HMS PID

Gas Cherenkov Detector

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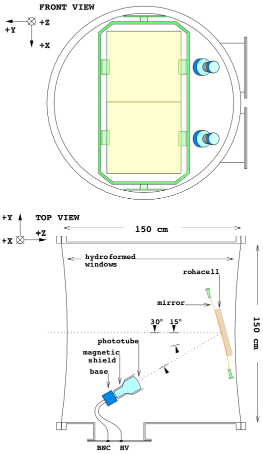
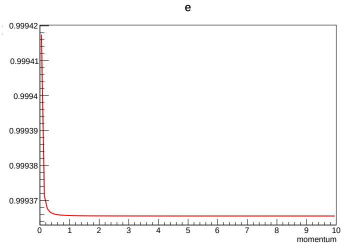
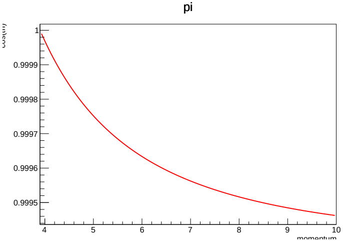
HMS Gas Cherenkov Detector

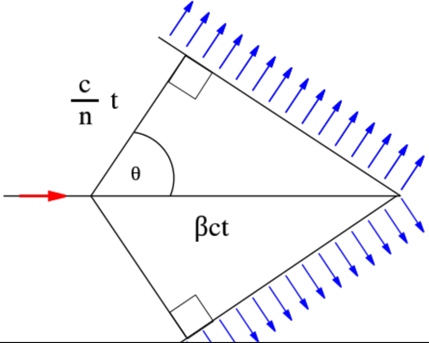
A Large cylindrical tank which containing two mirrors which focus light onto two 5 inch Burle8854 multiplier photo tubes.
$\phi_{in} = 59”$, $L = 60”$
The tank is filed with 0.5 atm C4F8O, which have pion threshold of around 3.8 or 3.9 GeV/c.

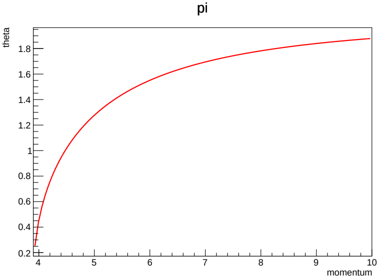

FRONT VIEW
+Y
+Z
+X
TOP VIEW
+Y
+Z
+X
150 cm
hydroformed windows
rohacell
mirror
30°
15°
phototube
magnetic shield
base
150 cm
BNC
HV

$$cos(\theta) = \frac{c}{vn} = \frac{1}{\beta n} = \frac{\sqrt{(p^2+m^2)}}{np}$$









For a given Cherenkov device, the Number of photoelectrons detected is

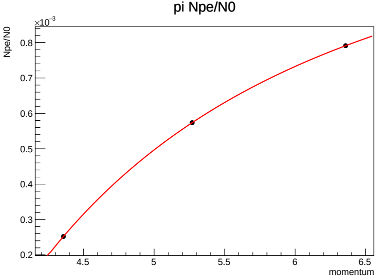
$$N_{p.e.} = L\frac{\alpha^2 z^2}{r_e m_e c^2} \int \epsilon(E) sin^2\theta(E) dE$$

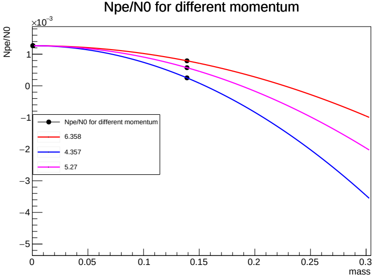
We define Cherenkov detector quality factor N_0

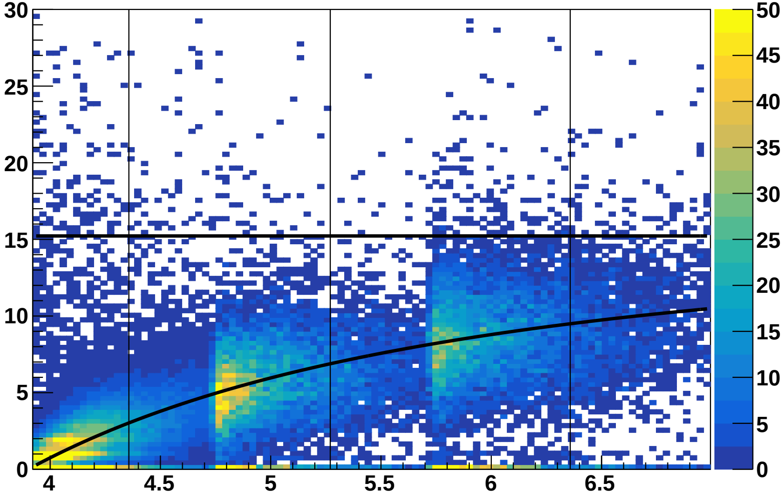
$$N_0 = \frac{\alpha^2 z^2}{r_e m_e c^2} \int \epsilon dE$$

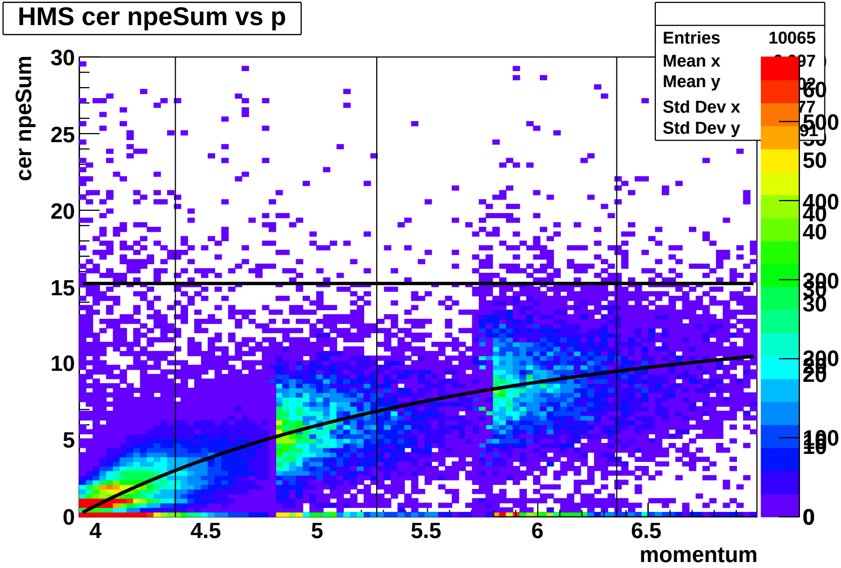
so that,

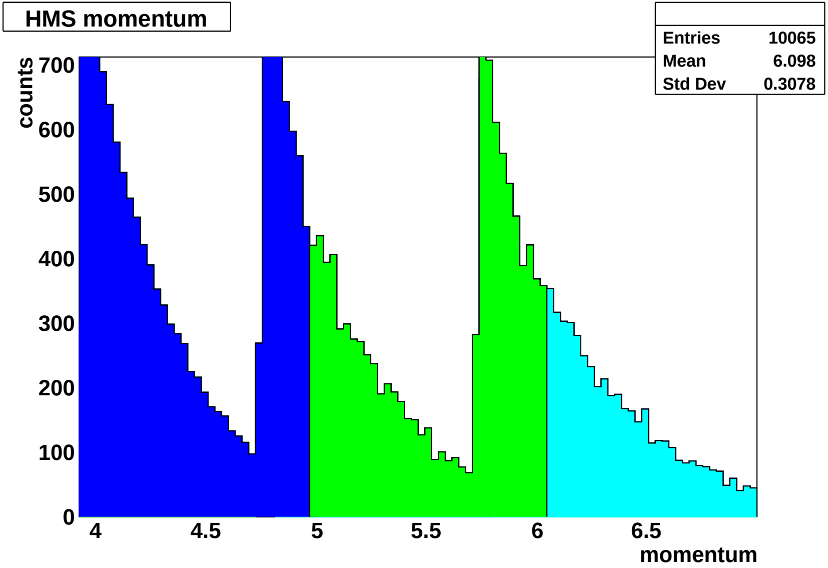
$$N_{p.e.} \approx LN_0 < sin^2\theta >= LN_0 \frac{(n^2-1)P^2-m^2}{n^2p^2}$$

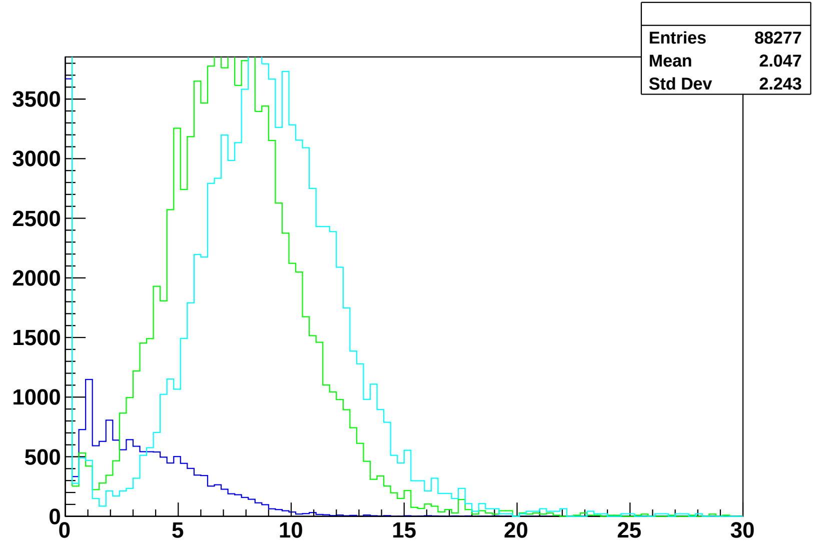


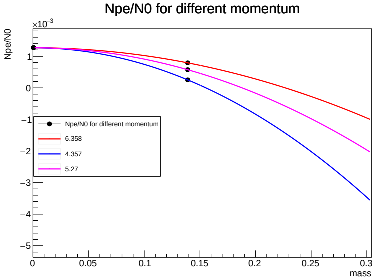


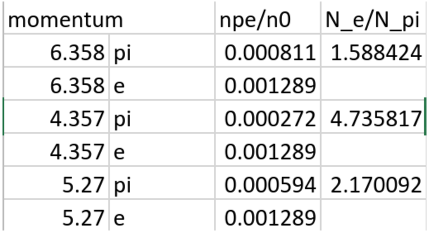

30
25
20
15
10
5
0
4
4.5
5
5.5
6
6.5
50
45
40
35
30
25
20
15
10
5
0


HMS cer npeSum vs p
Entries 10065
Mean x
Mean y
Std Dev x
Std Dev y
cer npeSum
0
5
10
15
20
25
30
momentum
4
4.5
5
5.5
6
6.5
0
10
20
30
40
50
60
100
200
300
400
500


HMS momentum
Entries 10065
Mean 6.098
Std Dev 0.3078
counts
0
100
200
300
400
500
600
700
4
4.5
5
5.5
6
6.5
momentum

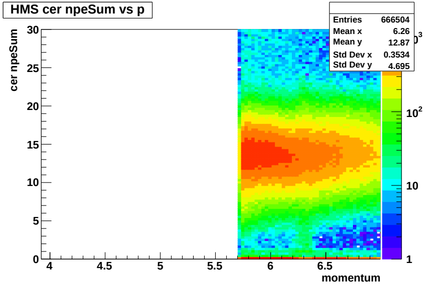

Entries 88277
Mean 2.047
Std Dev 2.243
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30

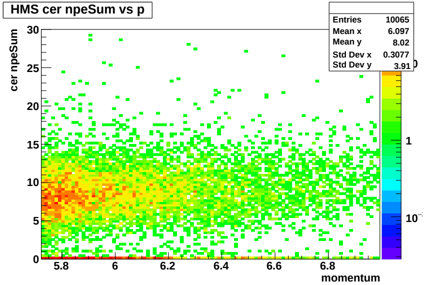




momentum		npe/n0	N_e/N_pi
6.358	pi	0.000811	1.588424
6.358	e	0.001289	
4.357	pi	0.000272	4.735817
4.357	e	0.001289	
5.27	pi	0.000594	2.170092
5.27	e	0.001289	

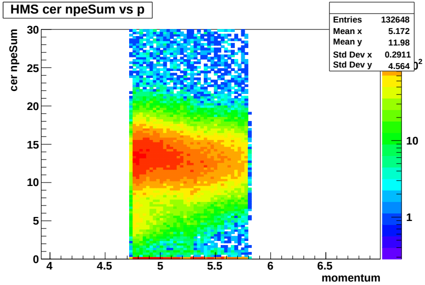
no cal pion cut,$\text{hms}_p = 6.358$

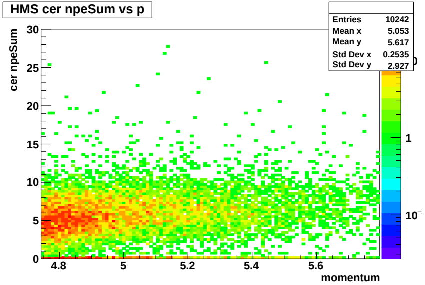




momentum: 6.358, calculated ratio: 1.588424

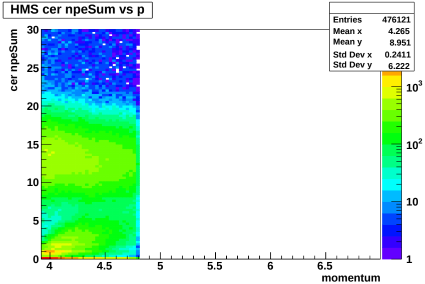
no cal pion cut,$\text{hms}_p = 5.27$

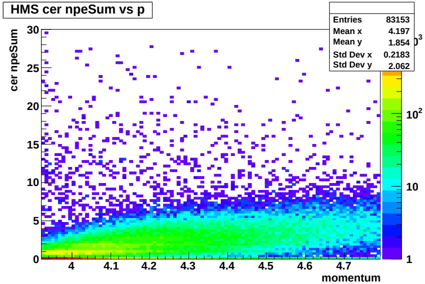




momentum: 5.27, calculated ratio: 2.170092

no cal pion cut,$hms_p = 4.357$





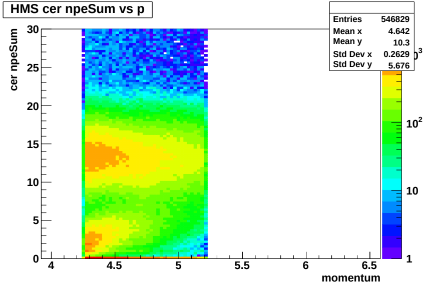
momentum: 4.357, calculated ratio: 4.735817

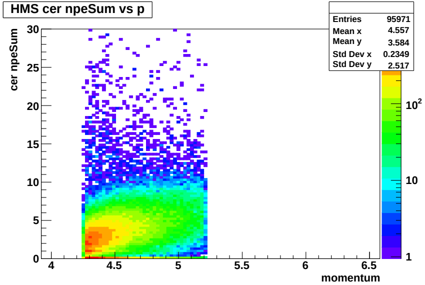
Gas

The tank is filled with pure gas, C4F8O at 0.5 atm $\beta = \frac{1}{n_{gas}}$

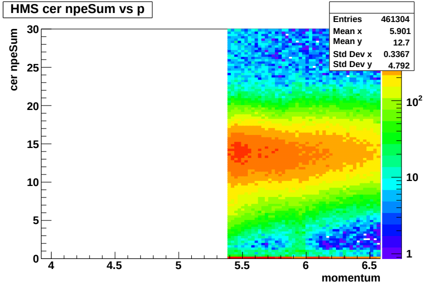
$$\frac{|p|}{\sqrt{(m^2+p^2)}} = \frac{1}{n_{gas}}$$

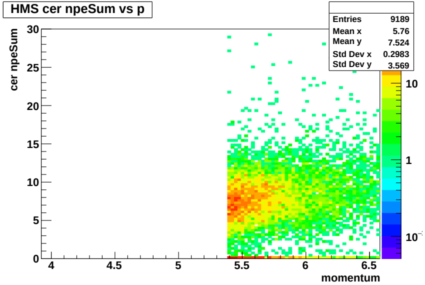
no cal pion cut,hms$_p = 4.736$



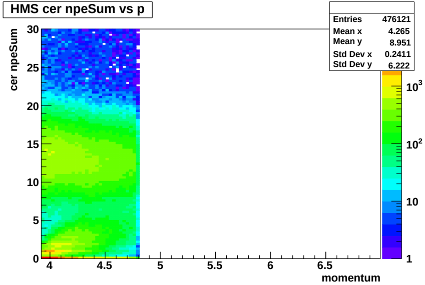


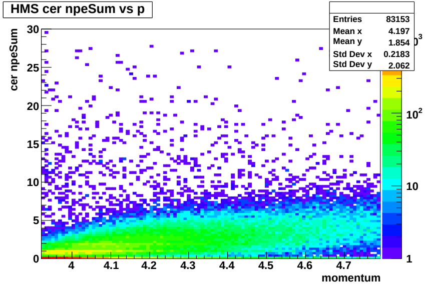
no cal pion cut, $\mathrm{hms}_p = 5.983$



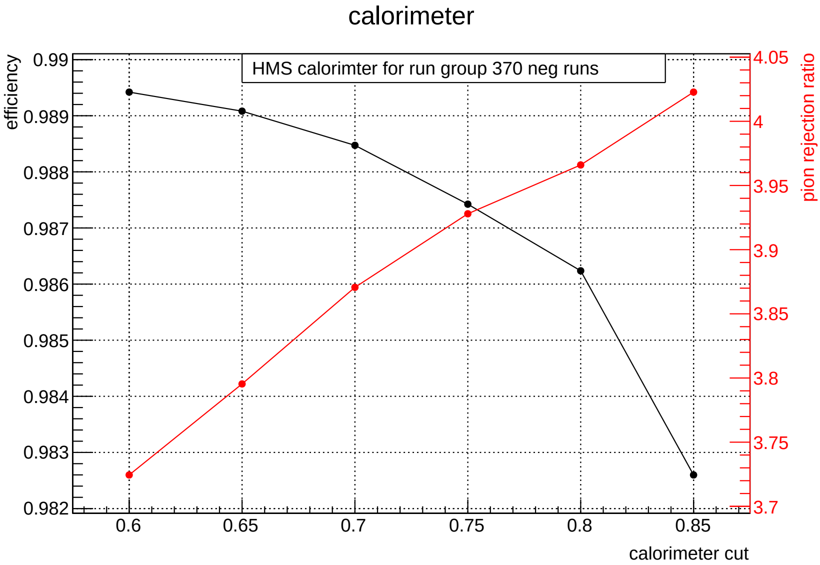


no cal pion cut,$hms_p = 4.357$

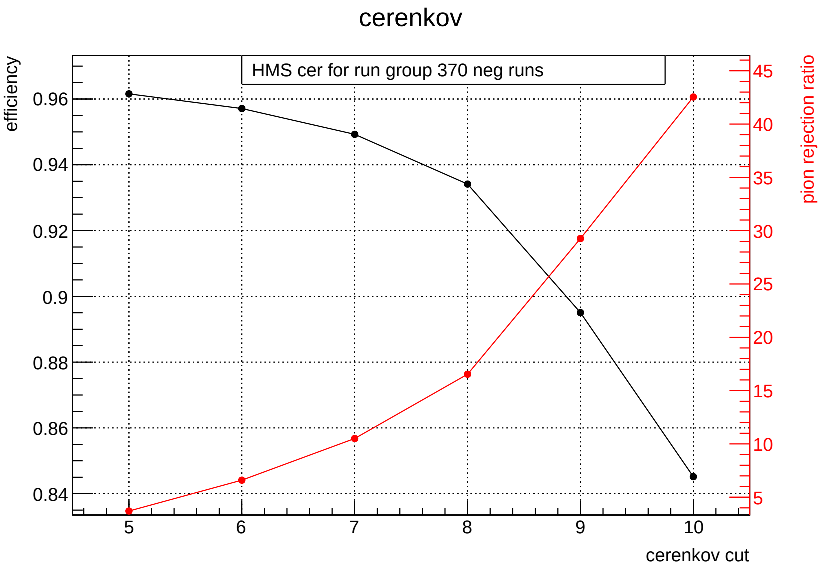




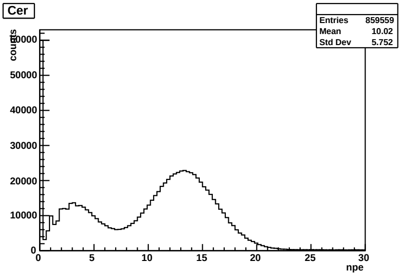
HMS_cal_neg

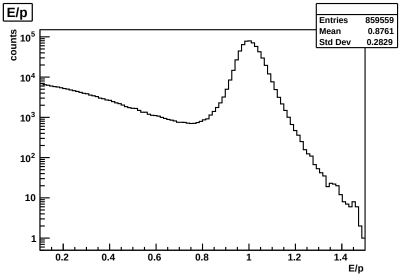

calorimeter
HMS calorimter for run group 370 neg runs
efficiency
0.99
0.989
0.988
0.987
0.986
0.985
0.984
0.983
0.982
pion rejection ratio
4.05
4
3.95
3.9
3.85
3.8
3.75
3.7
0.6
0.65
0.7
0.75
0.8
0.85
calorimeter cut

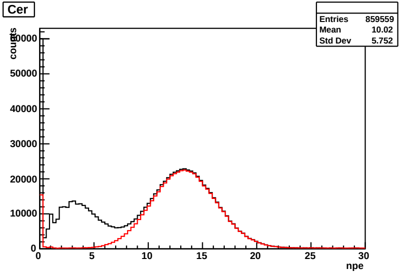
HMS_cer_neg_370

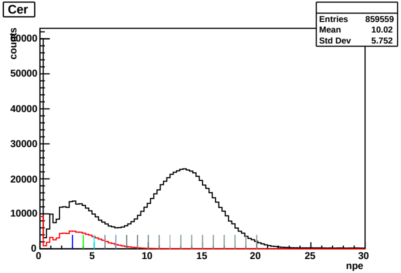


HMS_PID_370cer_neg

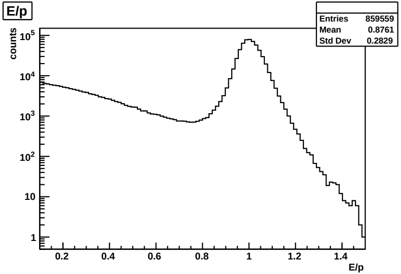


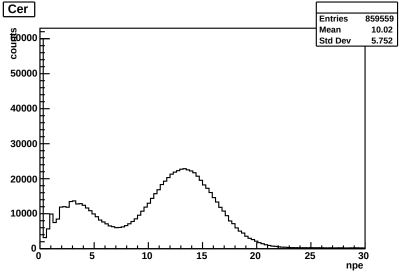


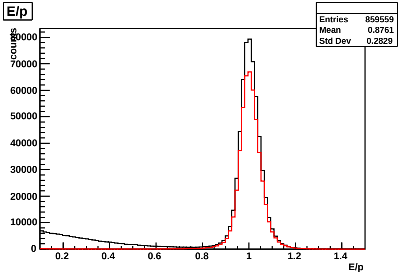


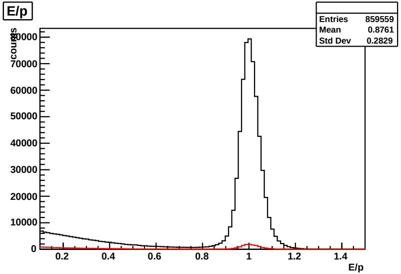


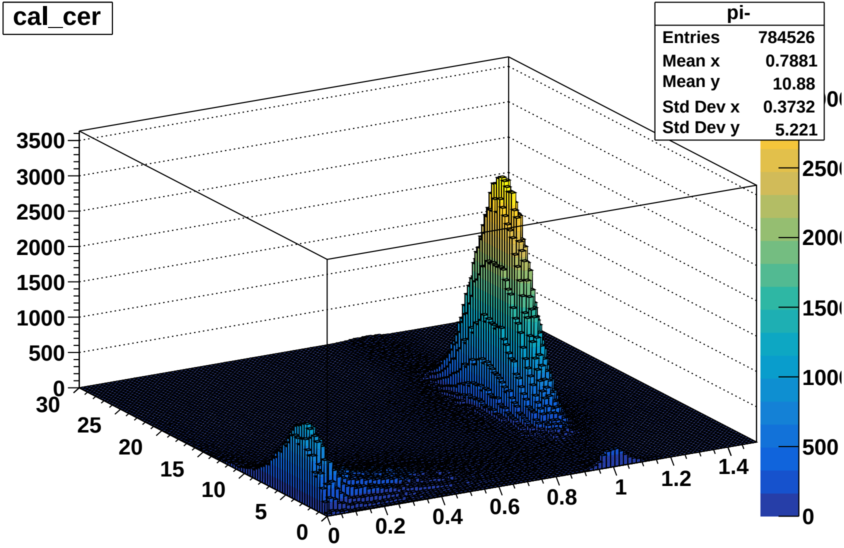
HMS_PID_370_neg









HMS_PID_370_lego$_{n}eg$