

ECAL Benchmark Tests at UCR

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Introduction: ECAL

ECAL was used by Yushan Cheng from UCLA at FNAL .

ECAL is a 16 Channel Tungsten-powder / scintillating fiber calorimeter readout with light guides and SiPMs

Tests were conducted with the ECAL at UCR. To prepare for combined ECAL + HCAL test in the future

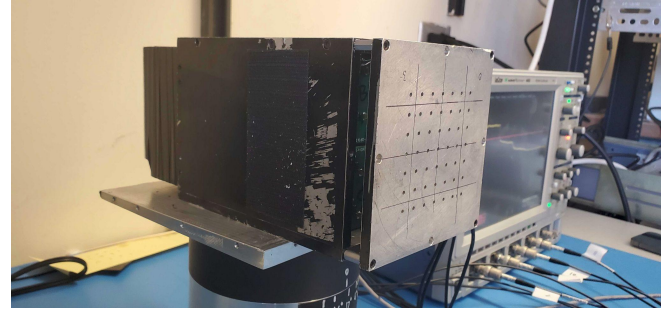
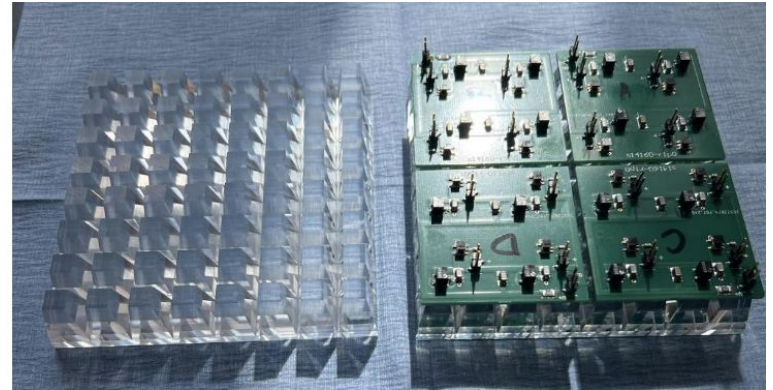


Image credit:Yunshan Cheng



UCR Set-Up: ECAL

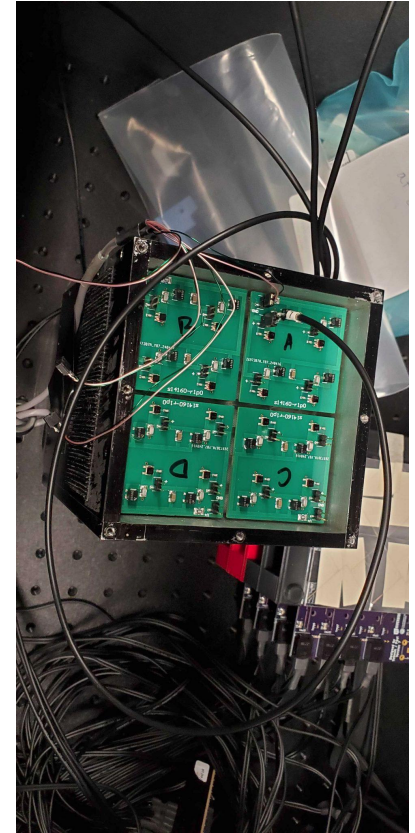
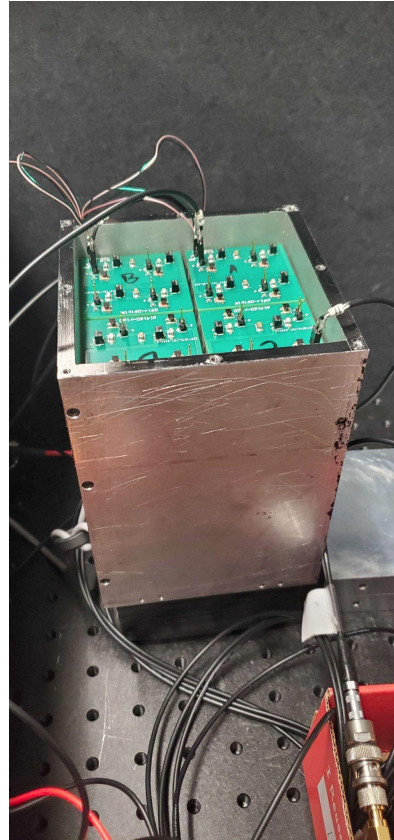
First test goal: Get signal from ECAL be read with a CAEN unit.

Each channel on the ECAL had to be connected to an inverting amplifier.

Polarity of ECAL Signal was the main issue.

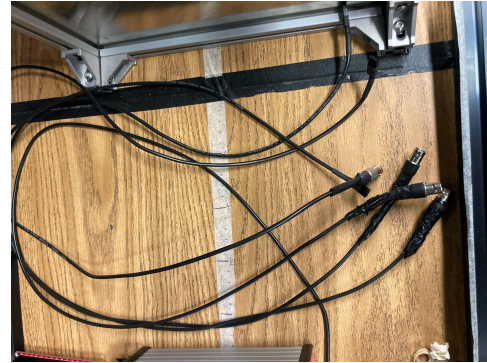
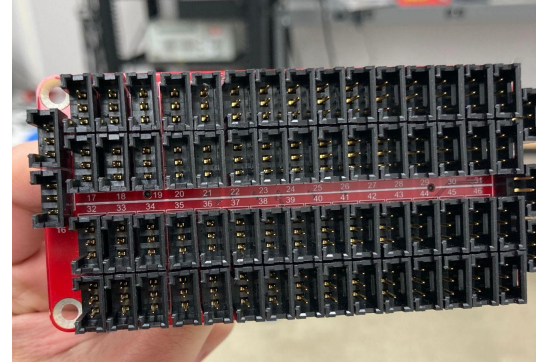
16 Channels in total.

Entire setup placed inside dark box.



Setting Up all 16 Channels

All 16 Channels required custom built cables in order to be read out into the CAEN Unit.



LED Test

Tests on a single channel were done first

An LED was connected to a fiber cable and placed in an opening of the ECAL.

Intensity of LED could be manually controlled.

Signal Measurement would be compared between Oscilloscope and CAEN Unit.



LED Test Results

Output signal one channel was first checked in oscilloscope.

Voltage peak-to-peak value was recorded in oscilloscope.

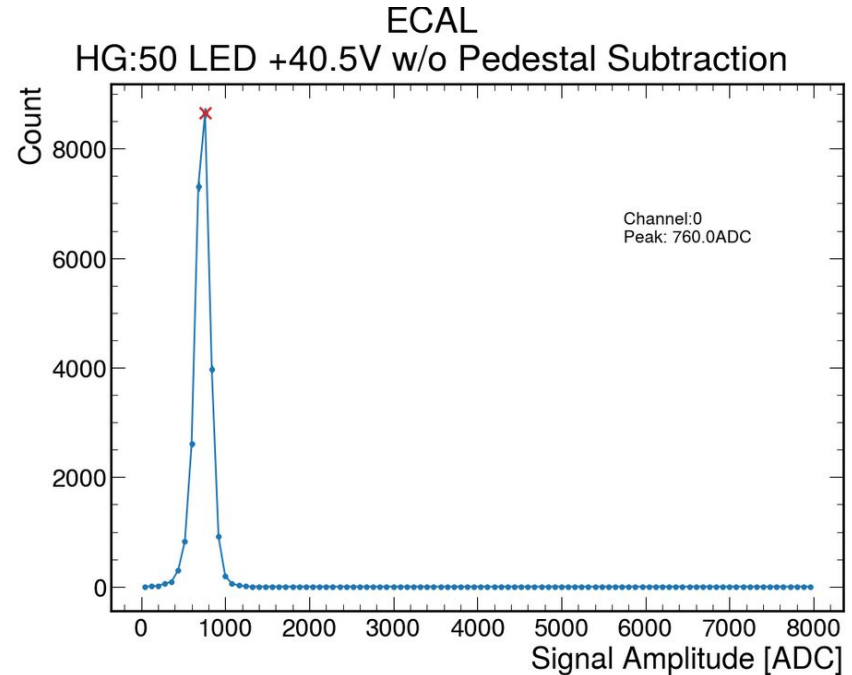


LED Test Results

Output signal was then switched to the CAEN Unit without changing the setup.

Signal histogram from CAEN machine was then analyzed to find the peak mean.

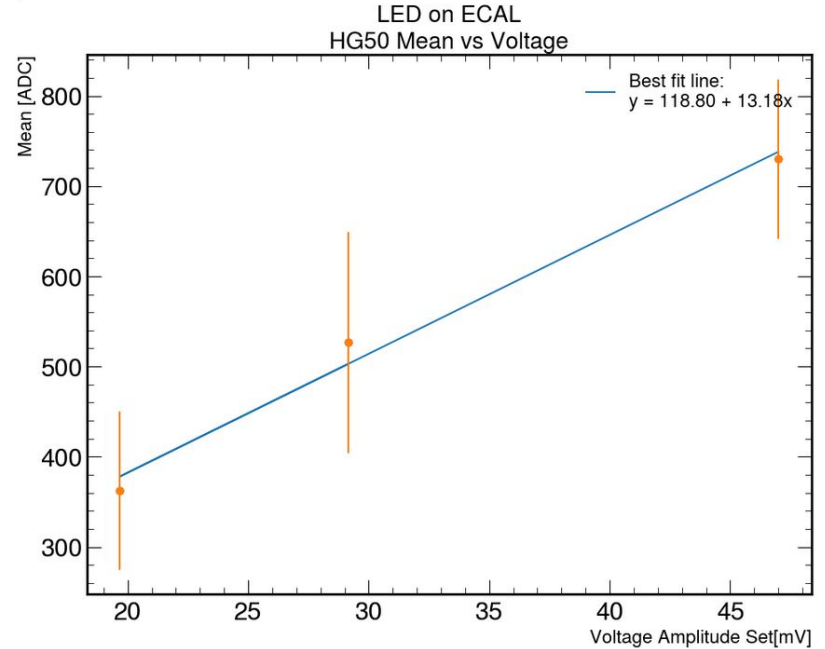
This value was then paired to the value that was read on the oscilloscope.



LED Test Results

This process was repeated with multiple data points. Pairs were then plotted as a linear function.

A ratio between ADC and Voltage could be found from the linear equation.



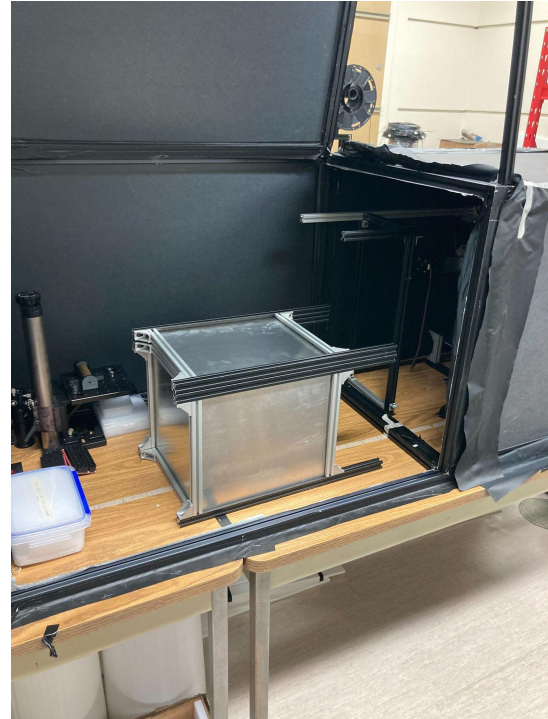
Cosmic Ray Tests 1

Initial Cosmic-ray tests involved only a few channels but were unsatisfactory.

Tests showed that too many bad events were triggered.

Cause was believed to be caused by external electrical noise.

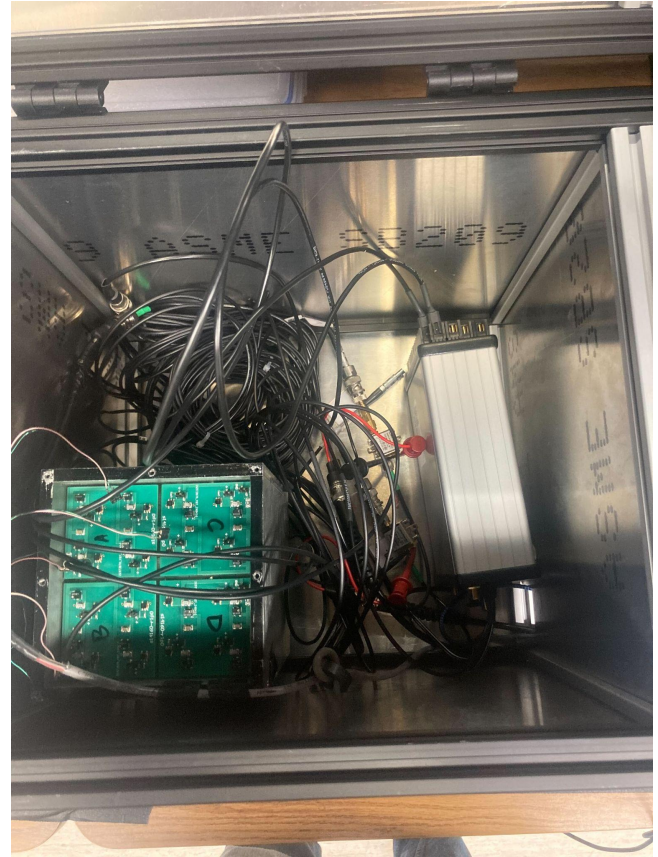
Solution: Create a Faraday box.



Faraday Box

Entire Set-up was placed inside the Faraday box.

Faraday box set-up showed no noticeable improvement.

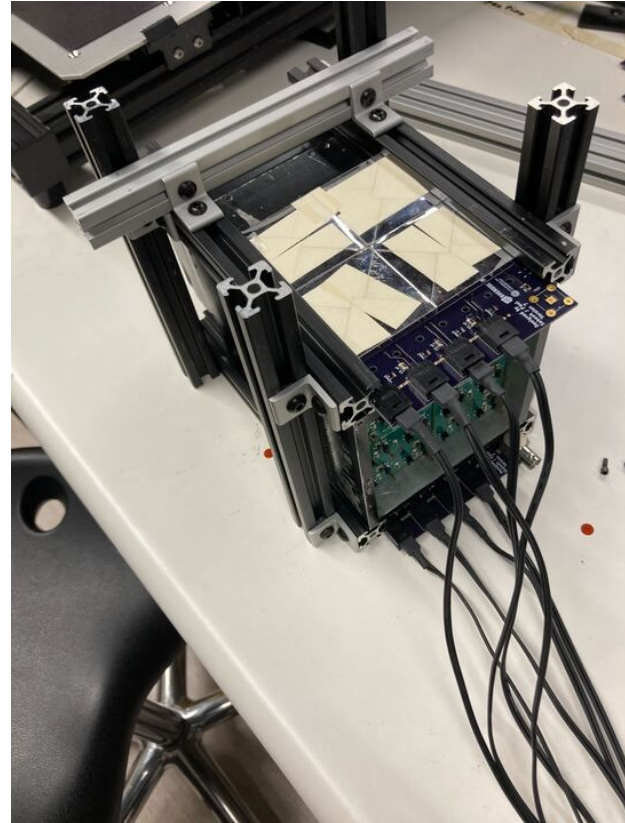


Cosmic Ray Tests 2

Next solution was to use an external trigger set up.

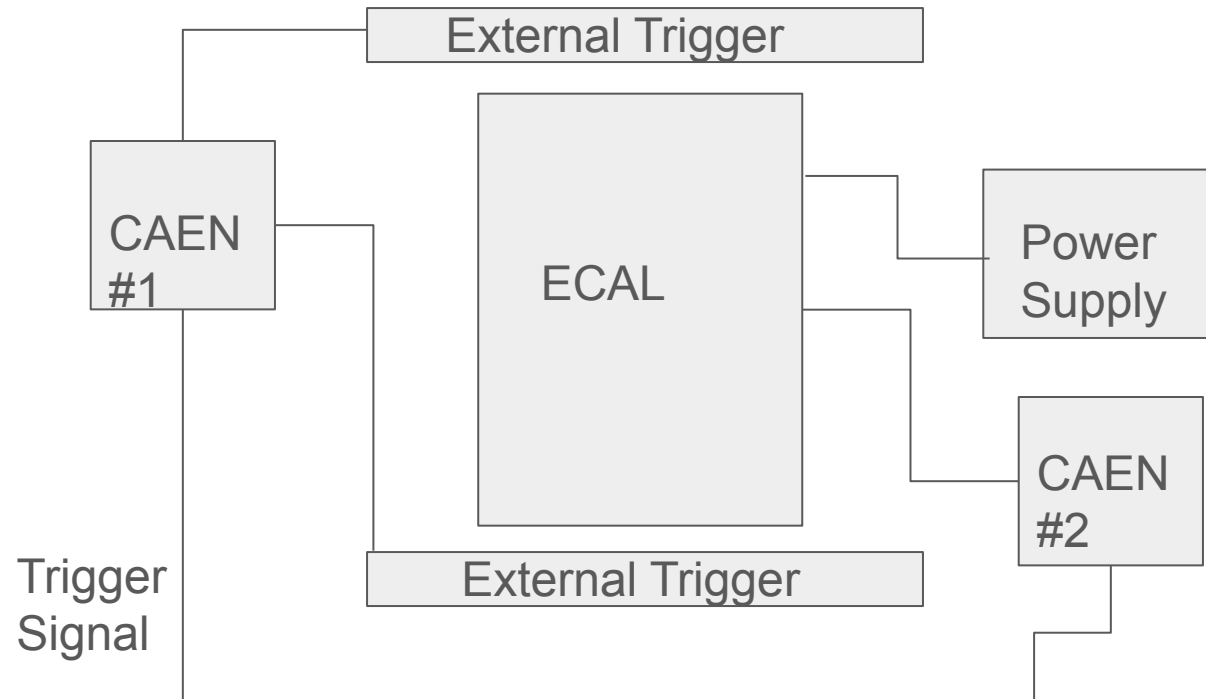
Two external trigger board from previous tests were used and connected to an additional CAEN Unit.

Trigger signal output on this CAEN unit was then connected to trigger signal input of CAEN unit for the ECAL



Cosmic Ray Test 2

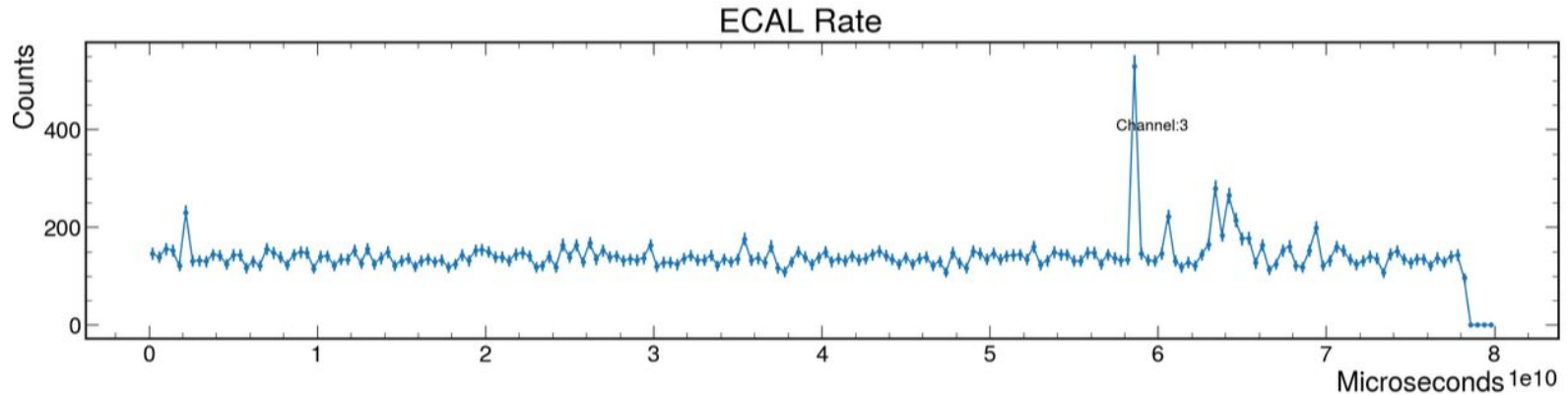
Diagram Setup



Cosmic Ray Tests 2

Great improvement by using this set-up.

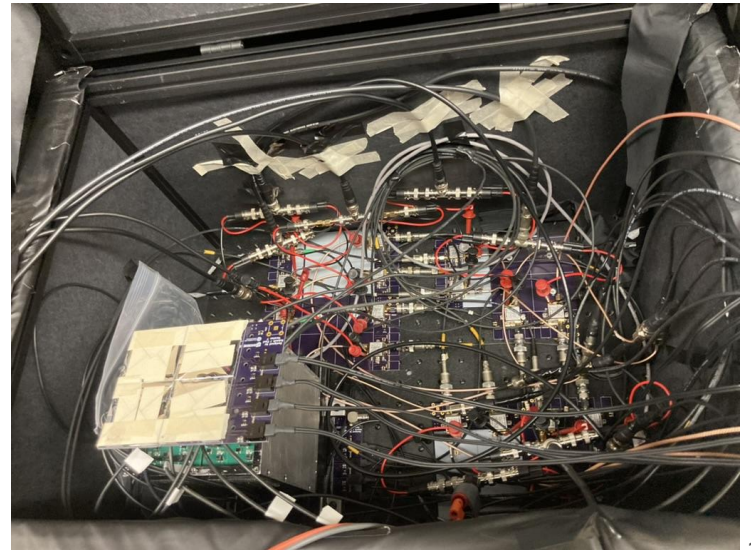
Improved steady rate of muons.



Cosmic Ray Test 2

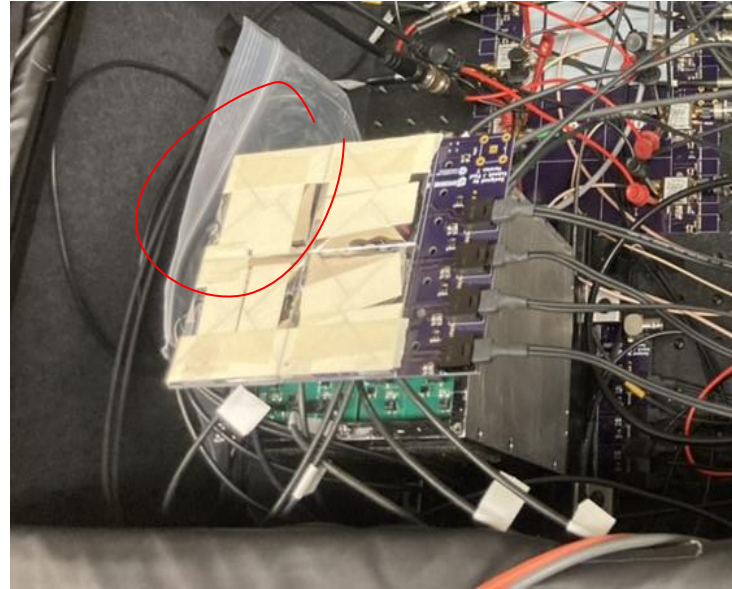
After all cable materials were constructed final setup of all 16 channels was complete.

Testing all 16 channels with cosmic rays could begin.



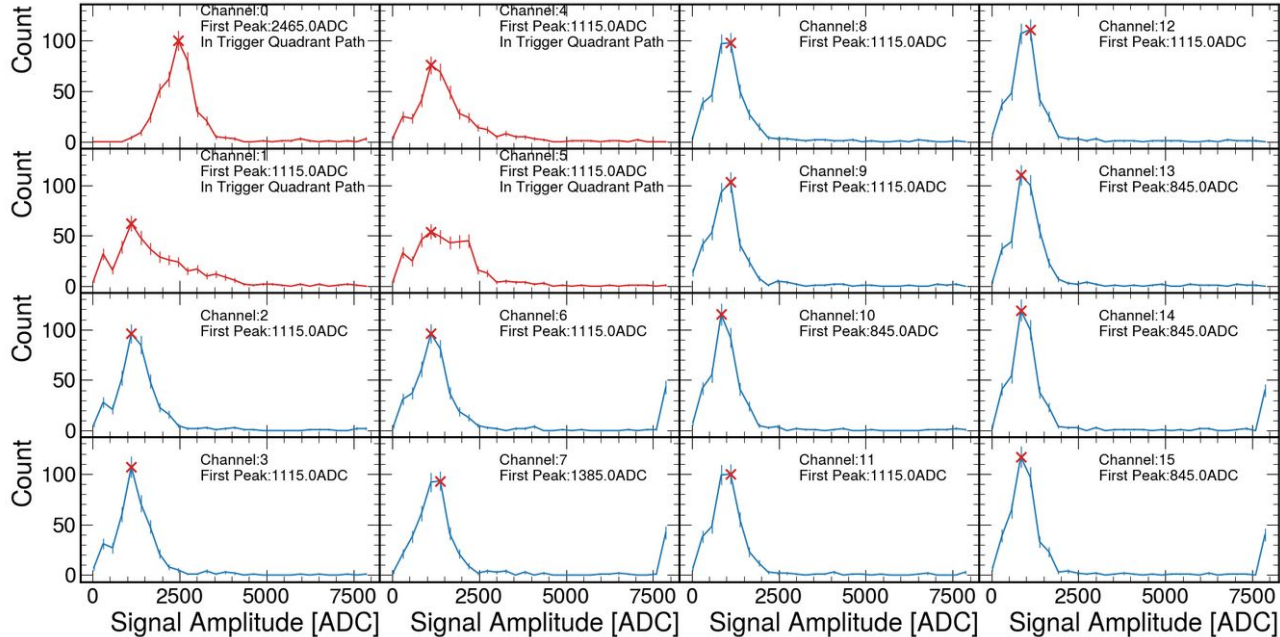
Cosmic Rays Test 2 Results

Using the external Triggers, a specific quadrant area of the entire ECAL could be tested.



Cosmic Ray Test 2 Results

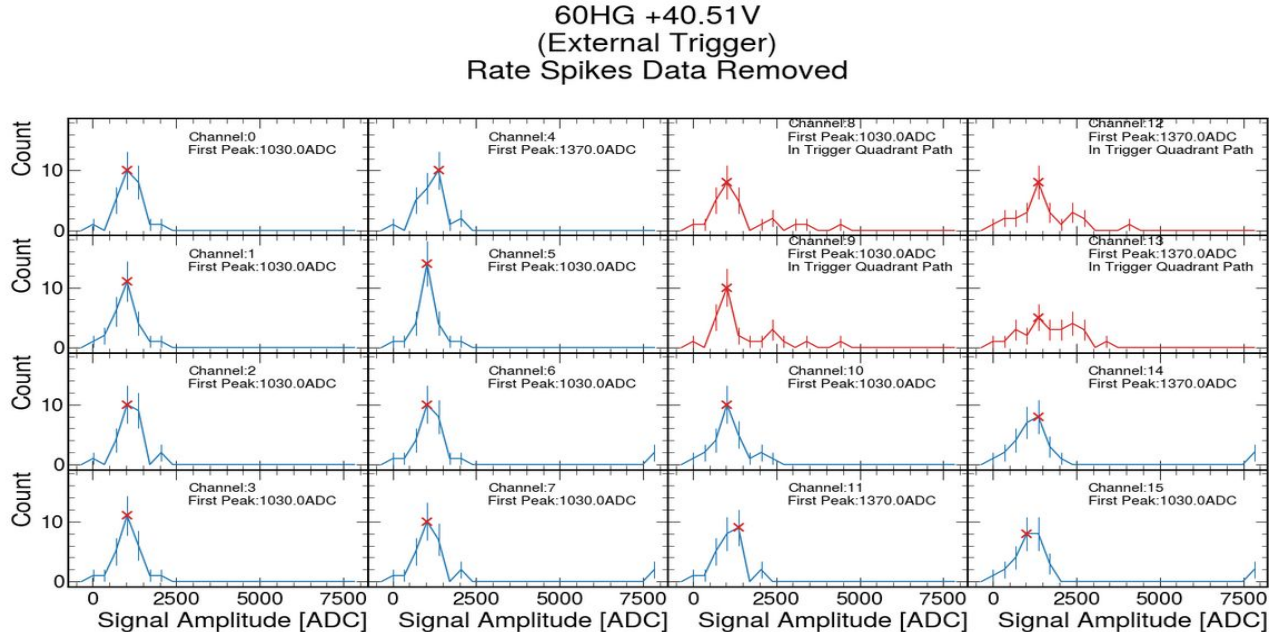
60HG +40.51V
(External Trigger)
Rate Spikes Data Removed



Results show a Landau shape forming between the same quadrant that was activated in the external triggers.

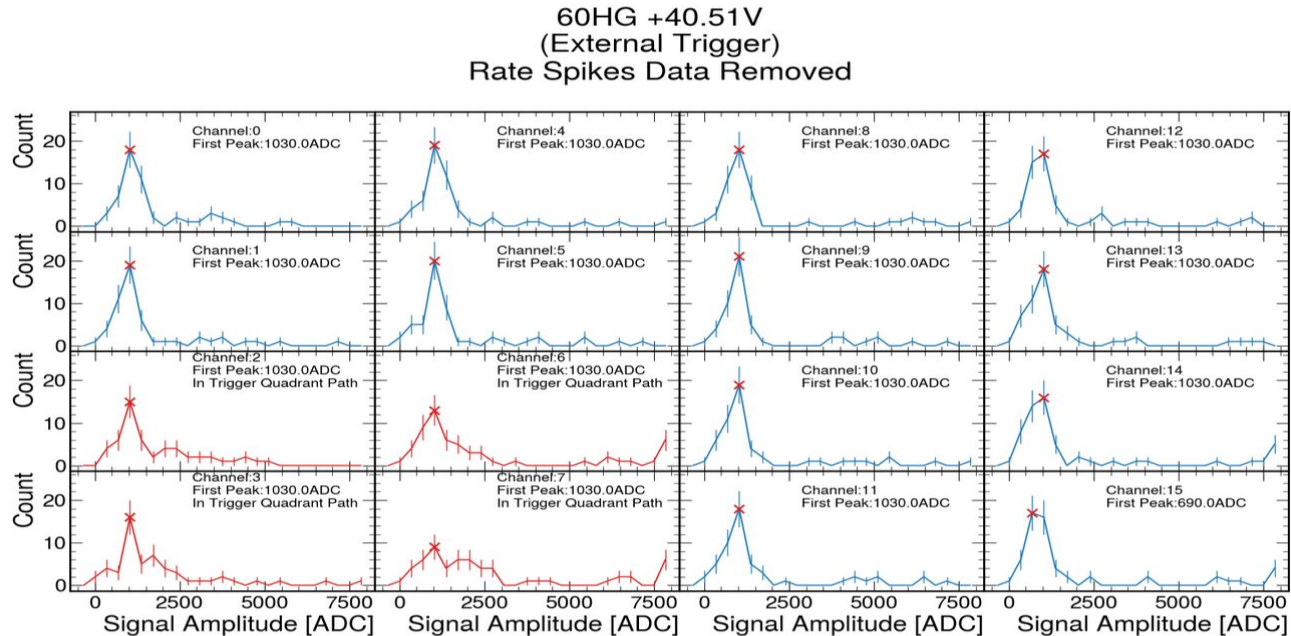
Cosmic Ray Test 2 Results

Activated different quadrants on the external triggers all show a similar result.



Cosmic Ray Test 2 Results

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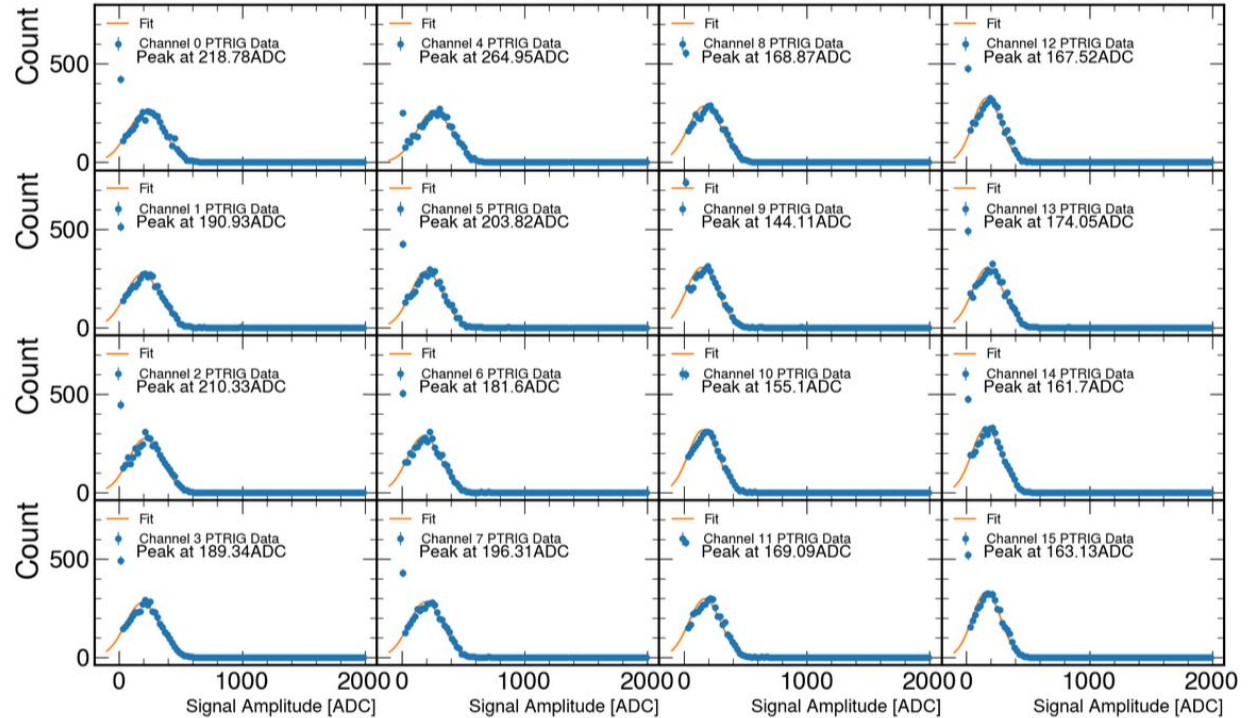


Cosmic Ray Test 2 Results

Pedestal Value
was obtained by
randomly
activating the
trigger signal
while recording
data on the ECAL.

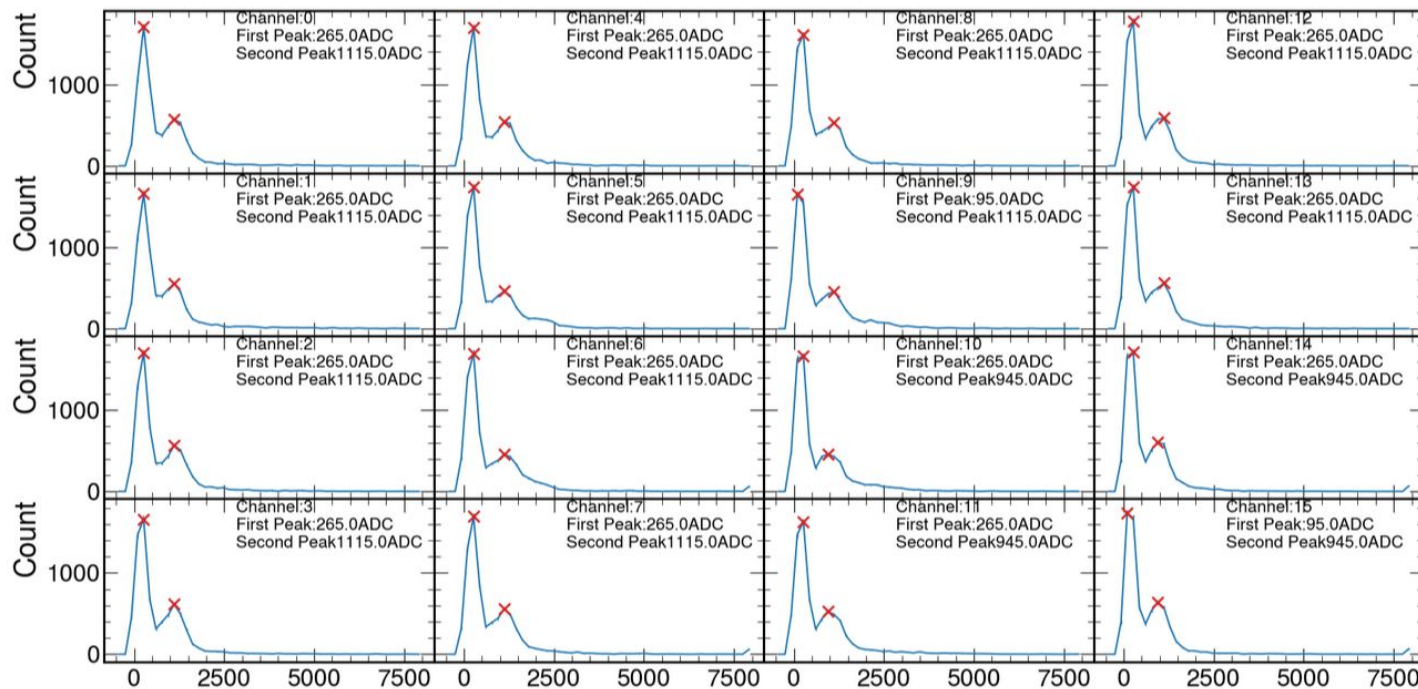
Pedestal peaks at
~200ADC.

External Trigger
PTRIG of Scintillators ECAL



Cosmic Ray Test 2 Final Results

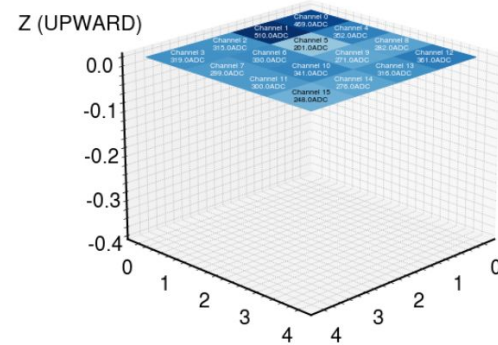
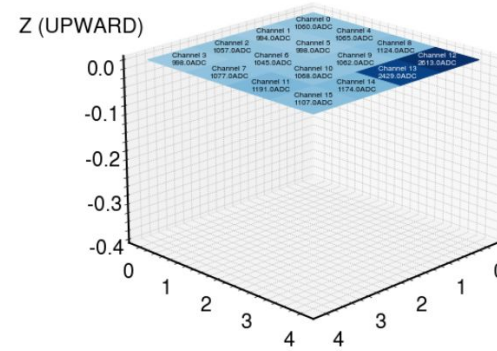
60HG +40.51V
(External Trigger)
Rate Spikes Data Removed



Activating the entire area on the external triggers show that the second peaks on the histogram 1115 ADC for the 16 channels.

Visual Read Out

A Visual Readout was created to better visualize the the path of energy particles during an event.



Summary

ECAL can be used with LED on a oscilloscope to find the voltage to ADC ratio on a CAEN unit.

ECAL successfully tested with cosmic rays on all 16 channels.

ECAL is now being readout by the same system that we use for reading out HCAL prototypes.

We will do ECAL + HCAL test in the future.