

# FIDUCIAL VOLUME STUDIES

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DPWG meeting  
14.11.2019

# Introduction

The goal: To define effective fiducial volume for various detector components using qualitative criteria.

DC: Several alternative methods were studied.  
Main characteristics for the fiducial volume definition are  $\chi^2$  or spacial distributions of reconstructed tracks.

PCAL: Estimates of effective fiducial volume are based on spacial distributions sampling fraction.

# DC fiducial volume cuts

Three different methods were used to define DC fiducial volume cuts

Define fiducial volume cuts based on average  $\chi^2$  distribution.

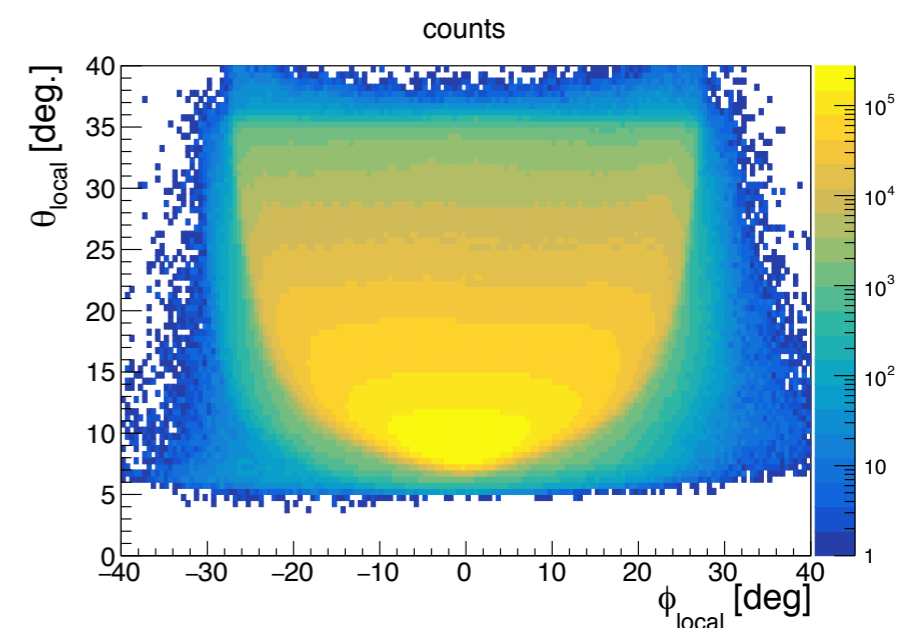
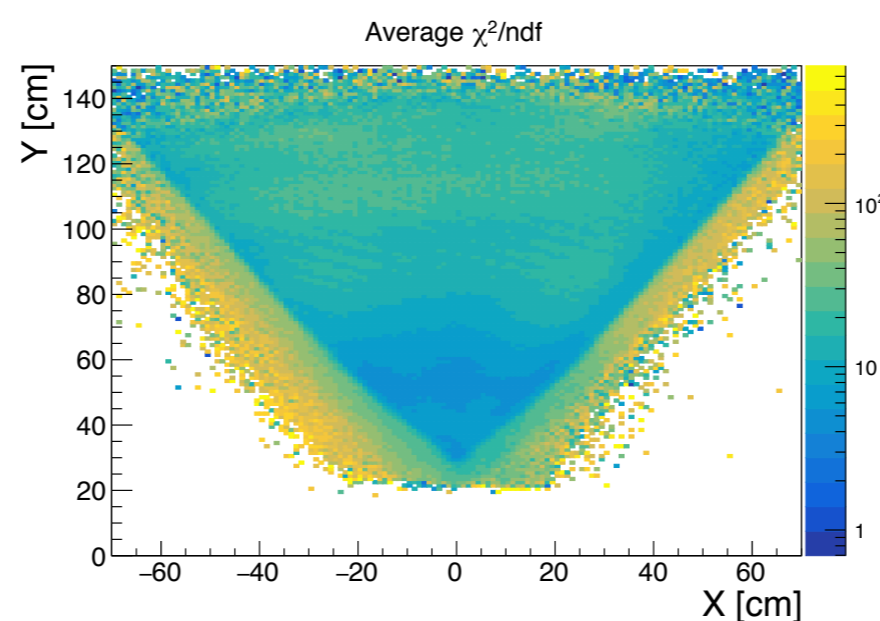
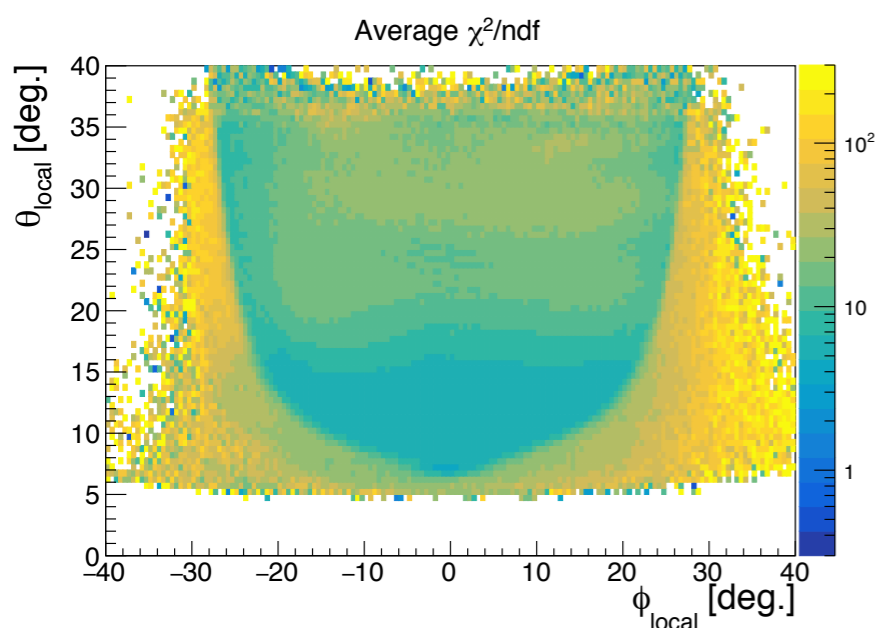
Using local  $\phi$  and  $\theta$  coordinates of the hits in DC

Define fiducial volume cuts based on average  $\chi^2$  distribution.

Using x and y coordinates of the hits in DC

Define fiducial volume cuts based on count rates.

Using local  $\phi$  and  $\theta$  coordinates of the hits in DC

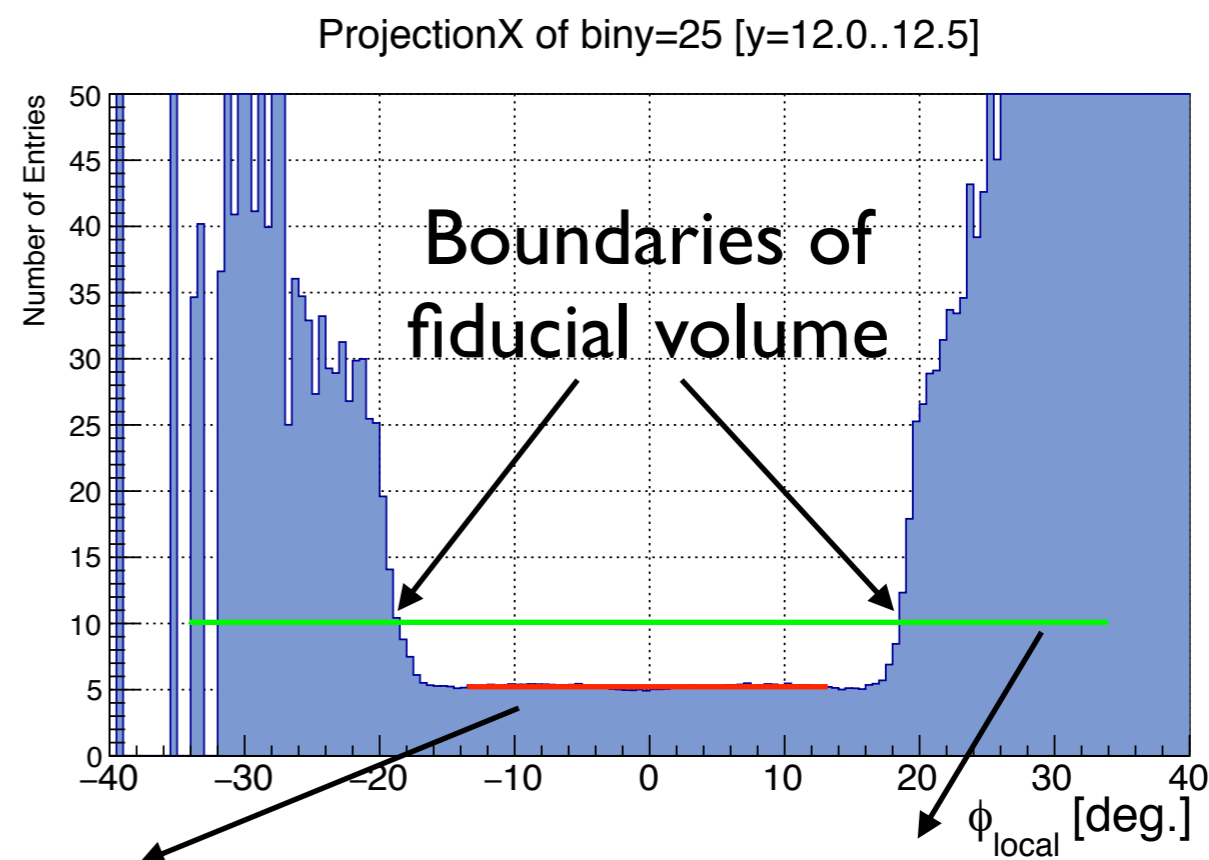
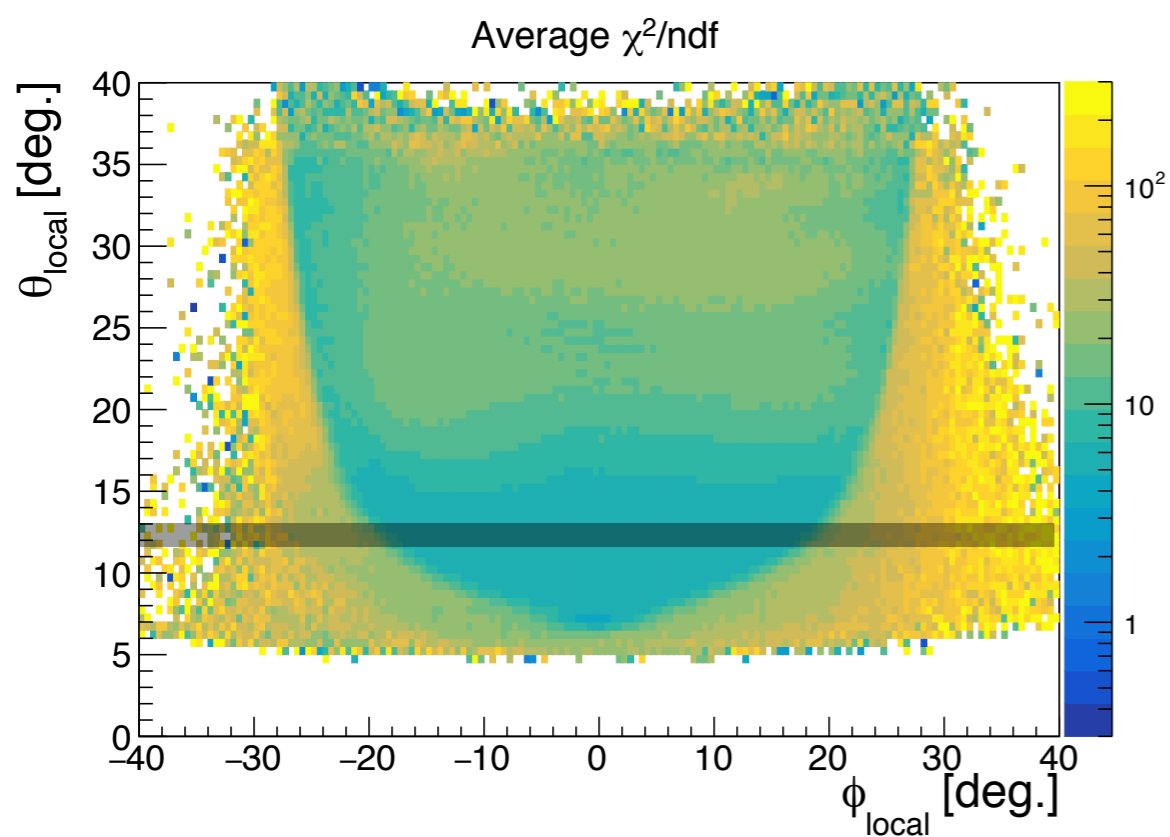


# DC: method I

Calculate local  $\phi$  and  $\theta$  coordinates of the tracks in each sector and each region of DC.

Calculate average  $\chi^2/\text{ndf}$  in bins of local  $\phi$  and  $\theta$ .

Analyze the  $\phi$  distribution of averaged  $\chi^2/\text{ndf}$  in slices of  $\theta$ .



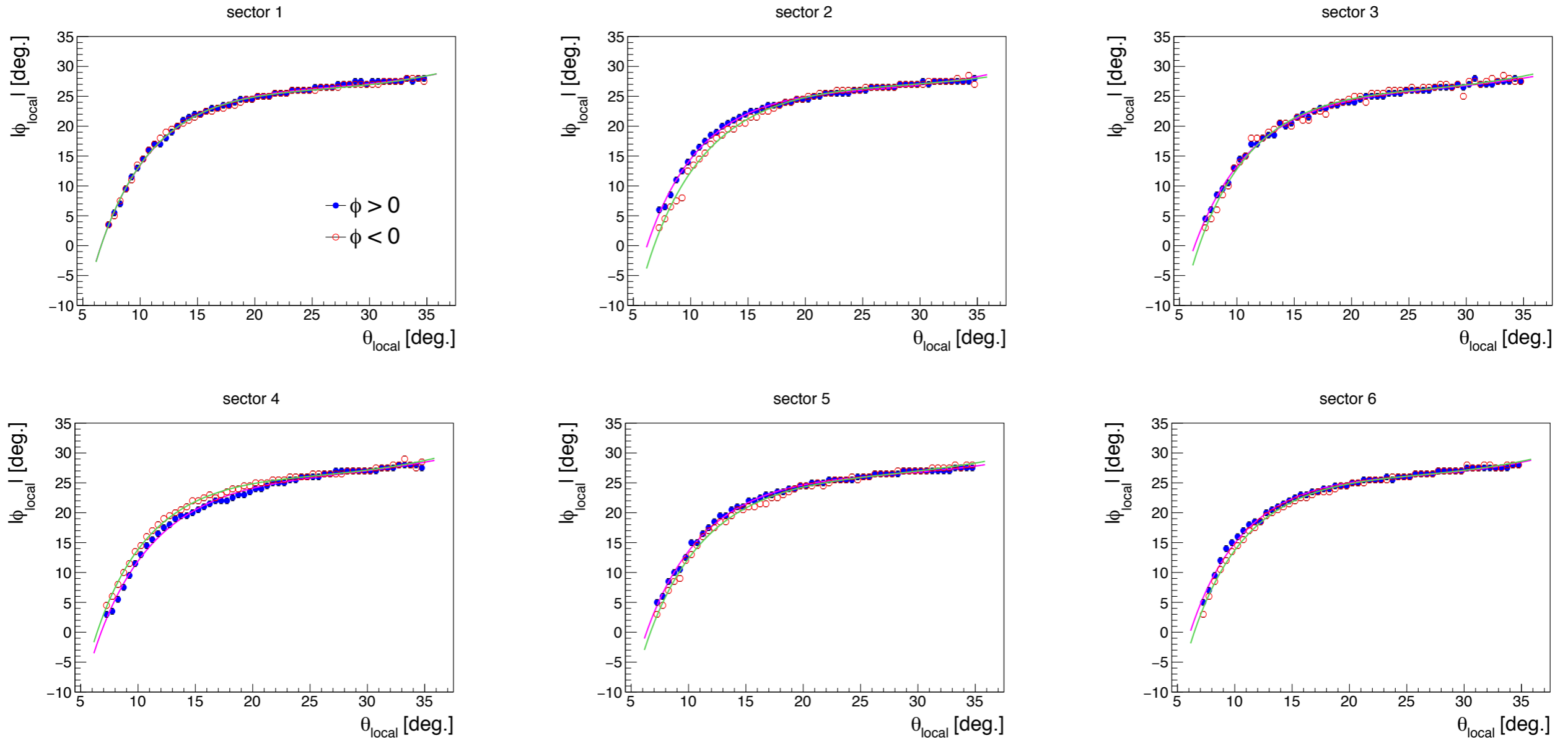
Fit with constant

50% level threshold  
with respect to the fit

# DC: method I

DC region I: Electrons with  $PID=|I|$ :

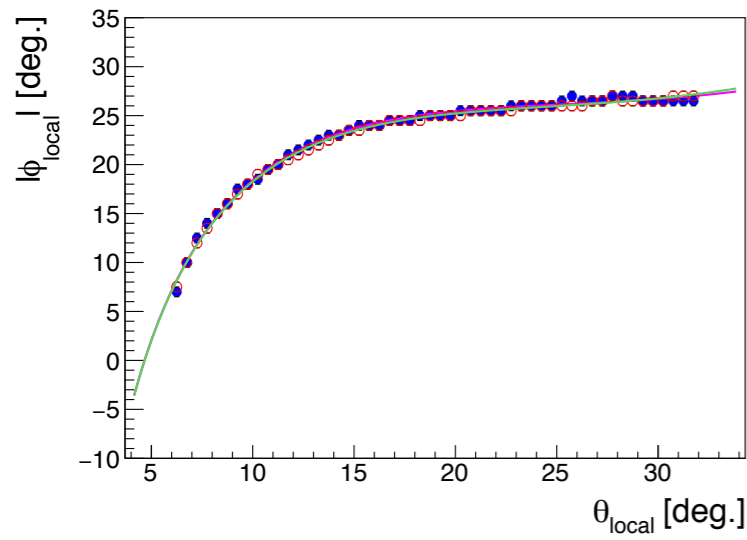
RGB data: runs 6428, 6433, 6442, 6450, 6467, 6474, 6481, 6492



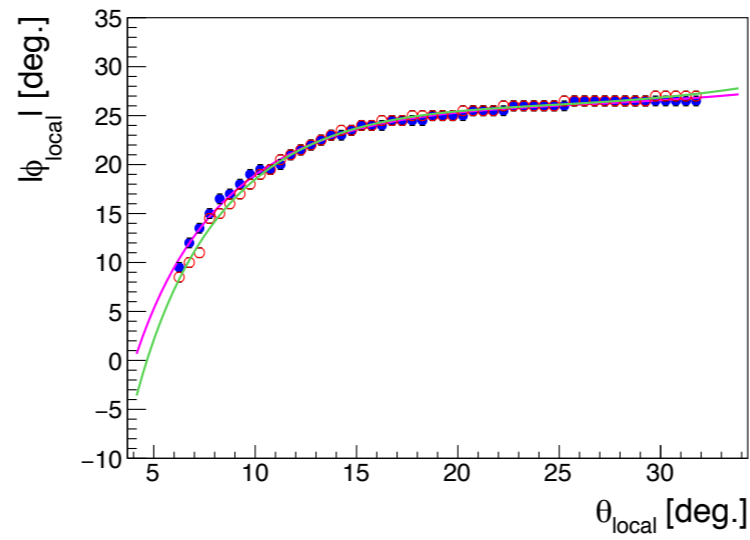
Fit function:  $P_0 + P_1 * \log(\theta) + P_2 * \theta + P_3 * \theta^2$

## DC region 3: Electrons with $PID=|I|$ :

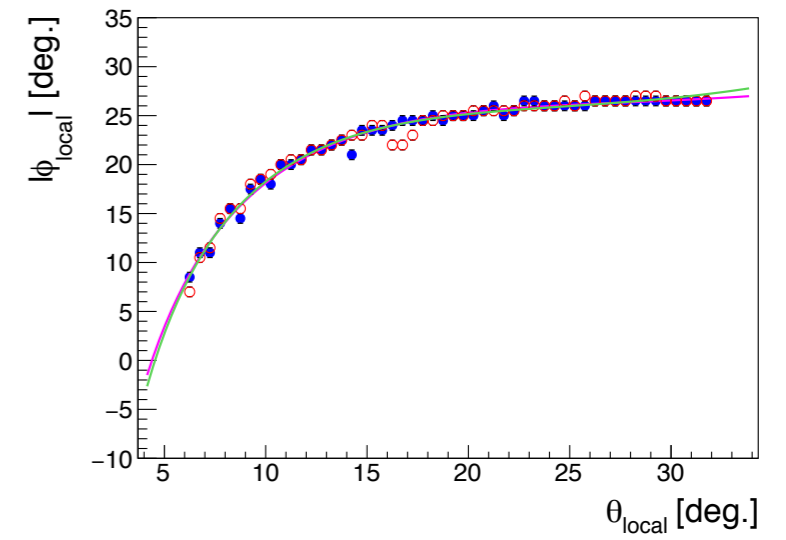
sector 1



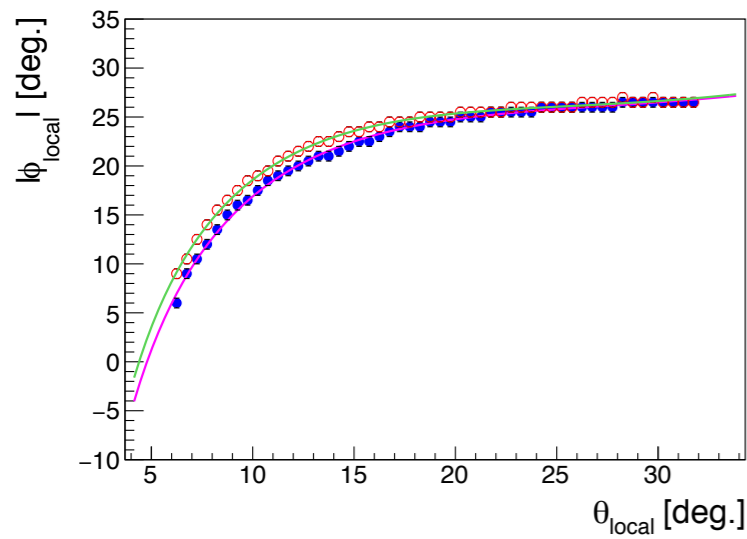
sector 2



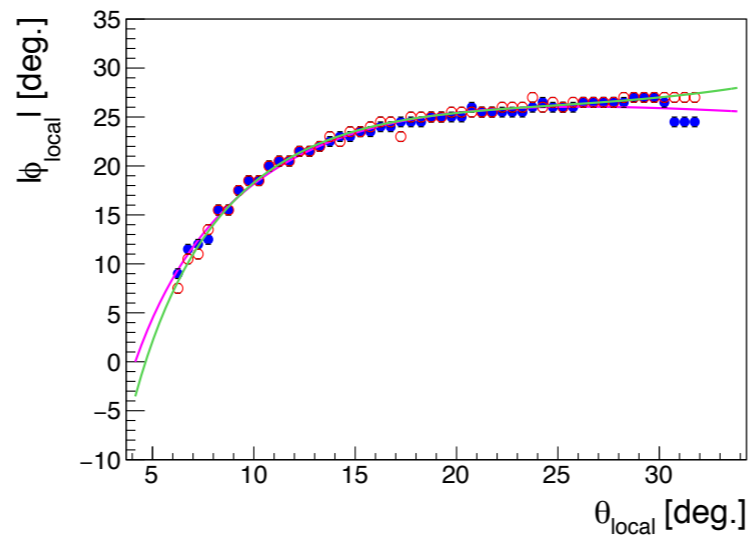
sector 3



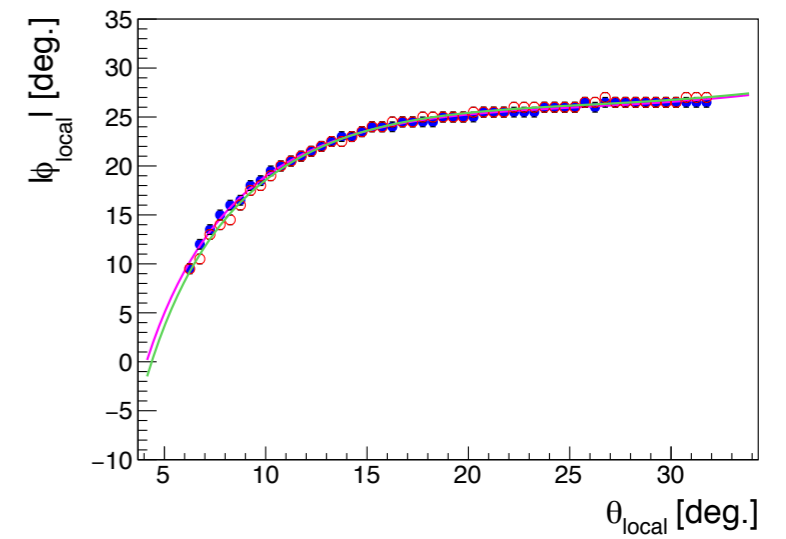
sector 4



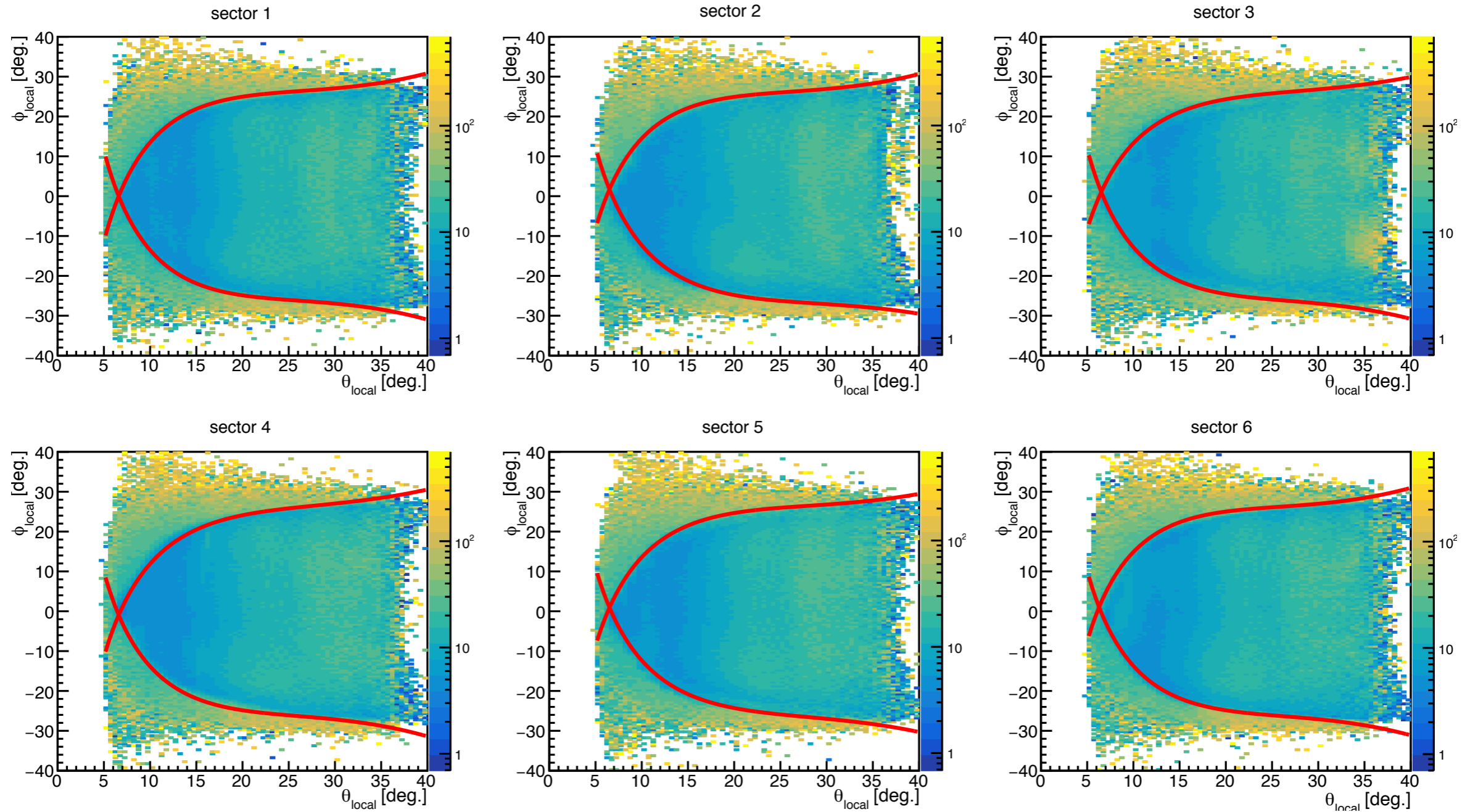
sector 5



sector 6



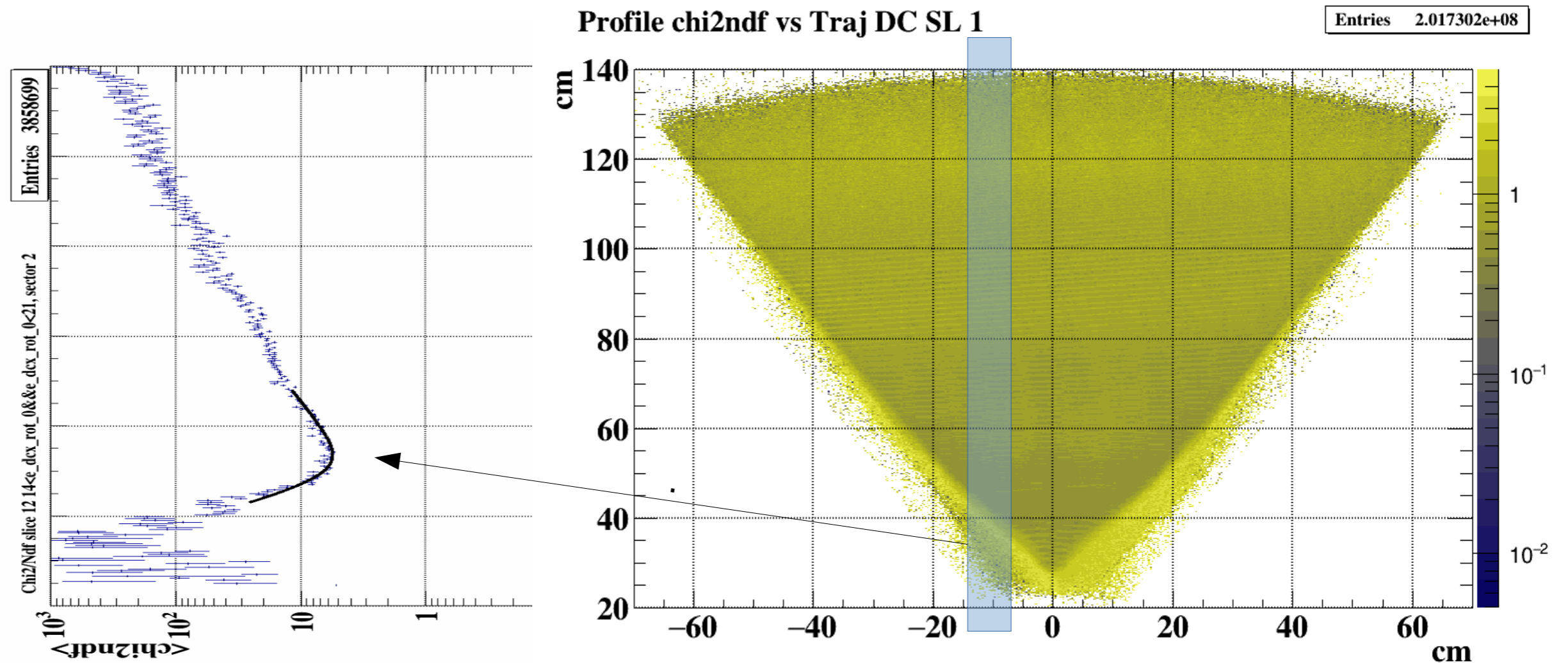
# DC: method I



Reg. 1	Sec. 1		Sec. 2		Sec. 3		Sec. 4		Sec. 5		Sec. 6	
P0	-93.5559	94.6925	-83.3437	90.7231	-77.5379	92.7231	-86.1796	88.8643	-80.3697	85.3909	-82.7300	89.0879
P1	65.1838	-66.27602	59.7779	-60.6672	53.9136	-63.8867	57.9769	-62.7975	55.9105	-57.9323	59.9868	-62.6443
P2	-4.77460	4.92772	-4.41993	4.04905	-3.6797	4.60712	-3.91174	4.6568	-3.8367	3.93717	-4.5063	4.60160
P3	0.04683	-0.04894	0.04439	-0.03636	0.03485	-0.04508	0.03708	-0.04679	0.04540	-0.03717	0.04540	-0.04573

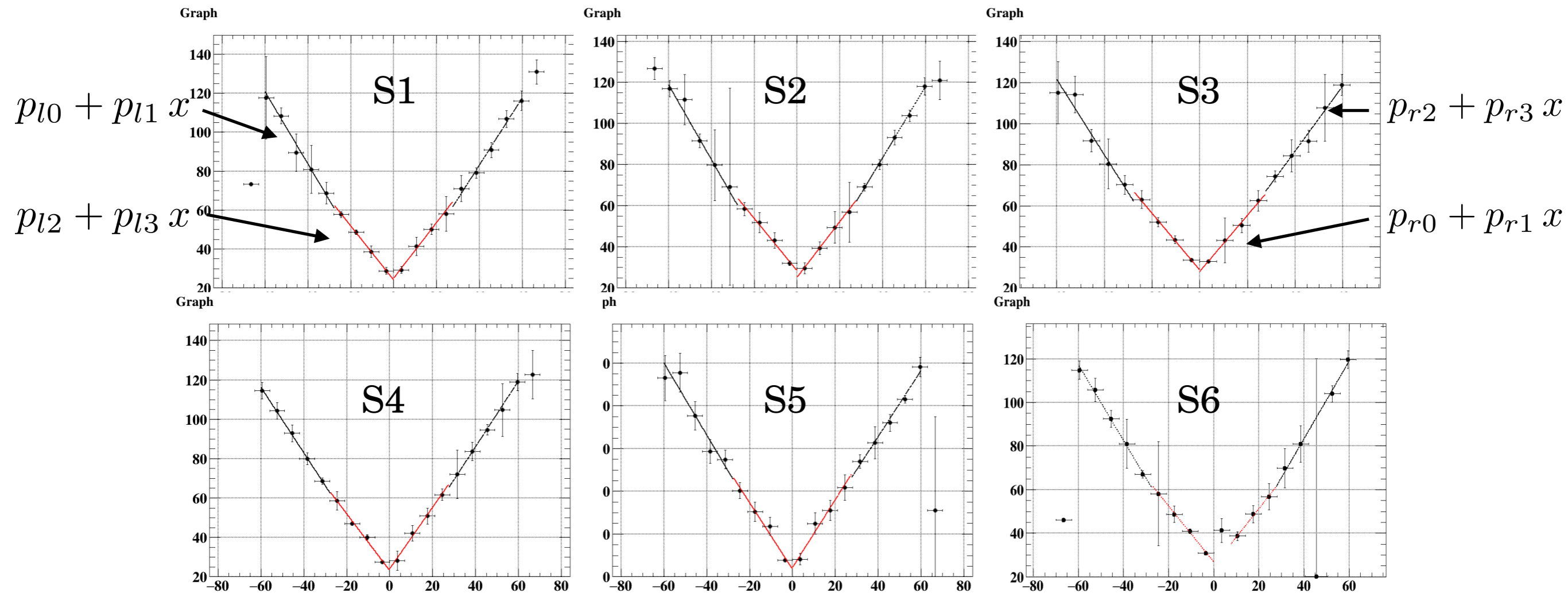
# DC: method 2

In each sector 20 Slices in x where done and the point where the two exponentials intercept was selected per each slice.





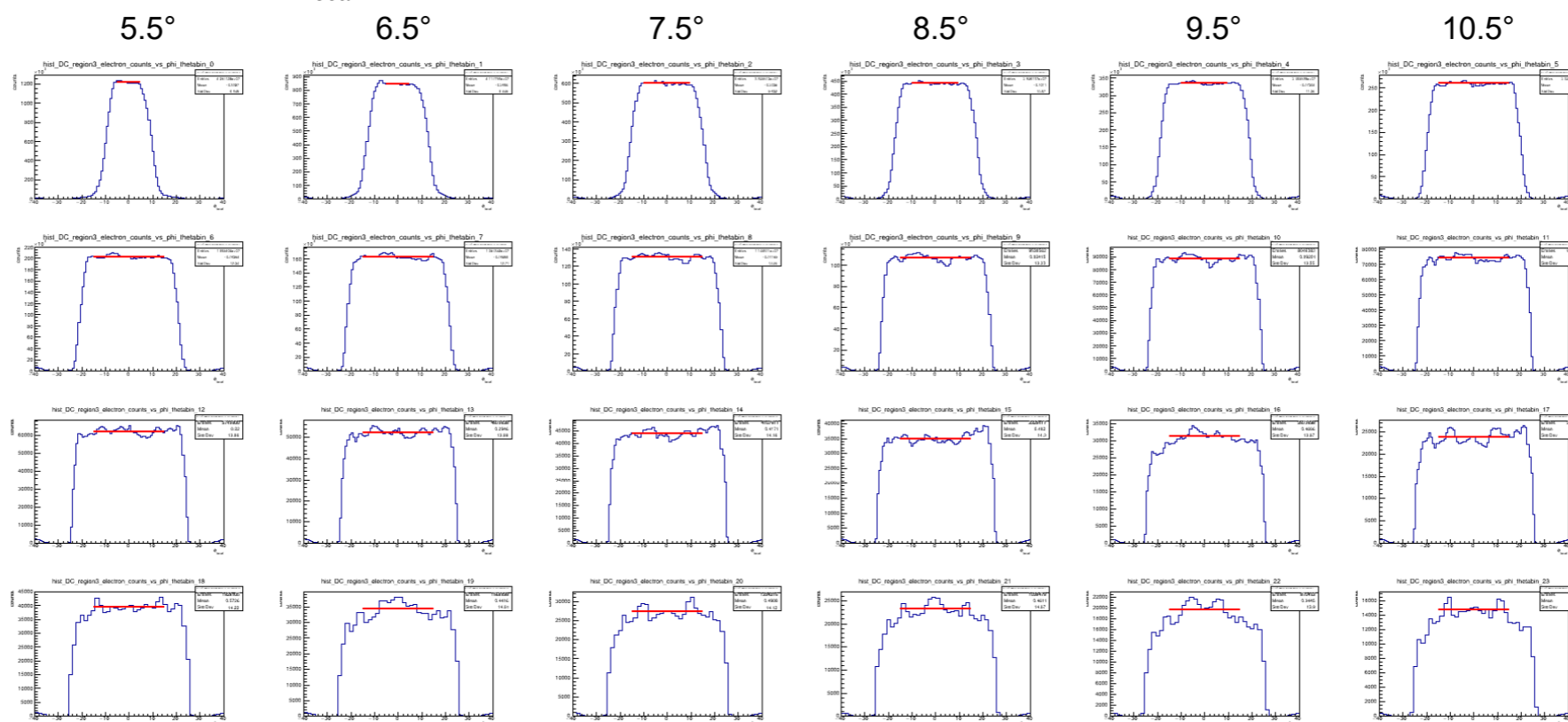
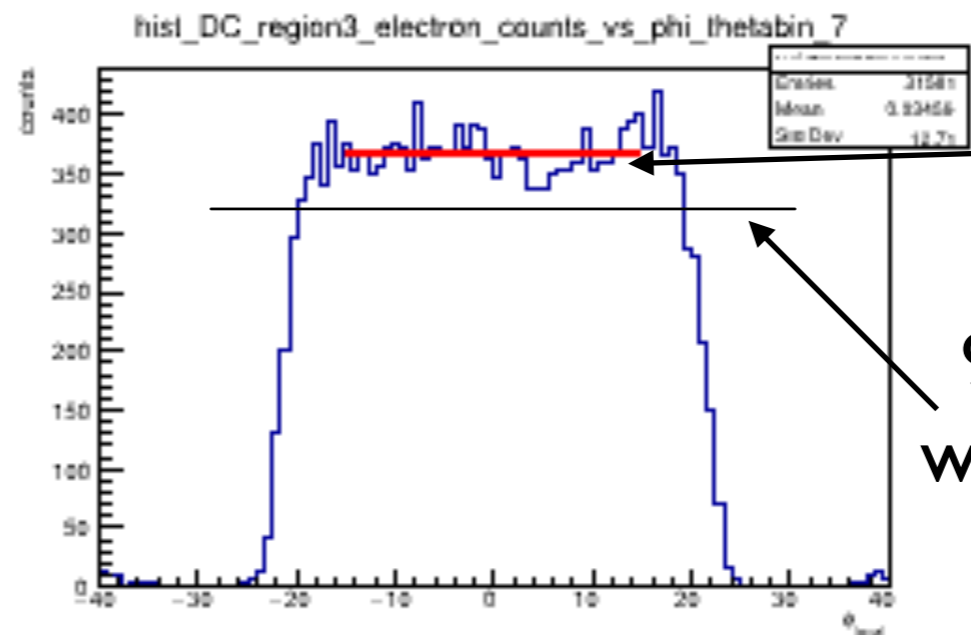
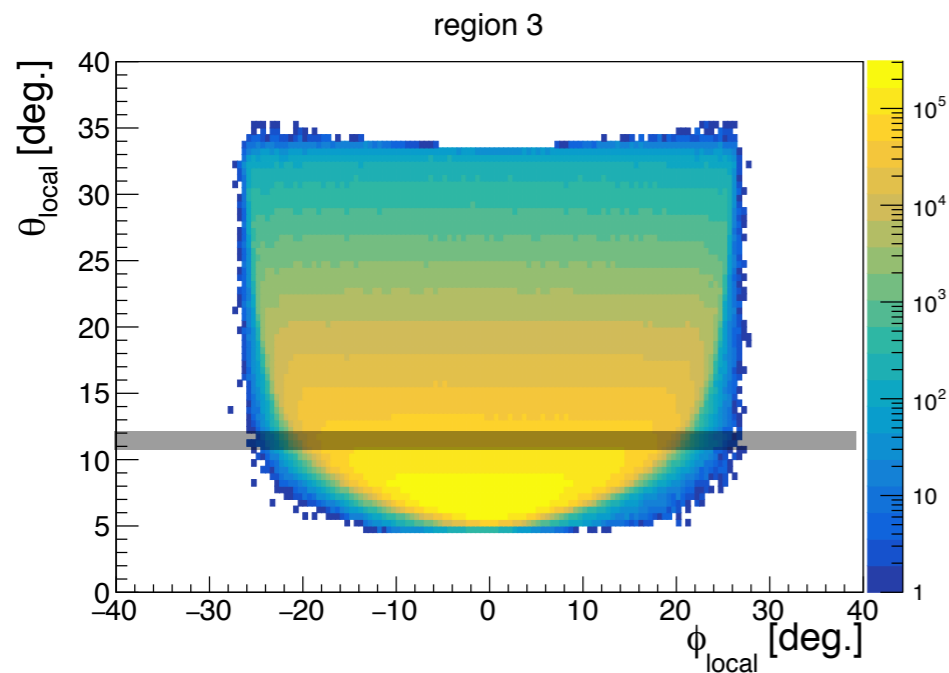
# DC: method 2



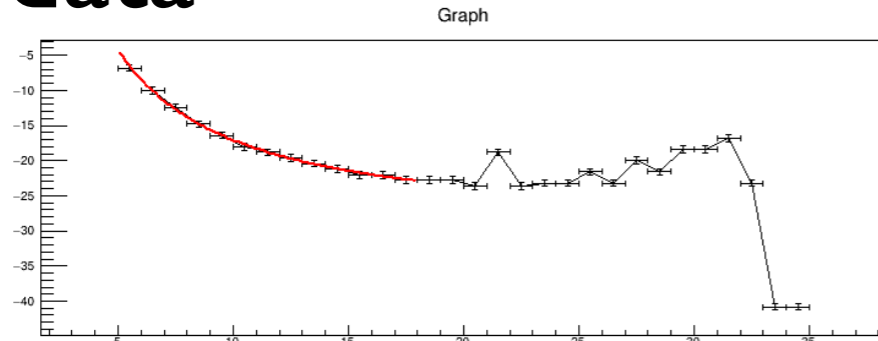
sec	pl0	pl1	pl2	pl3	pr0	pr1	pr2	pr3
1	9.4487	-1.85609	24.0573	-1.38684	24.9107	1.42733	13.9578	1.72647
2	9.6988	-1.82014	28.3571	-1.27469	25.0105	1.35964	13.9829	1.73264
3	11.1452	-1.84042	28.6746	-1.38146	27.9758	1.3651	23.1612	1.58585
4	16.2675	-1.66529	23.0932	-1.43993	23.839	1.56257	19.0212	1.6702
5	18.8583	-1.68735	23.4829	-1.5583	24.107	1.59231	23.5651	1.5467
6	12.9947	-1.73672	26.7278	-1.28616	25.1901	1.30976	25.1906	1.30975

# DC: method 3

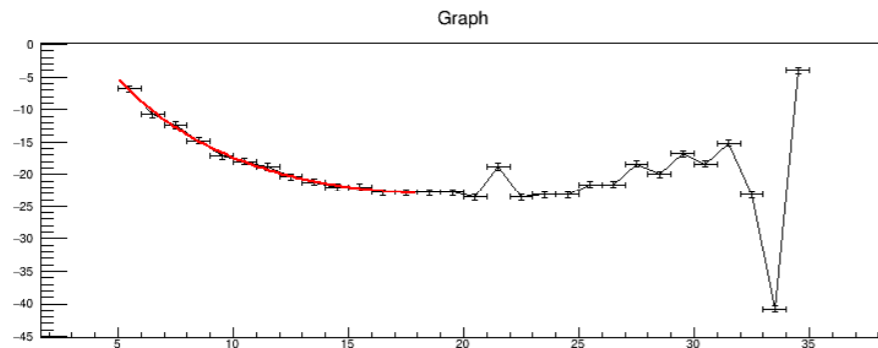
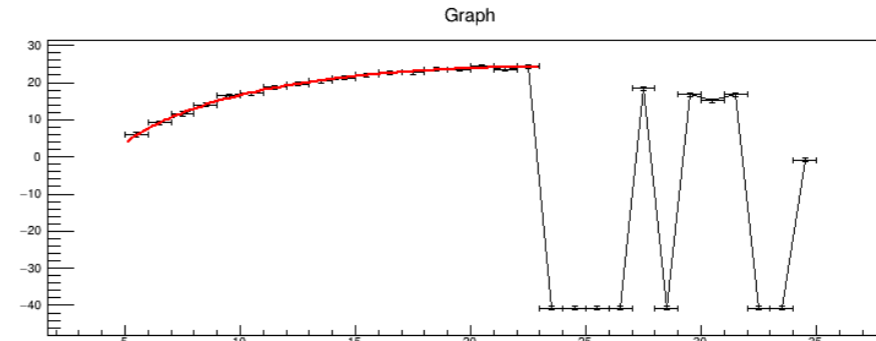
Calculate local  $\phi$  and  $\theta$  coordinates of the tracks in each sector and each region of DC.



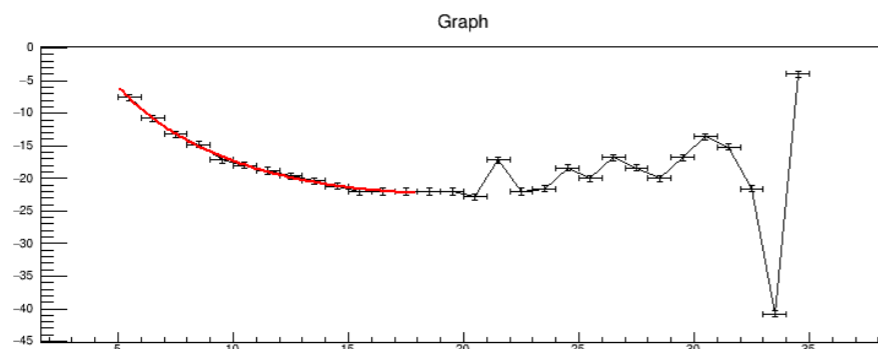
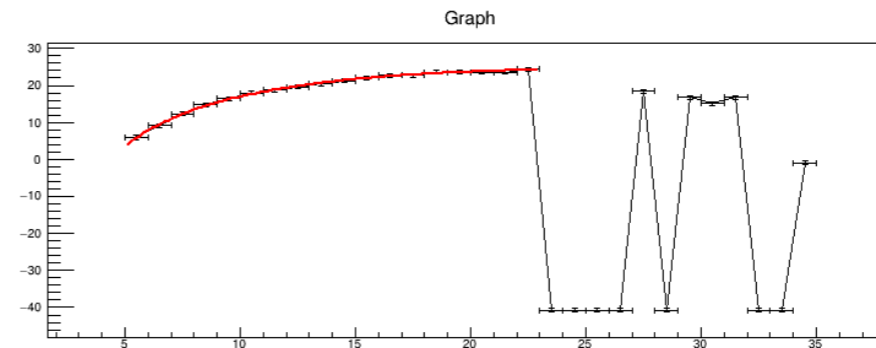
## DC regions 1,2,3: Electrons with PID=11: RGA data



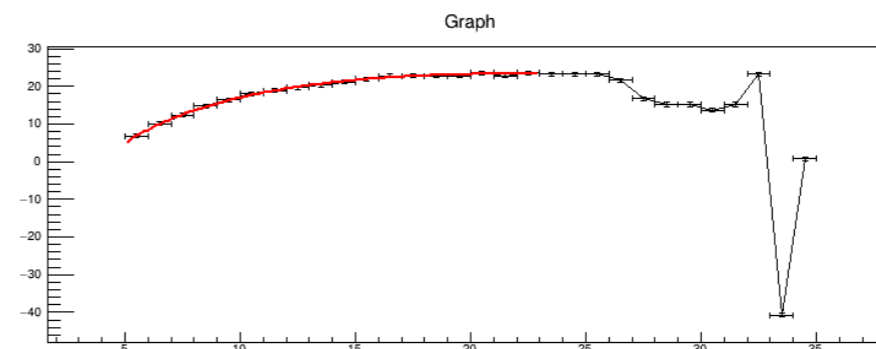
region 1



region 2



region 3



Fit function:

$$A + B\sqrt{\theta} + C/\theta + D\theta$$

$$\text{const}(\theta_{max})$$

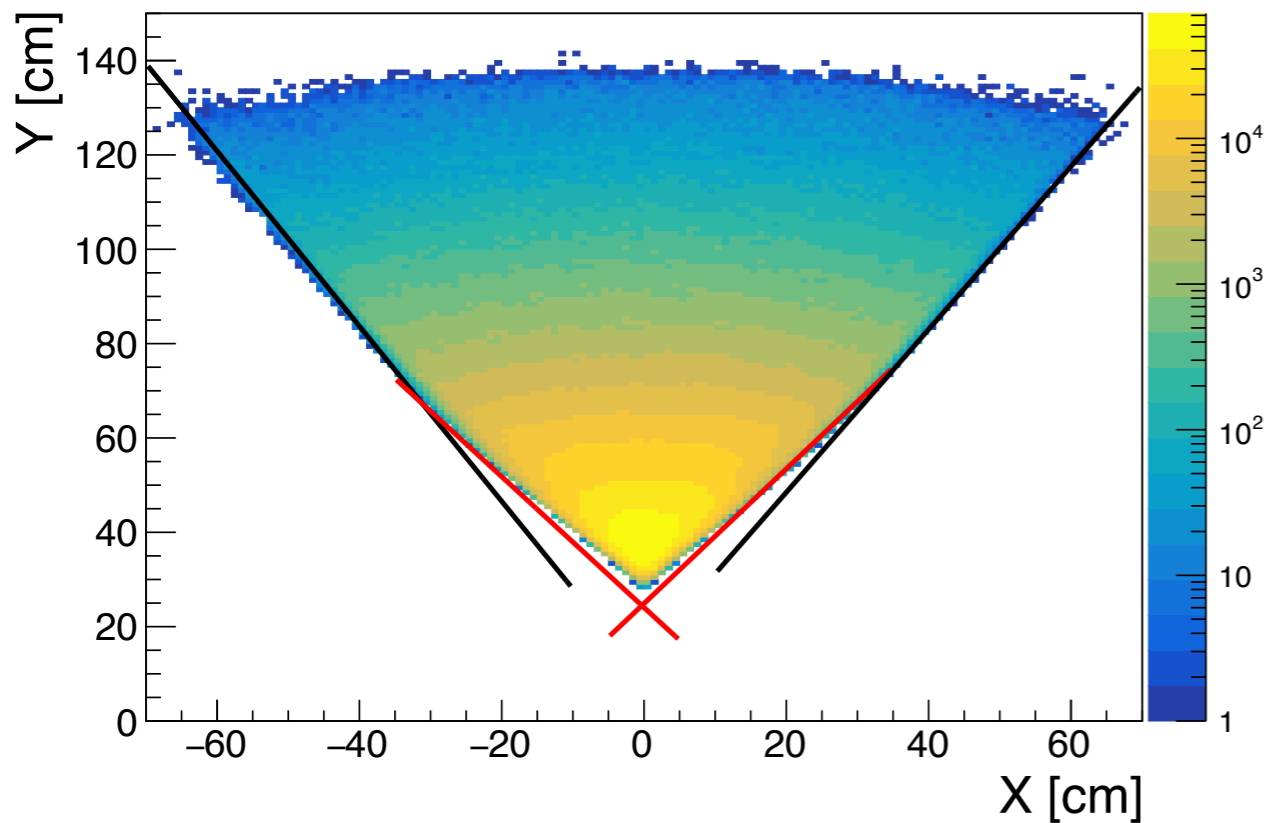
$$\text{for } \theta \leq 17^\circ$$

$$\text{for } \theta > 17^\circ$$

# Comparison of different methods

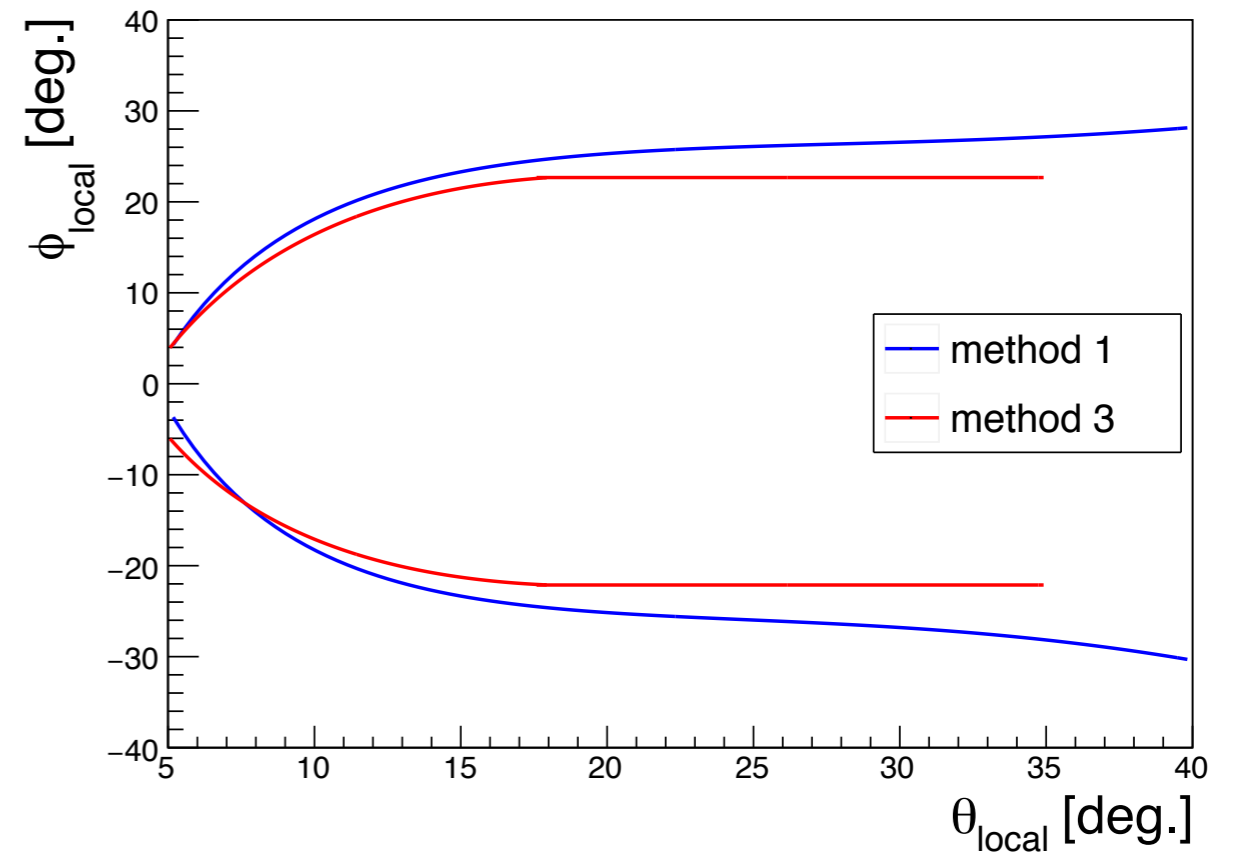
Comparison of methods 1 and 2.  
Example for sector 1 of DC  
region 1.  
Curves represent the cuts  
obtained with method 2.

region 1 sector 1



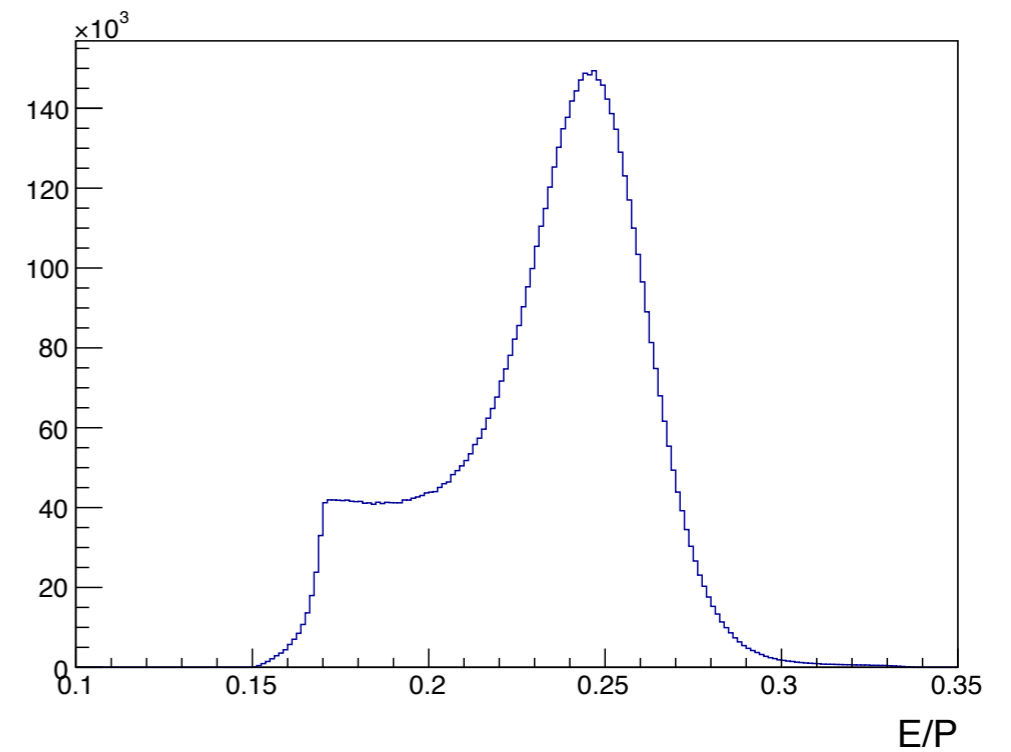
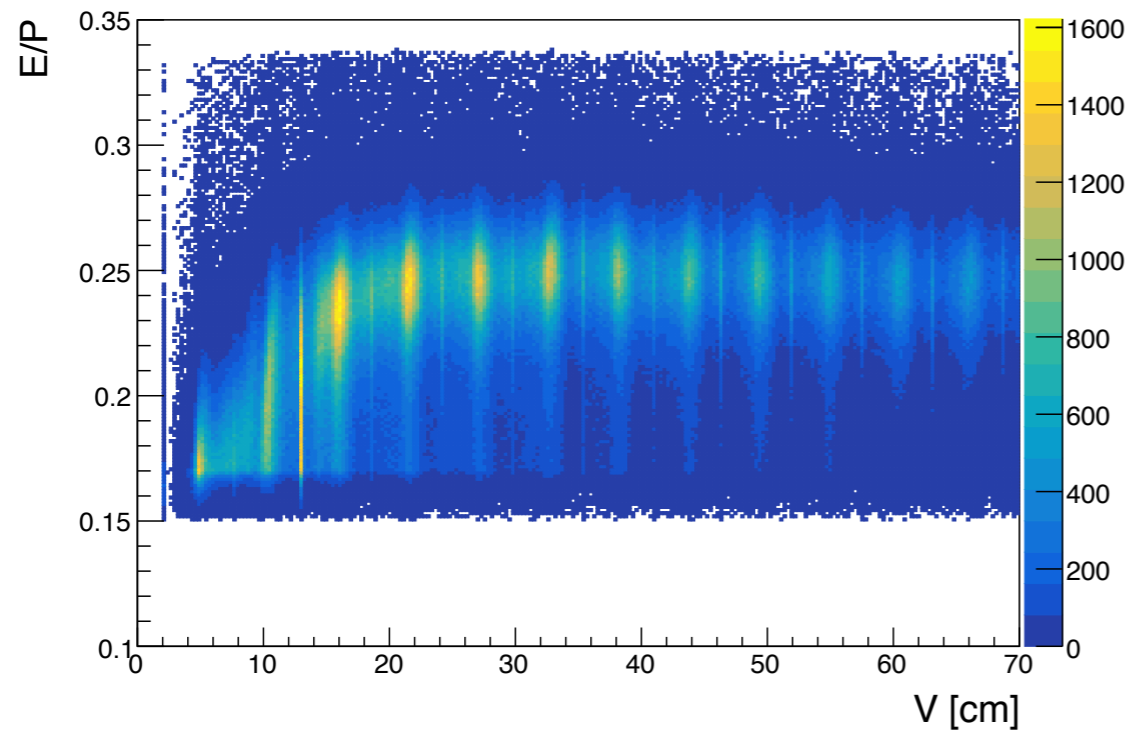
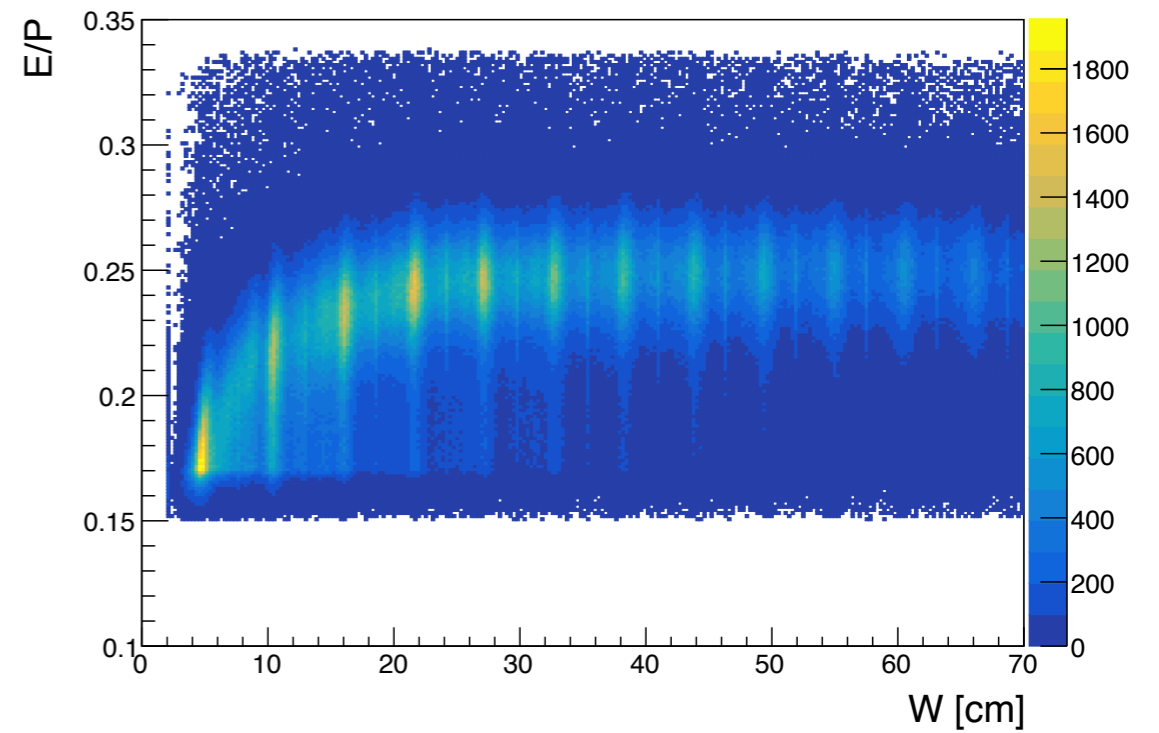
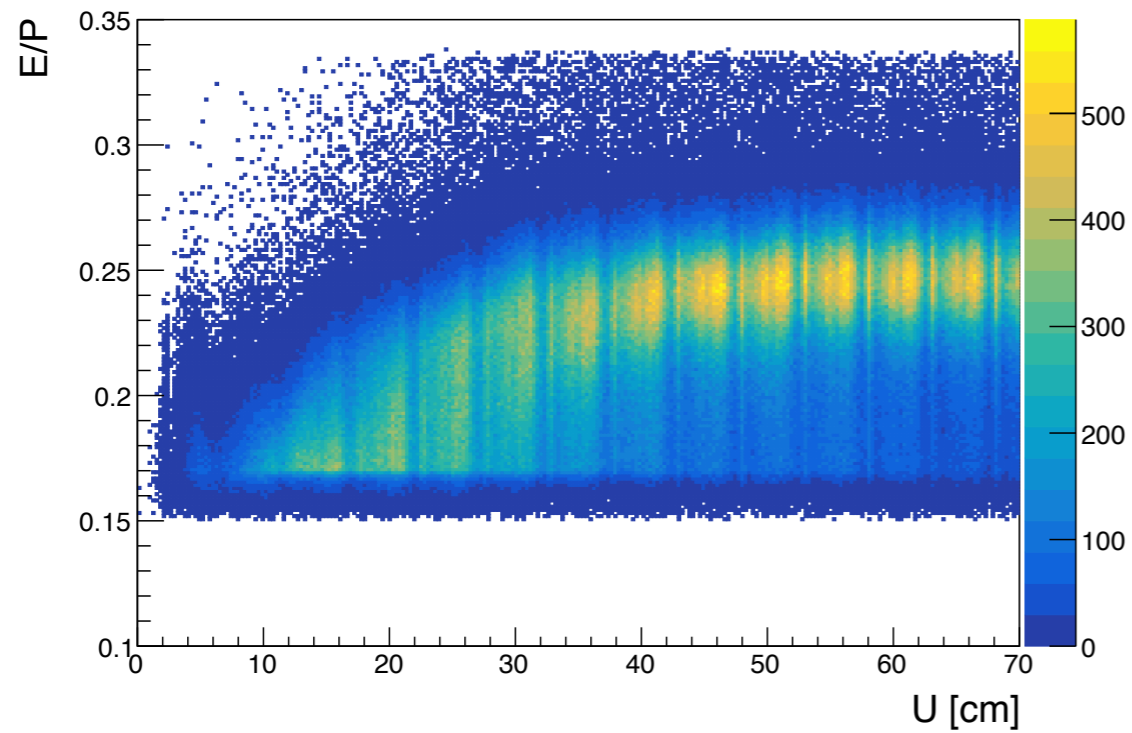
Comparison of methods 1 and 3.  
The cuts obtained with both  
methods are shown for sector 3  
of DC region 3.

region 3 sector 3

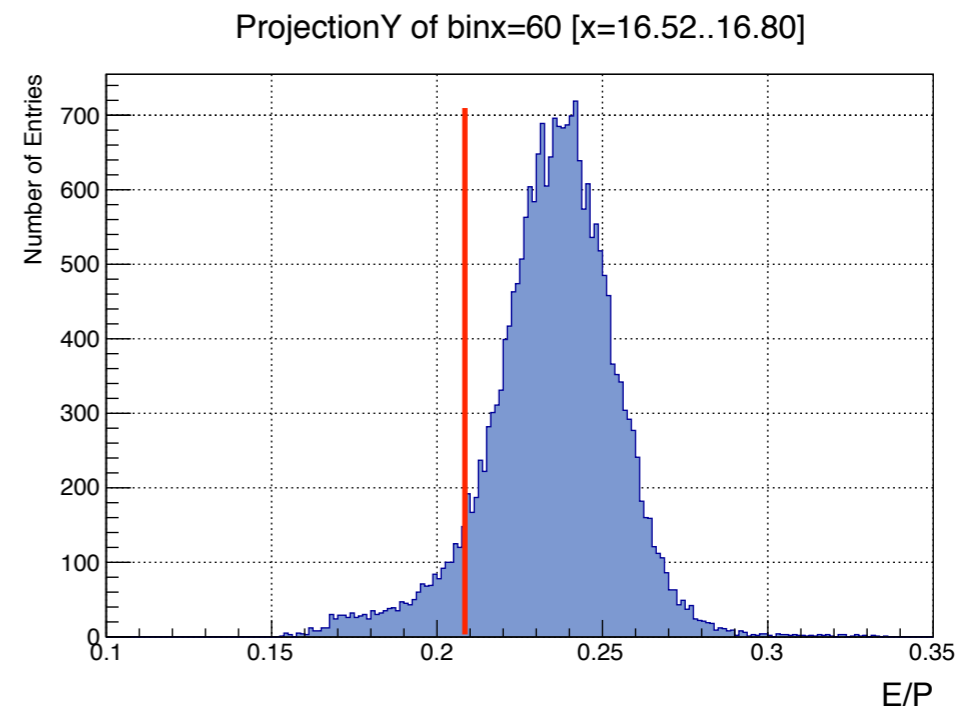
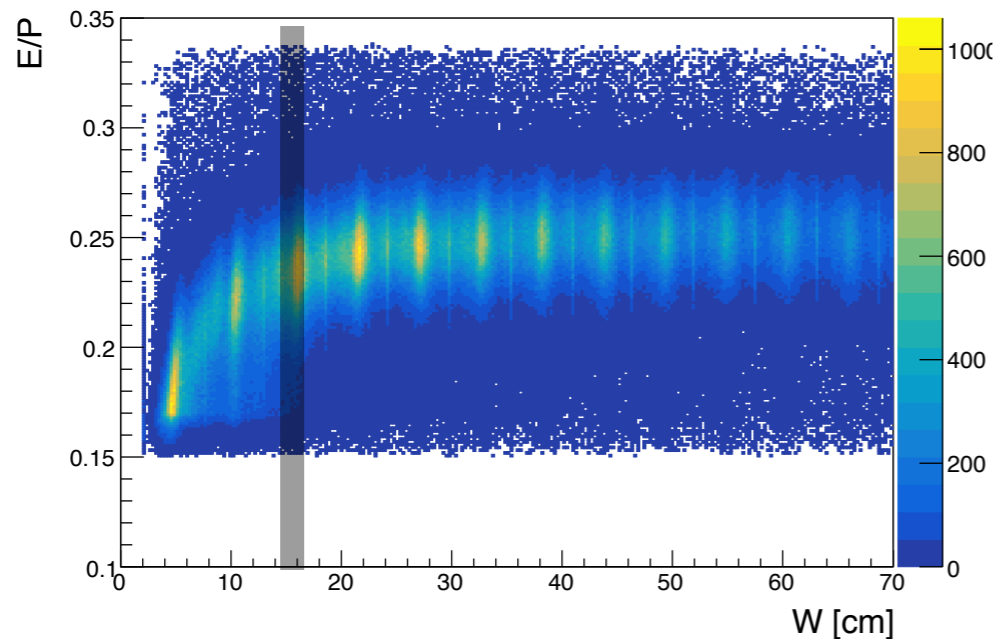
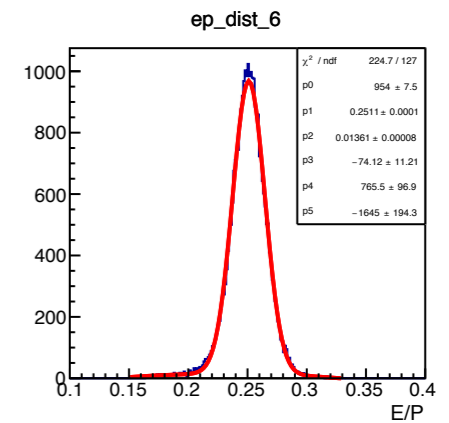
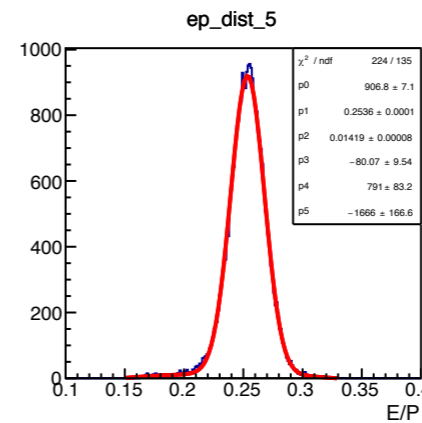
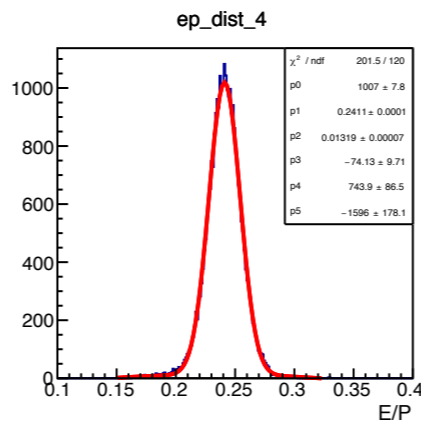
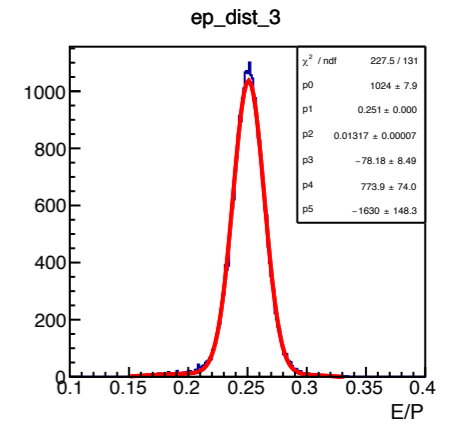
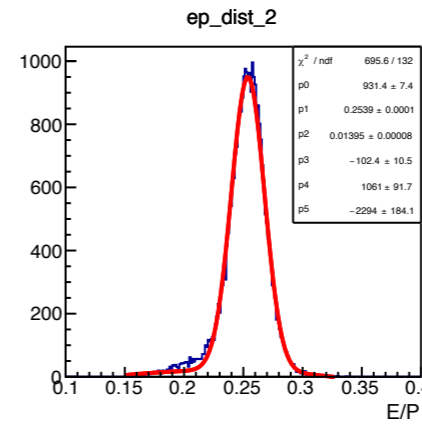
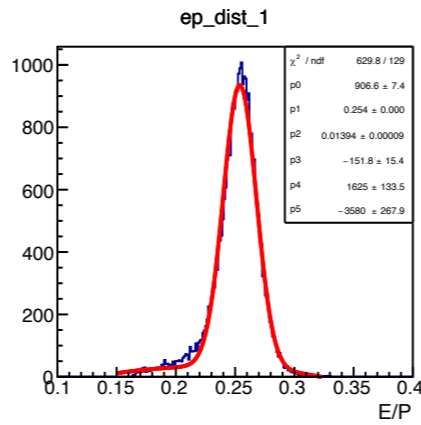


reduction in statistics varies between methods from 0.8 to 1.3 %.

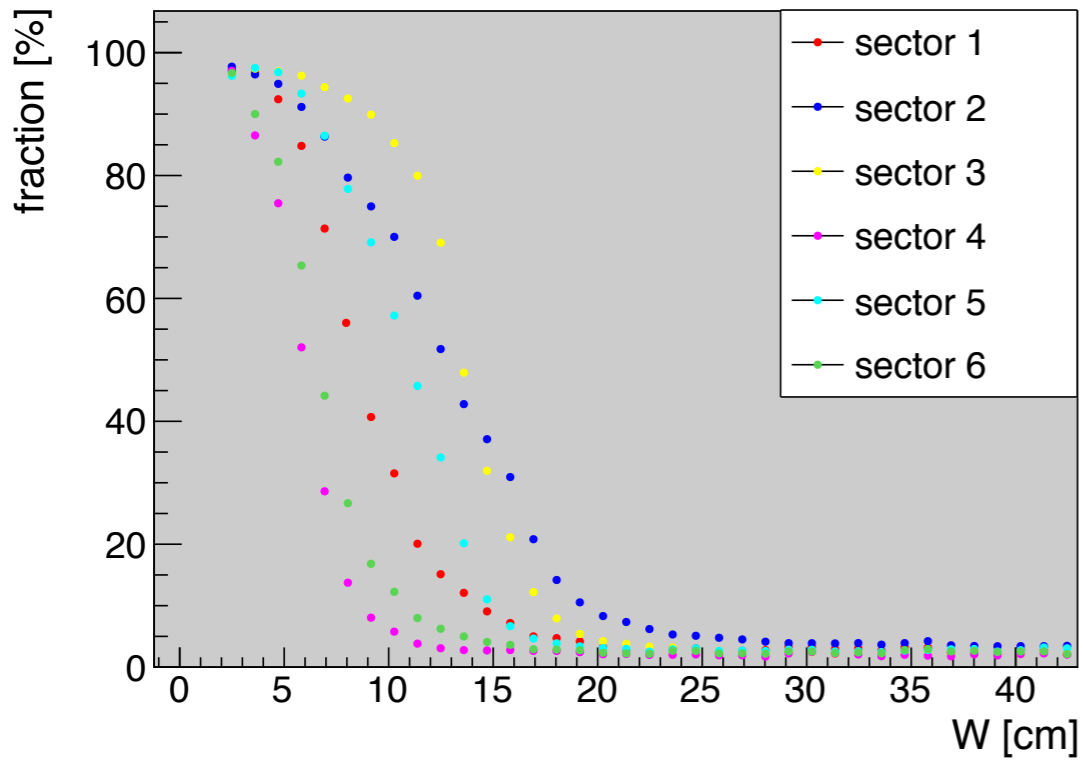
## Sampling fraction distributions for electrons: $PID=11$ & $P > 2$ GeV



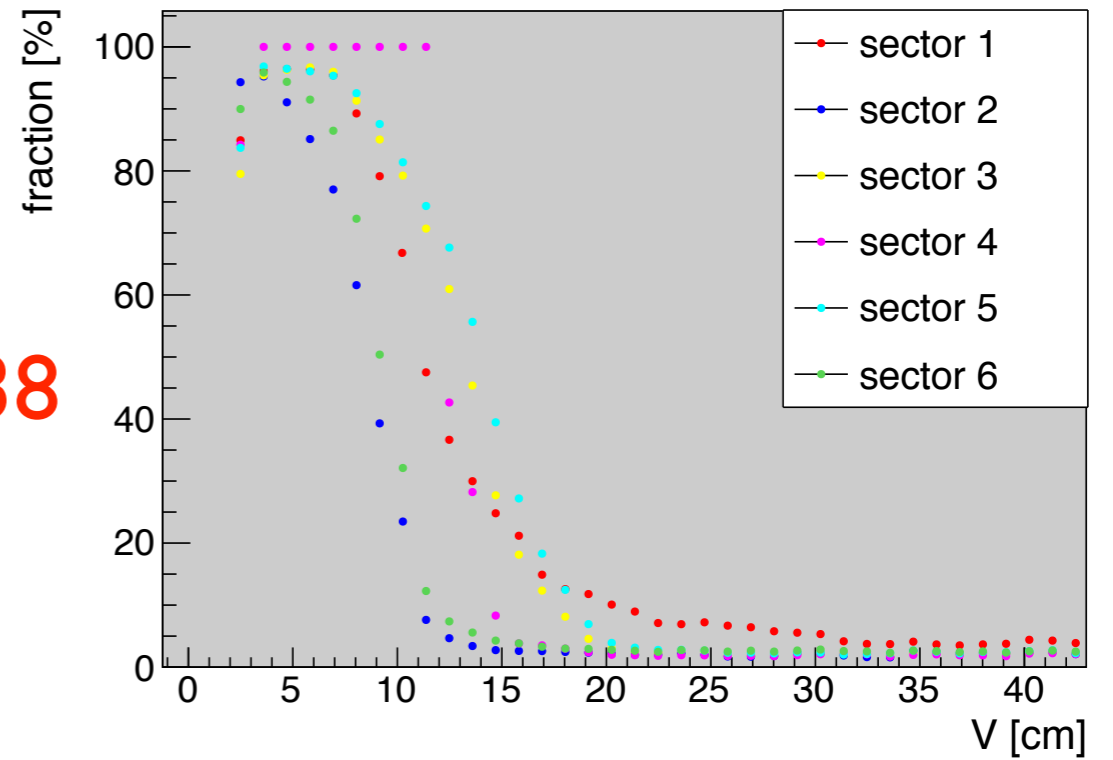
1. Apply hard cuts on U,V and W coordinates. ( $> 60$ )
2. Define the mean and the width of sampling fraction (to be used as a reference)
3. Scan over V and W and calculate the fraction of events outside  $3\sigma$  region.



V > 30

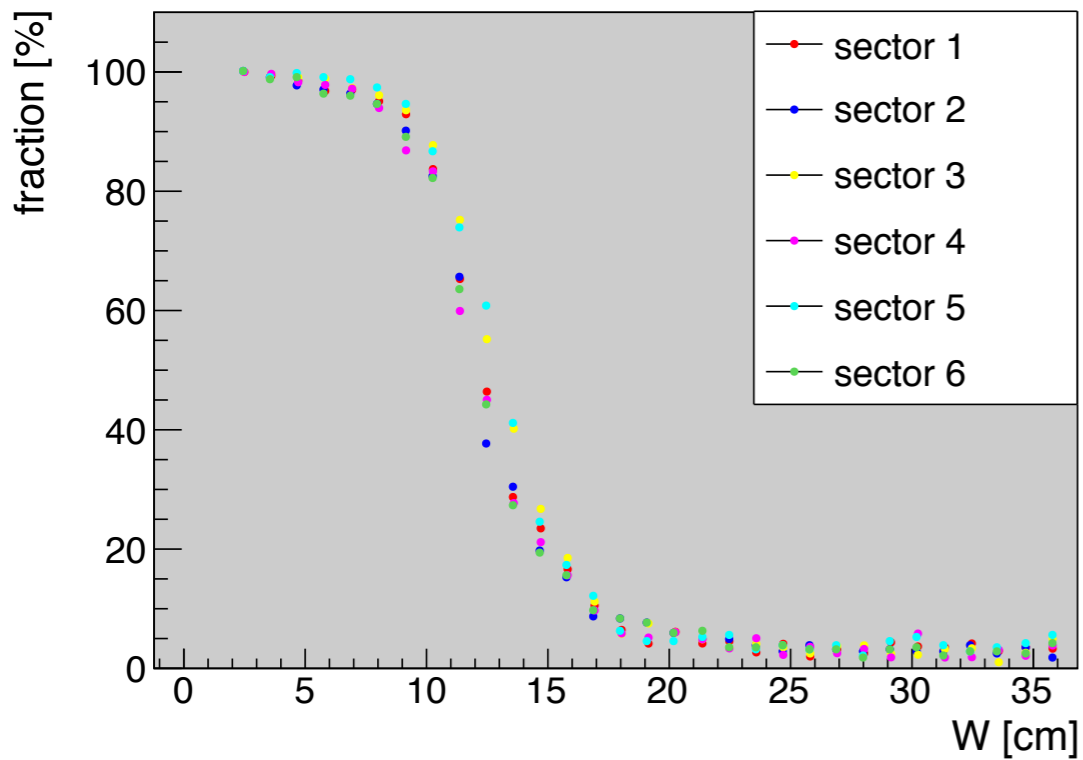


W > 30

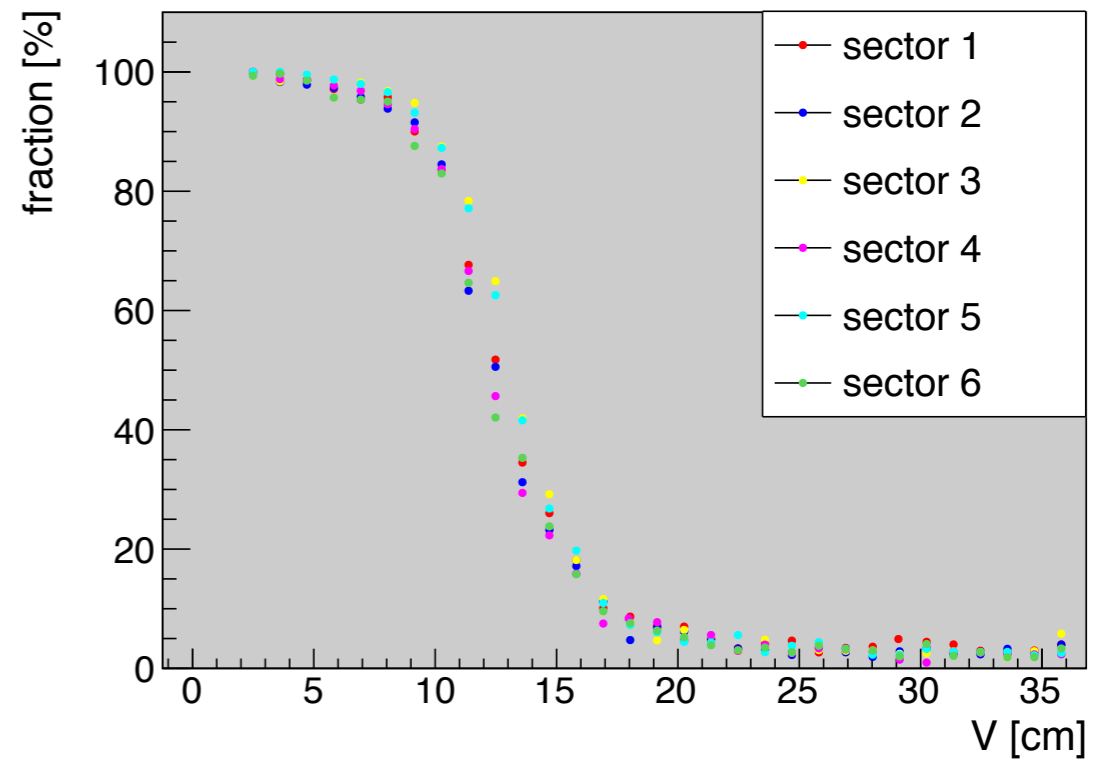


RGA  
run 5038

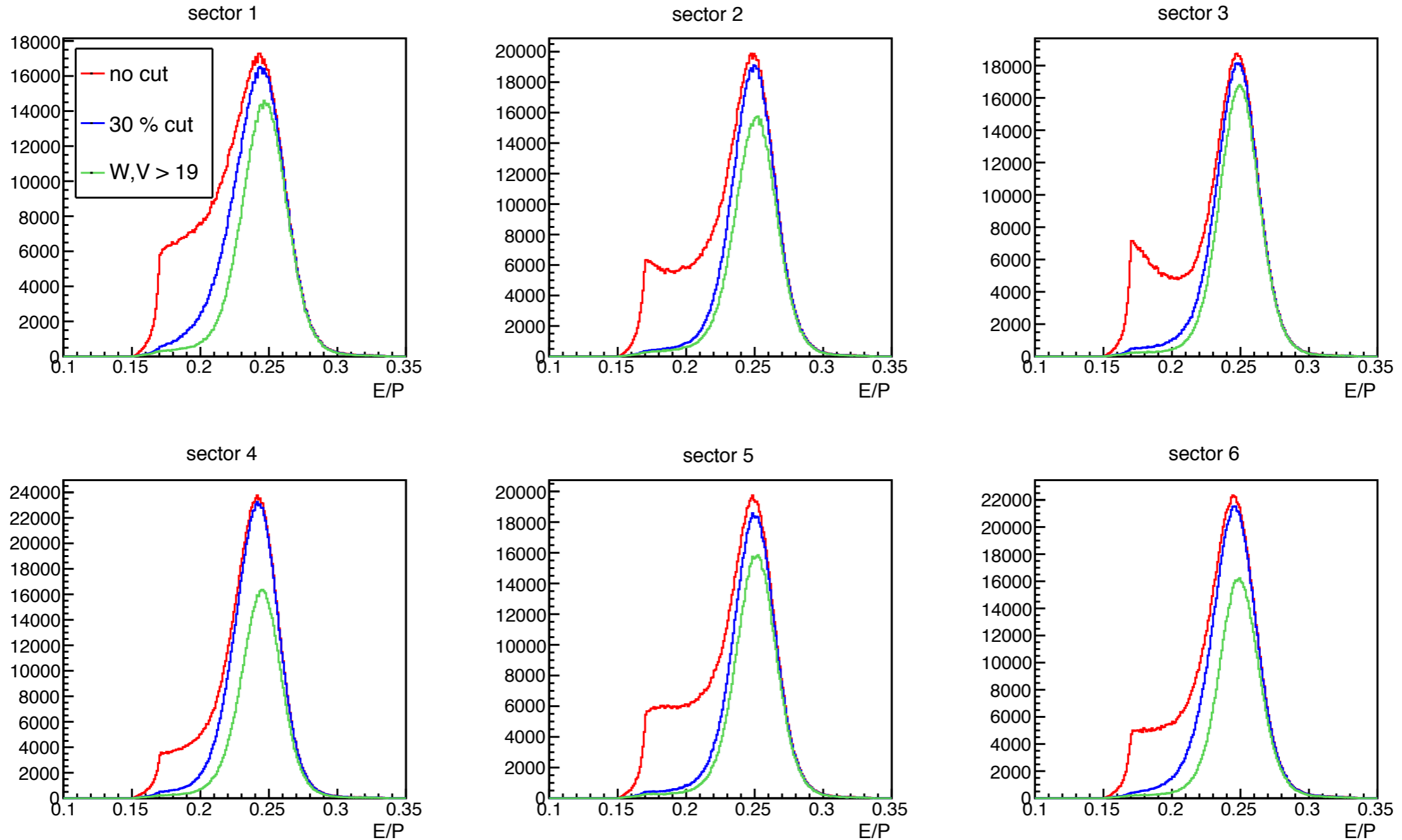
V > 30



W > 30



MC



**72.85% of electrons pass 30% cut**

**55.15% of electrons pass constant cut  $V, W > 19$  cm**



Thank you !