Muon Scan
Testbeam 2024

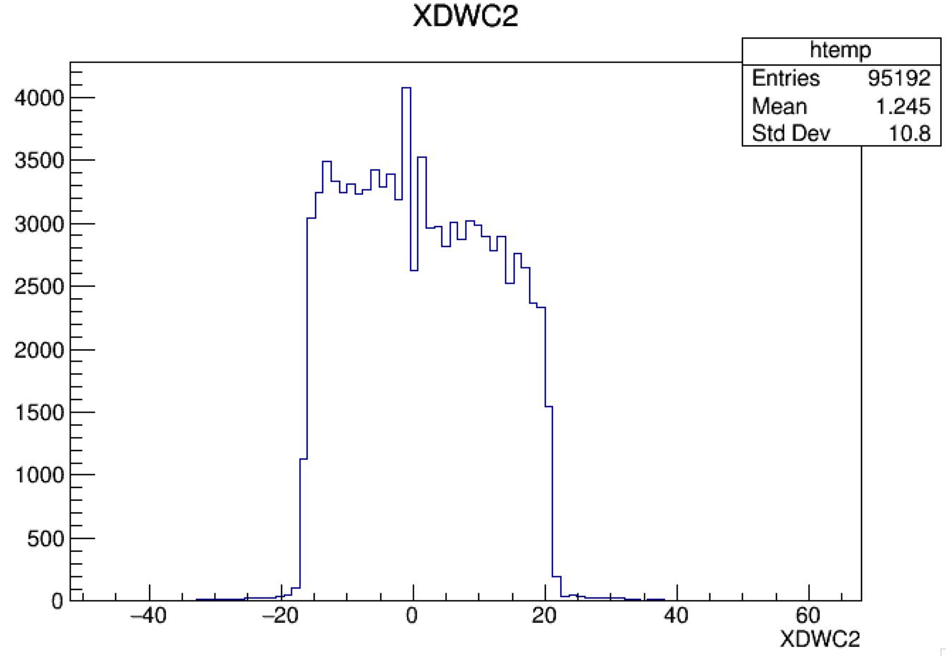
In this presentation

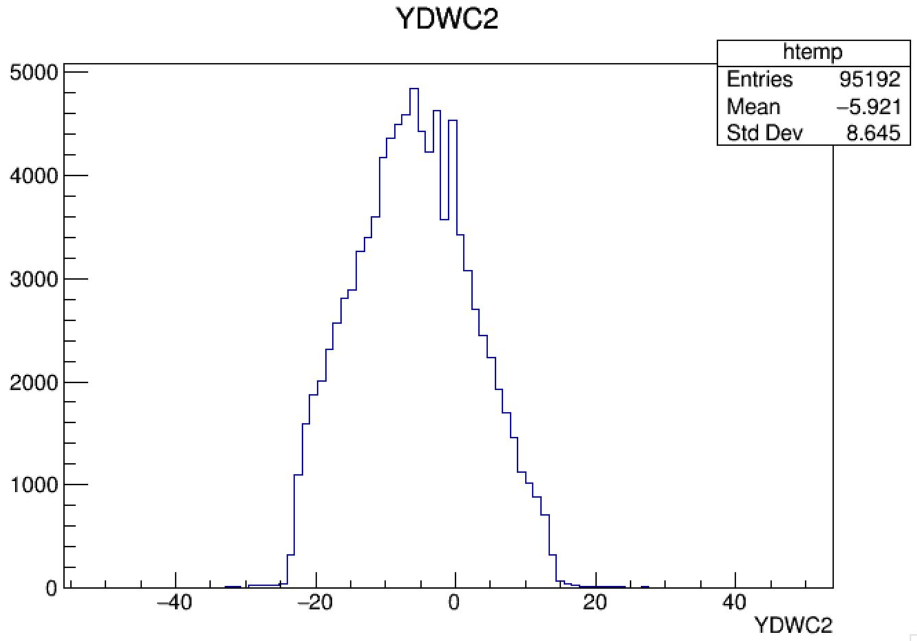
- Ancillaries pedestal studies
- Proposal cuts
- Scintillant - Cerenkov distribution vs muon energy scan

General info

- Run considered for testing: 992
- Pedestal run: 974, 993

XDWC2 and YDWC2



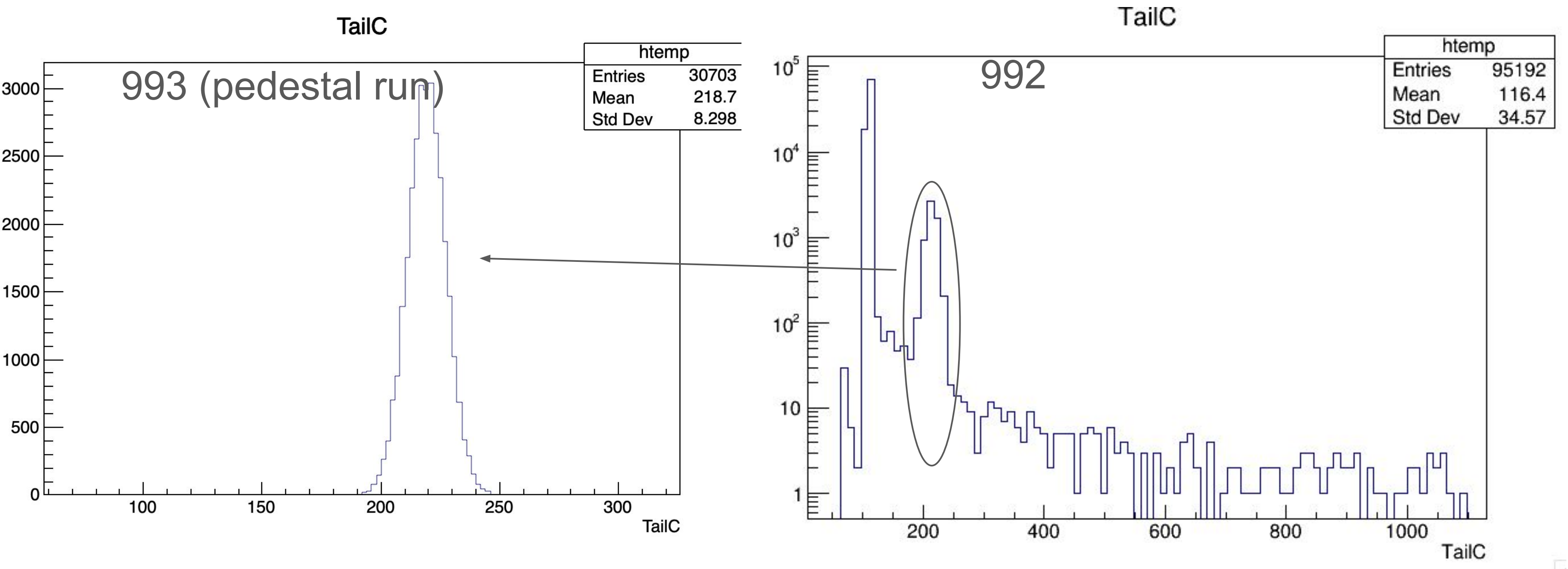


xmin = Mean - 2 σ < X < Mean + 2 σ = xmax

ymin = Mean - 2 σ < Y < Mean + 2 σ = ymax

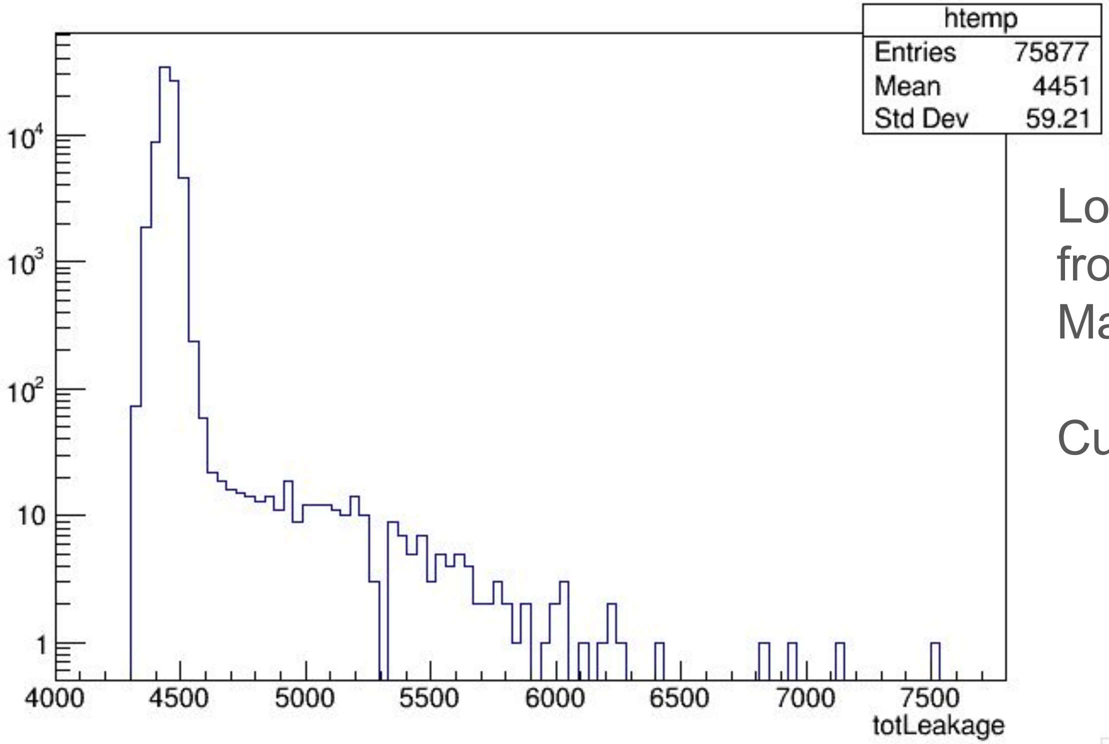
If considered gaussian, 2 σ corresponds to more than 95% of efficiency.

Tail Catcher



Cut: TailC<180, TailC>242

Leakage

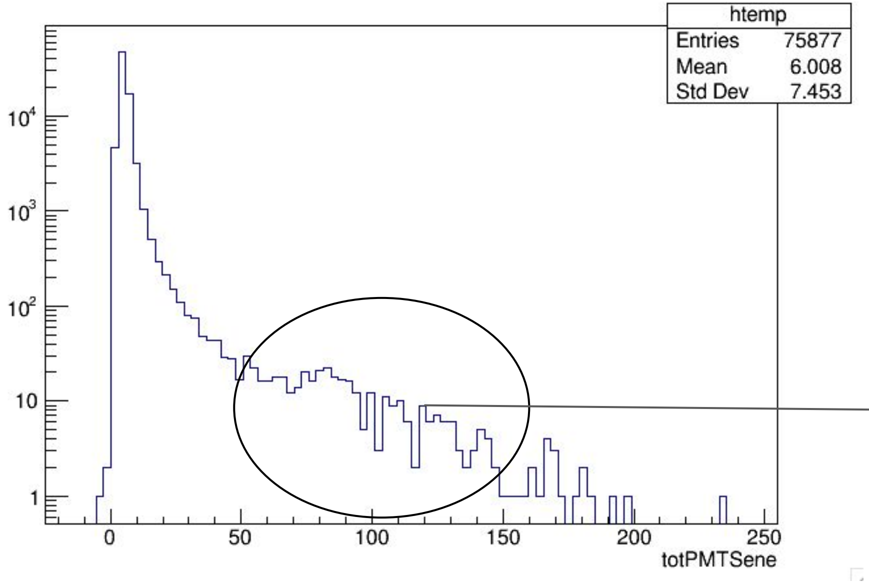


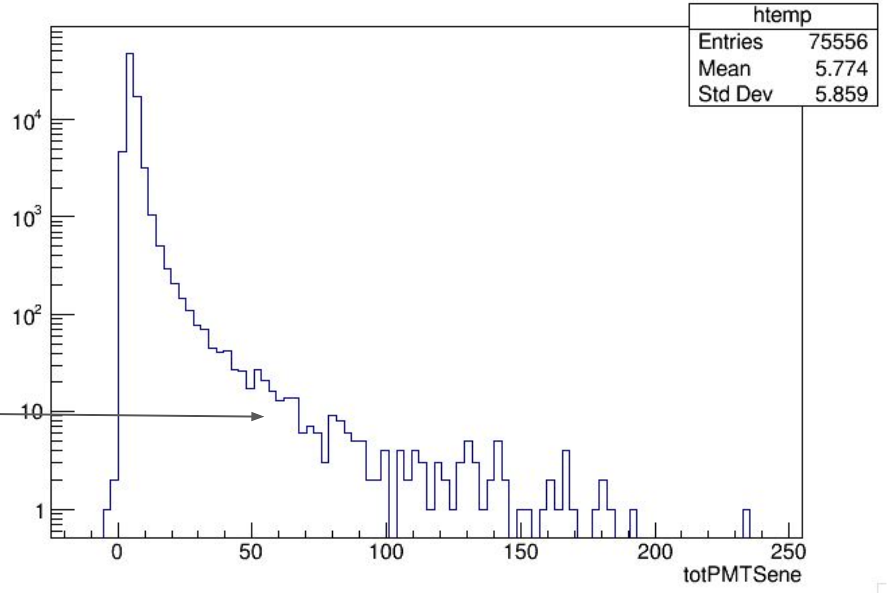
Long queue probably not coming from muon or electron deposits. Maybe pion contribution (?)

Cut: totLeakage < 4600

Leakage - after cut - effect on PMT energy

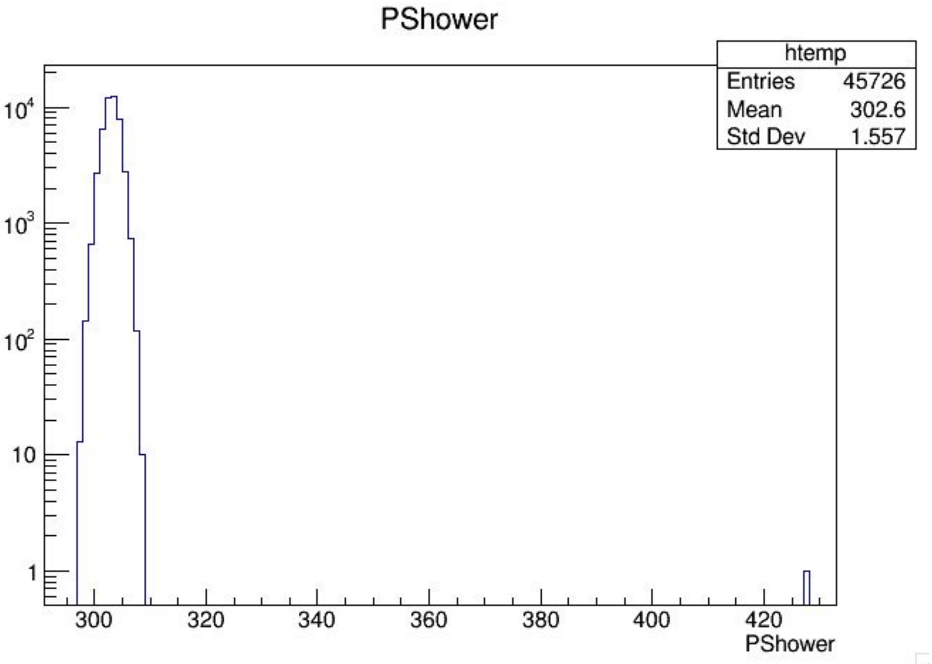
The adding of the leakage cut has an effect on the peak at 80 (60) in the tot energy deposited in the PMT Scint (Cherenkov).

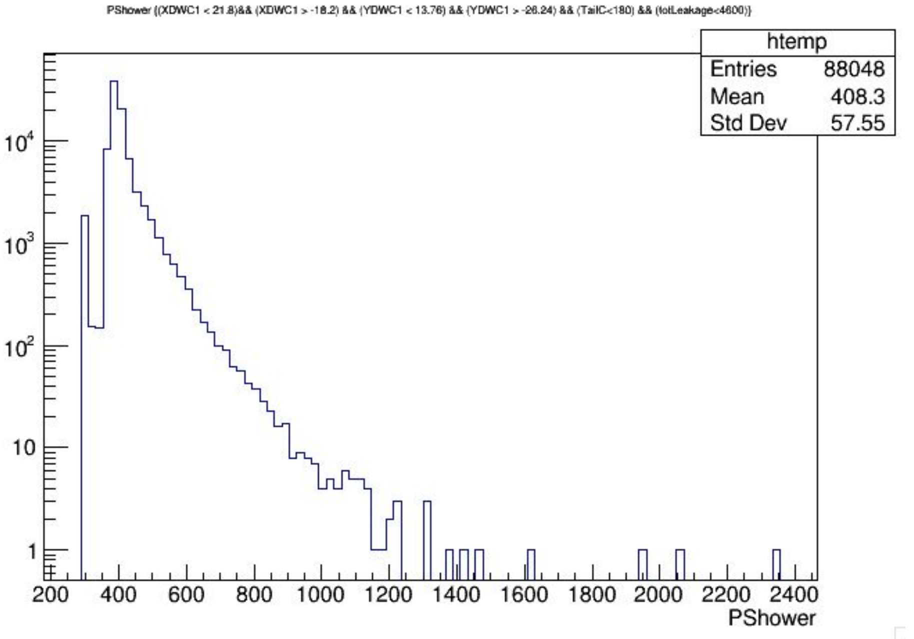




PShower

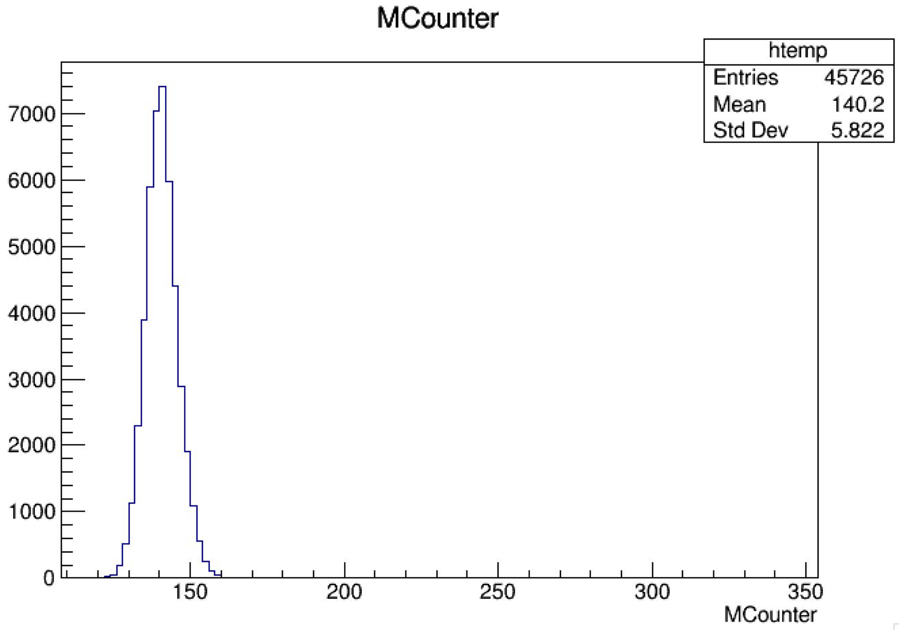
350<PShower<450 for MIP identification and removing the pedestal.

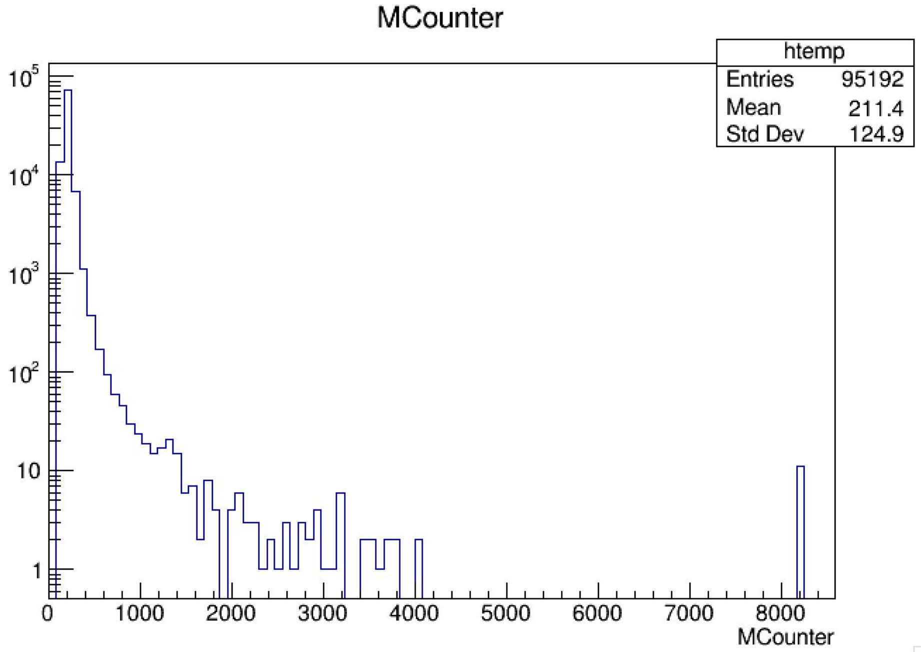




Muon Counter

Pedestal

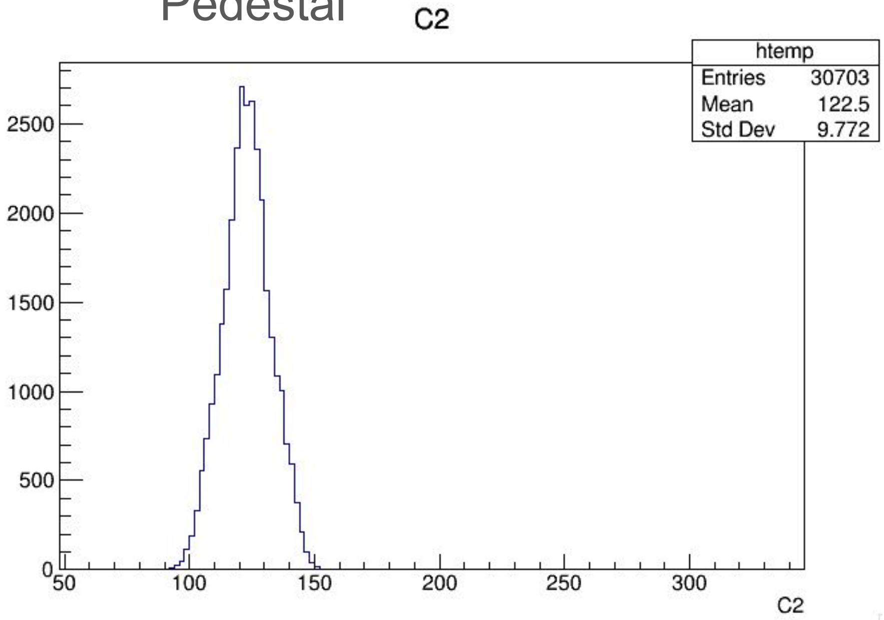


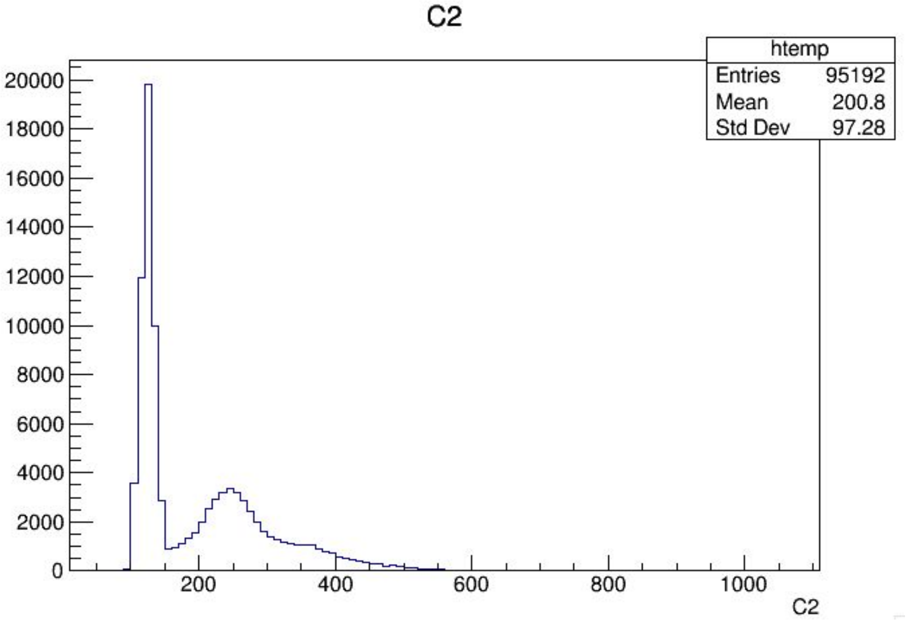


Cut proposed : Mcounter <8000, MCounter>160

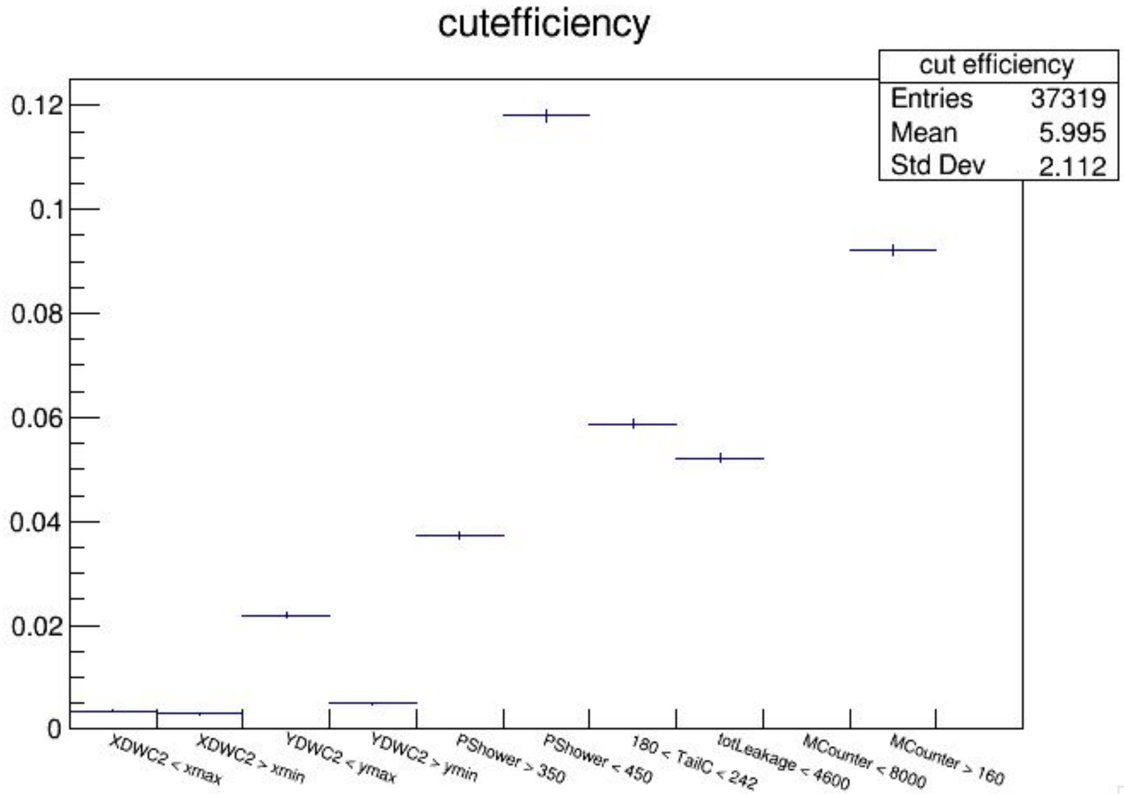
C2

Pedestal


C2
htemp
Entries 30703
Mean 122.5
Std Dev 9.772
0
500
1000
1500
2000
2500
50
100
150
200
250
300
C2


C2
htemp
Entries 95192
Mean 200.8
Std Dev 97.28
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
200
400
600
800
1000
C2

Efficiency run 992



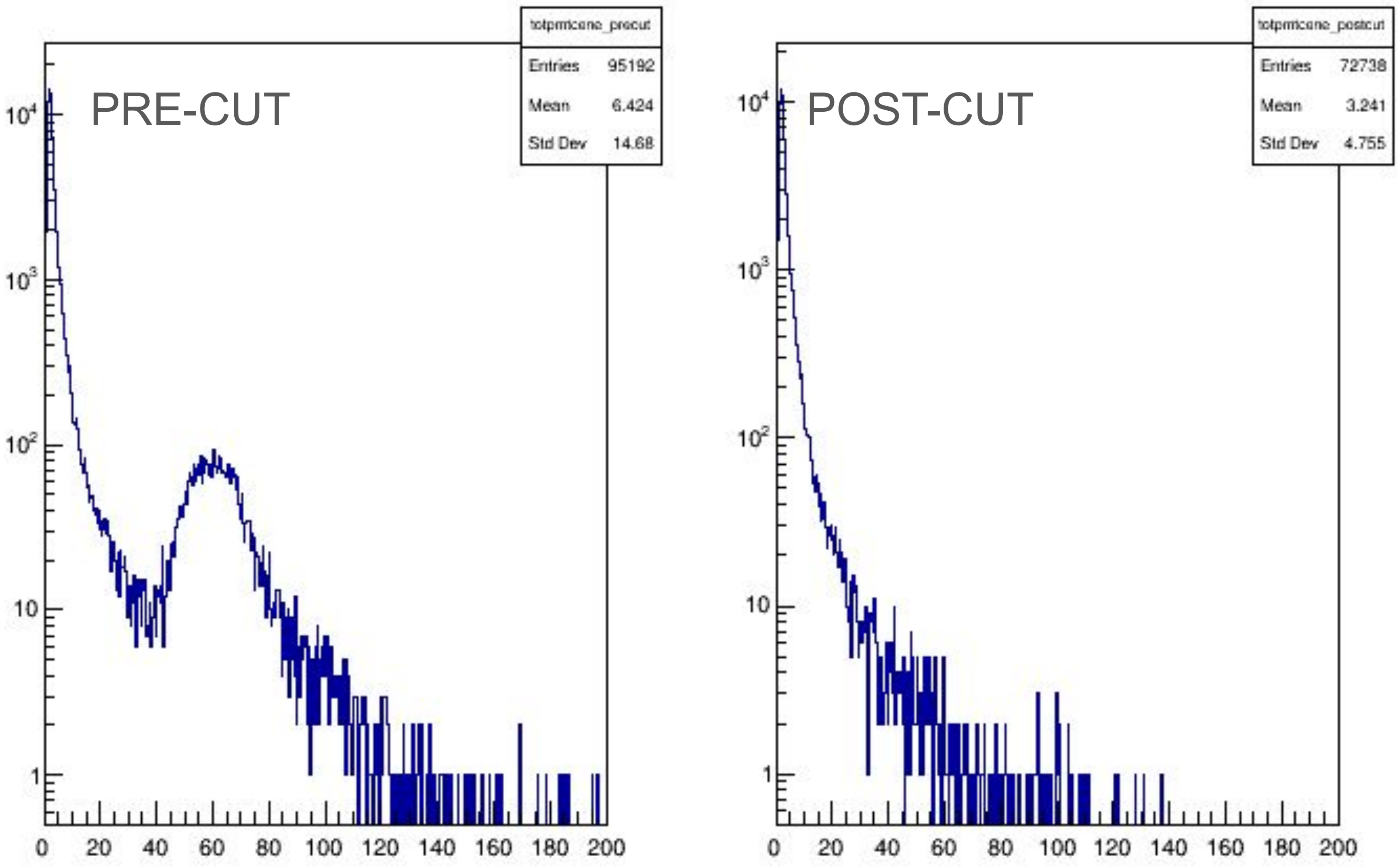
XDWC2<xmax	0.4%
XDWC2>xmin	0.3%
YDWC2<ymax	2%
YDWC2>ymin	0.5%
PShower>350	4%
PShower <450	12%
TailC<180 || TailC>242	6%
totLeakage<4600	5%
MCounter<800	0.011%
MCounter>160	9%
tot lost eff	39%

Efficiency per run

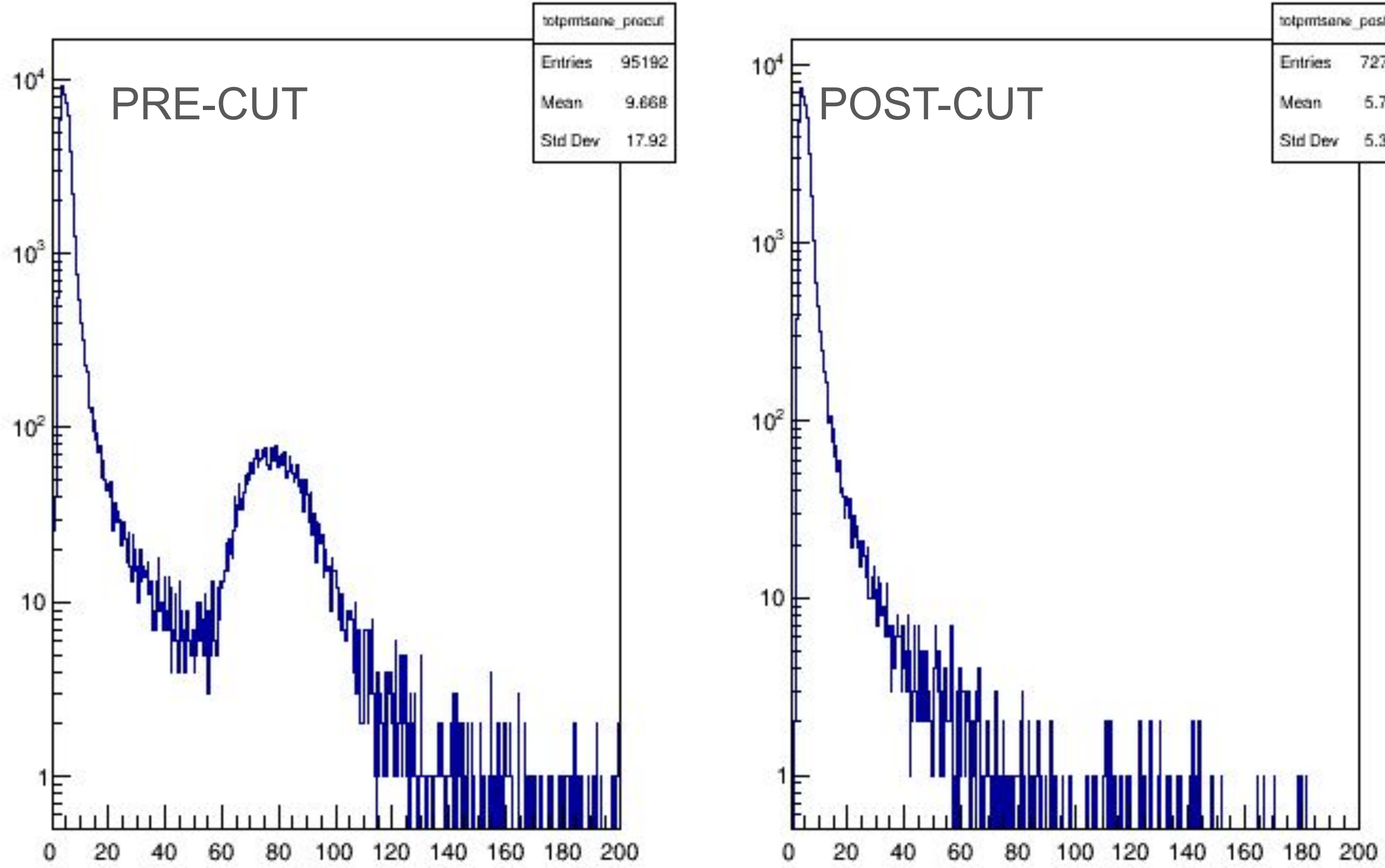
Run #	Energy [GeV]	XDWC2	YDWC2	PShower	TailC	totLeak	MCounter	Efficiency
992	110	0.7%	3%	16%	6%	5%	9%	61%
982	120	0.7%	2%	16%	5%	5%	9%	62%
983	130	0.6%	3%	16%	4%	4%	8%	65%
988	140	0.7%	3%	16%	3%	3%	7%	68%
989	150	0.6%	3%	16%	2%	2%	6%	71%
990	160	0.6%	3%	15%	2%	1%	5%	73%
991	170	0.6 %	3%	15%	1%	1%	5%	74%

The most fluctuating variables are TailC, totLeak and MuonCounter. I can try to tune better the totLeak, while the other cuts depend on the pedestals.

tot Cherenkov energy



tot Scintillant energy



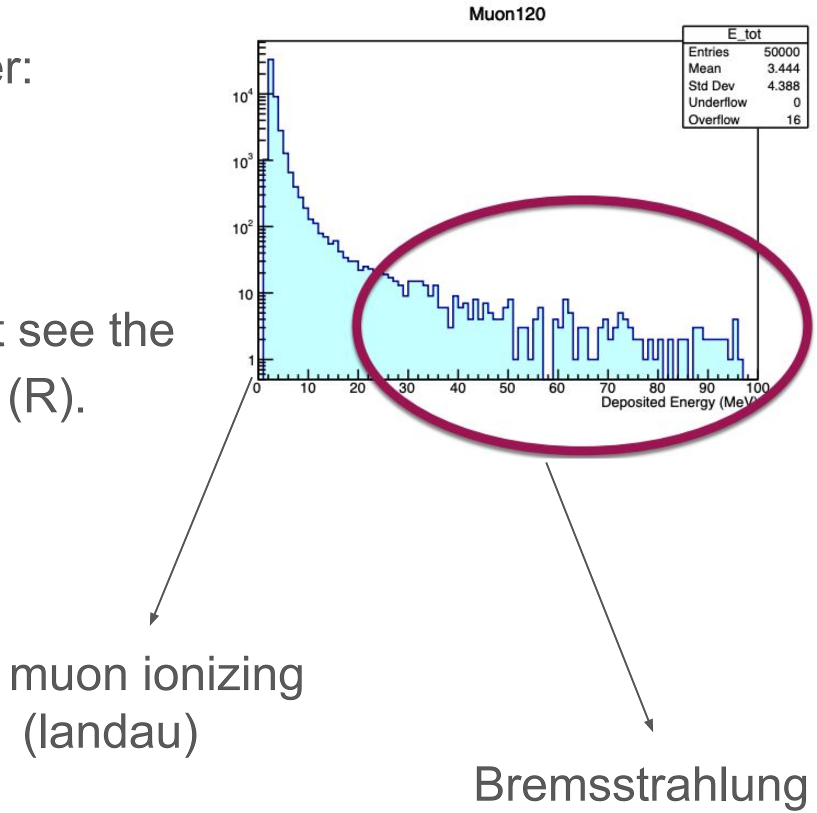
Analysis scope

Energy contribution for muons in the calorimeter:

- Ionizing
- Radiation emissions

For geometric reasons, the cherenkov does not see the ionization (I), but only the radiation contribution (R).

While scintillator can see both.



Analysis scope

Consideration:

- cherenkov and scintillator are calibrated at the same energy value
- that the radiation contribution is energy **dependent**.

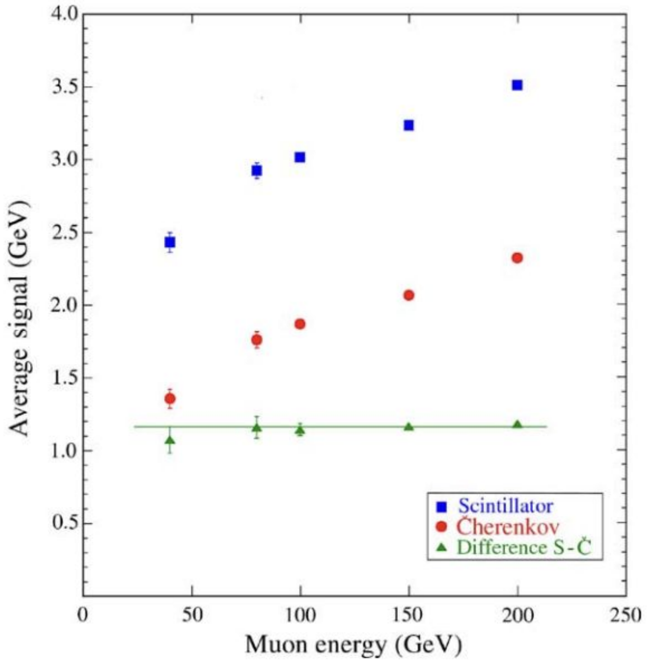
We expect that:

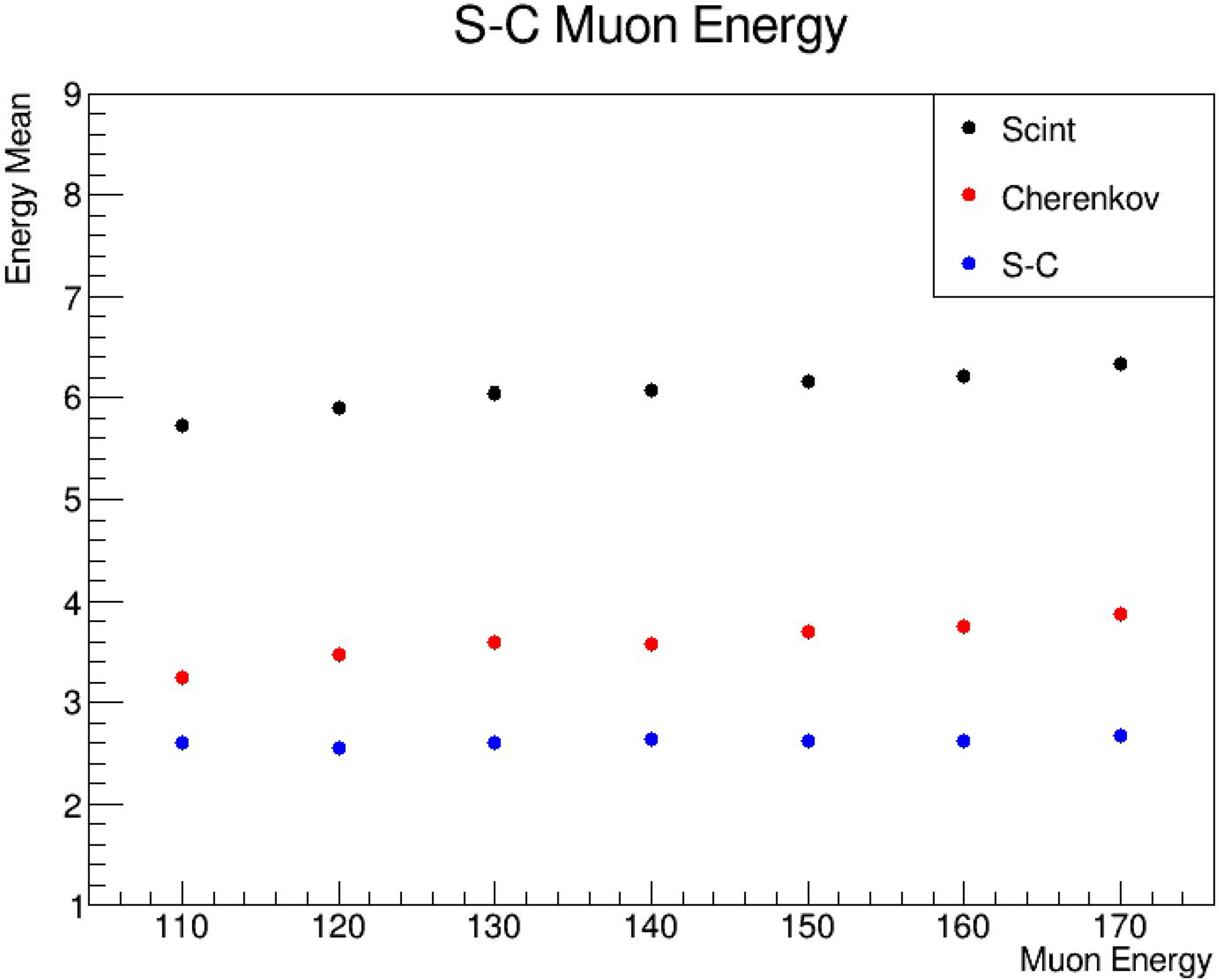
S(E)= I1 + R(E)

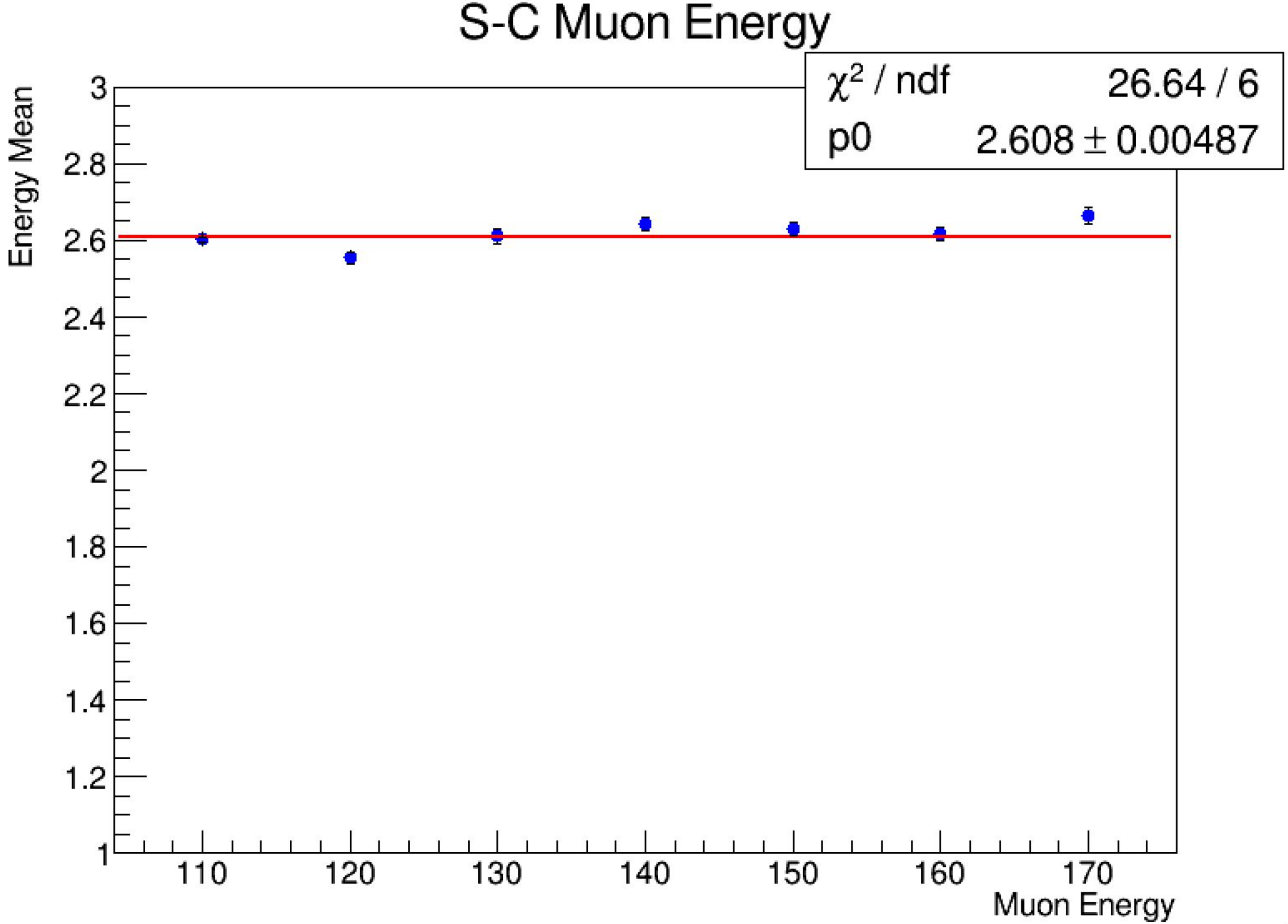
C(E)= I2 + R(E)

S(E)-R(E) = I1-I2 which is constant in energy, (if we suppose the ionizing contribution is constant as well).

The idea is to reproduce the plot on the right measured with DREAM, in this article, where the difference S-C was found to be constant.



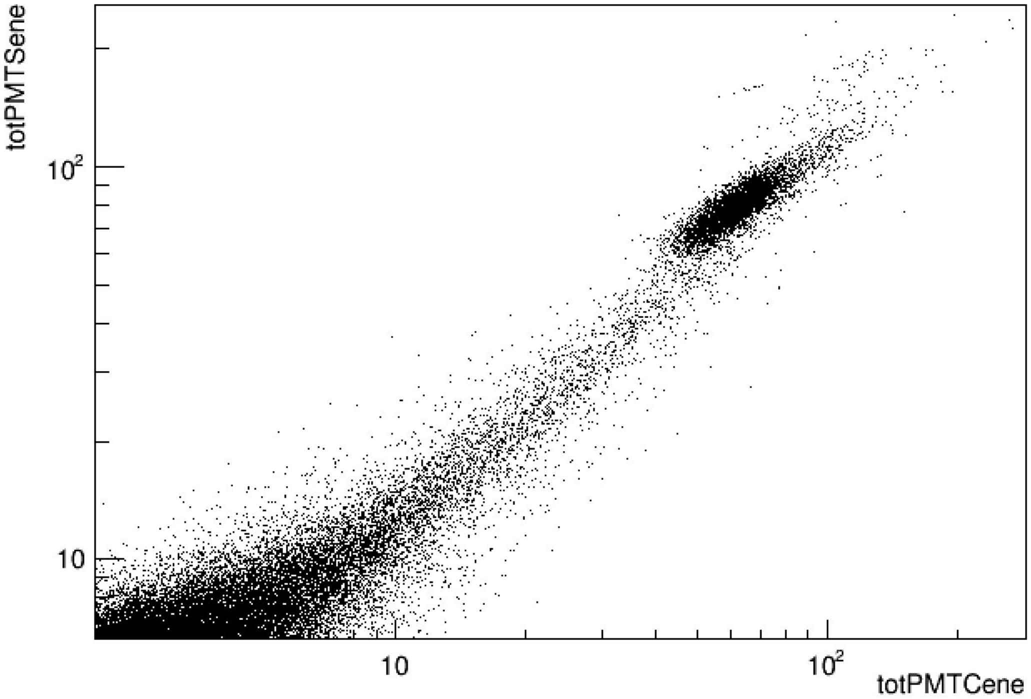

S-C Muon Energy
Energy Mean
9
8
7
6
5
4
3
2
1
110
120
130
140
150
160
170
Muon Energy
Scint
Cherenkov
S-C



S-C Muon Energy
χ^2 / ndf 26.64 / 6
p0 2.608 ± 0.00487
Energy Mean
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
110
120
130
140
150
160
170
Muon Energy

S vs C correlation

For the S-C subtraction, I could not directly propagate the error since the uncertainty was overestimated. We have to take into account also the strong correlation between the two distributions. (Thanks Bob for the suggestion).



Conclusions

- Proposal of several cuts on ancillaries, looking at the pedestals
- Efficiency decrease with the energy run increasing, can be tuned a bit better the totLeak, but not sure how to proceed with Muon Counter and Tail Catcher.
- The new cuts remove totally the “gaussian” peak
- The Scintillant and Cherenkov distribution results correlated, necessary to take it into consideration for the uncertainty estimation of S-C
- S-C good estimation as constant

To Do:

Energy Mean calculated as the MPV of a landau fit and see the results

Something else?