

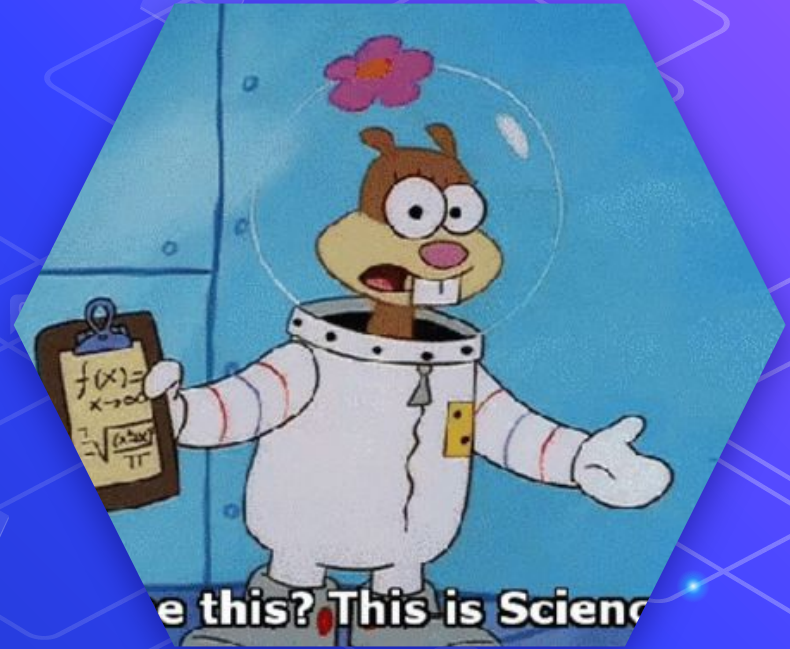
California EIC Consortium Collaboration



Hello!

Here's a quick introduction:

We will be going over MIP data analysis and what we do to contribute to the lab with these findings to assist with the EIC.



The Electron-Ion Collider

at Brookhaven

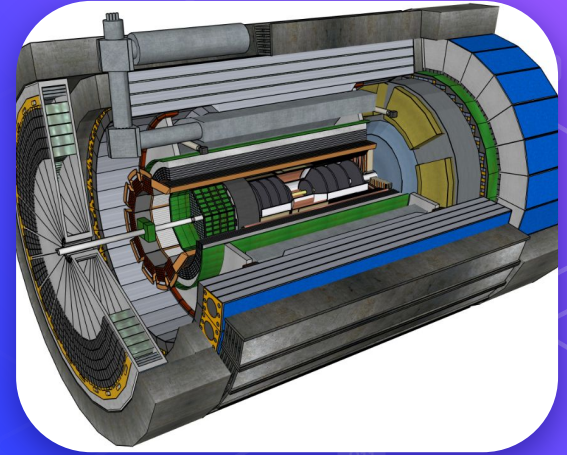
National Laboratory. ;)

This uses electrons to image
quarks & gluons, this helps take
tomographic 3D pics of the
nucleus



Where MIP detection occurs:

- ePIC detector at EIC with Few Degree Calorimeter inserts (FDC)
- Inside these are printed circuit board with SiPMs for SiPM-on-tile calorimeter insert prototype for the Electron-Ion Collider. Hexagon pattern flower PCB design.



What does the SiPM do ?

- These little guys measure the energy that is released from the different cosmic rays that pass through each channel
- Every cosmic ray deposits 1 Mip (which is a unit of energy)

We use a cool python software called janus to conduct data analysis of these energy deposits

What's a MiP ?

- A MiP is Minimum Ionizing Particle.
- deposits the least amount of ionization energy per unit length, which is important because they help w/ the processing of removing electrons.



More about MiPs

- The specific pattern of energy lost can help determine what type of particle had passed through the detector.
- Mips can be used to differentiate between particles (quark vs. muon)

Understanding how a detector responds to known particles like MiPs is essential for interpreting the signals produced by other particles of interest.

Okay but How does MIPs help?

MIPs helps set a standard for calibrating particle detectors. This calibration is crucial for accurately measuring the energy of other particles passing through the detector.



Steps of how data analysis is conducted for MiPs

Procedure:

After the data has been collected we run this data through the software janus and convert the file in python. After the data is saved you take another sample of “noise” or pTrig data to help filter out any background data that

Isn't relevant to our data. You set the data in a best fit curve to a landau curve. The reason for doing this is to help understand the characteristics of the signals, for a better understanding of the MiP distribution.

Break down of steps

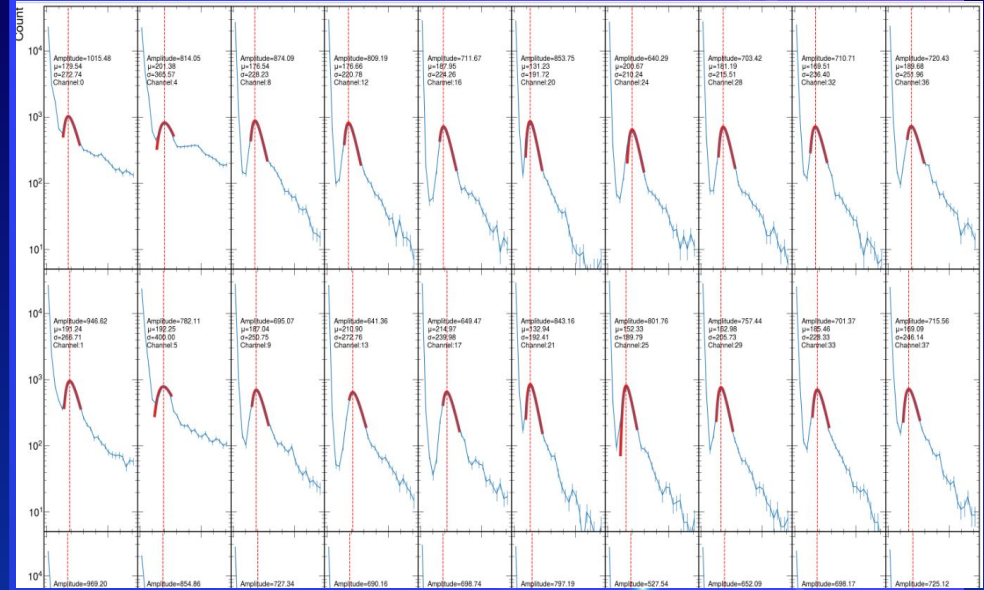
1. Subtracting the $(\text{PedestalMean})+4\sigma$ from the cosmic data, hence subtracting out the noise.
2. Only selecting events in which cells directly in front and behind the cell in analysis are activated.
3. Plotting the remaining data in a histogram and fitting to a landau to find. The mean value of the landau is the MIP value.

MiP Landau Curves

Here are the energy deposits for 62 different channels that show the landau curves

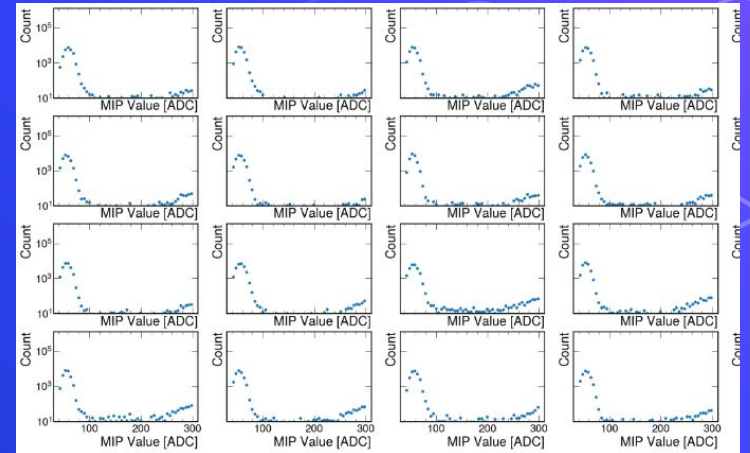
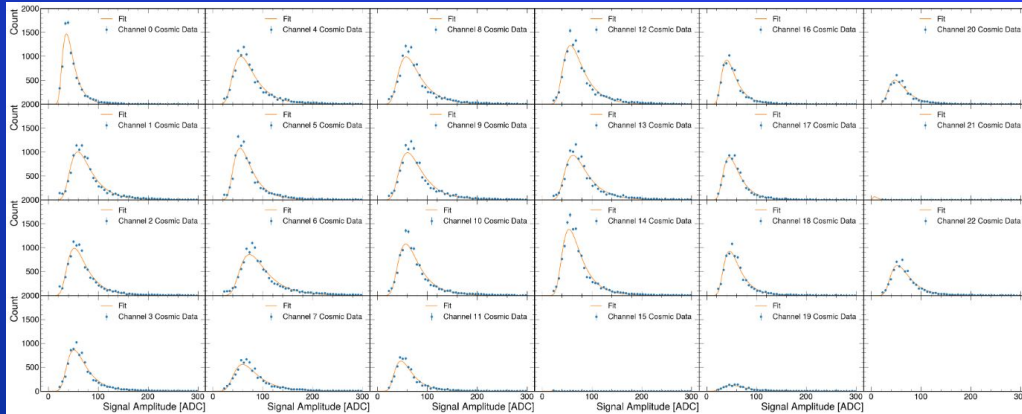
We want to be able understanding how MiPs interact with the detector material

The red lines are the fitted landau distributions



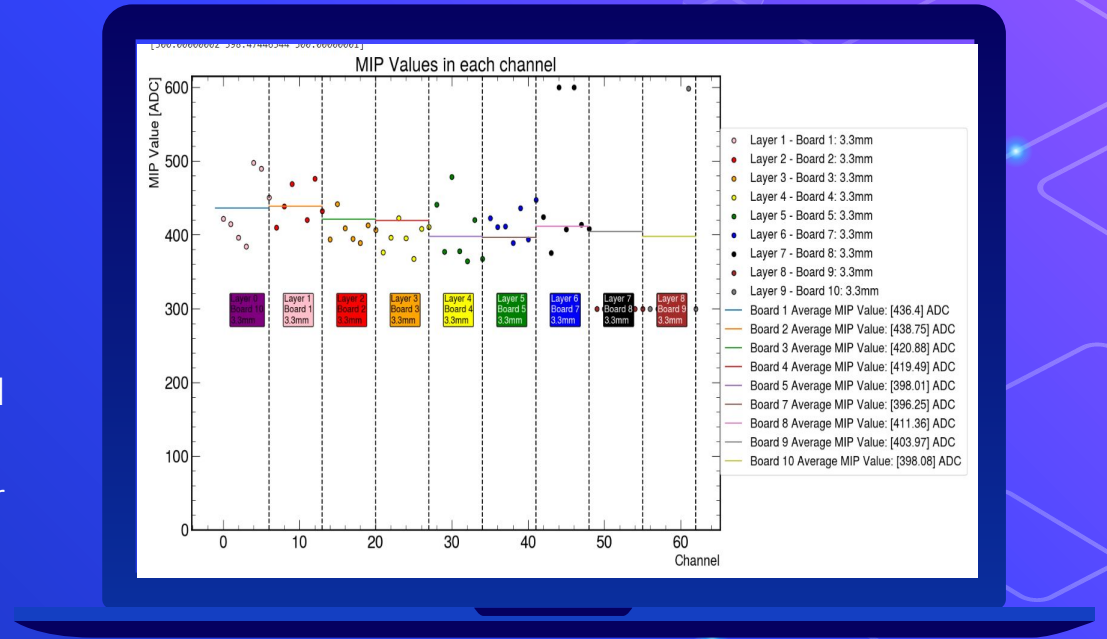
Cosmic ray Data (woot woot!)

Here's a few images of what cosmic data should look like



Scatter Plot of MIP Values

This processes MIP values from different channels, calculates the average MIP value for each board, and then visualizes the distribution and averages of MIP values using a scatter plot with annotations and averages displayed.



Below is a link to
the simulation of
what the detector is
supposed to do:
[EIC simulation](#)

EIC

Closing remarks ! (and any questions!)

MiP calibration is key to providing a better standard for particle detectors when measuring energies of different particles that pass through.

- Provided from Arratia lab
- Images & more info can be found at arratialab.ucr.edu

