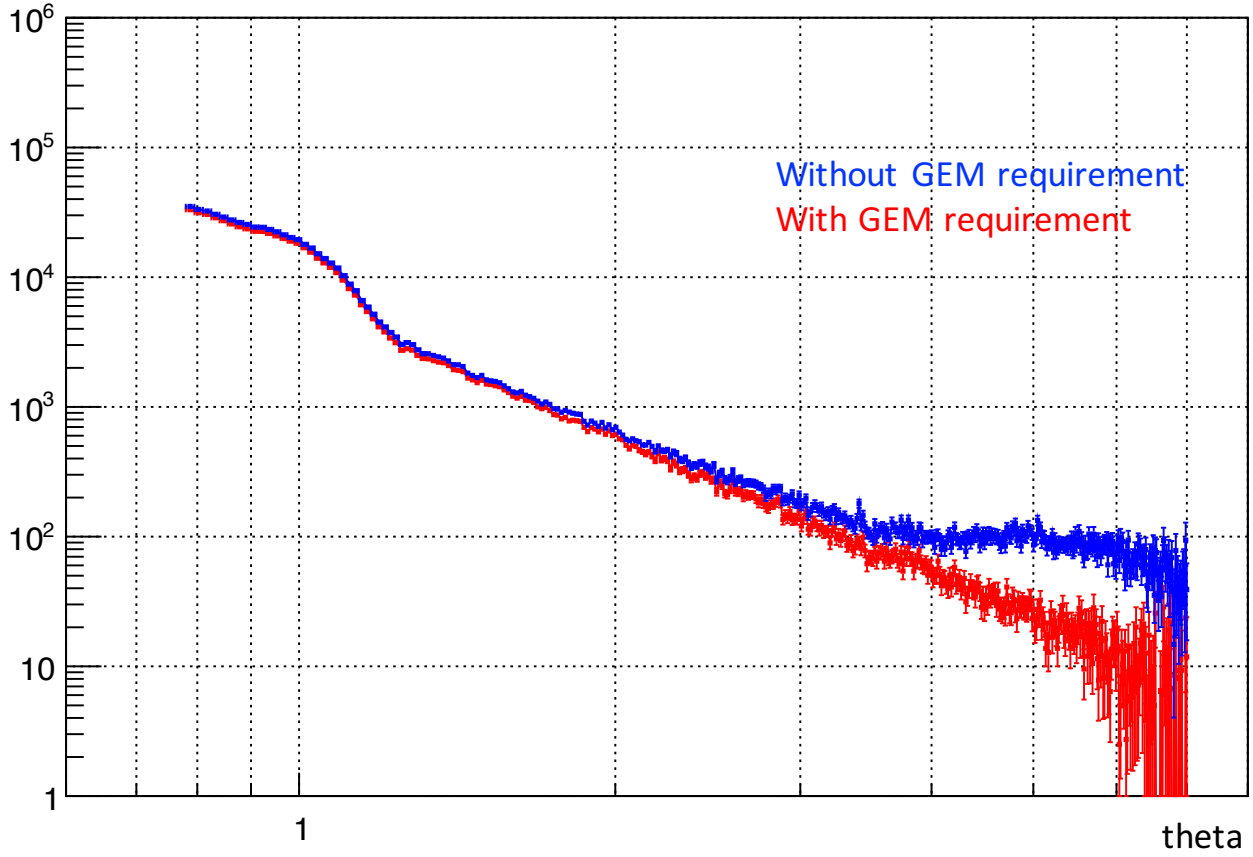
The ep yield vs. scattering angle theta for background runs

Graph

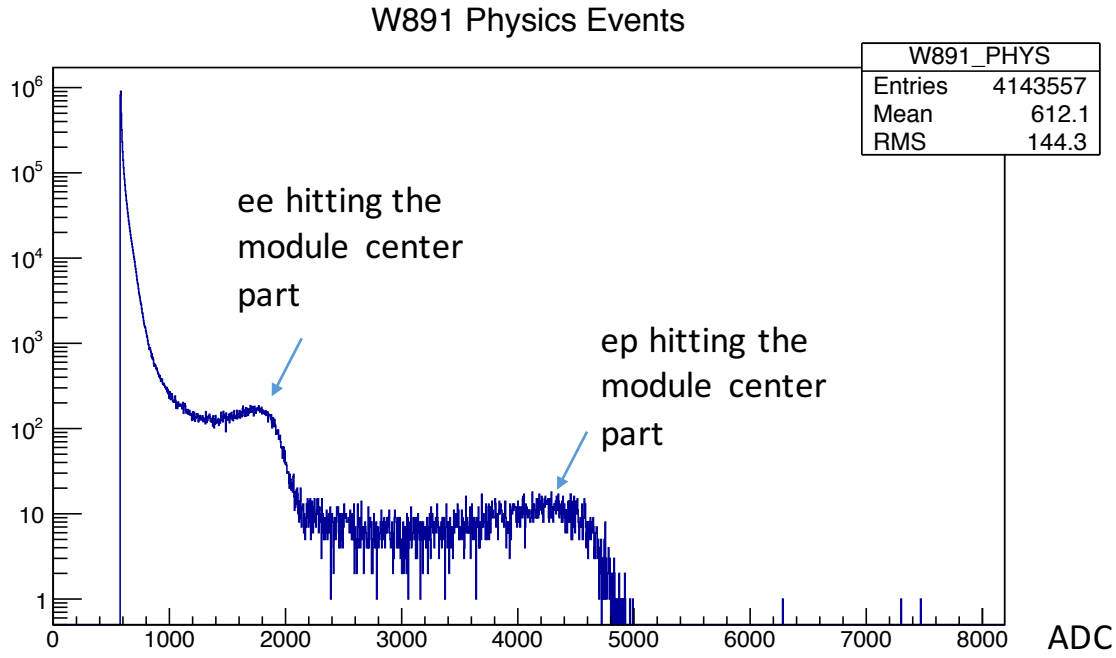


Progress Update

- For this week, I carefully checked a few issues with HyCal
  - Problem with the module W891
  - Problem with overflow channels
  - Problem with discharge channels
  - And a few channels seems have much less counts compared to the neighboring channels

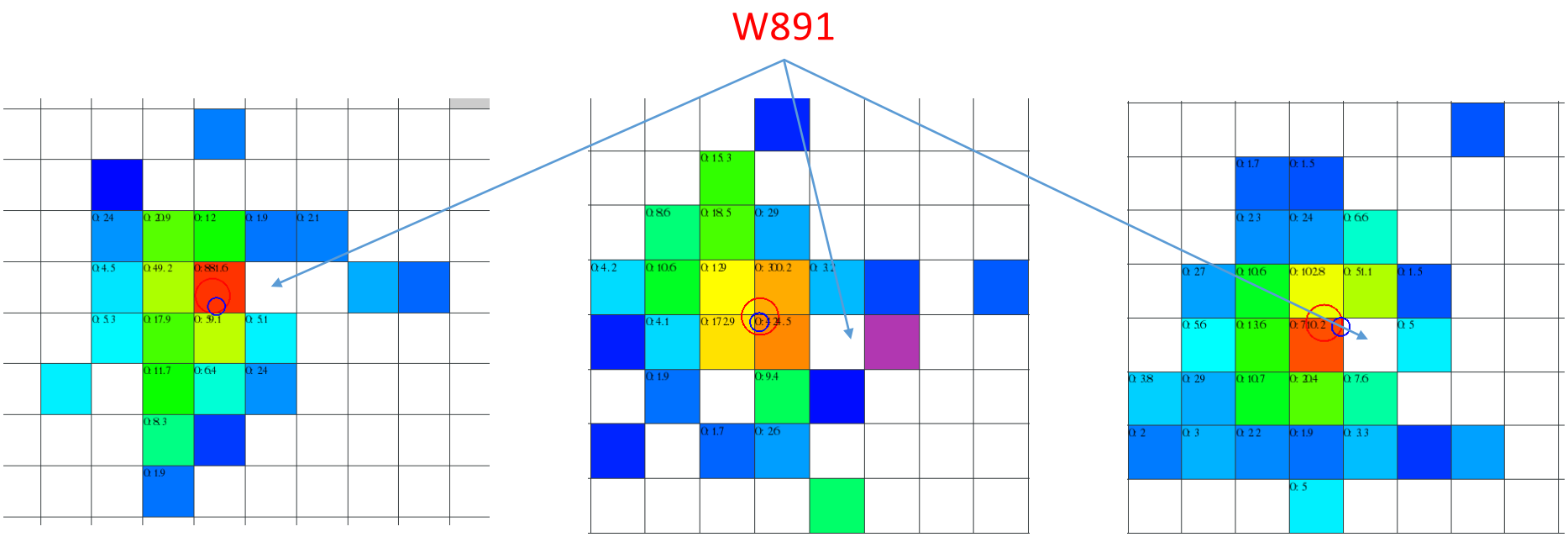
Problem with W891

- We always thought that W891 has a dead dynode (cannot trigger), because it signal looks perfectly fine, but never has a maximum of ee or ep cluster



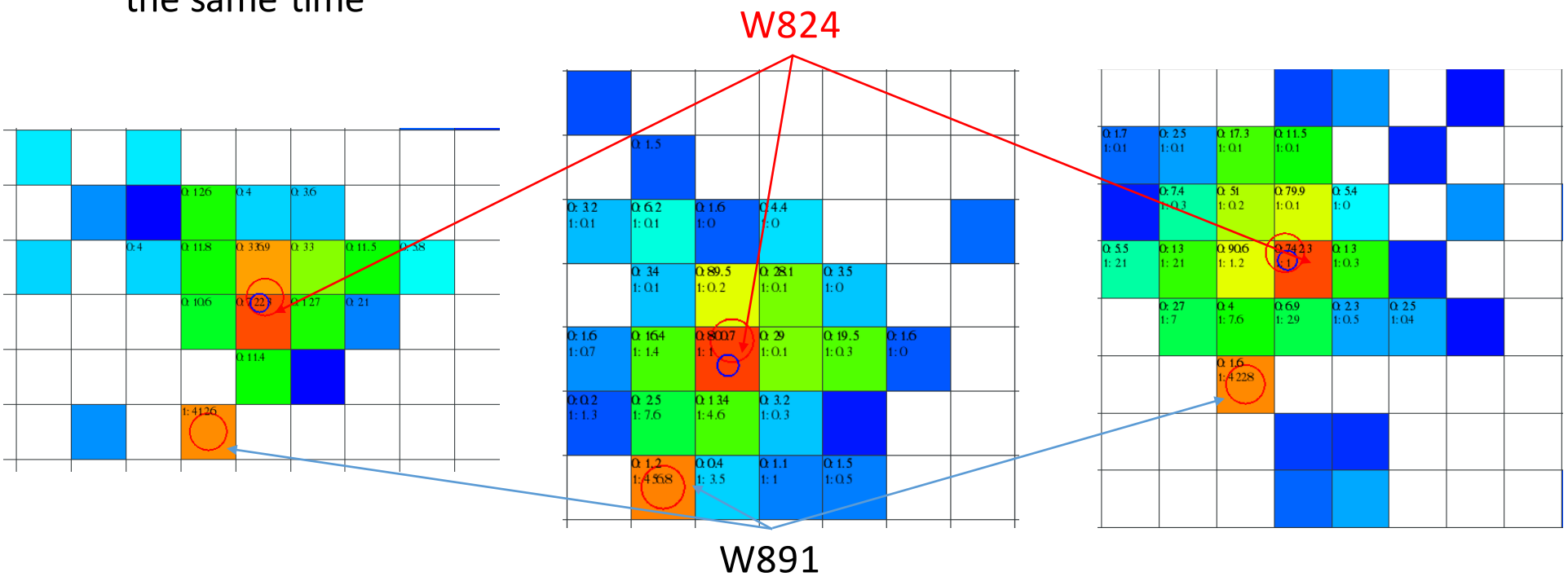
Problem with W891

- However, when checking the clusters on event display, this module never has a strong signal if the particle is hitting the neighboring modules



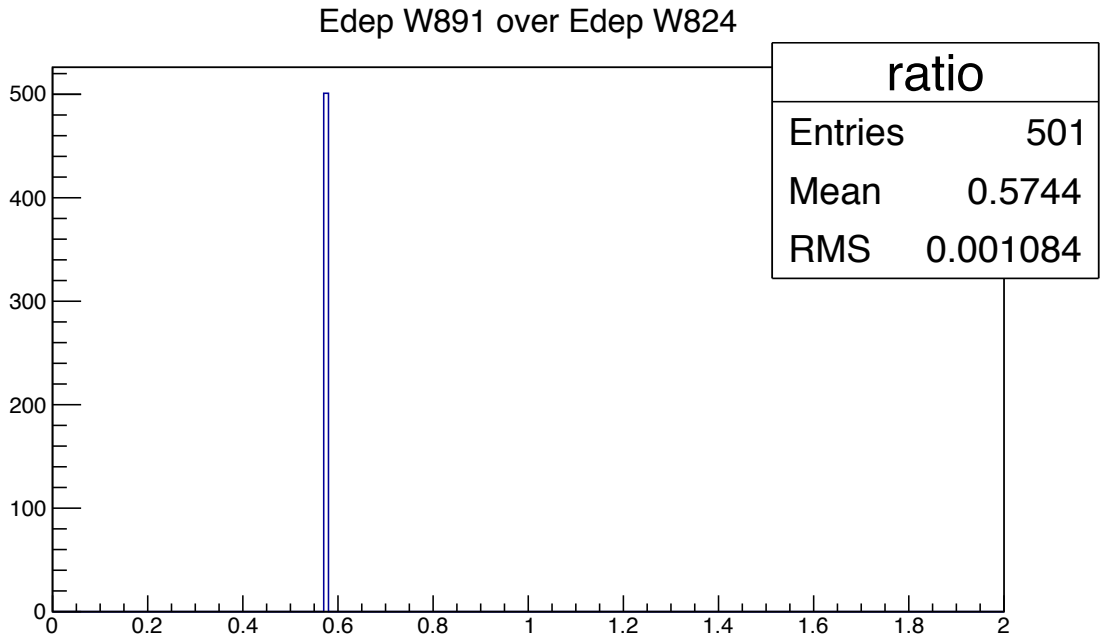
Problem with W891

- This is not because the calibration constant of W891 is too small
- When particle is hitting W824, we do see strong signal on W891
- And it turn out that this is always the case, when W824 has a signal, W891 has at the same time



Problem with W891

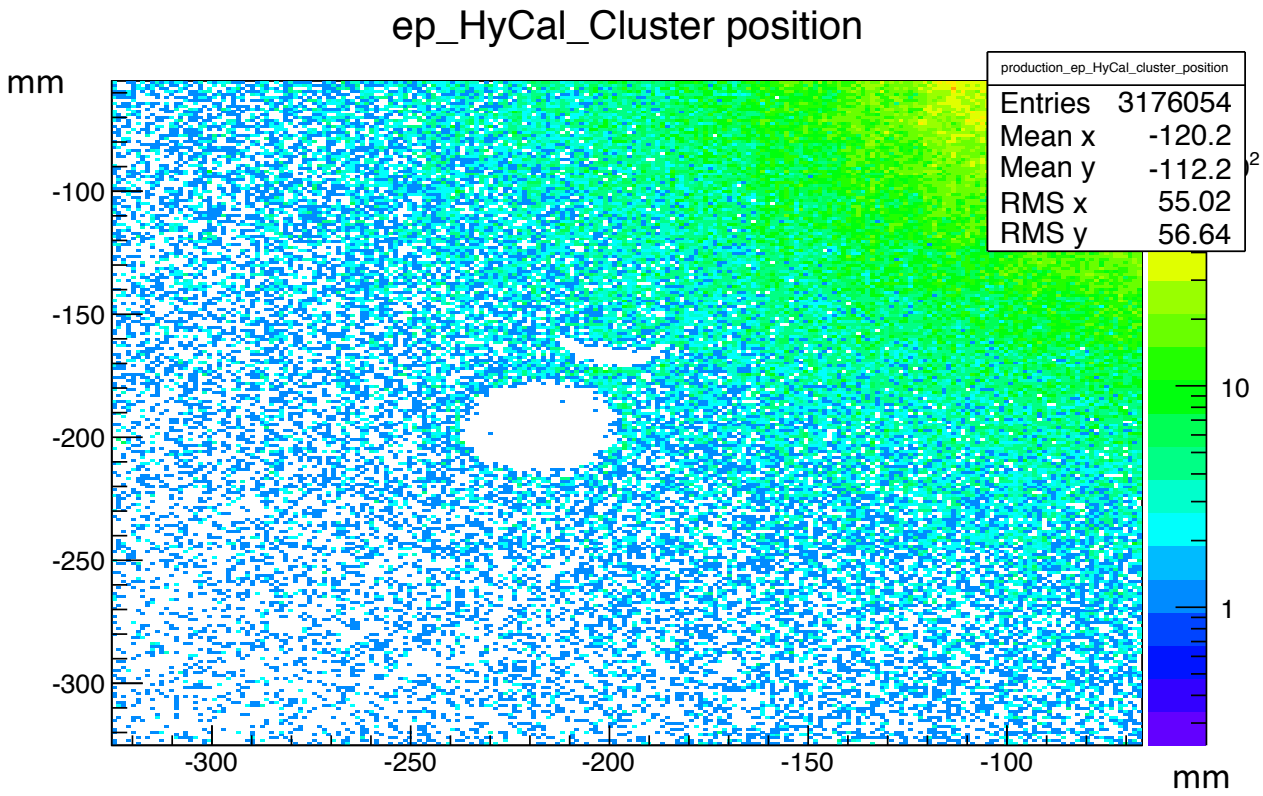
- For each event, if the energy on W824 is > 100 MeV, fill the ratio of (E W891) / (E W824) into a histogram, without clustering



(calib constant of W891) / (calib constant of W824) = 0.12971 / 0.22689 = 0.5717

The ADC of these two channels are almost identical all the time

Problem with W891

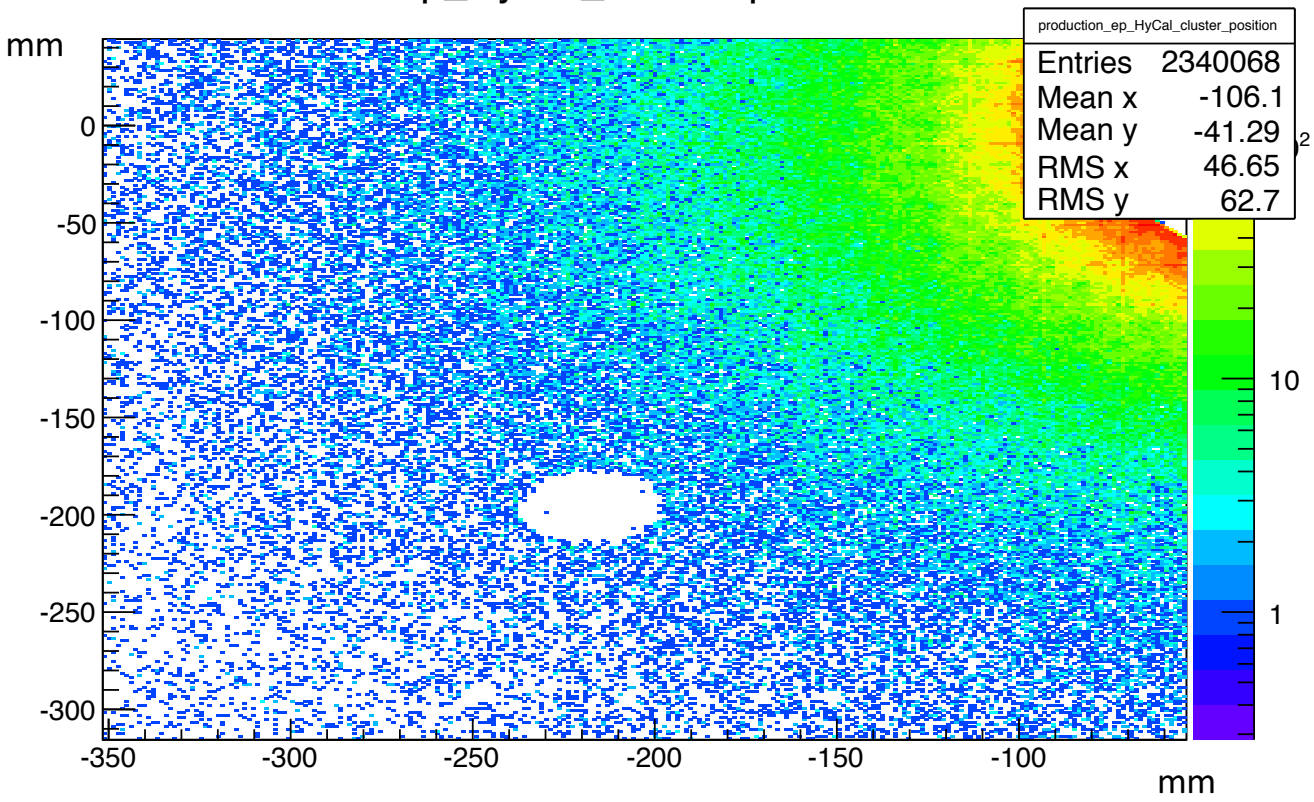


The strange signal on W891 will result in a cluster splitting, when a particle is hitting the module W824, thus distort the reconstructed position on W824

Problem with W891

If set the calib constant of W891 to 0

ep_HyCal_Cluster position



Problem with Overflow

- The maximum valid ADC output above pedestal threshold for HyCal is 8192
- If an ADC overflow occurs, then the output will become 16383, not continuous
- If a module of a ep cluster has problem with overflow, then this cluster will most like be cut away by energy cut
- Overflow mostly happens for channel discharge, or cosmic that has generated a huge shower
- But there are around 10 channels that has potential problem with physics overflow

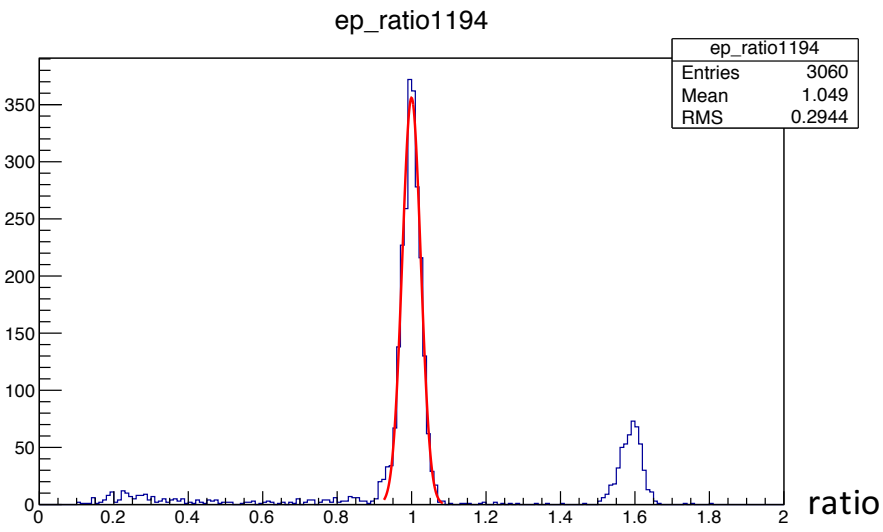
Problem with Overflow (1.1GeV)

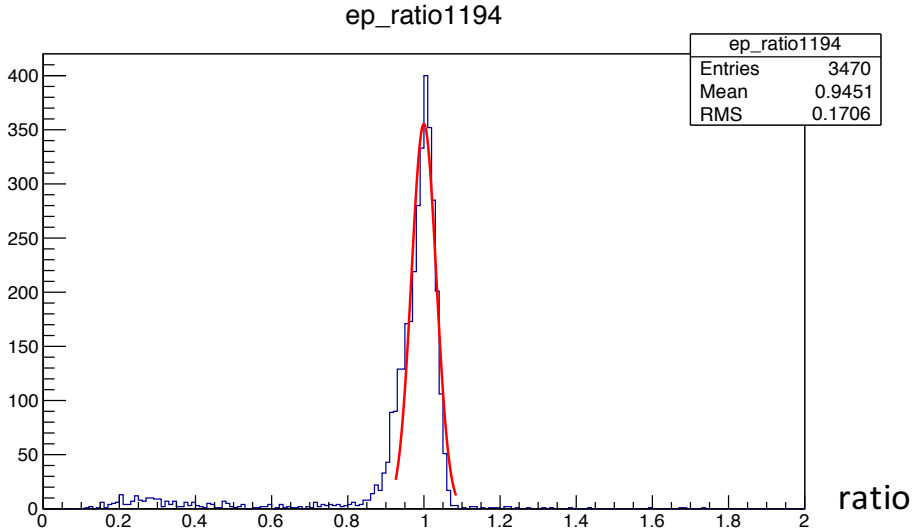
- A channel is like has physics overflow when the maximum allow energy is close to 1100 x 0.8 + (27 x 3) = 961 MeV (for 1.1 GeV data)
  - Maximum allow energy is calibration constant x 8192
  - 1100 is beam energy (or approx ep energy)
  - When a particle hitting the module center it deposite ~80% of its energy
  - 27 MeV is the HyCal resolution

Channel	Max E allowed	Channel	Max E allowed
W194	782 MeV	W885	909 MeV
W526	742 MeV	W927	962 MeV
W527	766 MeV	W958	967 MeV
W646	923 MeV	W969	775 MeV
W728	921 MeV	W1116	871 MeV

Problem with Overflow (1.1GeV)

Ratio of (E recon) / (E expected) for ep clusters





In order not to lose the overflowed physics events, we can either

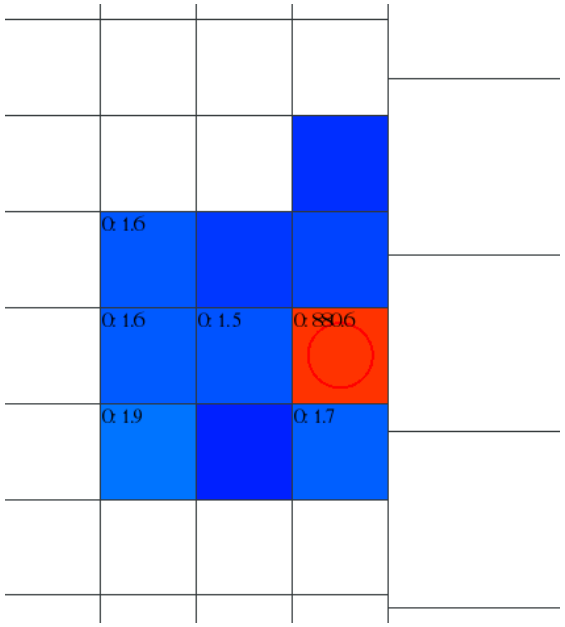
- Don't put a hard cap on the maximum allowed ADC, but look for the right place when overflow is detected
- Put a hard cap to be 8192, in that case, overflow clusters will have slightly lower energy

Problem with Discharge

- Discharge happens quite over among HyCal channels, many channels has more discharge counts than ep counts
- Most of the discharge events can be removed by requiring HyCal cluster size > 1 module
- But there are exceptions

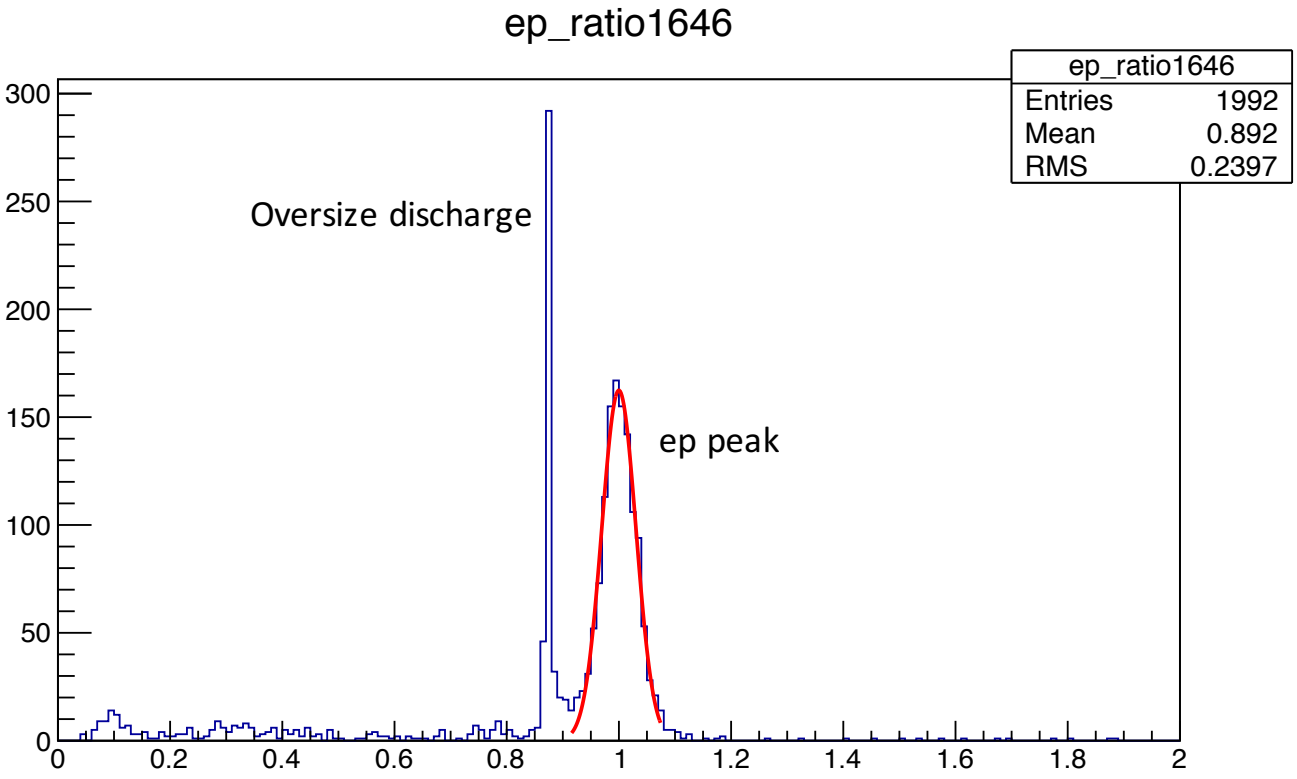
- Sometimes a discharge channel can produce small signal on surrounding channels, thus the cluster size cut might not work

- Eventually, discharge can be removed by matching with GEM, but they may affect the GEM efficiency calculation



Problem with Discharge

Ratio of (E recon) / (E expected) for ep clusters
When setting maximum ADC cap at 8192



A few Channel has very low ep counts