# *HCAL first look with EMCAL energy scan data*

Abhisek Sen, Tim Rinn, John Haggerty

# Cosmics Calibrations - Tim

Inner: Energy MPV (cosmics sims)
MeV

| | | | |
|---|---|---|---|
| 7.2 | 7.2 | 7.1 | 7.2 |
| 7.5 | 7.6 | 7.6 | 7.6 |
| 8.1 | 8.1 | 8.1 | 8.1 |
| 8.6 | 8.6 | 8.6 | 8.8 |

Inner low gain:
ADC MPV (cosmics data)

| | | | |
|---|---|---|---|
| 16.38 | 19.21 | 25.63 | 19.35 |
| 19.18 | 19.29 | 28.32 | 19.64 |
| 19.45 | 19.74 | 30.97 | 20.31 |
| 20.91 | 20.14 | 34.3 | 27.69 |

Outer: Energy MPV (cosmics sims)
MeV

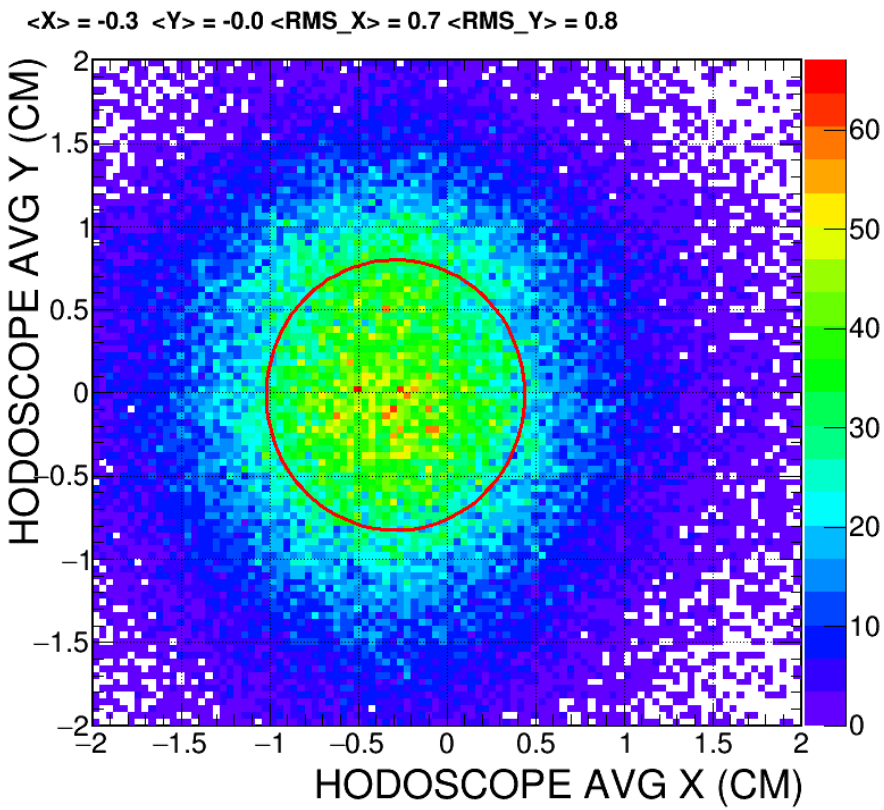
| | | | |
|---|---|---|---|
| 7.2 | 7.2 | 7.2 | 7.2 |
| 7 | 7 | 7 | 7 |
| 6.8 | 6.8 | 6.8 | 6.8 |
| 6.7 | 6.7 | 6.7 | 6.7 |

Outer low gain:
ADC MPV (cosmics data)

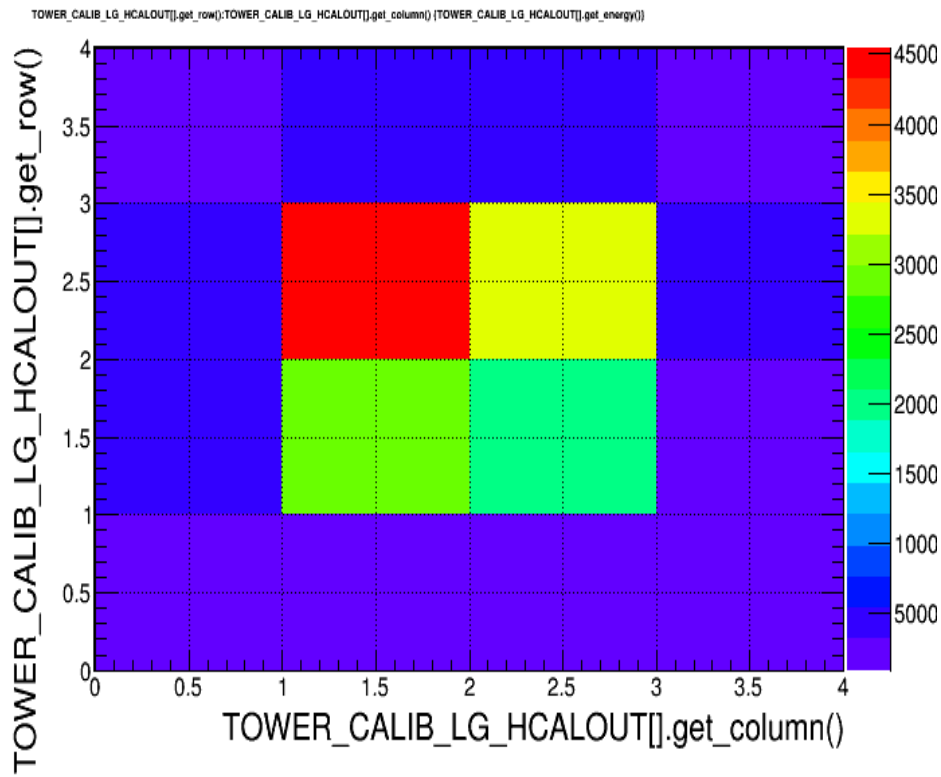
| | | | |
|---|---|---|---|
| 32.88 | 34.05 | 39.13 | 37.91 |
| 33.98 | 38.45 | 39.85 | 37.38 |
| 35.09 | 36.27 | 38.95 | 33.76 |
| 34.58 | 33.85 | 37.58 | 37.71 |

I have another set of calibration numbers from Edward (measured with cosmic self trigger data).

# *Beam profile at 16 GeV*

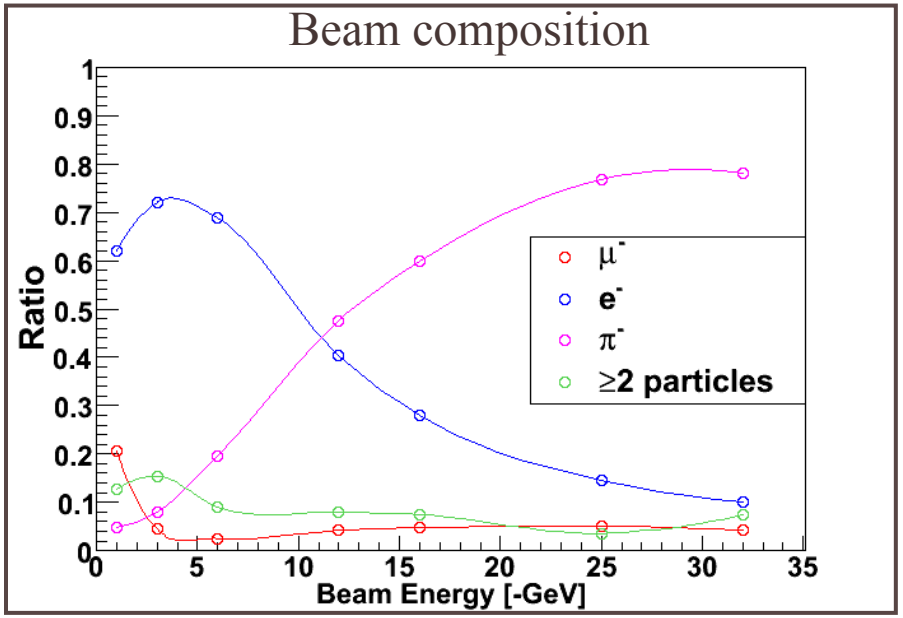



Beam location




HCAL energy deposition

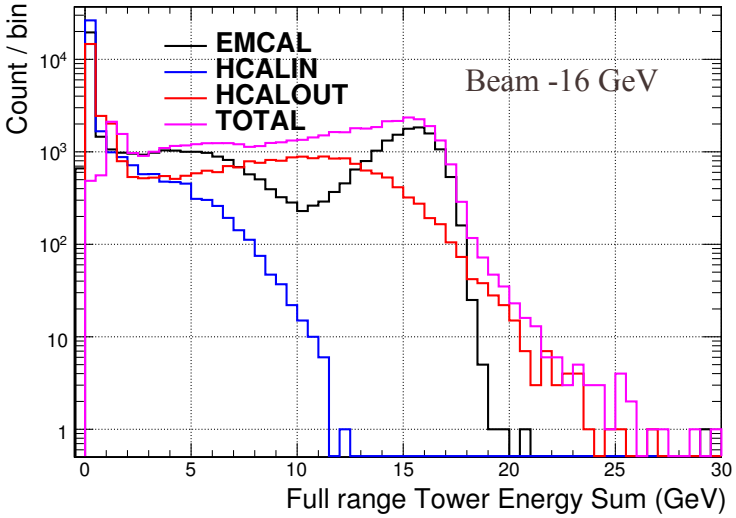
# Negative beam




No standalone HCAL data yet.

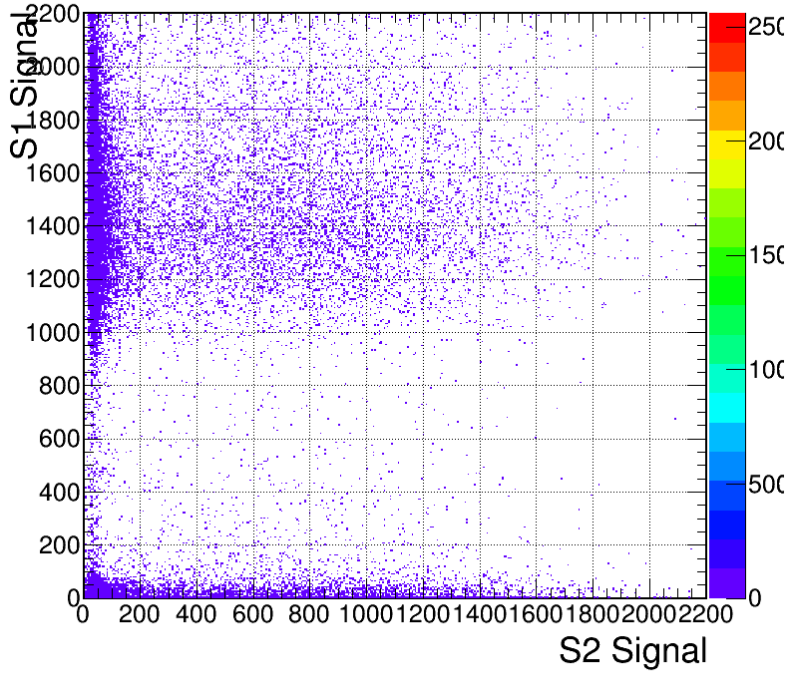
I looked into EMCAL energy scan data from last week.

EMCAL was stationed very upstream than the HCAL. If shower develops in EMCAL its no use for HCAL.

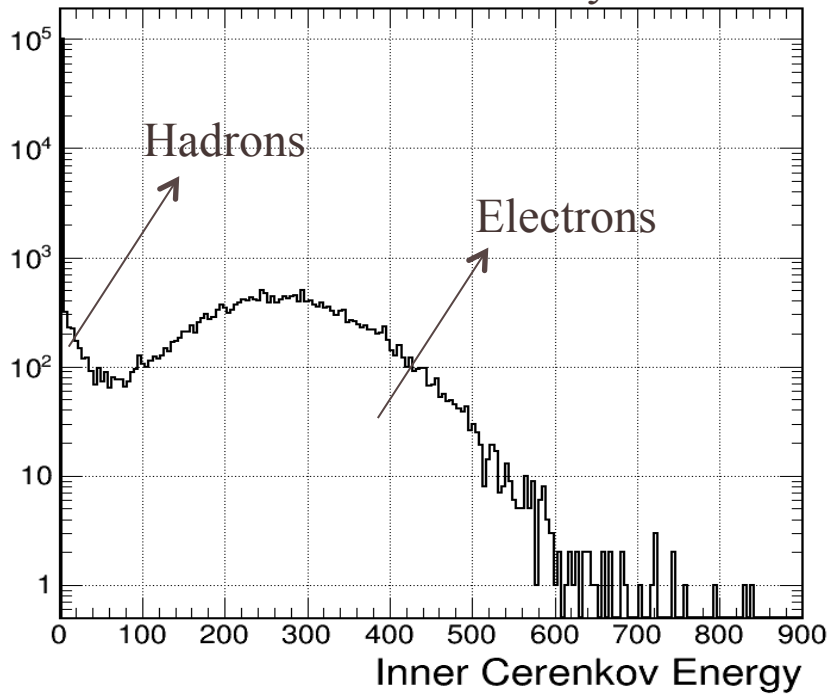


# *Electron cut*

HCAL scintillator activity



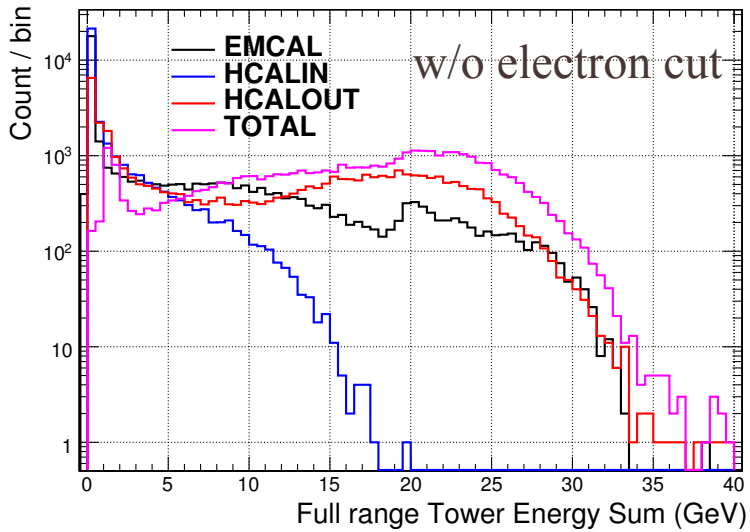

Inner Cerenkov activity

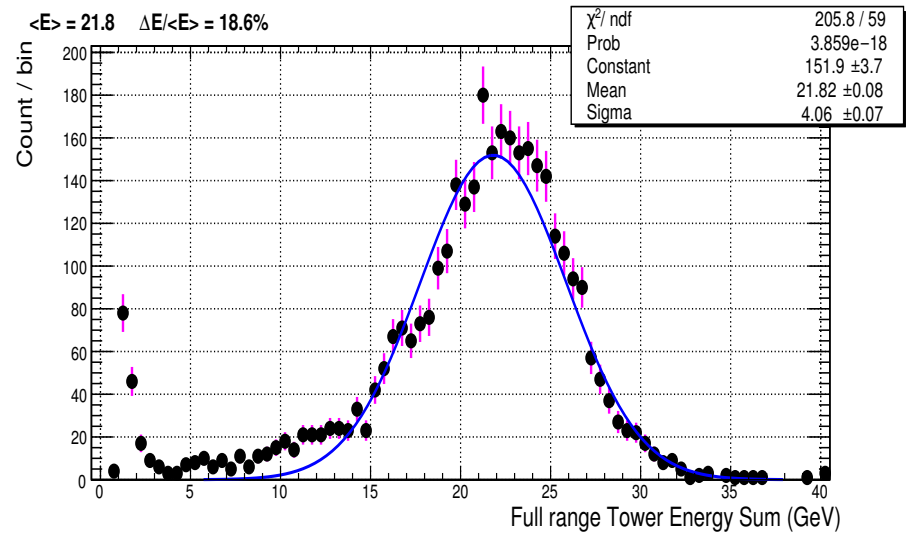


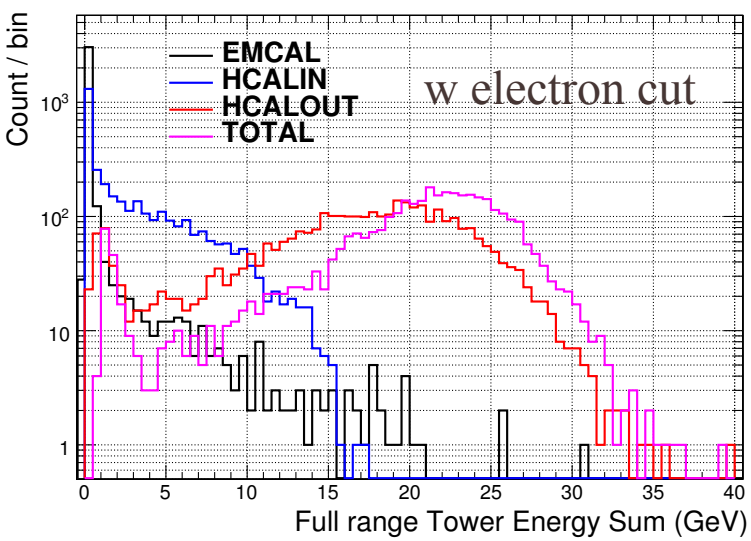

To remove the electrons, I applied:

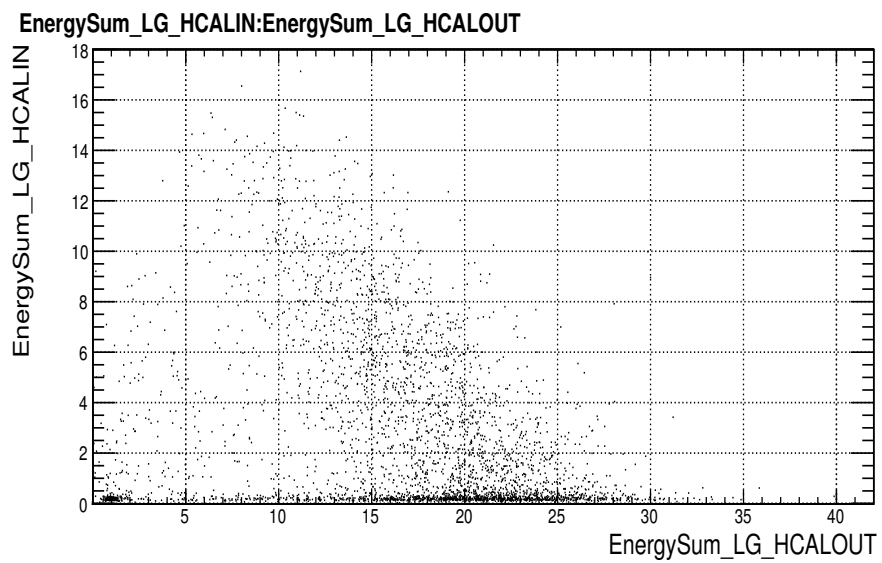
S1 signal >50 (S1 at the front of IHCAL)
S3 signal>50 (S3 at the wall behind OHCAL)
Cerenkov inner counter <10

# 32 GeV

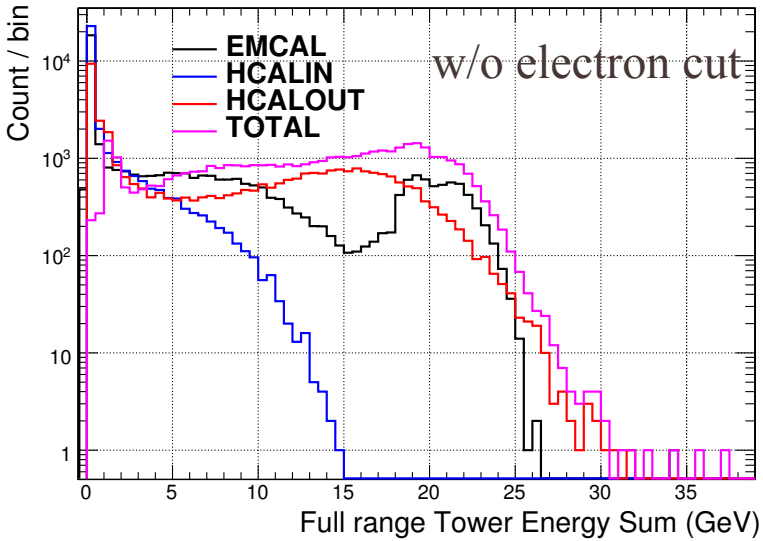

EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)

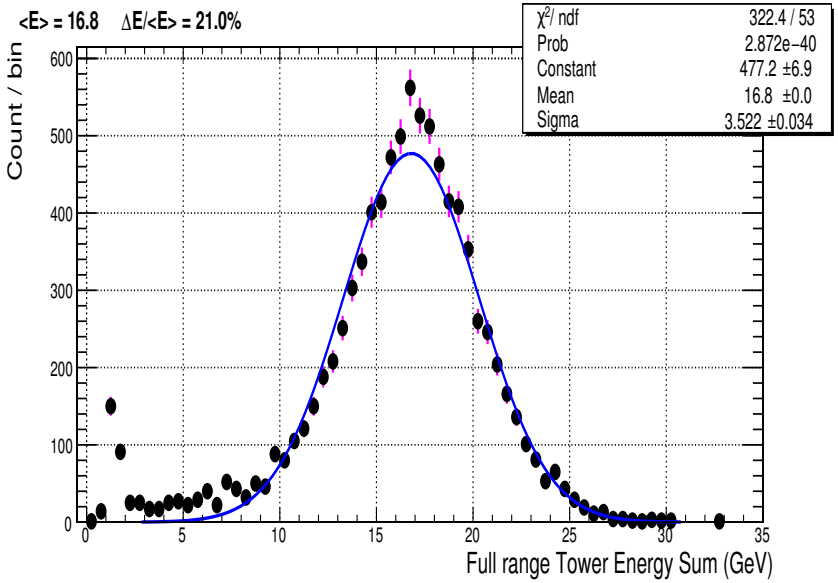

<E> = 21.8 ΔE/<E> = 18.6%
χ²/ ndf 205.8 / 59
Prob 3.859e−18
Constant 151.9 ±3.7
Mean 21.82 ±0.08
Sigma 4.06 ±0.07
Count / bin
Full range Tower Energy Sum (GeV)

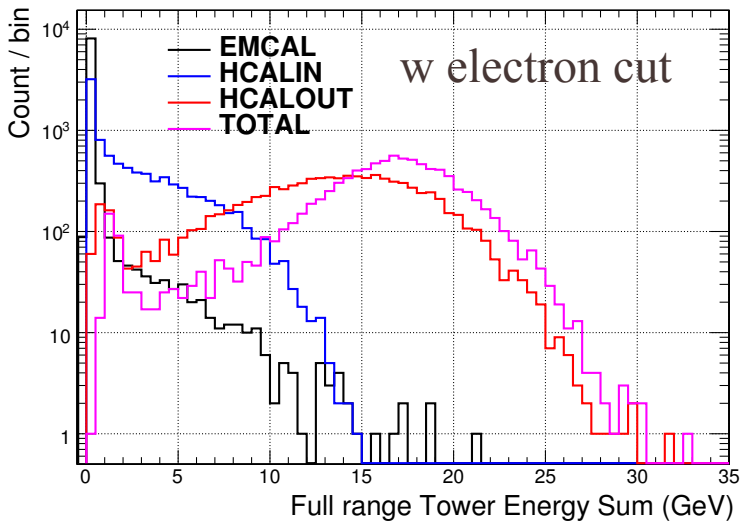

EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)

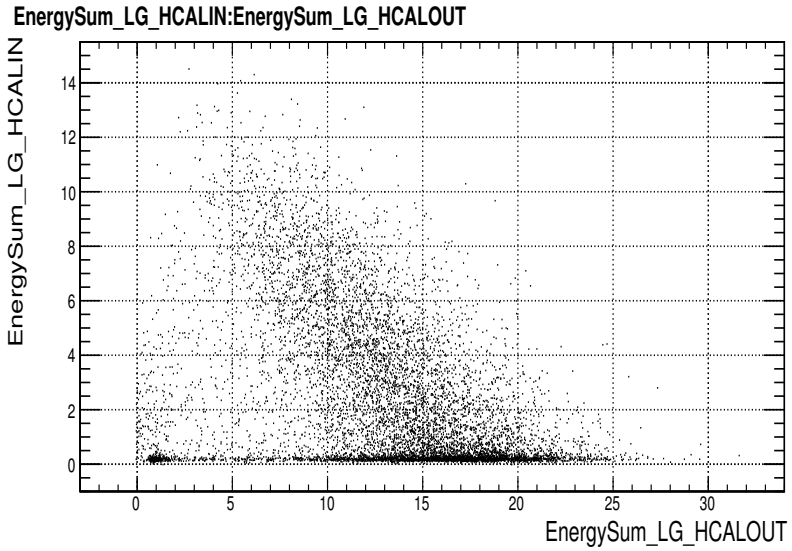

EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# 24 GeV

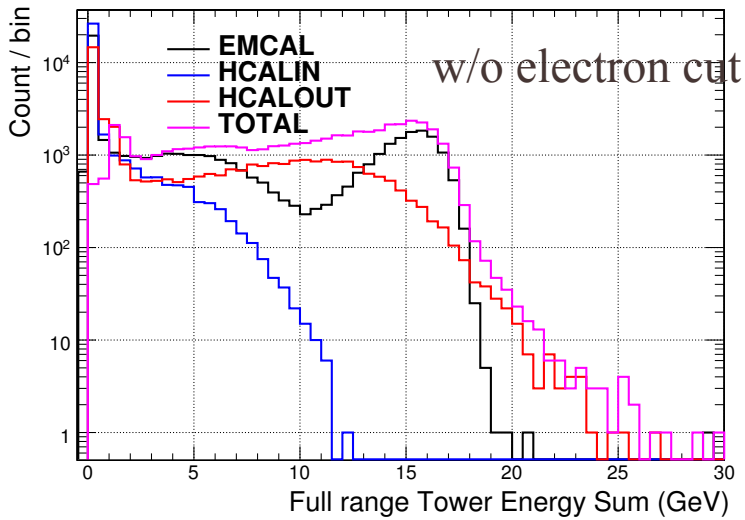

EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)

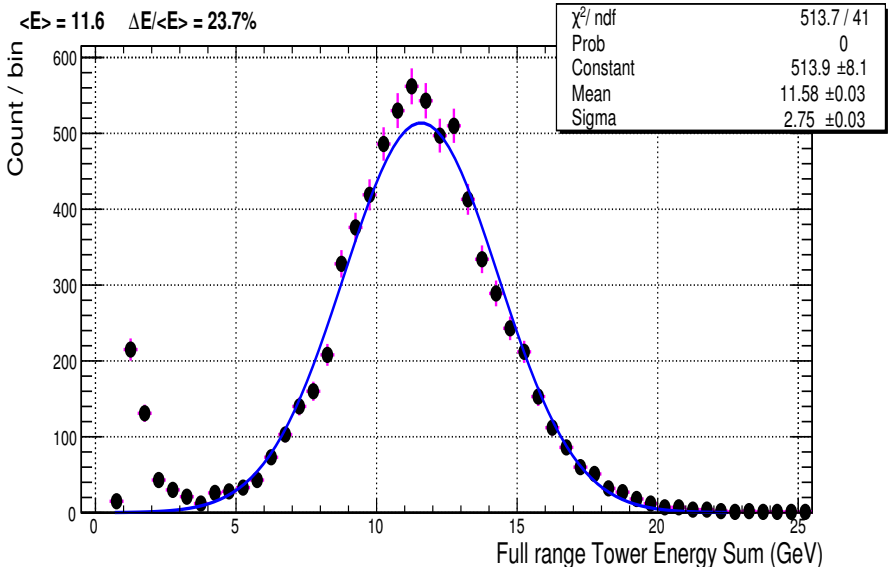

<E> = 16.8 ΔE/<E> = 21.0%
χ2/ ndf 322.4 / 53
Prob 2.872e−40
Constant 477.2 ±6.9
Mean 16.8 ±0.0
Sigma 3.522 ±0.034
Count / bin
Full range Tower Energy Sum (GeV)

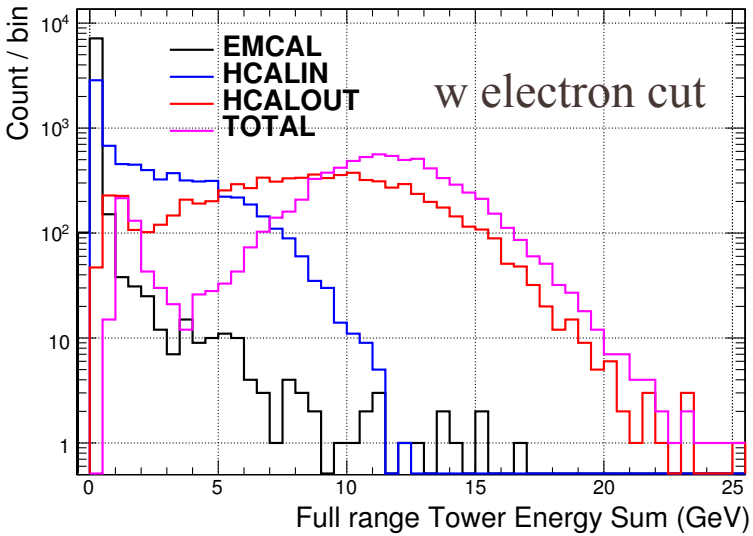

EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)

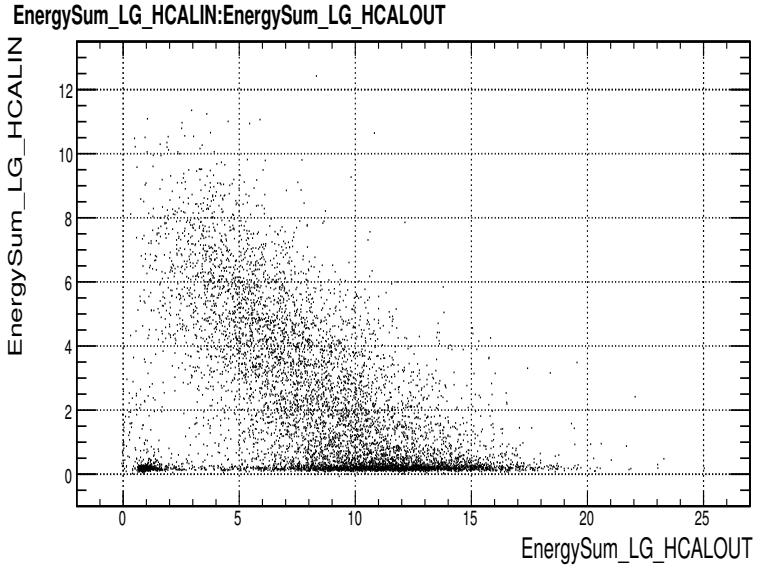

EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# 16 GeV

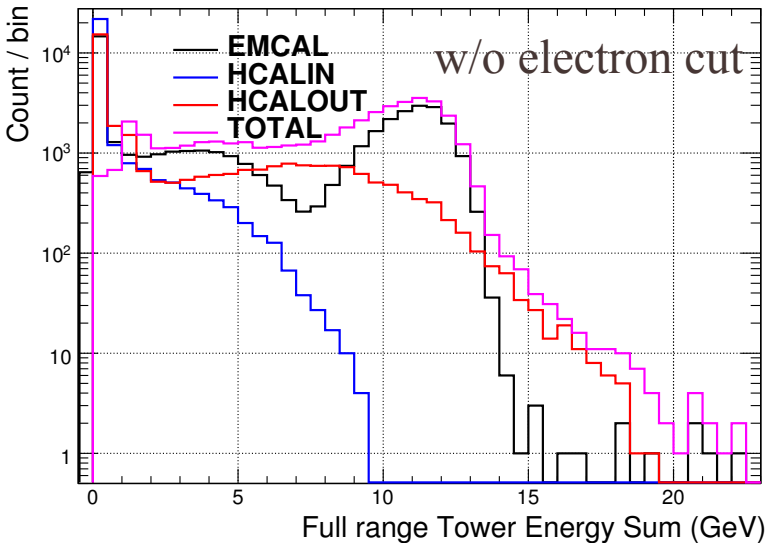

EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)

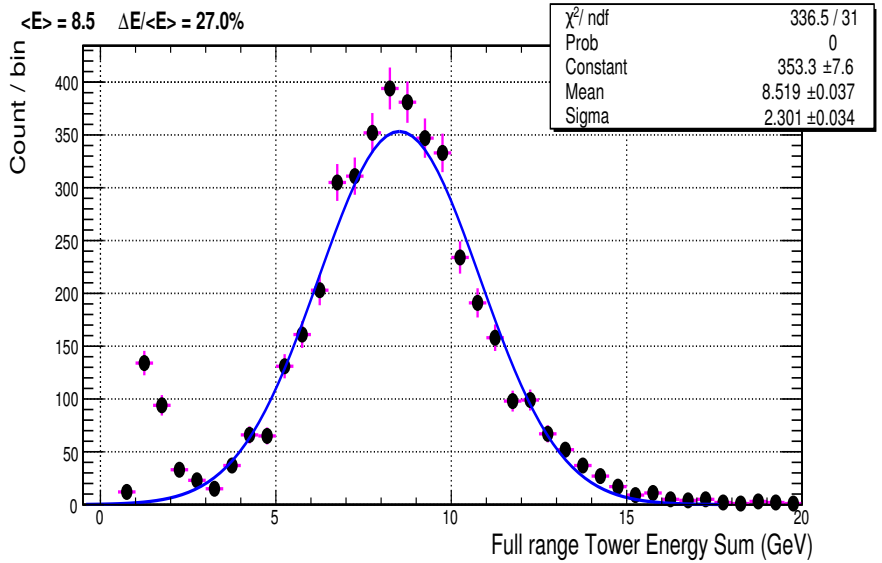

<E> = 11.6 ΔE/<E> = 23.7%
χ²/ ndf 513.7 / 41
Prob 0
Constant 513.9 ±8.1
Mean 11.58 ±0.03
Sigma 2.75 ±0.03
Count / bin
Full range Tower Energy Sum (GeV)

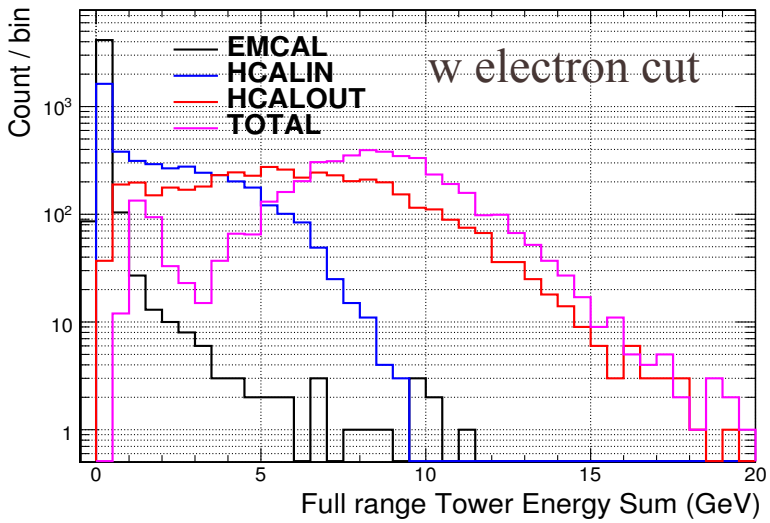

EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)

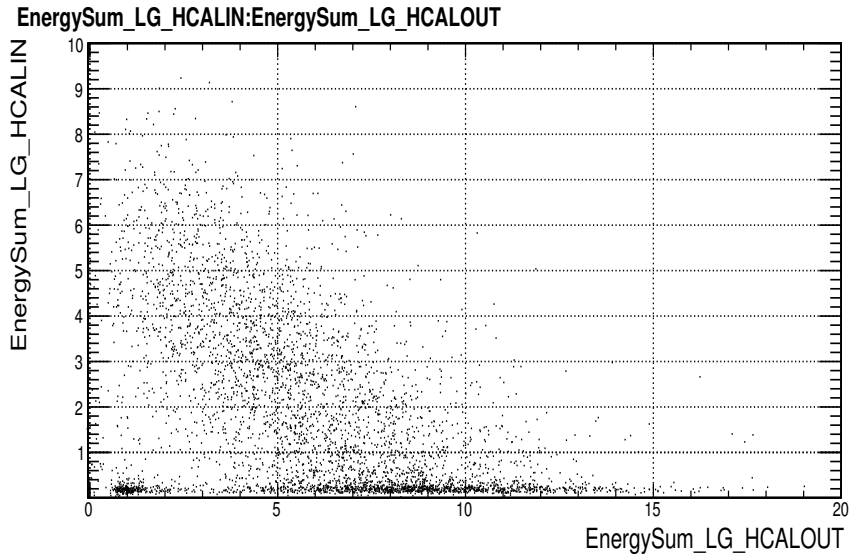

EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# 12 GeV

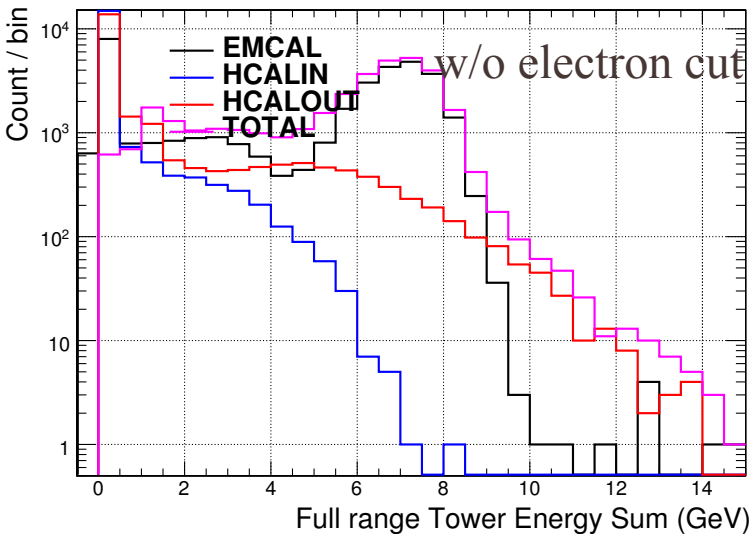

EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)

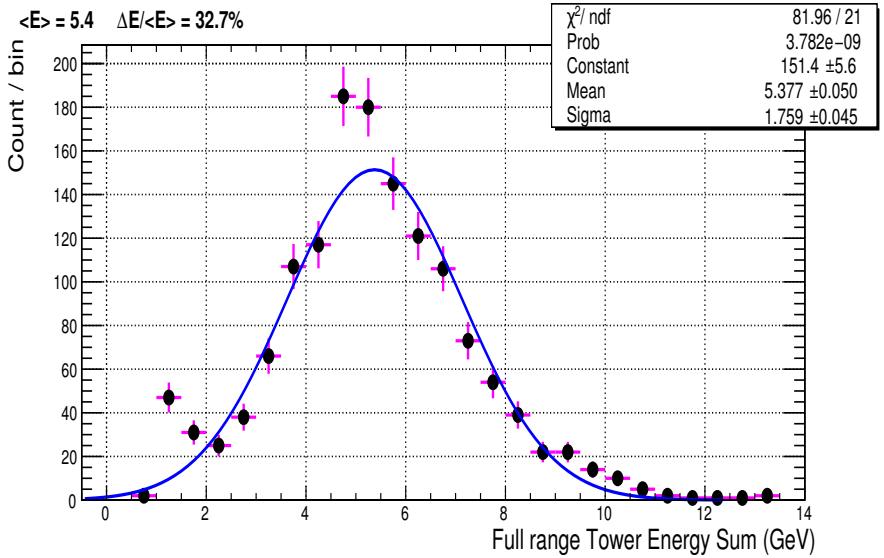

<E> = 8.5 ΔE/<E> = 27.0%
χ2/ ndf 336.5 / 31
Prob 0
Constant 353.3 ±7.6
Mean 8.519 ±0.037
Sigma 2.301 ±0.034
Count / bin
Full range Tower Energy Sum (GeV)

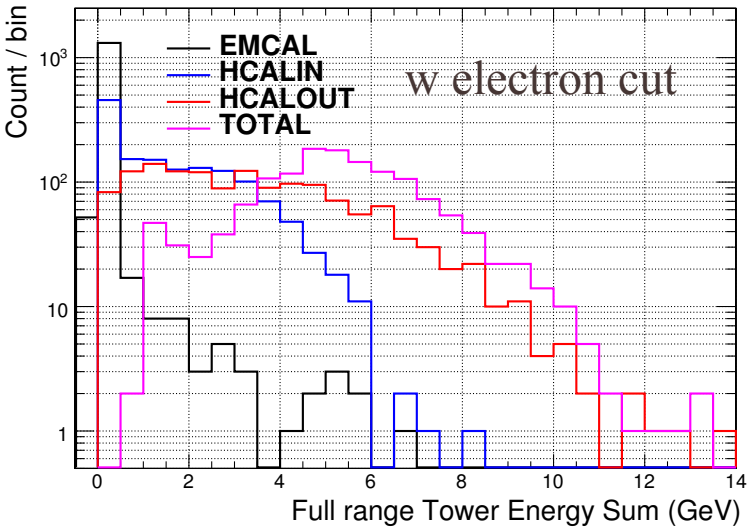

EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)

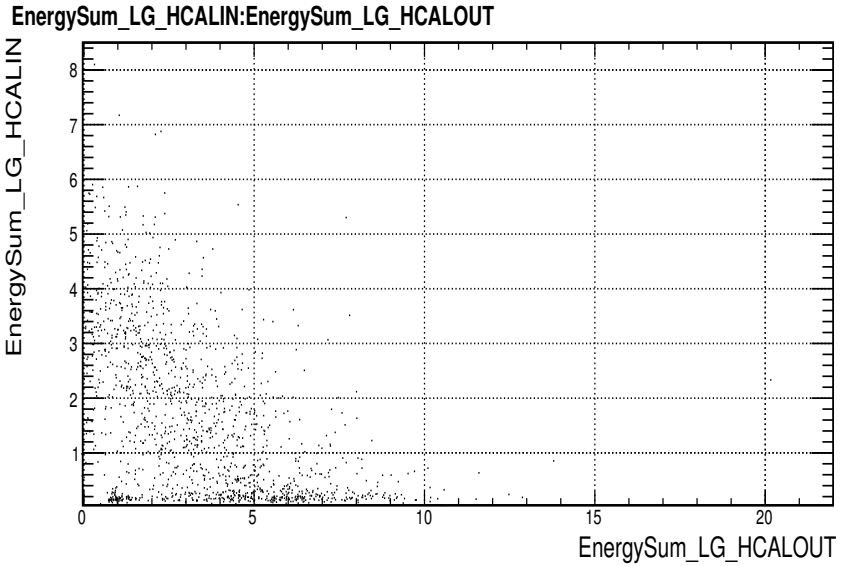

EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# 8 GeV

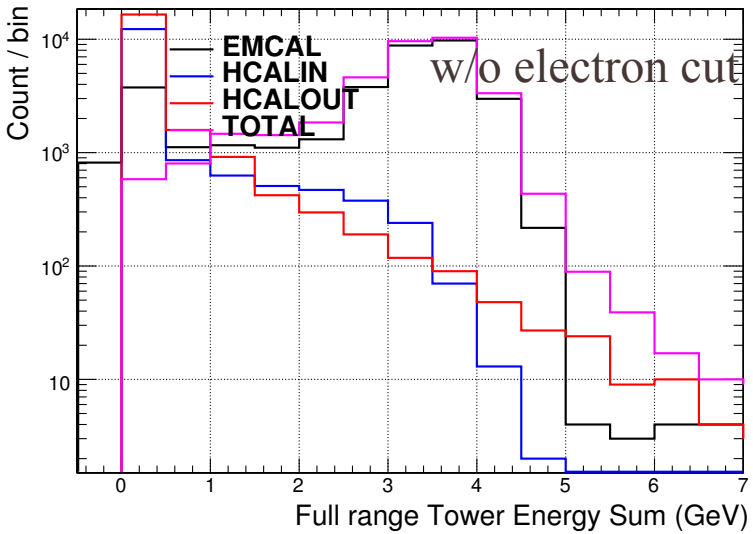

EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)

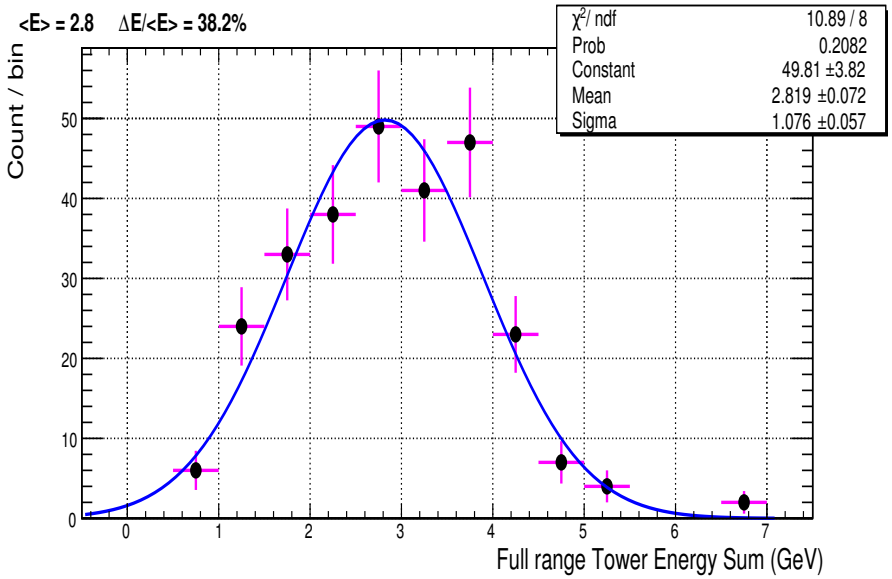

<E> = 5.4 ΔE/<E> = 32.7%
χ2/ ndf 81.96 / 21
Prob 3.782e−09
Constant 151.4 ±5.6
Mean 5.377 ±0.050
Sigma 1.759 ±0.045
Count / bin
Full range Tower Energy Sum (GeV)

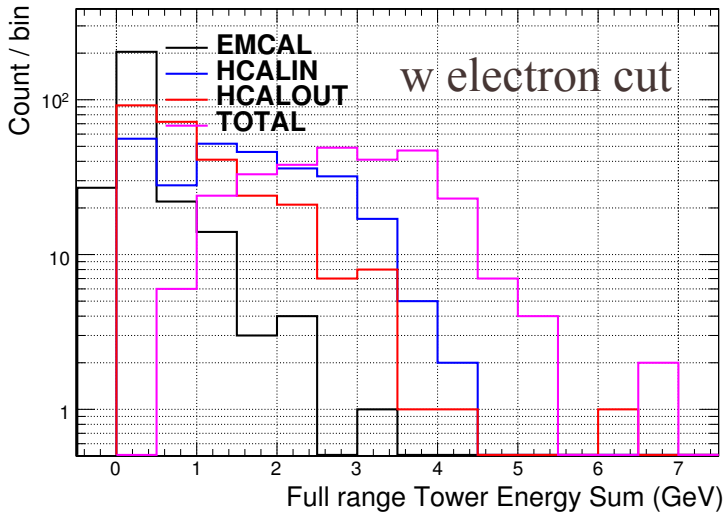

EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)

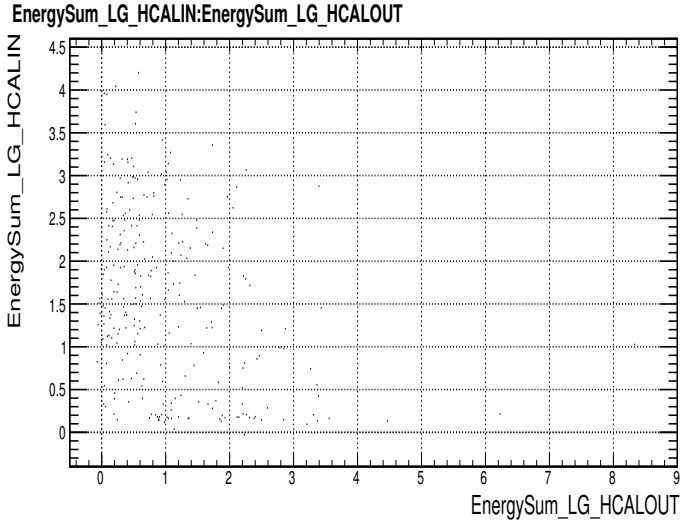

EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# 4 GeV

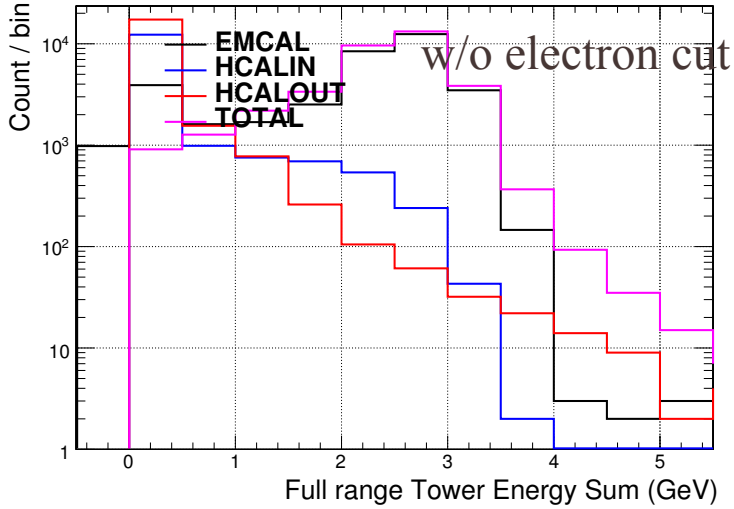

EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)

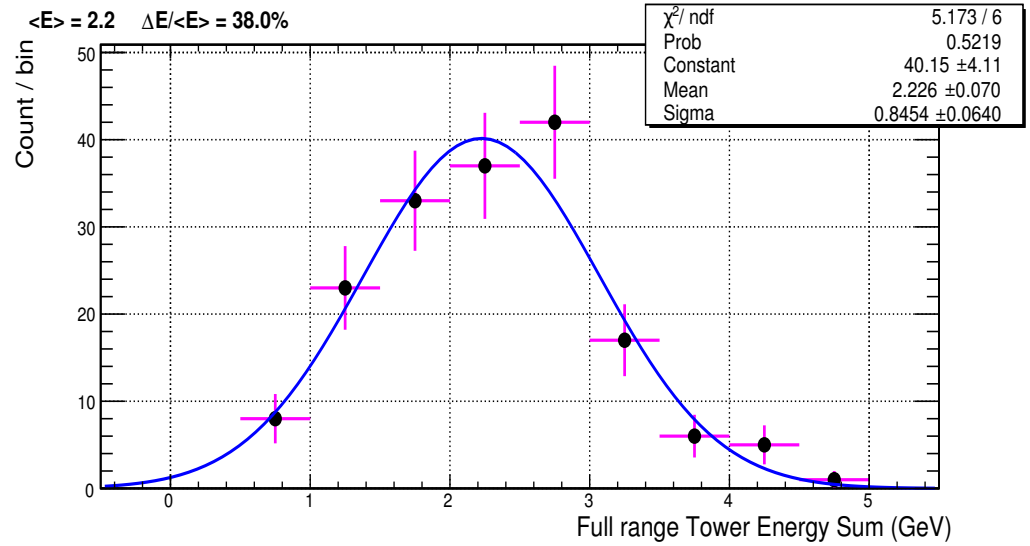

<E> = 2.8 ΔE/<E> = 38.2%
χ2/ ndf 10.89 / 8
Prob 0.2082
Constant 49.81 ±3.82
Mean 2.819 ±0.072
Sigma 1.076 ±0.057
Count / bin
Full range Tower Energy Sum (GeV)

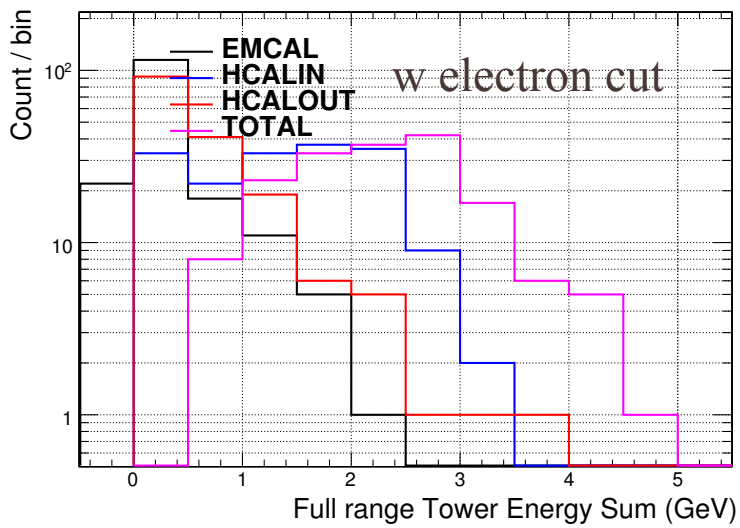

EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)

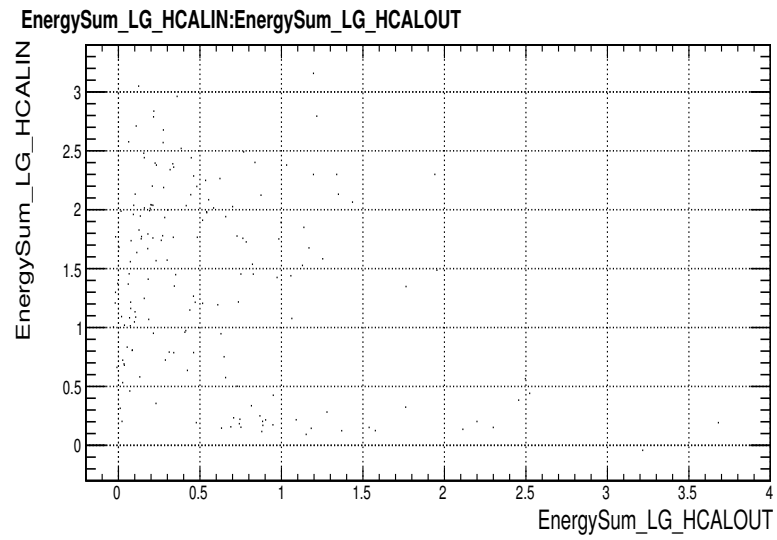

EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# 3 GeV

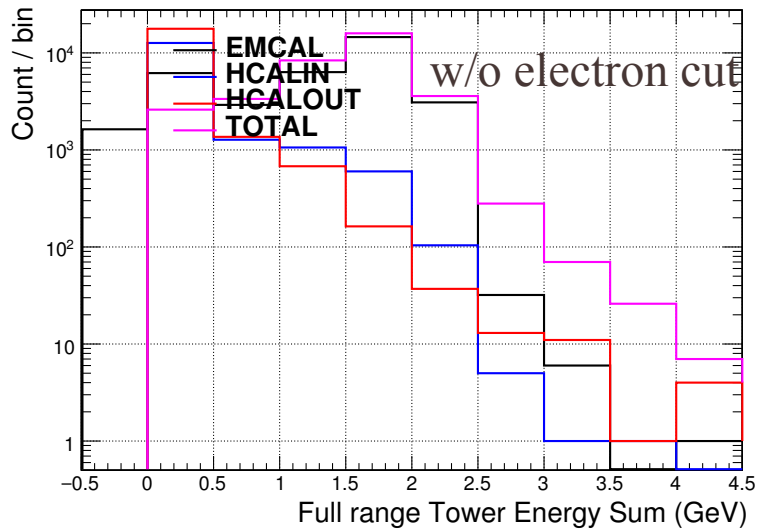

EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)

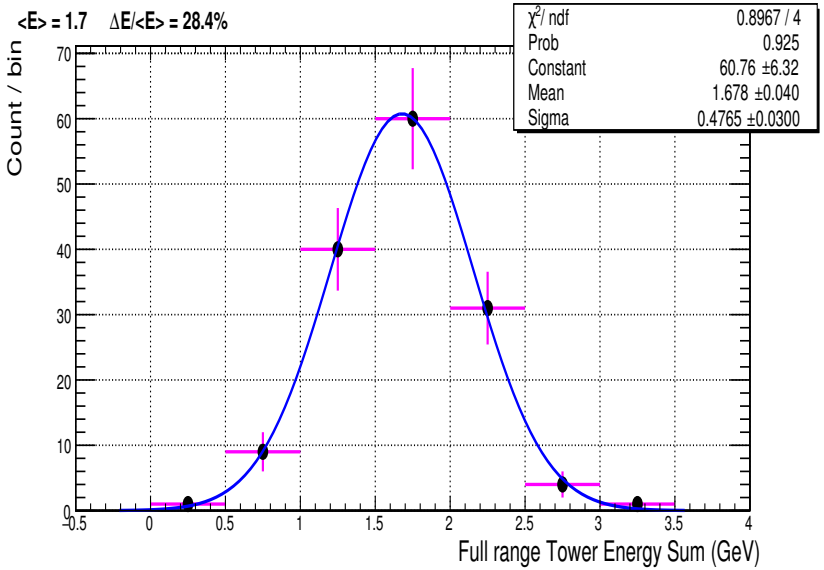

<E> = 2.2 ΔE/<E> = 38.0%
χ2/ ndf 5.173 / 6
Prob 0.5219
Constant 40.15 ±4.11
Mean 2.226 ±0.070
Sigma 0.8454 ±0.0640
Count / bin
Full range Tower Energy Sum (GeV)

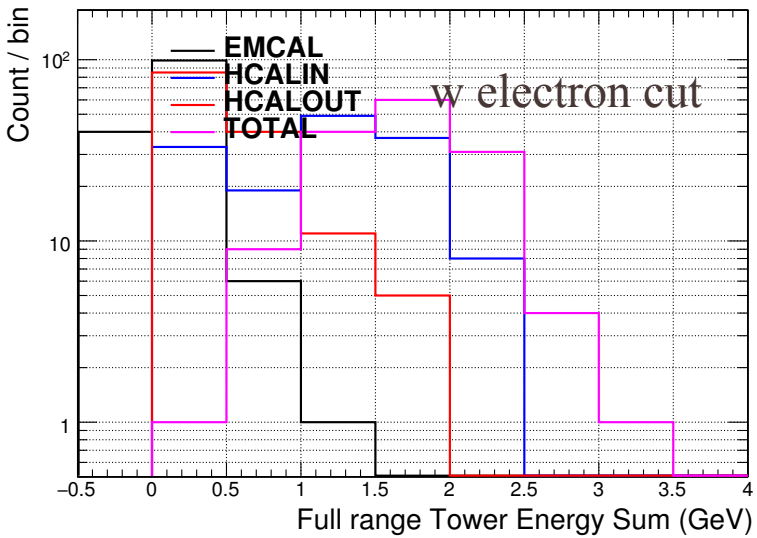

EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)

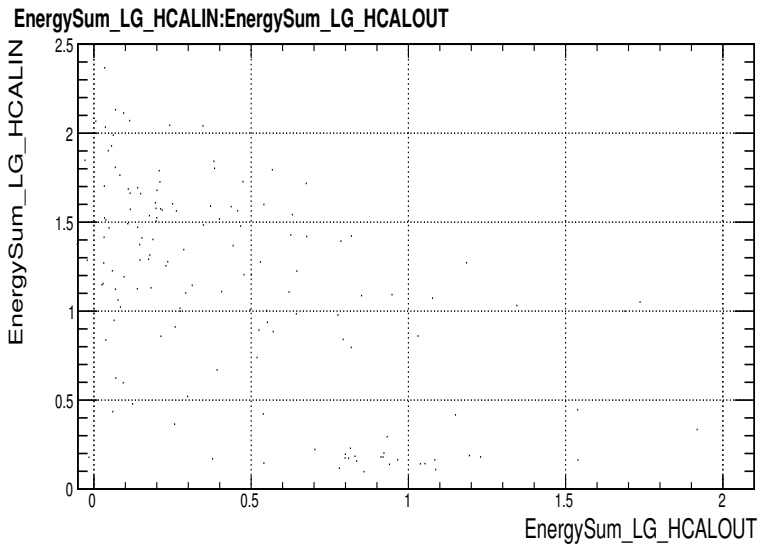
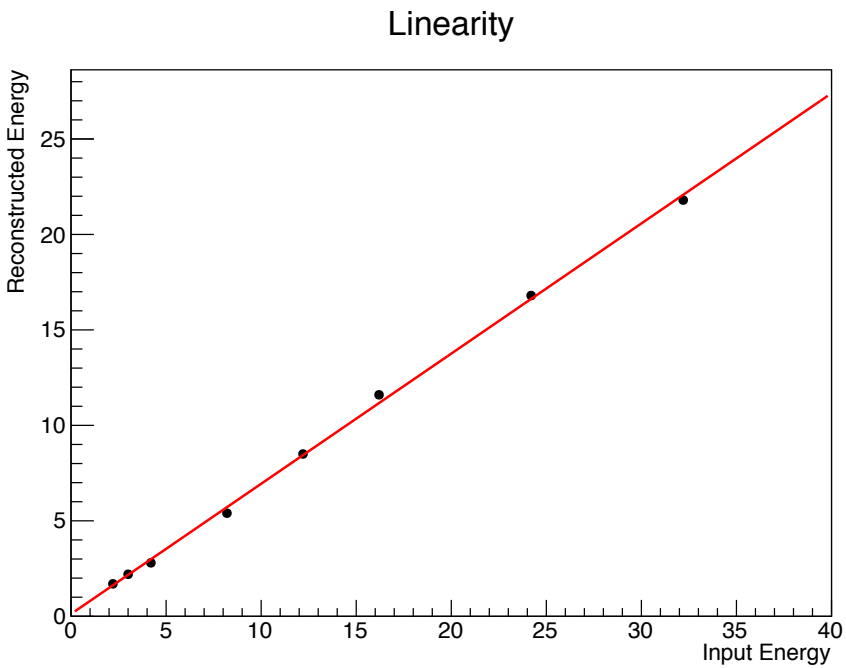
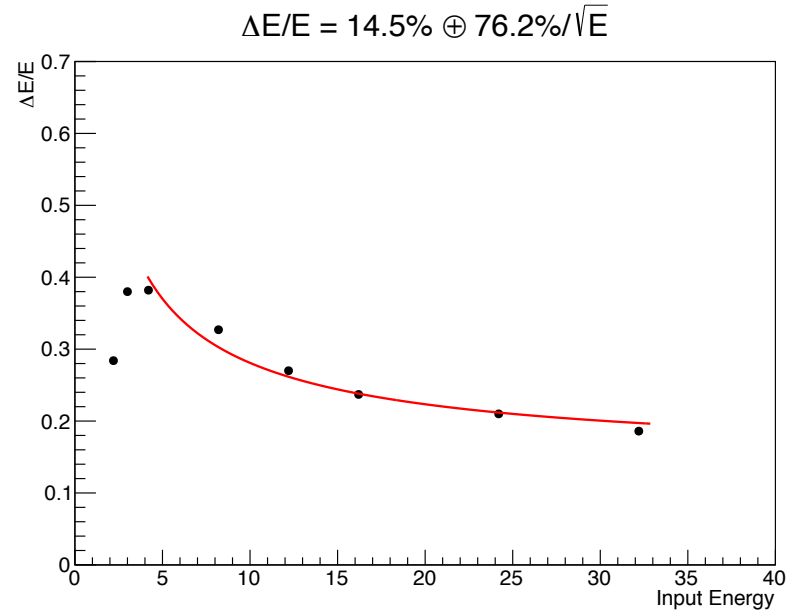

EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# 2 GeV


EMCAL
HCALIN
HCALOUT
TOTAL
w/o electron cut
Count / bin
Full range Tower Energy Sum (GeV)


<E> = 1.7 ΔE/<E> = 28.4%
χ²/ ndf 0.8967 / 4
Prob 0.925
Constant 60.76 ±6.32
Mean 1.678 ±0.040
Sigma 0.4765 ±0.0300
Count / bin
Full range Tower Energy Sum (GeV)


EMCAL
HCALIN
HCALOUT
TOTAL
w electron cut
Count / bin
Full range Tower Energy Sum (GeV)


EnergySum_LG_HCALIN:EnergySum_LG_HCALOUT
EnergySum_LG_HCALIN
EnergySum_LG_HCALOUT

# HCAL preformance