BCAL GAIN CALIBRATION UPDATE

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Gluex Collaboration Meeting 5/12/15

Run Conditions

	R2931	R3079	R3178	R3180	R3182	R3185
Solenoid	800A	1200A	1300A	1300A	1300A	1300A
Events	74.6M	25.9M	14.6M	41.2M	29.3M	19.9M
Mode	7	8	7	7	8	7
Beam current	100 nA	45 nA	70 nA	70 nA	70 nA	12 nA
Radiator	J1A50	1*10^-4	1*10^-4	1*10^-4	1*10^-4	J1A50

Gain calibration

- Using pi0 width minimization technique presented in Jones et al., NIMA566 (2006) 366.
- Pi0 statistics from Fall and Spring data taking:

Cluster energy threshold	Fall pi0 events	Spring pi0 events B-field on	Spring pi0 events all fields
350 MeV	469,000	853,000	1,342,000
550 MeV	161,000	237,000	397,000
750 MeV	62,000	78,000	132,000
950 MeV	25,000	26,000	44,000

Expected Resolution

http://argus.phys.uregina.ca/cgi-bin/private/DocDB/ShowDocument?docid=985

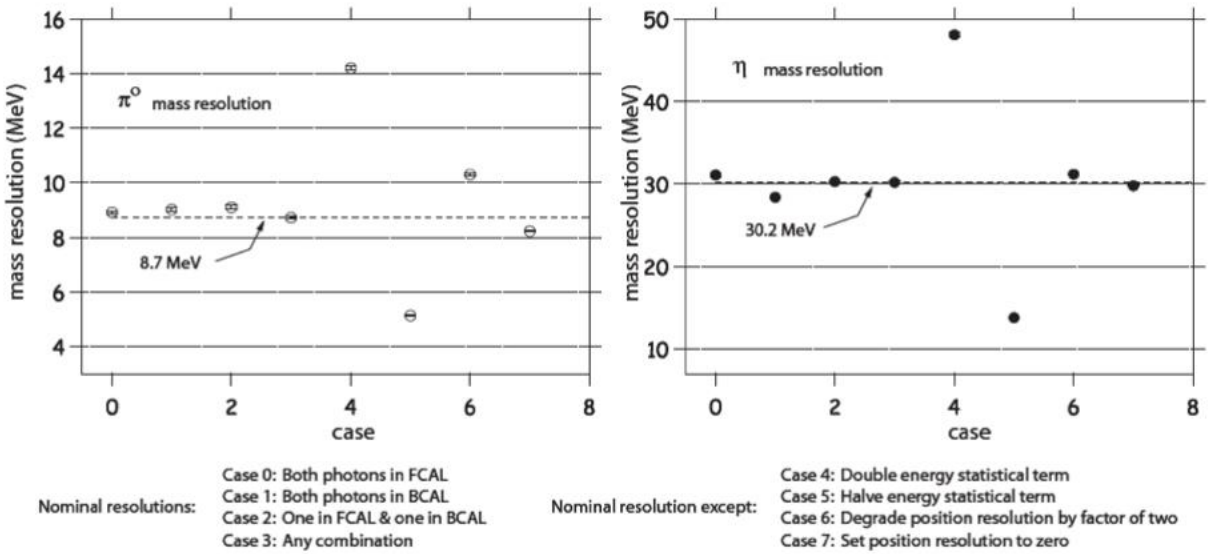
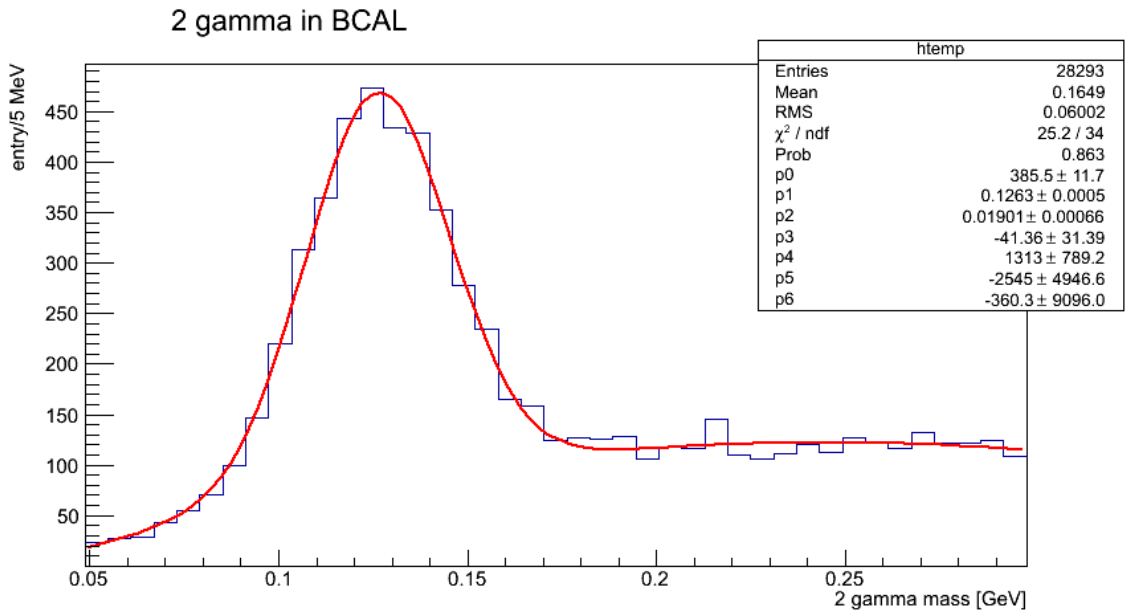


Figure 1.10: The π^0 and η mass resolutions obtained under different assumptions for energy and position resolutions in FCAL and BCAL.

- Excerpt from 2008 Calorimeter Final Design and Safety Review
- Expecting an 8.7 MeV pi0 width

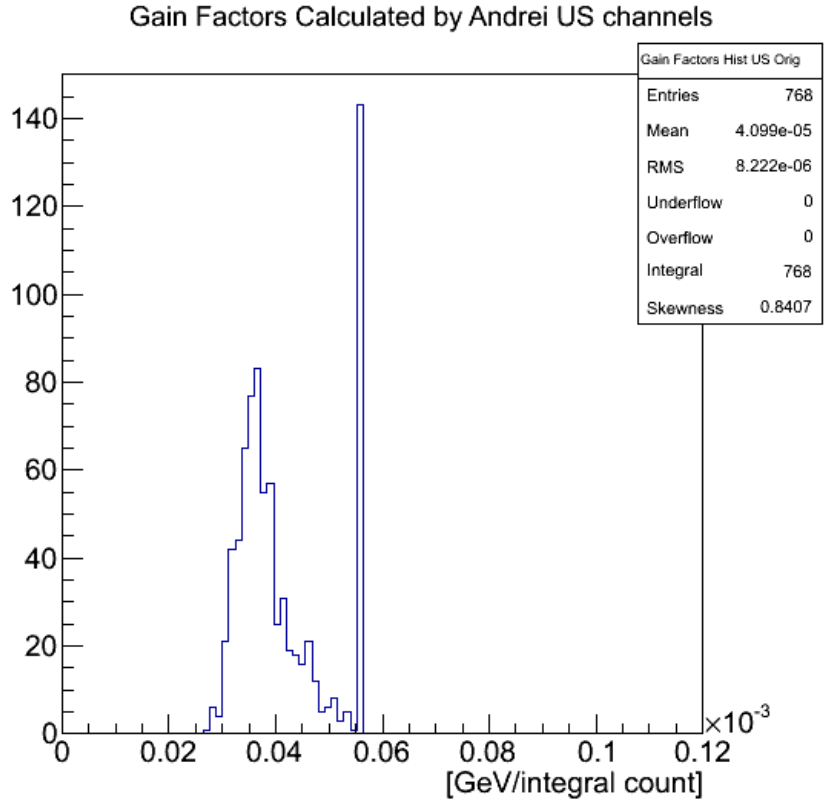
Before using pi0 events to calibrate

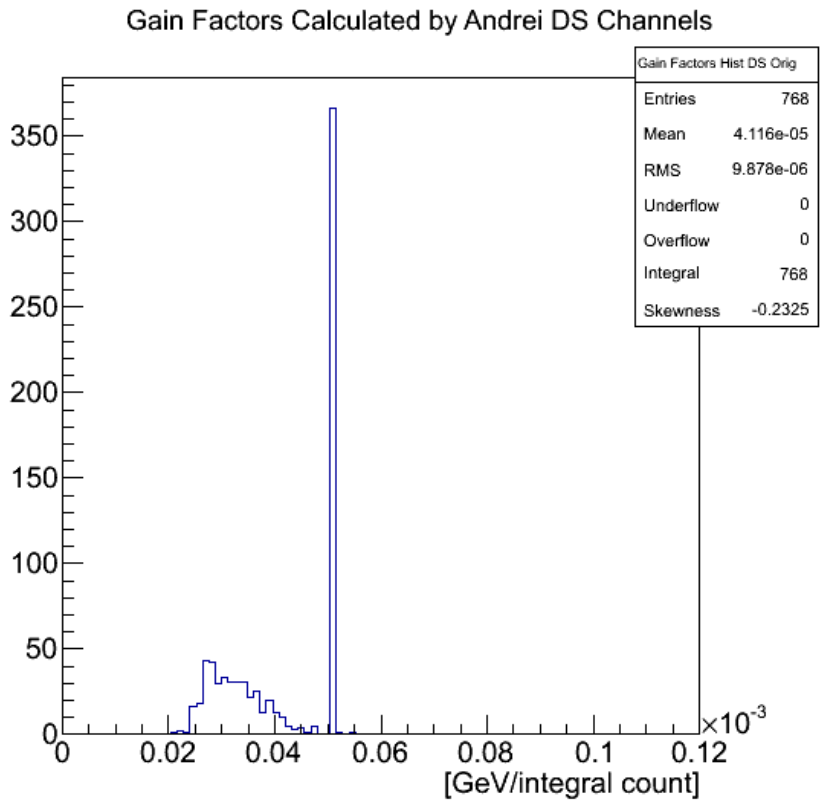
- Andrei used through going cosmics to put us near the pi0 mass.
- BCAL cluster energy > 750 MeV
- 62cm < vertex.Z < 68cm



- Mean = 126 MeV
- Width = 19 MeV

Gain factors obtained from cosmic data

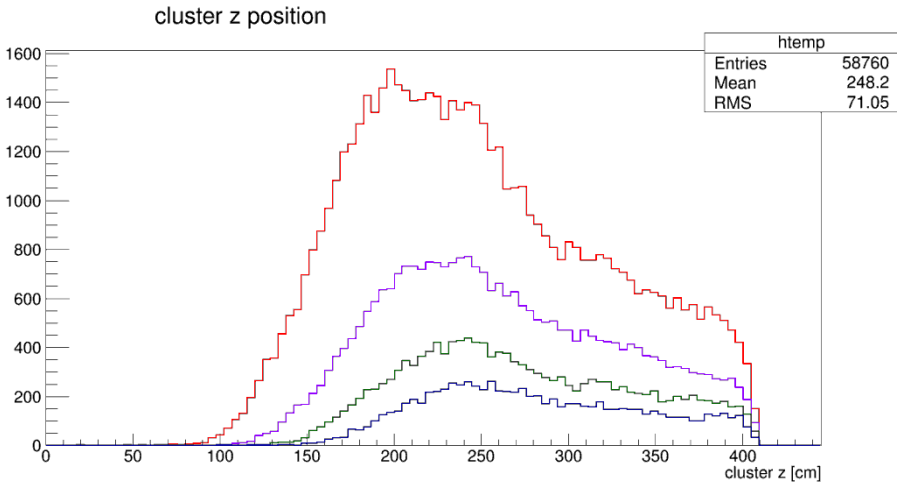




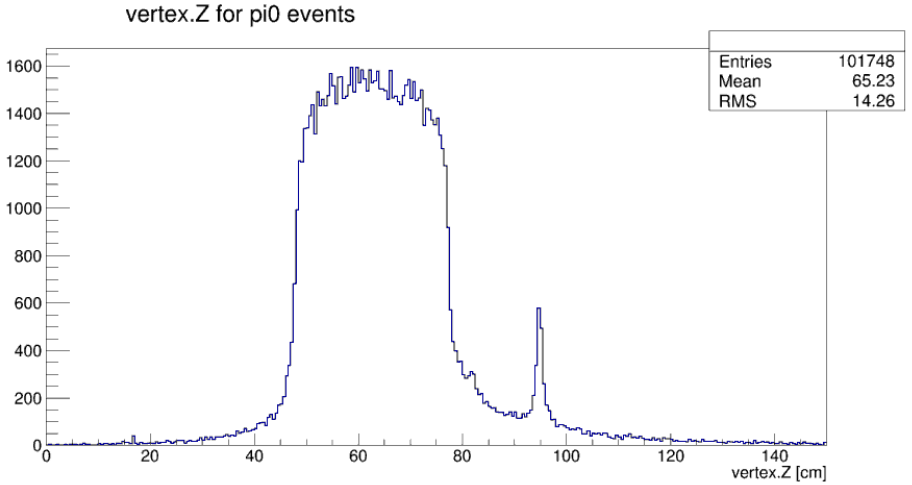
- Single-binned gain factors are an artifact of low statistics in those channels

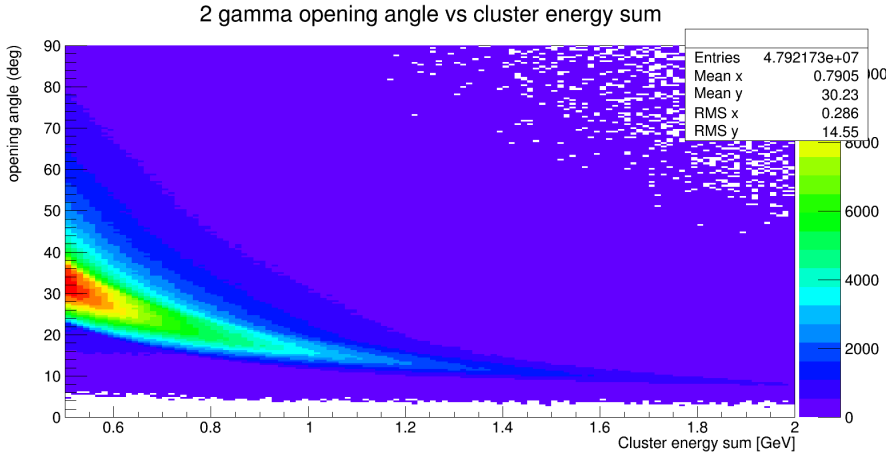
Pi0 Reconstruction

- Spring data
- First look at pi0 data is as expected

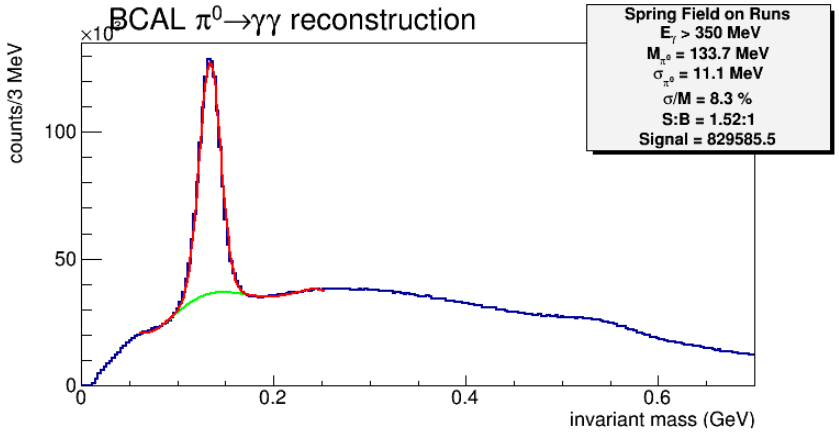


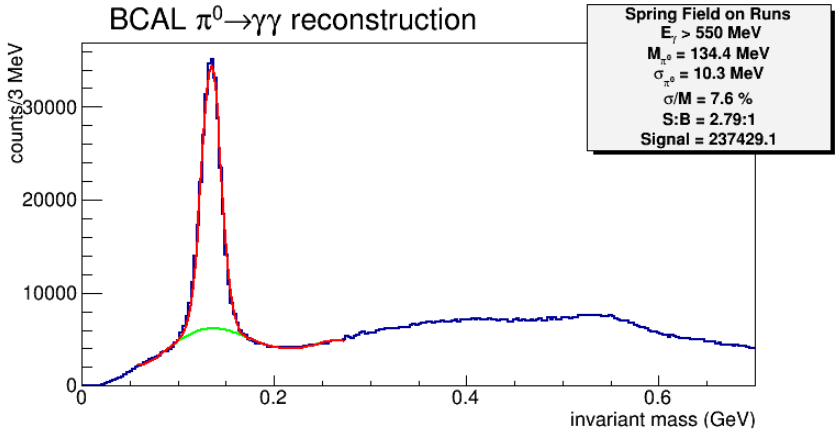
- Red: 500 MeV < E < 600 MeV
- Purple: 600 MeV < E < 700 MeV
- Green: 700 MeV < E < 800 MeV
- Blue: 800 MeV < E < 900 MeV

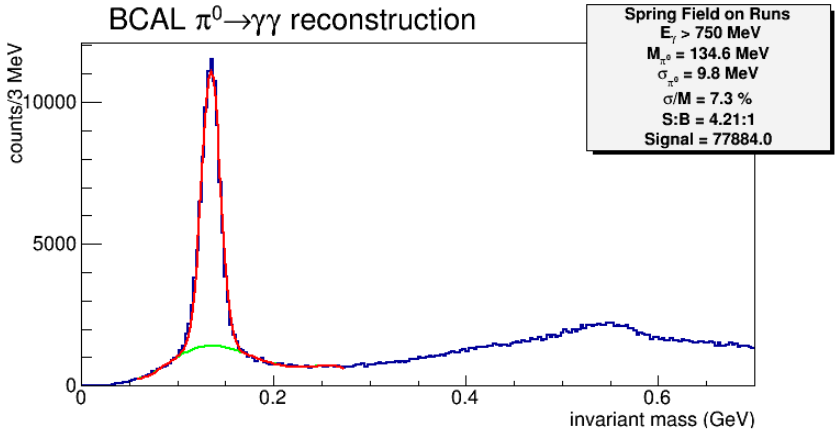


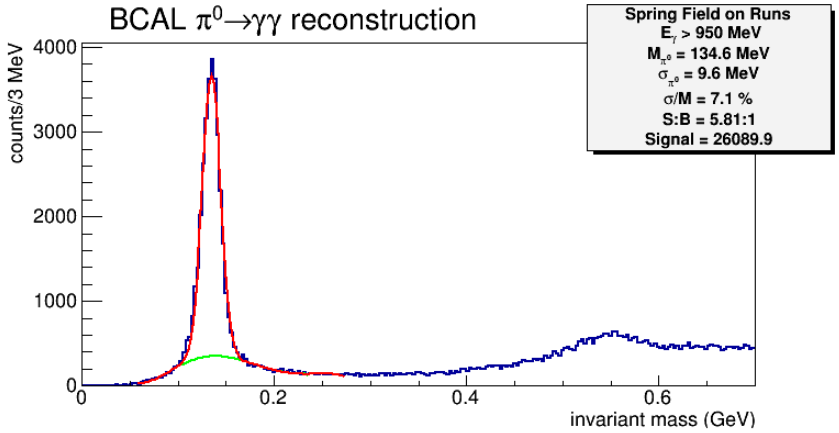


After a few calibration iterations



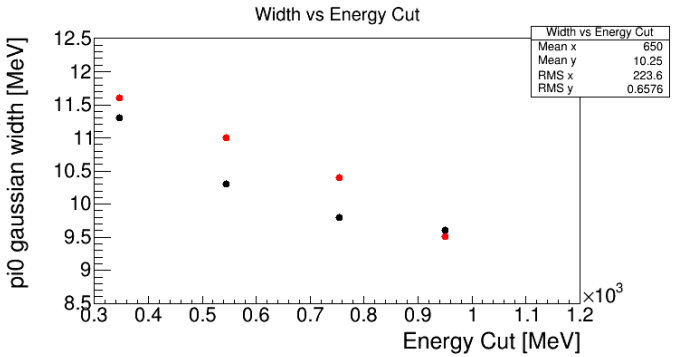


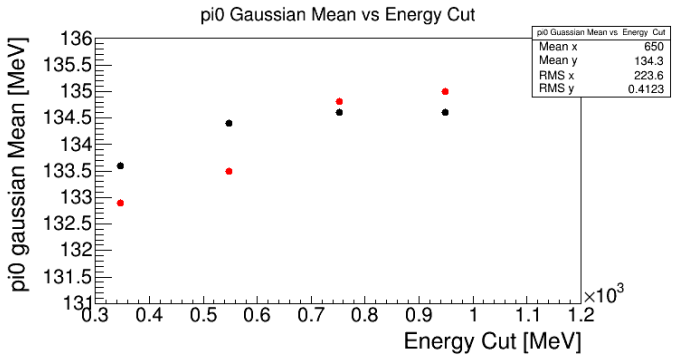


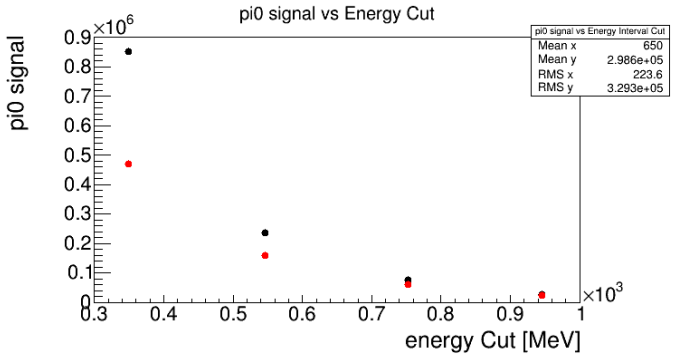


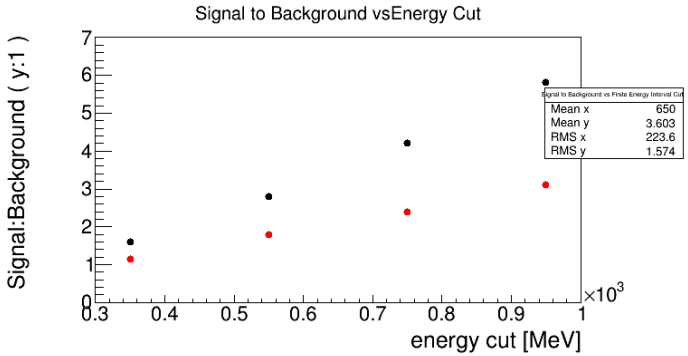
- Gaus+pol5 fit

Summary Info



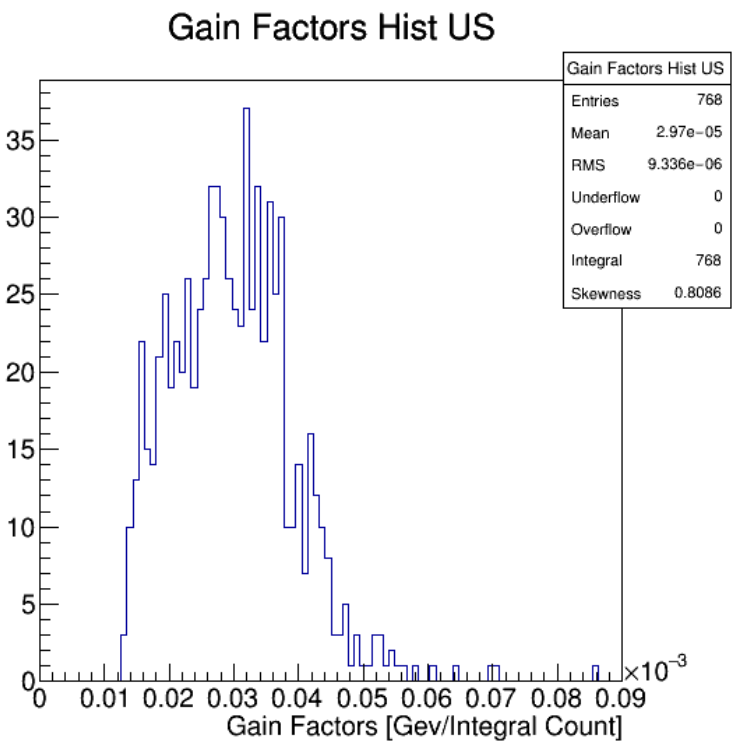


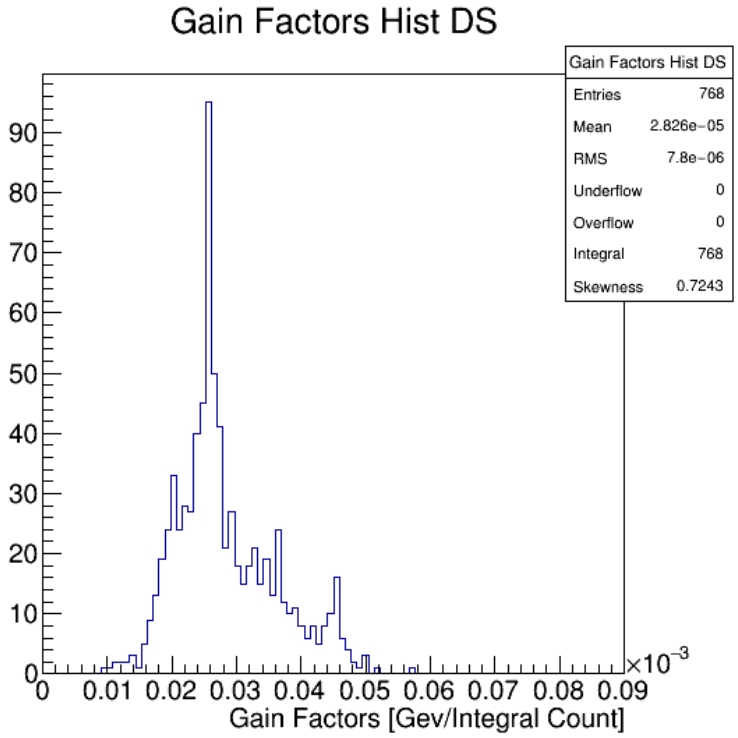




- Black points – Spring
- Red points – Fall
- Spring data set has lower width at lower energy
- Spring data has more stable mean value
- Spring data has a higher S:N
- Pi0 events is comparable at higher energy

Gain factors after iterations

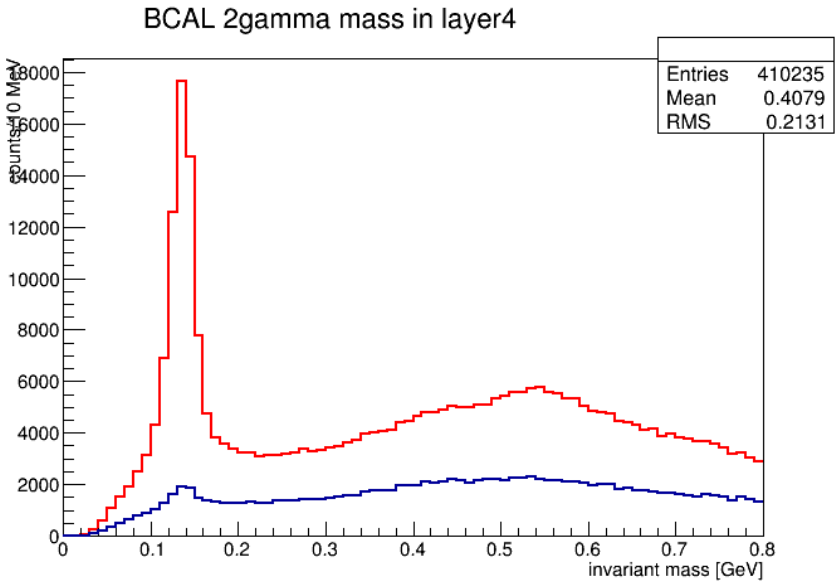




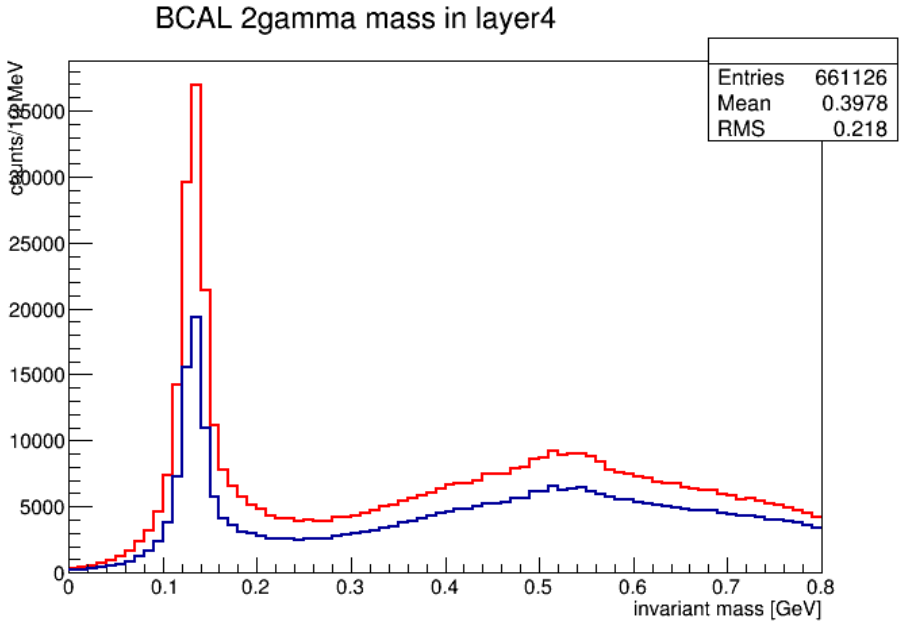
- Still has a large dynamic range
- Most of the single-valued gains have spread out

Pi0 signal in layer 4

- Red: All layers
- Blue: Require at least 1 photon from either of the 2 clusters to deposit energy in layer 4

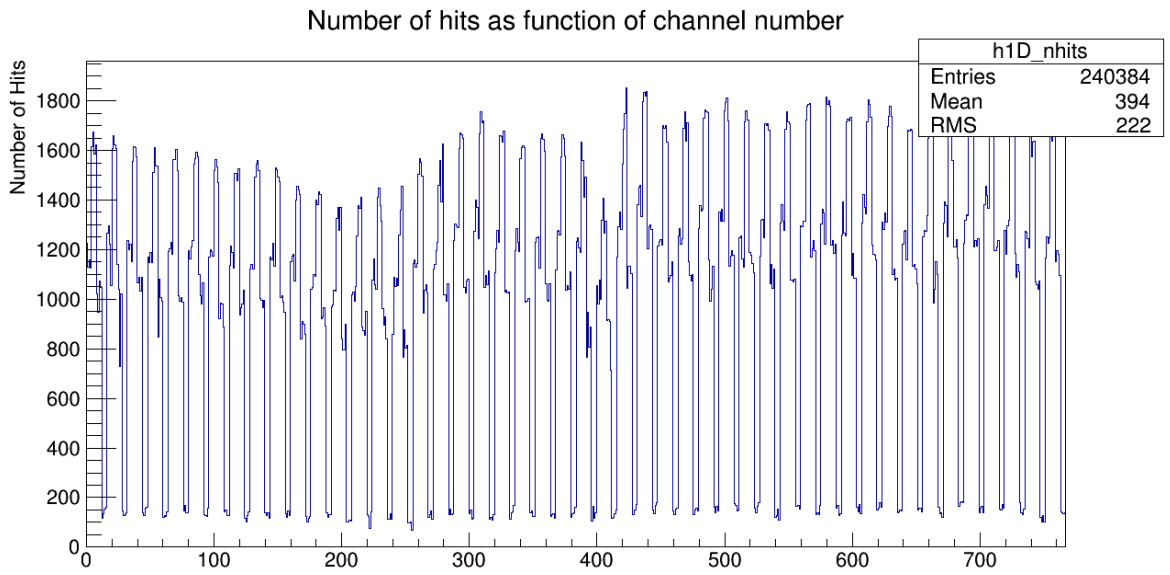


- Subset of Fall data
- E>700 MeV



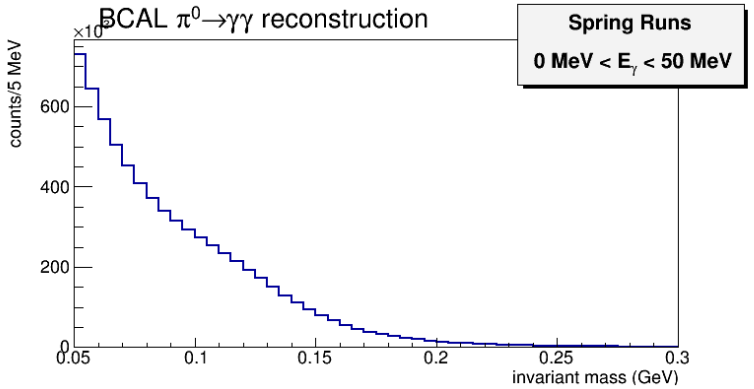
- Spring data set
- E>700 MeV

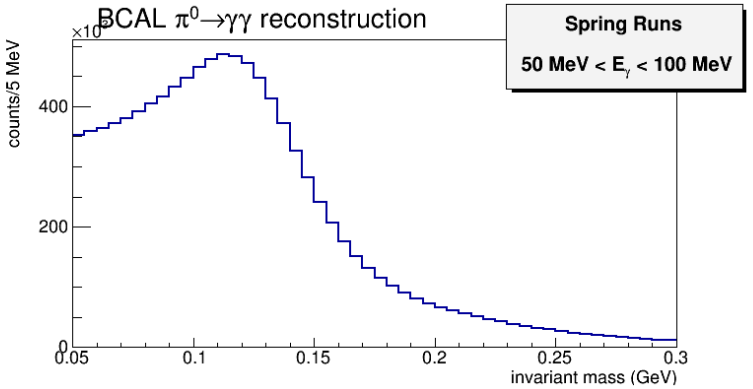
Hits per Channel

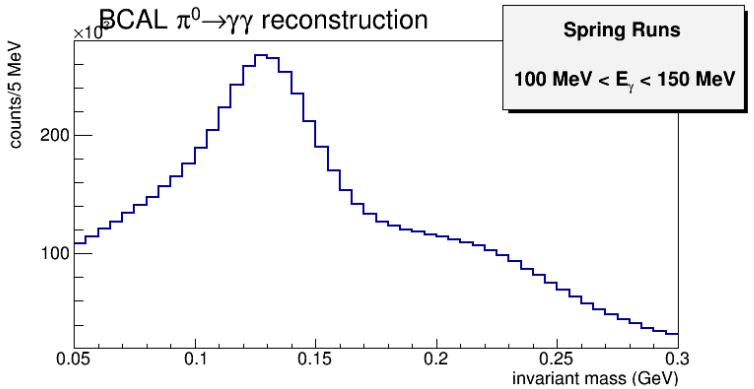


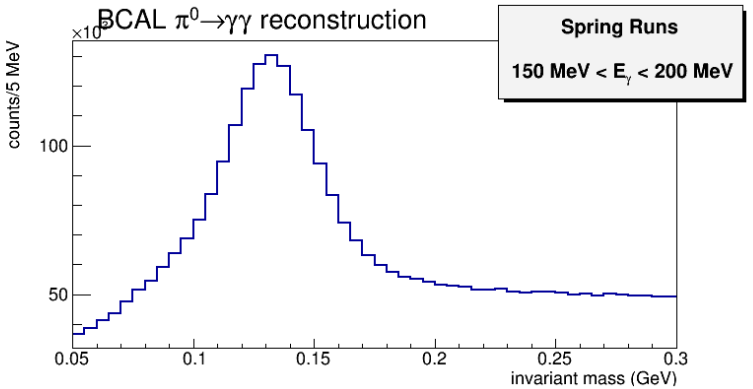
- Numbering scheme goes as module/layer/sector (channels with < 200 hits are all layer 4)
- Spring data
- Even though we see pi0s in layer 4 in the Spring running we don't have enough layer 4 hits to do a calibration

Low energy invariant mass





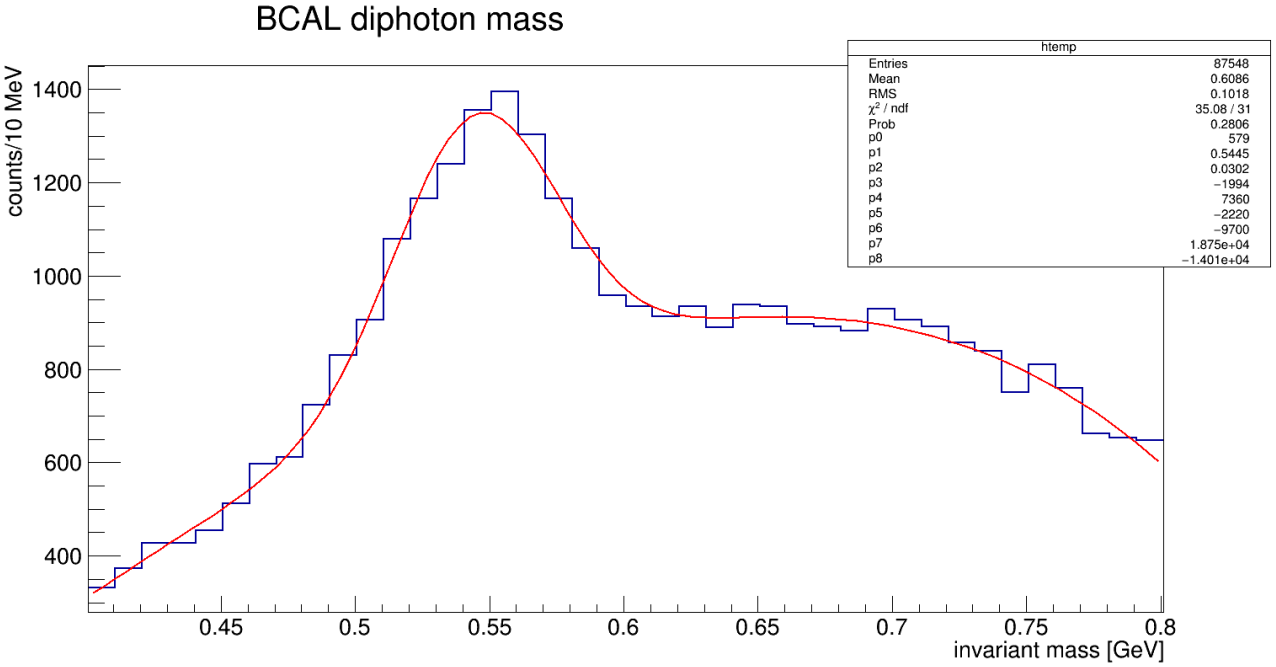




- We are able to detect pi0 signals with a 100 MeV cluster energy threshold

Glimpse at eta bump

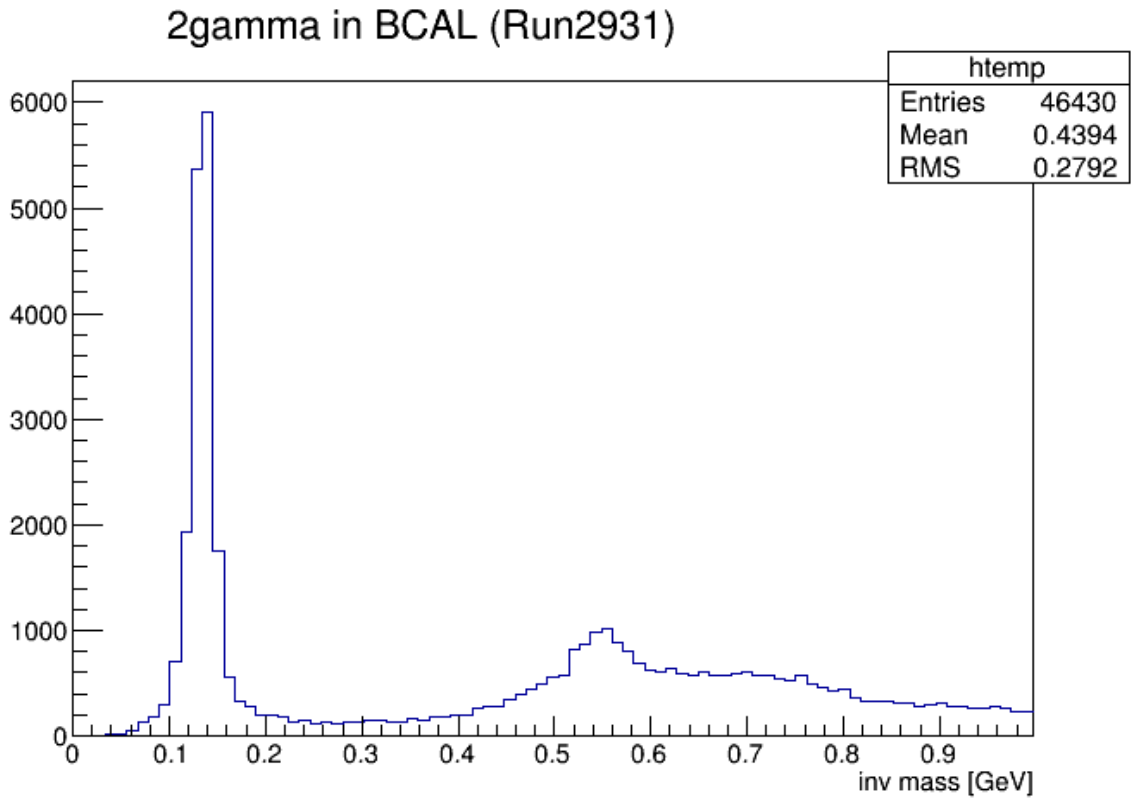
- Resolution is good enough now to start to see a bump at the eta mass
- Cluster energy > 950 MeV
- BCAL clusters reconstructed in each event < 6



mean = 545 MeV
width = 30.2 MeV

Bcal diphoton invariant mass spectra up to 1 GeV

- Cluster energy > 950 MeV
- BCAL clusters in each event < 6



Future Plans

- Continue analyzing Spring data
- Use field off data to calibrate
- Study resolution dependence on energy and position
- Revisit cosmics for a calibration, especially for layer 4