0.0	0.0	18.0	3.7
primexroc5	downloaded	0.0	0.0	23.2	1.2
primexroc6	downloaded	0.0	0.0	23.2	1.2
primexroc4	downloaded	0.0	0.0	23.2	1.2
primexts2	downloaded	0.0	0.0	29.6	1.8

Name	Message	Time	Severity
primexts2	CODA2 DP communication error.	15:09:07 09/08	Error
primexts2	CODA2 DP communication error.	15:09:07 09/08	Error
rcGui-21	Configure is started.	15:09:16 09/08	Info
ControlDesigner	configure is started.	15:09:16 09/08	Info
sms_TTest	Configure succeeded.	15:09:17 09/08	Info
sms_TTest	Download is started.	15:09:23 09/08	Info
sms_TTest	Waiting for primexroc5, primexroc6, primexroc4,	15:09:32 09/08	Warning
sms_TTest	Download succeeded.	15:09:42 09/08	Info
sms_TTest	Prestart is started.	15:10:03 09/08	Info
sms_TTest	Prestart succeeded.	15:10:12 09/08	Info
sms_TTest	Go is started.	15:10:14 09/08	Info
sms_TTest	Go succeeded.	15:10:22 09/08	Info
sms_TTest	End is started.	15:10:31 09/08	Info

The screenshot shows the Xcefdmp interface. The top bar includes 'Data\_Source', 'Dictionary', 'View', 'Options', and 'Help'. The main area is divided into several sections:

- Data Source:** adrun/coda/data/T1\_test217.dat
- Dictionary:** /home/pradrun/coda/2.6.2/com
- Tag Name:** 1
- Event Number:** 3
- Event Number Slider:** A slider showing the current event number (1).
- Dump Options:** Decimal Dump, Hex Dump, Enable Dictionary, Disable Dictionary.
- View File, Spy Event, View Next, View Previous, Refresh, Quit.**
- Info:** --> To start, enter a file name; --> Number of events: 274.
- Event Tree:** A tree view showing the event structure: type\_13\_physics\_event -> header -> ROC1, ROC11, ROC12, ROC14. Each ROC has associated data (0x4, 0x3).



# Online software

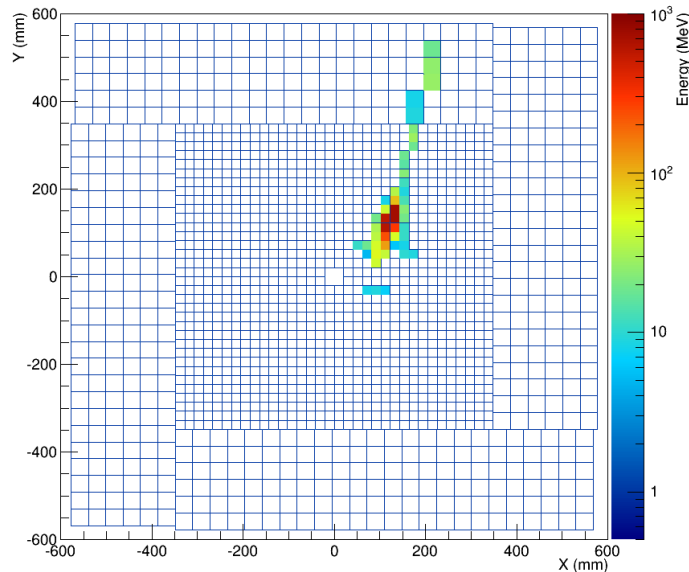
- The software for HyCal is based on previous primex software package, modified according to the new PRad DAQ configuration.
- Current online software
  - HyCal event viewer
  - HyCal gain equalizer
  - High voltage monitor and control
  - Temperature monitor
  - HyCal movement control and calibration scripts (needs updated coordinate input)
- Implementation ongoing
  - Other subsystem monitors (LMS, ROCs, Triggers, DAQ Crates)
  - Integrated alarm server

# Online software

## High Voltage Control

The High Voltage Control software displays the configuration for channel W113. It shows the channel name, Vset (921), and Vmon (1.0 OFF). The primary channel is PRIMARY3\_4 with Vset 1515 and Vmon 3.0 OFF. A table lists associated channels for PRIMARY3\_4, including W149, W13, G10, W82, C102, W150, W14, G11, W112, G130, W151, W44, G12, W181, W113, G131, W180, W45, G40, W114, G132, W181, W46, G41, W115, G160, W182, G42, W116, G161, W180, G70, W117, G72, W12, W11, W148, W80, and G71. The interface also includes a grid of detector channels and control buttons for PbGlass and PbWO4 group sets.

## Online Event Viewer



## Temperature Monitor

The Temperature Monitor software displays a dashboard of temperature and humidity data. It includes several plots: 'Water In / Out' showing flow rates, 'Lead Glass' showing temperature profiles, 'Cooling Plates (upstream edge)' showing temperature profiles, 'Looking at the front of HfCal' and 'Looking at the back of HfCal' showing temperature distributions, 'Lead Tungstate' showing temperature profiles, 'Center Two Lead Tungstate (nearest beam)' showing temperature profiles, 'Beam Right IX & Vera' showing temperature profiles, and 'W529 HV Divider & Brass Flange' showing temperature profiles. The interface also includes a status bar and a taskbar.

# CODA for GEM

Run Control rcGui-65

Platform Sessions Configurations Options Expert Help

Start Time: 23:34:55

End Time: 05 November

Run Parameters

Expid: PRAD Session: PRAD01 Configuration: PRadGEM

Output File: /home/pradrun/pgemtest/test529.dat

Run Status

Run Number: 529 Run State: Active Event Limit: 0

Total Events: 852 Data Limit: 0.0

Name	State	EvtRate	DataRate	In-EvtRate	In-DataRate
ER7	active	50.0	96.4	22.4	47.3
EB7	active	50.0	99.2	24.3	50.8
PGemROC	active	50.0	99.2	25.5	52.9

Event Rate

Name	Message
rcGui-65	Configure is started.
ControlDesigner	configure is started.
sms_PRadGEM	Configure succeeded.
sms_PRadGEM	Download is started.
sms_PRadGEM	Download succeeded.
sms_PRadGEM	StartRun is started.
sms_PRadGEM	StartRun succeeded.

Xcfdmp

Data Source: /pradrun/pgemtest/save444.daf

Dictionary: /home/pradrun/coda/2.6.2/com

Tag Name: 0x5

Event Number: 0x00000001 0x0000dead 0xcxbaf111

Event Number Slider

Decimal Dump Hex Dump

Enable Dictionary Disable Dictionary

View File Spy Event

View Next View Previous

Received Quit

header:Event ID Bank

```

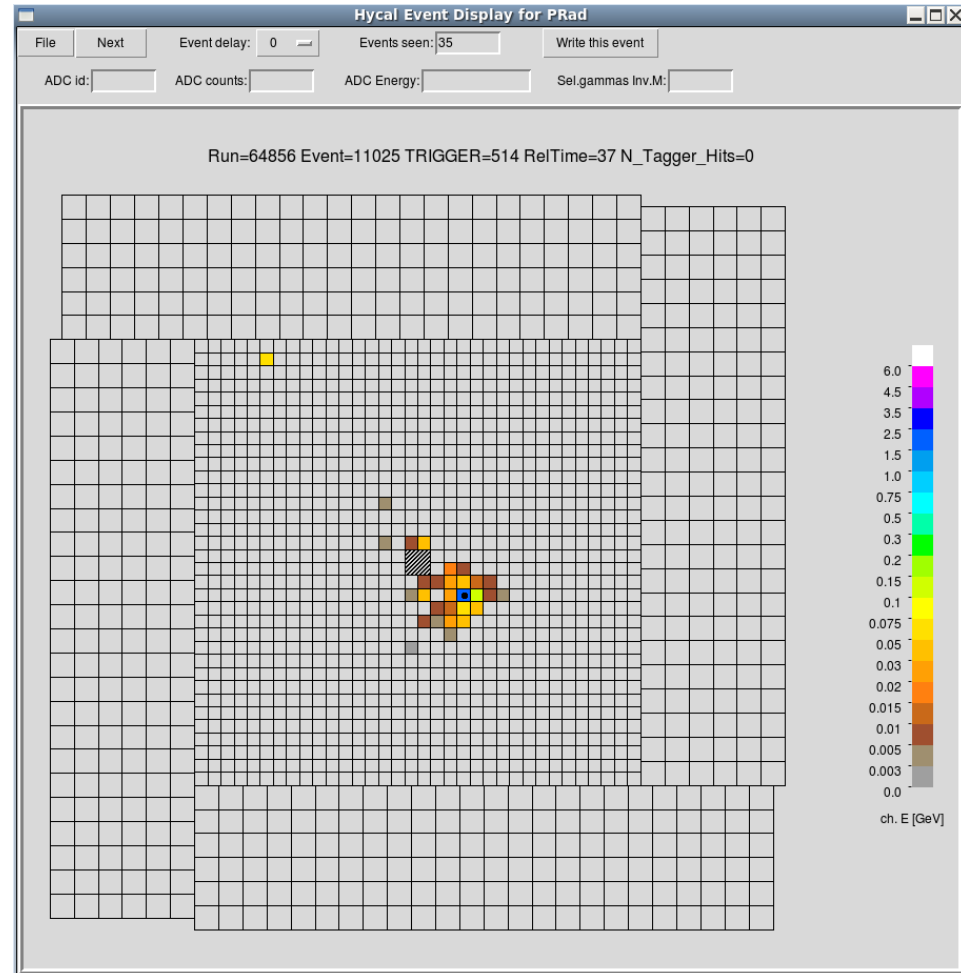
0xda000022 0x00000000 0x41444300 0x00000001
0xff07ff07 0xfe070008 0xff07ff07 0xfe07ff07
0xfe070008 0x00080008 0xfe07ff07 0x0008ff07
0xff07ff07 0xff07ff07 0xfe070008 0xff07ff07
0x0008ff07 0xff070008 0x0008ff07 0xff07ff07
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```

A typical CODA (2.6.2) event viewed with "xcfdmp" utility showing SRS data bank and various other information.

# Offline software

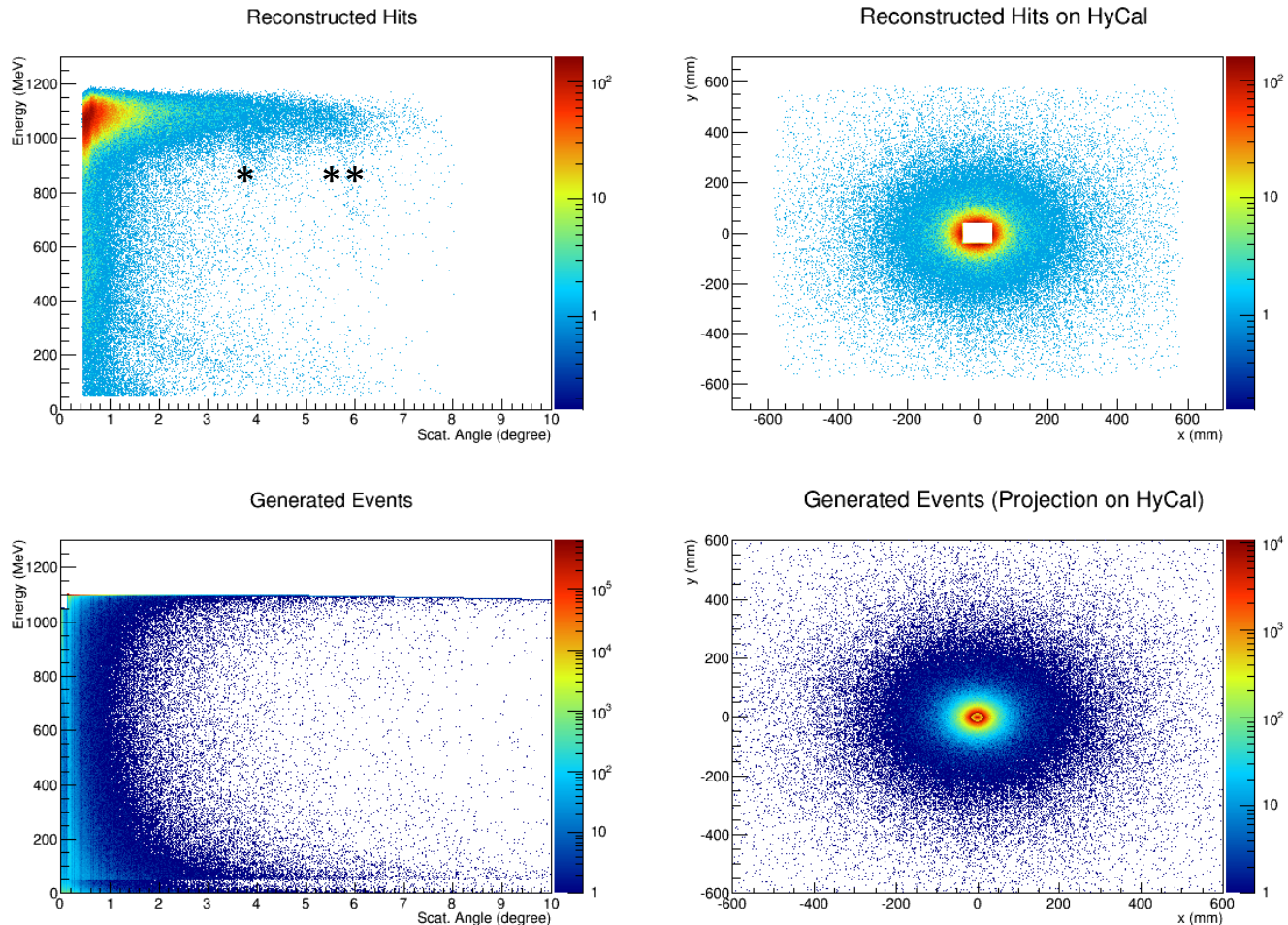
- Replay code for CODA file
- HyCal events reconstruction program
- HyCal offline events viewer, based on PrimEx event display

## Offline events viewer (input from simulation)



# Offline software

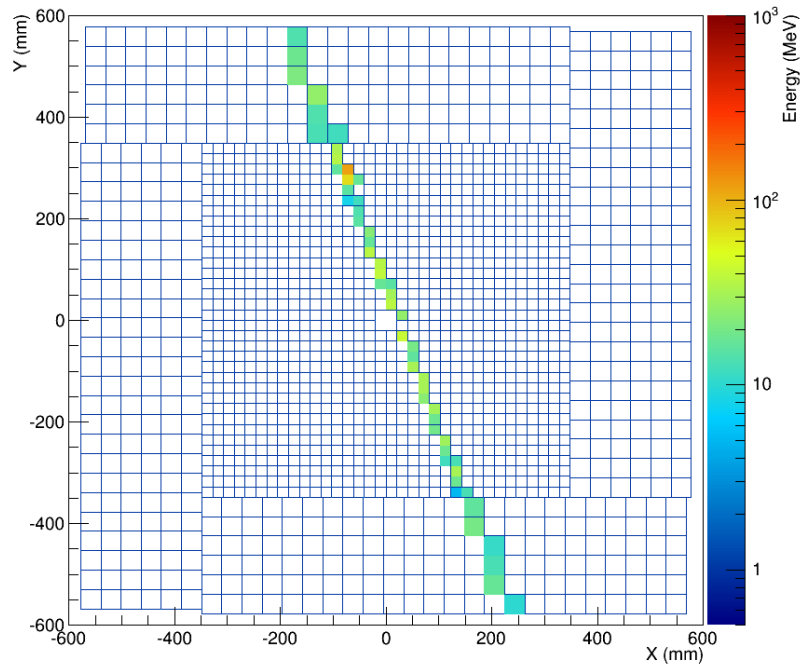
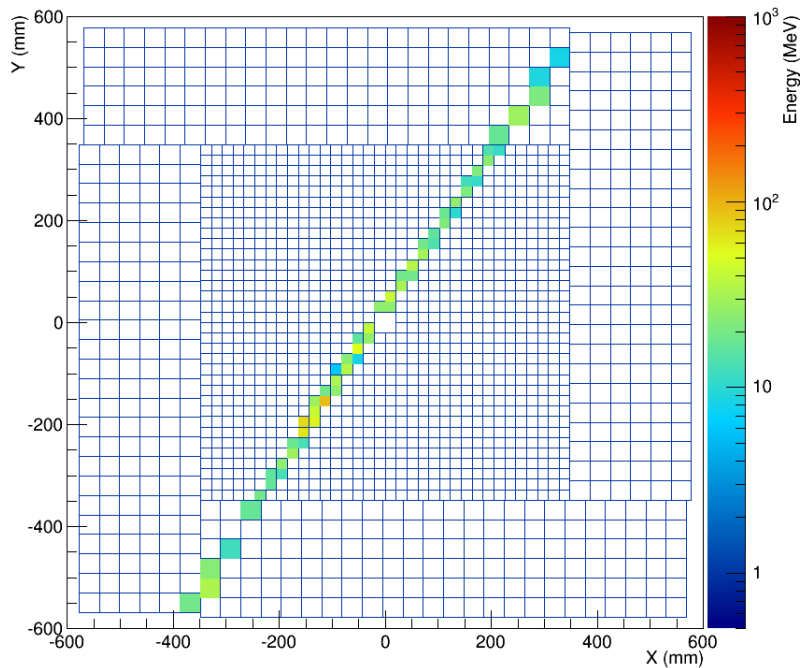
- Reconstruction with simulation input



- \* Shift between Lead glass and Lead Tungsten
- \*\* Phi coverage start to be  $< 2\pi$

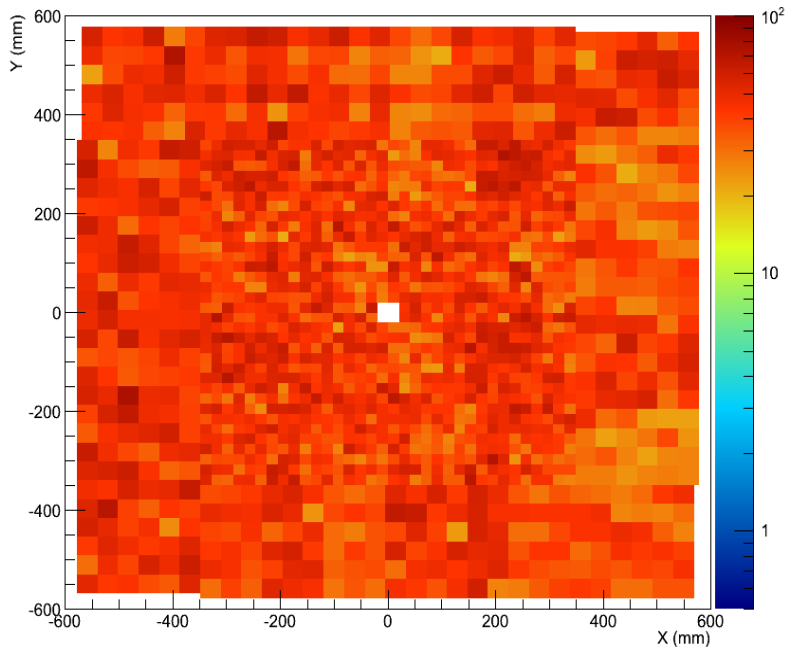
# Cosmic tests for HyCal

- Cosmic rays detected by HyCal and reconstructed by DAQ

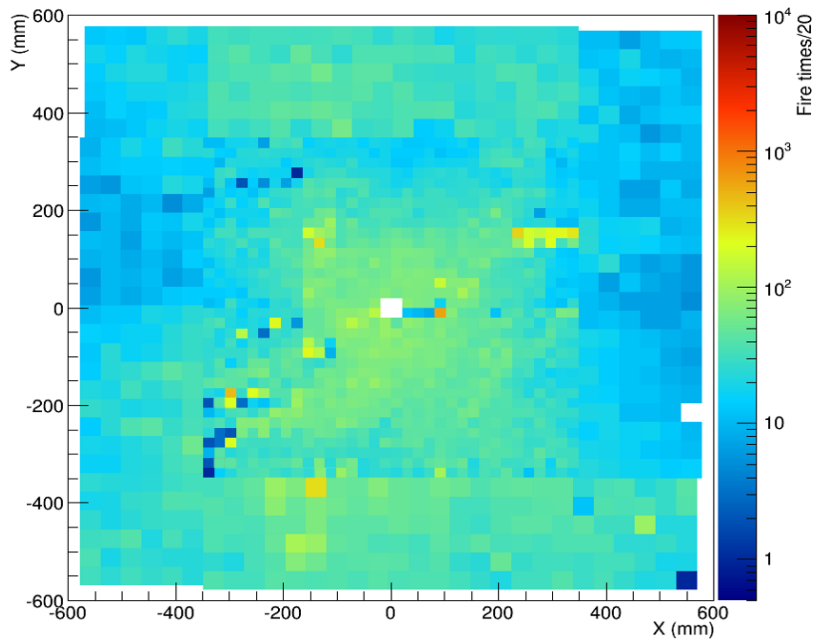


# Cosmic tests for HyCal

- Pedestal is at 500 ~ 700 channels
- A few modules have low occupancy, but the gain for each modules is not optimized yet.



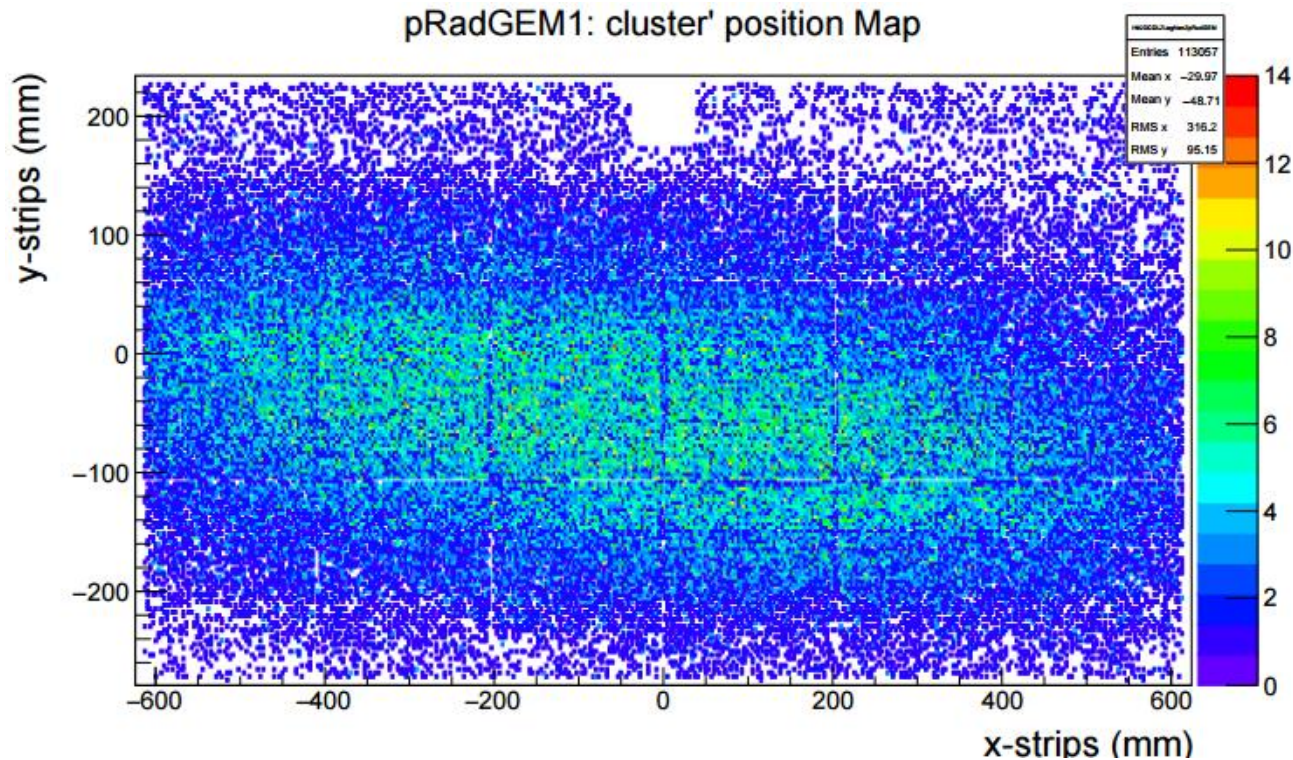
Pedestal Map



Occupancy

# Cosmic tests for GEM

- Test was conducted in the Lab at UVA
- Triggered by a scintillator on the top of GEM chamber, only covered the central part





# Summary

- HyCal is ready to take data, and has already taken some cosmic data in Hall B
- Integration of GEM will be finished in several weeks, we can read SRS data through CODA now
- Online software package is functioning, will be improved at the meantime

Month	Nov. 2015			Dec. 2015			Jan. 2016					Feb. 2016				Mar. 2016				
Week	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20
GEM	Finalize the GEM DAQ			Cosmic test								Long cosmic run for efficiency data								
DAQ							Integration of whole DAQ system													
Software	Finalize the software package						Along with software test					Continue on software improvement and debugging								

↓  
The whole system is ready

# Thanks

- Thanks the help from David Abbott, Sergey Boyarinov, David Lawrence, Bryan Moffit, Xuefei Yan and Weizhi Xiong