

SmartPhantom: Film Material Comparison

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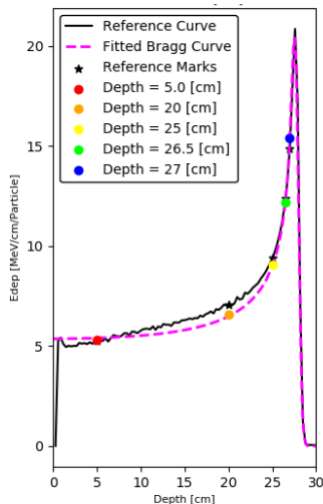
June 11, 2019

Assuming my simulations are correct, for protons (62.4 MeV & 207.0 MeV) and carbon (120.0 MeV/u & 402.8 MeV/u):

The effect on energy deposition of...

- 50 to 60 micron aluminium foil (G4_ALUMINUM_OXIDE) is roughly equivalent to 300 micron Mylar
- 70 to 80 micron aluminium foil (G4_ALUMINUM_OXIDE) is roughly equivalent to 400 micron Mylar
- 90 micron aluminium foil (G4_ALUMINUM_OXIDE) is roughly equivalent to 500 micron Mylar

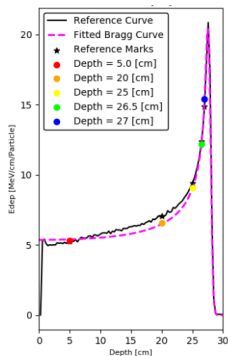
How to Interpret Figures



- Figure of energy deposition divided by the length of material being sampled per number of starting particles
- Black curve from simulations from BDSIM simulating phantom walls and water without any detectors
- Coloured points represent energy depositions in detectors simulated with native Geant4 code at varying depths (Multiplicative correction applied to fit to reference marks)
- Curve in magenta is the predicted Bragg curve fitted according to only energy depositions in detectors

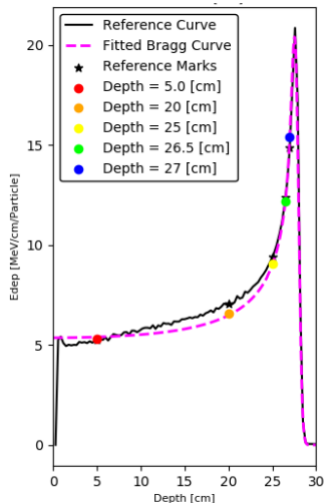
Figure of Merit for Comparisons

- I looked at the difference in Edep [MeV/cm/Particle] between the Edep at the detector against the reference marks
- I summed the absolute value of each error to use as a figure of merit



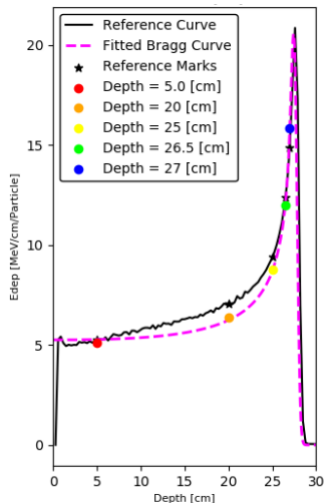
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.460	+0.061
Depth = 20 [cm]	-1.720	-0.472
Depth = 25 [cm]	-2.080	-0.305
Depth = 26.5 [cm]	-0.490	-0.225
Depth = 27 [cm]	-0.550	+0.521
Absolute Error	+7.300	+1.584

p207 – No Mylar



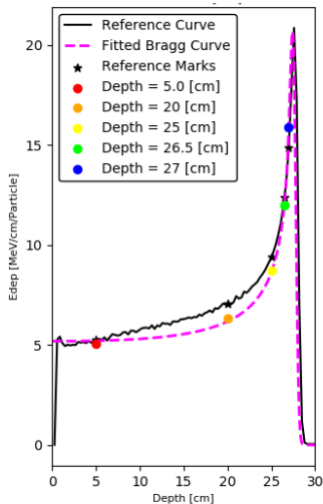
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.460	+0.061
Depth = 20 [cm]	-1.720	-0.472
Depth = 25 [cm]	-2.080	-0.305
Depth = 26.5 [cm]	-0.490	-0.225
Depth = 27 [cm]	-0.550	+0.521
Absolute Error	+7.300	+1.584

p207 – 0.3mm Mylar



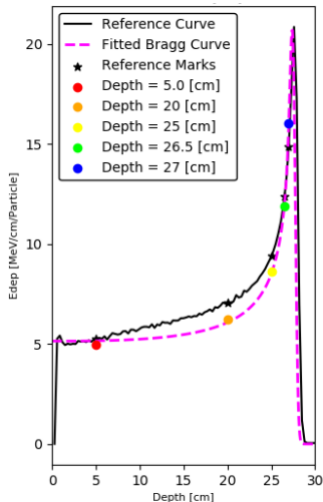
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.740	-0.121
Depth = 20 [cm]	-1.900	-0.647
Depth = 25 [cm]	-2.380	-0.597
Depth = 26.5 [cm]	-0.650	-0.374
Depth = 27 [cm]	-0.530	+0.934
Absolute Error	+8.200	+2.674

p207 – 0.4mm Mylar



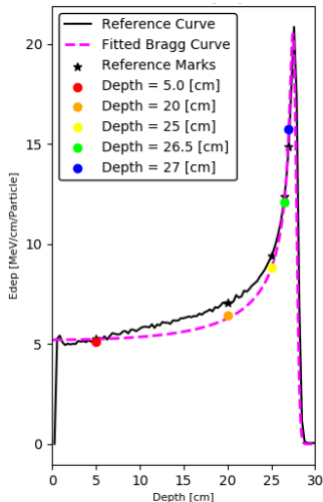
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.150	-0.166
Depth = 20 [cm]	-2.800	-0.741
Depth = 25 [cm]	-2.060	-0.658
Depth = 26.5 [cm]	-0.440	-0.404
Depth = 27 [cm]	-1.330	+1.024
Absolute Error	+8.780	+2.992

p207 – 0.5mm Mylar



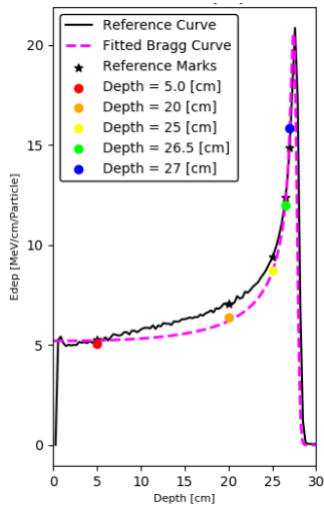
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.110	-0.254
Depth = 20 [cm]	-2.610	-0.802
Depth = 25 [cm]	-2.400	-0.767
Depth = 26.5 [cm]	-1.640	-0.494
Depth = 27 [cm]	-1.430	+1.172
Absolute Error	+10.190	+3.488

p207 – 0.05mm Aluminum Oxide



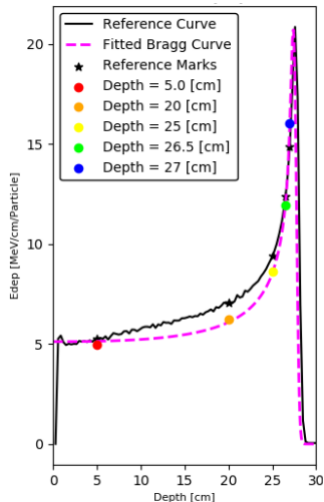
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.370	-0.119
Depth = 20 [cm]	-2.920	-0.635
Depth = 25 [cm]	-2.410	-0.567
Depth = 26.5 [cm]	-1.100	-0.293
Depth = 27 [cm]	-1.190	+0.834
Absolute Error	+9.990	+2.448

p207 – 0.07mm Aluminum Oxide



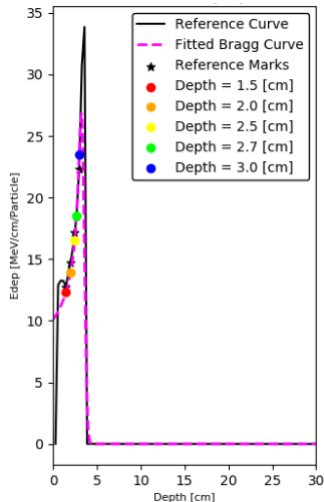
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.310	-0.164
Depth = 20 [cm]	-2.940	-0.694
Depth = 25 [cm]	-1.130	-0.650
Depth = 26.5 [cm]	-0.980	-0.390
Depth = 27 [cm]	-1.110	+0.972
Absolute Error	+8.470	+2.869

p207 – 0.09mm Aluminum Oxide



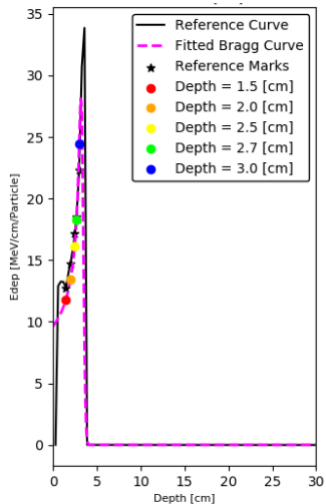
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-2.300	-0.270
Depth = 20 [cm]	-1.590	-0.792
Depth = 25 [cm]	-1.500	-0.752
Depth = 26.5 [cm]	-0.810	-0.459
Depth = 27 [cm]	-1.400	+1.149
Absolute Error	+7.600	+3.422

p62.4 – No Mylar



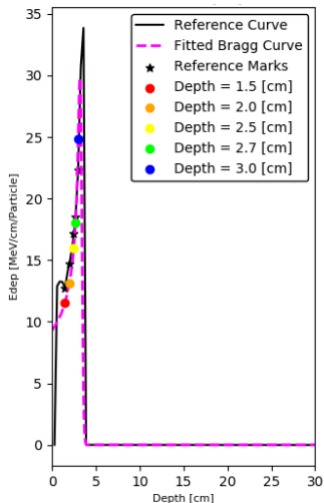
	Delta FWHM	Delta Edep
Depth = 1.5 [cm]	-1.020	-0.452
Depth = 2.0 [cm]	-1.660	-0.847
Depth = 2.5 [cm]	-1.420	-0.672
Depth = 2.7 [cm]	+0.090	-0.026
Depth = 3.0 [cm]	-1.440	+1.205
Absolute Error	+5.630	+3.202

p62.4 – 0.3mm Mylar



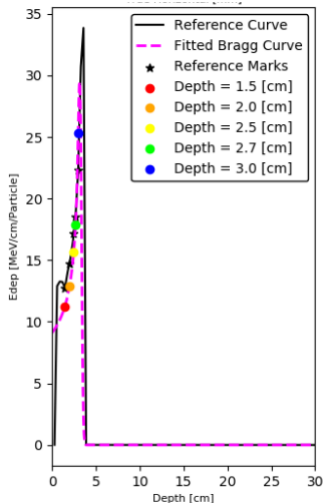
	Delta FWHM	Delta Edep
Depth = 1.5 [cm]	-2.380	-0.954
Depth = 2.0 [cm]	-1.520	-1.296
Depth = 2.5 [cm]	-1.150	-1.054
Depth = 2.7 [cm]	-1.320	-0.287
Depth = 3.0 [cm]	-0.910	+2.103
Absolute Error	+7.280	+5.694

p62.4 – 0.4mm Mylar



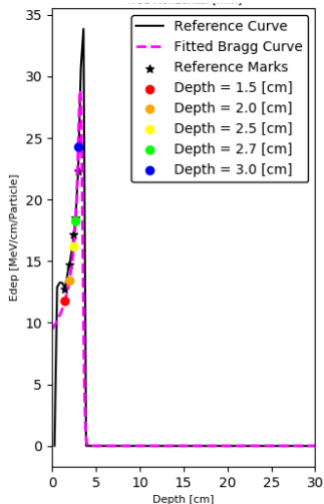
	Delta FWHM	Delta Edep
Depth = 1.5 [cm]	-0.640	-1.231
Depth = 2.0 [cm]	-2.360	-1.584
Depth = 2.5 [cm]	-0.130	-1.225
Depth = 2.7 [cm]	-1.180	-0.487
Depth = 3.0 [cm]	-0.970	+2.522
Absolute Error	+5.280	+7.050

p62.4 – 0.5mm Mylar



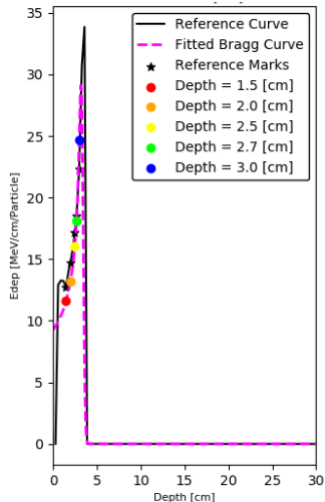
	Delta FWHM	Delta Edep
Depth = 1.5 [cm]	-0.020	-1.512
Depth = 2.0 [cm]	-1.060	-1.854
Depth = 2.5 [cm]	-0.900	-1.489
Depth = 2.7 [cm]	-1.070	-0.653
Depth = 3.0 [cm]	-1.350	+2.995
Absolute Error	+4.400	+8.504

p62.4 – 0.05mm Aluminum Oxide



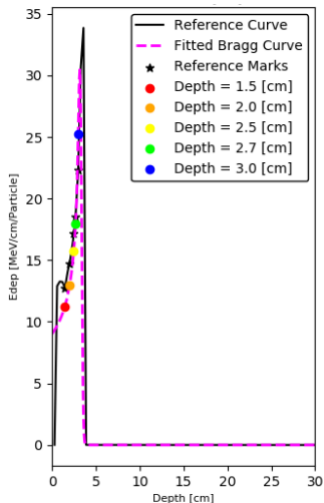
	Delta FWHM	Delta Edep
Depth = 1.5 [cm]	-0.070	-0.955
Depth = 2.0 [cm]	-0.570	-1.279
Depth = 2.5 [cm]	-1.090	-0.970
Depth = 2.7 [cm]	-0.820	-0.261
Depth = 3.0 [cm]	-1.730	+2.004
Absolute Error	+4.280	+5.470

p62.4 – 0.07mm Aluminum Oxide



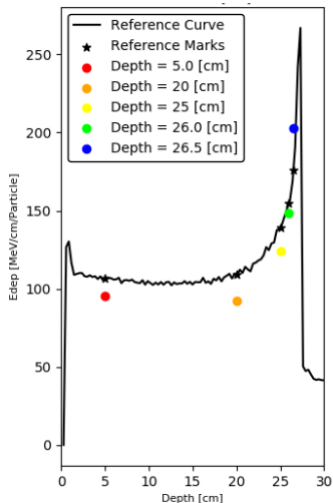
	Delta FWHM	Delta Edep
Depth = 1.5 [cm]	-0.140	-1.177
Depth = 2.0 [cm]	-0.320	-1.521
Depth = 2.5 [cm]	-0.890	-1.145
Depth = 2.7 [cm]	-0.730	-0.382
Depth = 3.0 [cm]	-1.290	+2.373
Absolute Error	+3.370	+6.598

p62.4 – 0.09mm Aluminum Oxide



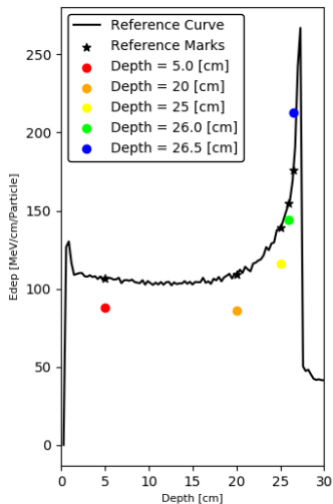
	Delta FWHM	Delta Edep
Depth = 1.5 [cm]	-1.340	-1.511
Depth = 2.0 [cm]	-0.900	-1.808
Depth = 2.5 [cm]	-1.100	-1.423
Depth = 2.7 [cm]	-0.640	-0.610
Depth = 3.0 [cm]	-1.360	+2.947
Absolute Error	+5.340	+8.300

c402.8 – No Mylar – Very Preliminary



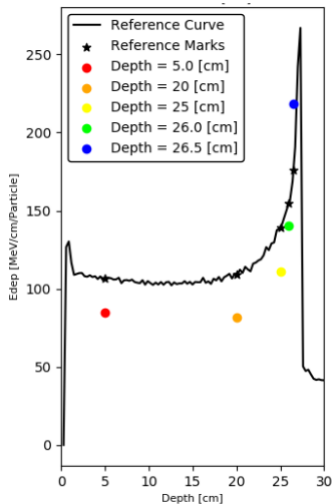
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-0.640	-10.912
Depth = 20 [cm]	-2.700	-16.884
Depth = 25 [cm]	-4.590	-14.928
Depth = 26.0 [cm]	-1.200	-6.622
Depth = 26.5 [cm]	-1.490	+27.016
Absolute Error	+10.620	+76.363

c402.8 – 0.3mm Mylar – Very Preliminary



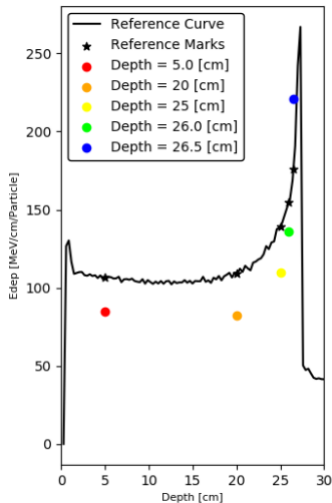
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-0.630	-18.307
Depth = 20 [cm]	-2.970	-23.209
Depth = 25 [cm]	-4.120	-23.359
Depth = 26.0 [cm]	-2.410	-10.657
Depth = 26.5 [cm]	-1.530	+36.751
Absolute Error	+11.660	+112.284

c402.8 – 0.4mm Mylar – Very Preliminary



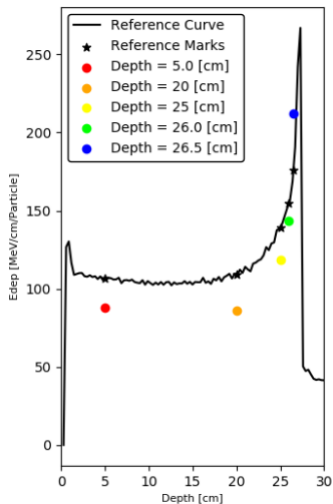
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-1.510	-21.866
Depth = 20 [cm]	-2.470	-27.668
Depth = 25 [cm]	-4.560	-28.572
Depth = 26.0 [cm]	-1.670	-14.618
Depth = 26.5 [cm]	-1.910	+42.521
Absolute Error	+12.120	+135.245

c402.8 – 0.5mm Mylar – Very Preliminary



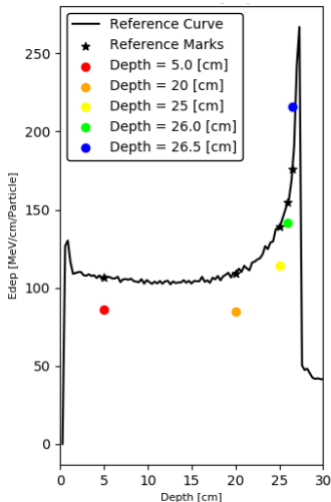
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-1.310	-21.257
Depth = 20 [cm]	-1.130	-26.988
Depth = 25 [cm]	-5.020	-29.839
Depth = 26.0 [cm]	-1.340	-18.986
Depth = 26.5 [cm]	-0.690	+44.921
Absolute Error	+9.490	+141.991

c402.8 – 0.05mm Aluminum Oxide – Very Preliminary



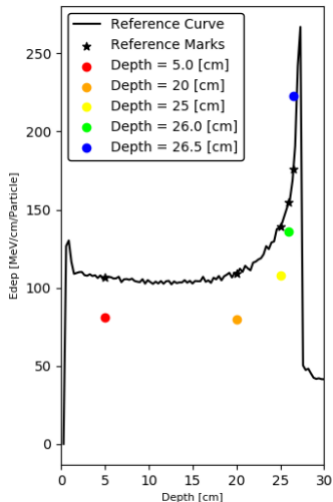
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-0.840	-18.161
Depth = 20 [cm]	-2.310	-23.121
Depth = 25 [cm]	-3.730	-20.988
Depth = 26.0 [cm]	-0.840	-11.236
Depth = 26.5 [cm]	-1.140	+36.242
Absolute Error	+8.860	+109.749

c402.8 – 0.07mm Aluminum Oxide – Very Preliminary



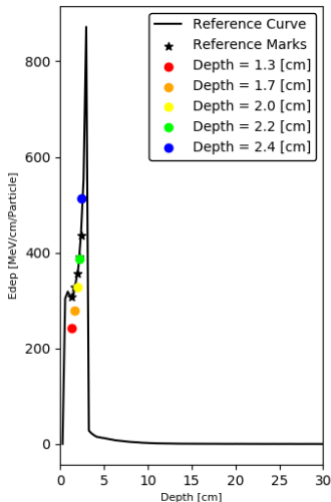
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-1.130	-20.437
Depth = 20 [cm]	-1.580	-24.676
Depth = 25 [cm]	-3.180	-24.963
Depth = 26.0 [cm]	-2.630	-13.264
Depth = 26.5 [cm]	-2.800	+39.830
Absolute Error	+11.320	+123.171

c402.8 – 0.09mm Aluminum Oxide – Very Preliminary



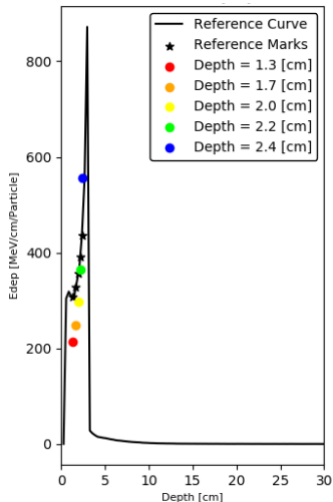
	Delta FWHM	Delta Edep
Depth = 5.0 [cm]	-1.800	-25.106
Depth = 20 [cm]	-2.500	-29.687
Depth = 25 [cm]	-3.610	-31.469
Depth = 26.0 [cm]	-1.630	-19.023
Depth = 26.5 [cm]	-1.200	+46.735
Absolute Error	+10.740	+152.020

c120.0 – No Mylar – Very Preliminary



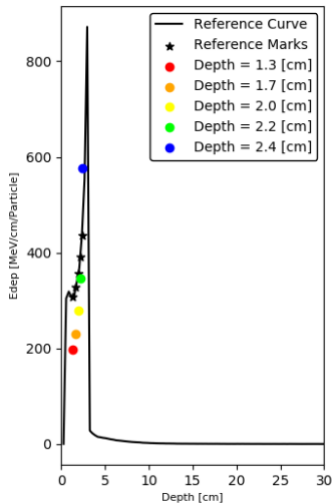
	Delta FWHM	Delta Edep
Depth = 1.3 [cm]	+1.050	-65.844
Depth = 1.7 [cm]	+0.890	-47.772
Depth = 2.0 [cm]	+0.350	-29.264
Depth = 2.2 [cm]	+0.360	-3.194
Depth = 2.4 [cm]	+0.280	+77.559
Absolute Error	+2.930	+223.633

c120.0 – 0.3mm Mylar – Very Preliminary



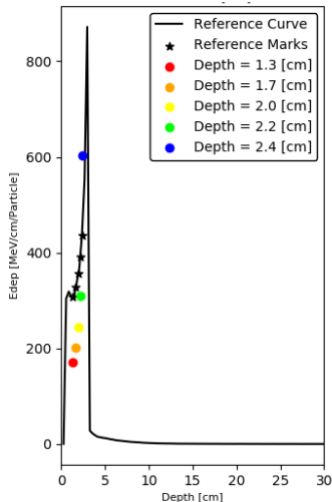
	Delta FWHM	Delta Edep
Depth = 1.3 [cm]	+1.080	-94.636
Depth = 1.7 [cm]	+0.590	-78.387
Depth = 2.0 [cm]	+0.390	-60.436
Depth = 2.2 [cm]	+0.080	-26.079
Depth = 2.4 [cm]	+0.170	+119.789
Absolute Error	+2.310	+379.327

c120.0 – 0.4mm Mylar – Very Preliminary



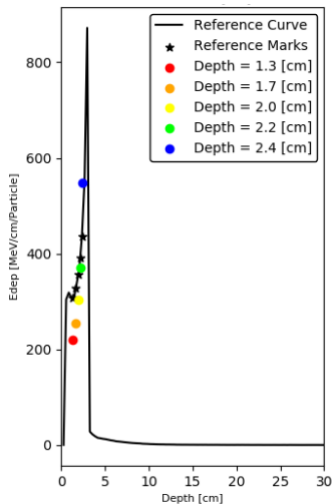
	Delta FWHM	Delta Edep
Depth = 1.3 [cm]	+0.730	-110.167
Depth = 1.7 [cm]	+0.690	-96.032
Depth = 2.0 [cm]	+0.470	-78.296
Depth = 2.2 [cm]	-0.060	-44.709
Depth = 2.4 [cm]	-0.010	+140.230
Absolute Error	+1.960	+469.433

c120.0 – 0.5mm Mylar – Very Preliminary



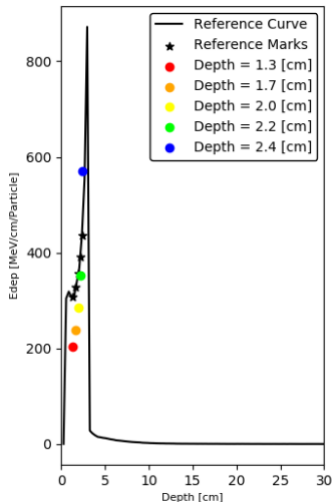
	Delta FWHM	Delta Edep
Depth = 1.3 [cm]	+0.140	-135.945
Depth = 1.7 [cm]	+0.090	-125.432
Depth = 2.0 [cm]	-0.090	-113.349
Depth = 2.2 [cm]	-0.390	-82.048
Depth = 2.4 [cm]	-0.510	+167.589
Absolute Error	+1.220	+624.362

c120.0 – 0.05mm Aluminum Oxide – Very Preliminary



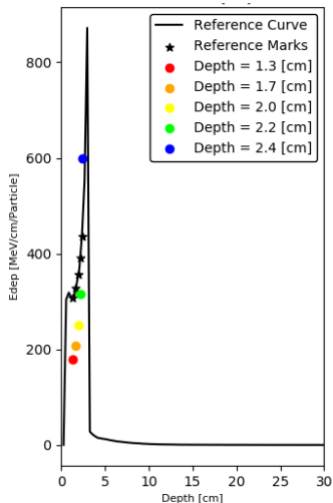
	Delta FWHM	Delta Edep
Depth = 1.3 [cm]	+1.370	-87.647
Depth = 1.7 [cm]	+1.390	-71.908
Depth = 2.0 [cm]	+1.090	-53.788
Depth = 2.2 [cm]	+0.800	-20.868
Depth = 2.4 [cm]	+0.610	+112.144
Absolute Error	+5.260	+346.355

c120.0 – 0.07mm Aluminum Oxide – Very Preliminary



	Delta FWHM	Delta Edep
Depth = 1.3 [cm]	-0.450	-104.180
Depth = 1.7 [cm]	-0.320	-88.543
Depth = 2.0 [cm]	-0.550	-71.814
Depth = 2.2 [cm]	-0.760	-37.490
Depth = 2.4 [cm]	-0.970	+133.039
Absolute Error	+3.050	+435.066

c120.0 – 0.09mm Aluminum Oxide – Very Preliminary



	Delta FWHM	Delta Edep
Depth = 1.3 [cm]	+1.310	-129.104
Depth = 1.7 [cm]	+0.800	-118.679
Depth = 2.0 [cm]	+0.260	-106.169
Depth = 2.2 [cm]	-0.070	-74.834
Depth = 2.4 [cm]	-0.330	+163.038
Absolute Error	+2.770	+591.824