Muon Scan
Testbeam 2024

Analysis scope

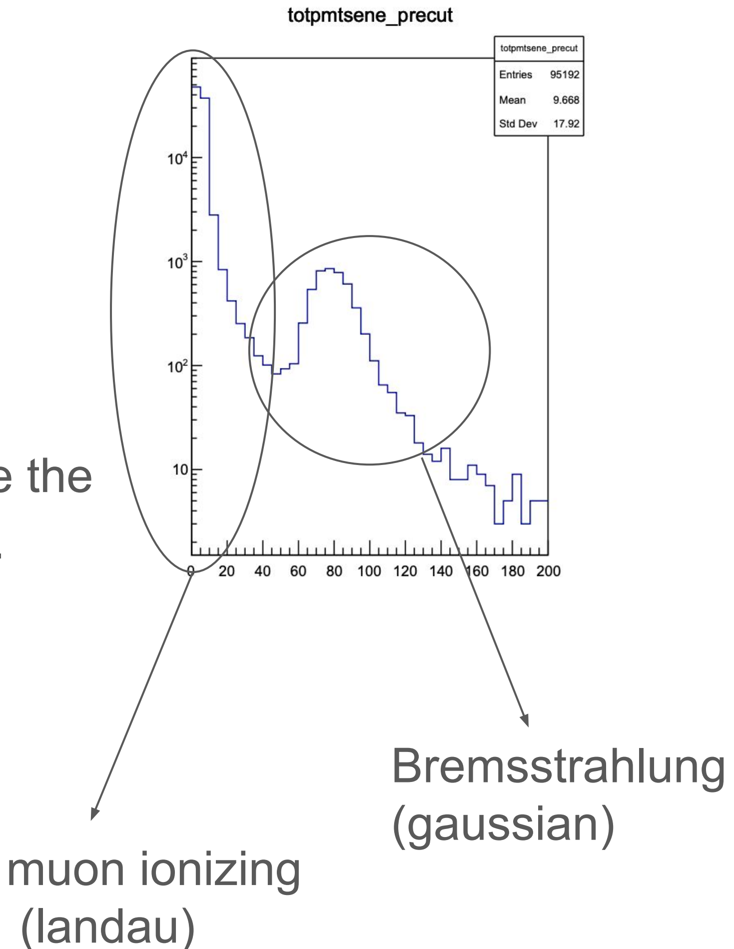
Energy contribution for muons in the calorimeter:

- Ionizing
- Radiation emissions

Describing by landau and gaussian distributions respectively.

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**.

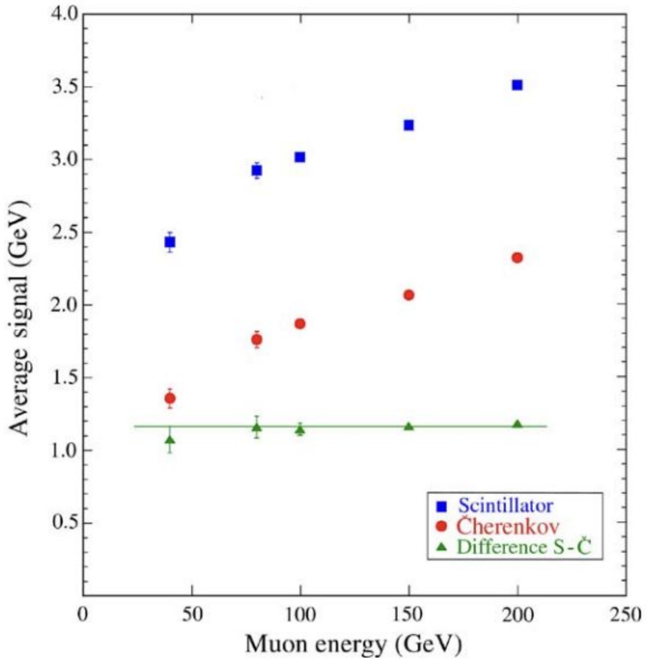
We expect that:

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.



Analysis strategy

1. Analysis cuts in order to improve the signal purity.
2. For each energy value of the scan on the total energy distribution for scintillator and cherenkov (starting from Gabriella and Nicolò code):
   a. Landau + Gaus fit: x[0]*Landau(x,x[1],x[2])+x[3]*Gaus(x, x[4],x[5])
   b. I considered the mean gauss parameter fit with uncertainty parameter
3. Plot all mean gaus with relative uncertainty vs muon energies

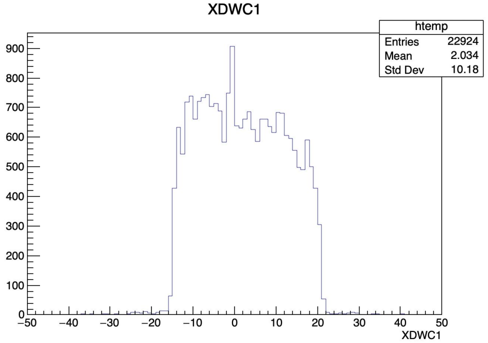
Muon Energy Scan in the central tower with NEW HV in Too

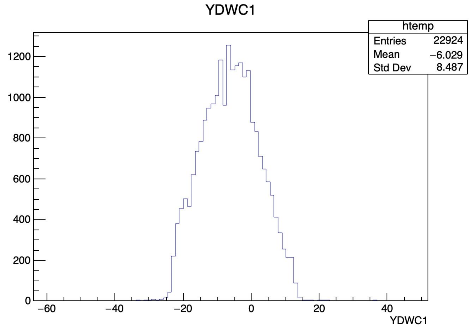
- Vertical angle 2.5°, Horizontal angle 2.5°
- X and Y position: (15; 855)

Run #	Energy [GeV]	N. Event (kevt)	Comment
982	120GeV	23	
983	130GeV	21	
988	140GeV	20.5	
989	150GeV	22	
990	160GeV	21	
991	170GeV	20	
992	110GeV	95	

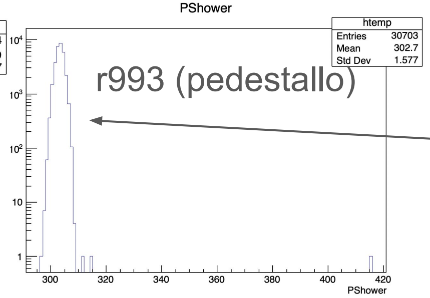
Cuts

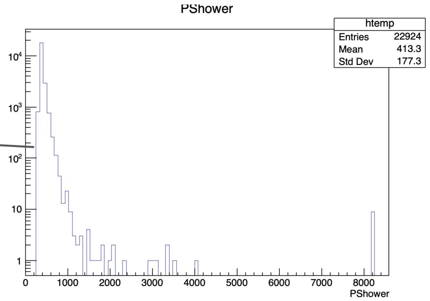
- -18.2<XDWC<21.8, -26.24<YDWC<13.76



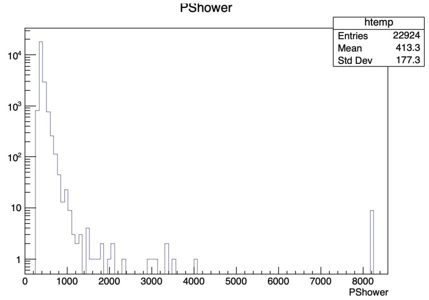


- PS>310 to remove pedestal



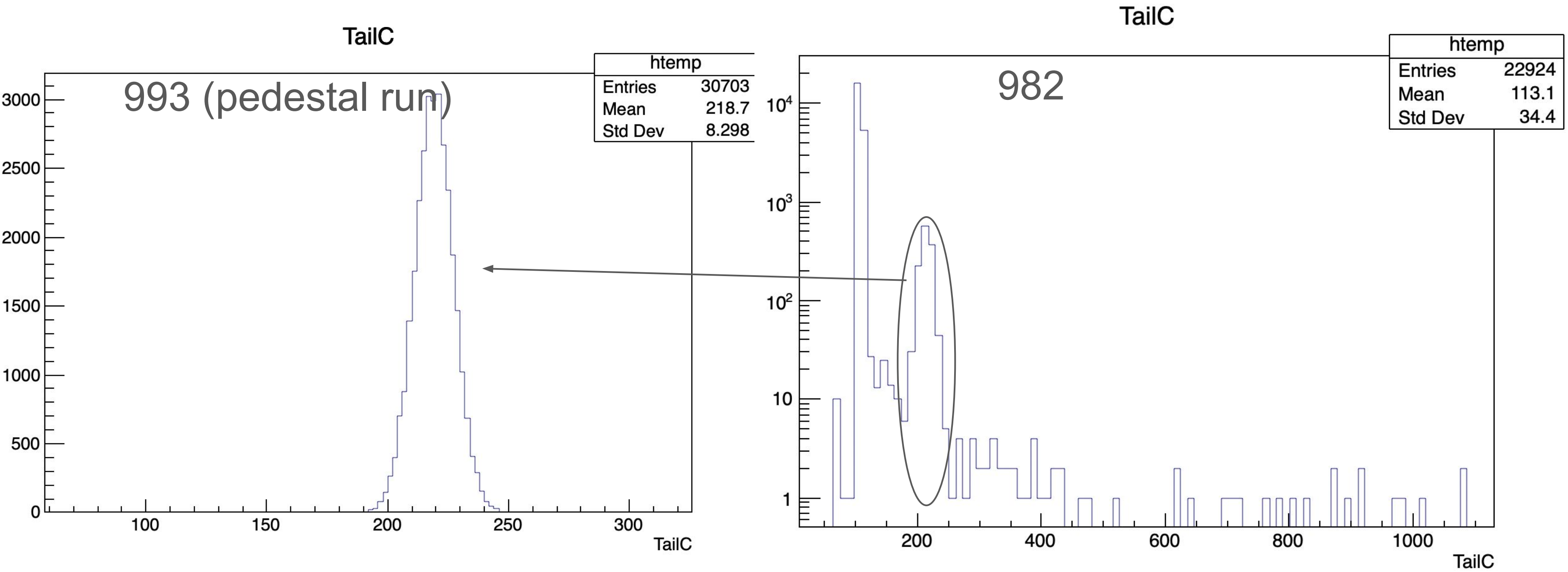


- PS<1000 for the separation between muons and electrons



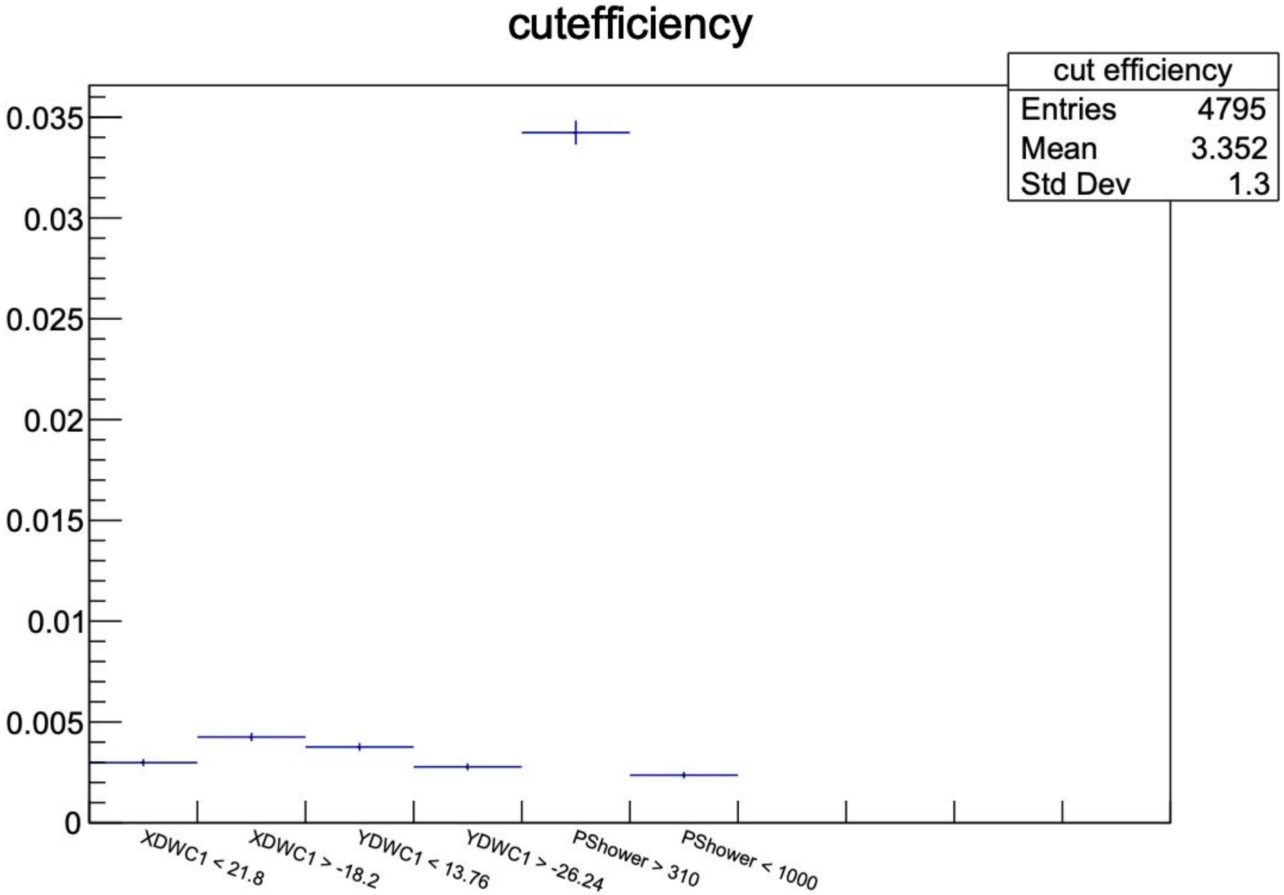
Cuts have an effect of 5% on the data

TailC pedestal strange behaviour



Pedestal looks shifted and appears in the middle of the distribution.

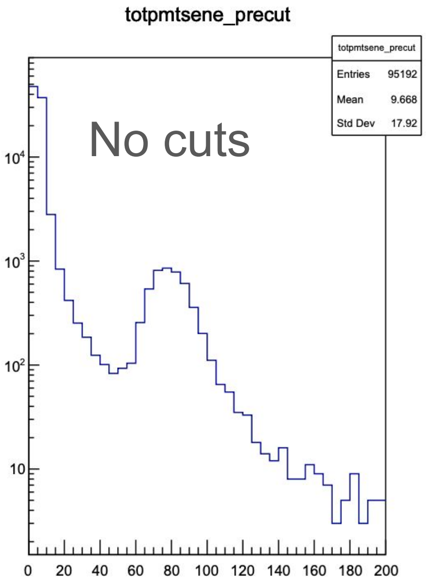
Run 992 E=110 GeV

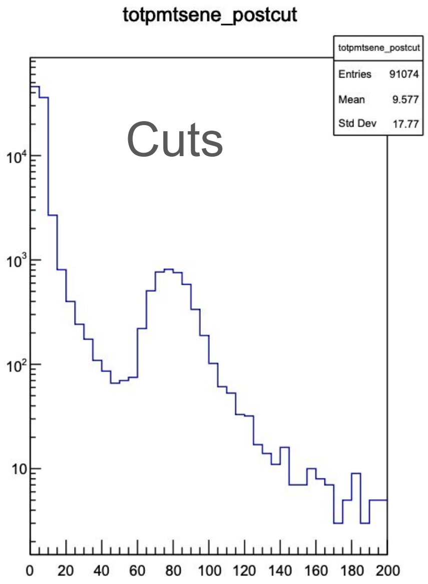


other runs in backup

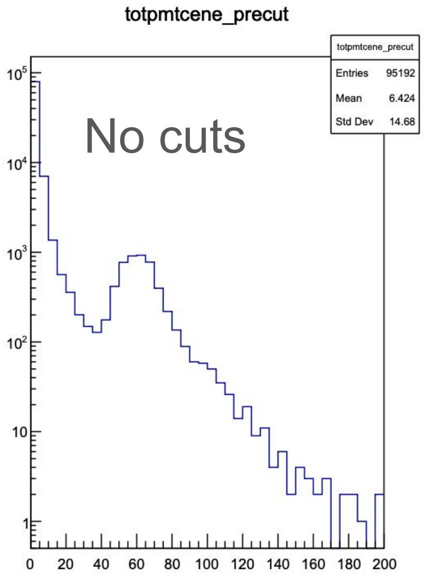
Run 992 E=110 GeV

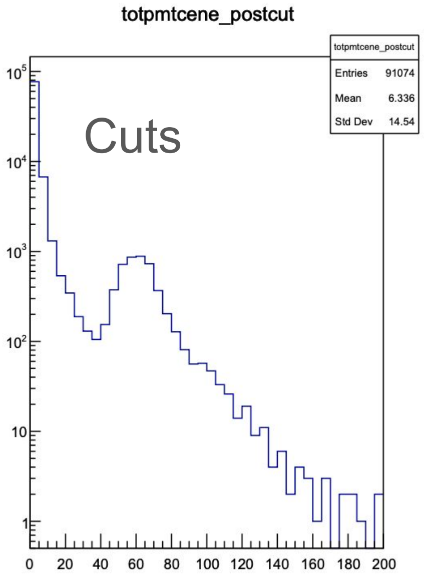
Scint





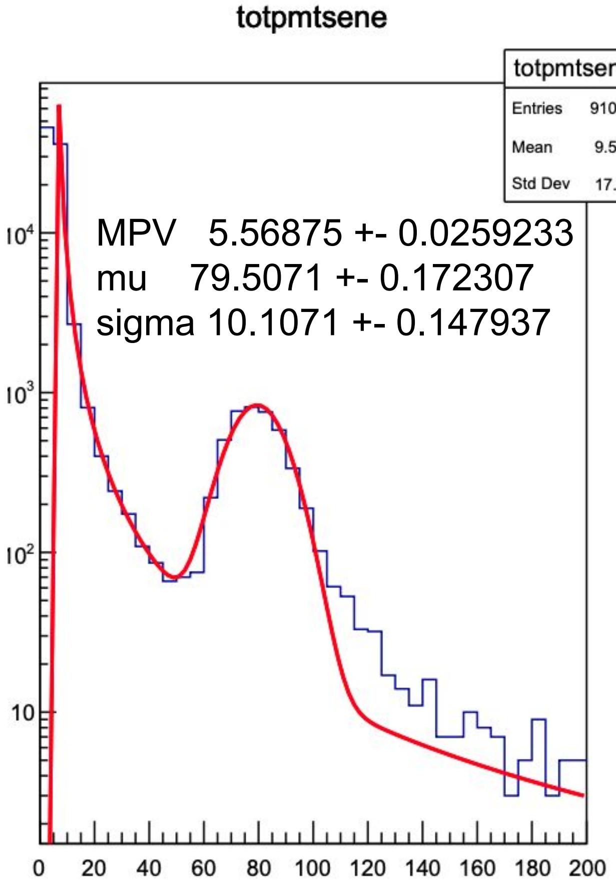
Cherenkov

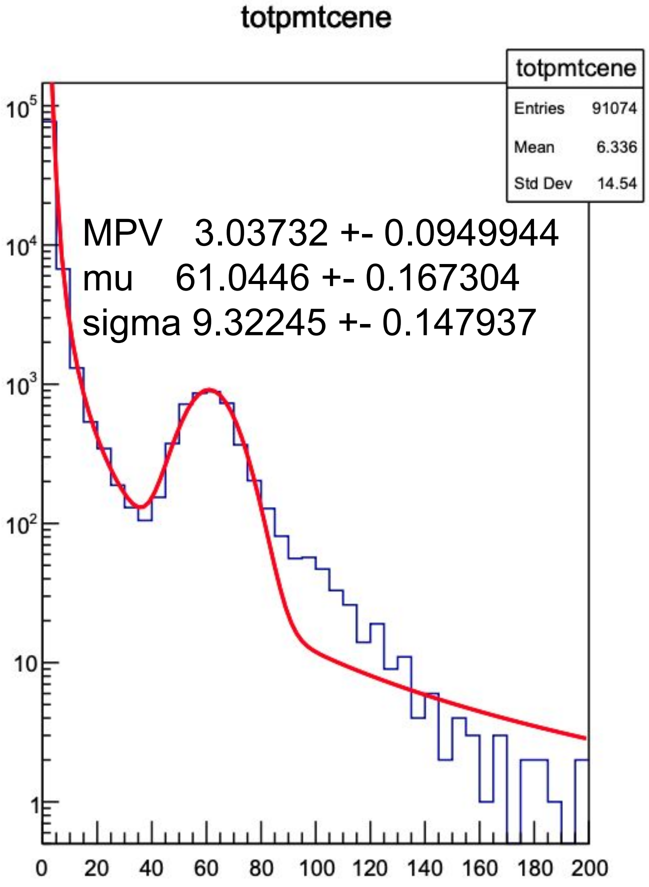




other runs in backup

Run 992 E=110 GeV

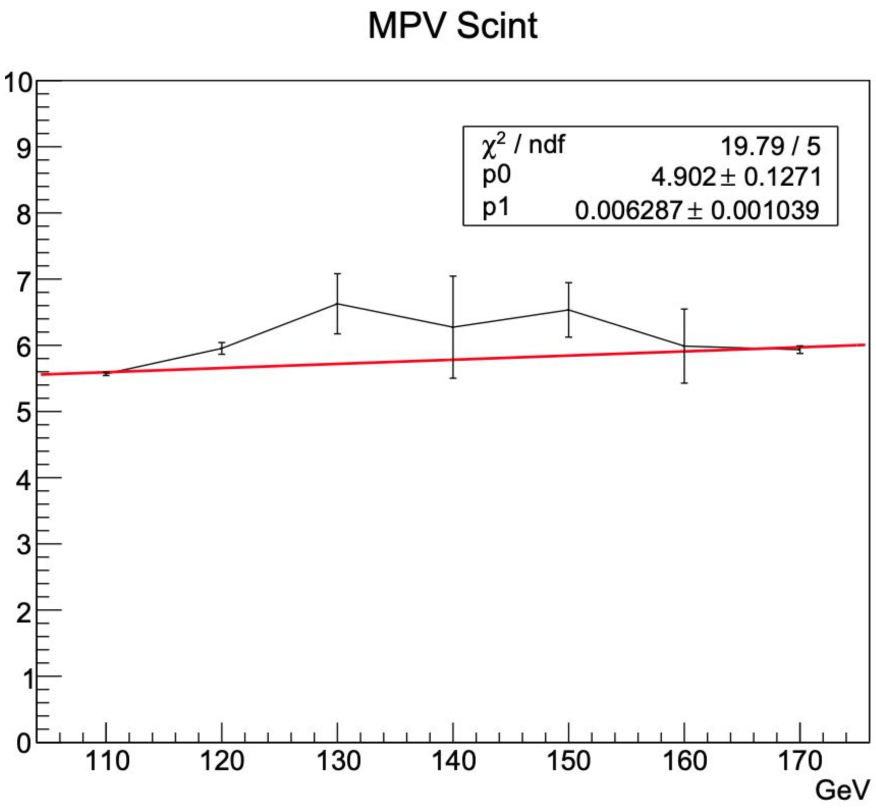


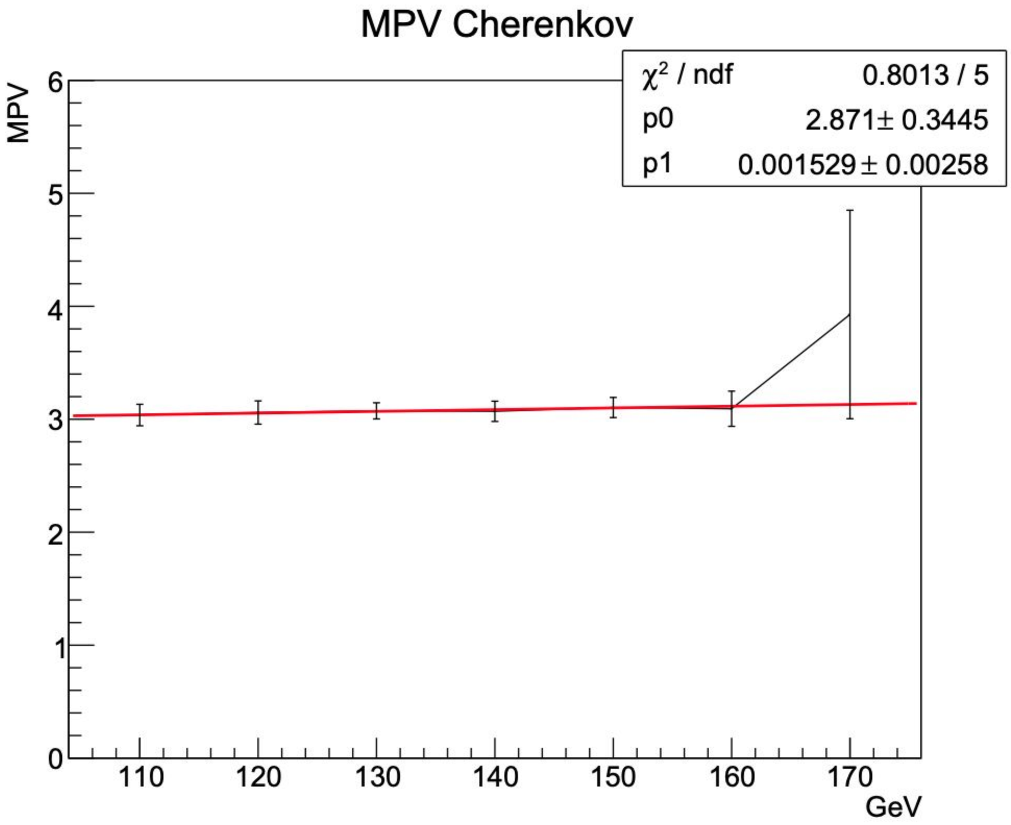


Fit not perfect in the tails. Nicolò suggestion to fit the gaussian + exponential

other runs in backup

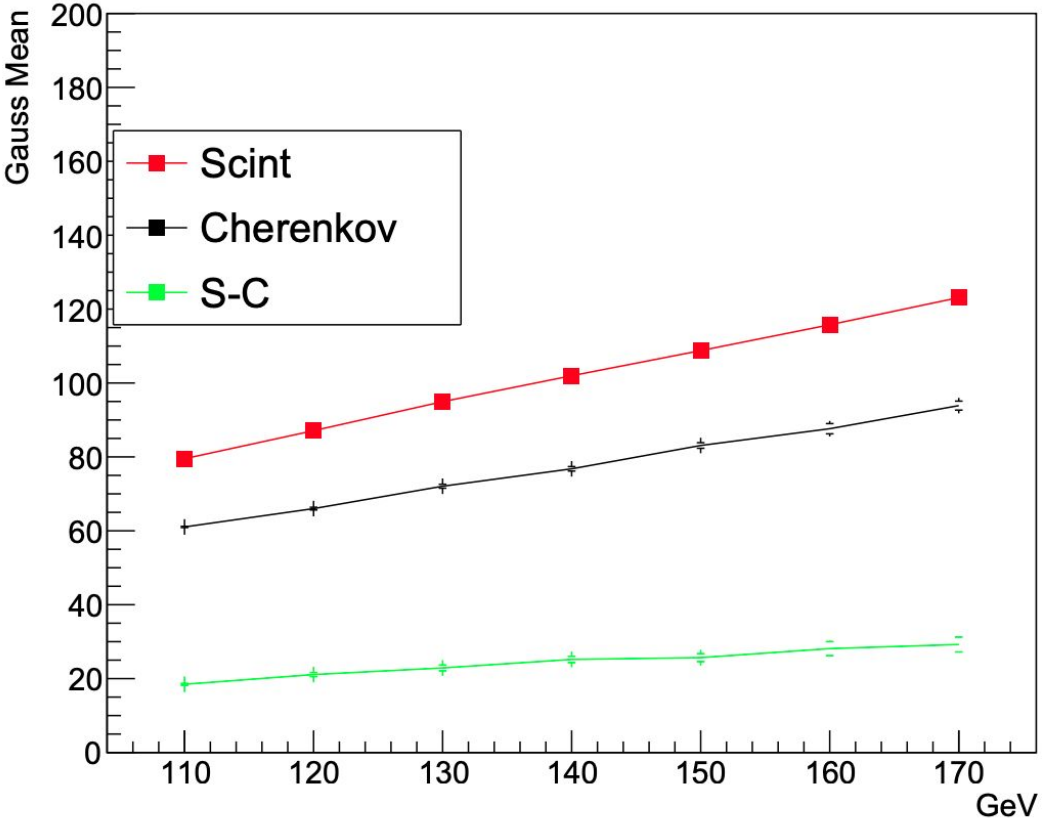
MPV values





Almost constant in cherenkov, a bit less in the scintillator.

Results



It is correct to consider the uncertainty of the parameter fitted?

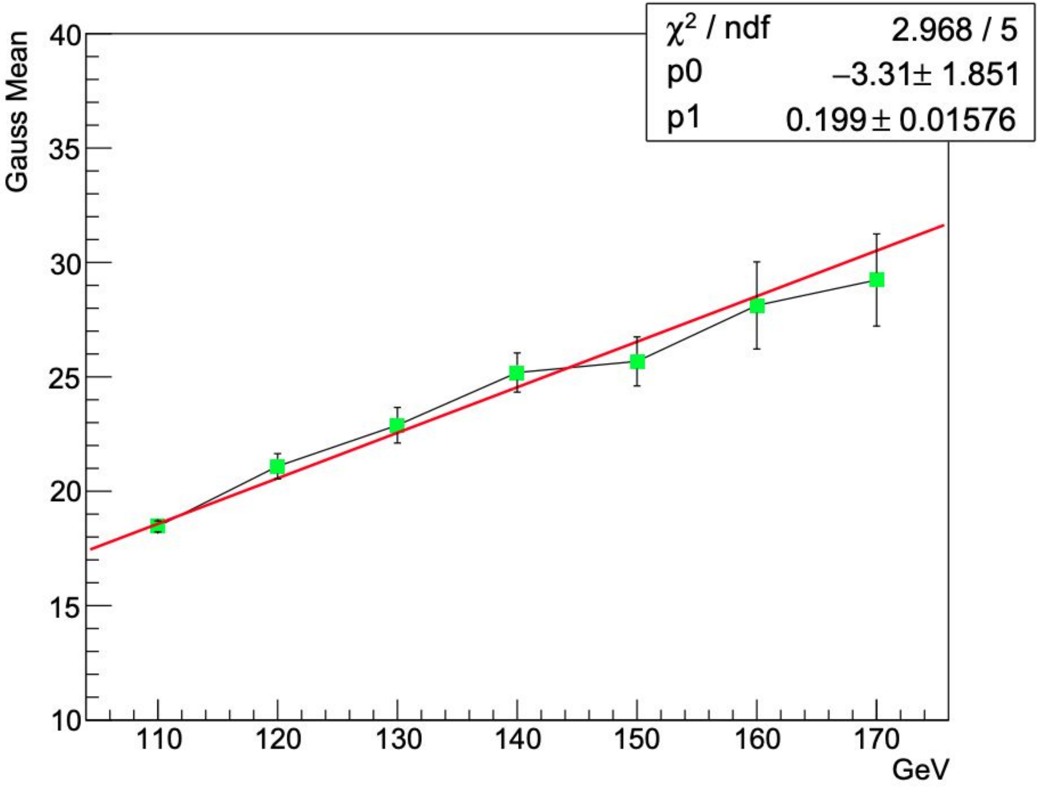
Nicolò: consider the difference between the gaus fit and the fit gaus + exponential as systematic error.

Results: S-C constant?

The scale could be a bit misleading, it looks less constant than it is.

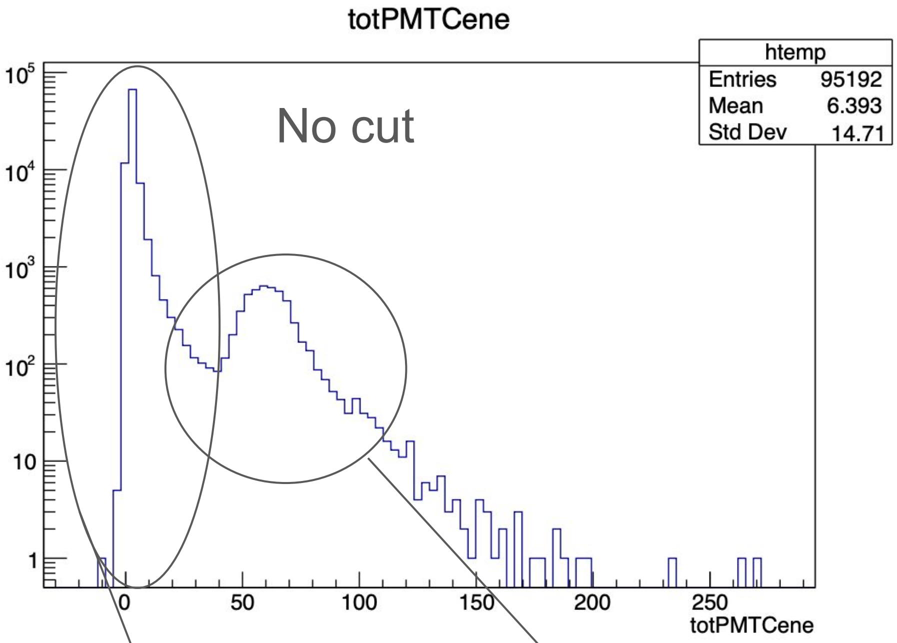
However the best fit is a pol1 with 0.2 of slope.

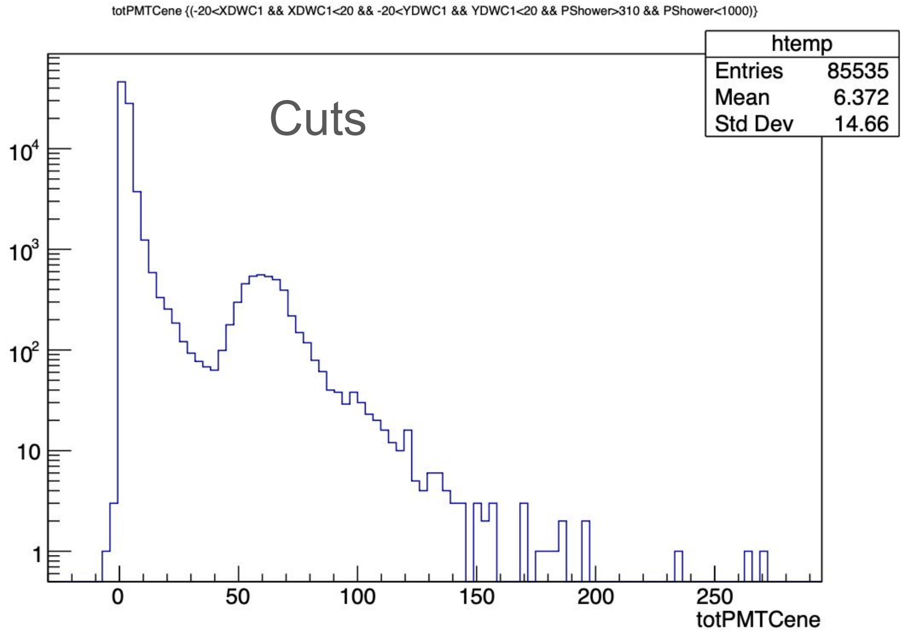
Is that considered constant?



Backup

Run 992 E=110 GeV





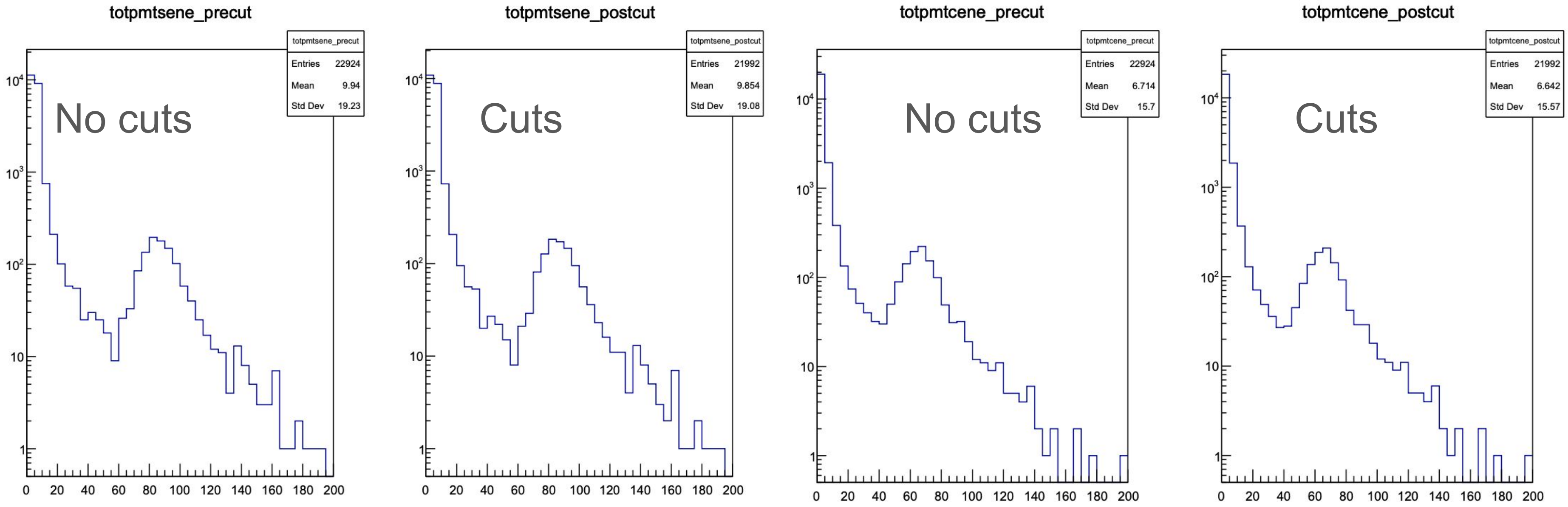
Bremsstrahlung gaussian

muon ionizing landau

Run 982 E=120 GeV

Scint

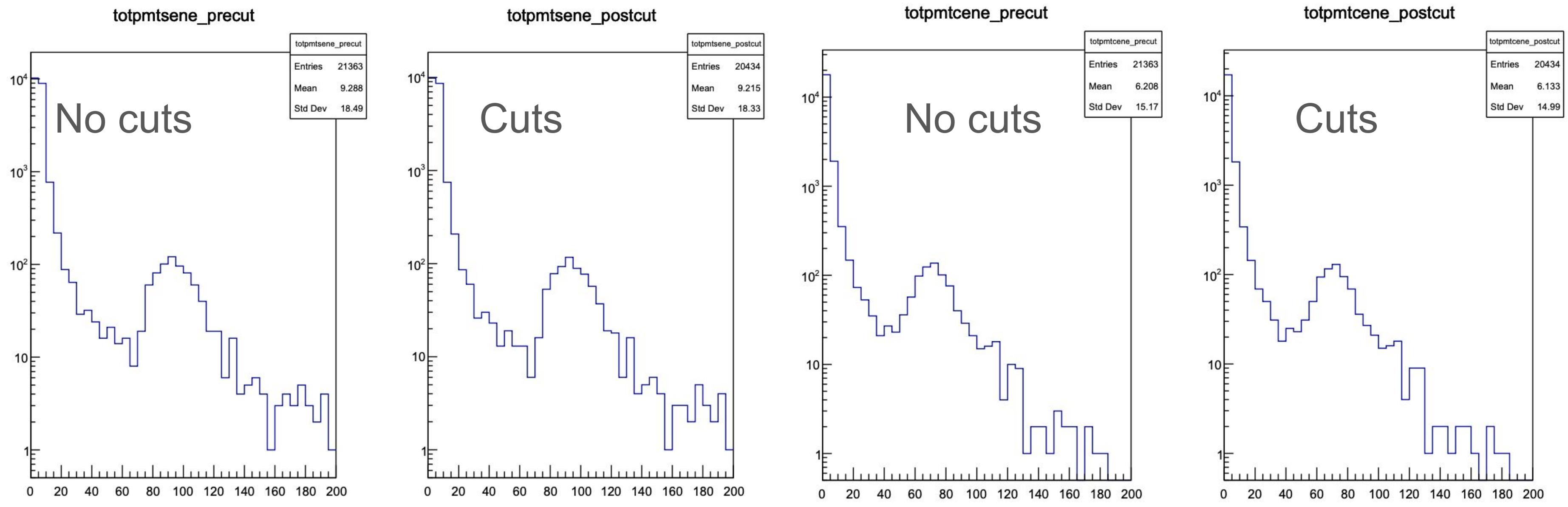
Cherenkov



Run 983 E=130 GeV

Scint

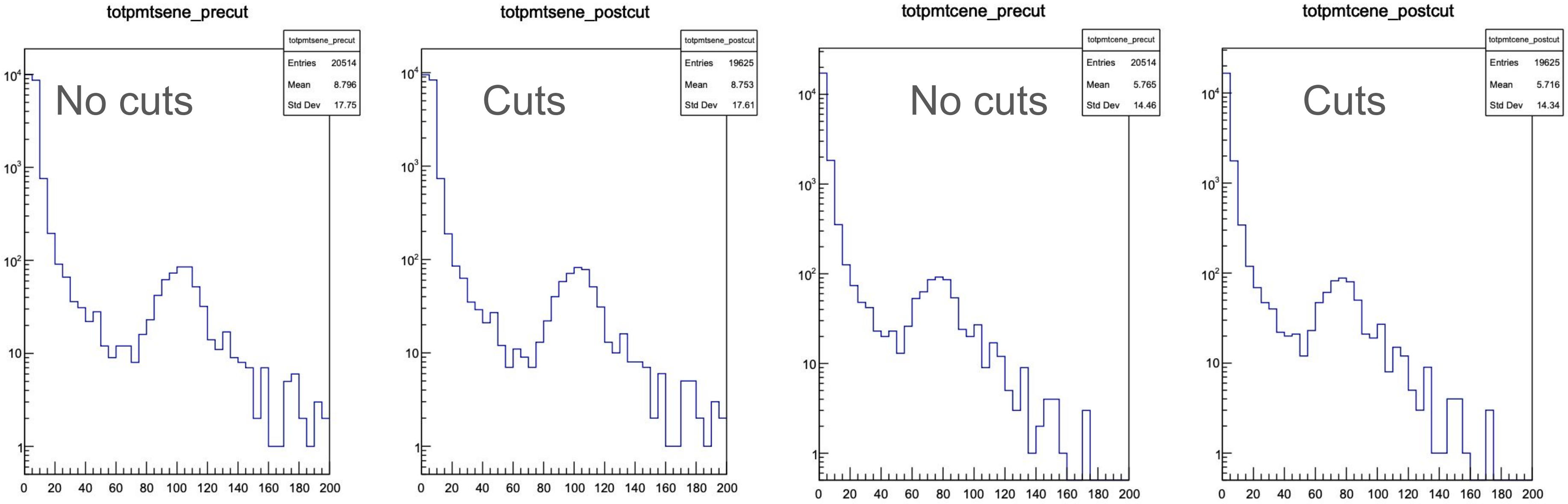
Cherenkov



Run 988 E=140 GeV

Scint

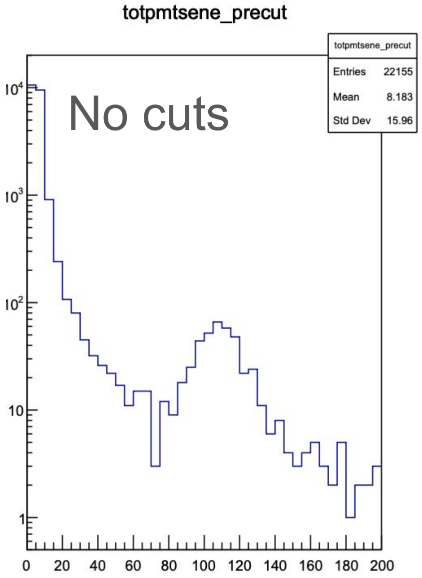
Cherenkov

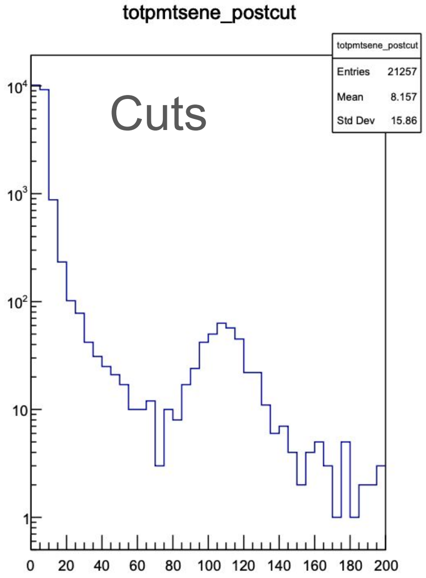


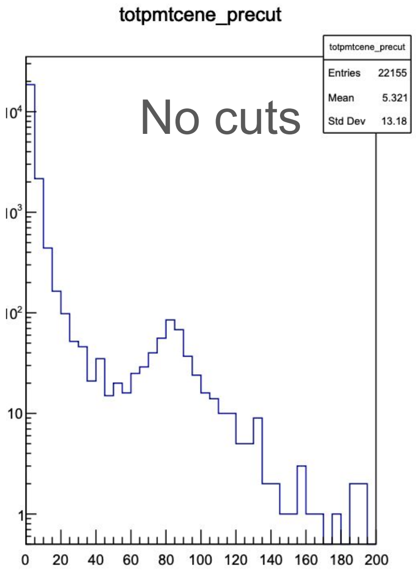
Run 989 E=150 GeV

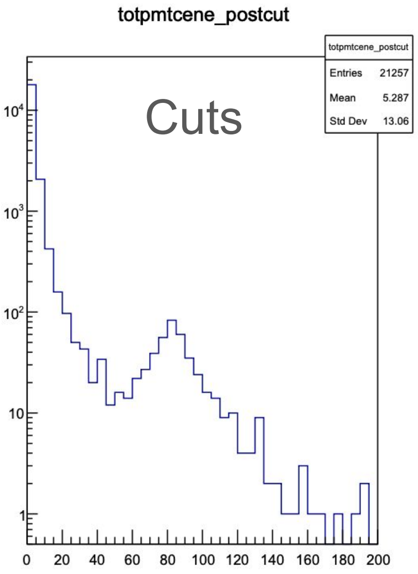
Scint

Cherenkov





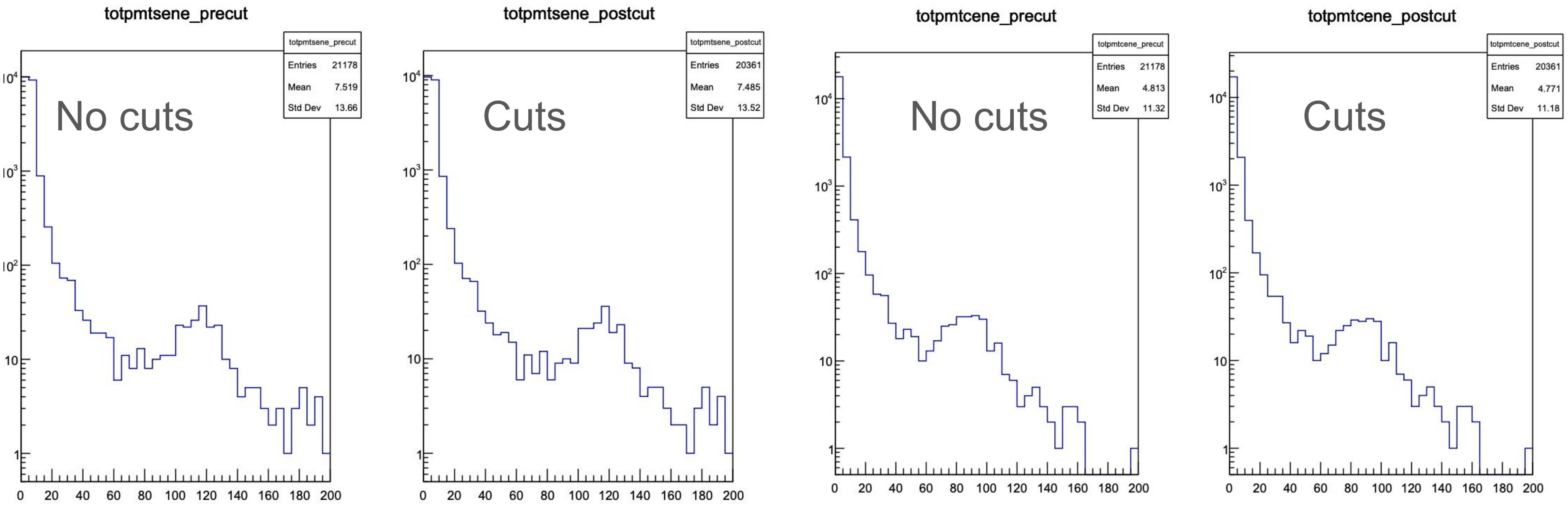




Run 990 E=160 GeV

Scint

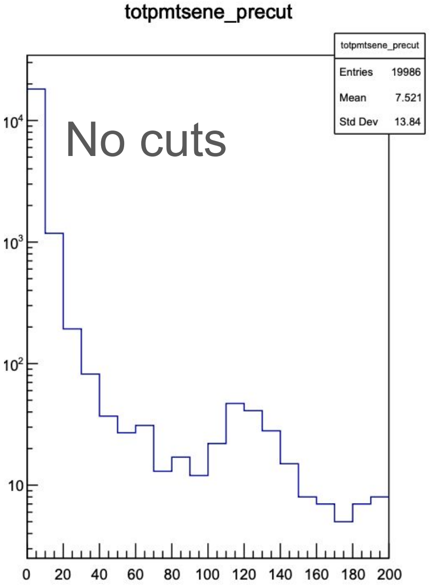
Cherenkov

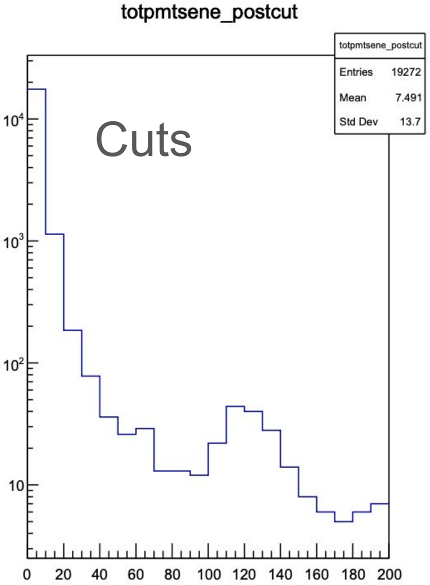


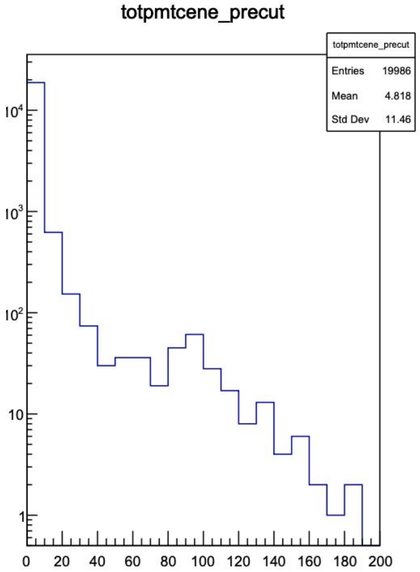
Run 991 E=170 GeV

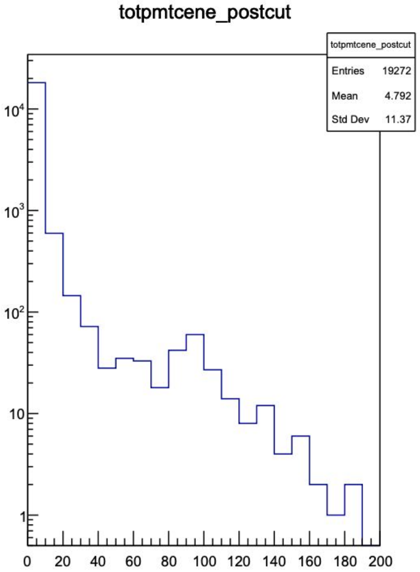
Scint

Cherenkov

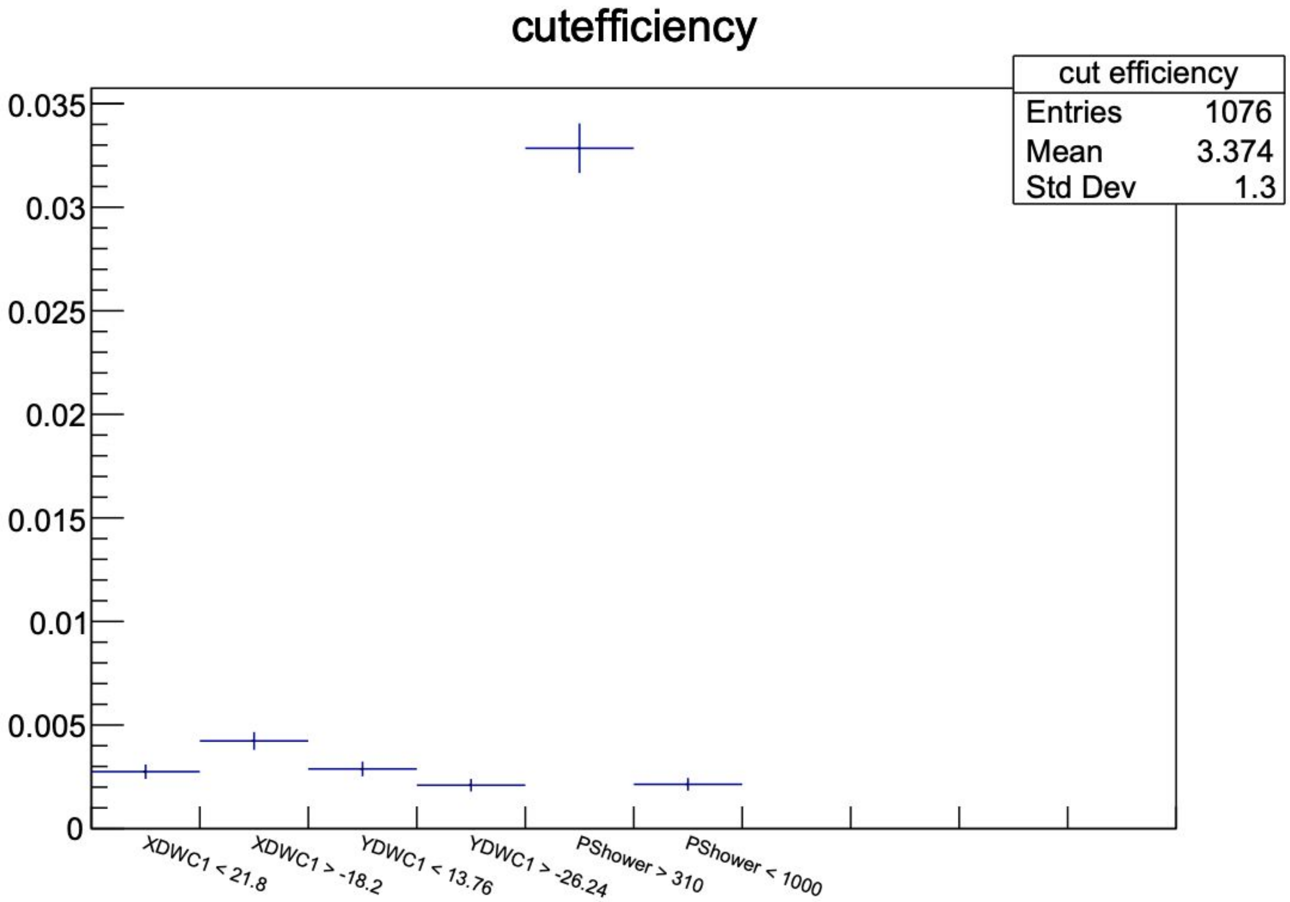




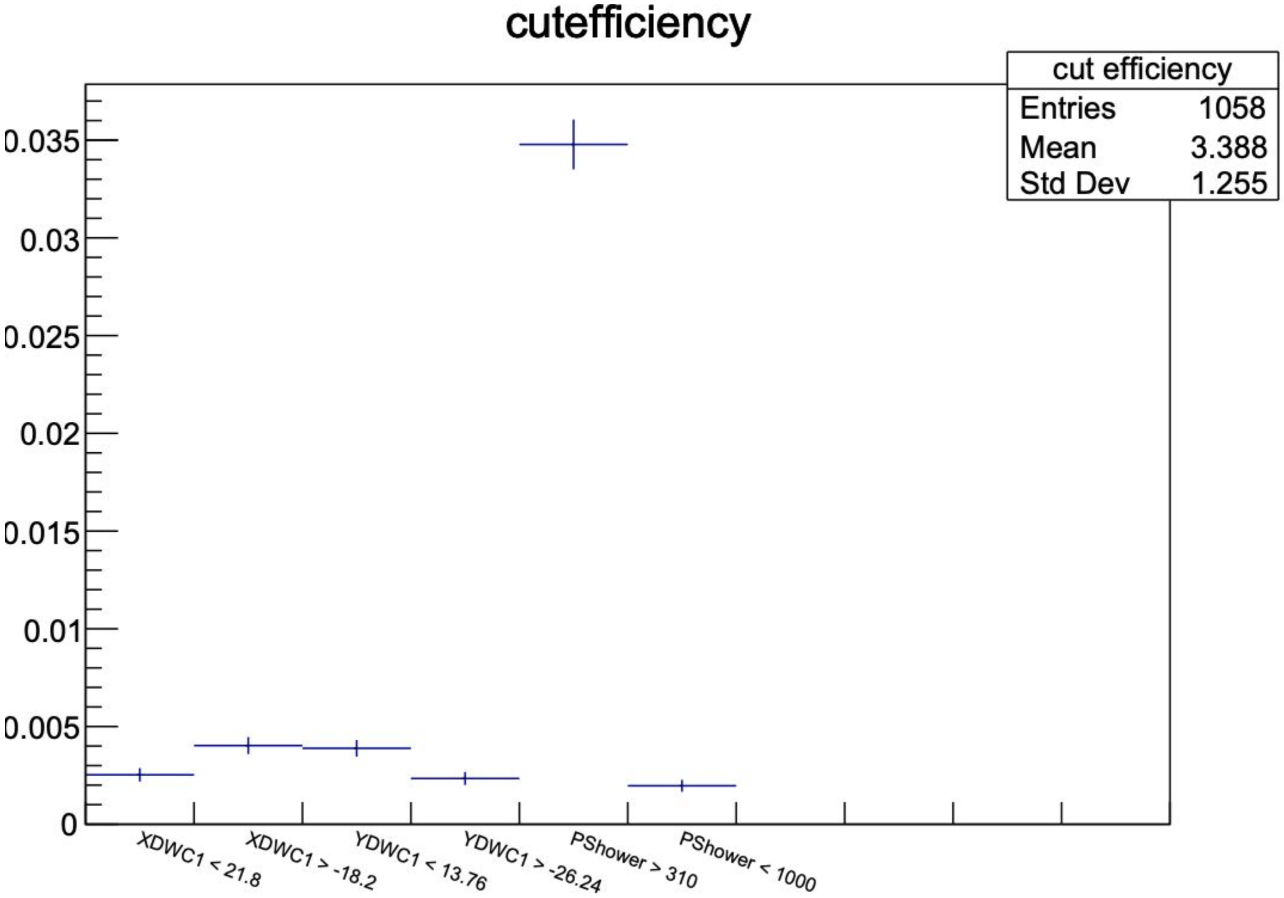




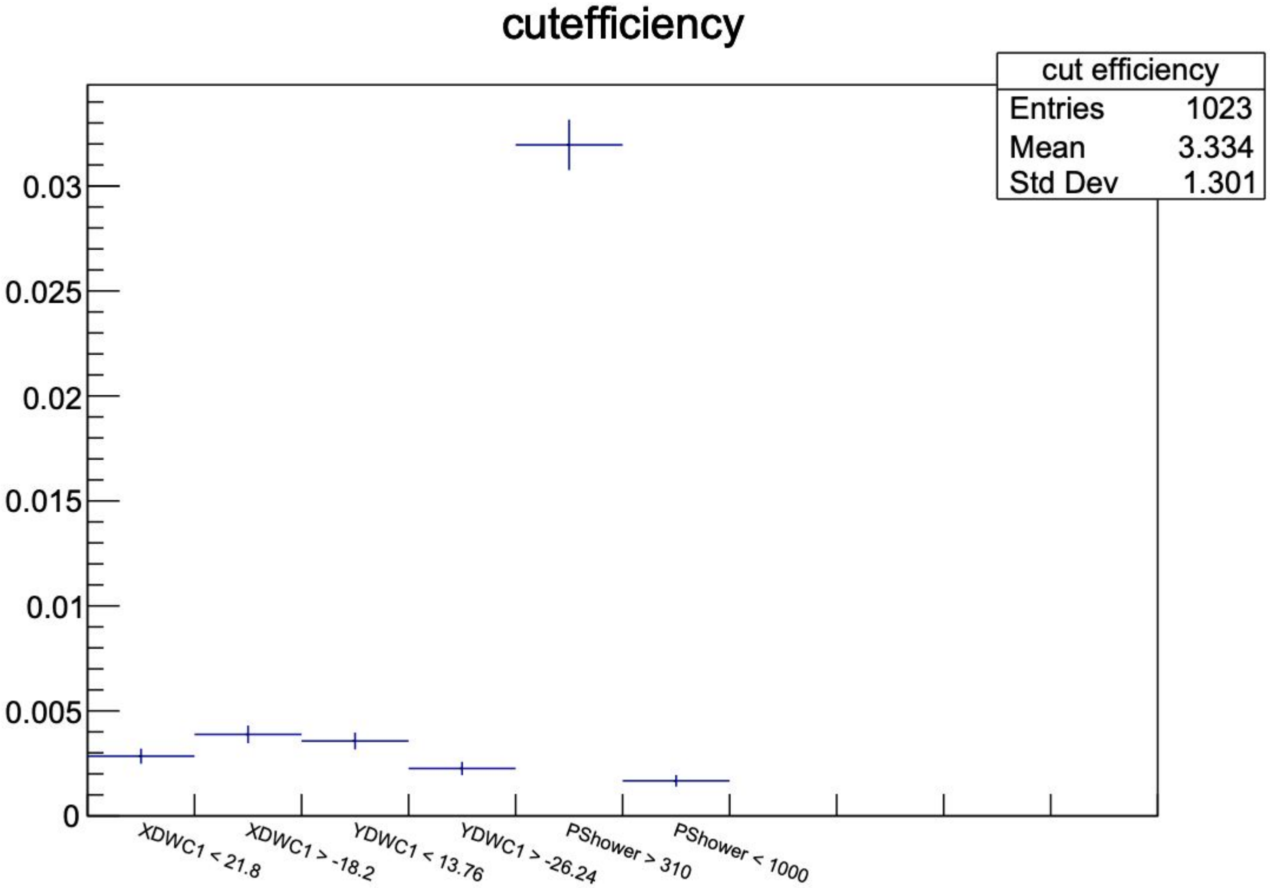
Run 982 E=120 GeV



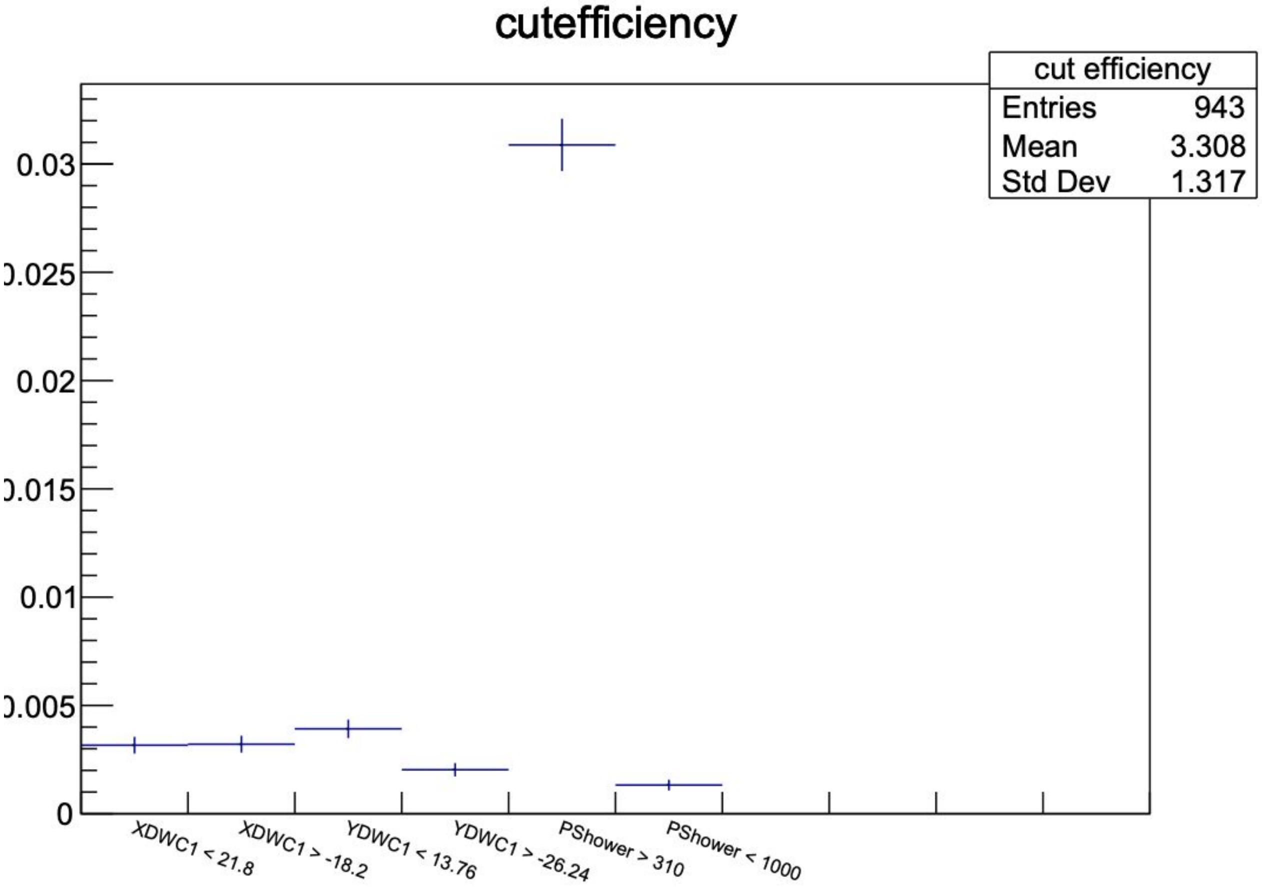
Run 983 E=130 GeV



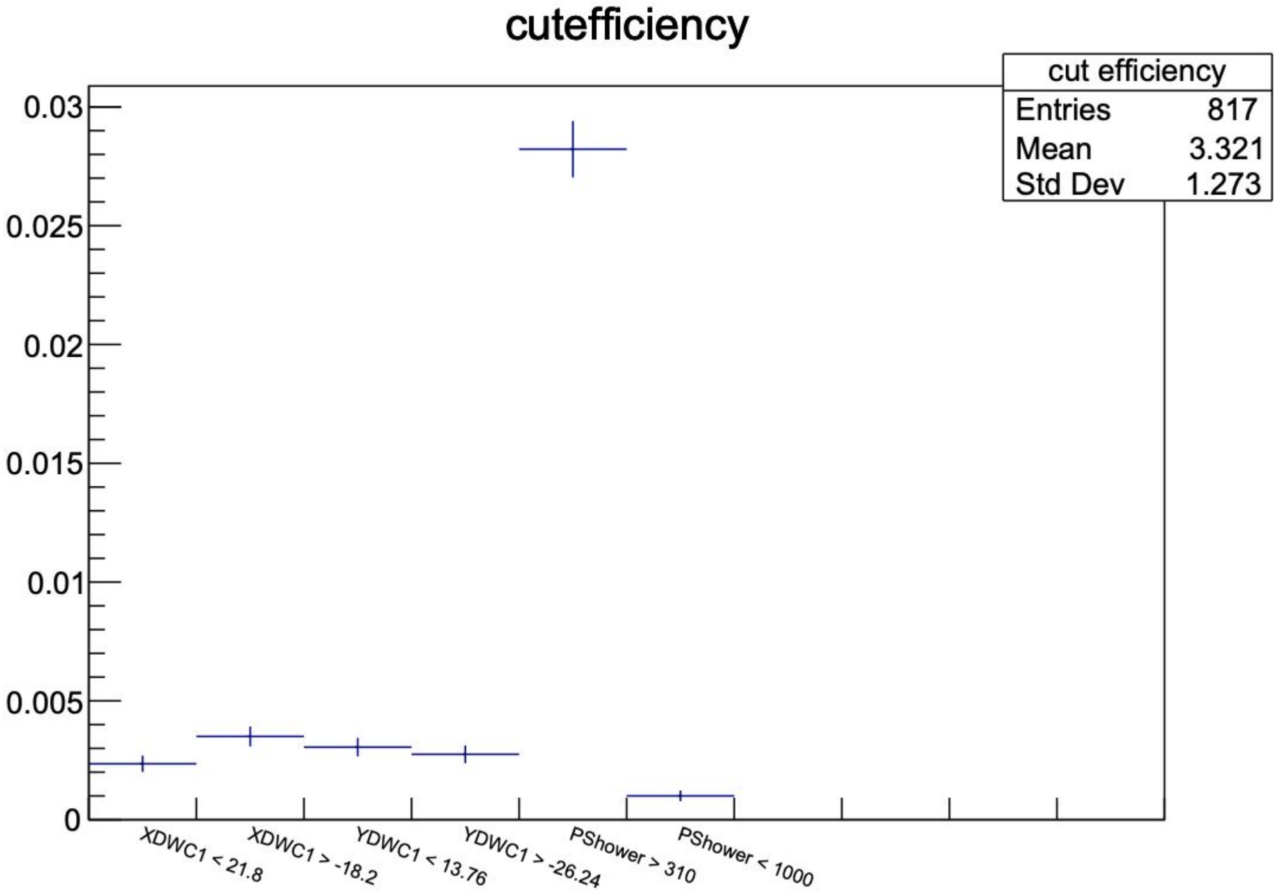
Run 989 E=150 GeV



Run 990 E=160 GeV



Run 991 E=170 GeV



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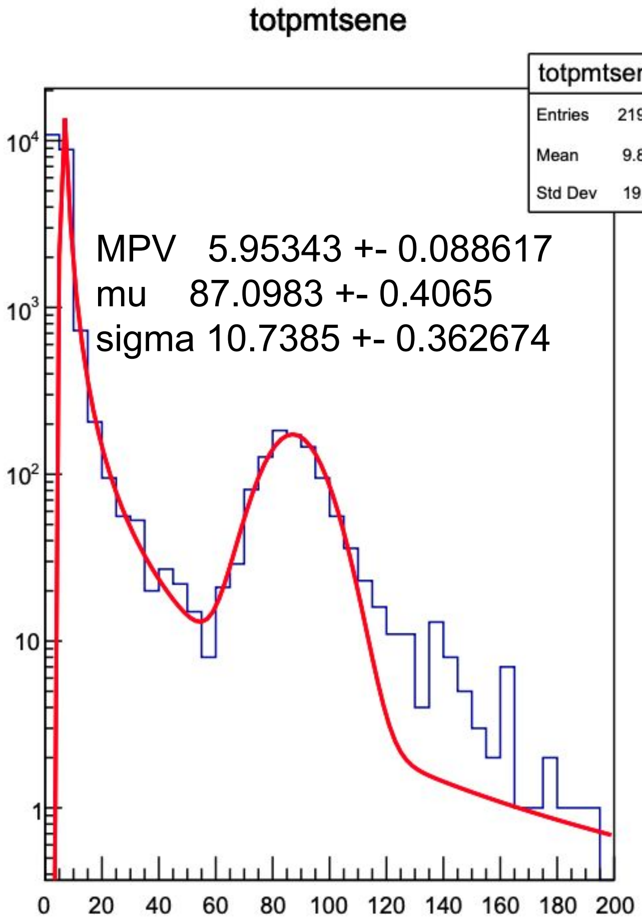
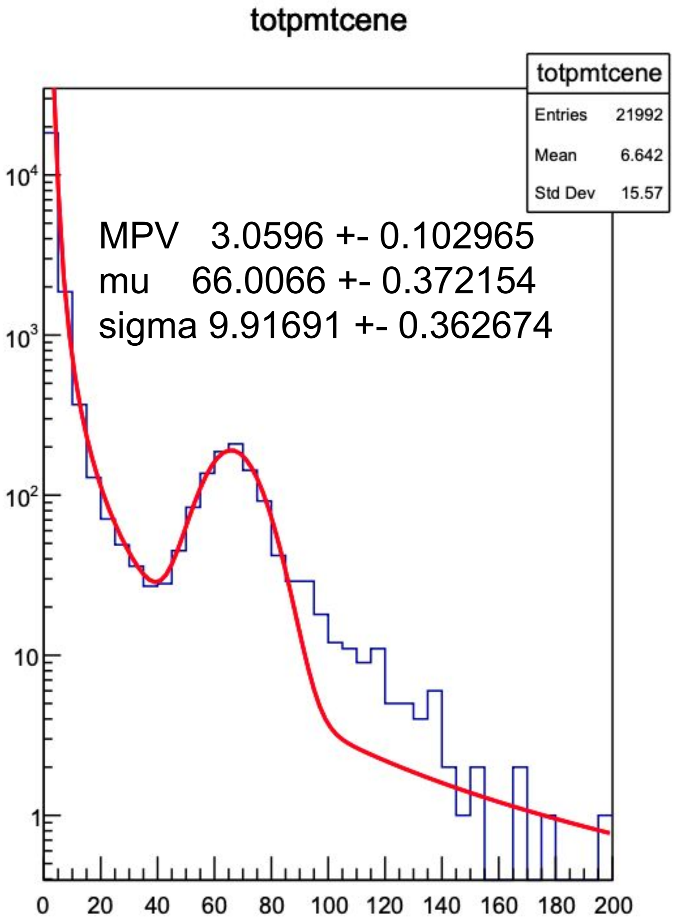
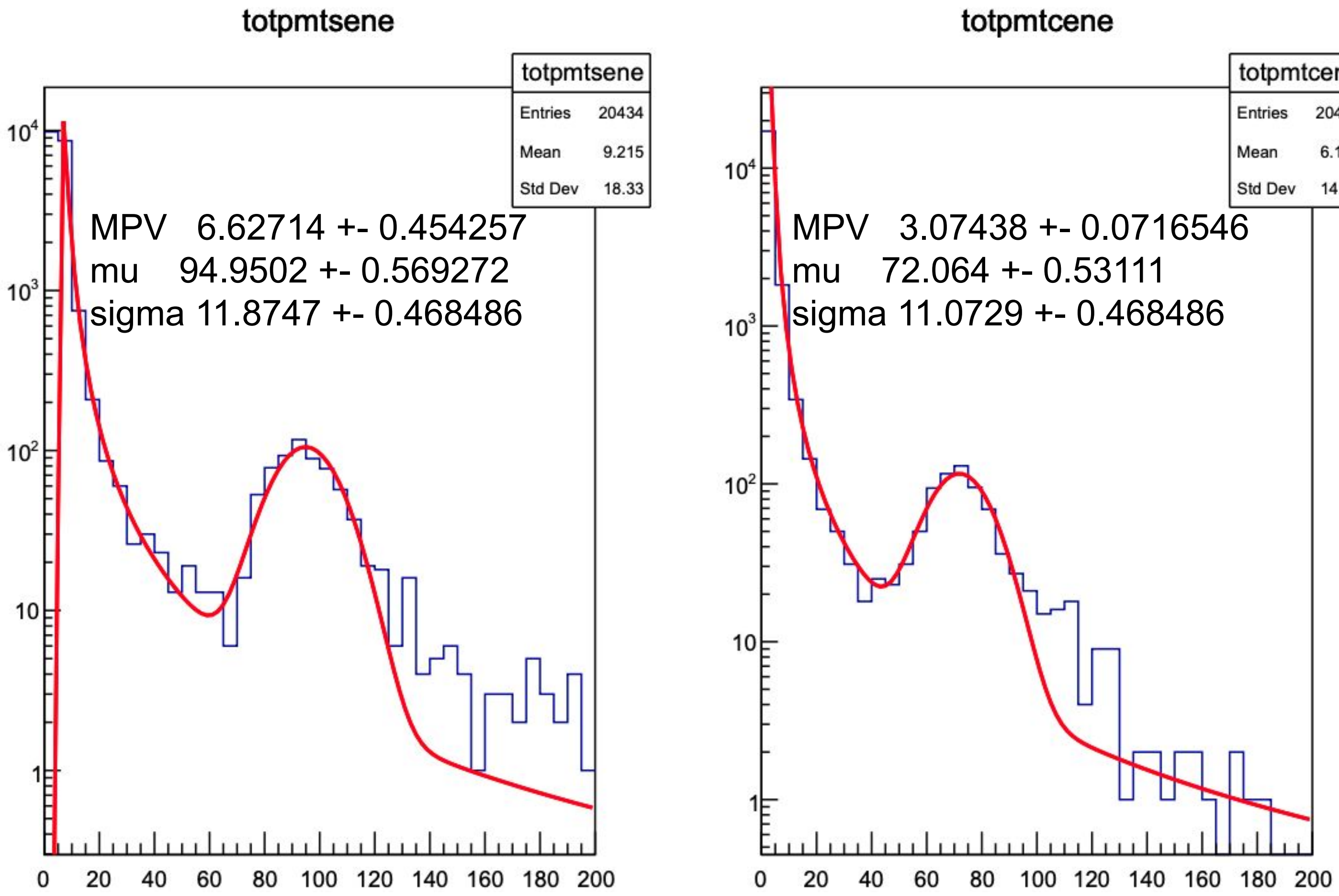
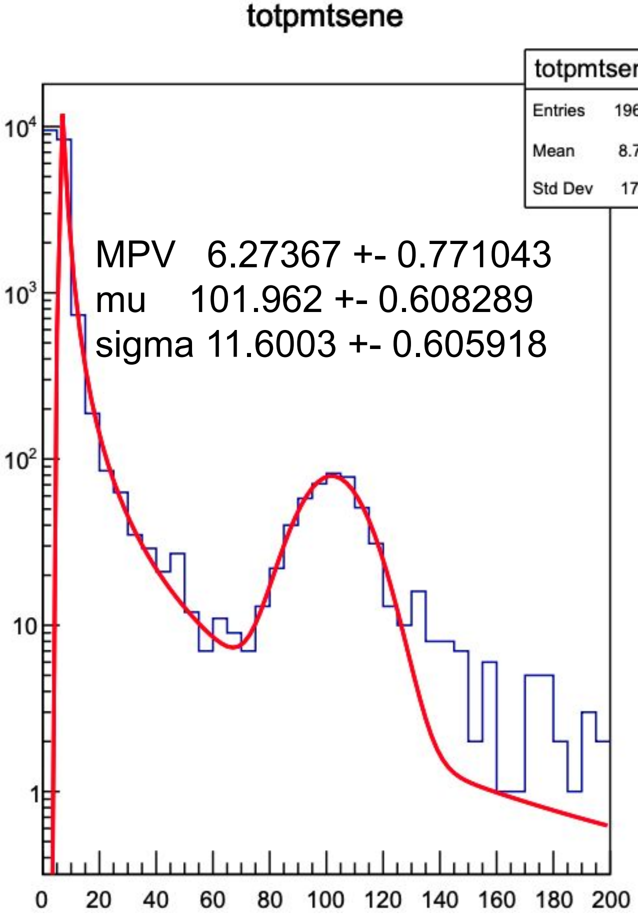


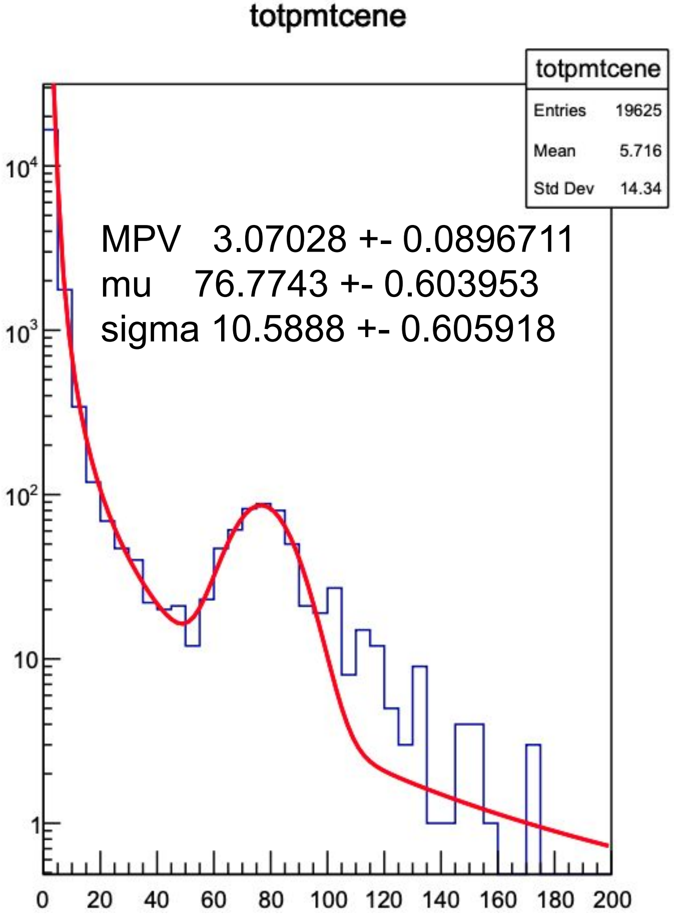


Run 983 E=130 GeV

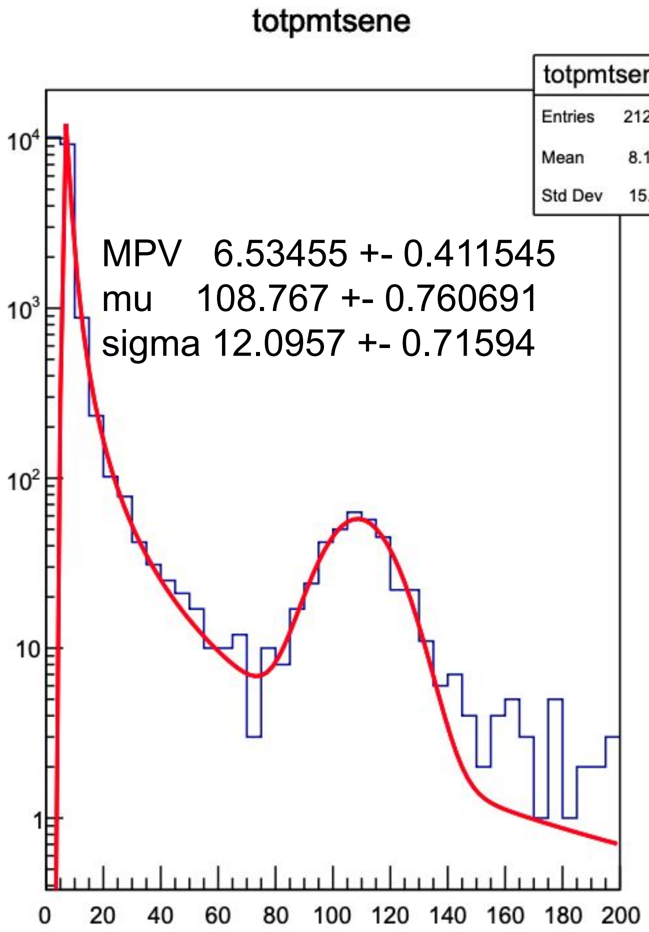


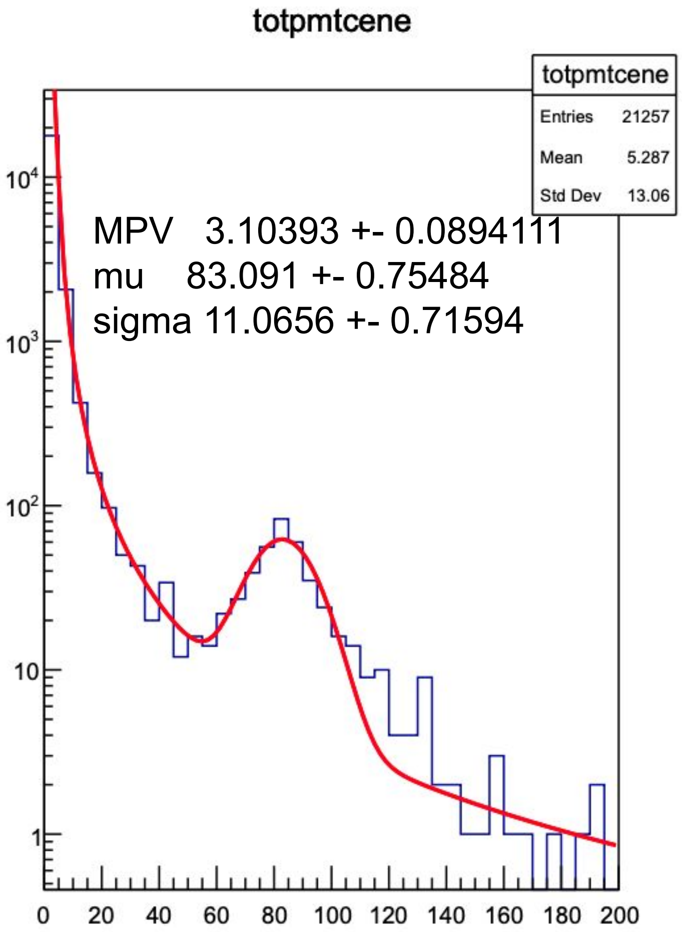
Run 988 E=140 GeV



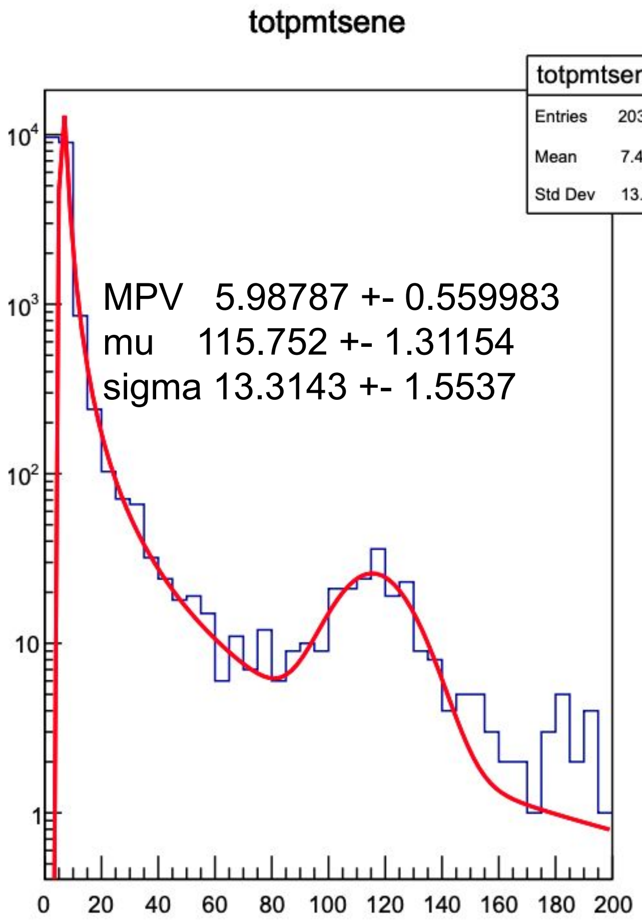


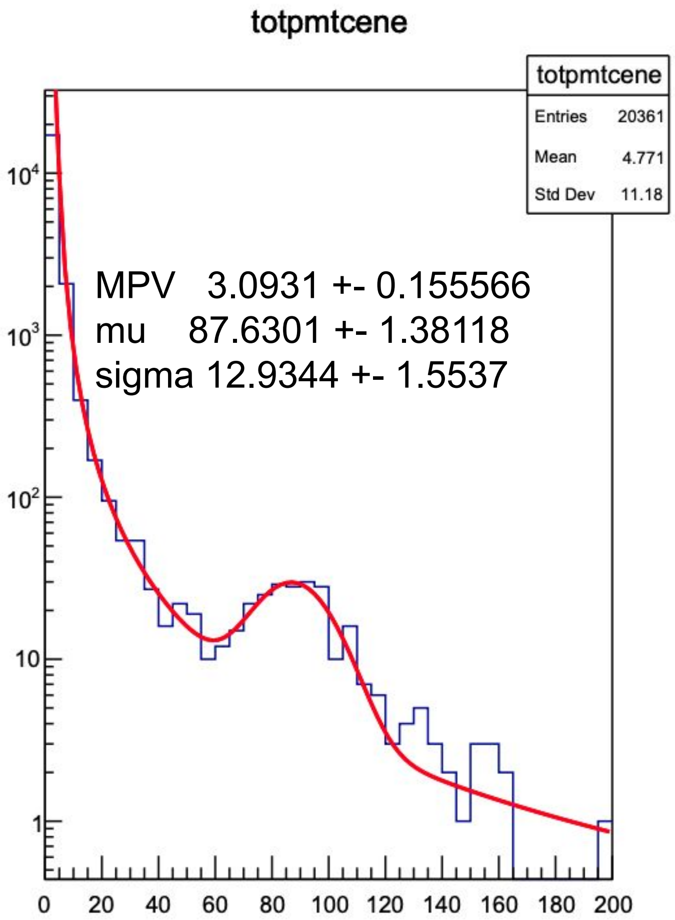
Run 989 E=150 GeV





Run 990 E=160 GeV





Run 991 E=170 GeV