FLUKA Simulations on Material Choice

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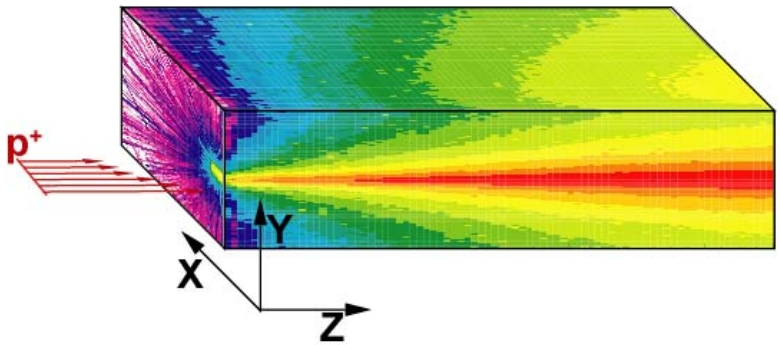
FLUKA Simulation Parameters

Collimator Geometry

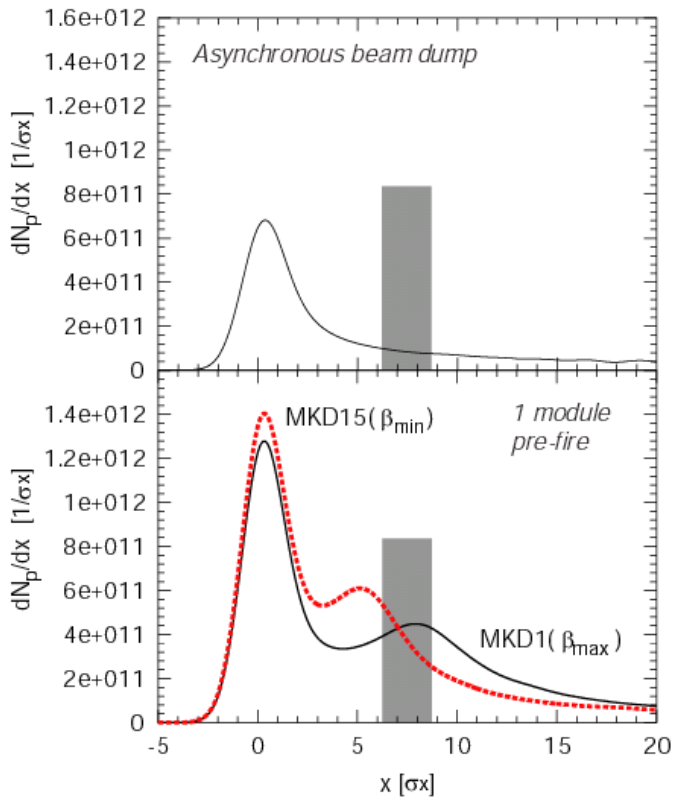
Right parallepiped

X: 0.1 – 5 cm
Y: -5 – 5 cm
Z: 0 – 160 cm



Beam Information

Time-projected horizontal proton distribution for dump failure
Single module pre-fire
Range: $5\sigma - 10\sigma$
Bunches: 20
Proton/Bunch: 1.05×10^{11} pr
Total: 2×10^{12} pr
Energy: 7 TeV
Beam: $\sigma_x=\sigma_y=200\mu m$
Vertical: Gaussian
Direction: Parallel to Z



Reference: LHC Project Note 293

FLUKA Simulations

Particle transport Cutoff

All particles: 100 keV
Neutron: thermal
Photon: 50 keV
Electron: 150 keV

Scoring

Energy deposition GeV/cm^3/pr

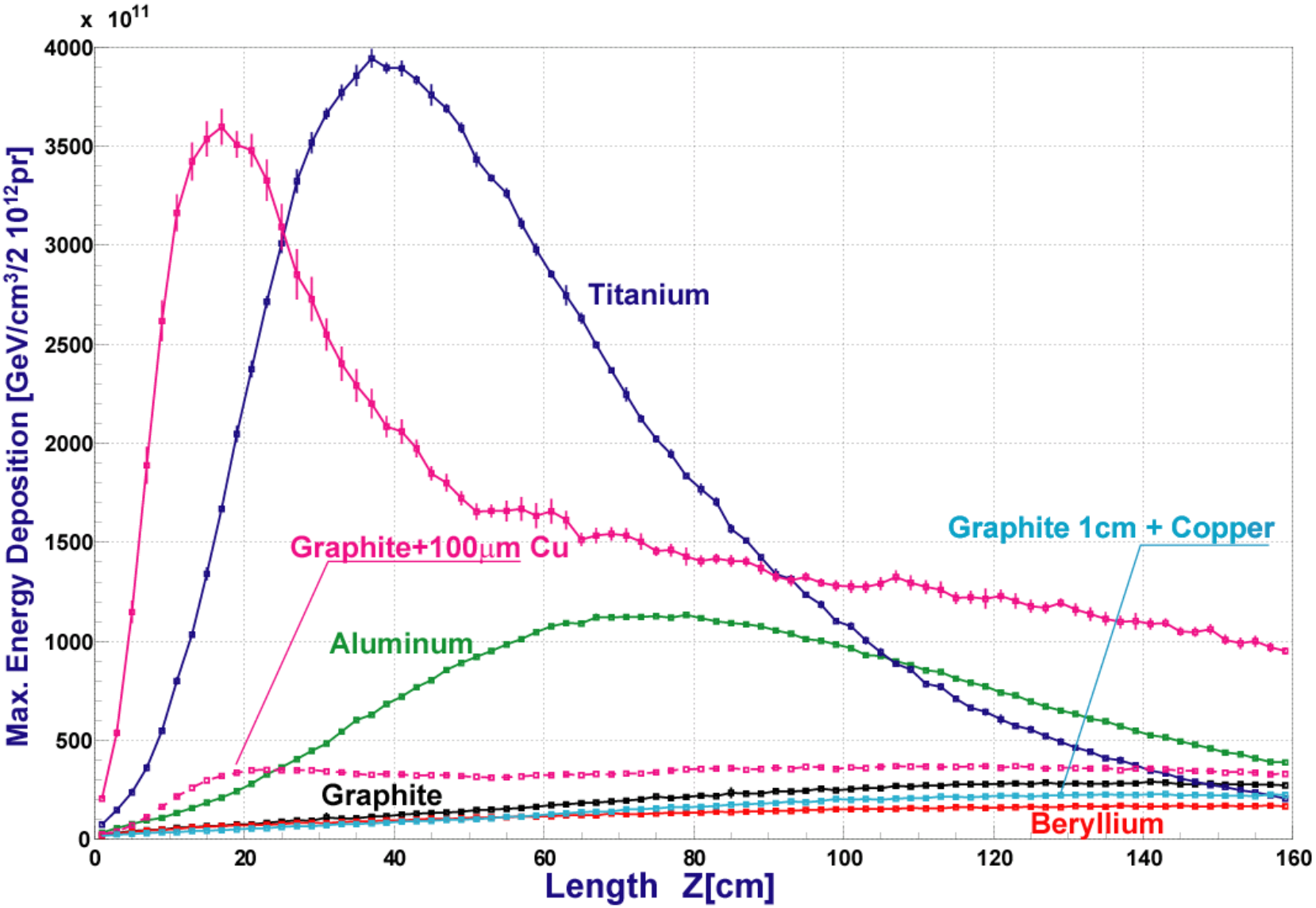
Binnings:

100μm x 100μm x 2cm
500μm x 500μm x 2cm

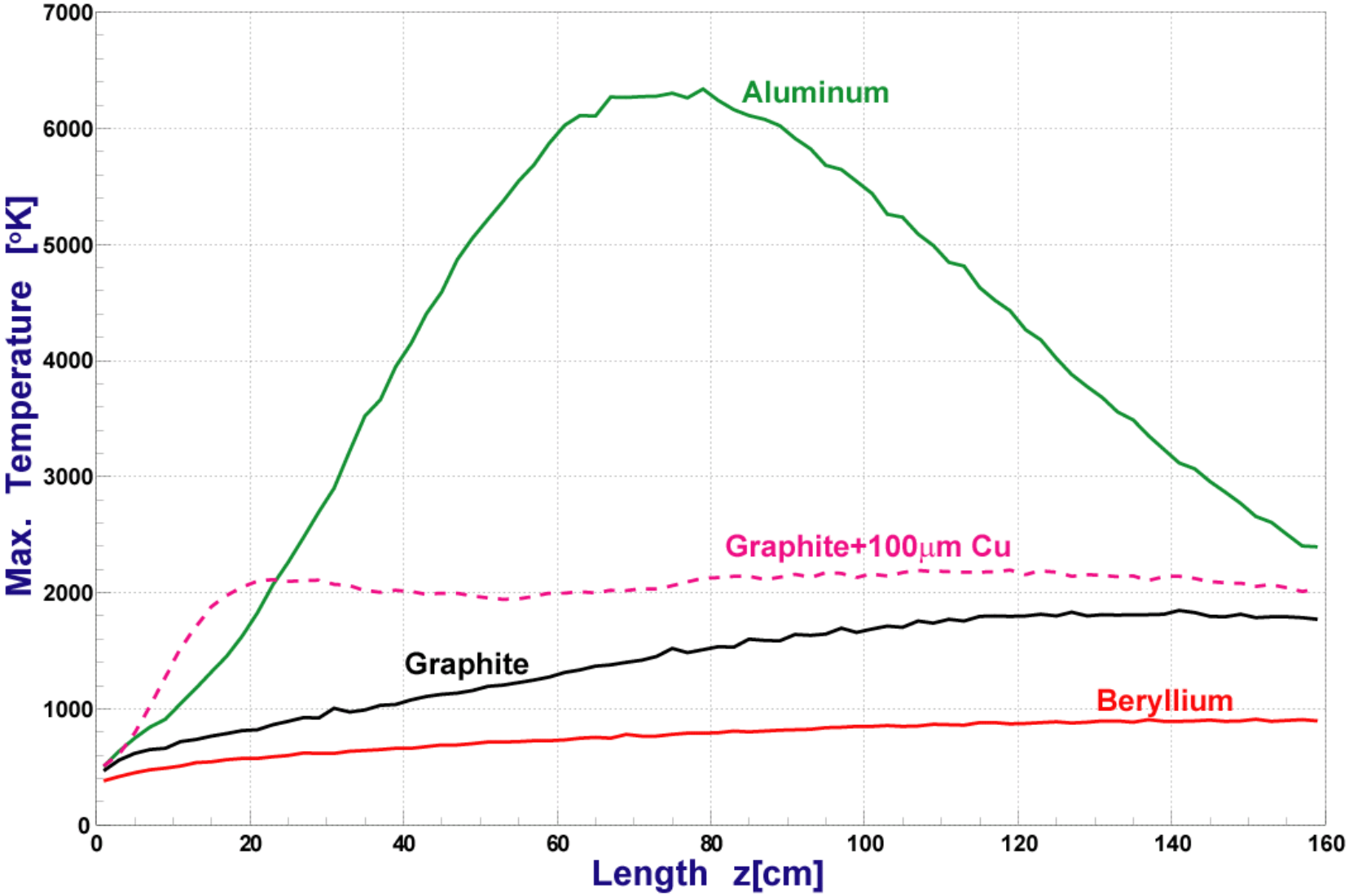
Cases Simulated

Material	Density g/cm^3	Max Energy GeV/cm^3	Max Temp ^{o}K approx.	Escaping %	EM %
Aluminum	2.7	1.2×10^{14}	~6500	88.8	9
Beryllium	1.848	0.2×10^{14}	900	97	1
Copper	8.96	16×10^{14}	> 10000	34.4	52.4
Graphite	1.77	0.3×10^{14}	1900	96.4	1.8
Graphite + Cu 100μm	1.77+8.9	3.6×10^{14} on Cu	2200 on C	94.1	3.9
1cm Graphite + Copper	1.77+8.9	0.22×10^{14}	1900 C, 450 Cu	94.5	3.8
Titanium	4.54	4×10^{14}	> 4000	79.5	16.7

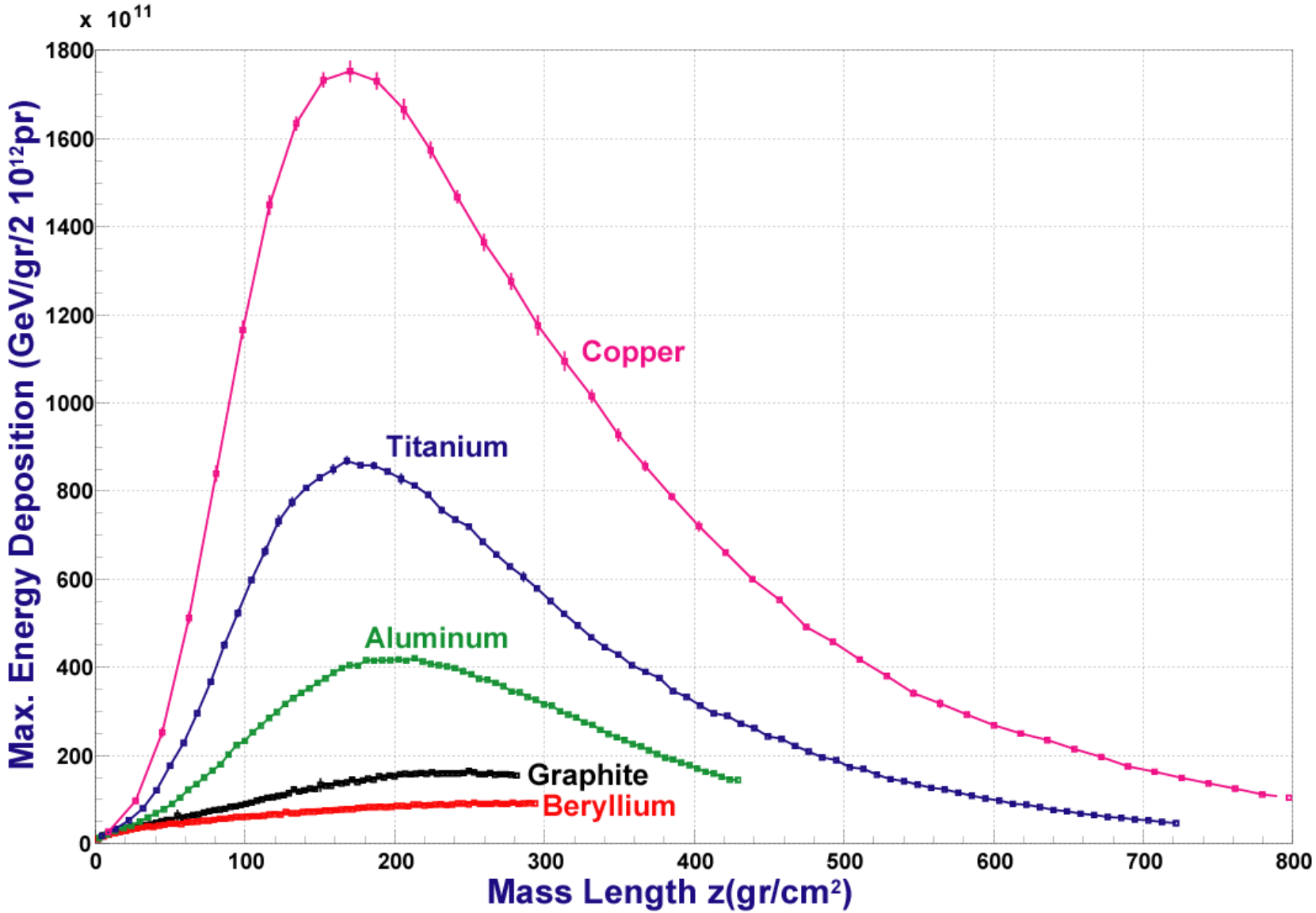
Maximum Energy Deposition



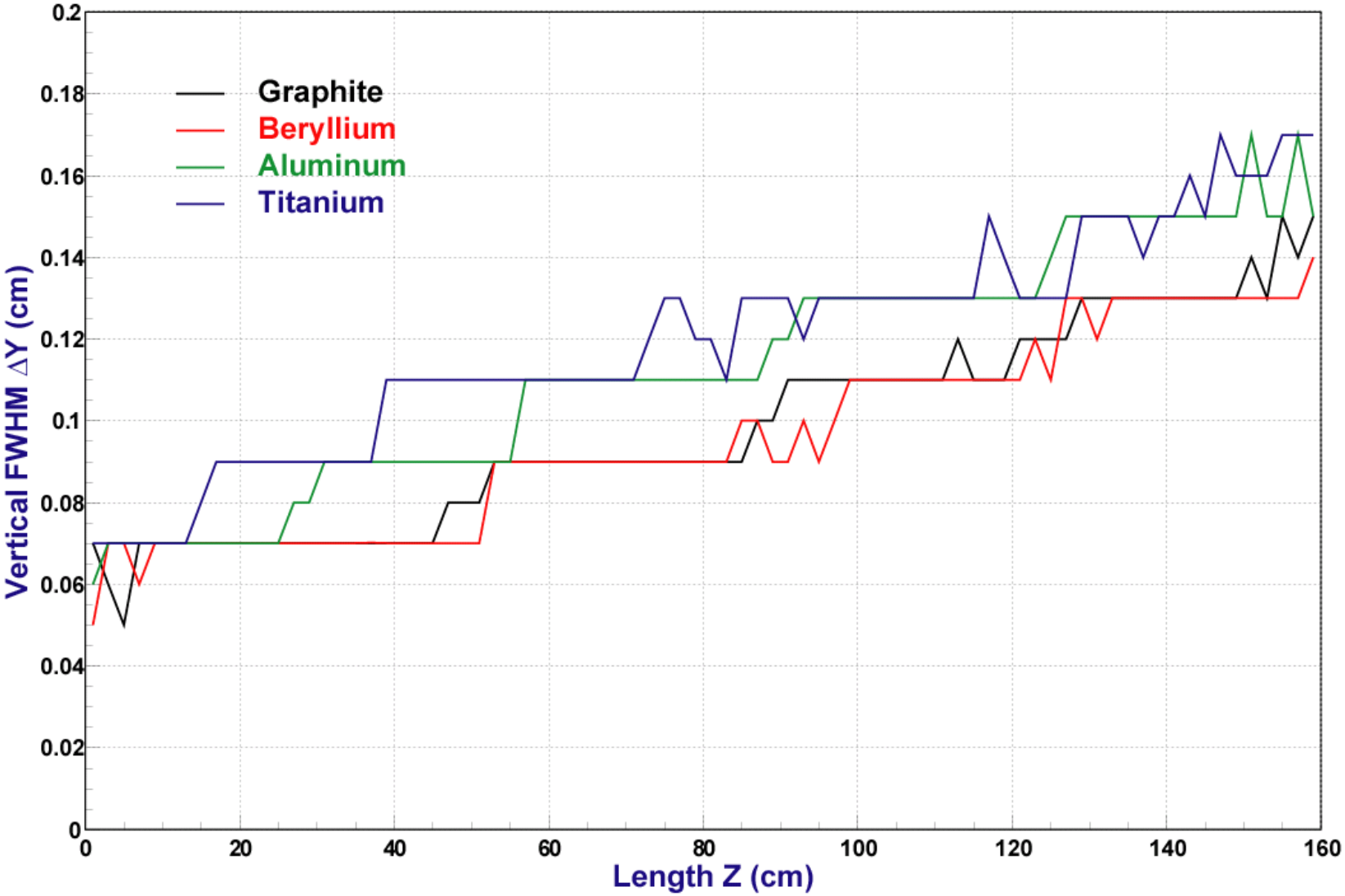
Maximum Temperature



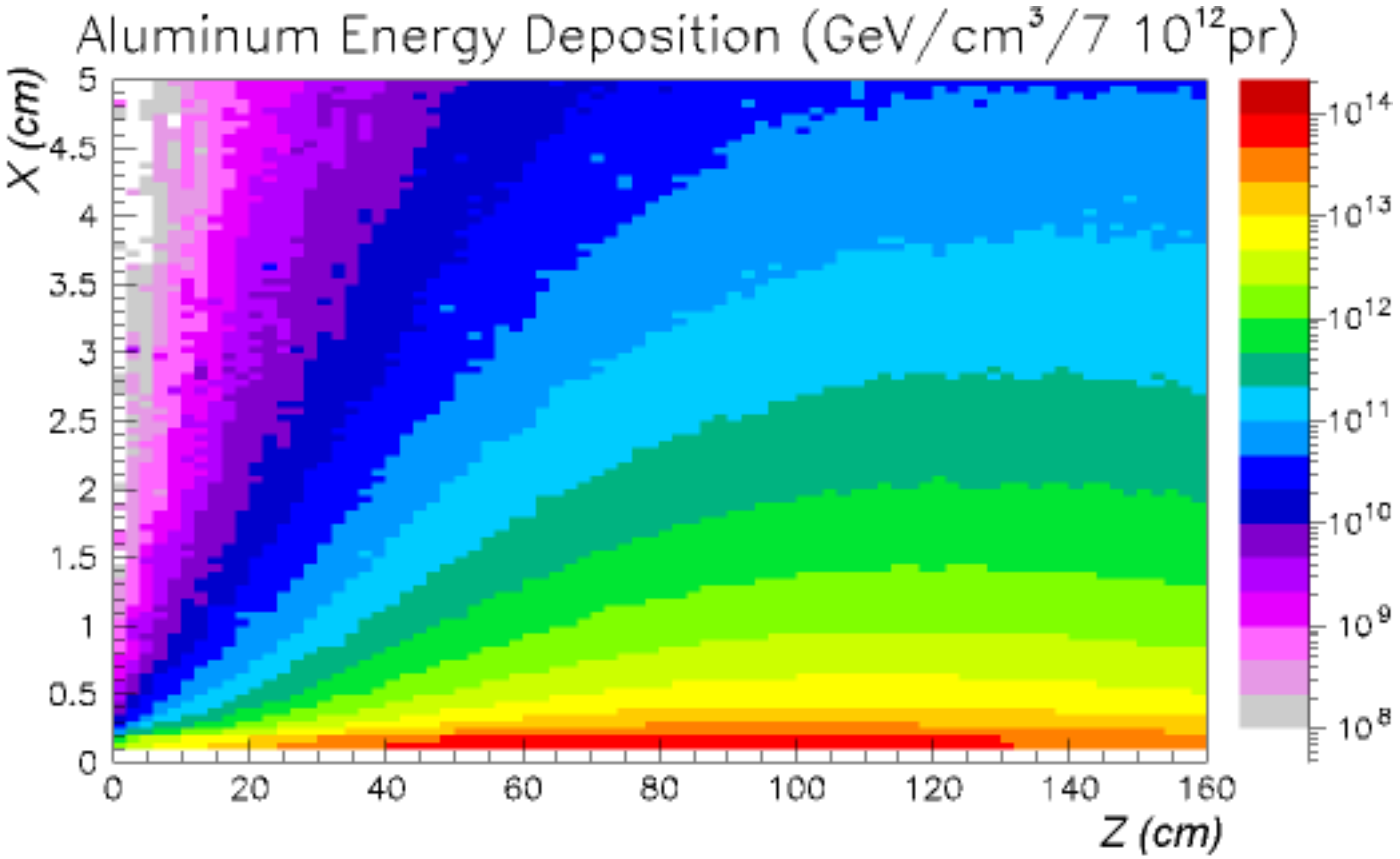
Max Energy per mass-length



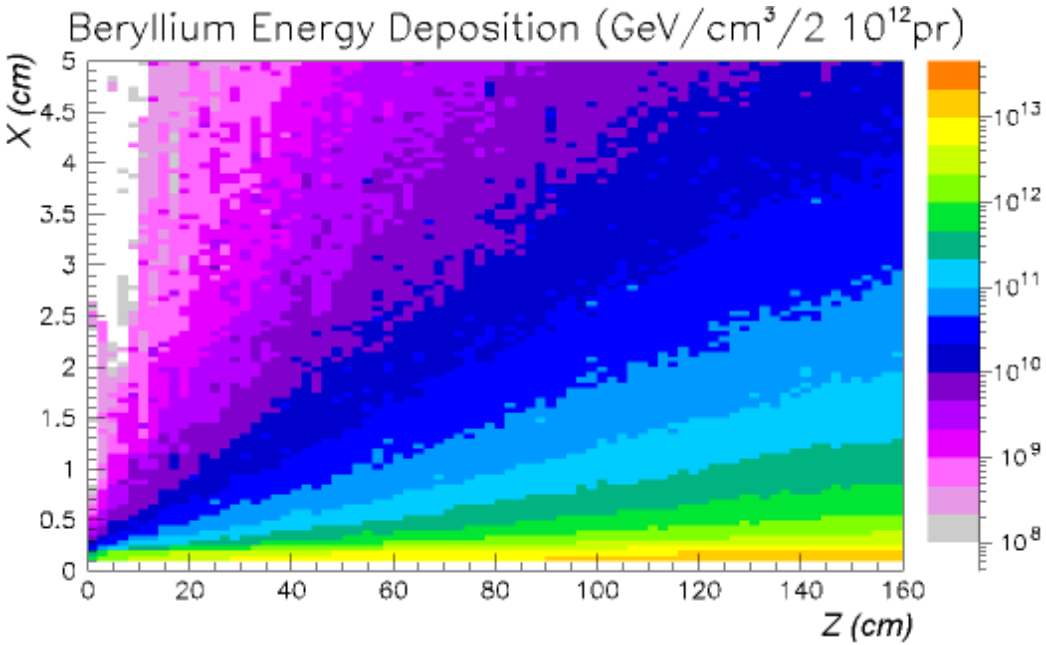
Vertical FWHM of Energy Dep.

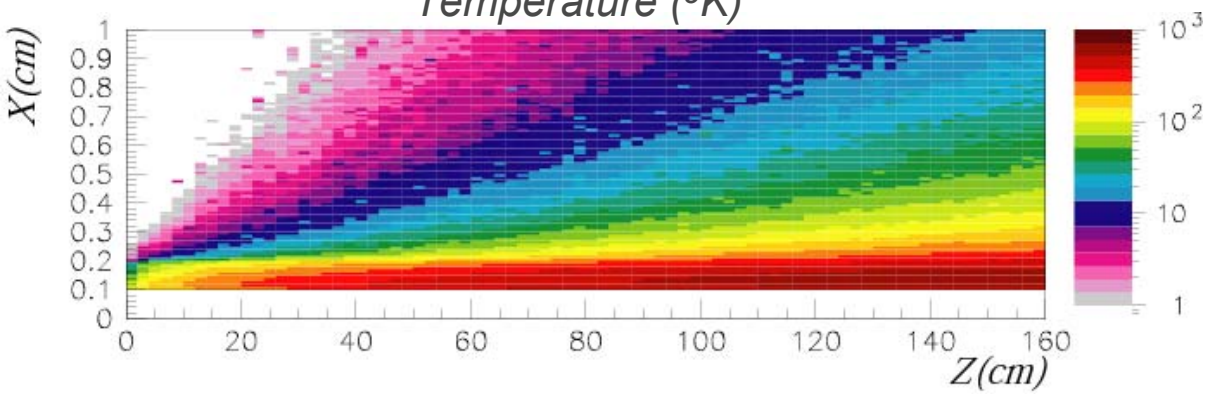


Aluminum

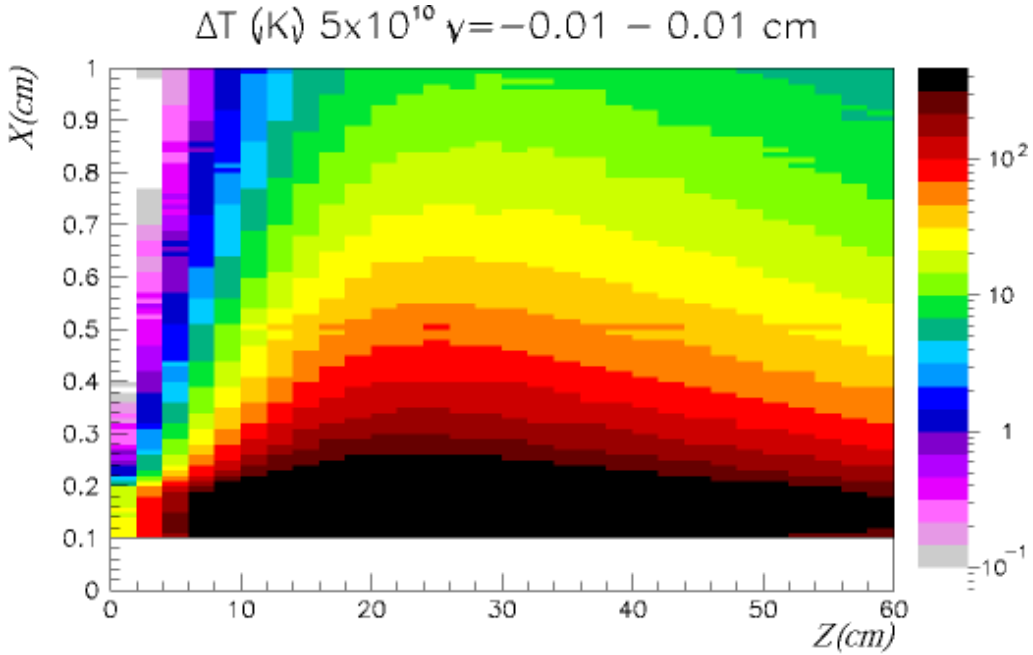

Aluminum Energy Deposition (GeV/cm³/7 10¹²pr)
X (cm)
Z (cm)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
20
40
60
80
100
120
140
160
10¹⁴
10¹³
10¹²
10¹¹
10¹⁰
10⁹
10⁸

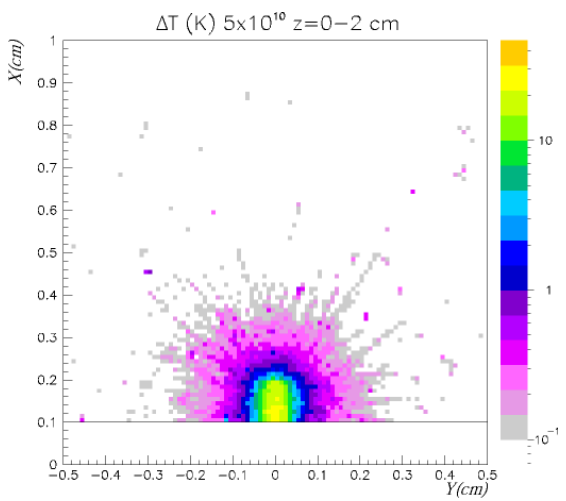
Beryllium

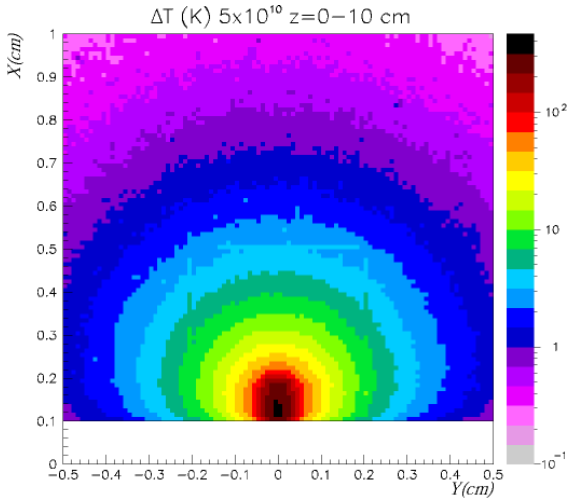

Beryllium Energy Deposition (GeV/cm³/2 10¹²pr)
X (cm)
Z (cm)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
20
40
60
80
100
120
140
160
10¹³
10¹²
10¹¹
10¹⁰
10⁹
10⁸

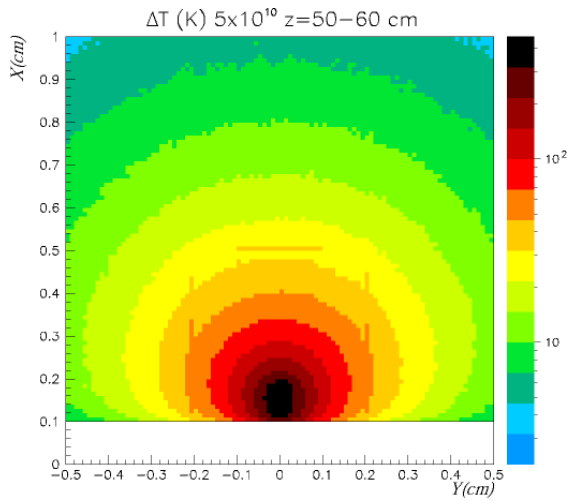

Temperature (°K)
X(cm)
Z(cm)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140
160
10³
10²
10
1

Copper

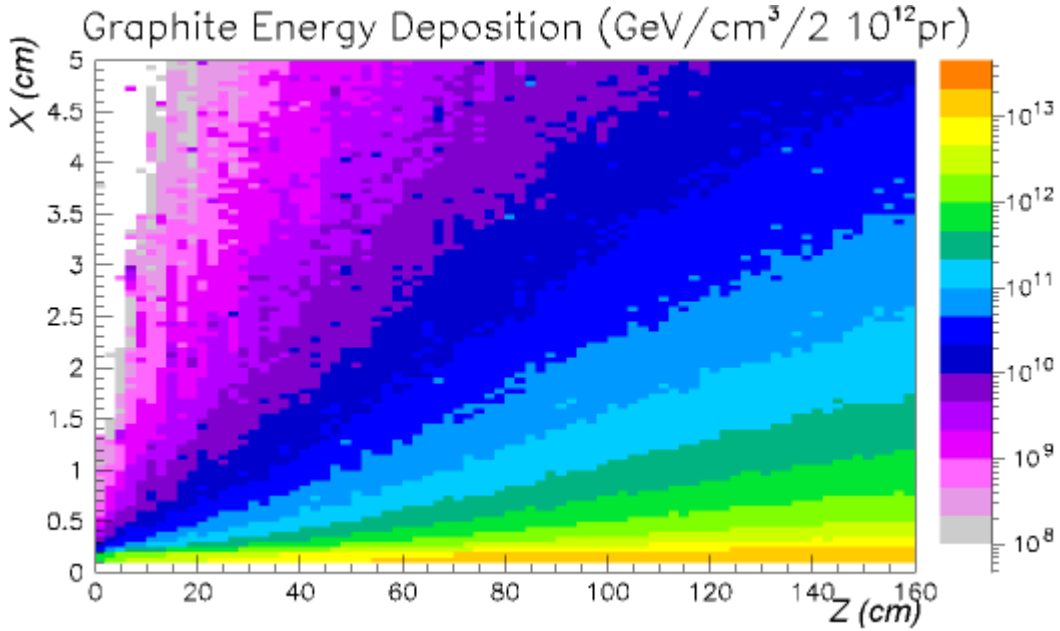

ΔT (K) 5x10¹⁰ γ=−0.01 − 0.01 cm
X(cm)
Z(cm)

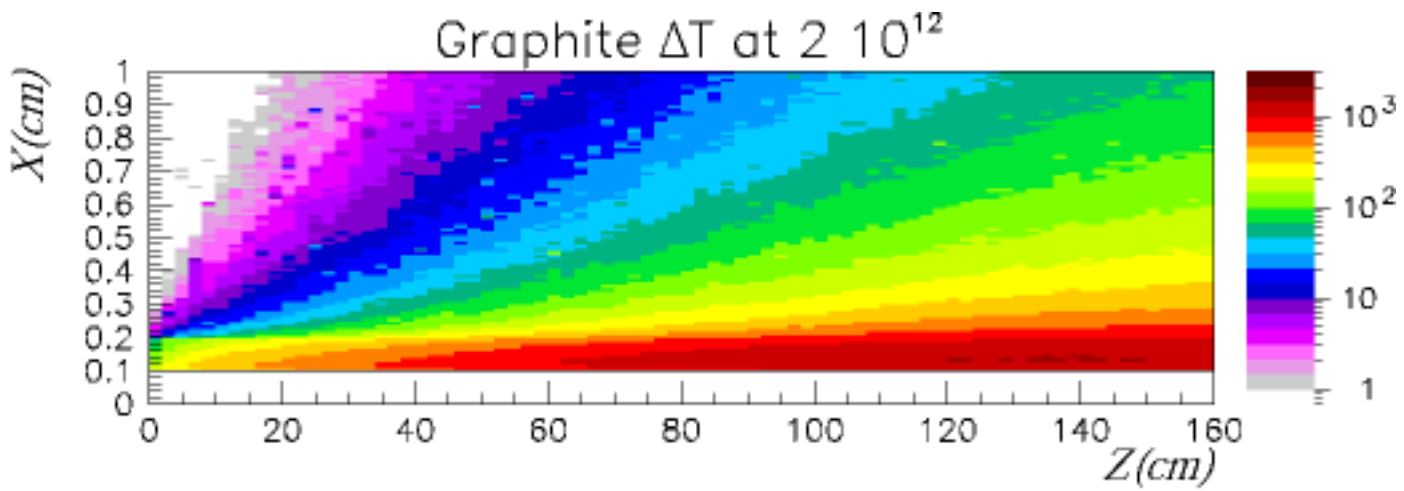

ΔT (K) 5x10¹⁰ z=0−2 cm
X(cm)
Y(cm)


ΔT (K) 5x10¹⁰ z=0−10 cm
X(cm)
Y(cm)

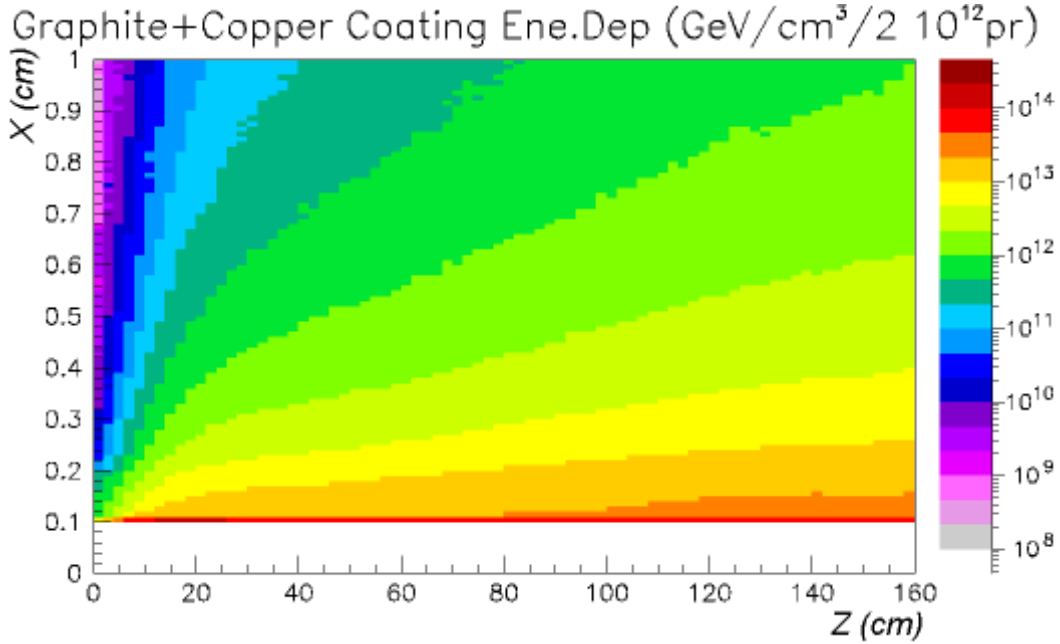

ΔT (K) 5x10¹⁰ z=50−60 cm
X(cm)
Y(cm)

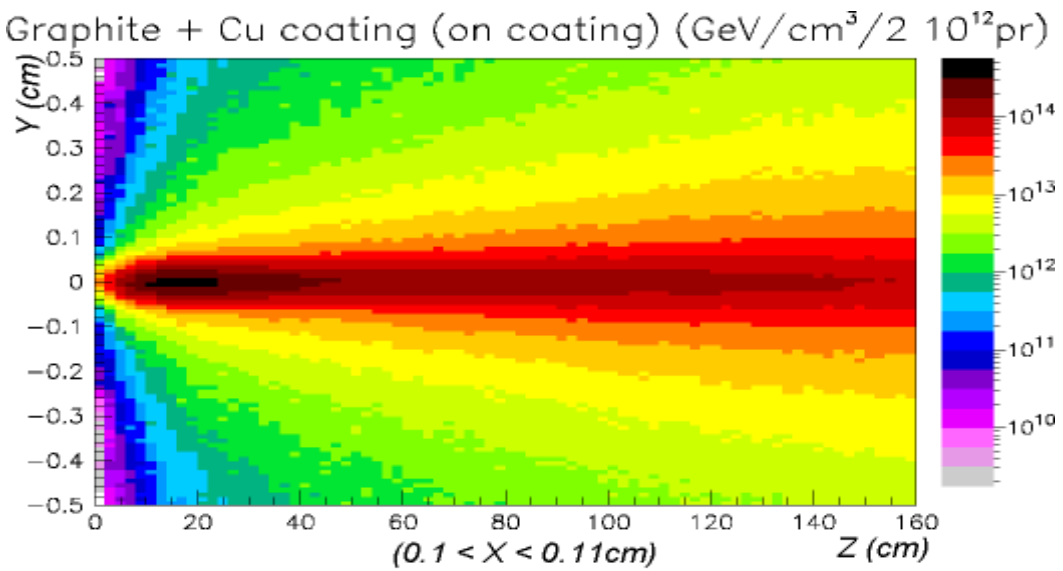
Graphite


Graphite Energy Deposition (GeV/cm³/2 10¹²pr)
X (cm)
Z (cm)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
20
40
60
80
100
120
140
160
10¹³
10¹²
10¹¹
10¹⁰
10⁹
10⁸

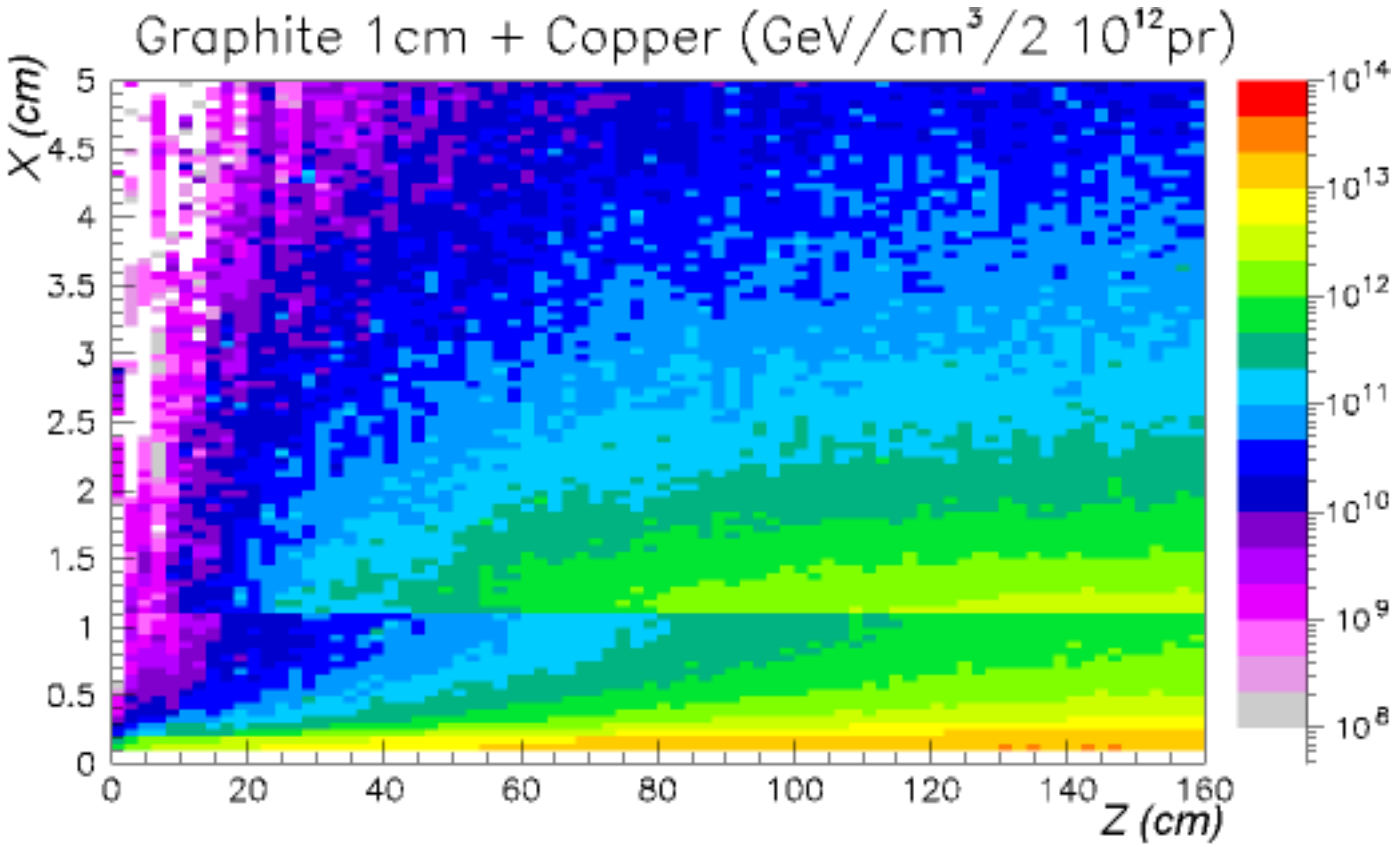

Graphite ΔT at 2 10¹²
X(cm)
Z(cm)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140
160
10³
10²
10
1

Graphite + Cu 100μm coating

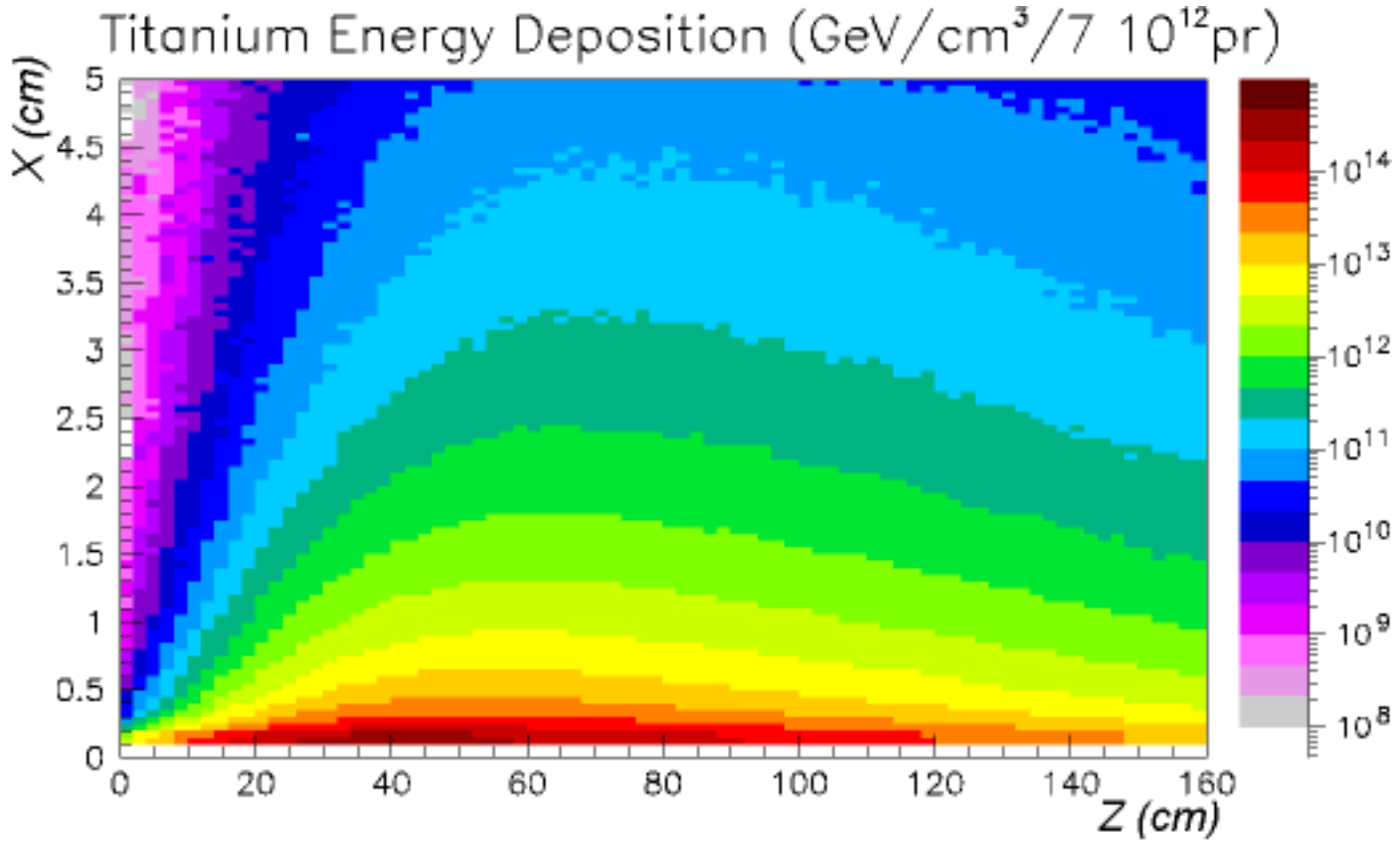




1cm Graphite + Copper



Titanium


Titanium Energy Deposition (GeV/cm³/7 10¹²pr)
X (cm)
Z (cm)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
20
40
60
80
100
120
140
160
10¹⁴
10¹³
10¹²
10¹¹
10¹⁰
10⁹
10⁸