

# DAQ system and its software

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On behalf of PRad Collaboration

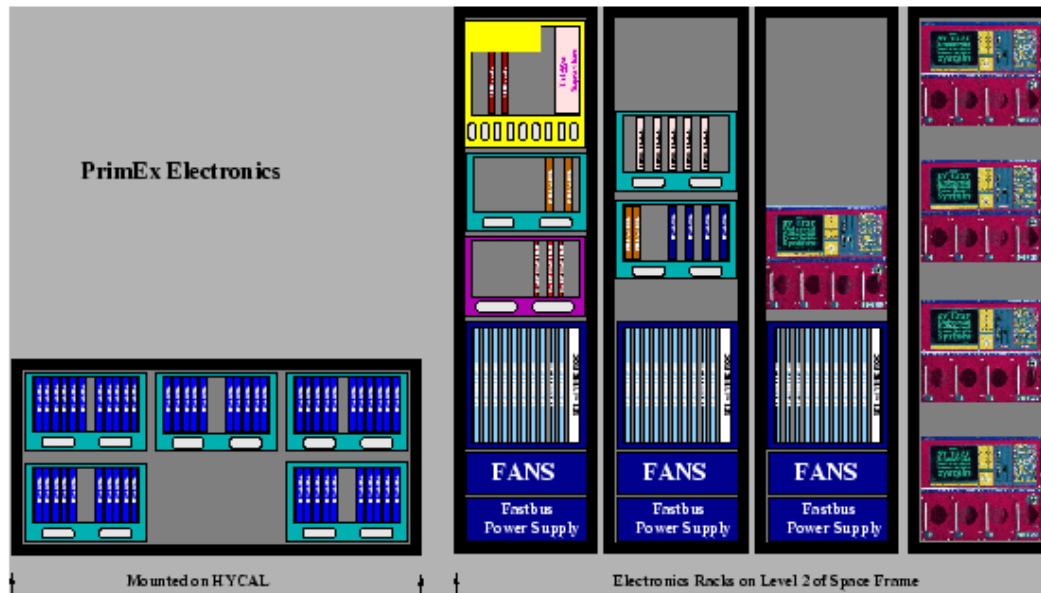
11/12/2015

# Outline

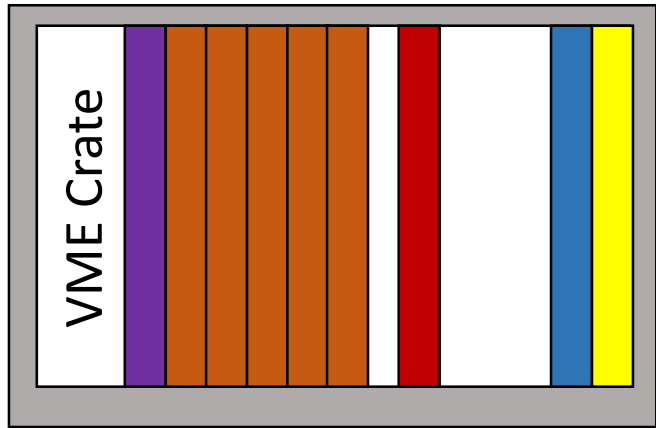
- DAQ system
  - Subsystem for HyCal
  - Subsystem for GEM
- Software
  - Online software
  - Offline software
- Cosmic tests
- Summary

# 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

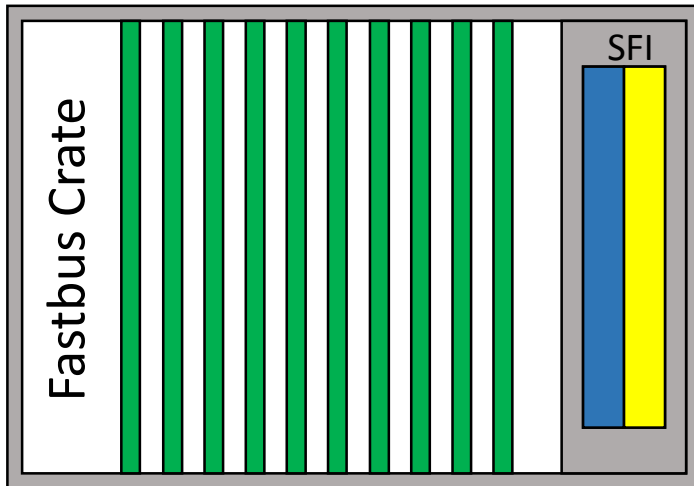


## TDC/Trigger Crate

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

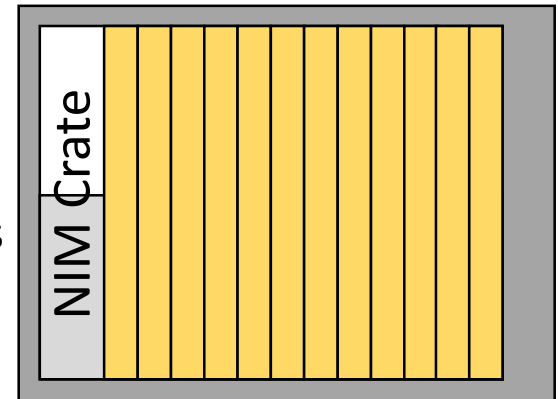
## Tagger Crate

- 1x ROC
- 1x JLAB TI
- SEVERAL TDC/DISCRIMINATORS



## 3x ADC Crates

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

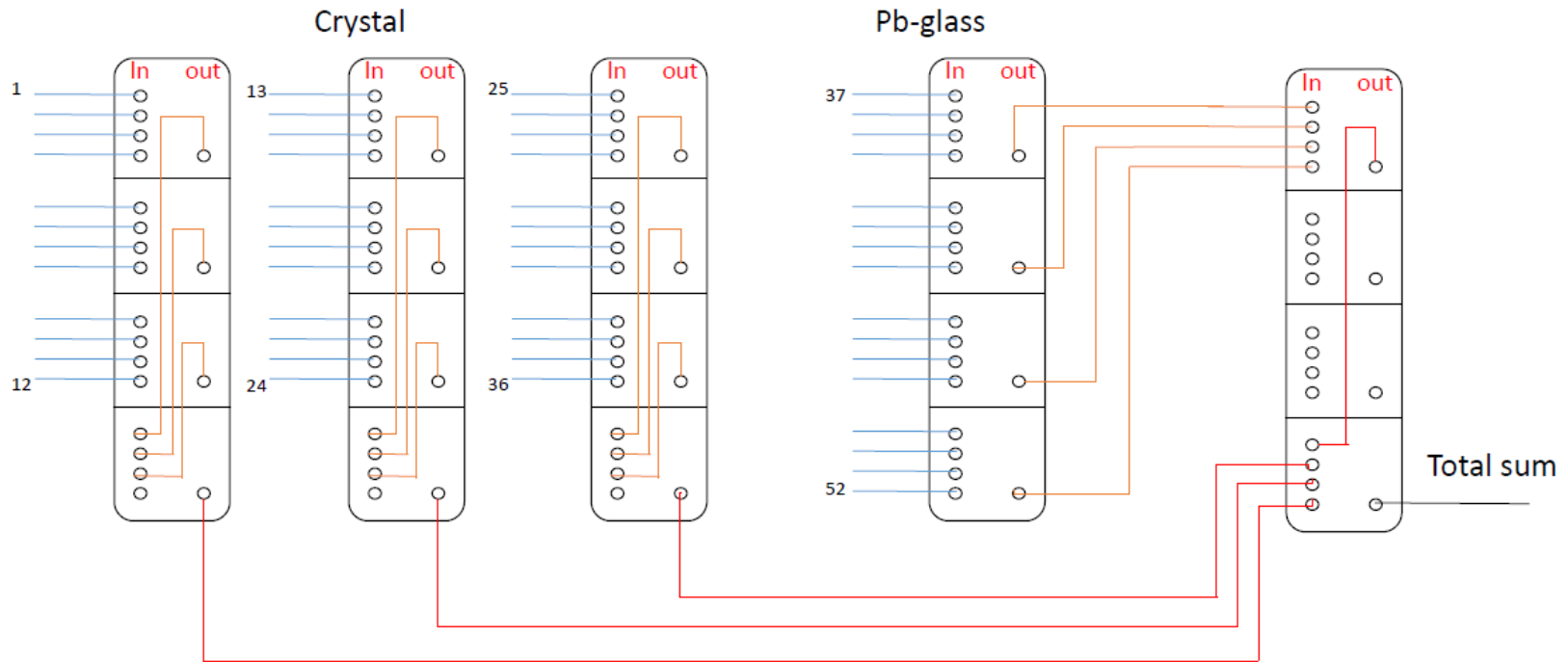


## 5x Linear Sum Crates

- 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

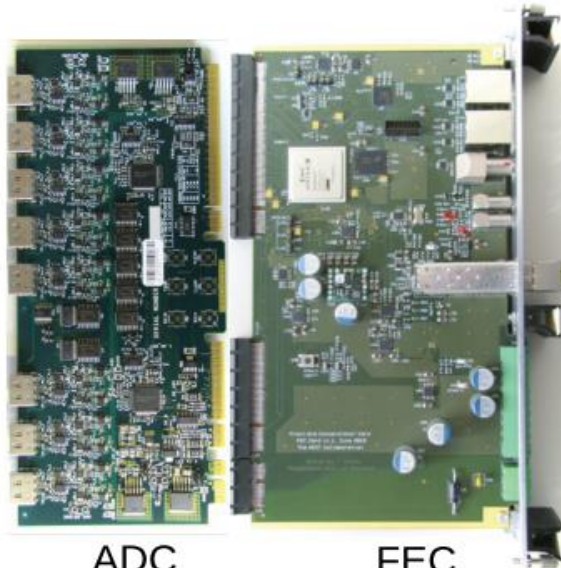


# DAQ System – GEM Part



APV25  
Hybrid

HDMI →



ADC

FEC

Gb Ethernet →



DAQ  
Computer

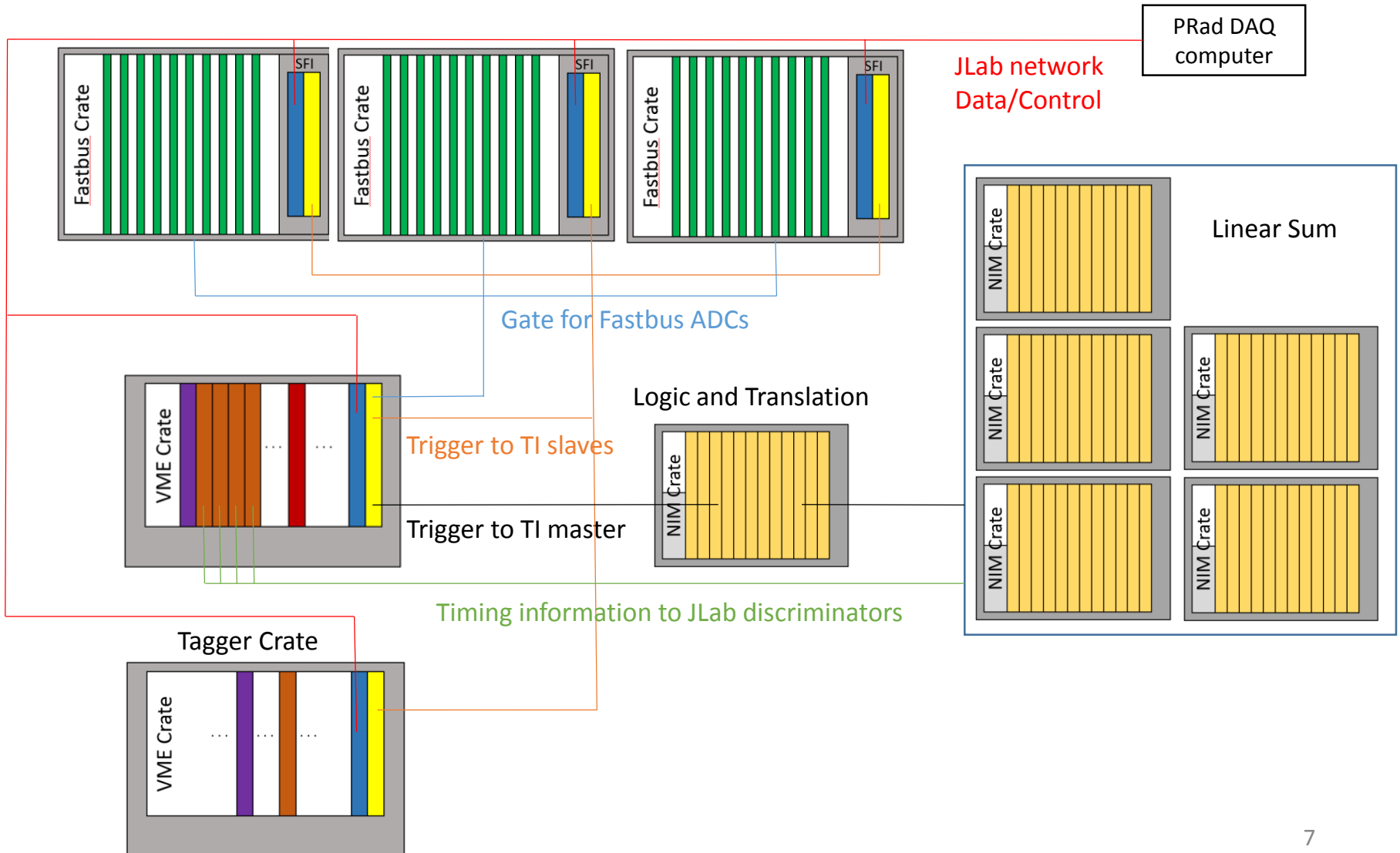
- 128 channel APV25 chip
- 192-deep analog sampling memory
- Master/slave configuration
- Diode protection against discharge
- RD51 standard 130-pin Panasonic connector interfaces to detector
- Mini HDMI (type C) connector

- 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.)

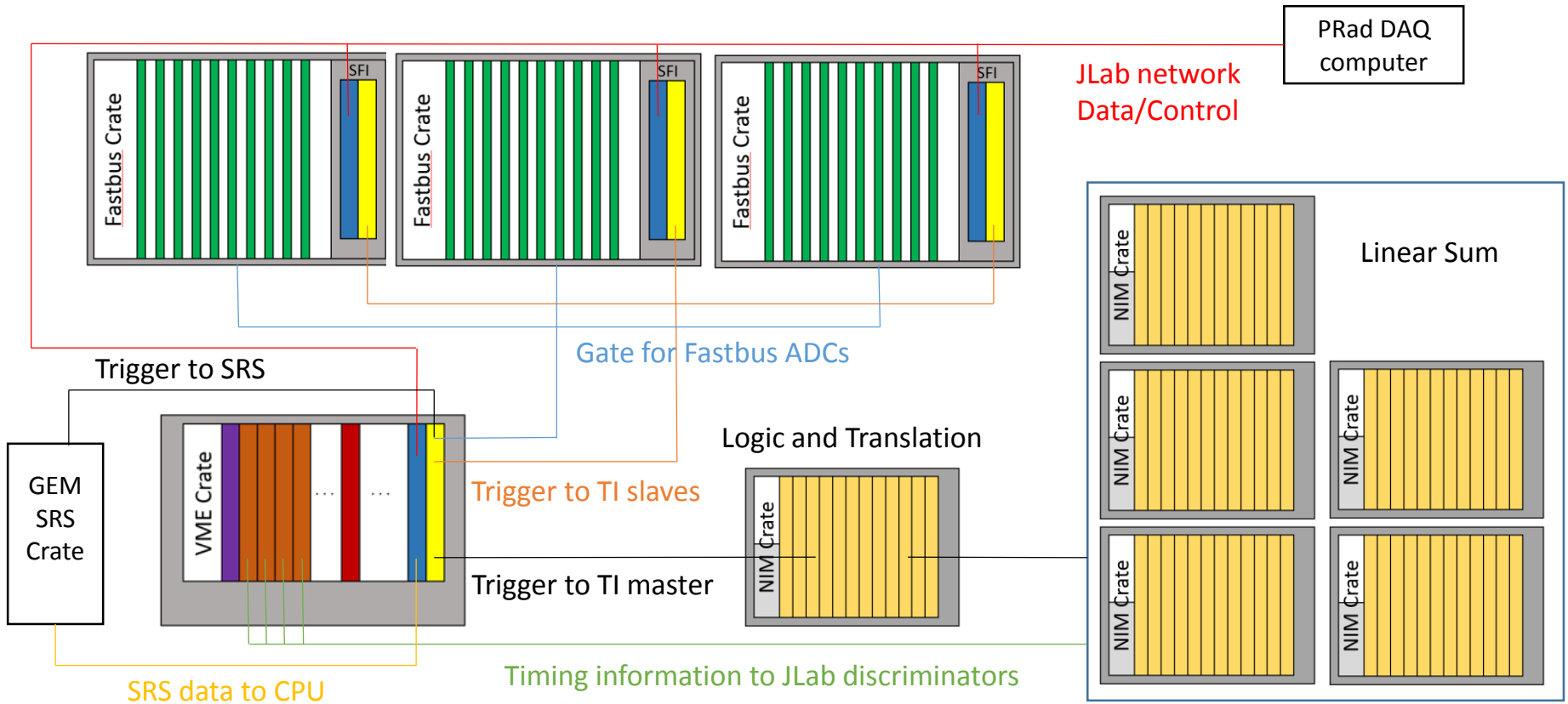
- Data Acquisition using CODA (JLab)
- Data transfer via UDP
- Slow control via ethernet

Developed by RD51 collaboration at CERN

# DAQ System for HyCal Calibration



# 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)

Name	State	EvtRate	DataRate	In-EvtRate	In-DataRate
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

# Online software

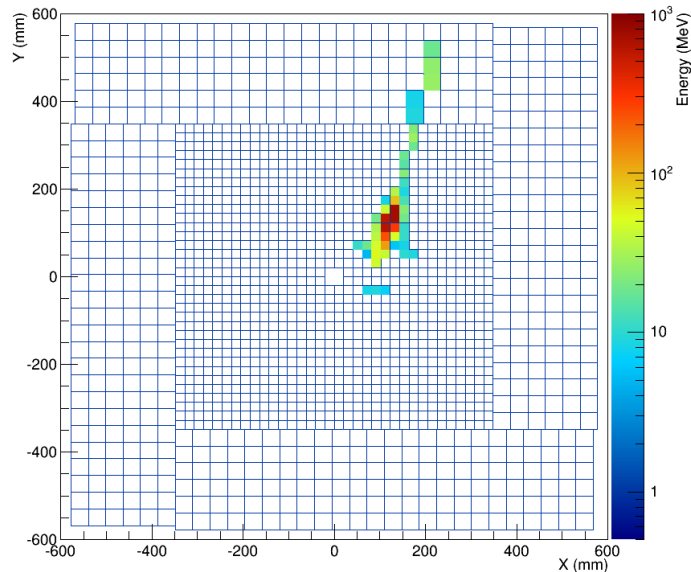
- The software for HyCal is based on previous primex software package, modified according to the new PRad DAQ configuration.
- Current online software
  - HyCal event viewer
  - HyCal gain equalizer
  - High voltage monitor and control
  - Temperature monitor
  - HyCal movement control and calibration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

# Online software

## High Voltage Control

The screenshot shows the 'High Voltage Control' interface. A window titled 'W113' displays 'HV channel info for: W113' with 'Vset' at 921 and 'Vmon' at 1.0. Below it, 'Primary channel info' shows 'PRIMARY3\_4' with 'Vset' at 1515 and 'Vmon' at 3.0. 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, W181, G101, W48, G70, W117, G72, W12, W147, W11, W148, W80, G71. A grid of channels is shown to the right, and a 'Channel Info' sidebar on the far right lists 'Channels monitored: 0' and 'primedv1-5' as 'CONNECTED'. Control buttons for 'PbGlass Group Set' and 'PbWO4 Group Set' are also visible.

## Online Event Viewer



## Temperature Monitor

The Temperature Monitor software interface shows multiple data plots. At the top, it displays 'Looking at the front of HyCal' and 'Looking at the back of HyCal' with corresponding 2D maps. Below these are several line graphs: 'Water In / Out' (24-40°C), 'Lead Glass' (11-20°C), 'Cooling Plates (upstream edge)' (16-20°C), 'Lead Tungstate' (21-22°C), 'Center Two Lead Tungstate (nearest beam)' (21-22°C), 'Beam Right IX & Vera' (15-20°C), and 'W529 HV Divider & Brass Flange' (16-20°C). The interface includes a menu bar, a toolbar, and a status bar at the bottom.

# CODA for GEM

Run Control rcGui-65

Platform Sessions Configurations Options Expert Help

Start Time: 23:34:55 | End Time: | 05 November | Afecs

Run Parameters: Expid: PRAD, Session: PRAD01, Configuration: PRadGEM

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 graph showing a peak around 25.

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: 1

View File | Spy Event | View Next | View Previous | Received | Quit

Event Details:

```

type_1_physics_event
├── header
└── ROC17
    ├── 0x5
    └── 0x6
    
```

Hex Dump:

```

0xda000022 0x00000000 0x41444300 0x00000001
0xff07ff07 0xfe070008 0xff07ff07 0xfe07ff07
0xfe070008 0x00080008 0xfe07ff07 0x0008ff07
0xff07ff07 0xff07ff07 0xfe070008 0xff07ff07
0x0008ff07 0xff070008 0x0008ff07 0xff07ff07
0xfe07ff07 0x00080008 0xfe07ff07 0x0008ff07
0xff07ff07 0xff07fe07 0xff070008 0xff07ff07
0xff07ff07 0xff07ff07 0xff070008 0xff070008
0xff070008 0xff07fe07 0x0008fe07 0xff07ff07
0xff07ff07 0xfe07ff07 0xff07fe07 0xff07ff07
0x0008ff07 0xff070008 0xff07fe07 0xff07ff07
0xff07ff07 0xfe070008 0xff070008 0x0008fe07
0xff07ff07 0xff070008 0xff070008 0x0008ff07
0xfe07ff07 0xff070008 0xff07ff07 0xff070008
    
```

header: Event ID Bank

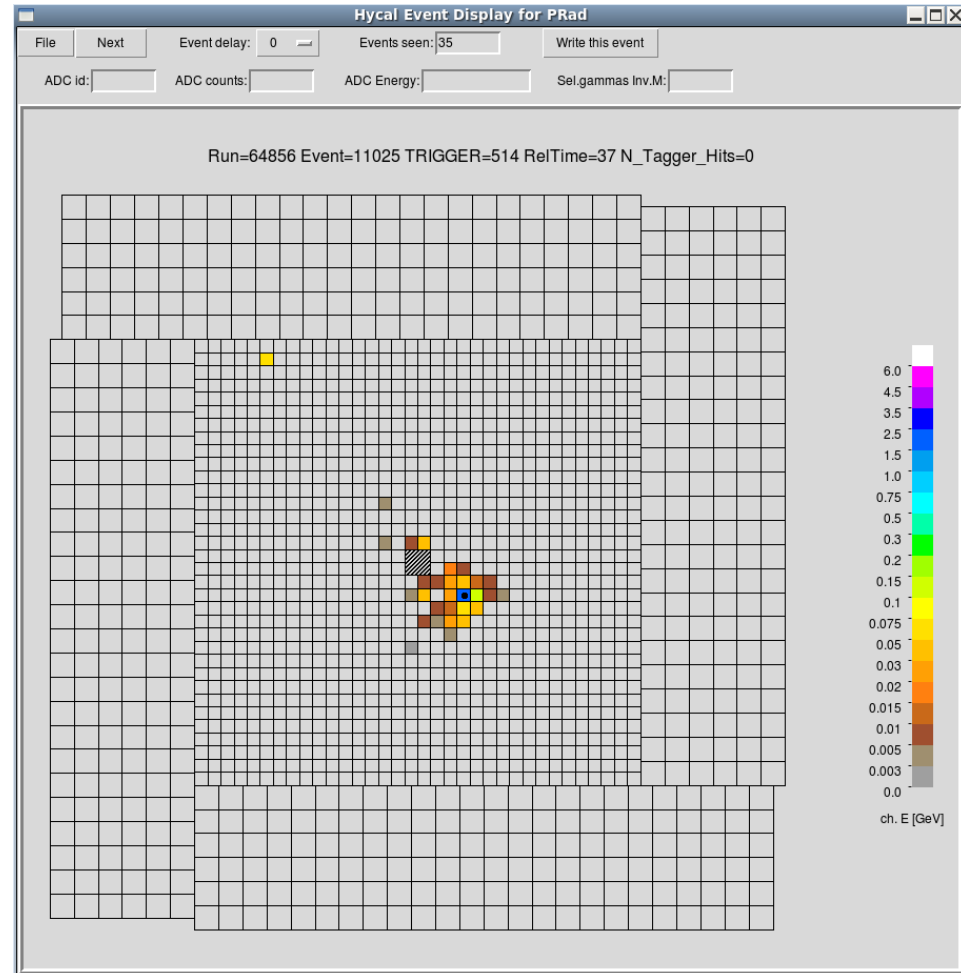
Info: --> To start, enter a  
Info: --> Number of ever

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

# Offline software

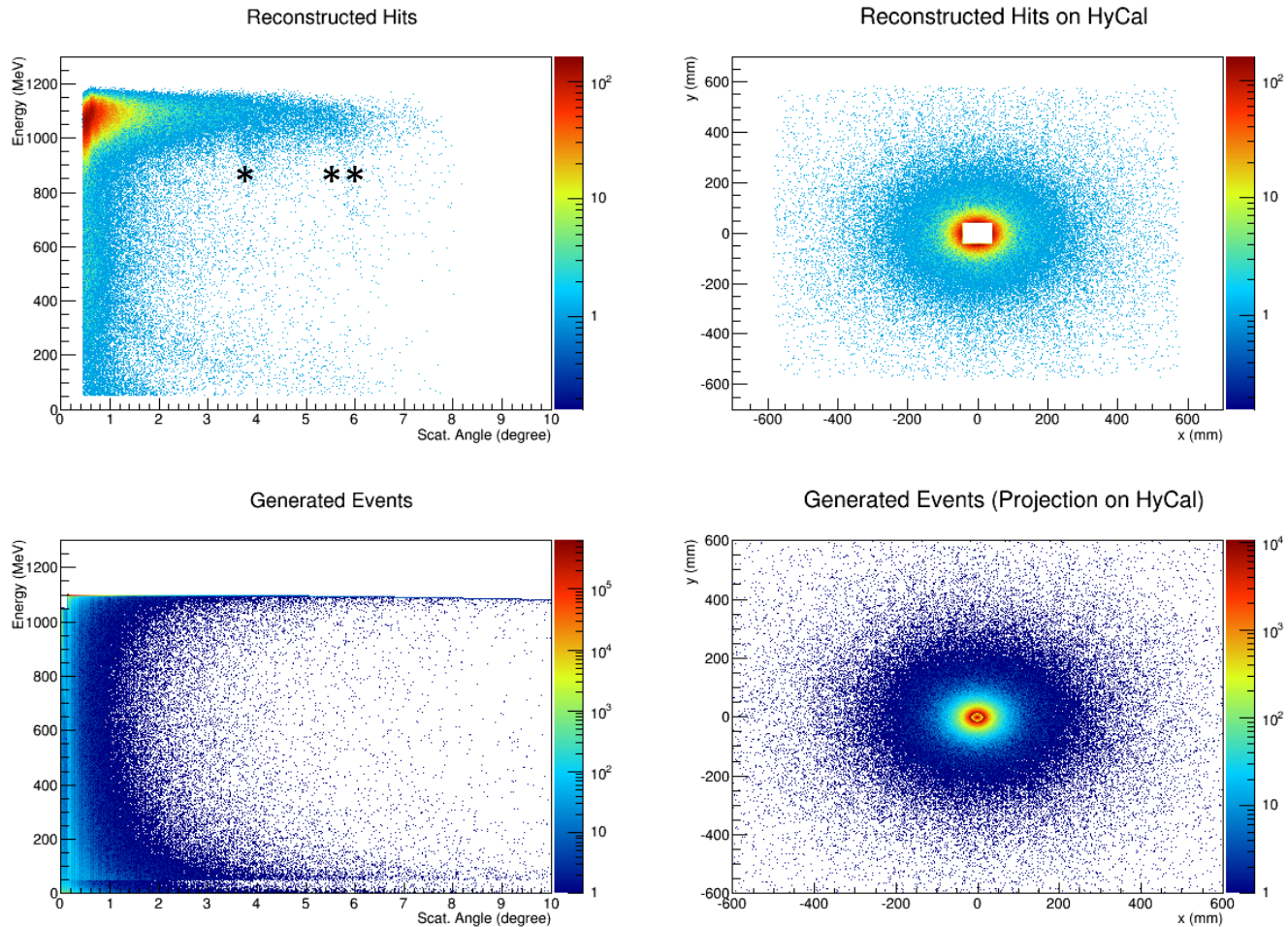
- Replay code for CODA file
- HyCal events reconstruction program
- HyCal offline events viewer, based on PrimEx event display

## Offline events viewer (input from simulation)



# Offline software

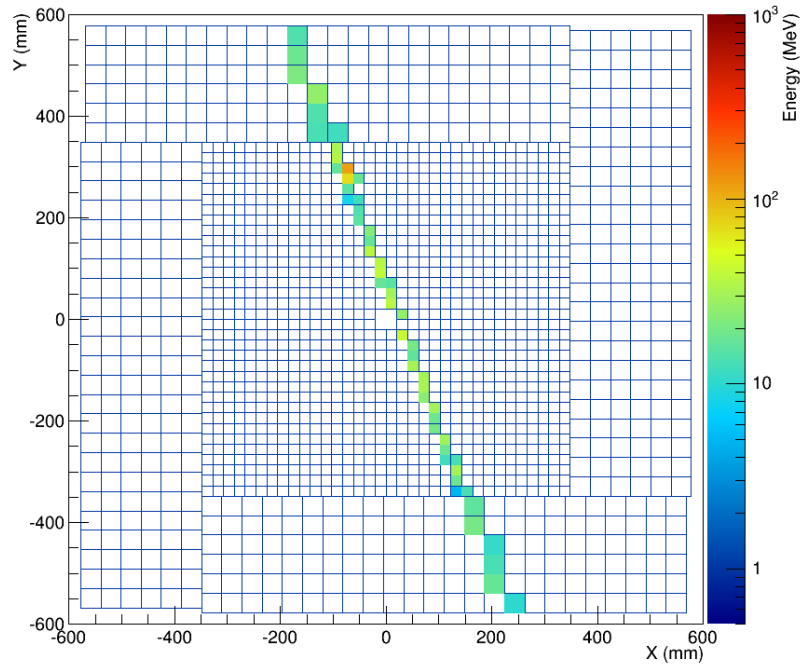
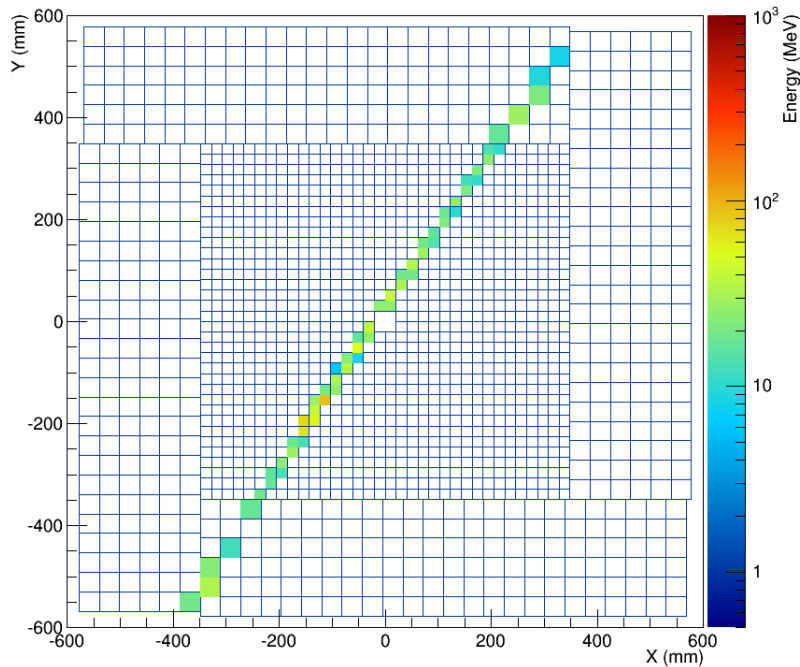
- Reconstruction with simulation input



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

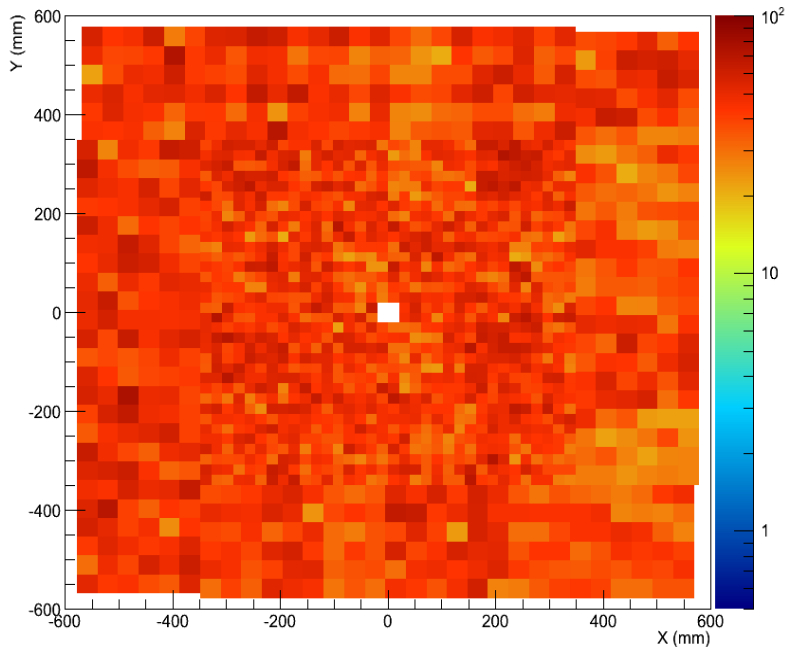
# Cosmic tests for HyCal

- Cosmic rays detected by HyCal and reconstructed by DAQ

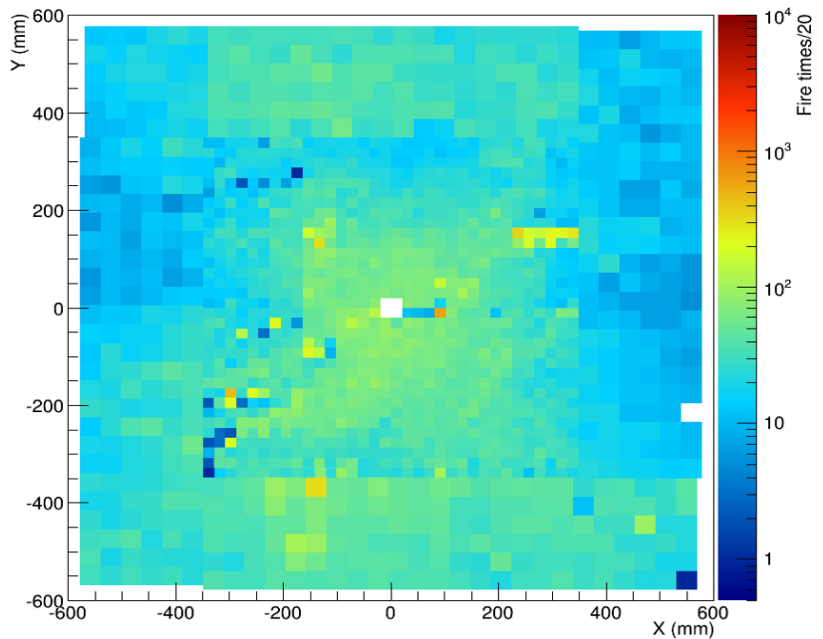


# Cosmic tests for HyCal

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



Pedestal Map

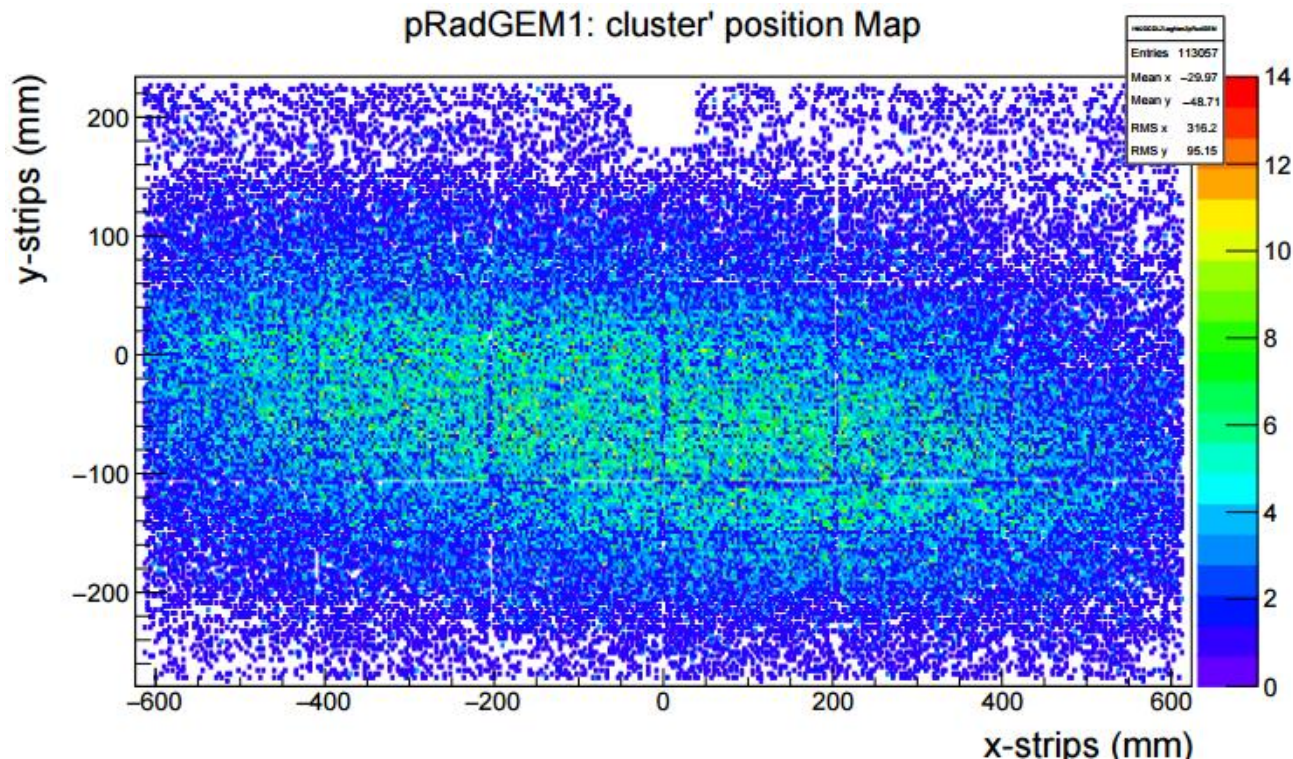


Occupancy



# 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