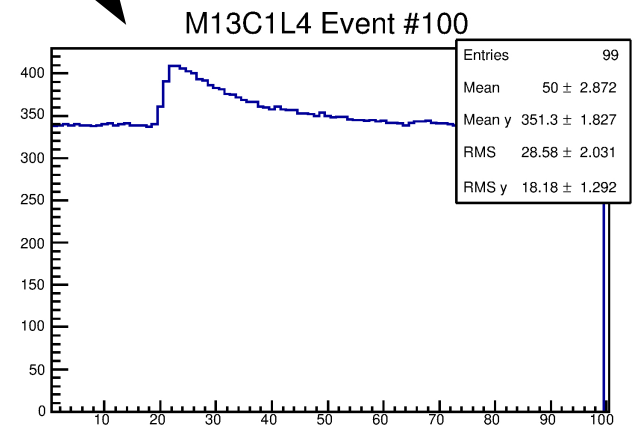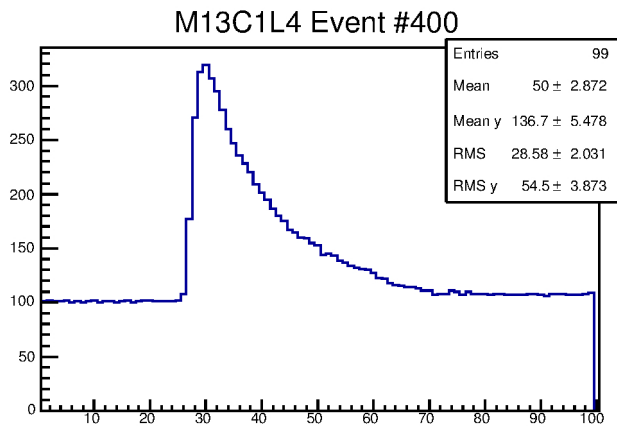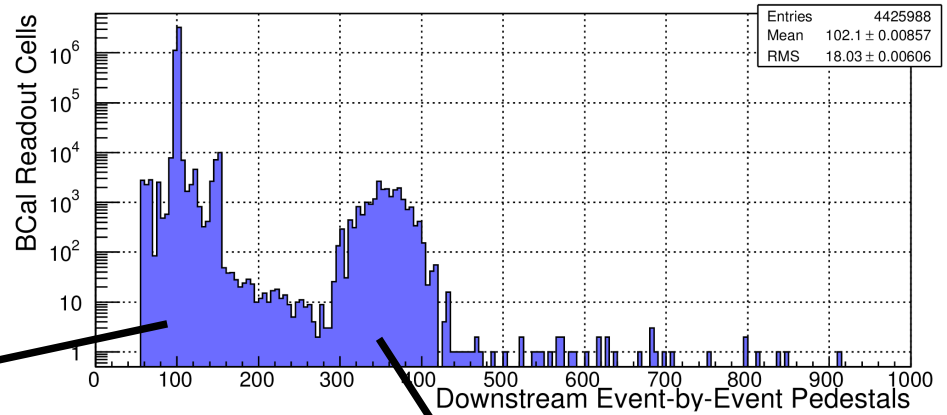# Calibration of BCAL with Cosmic Data

Andrei Semenov, Irina Semenova
(University of Regina)

December 03, 2014

Pedestals in Cosmic Runs:

Downstream Event-by-Event Pedestals Over 120

Entries	47074
Mean x	19.06 ± 0.06356
Mean y	1.946 ± 0.004421
RMS x	13.79 ± 0.04494
RMS y	0.9592 ± 0.003126

Entries	4425988
Mean	102.1 ± 0.00857
RMS	18.03 ± 0.00606

M13C1L4 Event #400

Entries	99
Mean	50 ± 2.872
Mean y	136.7 ± 5.478
RMS	28.58 ± 2.031
RMS y	54.5 ± 3.873

M13C1L4 Event #100

| Entries	99
Mean	50 ± 2.872
Mean y	351.3 ± 1.827
RMS	28.58 ± 2.031
RMS y	18.18 ± 1.292
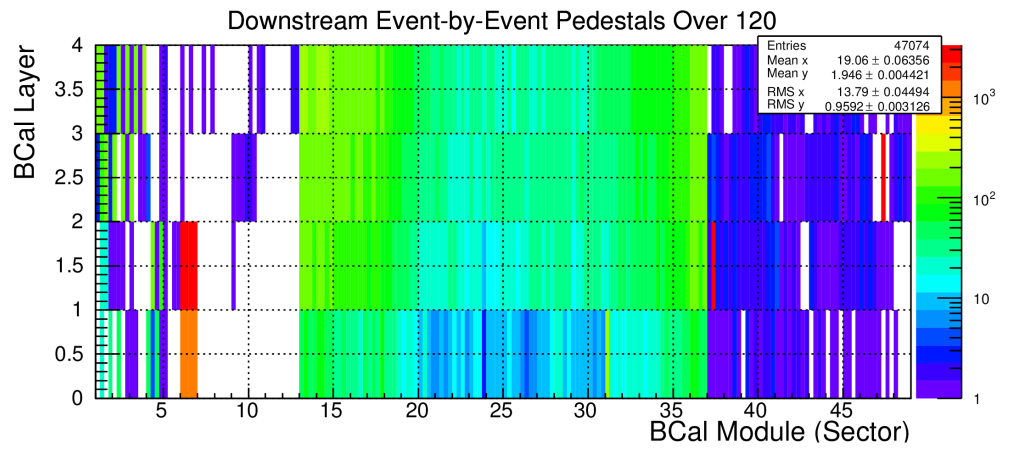
Looks like it's a real pedestal instability
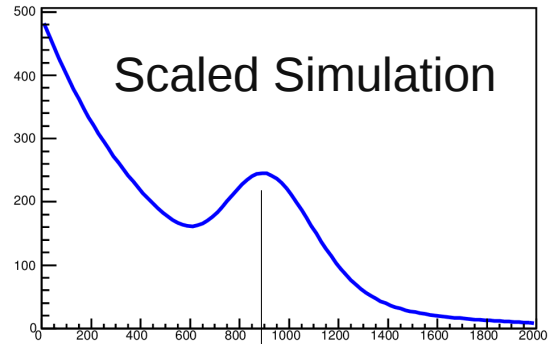
Whole statistics includes the runs:

455, 456, 538, 546, 553, 557, 558, 3081, 3086, 3127, 3132, 3133, 3166,
3217, 3235, 3297, 4020, 4030, 4031, 7134, 7216, 7217, 7218, 7229,
9009, 9012, 9019, 9036, 9037, 9038, 9040, 9044, 9045, 9048, 9050

Event-by-Event Pedestals Over 120

Entries	25591
Mean x	23.44 ± 0.05348
Mean y	2.352 ± 0.006571
RMS x	8.555 ± 0.03782
RMS y	1.051 ± 0.004646

Now, for these "red"
runs only (very last ones
before the beam time)

For the following analysis,
"Ped<300" cut was used

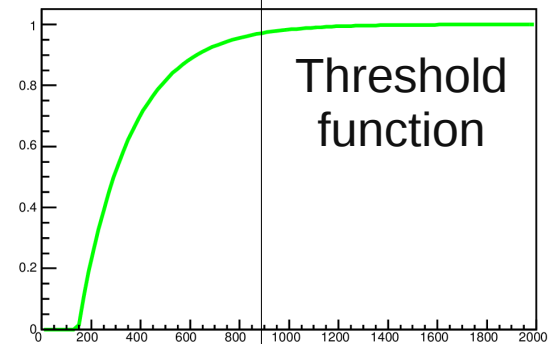| Entries | 618766 |
| Mean | 110.7 ± 0.06405 |
| RMS | 50.38 ± 0.04529 |
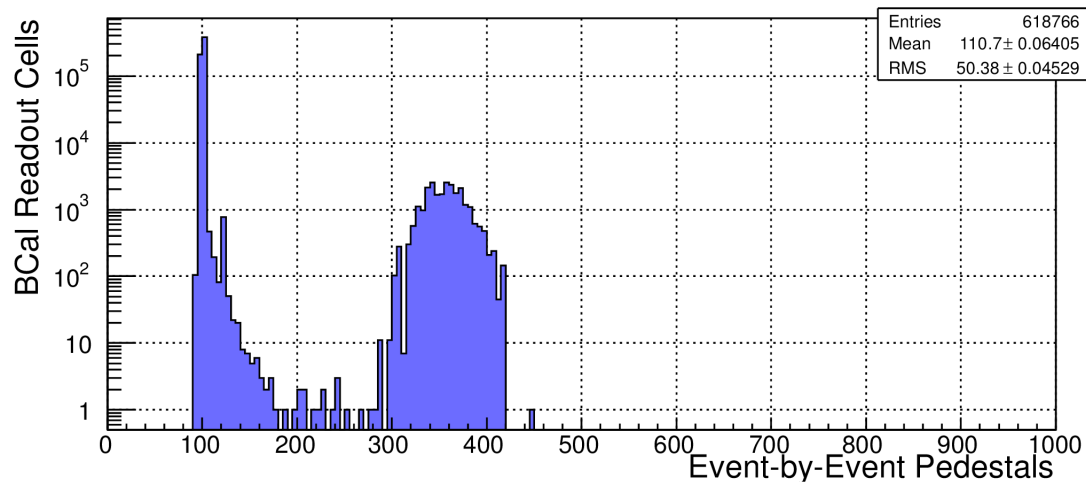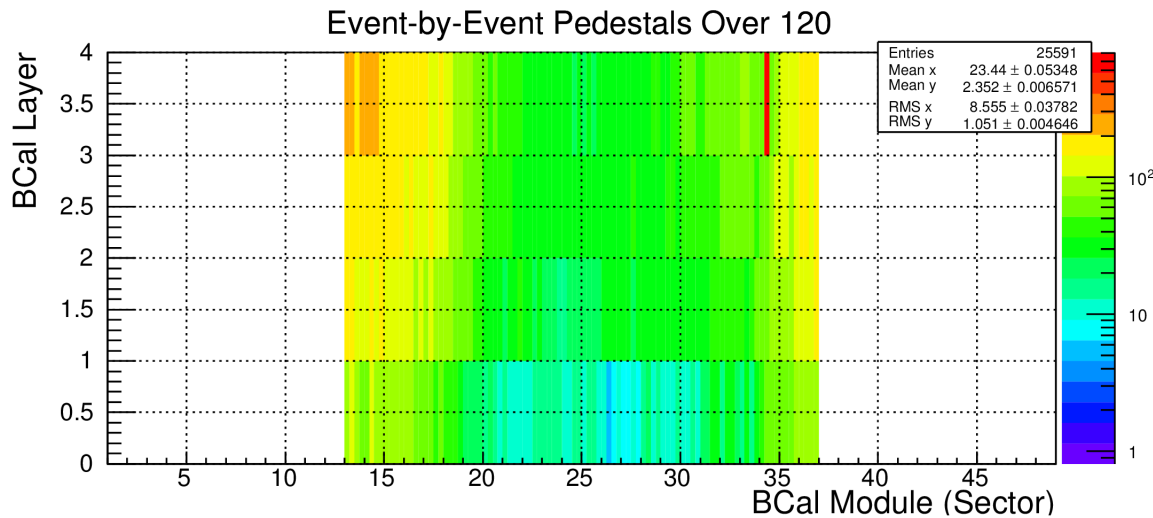
Comparison of the energy deposited in the fibers from BCAL simulation with the collected spectra

Case #1 (the "good one"):

Scaled Simulation
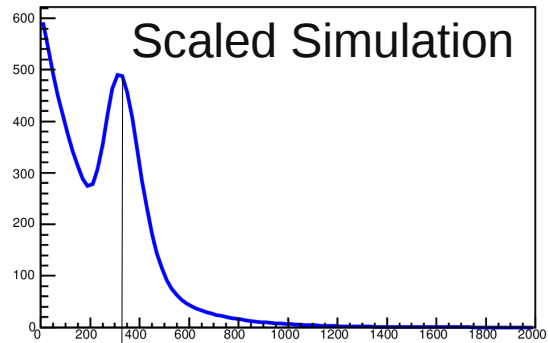
X

Threshold function

=

Observation

E_up: M12 C3 R3

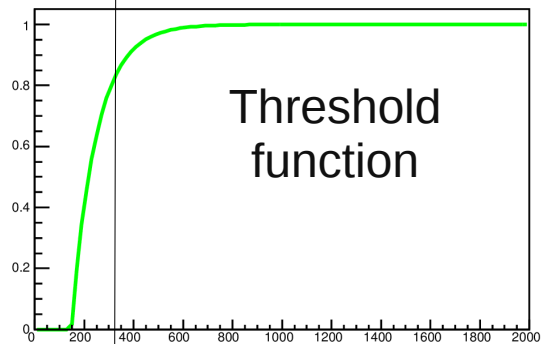| Entries	9856
Mean	817 ± 3.768
RMS	371 ± 2.665
χ^2 / ndf	88.26 / 75
p0	167 ± 5.0
p2	0.6772 ± 0.0275
p3	0.1249 ± 0.0373
p4	2.864 ± 0.159
p6	0.003939 ± 0.000032
p7	0.6353 ± 0.0093
p8	0.6847 ± 0.0577

Integral from fADC
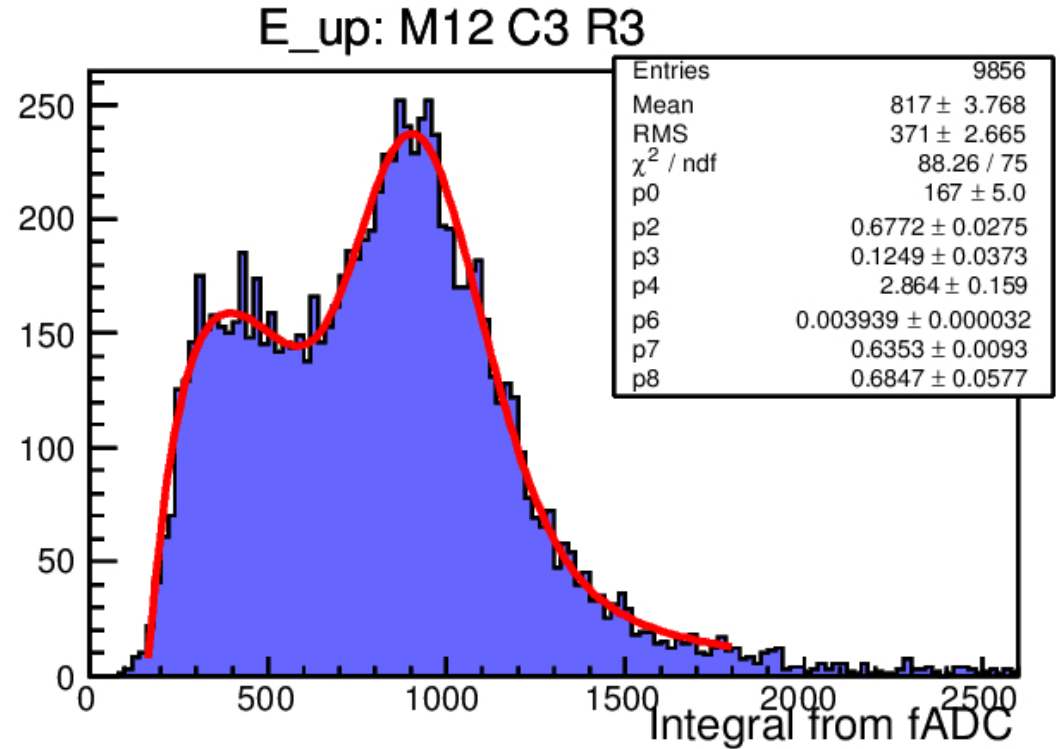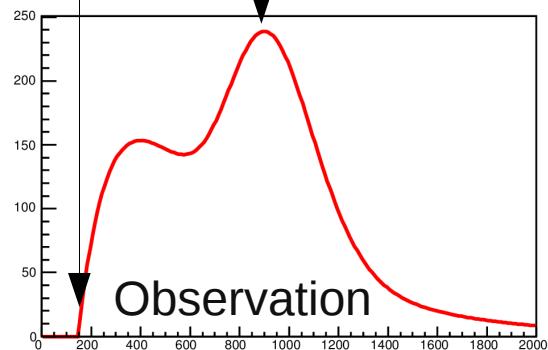
Easy to extract fADC-to-MeV calibration and hardware threshold (in attenuated-MeV)

Case #2 (more difficult)
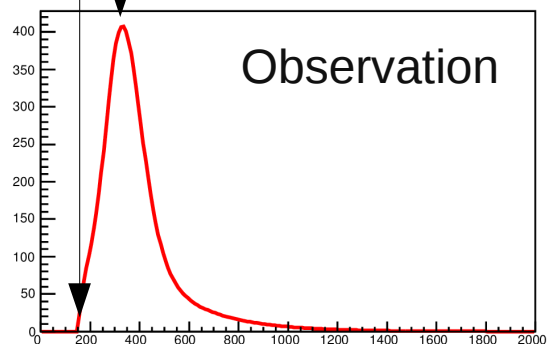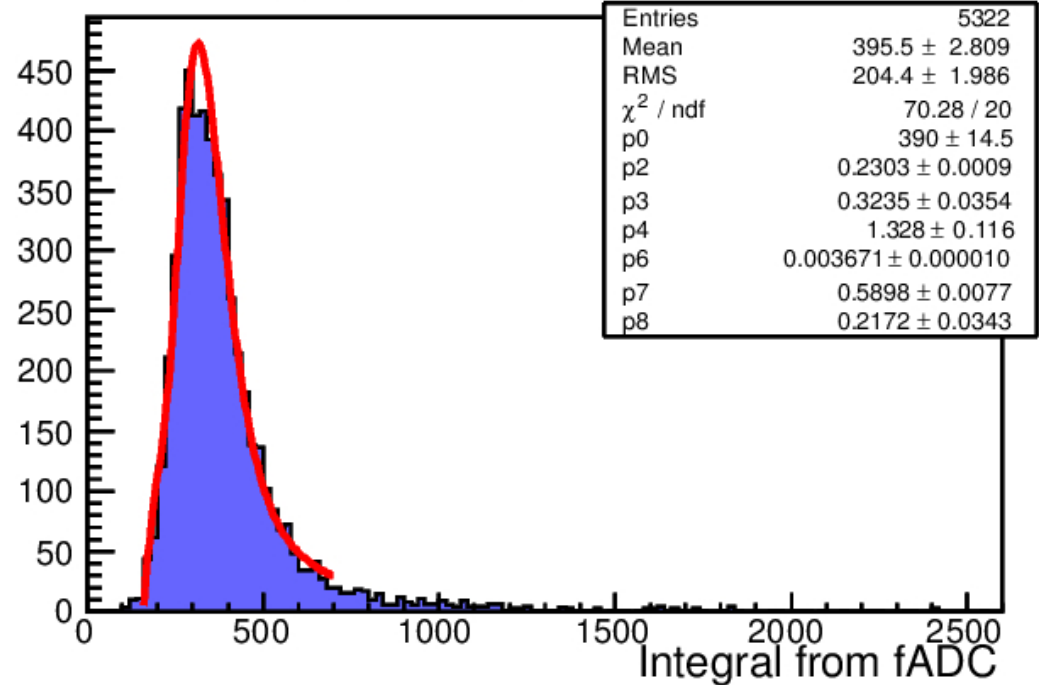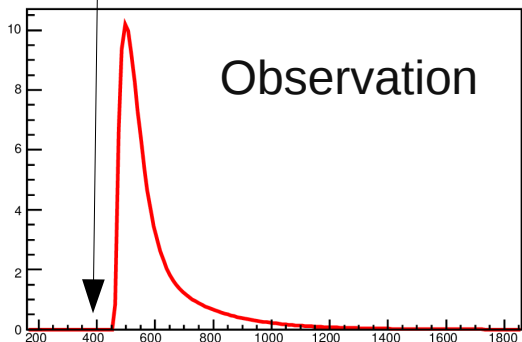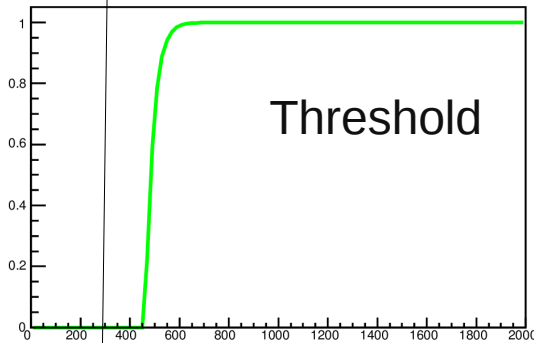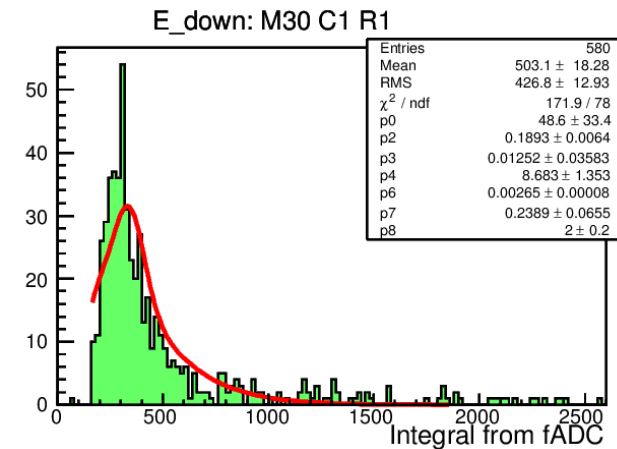# Threshold is very close to the left edge of the peak:

Scaled Simulation

X

Threshold function

=

Observation

E_up: M12 C2 R1

Entries	5322
Mean	395.5 ± 2.809
RMS	204.4 ± 1.986
χ^2 / ndf	70.28 / 20
p0	390 ± 14.5
p2	0.2303 ± 0.0009
p3	0.3235 ± 0.0354
p4	1.328 ± 0.116
p6	0.003671 ± 0.000010
p7	0.5898 ± 0.0077
p8	0.2172 ± 0.0343

Integral from fADC
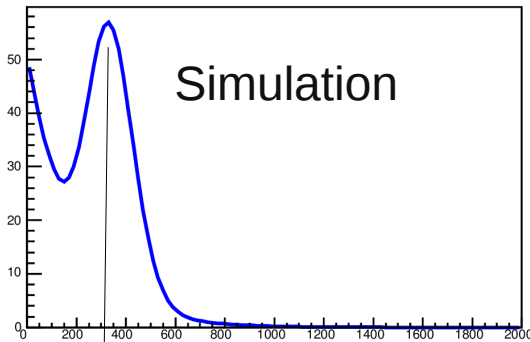
Still do-able...

Case #3 (very difficult)
Threshold is inside the peak:

Simulation

Threshold

Observation

E_up: M30 C1 R1

Entries	1570
Mean	441.4 ± 8.276
RMS	324 ± 5.852
χ^2 / ndf	62.72 / 23
p0	125.1 ± 4.5
p2	0.2626 ± 0.0169
p3	0.04565 ± 0.03445
p4	4.191 ± 0.481
p6	0.003885 ± 0.000050
p7	0.564 ± 0.011
p8	0.8227 ± 0.0814

Integral from fADC

E_down: M30 C1 R1

Entries	580
Mean	503.1 ± 18.28
RMS	426.8 ± 12.93
χ^2 / ndf	171.9 / 78
p0	48.6 ± 33.4
p2	0.1893 ± 0.0064
p3	0.01252 ± 0.03583
p4	8.683 ± 1.353
p6	0.00265 ± 0.00008
p7	0.2389 ± 0.0655
p8	2 ± 0.2

Integral from fADC
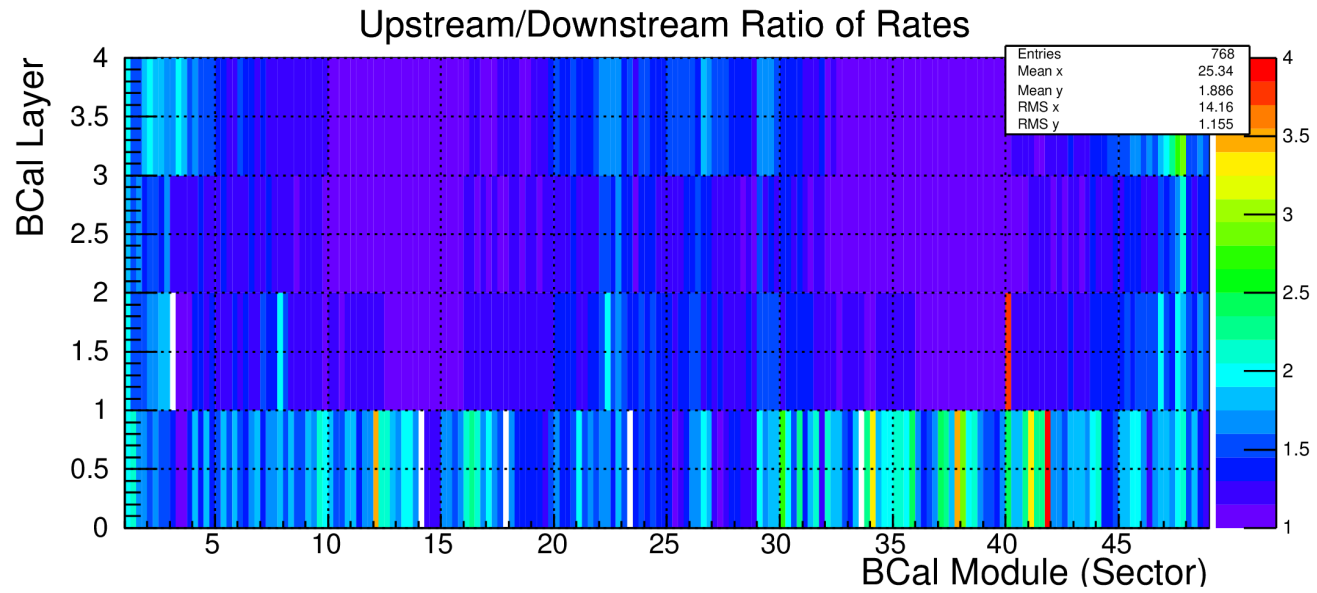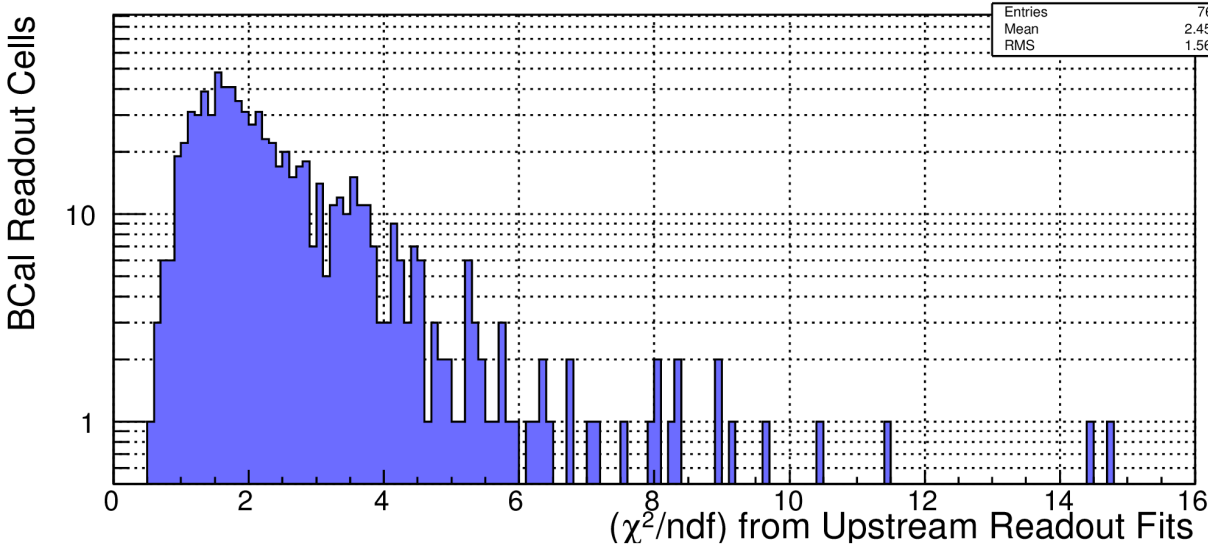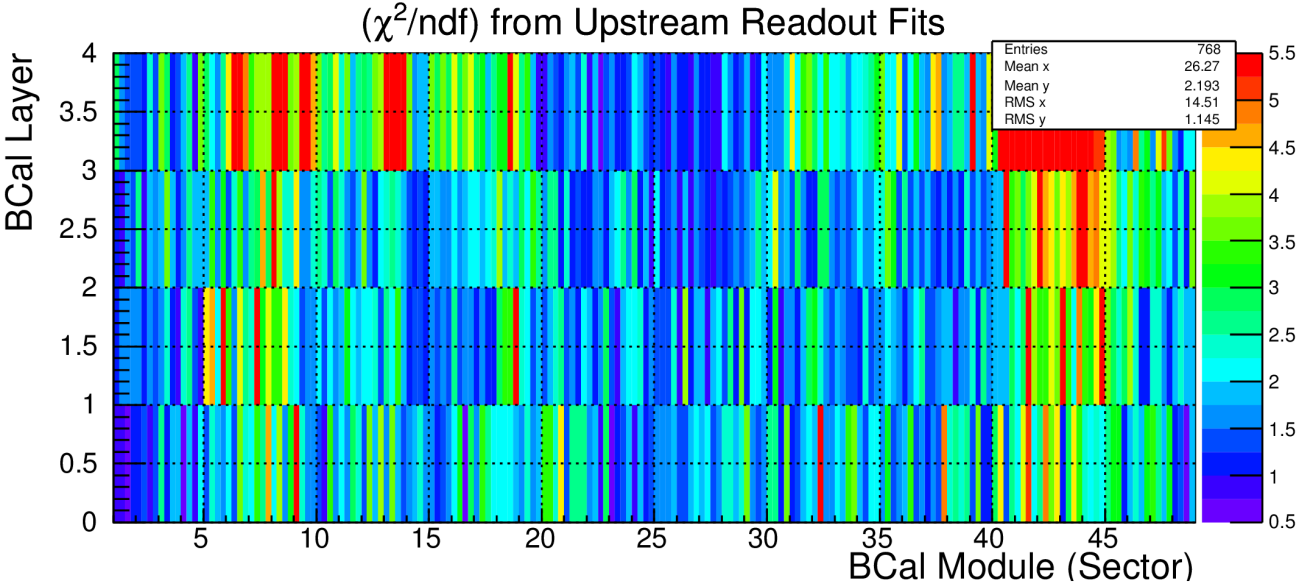
Pretty hard to extract both calibration and threshold..
(I didn't say "impossible" :)

Indication of the problem:
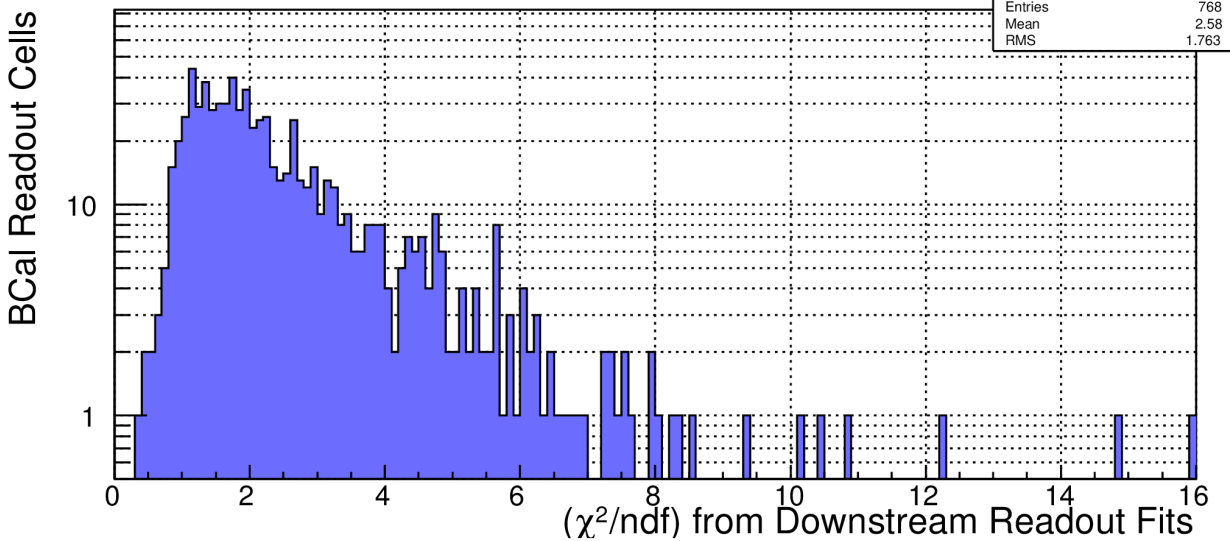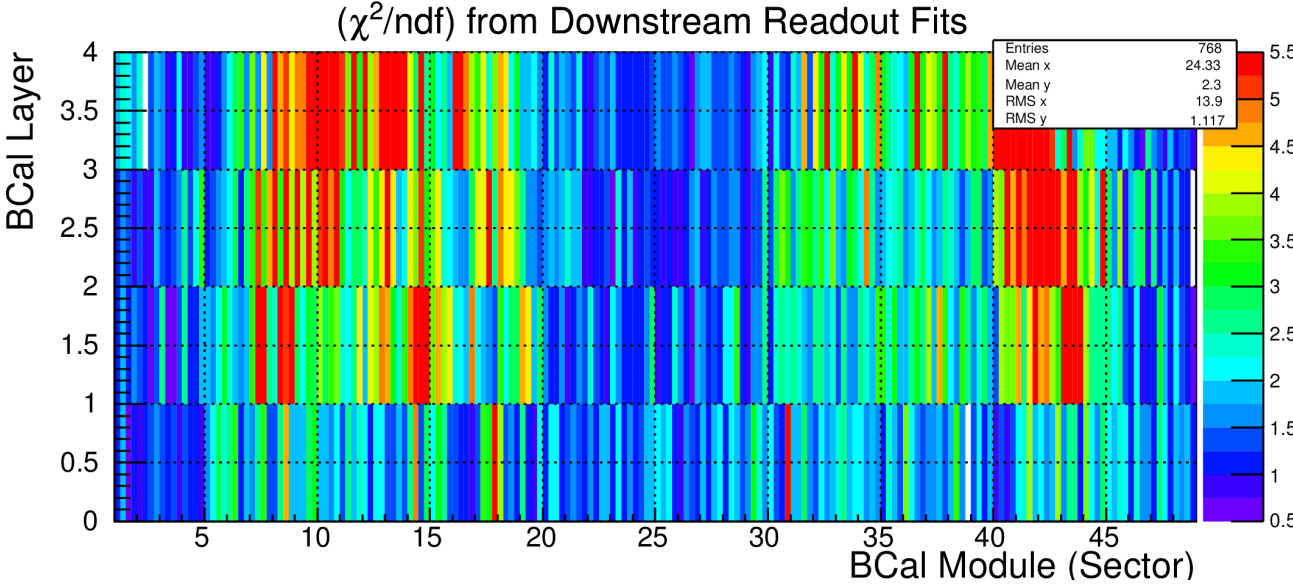**Distorted upstream/downstream ratio**
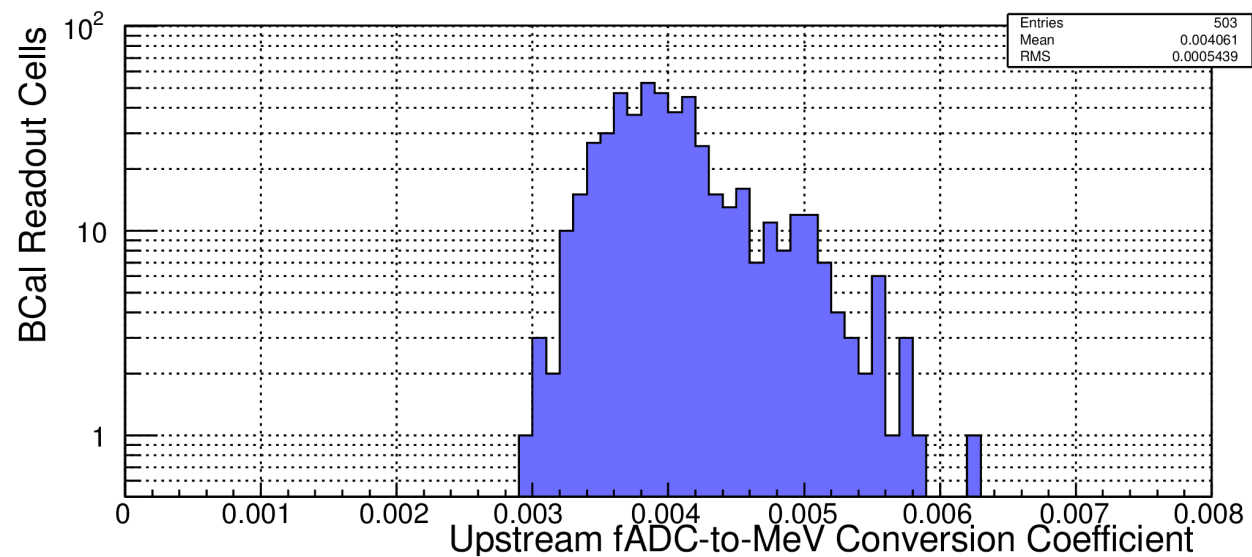**Of events in histograms (viz., rates)**
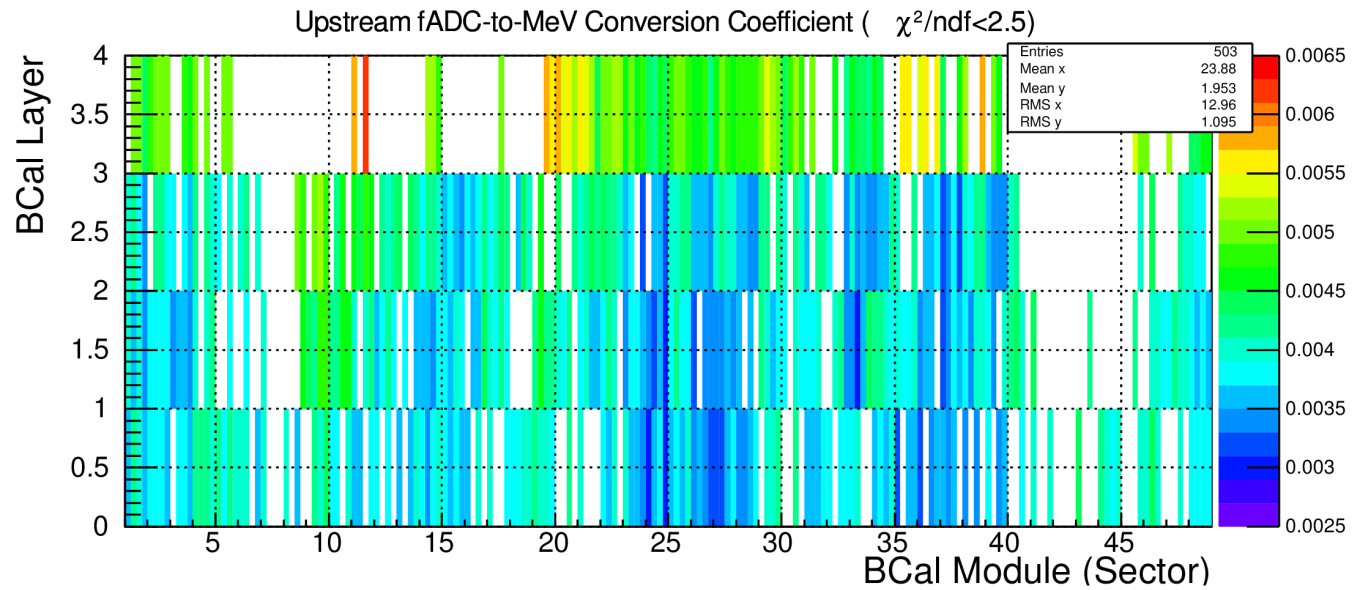
Ratios:
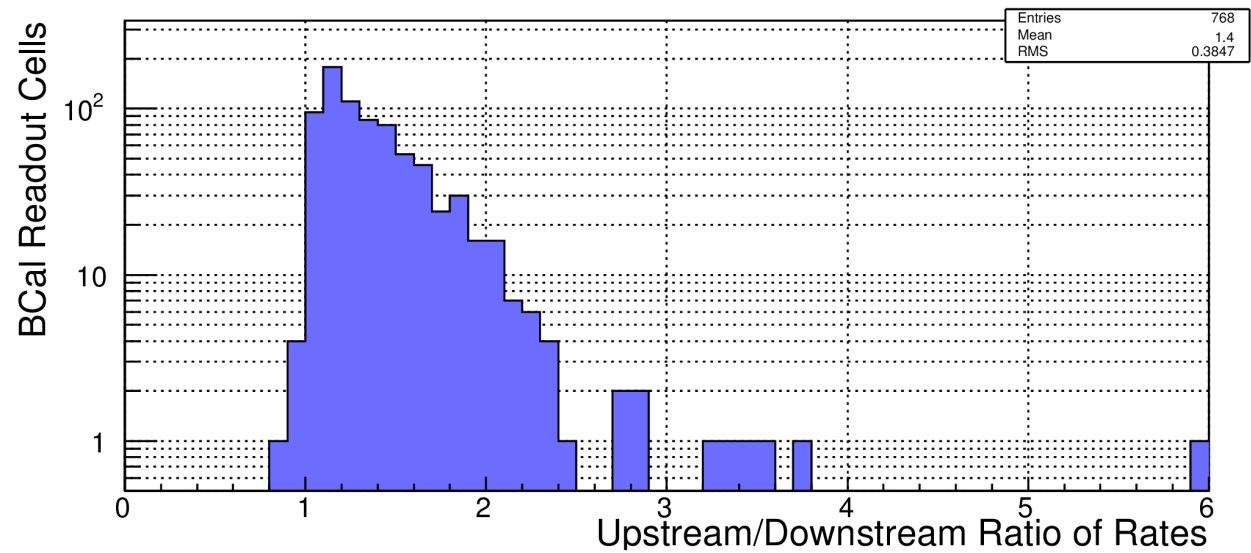
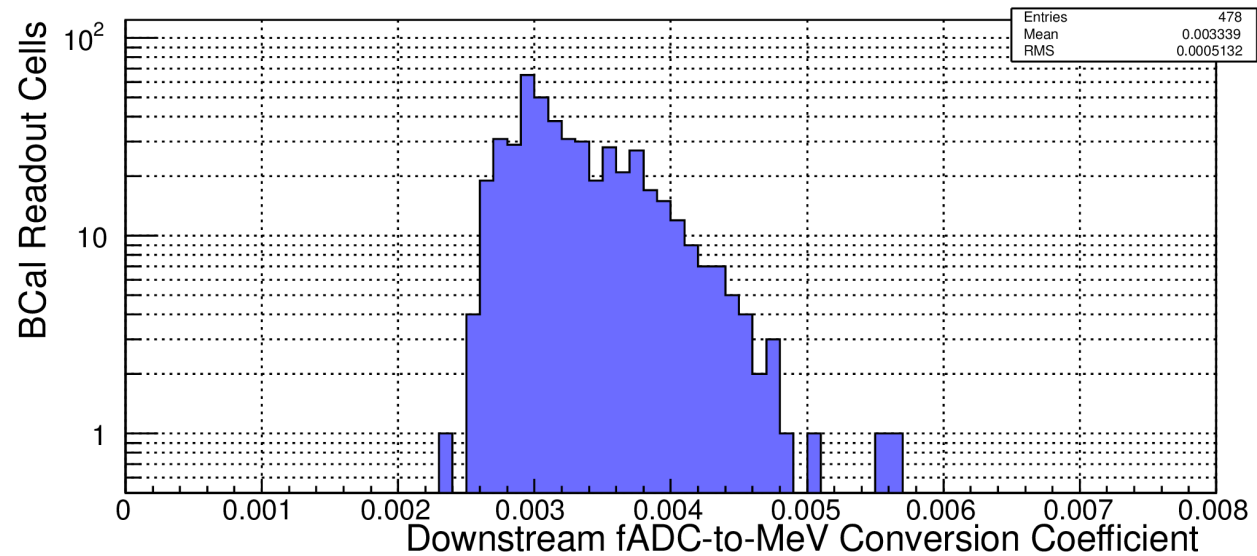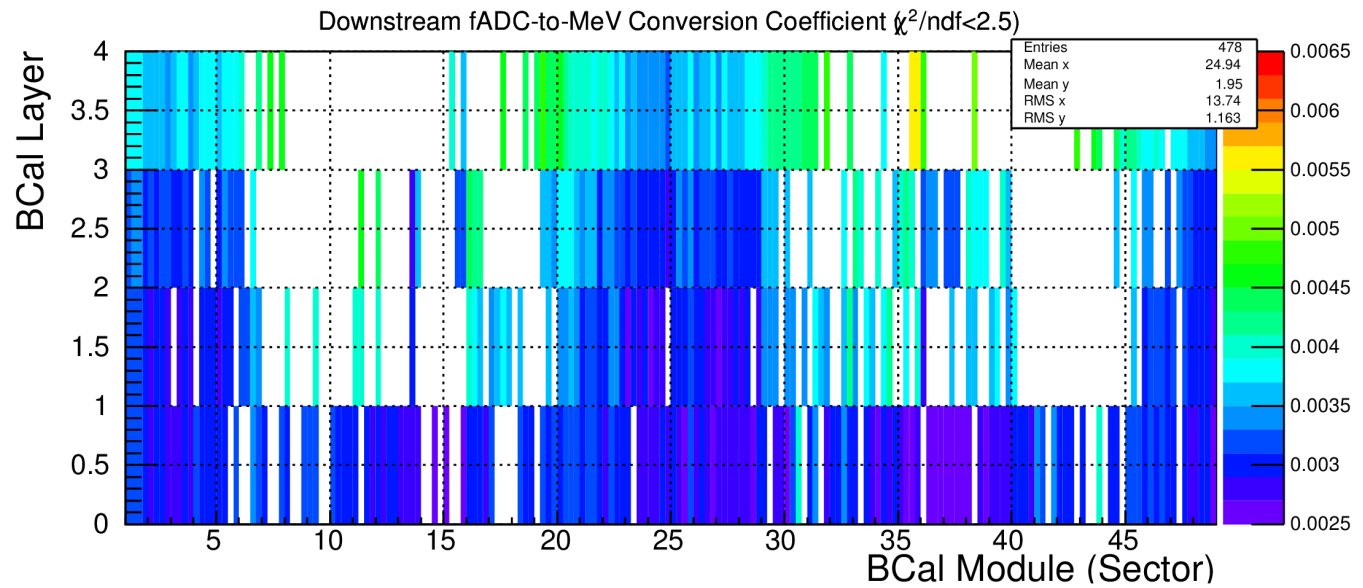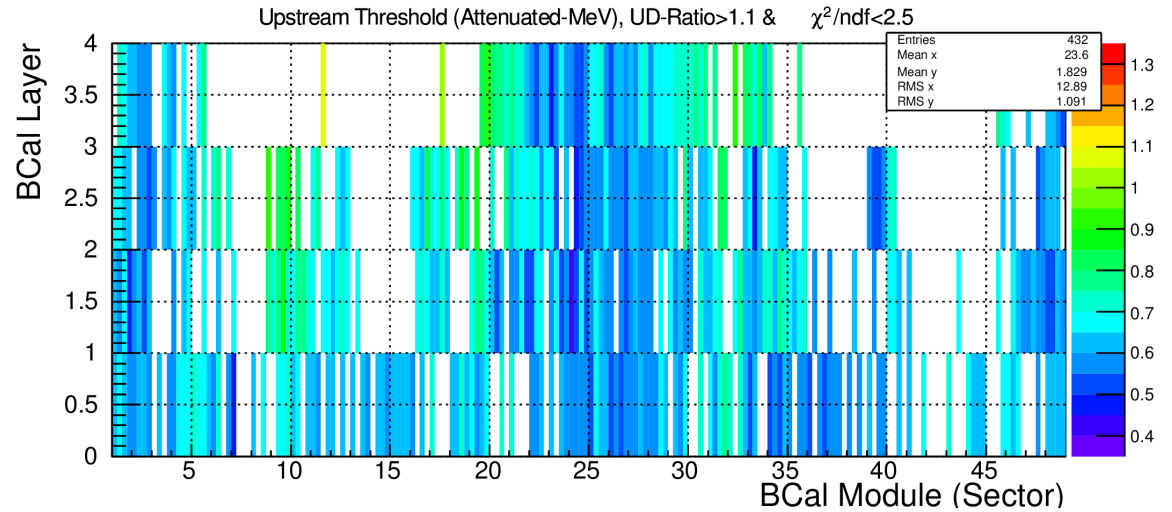# Quality of the fitting (Upstream spectra):

Quality of the fitting (Downstream spectra):

Upstream Readout Calibration Coefficients:

Downstream Readout Calibration Coefficients:
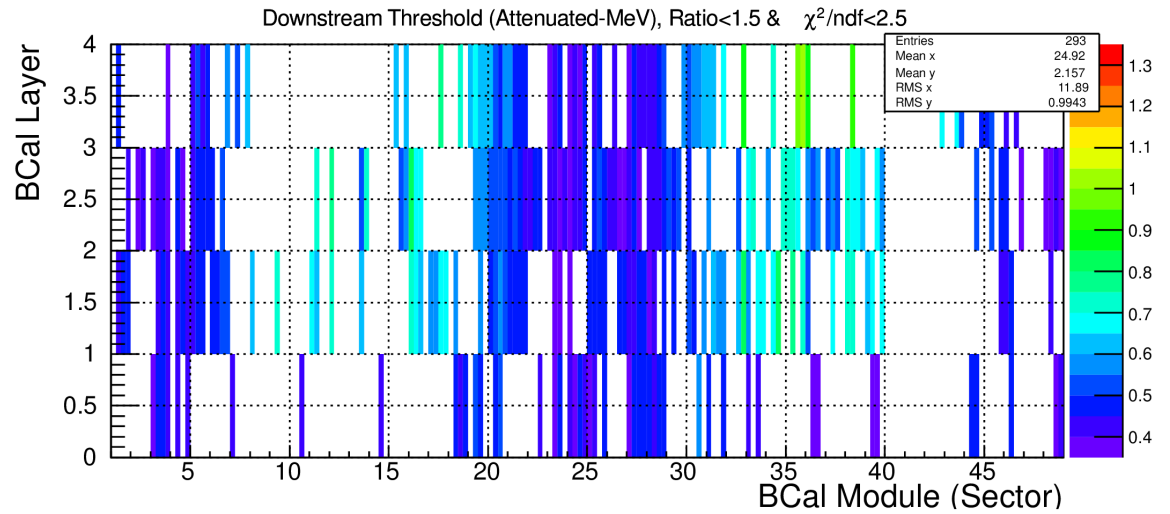

Downstream fADC-to-MeV Conversion Coefficient (χ^2/ndf<2.5)

Entries	478
Mean x	24.94
Mean y	1.95
RMS x	13.74
RMS y	1.163

Entries	478
Mean	0.003339
RMS	0.0005132

Upstream Thresholds:

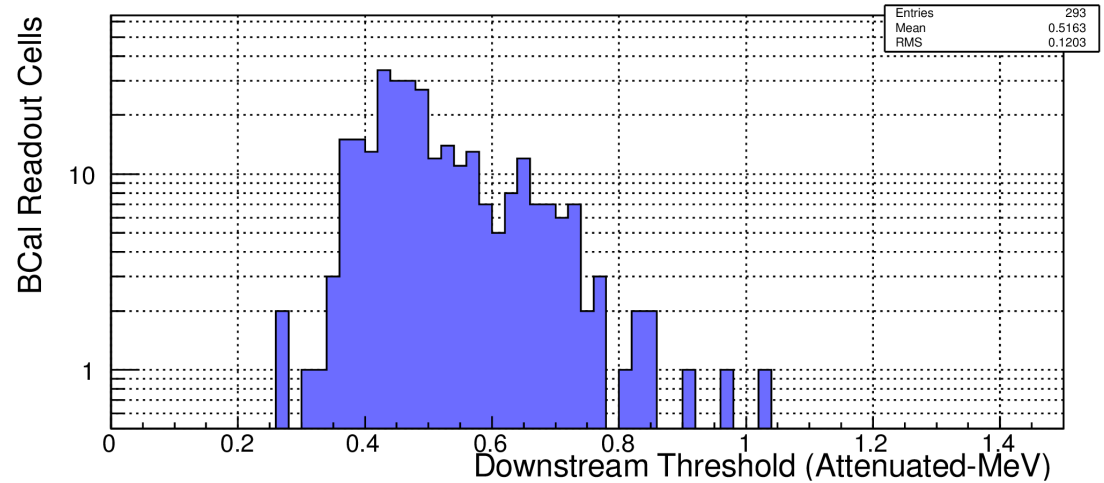Upstream Threshold (Attenuated-MeV), UD-Ratio>1.1 & χ^2/ndf<2.5

NB: This is energy Deposited in the FIBERS (attenuated-MeV)

Downstream Thresholds:

**NB: This is energy
Deposited in the FIBERS
(attenuated-MeV)**

Work is still in progress...