Compact Photon Source

updates&ideas for 11/21/2017

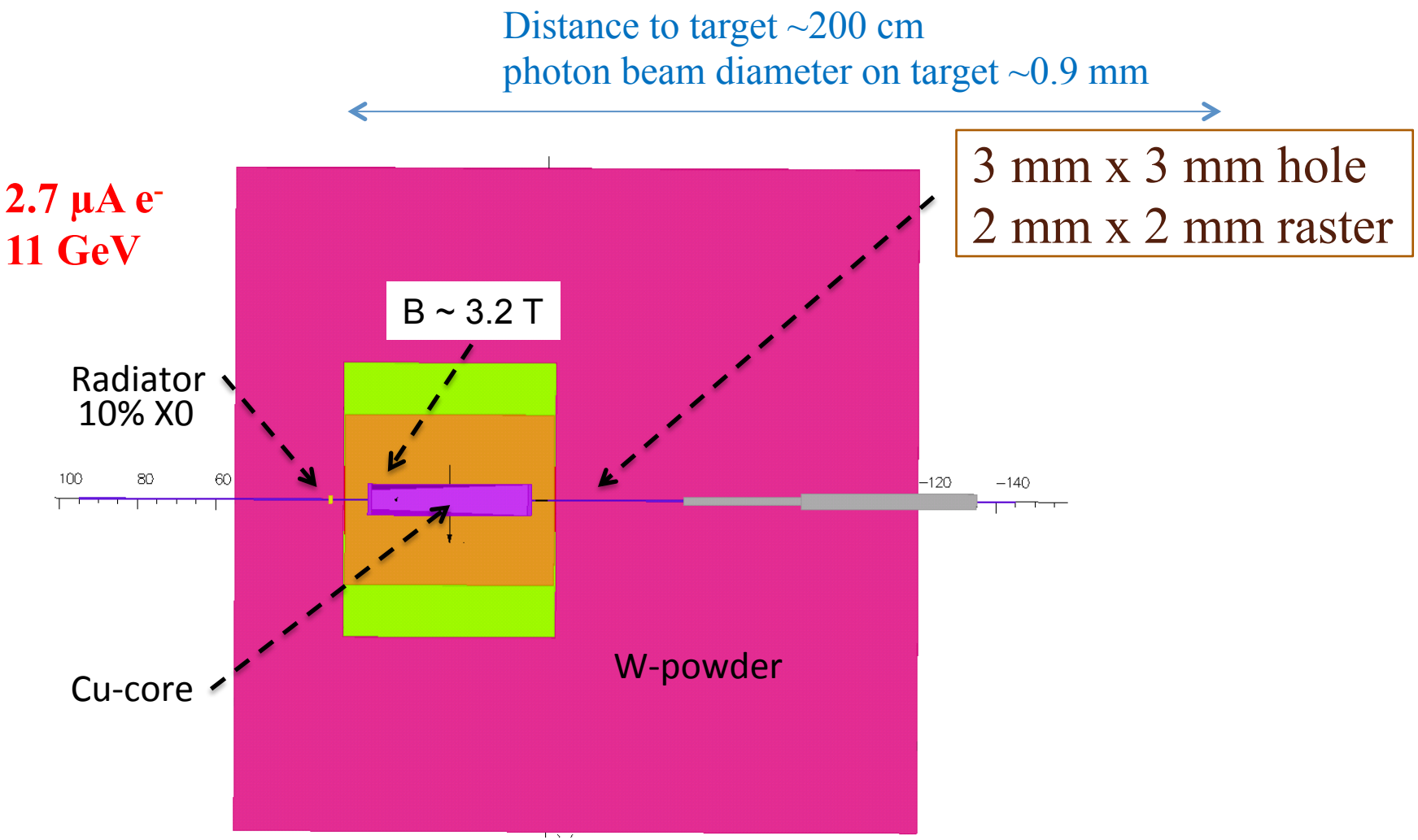
B. Wojtsekhowski for the collaboration

New developments

the list from our previous meeting

1. The raster is 2 mm x 2 mm (requires pol. target rotation)
2. The magnet pole is shaped to boost the B field to 3.2 T -> length reduction which allows a longer front shield and a wedged absorber.
3. The central absorber of Cu has 1.9 x better heat conductivity, 4.2 x longer radiation length than the W-Cu (20%) alloy.
4. W-powder external shield (16 g/cm^3 density) for better shielding.
5. Gradual "stepped" opening of the beam line for rad. leak reduction
6. Shielding requirement logic: The radiation from the source should be a few times lower than that from the photon beam interaction with the material of a polarized target.

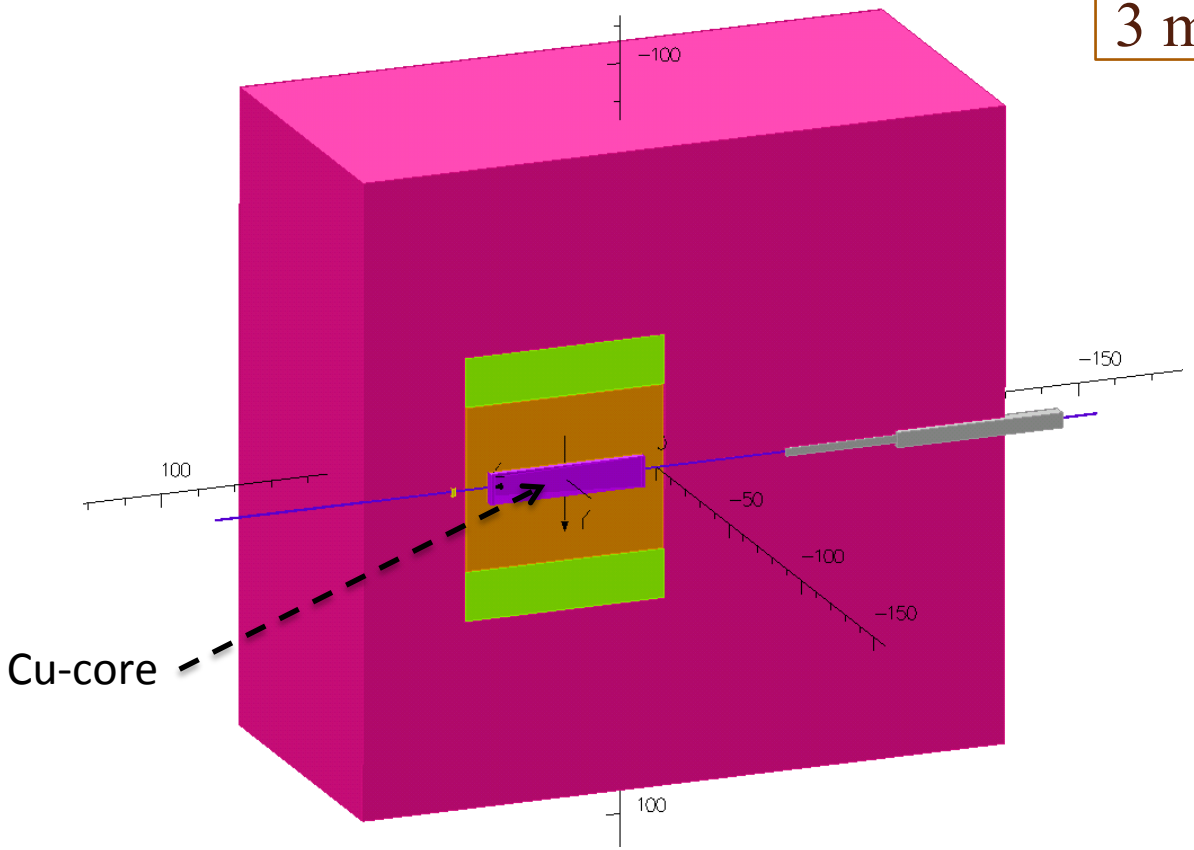
Current model of the γ-Source



Current model of γ-Source

Distance to target ~200 cm
photon beam diameter on target ~0.9 mm

3 mm x 3 mm hole



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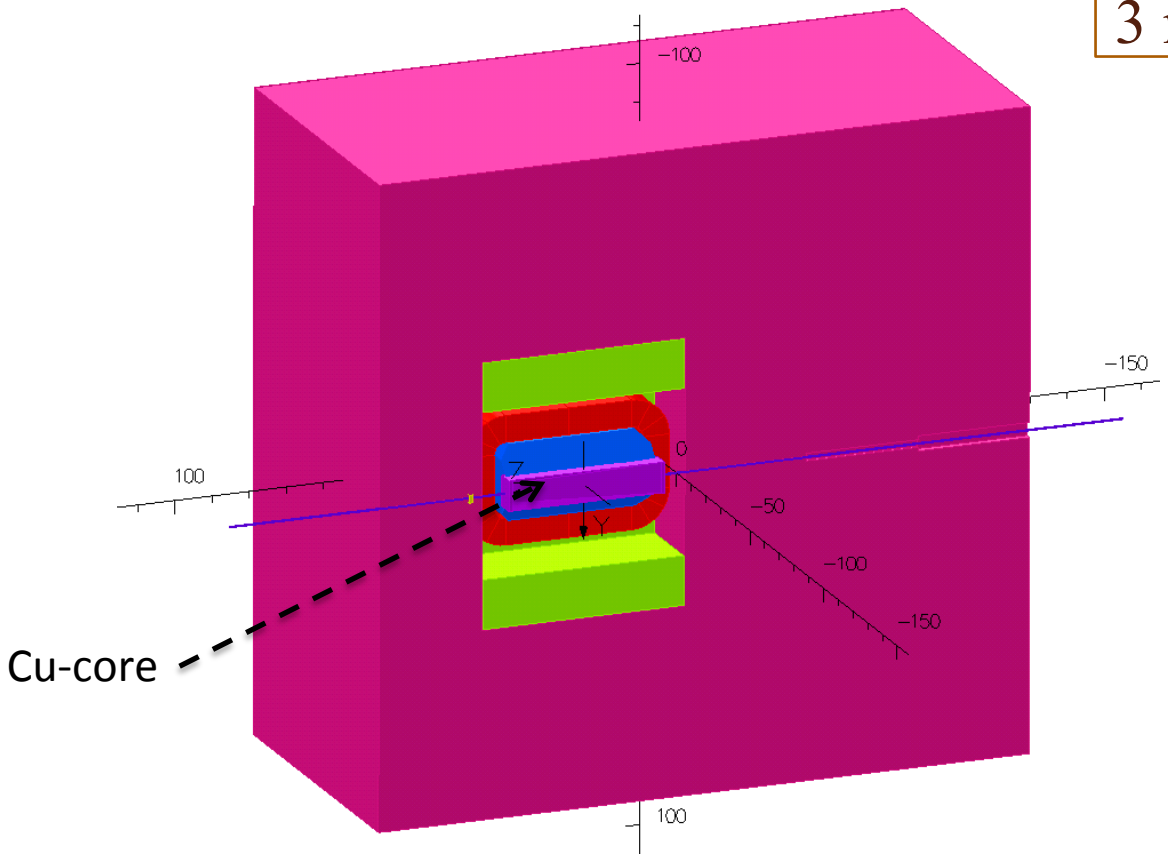
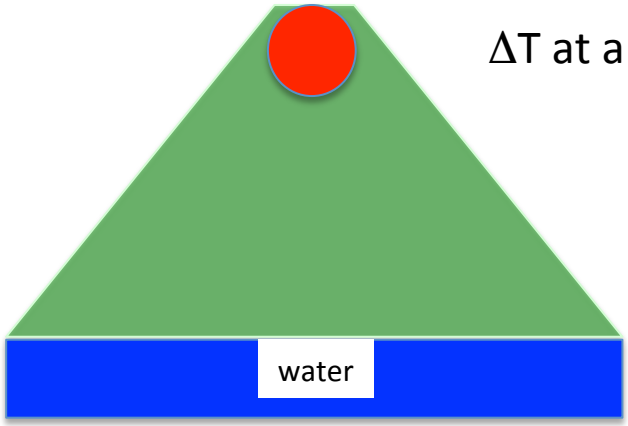


Considerations for a 6-point list

3. The central absorber of Cu has 1.9 x better heat conductivity, 4.2 x longer radiation length than the W-Cu (20%) alloy.

An estimate: The power distributed over 30 cm with diameter of 2 cm. Using a wedge shape of the Cu (in x-y plane) with angle of 90 degrees and cooling at 12 cm distance from the power source we can estimate the temperature profile: 600+ 140 x $(1-r^2)$ for r<1 cm and a log. profile for r>1 cm 240 ln(12/r). A 3D calculation would be useful.



ΔT at a hot center = 600 + 140 C

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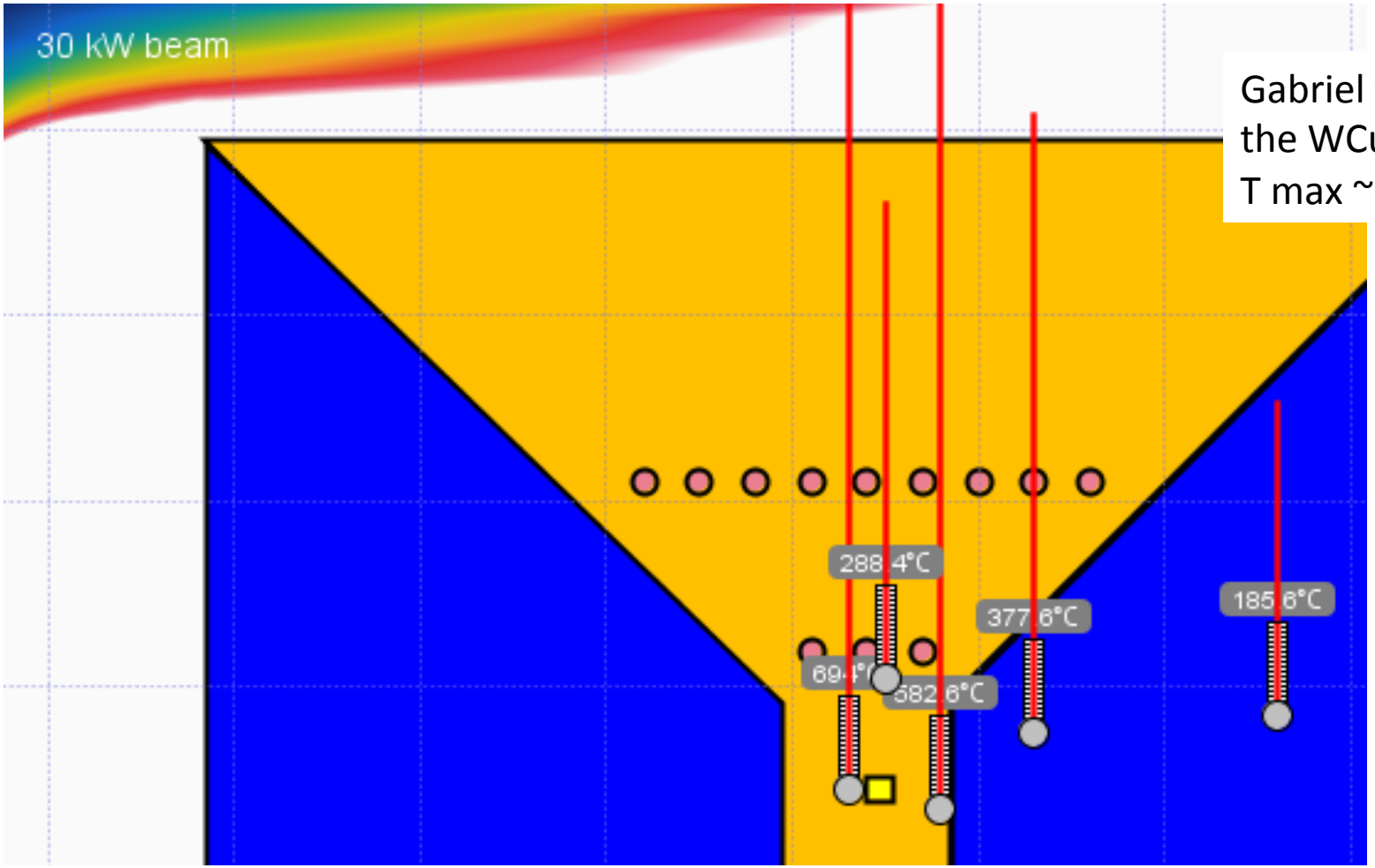


Gabriel found for the WCu absorber: T max ~ 700 C

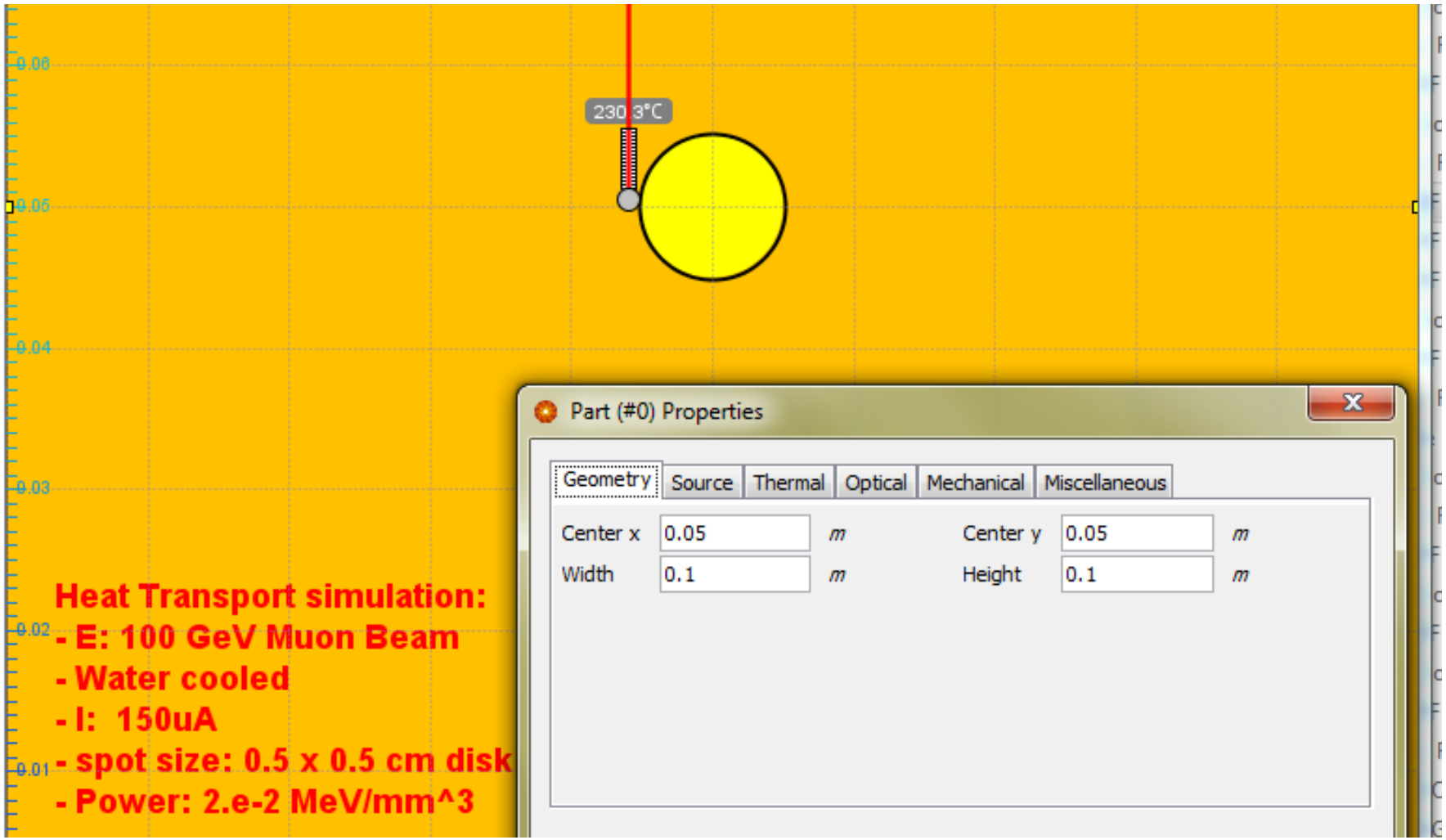
Test of 2D Temp-code

Marco made a GEMC with a set of 44 Cu blocks 10x10x1 cm; 100 GeV muons in 1 cm diameter spot for heat generation – mainly ionization losses.

Gabriel used the G4/root output file to find the max power in Z and used it for 2D analysis of the temperature profile => $T_{r=0.5\ cm}$ = 240 C

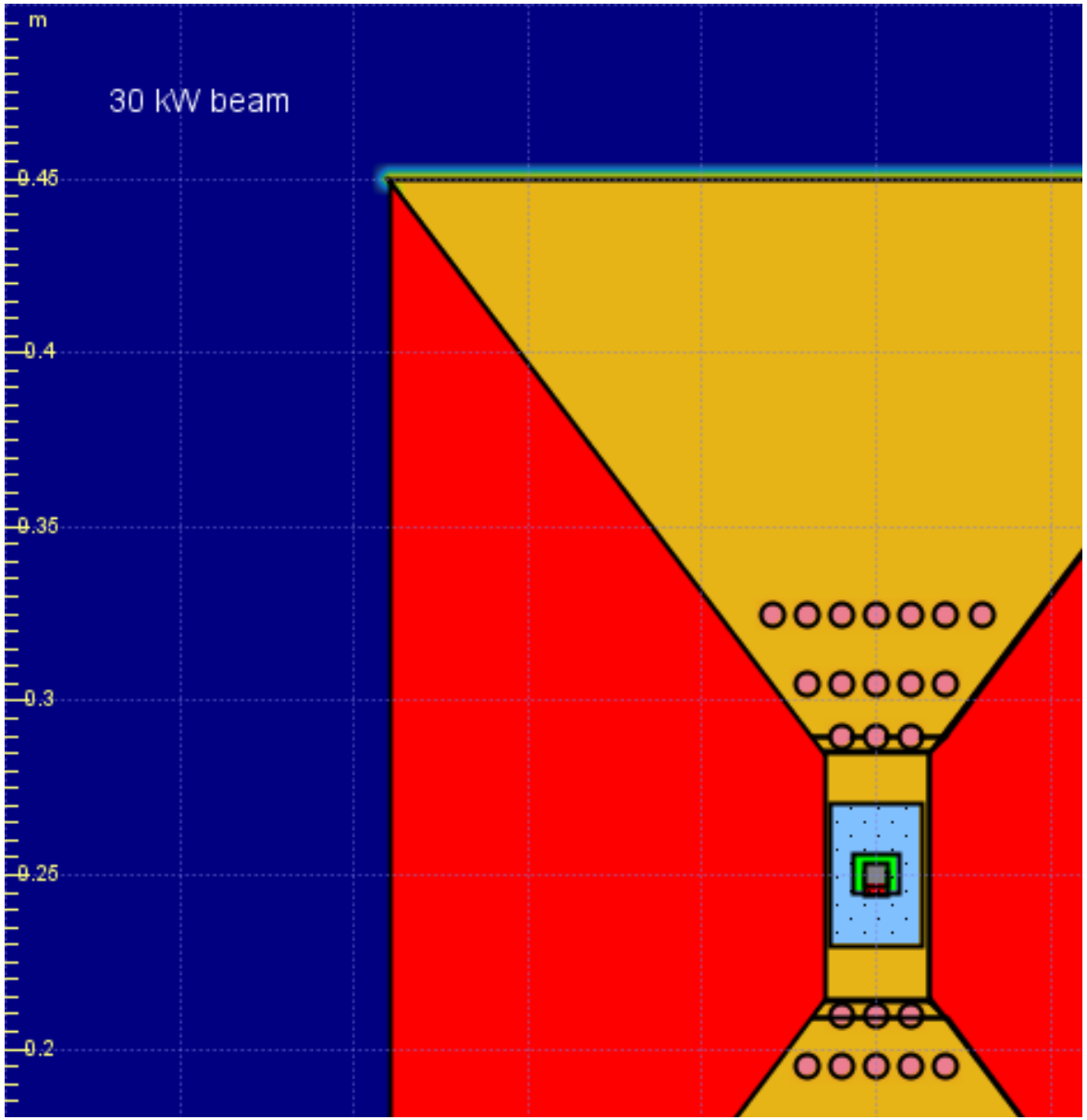
My analytical result for that point is about 246-255 C

Test of 2D Temp-code

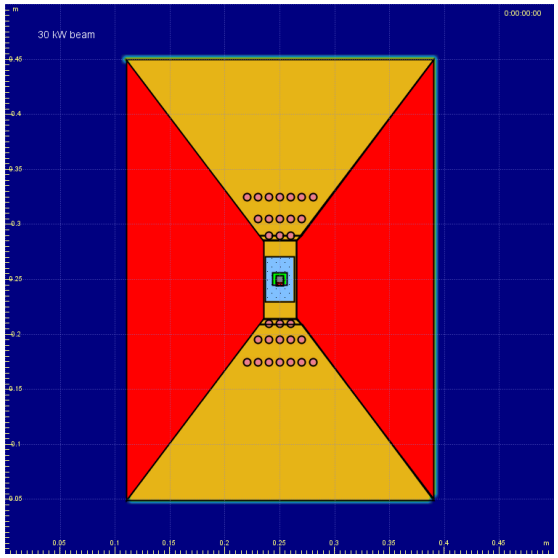


Considerations for a 6-point list

Gabriel used Marco's CPS power profile, took the max power at
Z = -55 cm



Updated calculations (Nov. 20)



HCPS, Cu center, 30 kW z=-55 cm

y [cm]

	0	2	4	6	8	10	12	14
0	379.5	289.2	244.4	178	139.3	115.1	99.1	88.2	80.6	75.2	71.8	68.7	67	66.1	64.2
−2	293.6	254	223.1	167.9	133.9	111.9	97.2	86.9	79.7	74.5	70.8	68.8	66.8	65.8	63.9
−4	124.4	121.5	121.4	114	103.3	93.5	85.4	79.1	74.2	70.5	67.8	65.8	64.5	63.8	62.1
−6	47.1	50.7	66.2	78.1	79.9	78	75	71.8	68.9	66.6	64.7	63.3	62.4	61.9	60.2
−8	40.8	42.3	42.9	51.1	60	63.3	64.5	64.1	63.2	62.1	61.2	60.4	59.8	59.5	58
−10	30	30	30	36.6	45.2	51.8	55.3	56.9	57.5	57.6	57.4	57.2	57	56.8	55.6
	30.6	30.8	31.5	33.4	35.8	43.1	47.9	50.7	52.4	53.3	53.8	54	54.1	54.1	53
	30	30	30	30	34.1	36.8	42.3	45.7	48	49.5	50.4	50.9	51.2	51.4	50.5
	31.4	31.5	31.8	32.6	34.1	35.5	38.5	41.9	44.4	46.1	47.3	48.1	48.6	48.8	48.2
	32.4	32.5	32.9	33.5	34.5	35.5	36.5	39	41.5	43.3	44.7	45.6	46.2	46.5	46
	33.2	33.3	33.7	34.2	34.8	35.6	36.3	37.1	39.3	41.1	42.4	43.4	44	44.3	44

x [cm]

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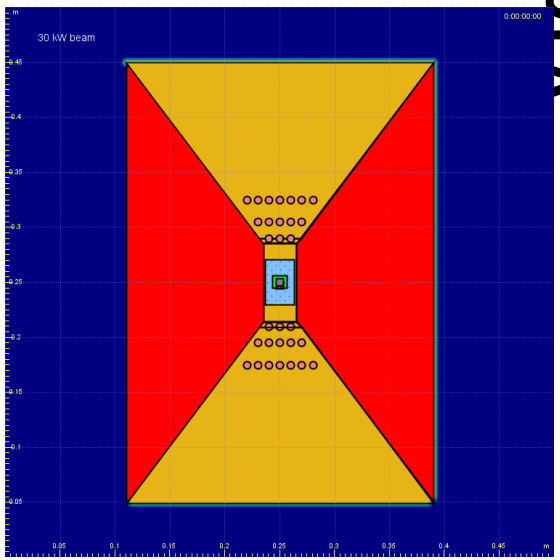
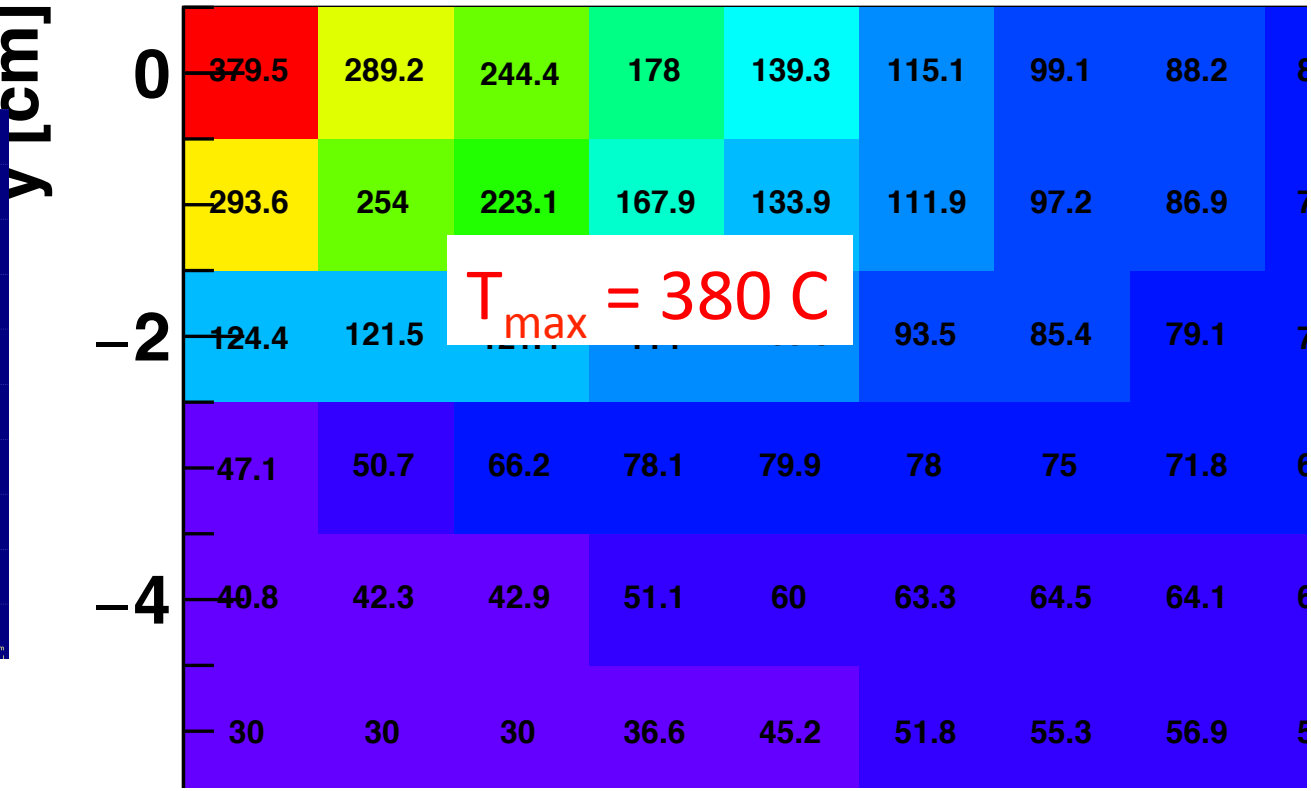
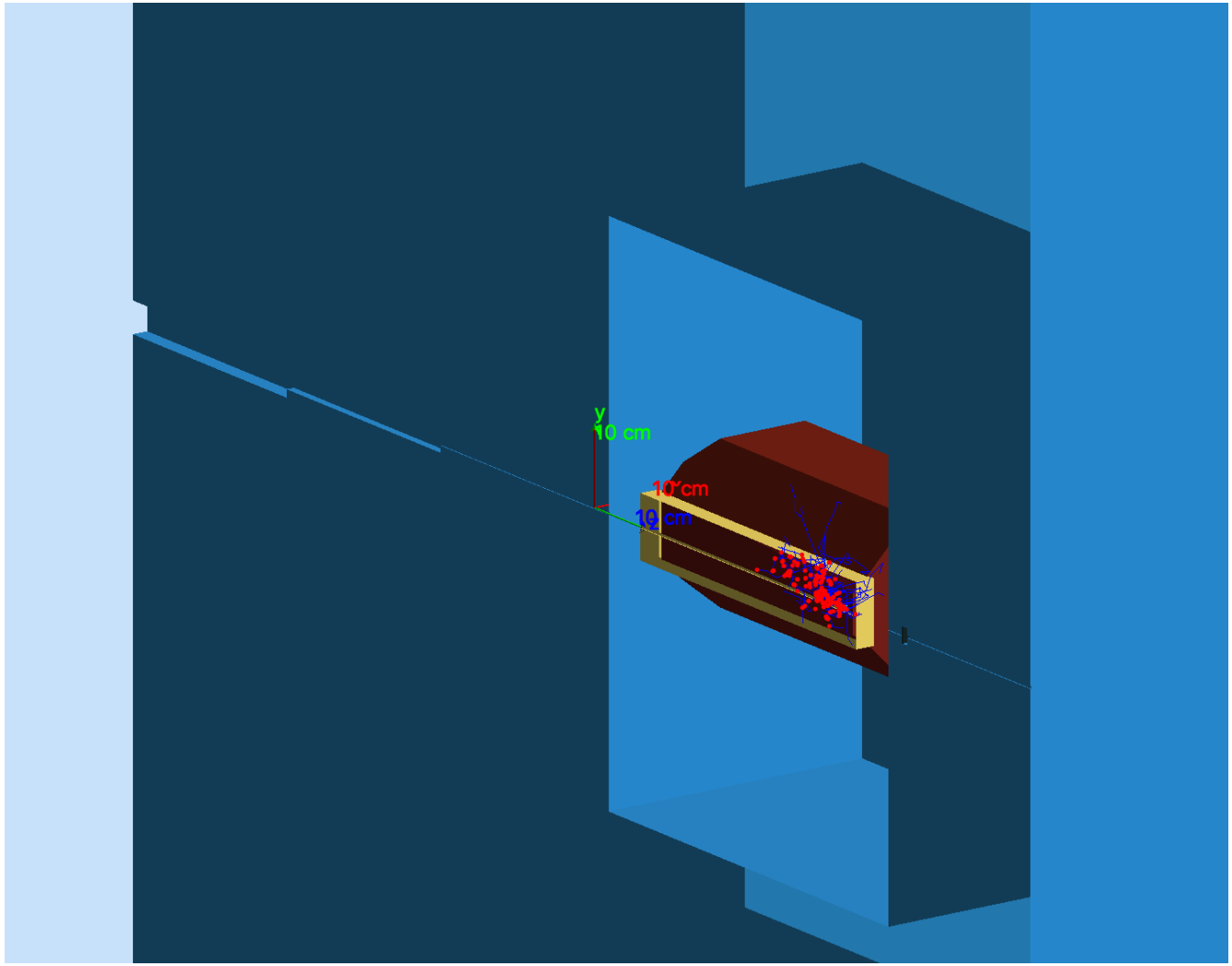




Geant4 model (GEMC framework)



Marco,
Maurizio
BW

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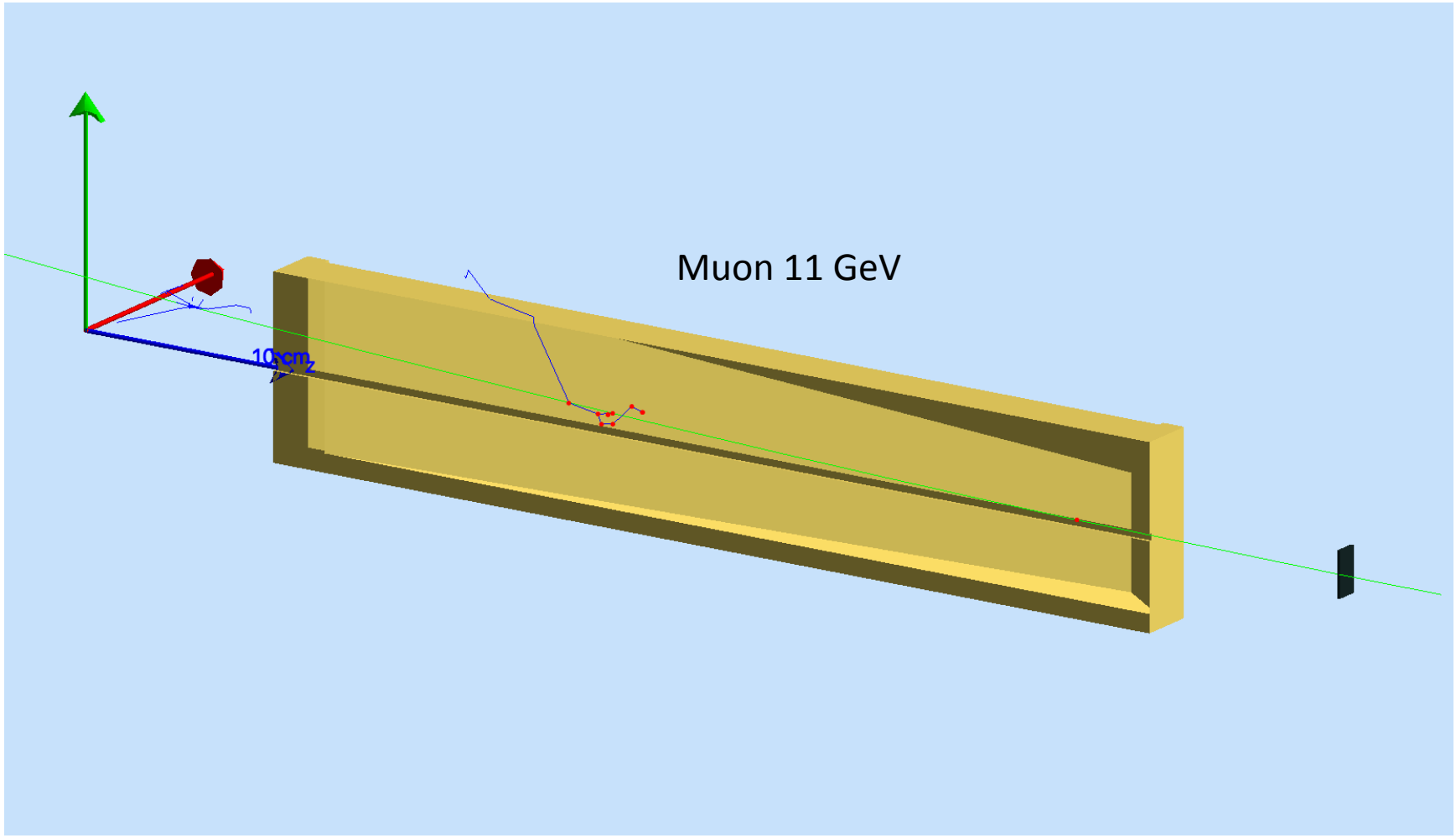

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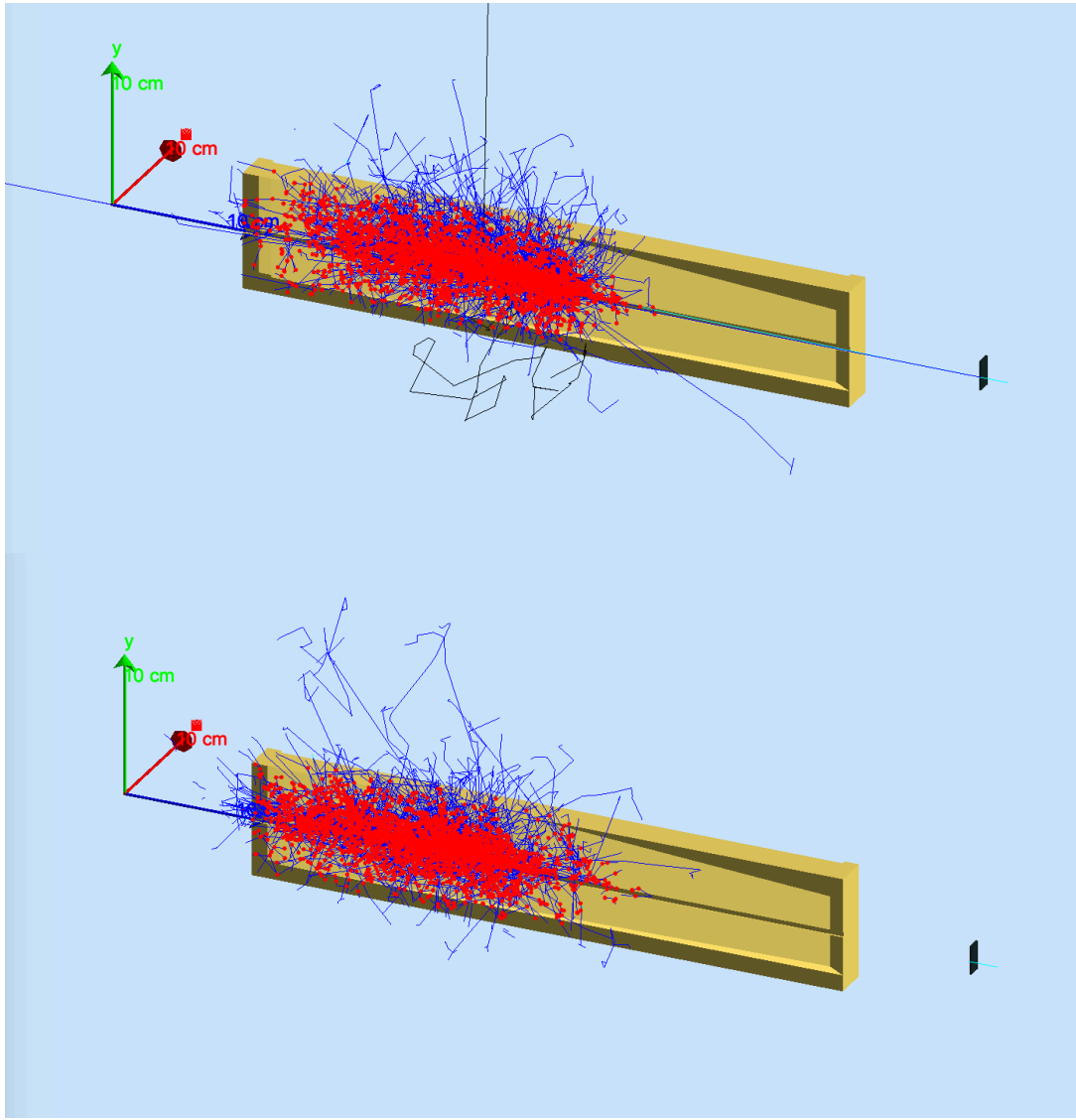


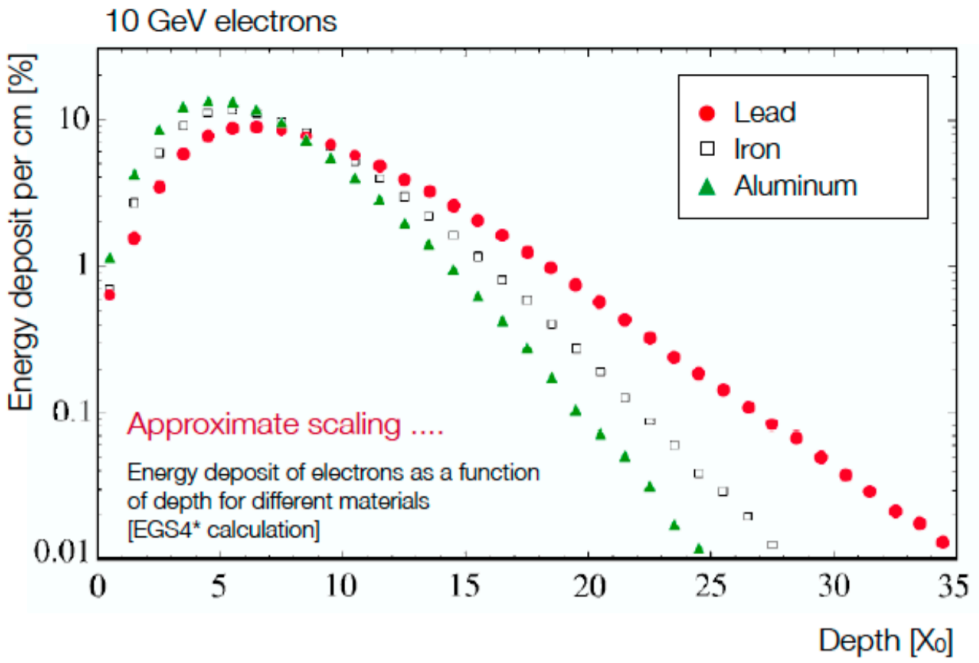
11 GeV e-
and a photon

11 GeV e-
Yv = -1 mm

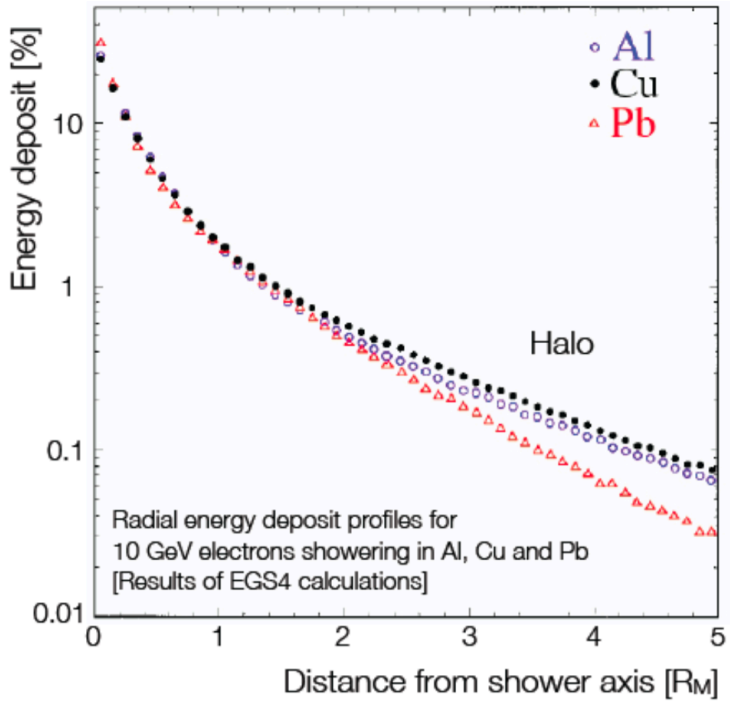
Geant4 model (GEMC framework)

We checked of the shower profiles, magnetic field implementation etc

Longitudinal profile



Transverse profile



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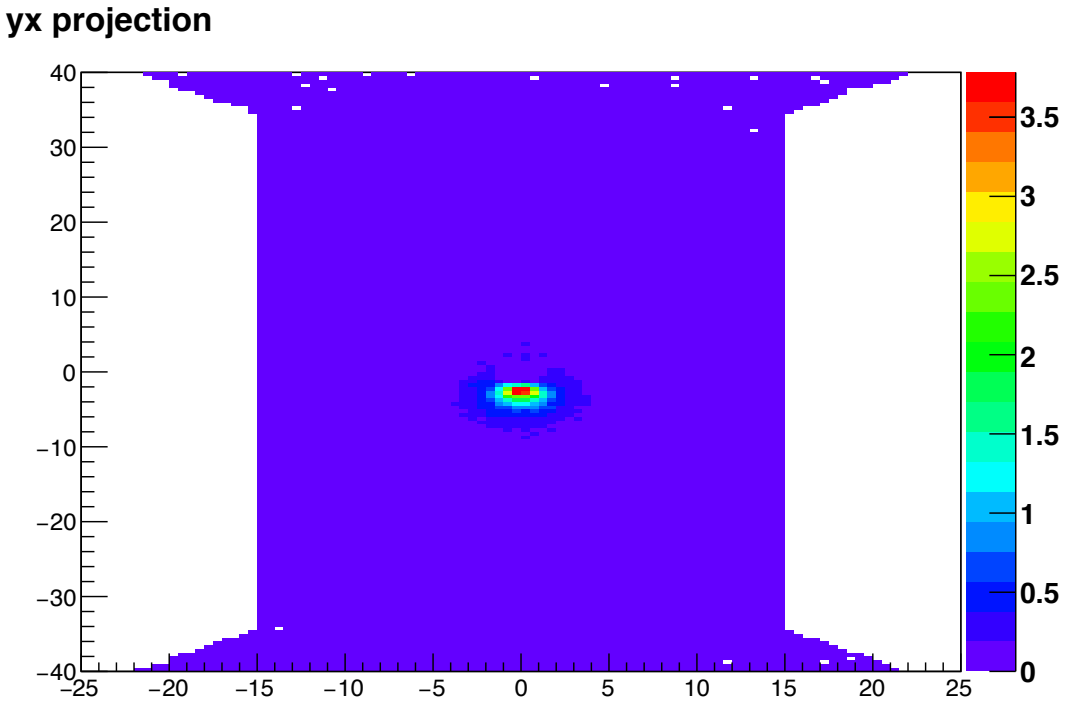
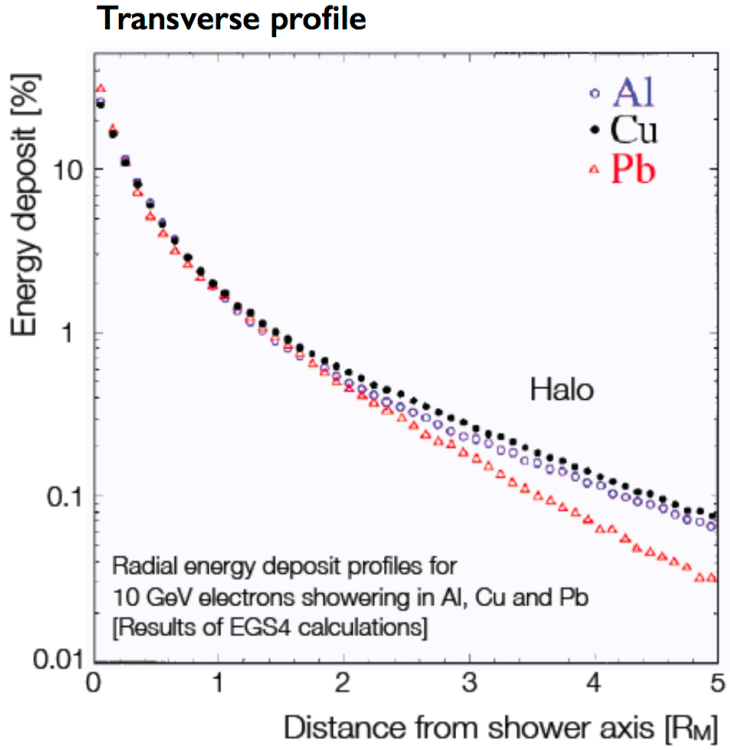
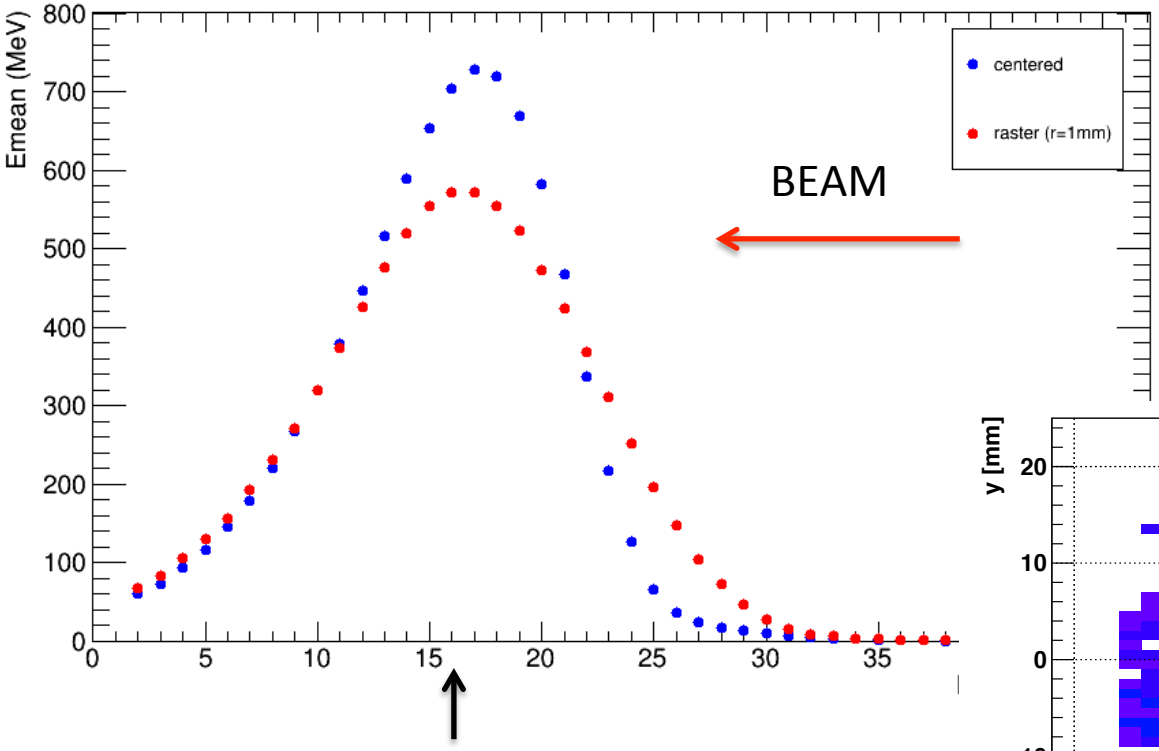
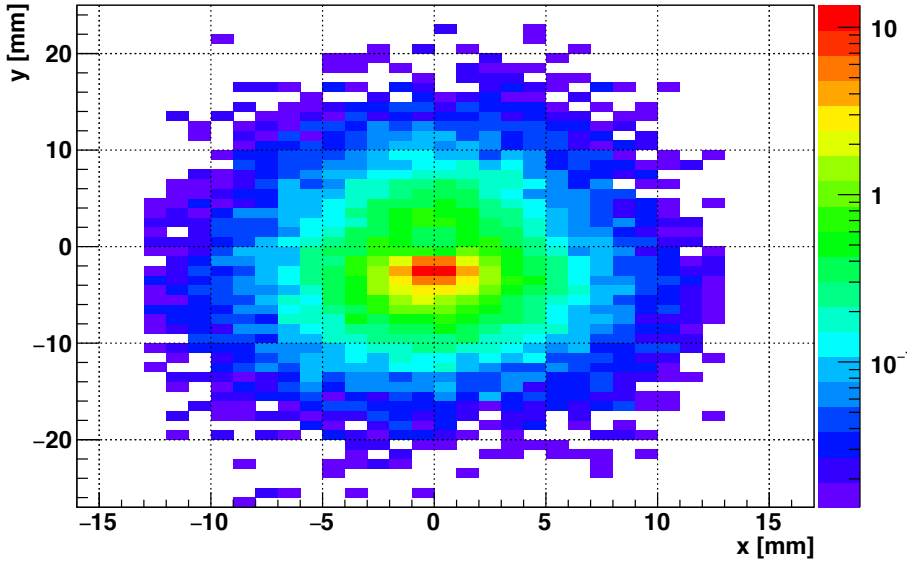




Geant4 model (GEMC framework)

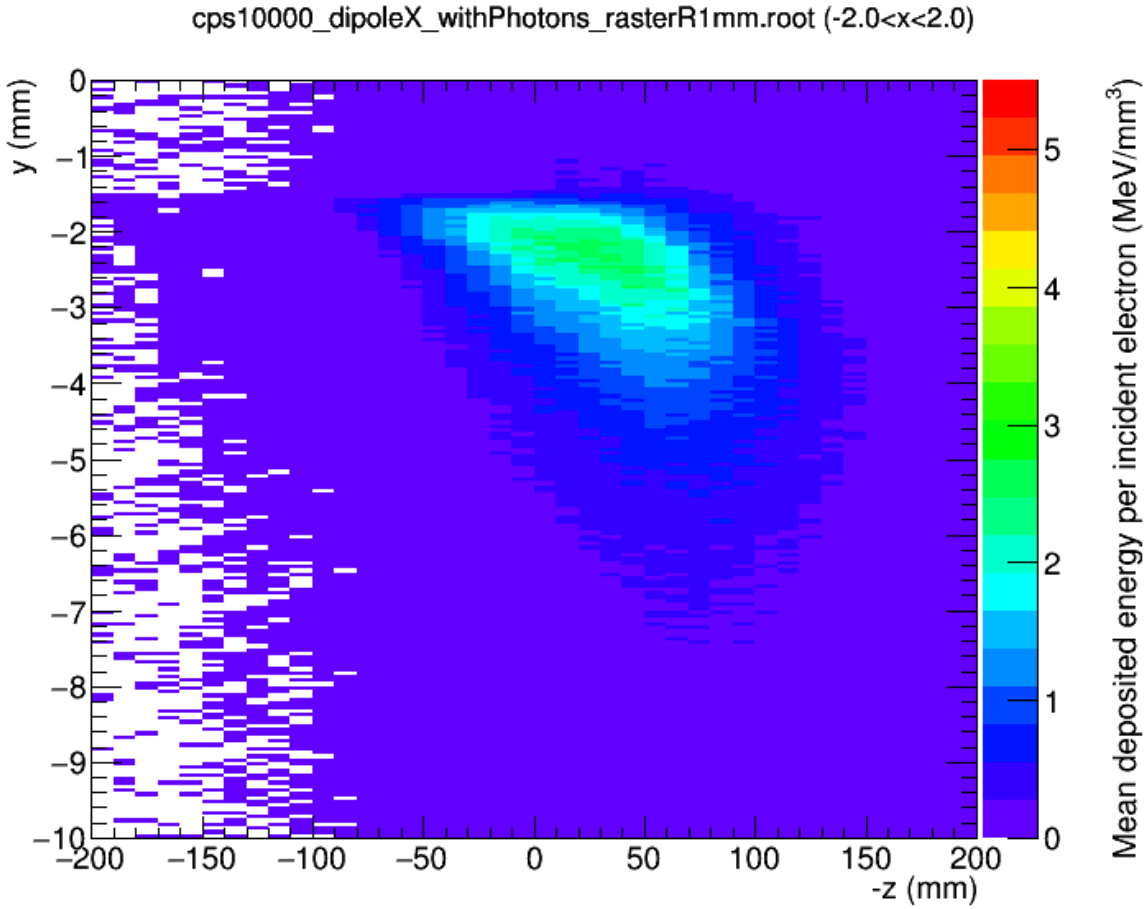
Marco got of the power profiles





Geant4 model (GEMC framework)

Marco got the snapshot for power profile



Geant4 model (GEMC framework)

Logical approach to optimization of the outer shielding:

What are the particle spectra?