Status and Plans for Insert/ZDC Test at RHIC
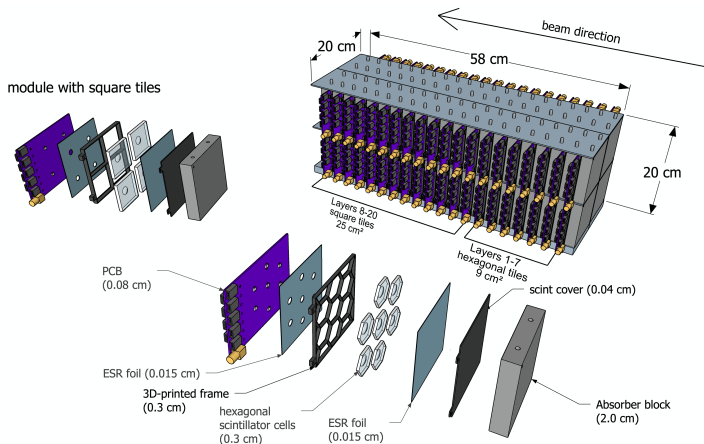
Weibin Zhang

UC Riverside
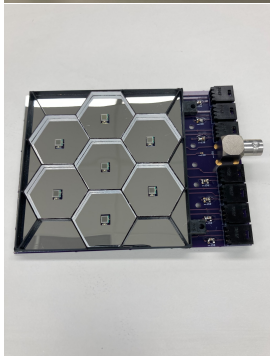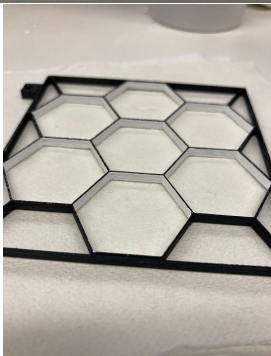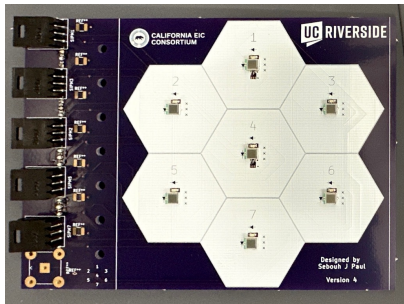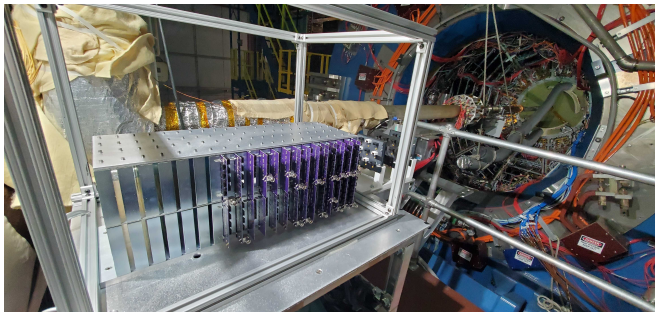
2024-06-26

CALI: Gen-II

- 20 sampling layers: 4 hexagonal layers + 16 square layers
- Iron absorber + scintillator tile + SiPM (on tile) + CAEN unit
- 20 cm × 20 cm transverse active area

Hexagonal Layer

Beam Test at BNL

- Operating and calibrating the prototype in realistic conditions, as well as quantifying system degradation due to radiation damage
- Measurement of MIP response using isolated tagged charged hadron
- Measurement of core of hadronic shower using isolated tagged charged hadron
- Measuring π^0 invariant mass and spectra to verify calibration and showcase the separation of two showers with a fine 3D shower shape

Installation in the STAR Hall
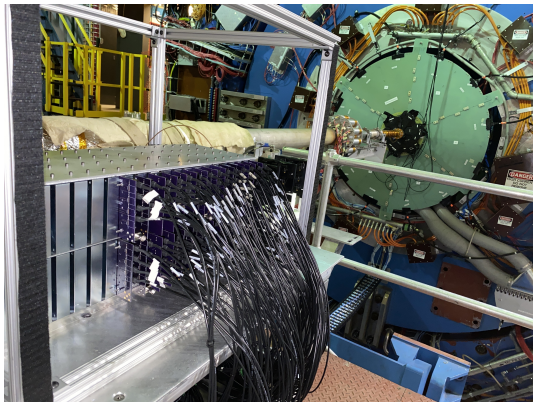
- East platform of the STAR detector, parallel to the beampipe
- 192 (268)/368 channels readout (connected)
- Hodoscope installed, but not in use yet

Trigger and Data Collection

- 4 trigger tiles: 2 in front and 2 at the showermax
- One radiation monitoring tile on the bottom right
- CAEN unit to bias and read out SiPM signals
- Multiple CAEN units, requires external trigger – DRS4
- Concentrator to distribute the trigger signal and collect the readout
- Janus for software configuration
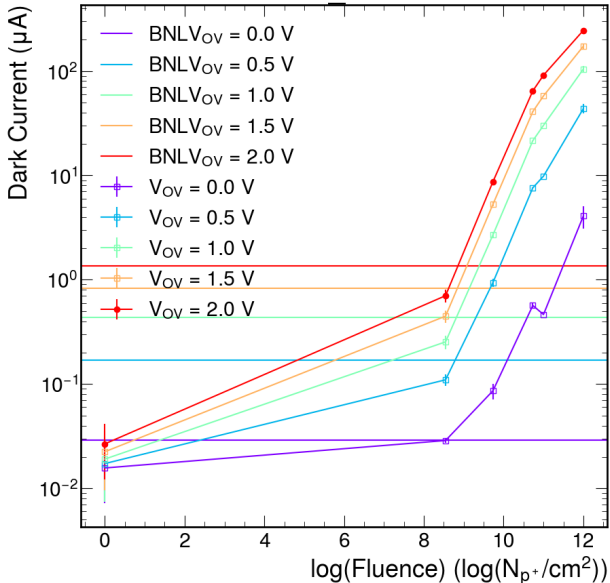
Trigger Logic (Slide by Sean Preins)
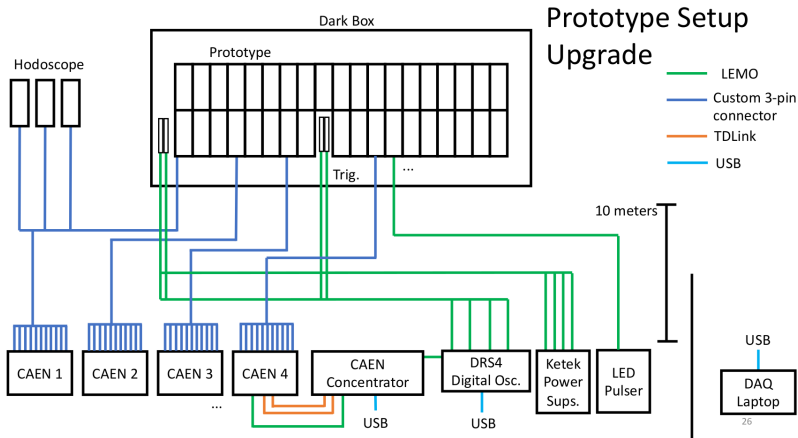
Radiation Monitoring
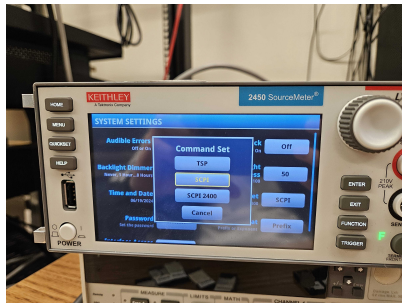
- A SiPM in front of the prototype for radiation monitoring, readout by a Keithley unit
- Perform I-V characterization with the Keithley unit
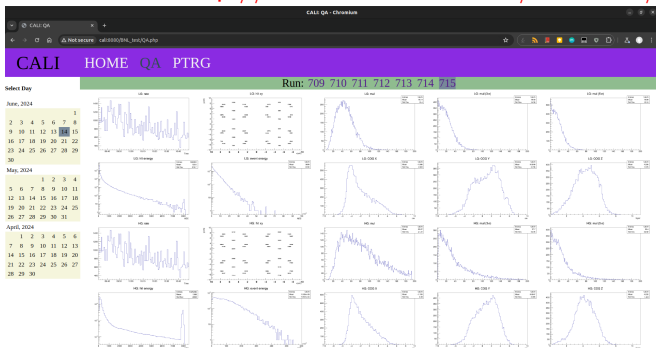
Radiation Monitoring

S14_3015

- Irradiation test at UC Davis last month as reference to calculate fluence for the BNL test
- Since RHIC Run24, the radiation received by the prototype is about $10^8 - 10^9$ p/cm^2

Daily Operation

Our website: http://138.23.151.181:8080/BNL_test/

- Automate most work for data taking and analysis with scripts
- Analysis framework is developed (github)
- At least one pedestal run every day
- Cosmic data on maintenance day and scheduled beam off time
- Power cycle the CAEN unit and concentrator through a NPS

Database

| Run	Type	Flag	StartTime	StopTime	Len (m)	#Ch	Trigger	Events	PedRun
692	data	good	2024-06-13 00:47	2024-06-13 02:17	90	192	T1 && T2 && T3	7353	683
693	data	good	2024-06-13 02:17	2024-06-13 03:47	90	192	T1 && T2 && T3	6069	683
694	data	good	2024-06-13 03:48	2024-06-13 05:18	90	192	T1 && T2 && T3	5563	683
695	data	good	2024-06-13 05:18	2024-06-13 06:48	69	192	T1 && T2 && T3	3939	683
696	data	good	2024-06-13 06:49	2024-06-13 08:19	89	192	T1 && T2 && T3	174	683
697	data	good	2024-06-13 08:19	2024-06-13 09:49	90	192	T1 && T2 && T3	6186	683
698	data	good	2024-06-13 09:49	2024-06-13 10:25	17	192	T1 && T2 && T3	1344	683
699	ptrg	good	2024-06-13 10:25	2024-06-13 10:25	0	192	0	12904	-1
700	cosmic	good	2024-06-13 10:44	2024-06-13 11:03	17	192	T1 && T2 && T3	6	699
701	cosmic	good	2024-06-13 11:03	2024-06-13 12:33	89	192	T1 && T2 && T3	205	699
702	cosmic	good	2024-06-13 12:33	2024-06-13 14:03	89	192	-2	61	699
703	data	good	2024-06-13 14:04	2024-06-13 15:34	88	192	-2	9949	699
704	data	good	2024-06-13 15:34	2024-06-13 17:04	90	192	-2	2575	699
705	data	good	2024-06-13 17:04	2024-06-13 18:34	90	192	-2	172737	699
706	data	good	2024-06-13 18:35	2024-06-13 20:05	90	192	-2	385395	699
707	data	good	2024-06-13 21:29	2024-06-13 22:59	90	192	T1 && T2 && T3	2087	699
708	data	good	2024-06-13 22:59	2024-06-14 00:29	90	192	T1 && T2 && T3	2345	699

- Run information is stored in a database
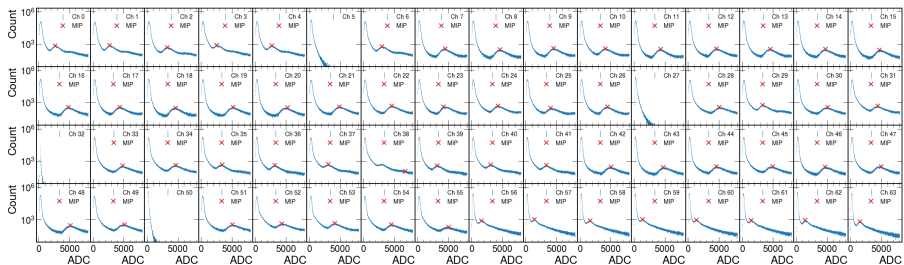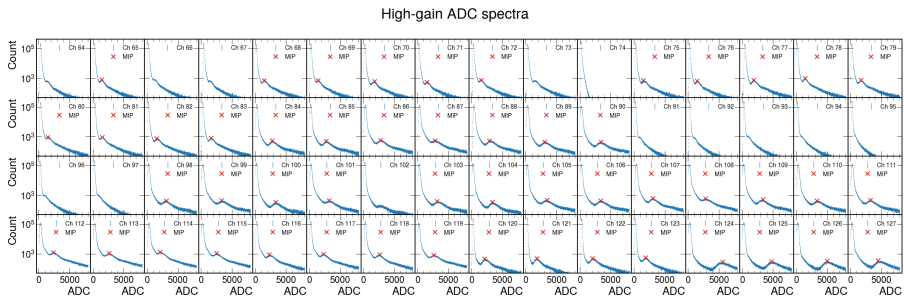- The database is accessible from the cali website

Pedestal
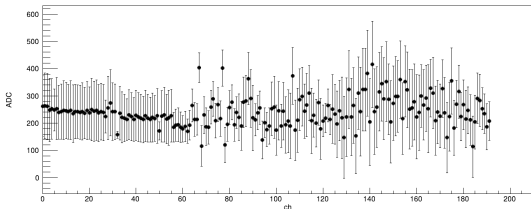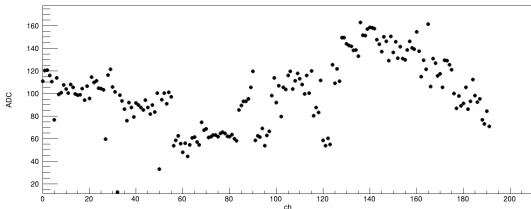
- HG pedestal from run 941 (2024-06-25)
- The pedestal is fluctuating in CAEN unit 2 and 3
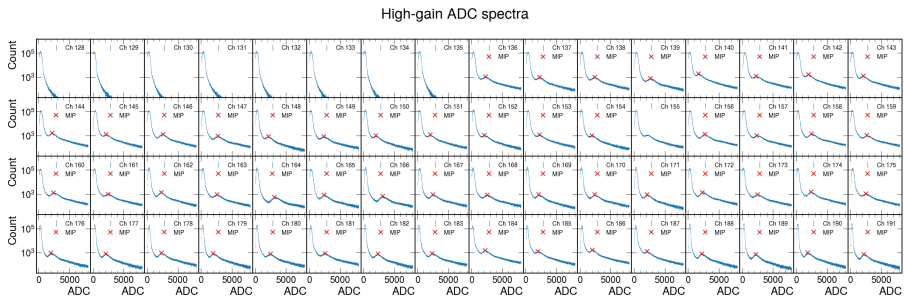- Increament of the pedestal RMS value (Imon) along time
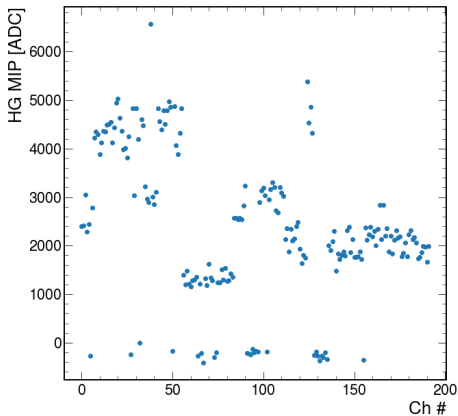
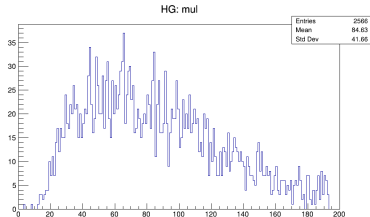# Cosmic (CAEN 0)

High-gain ADC spectra

Cosmic (CAEN 1)

High-gain ADC spectra
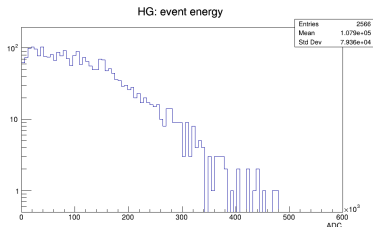
Cosmic (CAEN 2)
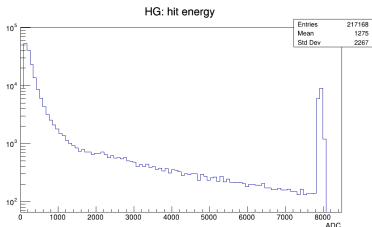

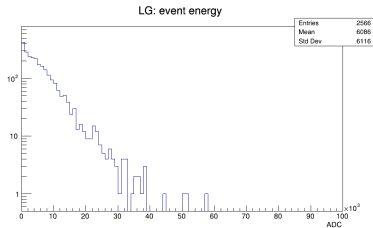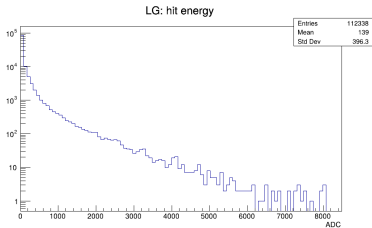High-gain ADC spectra

MIP

- 1.3 mm and 3 mm SiPMs
- Hexagonal and sqaure tiles
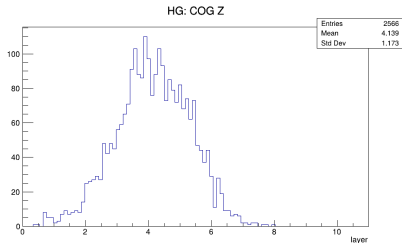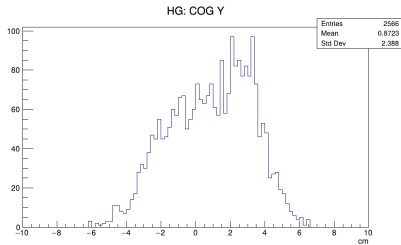- MIP analysis with beam data is under development
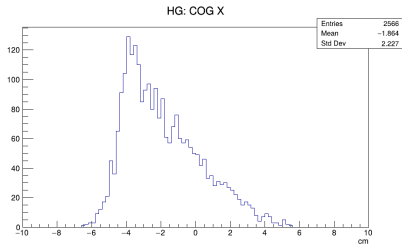
Data
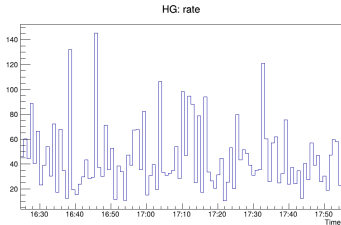
- Event rate at a few Hz
- Most are low energy particles

Data

- HG for MIP analysis
- LG for high energy particles
- Monitoring total energy along time

Data

$$\text{COG} = \frac{\sum_i E_i \cdot \vec{X}}{\sum_i E_i}$$

- Shower shape analysis is under development
- Aims at separating the two photons from π^0

Summary

- The first operation of a SiPM-on-tile calorimeter in a hadron collider ever
- Will run it until next year
- The goal: maintain stable performance along time under harsh radiation environment – radiation effect, MIP response, shower shape analysis and particle reconstruction
- The beam test is still in the commissioning phase
- More cables, SiPM boards and CAEN units will be added
- Shower shape analysis is under development
- Pythia simulation is coming