

RHRS calorimeter calibration with TMinuit

Tyler Kutz
Zhihong Ye
Mike Nycz
Tong Su

February 14, 2018

Calibrating with TMinuit

Alternate to matrix approach, use TMinuit to calibrate calorimeter:

- The TMinuit package minimizes an arbitrary function with respect to an array of free parameters `par[]`
- Define function

$$\chi^2 = \sum_j^{events} \left(\sum_i^{blocks} \text{par}[i] A_{ij} - p_j \right)^2$$

where

- `par[0...47]` are the preshower block gains
- `par[48...122]` are the shower block gains
- A_{ij} is the pedestal-subtracted ADC signal in block i for event j
- p_j is the track momentum for event j
- Use TMinuit to find block gains that minimize χ^2

Runs

Runs used for calibration

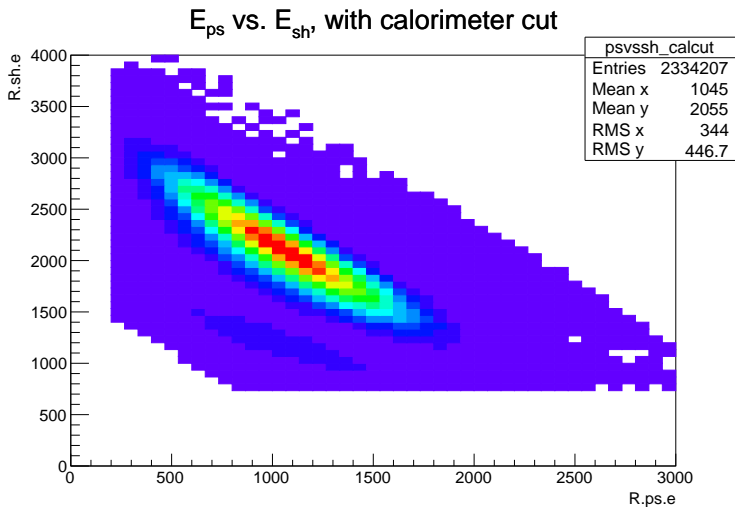
- 90838 (carbon foil)
- 90840 (multifoil)
- 90849 (hydrogen)
- 90850 (hydrogen)
- 90854 (helium)
- 90855 (helium)
- 90856 (helium)
- 90870 (tritium)
- 90873 (tritium)
- 90874 (tritium)
- 90875 (tritium)
- 90876 (deuterium)
- 90877 (deuterium)

Good event cuts

Want to select clean high-energy tracks:

- T5 trigger
`DL.evtypebits == 48 || 112`
- Single tracks/clusters
`R.tr.n == 1`
`R.vdc.{u1,u2,v1,v2}.nclust == 1`
- Large gas Cherenkov signal
`R.cer.asum_c > 5000.`
- Positive track momentum
`R.tr.p > 0.`
- Large calorimeter signal
`(R.ps.e + 0.85*R.sh.e) > 1500.`
`R.ps.e > 250.`
`R.sh.e > 750.`

Resulting calorimeter events



Calorimeter distribution with applied cuts

One more cut!

Exclude events where the block with max signal lies on the perimeter

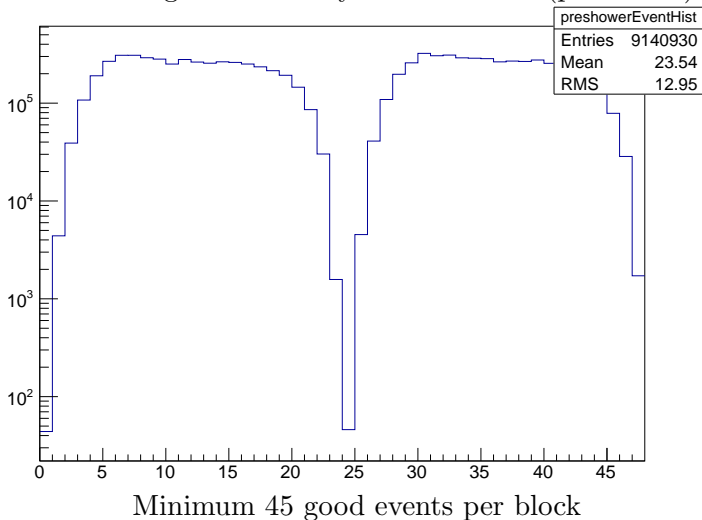
0	24
1	25
2	26
3	27
4	28
5	29
6	30
7	31
8	32
9	33
10	34
11	35
12	36
13	37
14	38
15	39
16	40
17	41
18	42
19	43
20	44
21	45
22	46
23	47

0	15	30	45	60
1	16	31	46	61
2	17	32	47	62
3	18	33	48	63
4	19	34	49	64
5	20	35	50	65
6	21	36	51	66
7	22	37	52	67
8	23	38	53	68
9	24	39	54	69
10	25	40	55	70
11	26	41	56	71
12	27	42	57	72
13	28	43	58	73
14	29	44	59	74

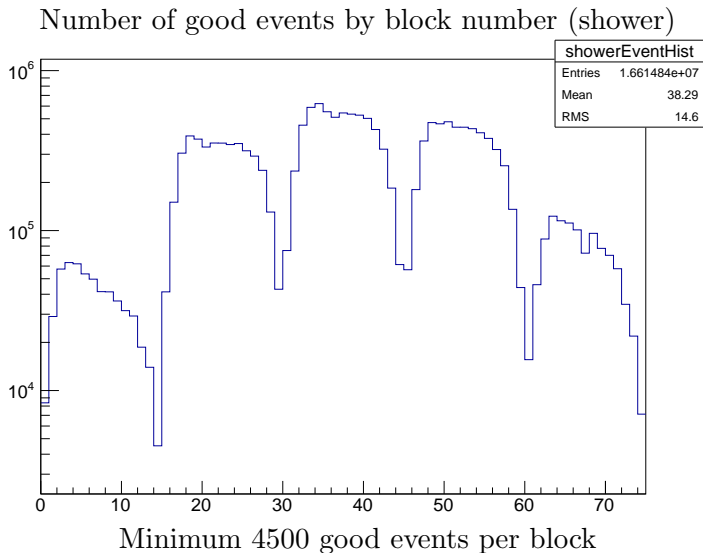
- Since all preshower blocks are perimeter blocks, this only applies to blocks 0, 23, 24, and 47
- For the shower calorimeter, this applies to all perimeter blocks
- Cut is not easily applied in ROOT (not included in previous plot)

Preshower good events

Number of good events by block number (preshower)

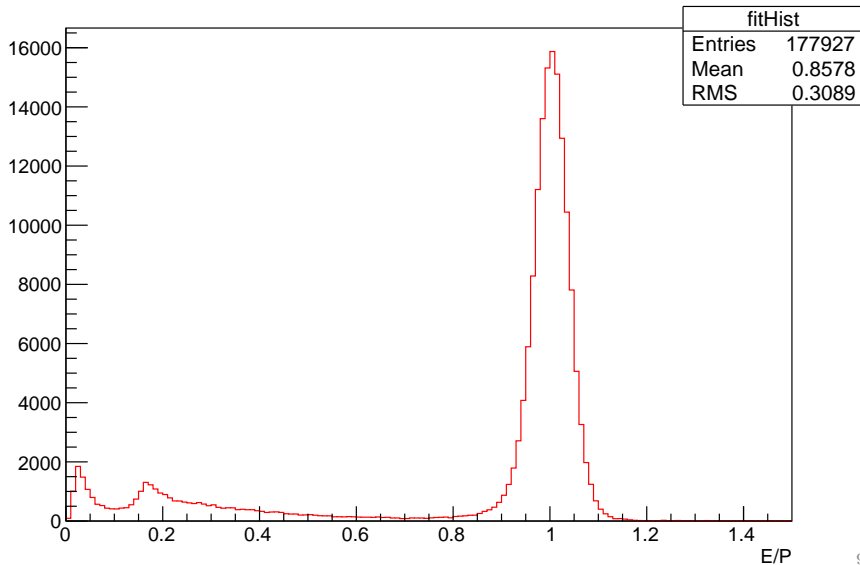


Shower good events



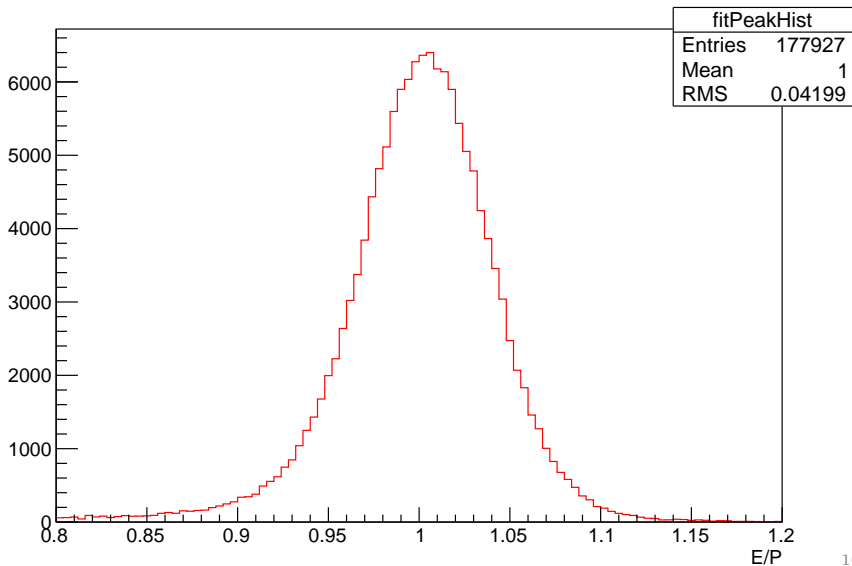
E/P results

TMinuit calibration



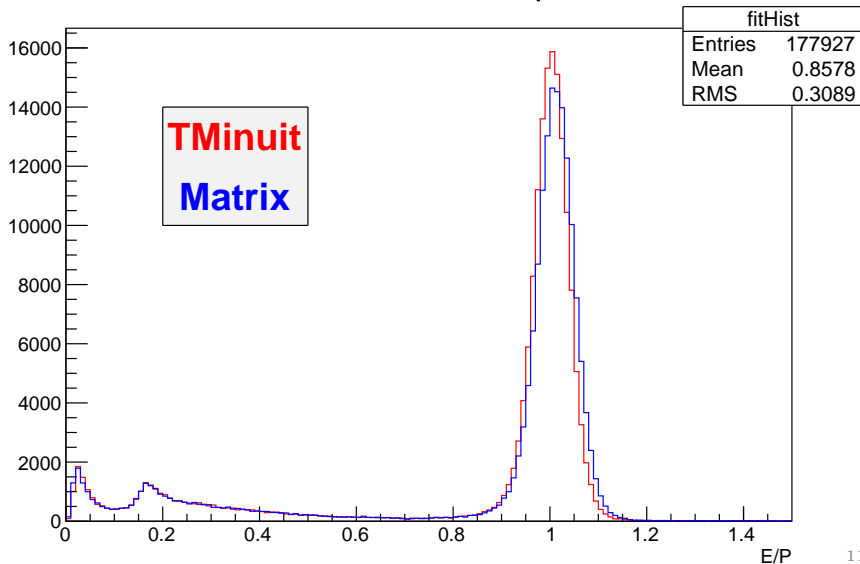
E/P peak

TMinuit calibration



E/P comparison

TMinuit and matrix comparison



E/P peak comparison

TMinuit and matrix comparison

