



Update on Bremsstrahlung studies

Study on Low Multiplicity Run

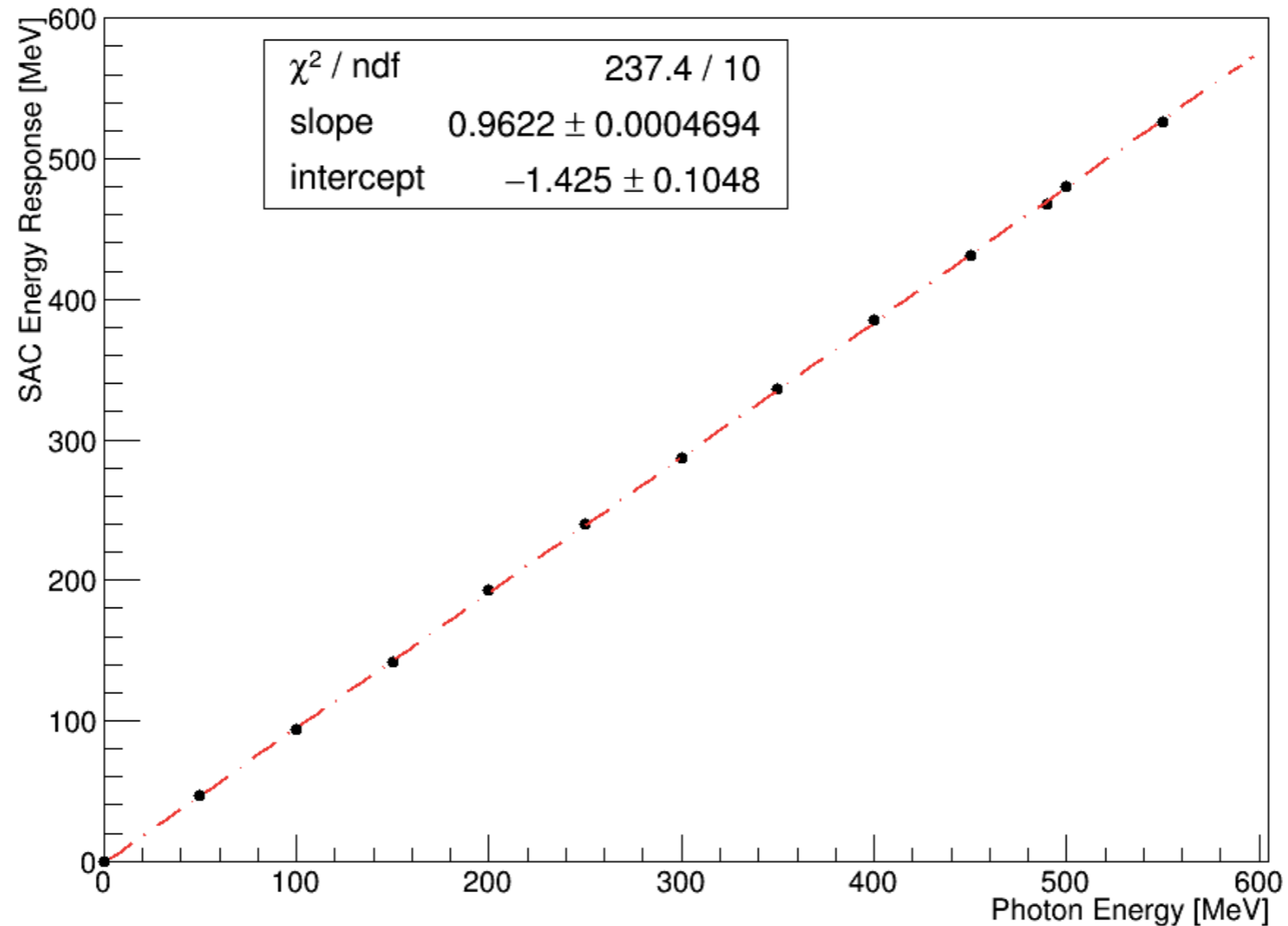
F. Oliva on behalf of the PADME Lecce group

MC SAC energy response

1kevents Single Photon

MC prod at different energies hitting SAC center crystal

SAC Energy MC Response VS Energy Single Photon

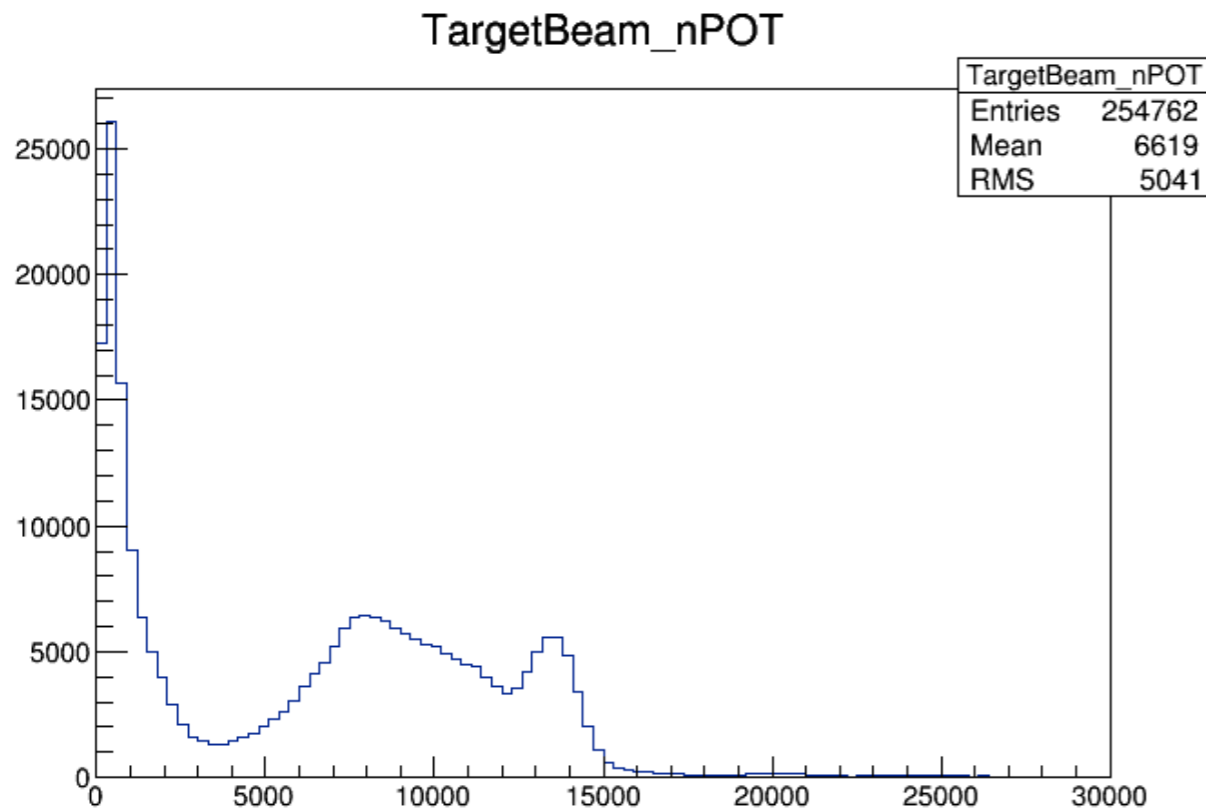
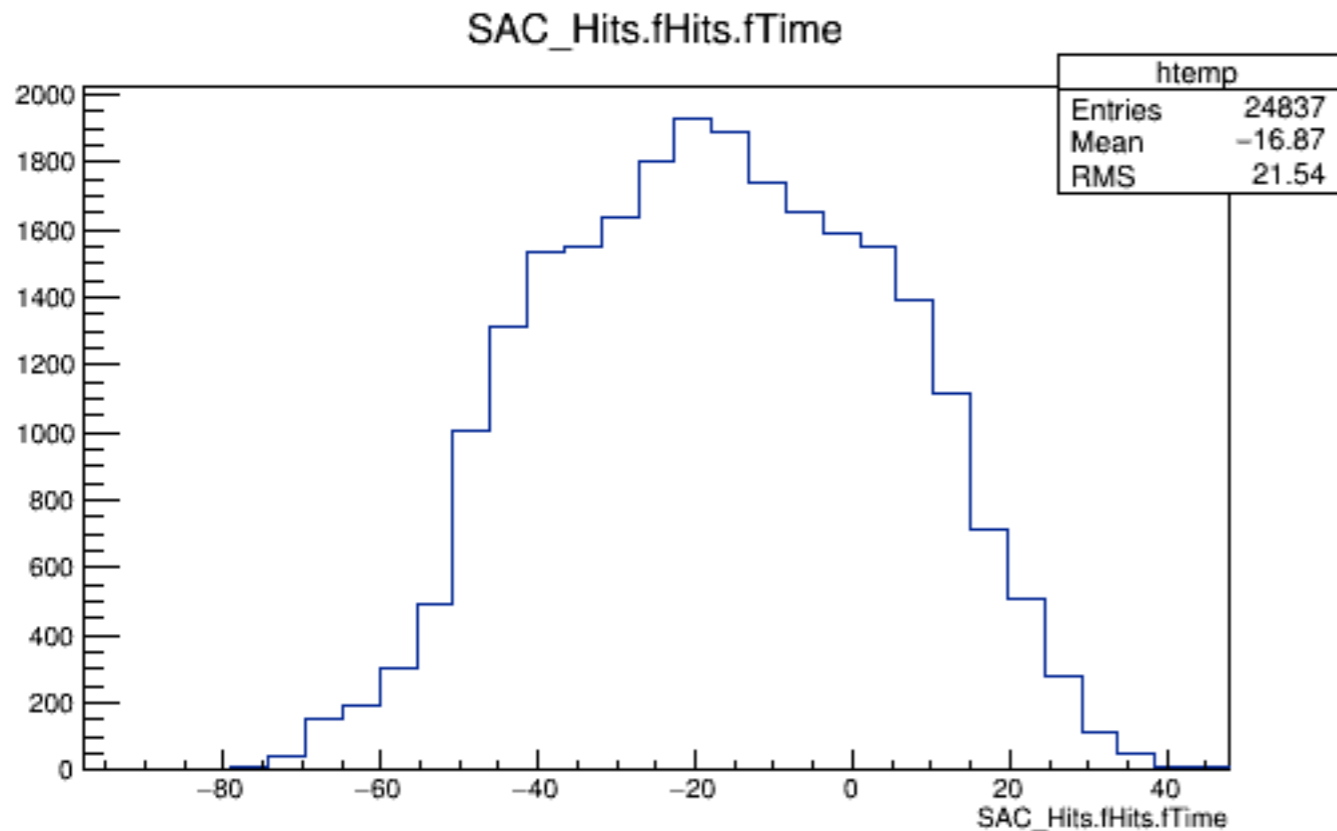


$$\text{SAC Response} = \text{PhEn} \cdot 0.9622 - 1.425 \text{ MeV}$$

$$\text{EnScale} \sim 1/0.9622 \sim 1.039$$

Linear Response

run_0000000_20190720_125615



Log

run_0000000_20190720_125615

Beam type: primary e+
Beam Energy: 490 MeV
Expected POT/bunch = 13k
Expected bunch length = 120 ns
PADME magnet current: 211.80
Detectors in the DAQ: Target, PVeto, EVeto, HEPVeto, ECal, SAC
Detectors out of the DAQ: TimePix, Mimosa

Other special conditions: missing last 16 channels of EVeto

Bunch length < 120 ns (!)

Bunch length ~ 70 ns

Particle density is more or less the same as the 20k run

Low Multiplicity Run (LMR)
PADME magnet current as default ✓

Legend for the following studies..

MCS MonteCarlo with SAC Energy scaled
LMR Low Multiplicity RUN

LMR**MC****LMR****MC**

Chld	E _{e+}	Z	E _{e+}	Chld	E _{e+}	Z	E _{e+}
14	85.2045	-325.3		51	201.765	76.7667	196.441
15	83.4707	-314.43		52	205.556	87.6333	198.945
16	82.4347	-303.567		53	210.285	98.5	205.227
17	85.3644	-292.7		54	218.253	109.367	207.968
18	83.3396	-281.833		55	222.857	120.233	215.418
19	87.1715	-270.967		56	226.062	131.1	220.306
20	92.4264	-260.1		57	229.632	141.967	224.95
21	93.7649	-249.233		58	233.048	152.833	229.804
22	96.0344	-238.367		59	237.242	163.7	235.929
23	98.8872	-227.5		60	243.395	174.567	240.823
24	100.968	-216.633		61	251.719	185.433	245.231
25	101.57	-205.767		62	257.366	196.3	250.391
26	104.733	-194.9	96.0272	63	265.064	207.167	256.544
27	105.784	-184.033	99.7814	64	270.97	218.033	265.584
28	109.696	-173.167	104.783	65	276.301	228.9	271.149
29	111.251	-162.3	108.114	66	278.837	239.767	276.204
30	114.007	-151.433	112.494	67	289.637	250.633	281.875
31	115.654	-140.567	113.904	68	295.165	261.5	287.521
32	117.819	-129.7	116.374	69	300.262	272.367	293.33
33	123.283	-118.833	120.217	70	306.366	283.233	298.99
34	125.297	-107.967	125.036	71	313.042	294.1	305.186
35	129.857	-97.1	127.229	72	321.771	304.967	313.378
36	134.964	-86.2333	132.722	73	333.033	315.833	321.586
37	140.47	-75.3667	137.468	74	340.272	326.7	328.053
38	143.816	-64.5	138.56	75	346.765	337.567	334.271
39	146.537	-53.6333	139.684	76	353.043	348.433	342.646
40	152.251	-42.7667	146.496	77	359.572	359.3	348.788
41	161.517	-31.9	149.143	78	370.753	370.167	354.945
42	164.067	-21.0333	155.821	79	384.202	381.033	363.249
43	164.232	-10.1667	160.338	80	392.176	391.9	369.447
44	169.397	0.7	165.936	81	397.216	402.767	375.962
45	174.807	11.5667	169.128				384.004
46	178.853	22.4333	172.029				391.966
47	181.436	33.3	177.95				399.118
48	184.909	44.1667	183.076				405.967
49	190.656	55.0333	185.954				414.407
50	195.545	65.9	190.886				420.722
							428.44
							446.679

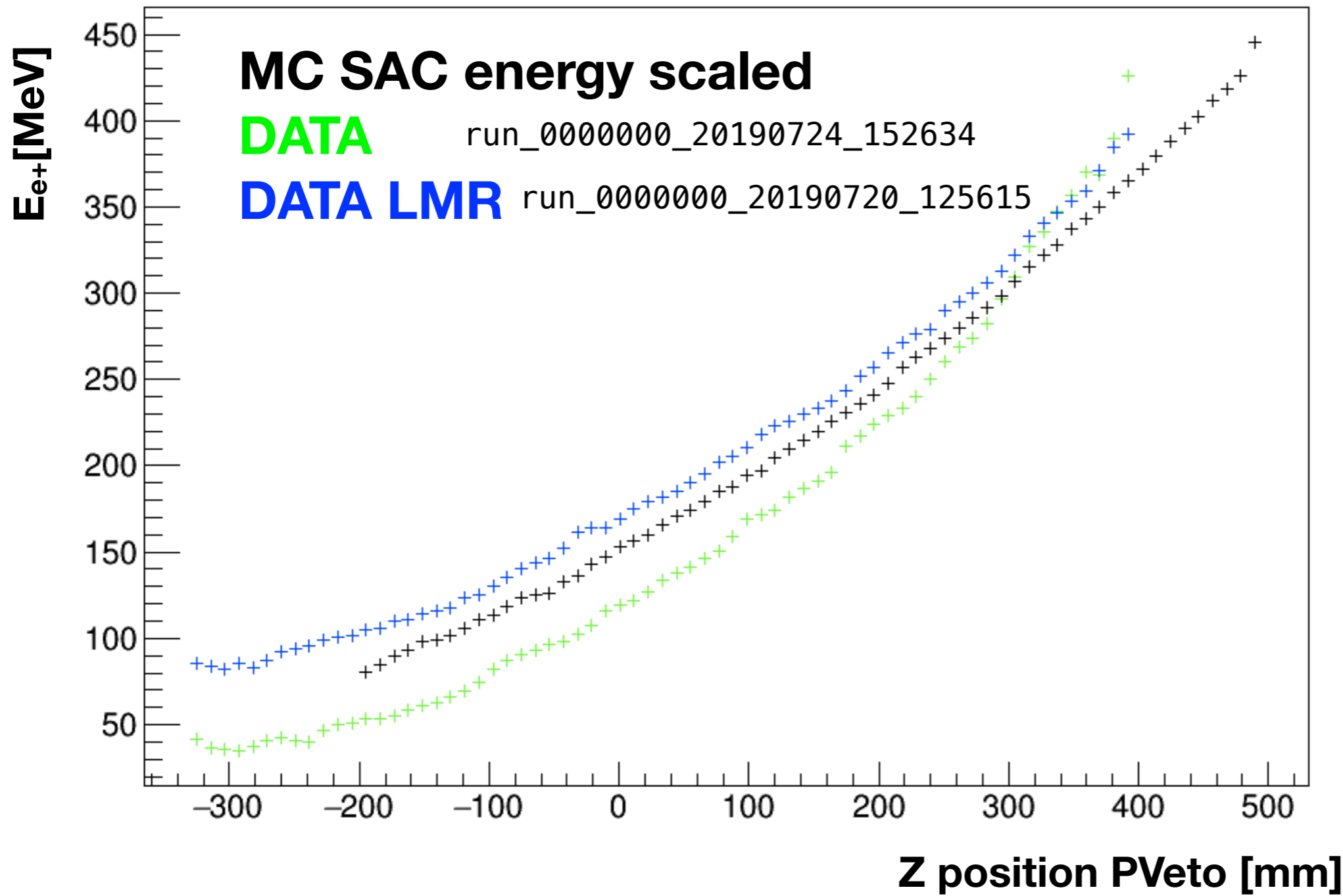
MC SAC energy not scaled

LMR			MC	LMR			MC
ChId	E _{sac}	Z	E _{sac}	ChId	E _{sac}	Z	E _{sac}
14	404.795	-325.3		51	288.235	76.7667	293.559
15	406.529	-314.433		52	284.444	87.6333	291.055
16	407.565	-303.567		53	279.715	98.5	284.773
17	404.636	-292.7		54	271.747	109.367	282.032
18	406.66	-281.833		55	267.143	120.233	274.582
19	402.829	-270.967		56	263.938	131.1	269.694
20	397.574	-260.1		57	260.368	141.967	265.05
21	396.235	-249.233		58	256.952	152.833	260.196
22	393.966	-238.367		59	252.758	163.7	254.071
23	391.113	-227.5		60	246.605	174.567	249.177
24	389.032	-216.633		61	238.281	185.433	244.769
25	388.43	-205.767		62	232.634	196.3	239.609
26	385.267	-194.9	393.973	63	224.936	207.167	233.456
27	384.216	-184.033	390.219	64	219.03	218.033	224.416
28	380.304	-173.167	385.217	65	213.699	228.9	218.851
29	378.749	-162.3	381.886	66	211.163	239.767	213.796
30	375.993	-151.433	377.506	67	200.363	250.633	208.125
31	374.346	-140.567	376.096	68	194.835	261.5	202.479
32	372.181	-129.7	373.626	69	189.738	272.367	196.67
33	366.717	-118.833	369.783	70	183.634	283.233	191.01
34	364.703	-107.967	364.964	71	176.958	294.1	184.814
35	360.143	-97.1	362.771	72	168.229	304.967	176.622
36	355.036	-86.2333	357.278	73	156.967	315.833	168.414
37	349.53	-75.3667	352.532	74	149.728	326.7	161.947
38	346.184	-64.5	351.44	75	143.235	337.567	155.729
39	343.463	-53.6333	350.316	76	136.957	348.433	147.354
40	337.749	-42.7667	343.504	77	130.428	359.3	141.212
41	328.483	-31.9	340.857	78	119.247	370.167	135.055
42	325.933	-21.0333	334.179	79	105.798	381.033	126.751
43	325.768	-10.1667	329.662	80	97.8239	391.9	120.553
44	320.603	0.7	324.064	81	92.7837	402.767	114.038
45	315.193	11.5667	320.872				105.996
46	311.147	22.4333	317.971				98.0345
47	308.564	33.3	312.05				90.882
48	305.091	44.1667	306.924				84.033
49	299.344	55.0333	304.046				75.593
50	294.455	65.9	299.114				69.2778
							61.5597
							43.3214

MC SAC energy not scaled

$E_{sac}(MC) > E_{sac}(LMR)$

$\Delta E \sim + 5 \text{ MeV}$



A positron with energy $E_{e^+} \sim 100$ MeV hits PVeto chld respectively

- DATA** ~ chld 41
- DATA LMR** ~ chld 25
- MC** ~ chld 27
- MC scaled** ~ chld 32

2 different curves for DATA

Fit Function

$$\rho = \frac{0.3 B}{2x} [(z + z_0)^2 + (x+x_0)^2]$$

+pile Up

$x=182.5$ mm

2 parameters

```
TF1 *fit2par = new TF1("fit2par", "(x+[0])*(x+[0])+182.5*182.5)/2/182.5*0.3*[1]", -500, 2100);  
fit2par->SetParameter(0, 500);  
fit2par->SetParName(0, "z0");  
fit2par->SetParName(1, "B");
```

3 parameters

```
TF1 *fit3par = new TF1("fit3par", "(x+[0])*(x+[0])+(182.5)*(182.5))/2/(182.5)*0.3*[1]+[2]", -500, 2100);  
fit3par->SetParameter(0, 500);  
fit3par->SetParName(0, "z0");  
fit3par->SetParName(1, "B");  
fit3par->SetParName(2, "PileUp");
```

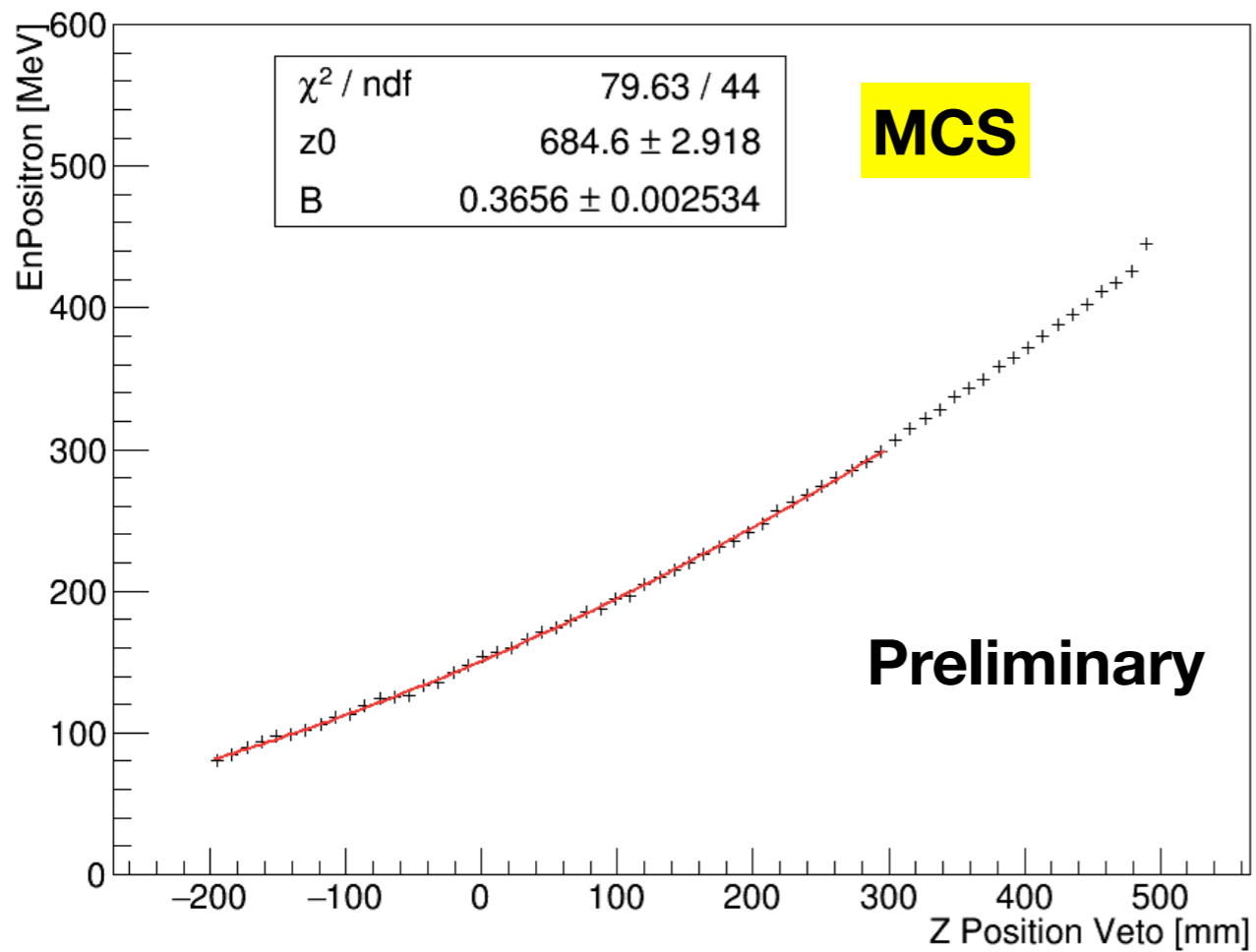
4 parameters

```
TF1 *fit4par = new TF1("fit4par", "(x+[0])*(x+[0])+(182.5+[3])*(182.5+[3]))/2/(182.5+[3])*0.3*[1]+[2]", -500, 2100);  
fit4par->SetParameter(0, 500);  
fit4par->SetParName(0, "z0");  
fit4par->SetParName(1, "B");  
fit4par->SetParName(2, "PileUp");  
fit4par->SetParName(3, "x0");
```

$$E_{e^+} = E_{\text{beam}} - E_{\text{SAC}} = E_{\text{beam}} - E_{\text{SAC}(\text{true})} - \text{pileUp}$$

Pile Up Parameter has to be negative

EnergyPositronVsZPositionPVeto_MCscal

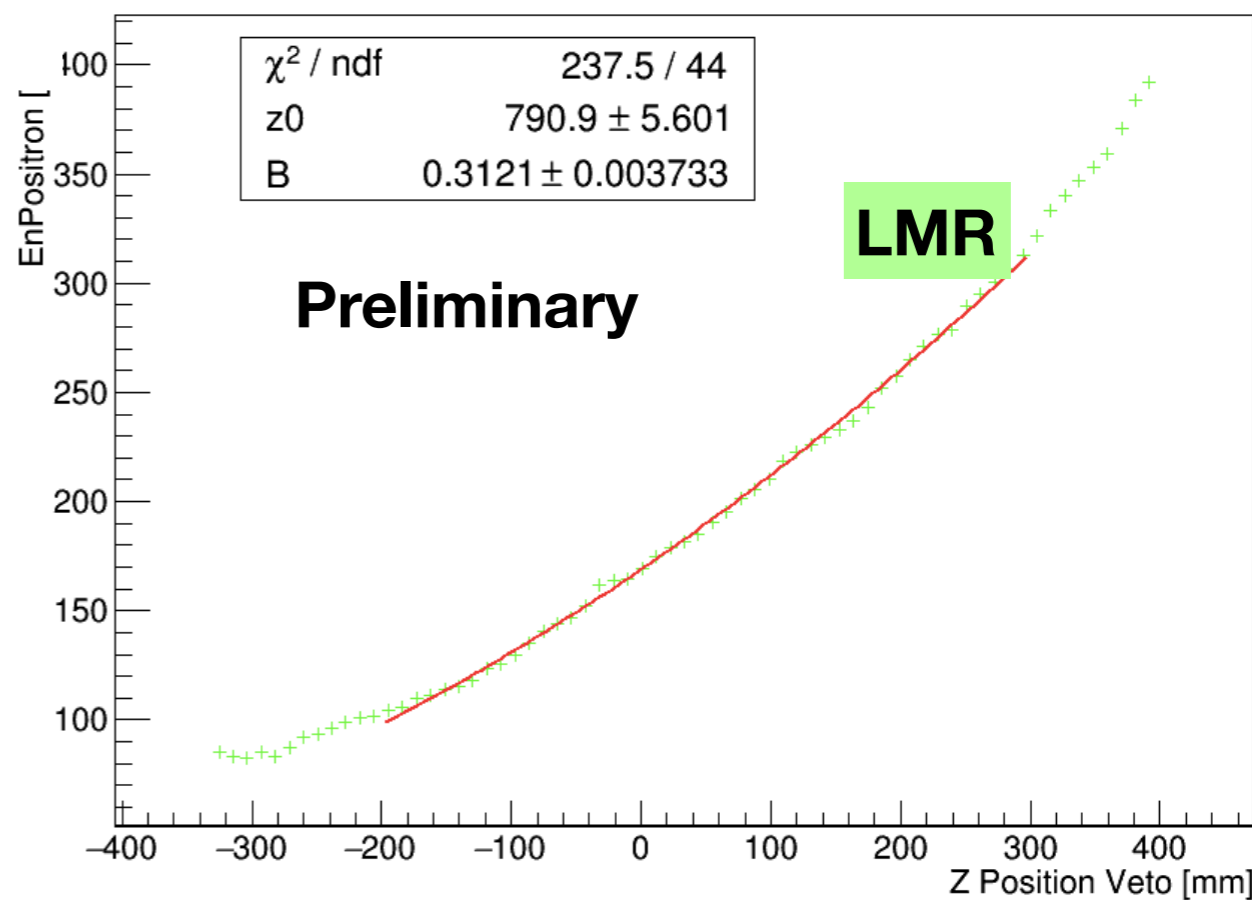


$$z_0 = (684.6 \pm 2.918) \text{ mm}$$
$$B = (0.3656 \pm 0.0025) \text{ T}$$

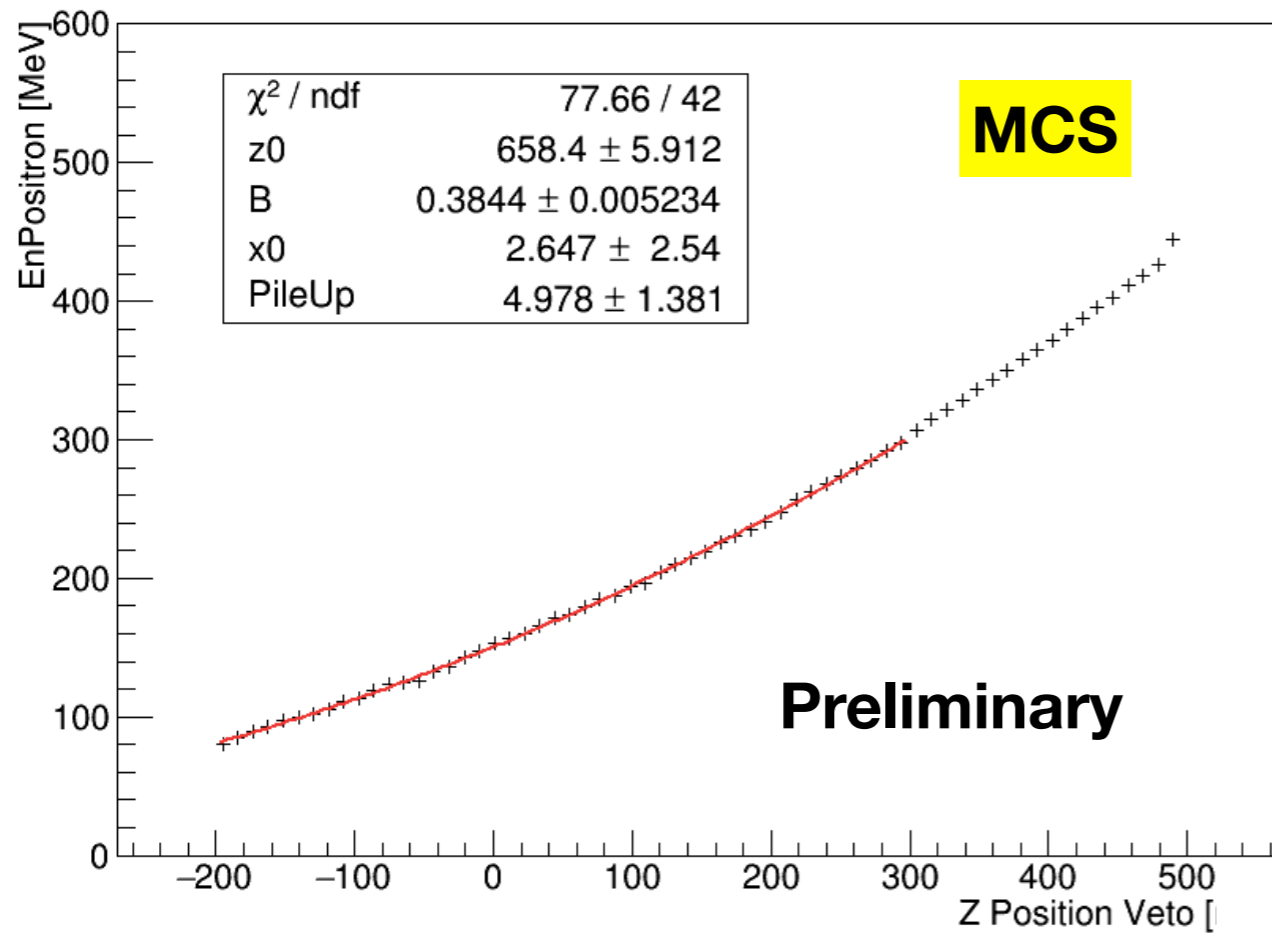
Fit with 2 free parameters

$$z_0 = (684.6 \pm 2.918) \text{ mm}$$
$$B = (0.3656 \pm 0.0025) \text{ T}$$

EnergyPositronVsZPositionPVeto_DATA



EnergyPositronVsZPositionPVeto_MCscal

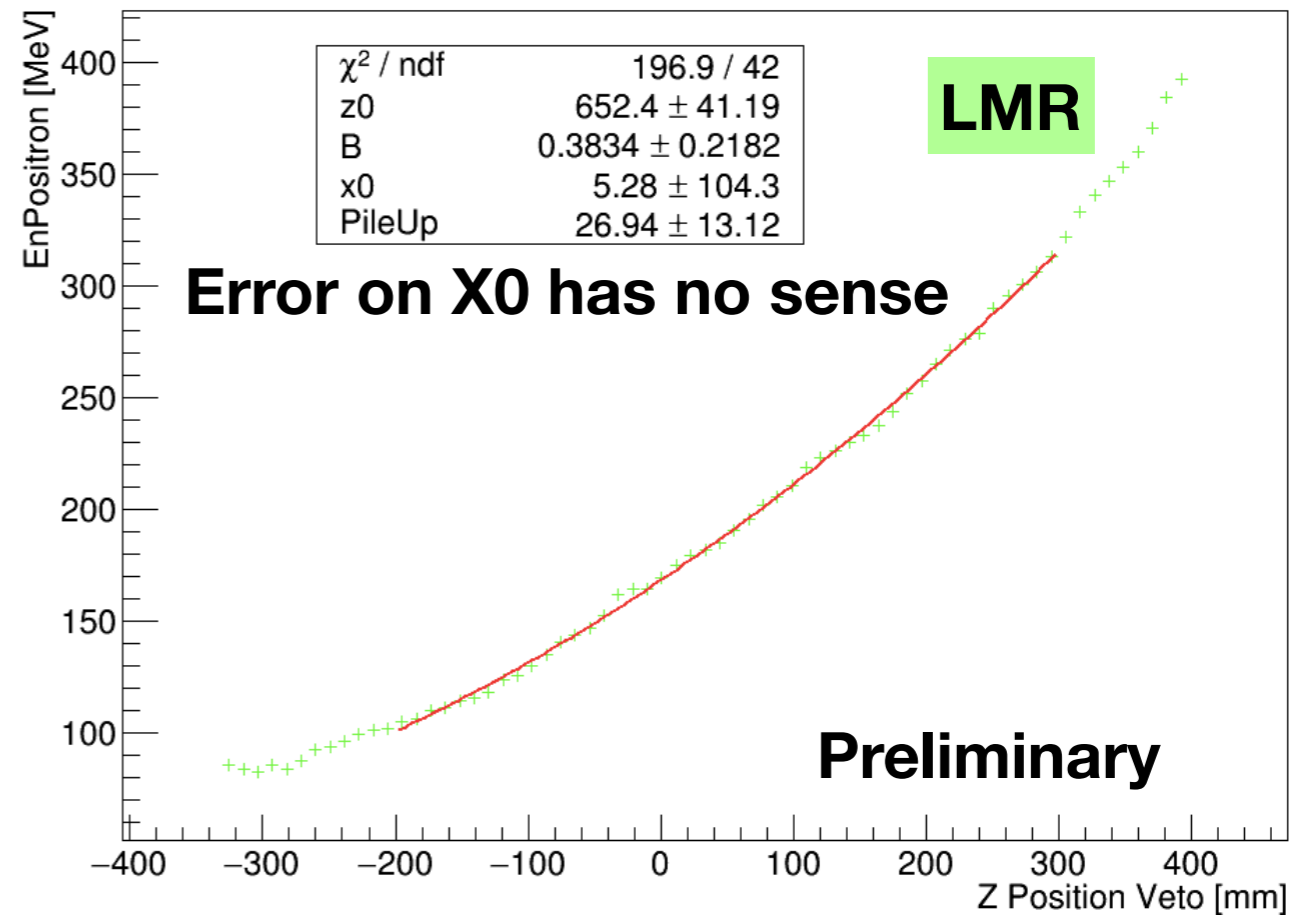


Fit with 4 free parameters

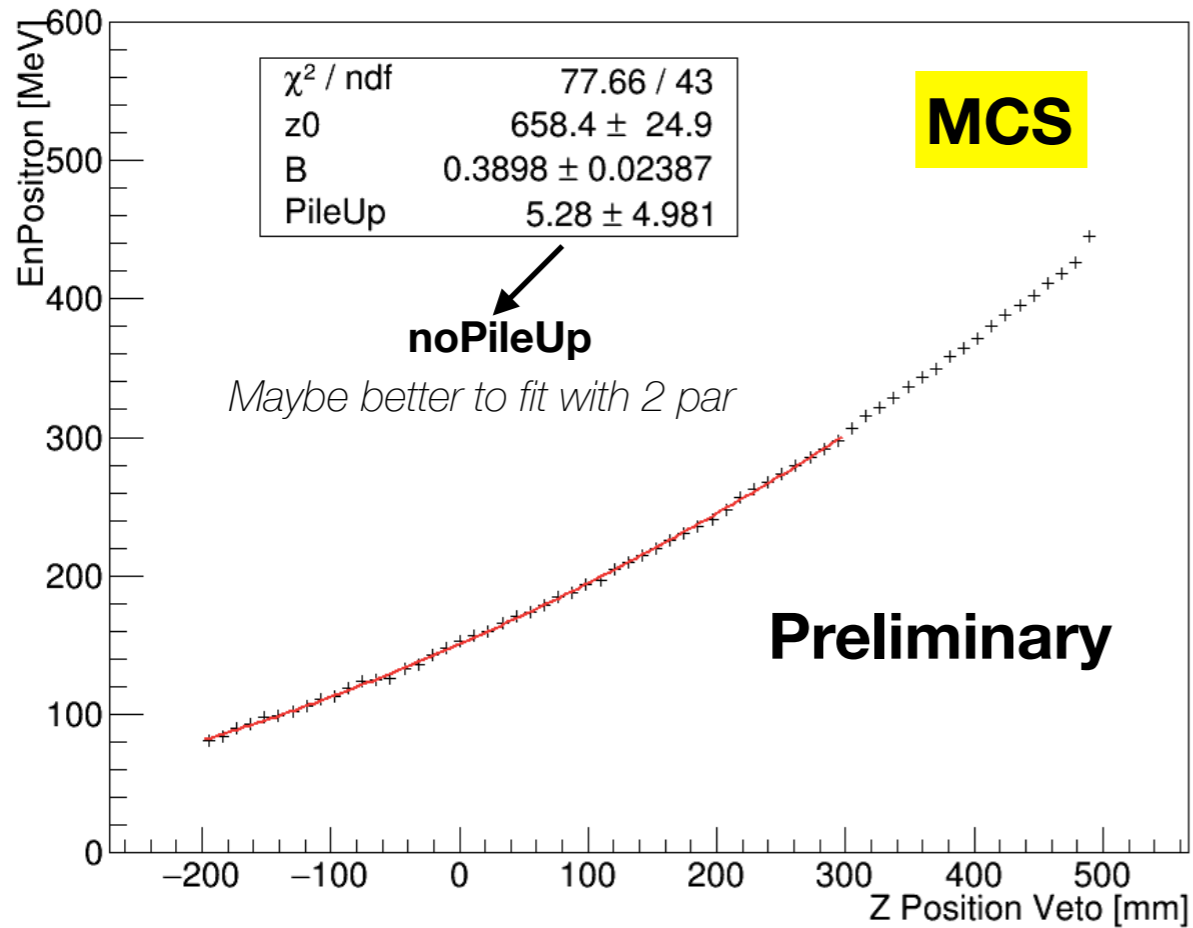
$$z_0 = (658.4 \pm 5.912) \text{ mm}$$

$$B = (0.3844 \pm 0.005) \text{ T}$$

EnergyPositronVsZPositionPVeto_DATA



EnergyPositronVsZPositionPVeto_MCscal



$$z_0 = (652.4 \pm 38.93) \text{ mm}$$

$$B = (0.3727 \pm 0.021) \text{ T}$$

MCS
LMR

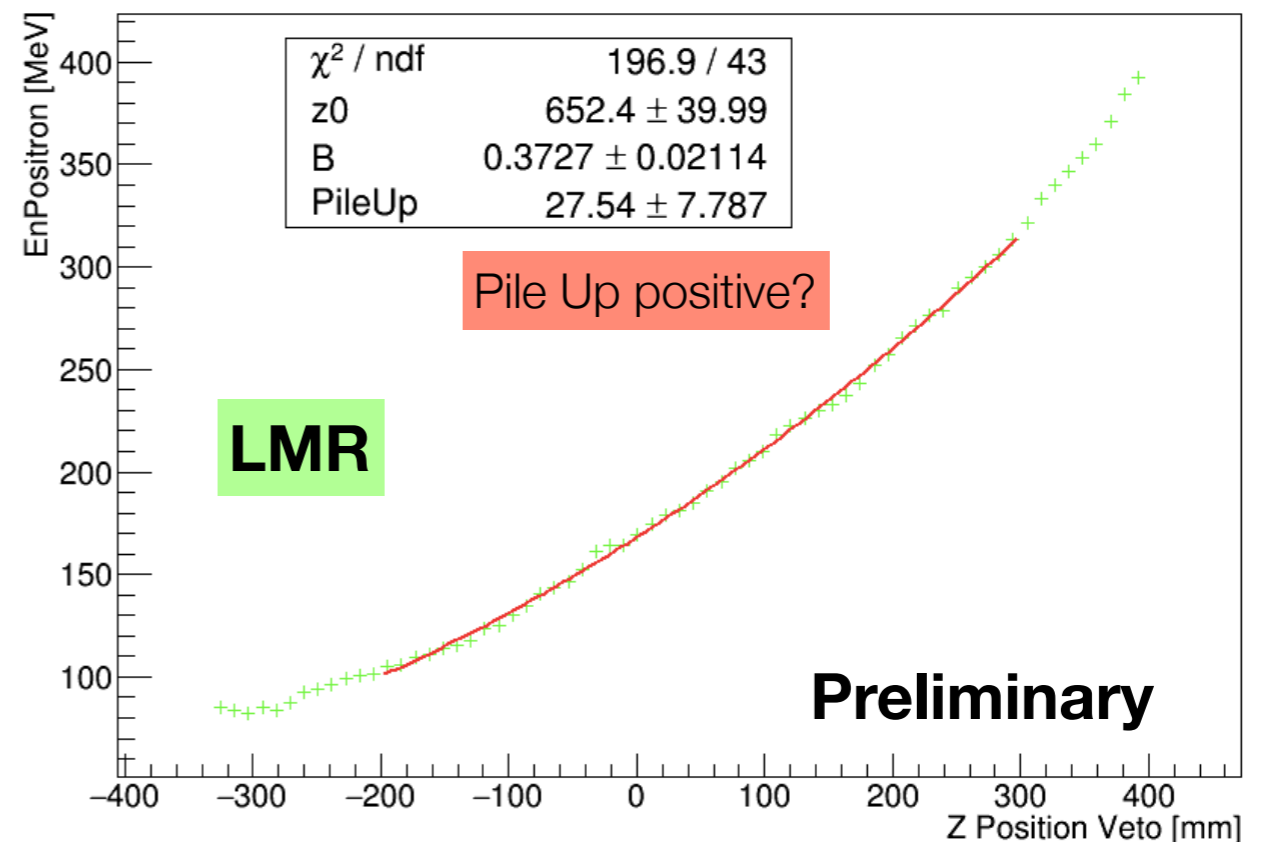
MonteCarlo with SAC Energy scaled
Low Multiplicity RUN

Fit with 3 free parameters

$$z_0 = (658.4 \pm 24.9) \text{ mm}$$

$$B = (0.3898 \pm 0.024) \text{ T}$$

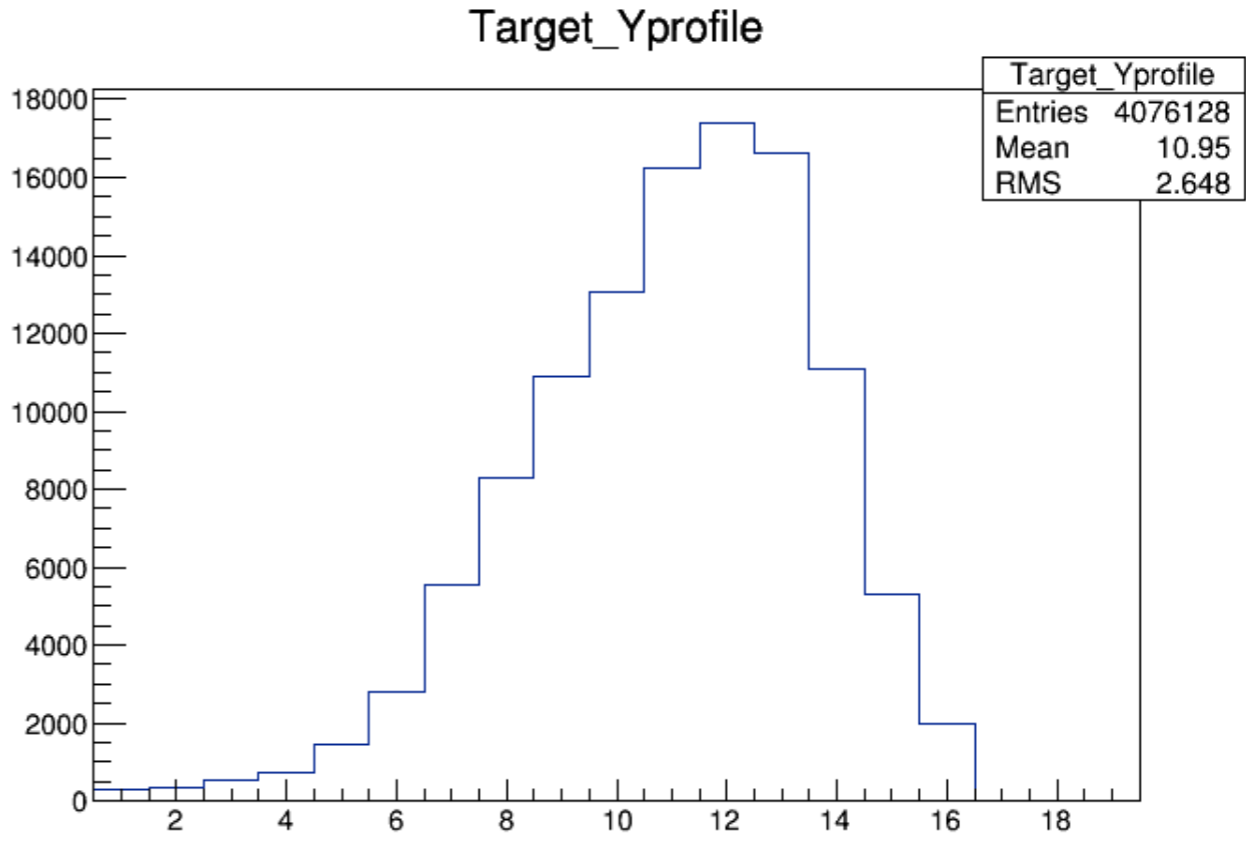
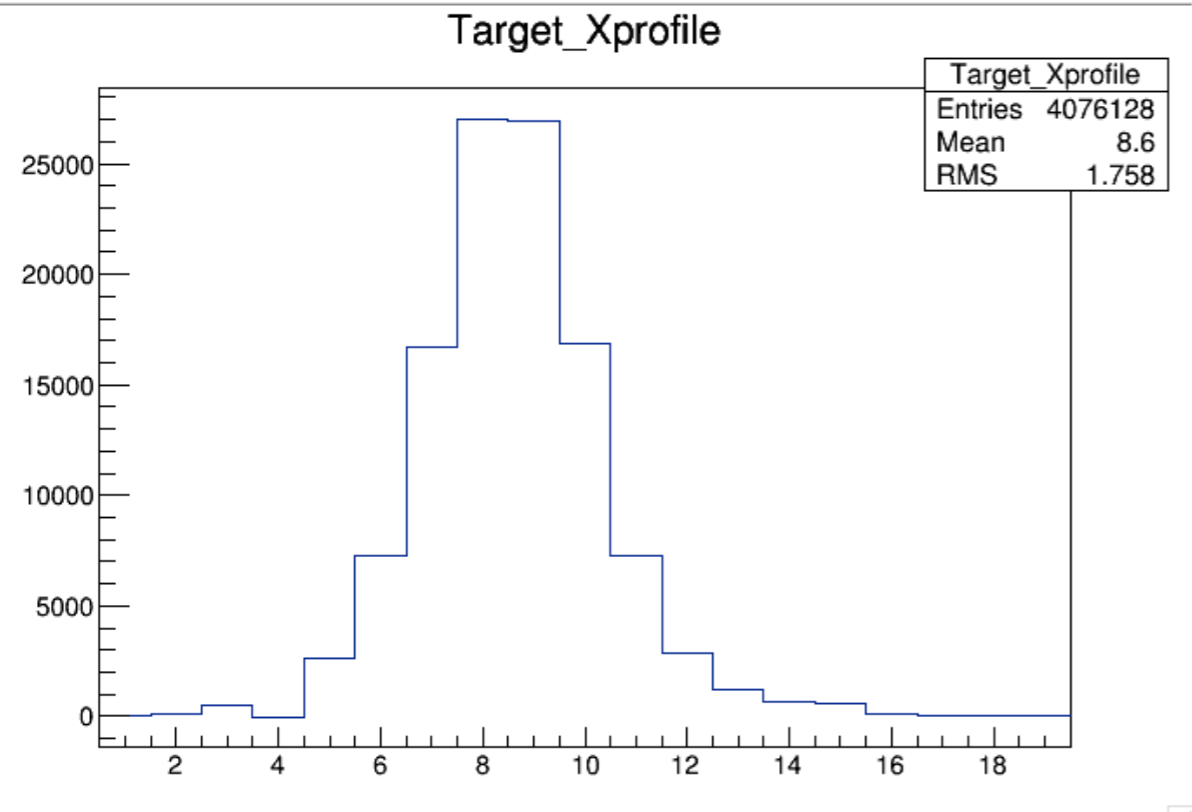
EnergyPositronVsZPositionPVeto_DATA



Other considerations...

Beam Profile

run_0000000_20190720_125615



The beam is centered in the X direction but not in the Y

It seems that the beam hits the target with a non-0 angle with the Z direction