Study the Compact Photon Source Radiation Using FLUKA

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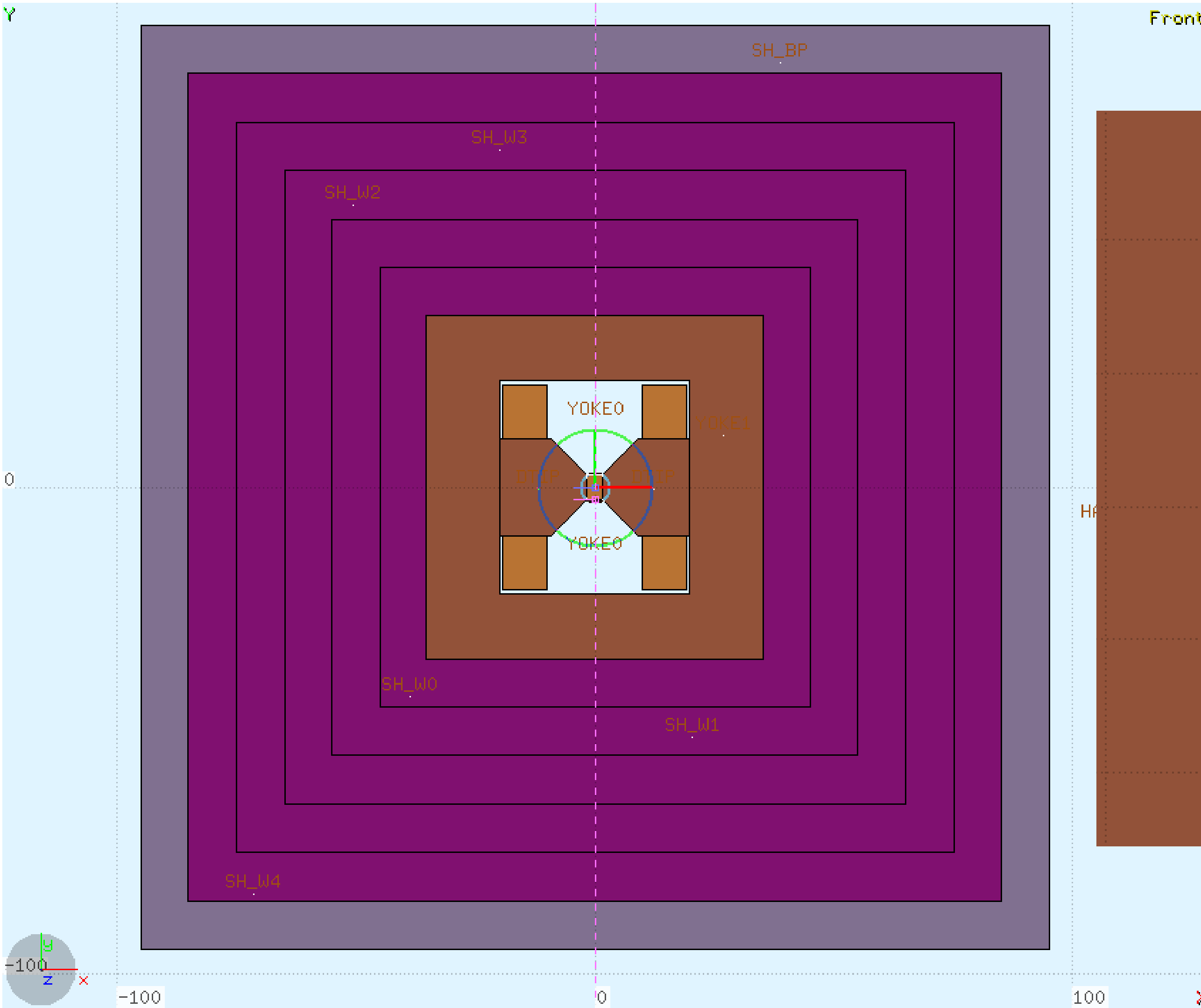
Outline

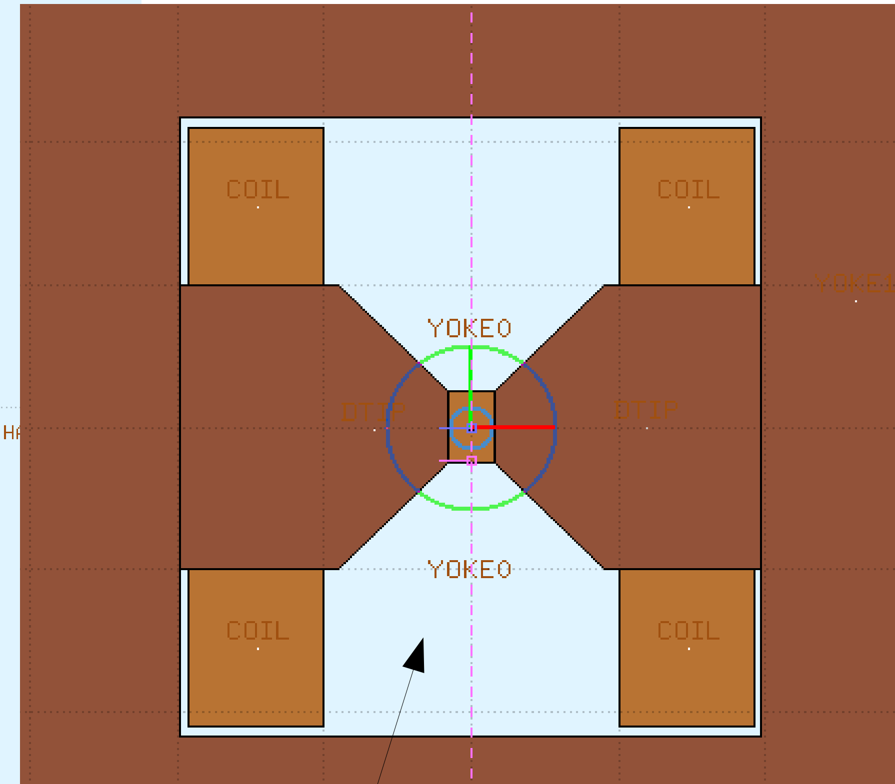
1) Geometry

2) FLUKA simulation result

3) Summary

Geometry: beam view





What material is this?

I add 10cm borated plastic shielding into this model. Which help a lot in reduce neutron flux.

Geometry: side view

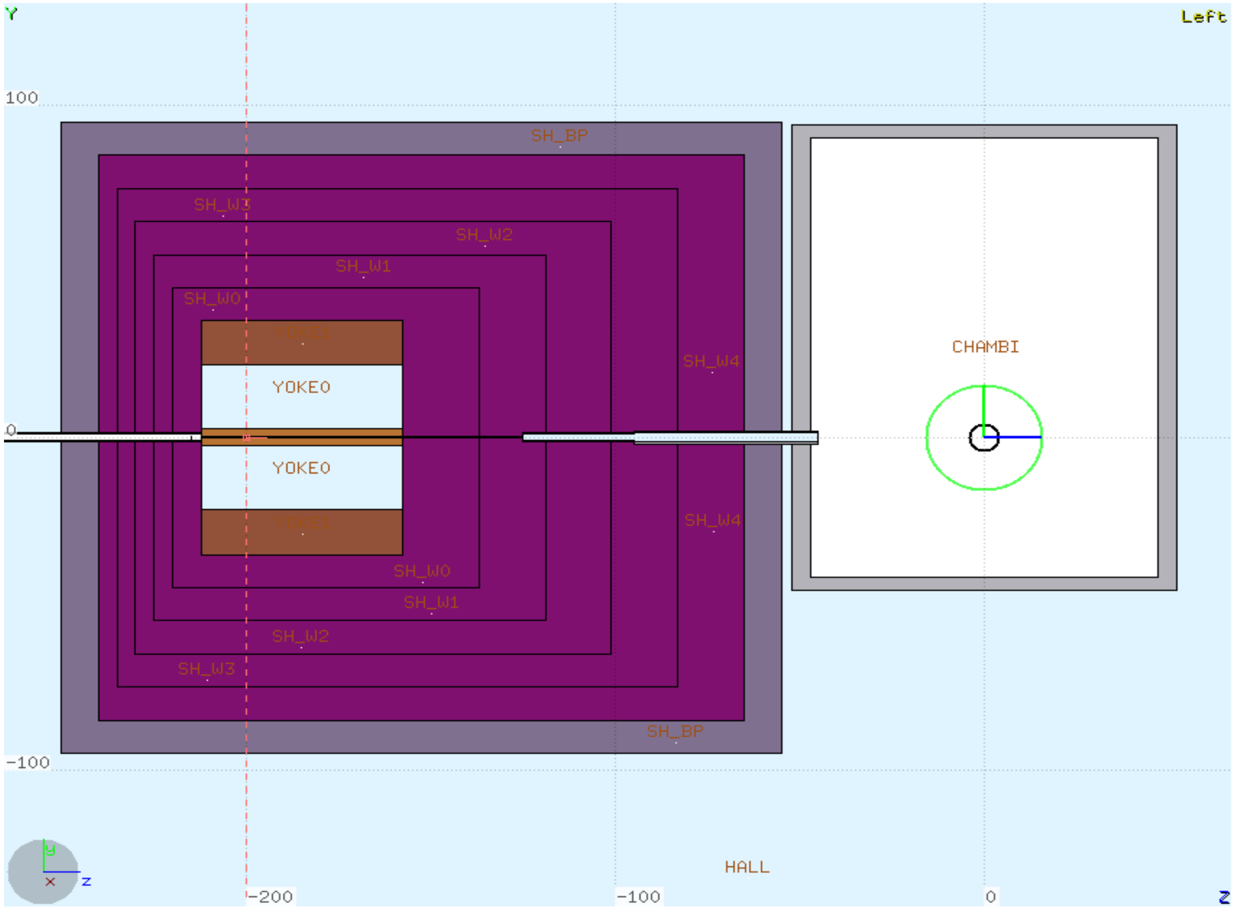
Correct some mistakes in Bogdan's original design:

1) NO plastic shielding layer.

→ Add 10cm thick of borated plastic in each side.

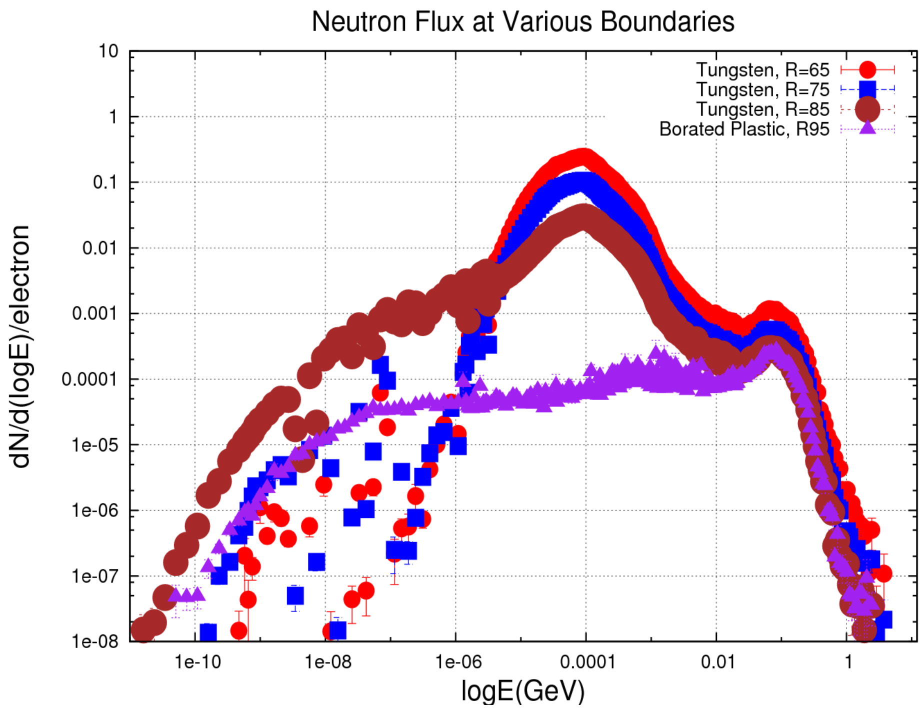
2) Under estimate the size of target chamber or the distance of entrance window to target center. No space for plastic layer.

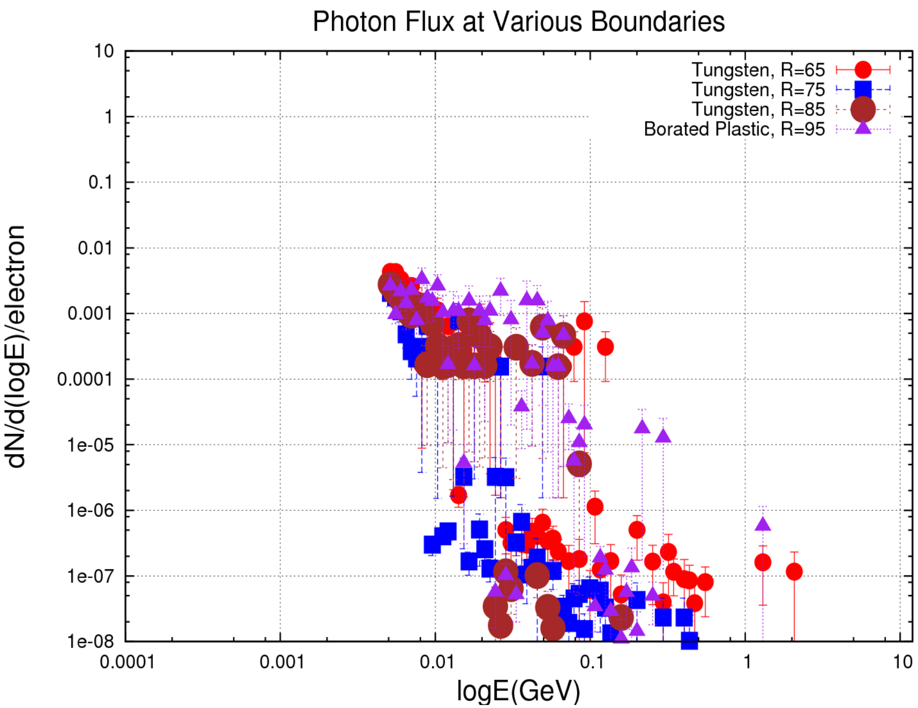
→ Move the whole thing 15cm upstream. Radiator is now 215 cm to target.



Dipole Yoke: (70.5cm x 70.5cm x 54.5cm)
Core: pure copper
Slot: 3mm(width) x 3mm(height)
Shielding: tungsten powder, 16g/cm^3, (5 layers)+ 10cm 30% borated plastic (1 layer). Shielding thickness is 92.75cm, 49.75cm and 27.75cm in downstream, side and upstream direction.
Radiatior: 10%, copper, located at z=-215cm
Beam raster:2mm x 2mm

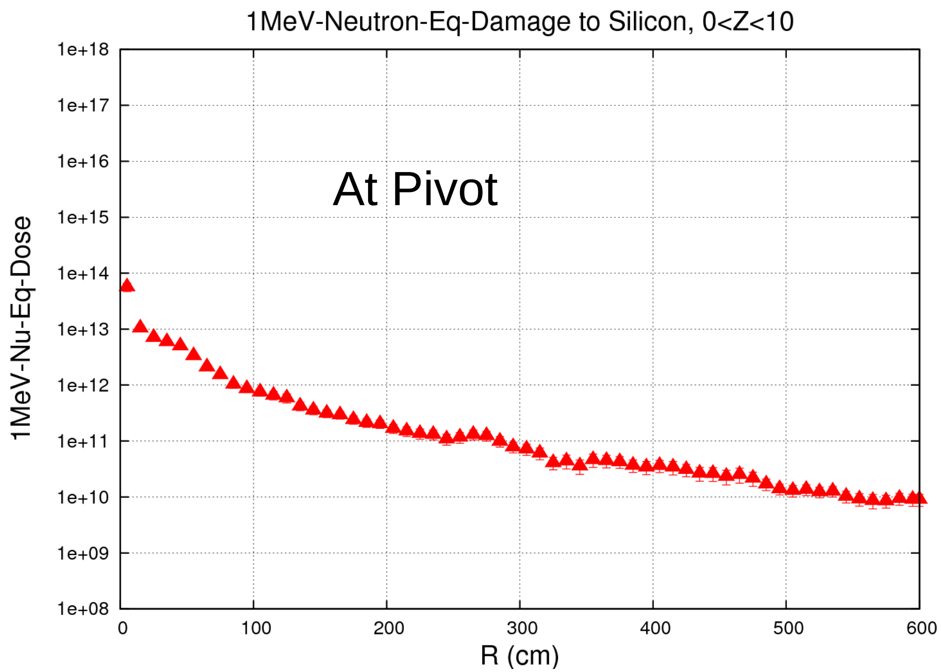
Neutron and Photon Fluence

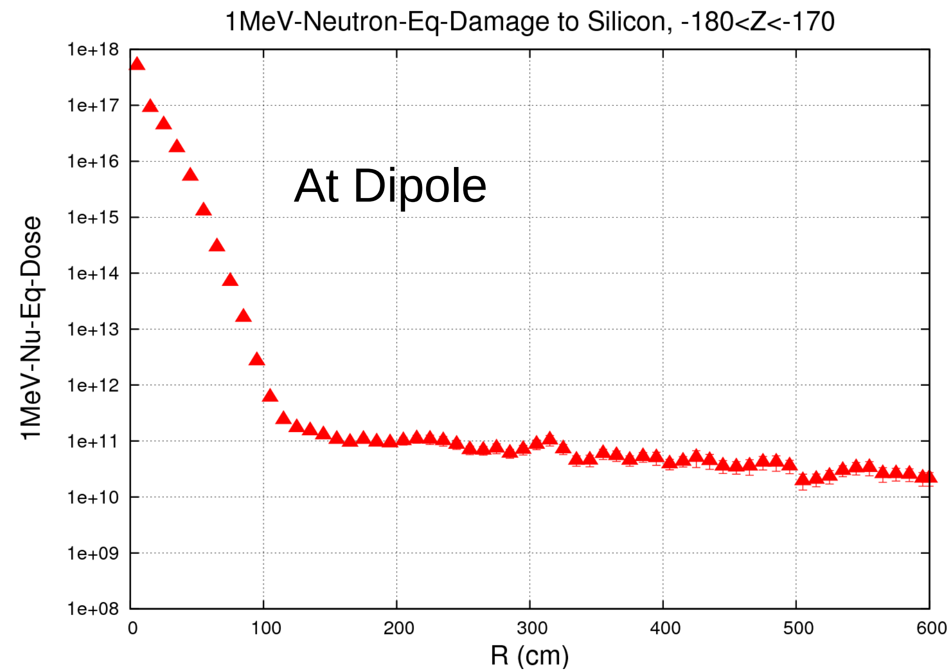




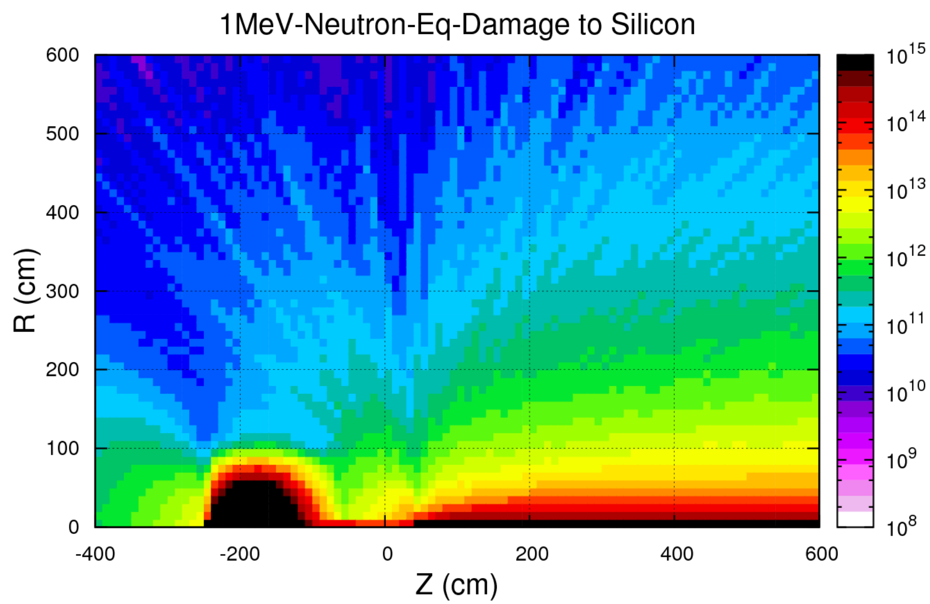
E=11 GeV, 2.7uA
10cm 30% borated plastic layer will reduce neutron flux a lot.

1 MeV Neutron Equivalent Damage

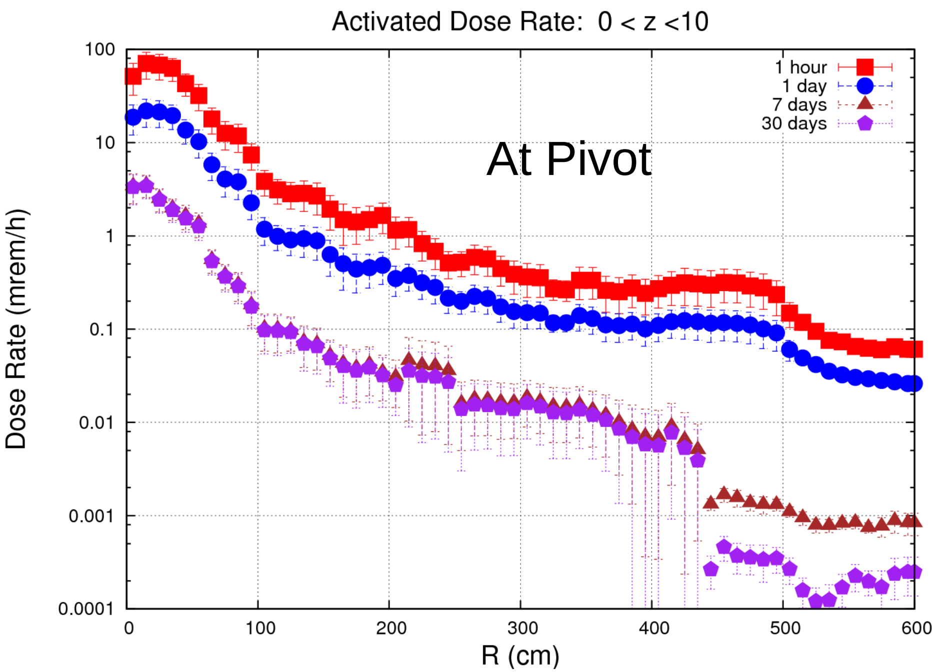


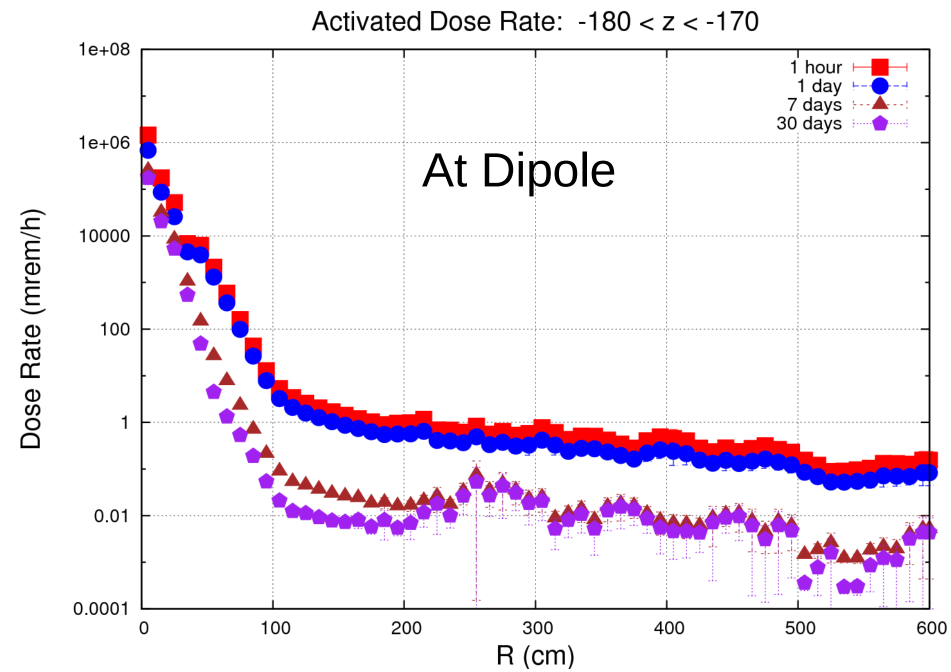


1000 hours of 2.7uA beam @ 11 GeV

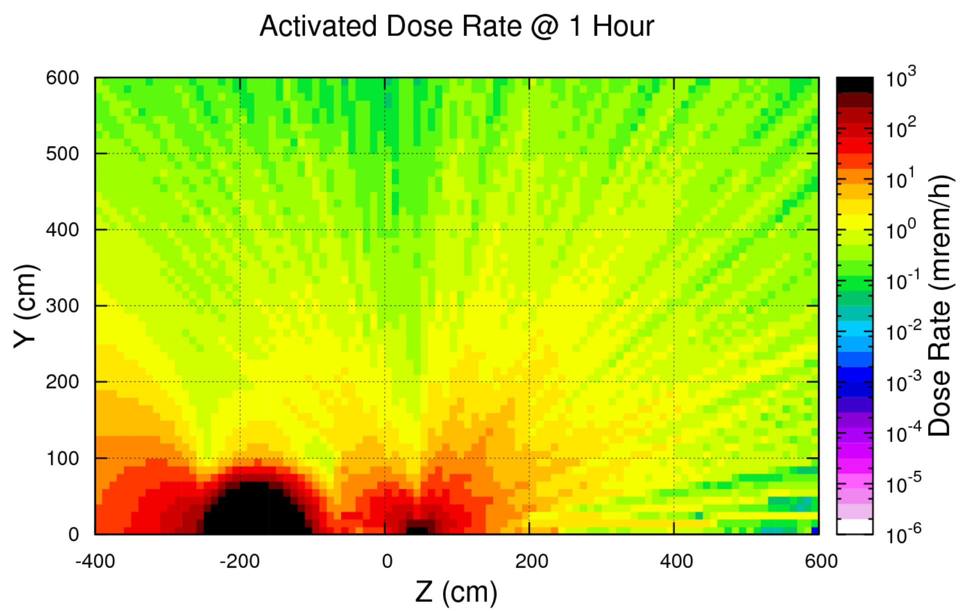


Dose Rate from Activation

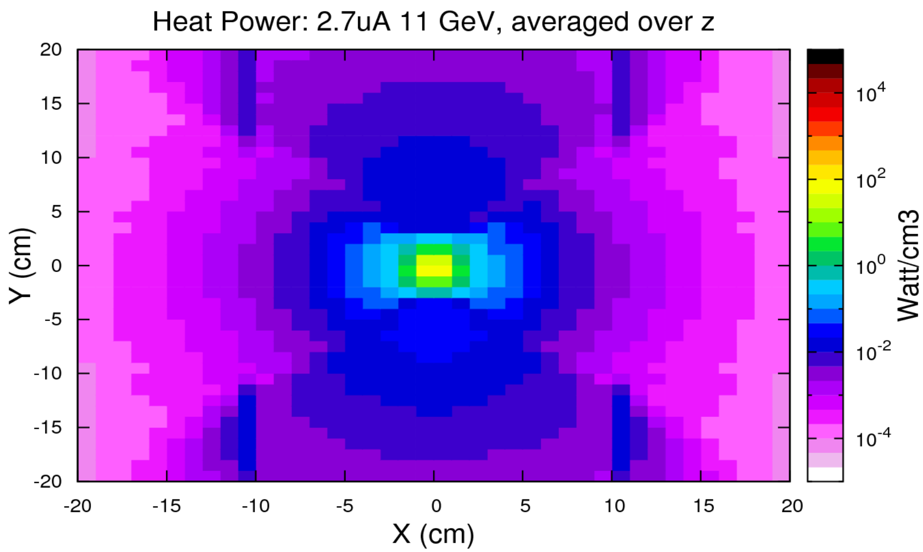


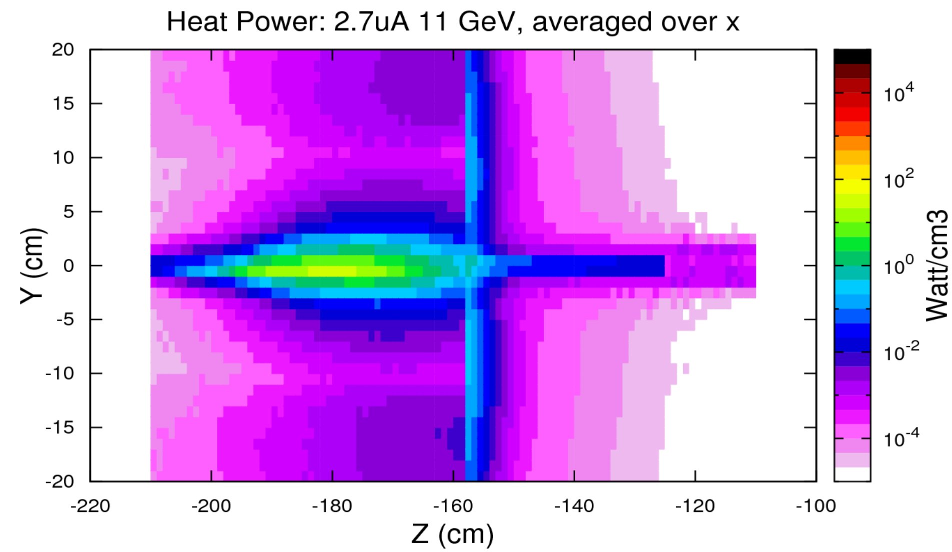


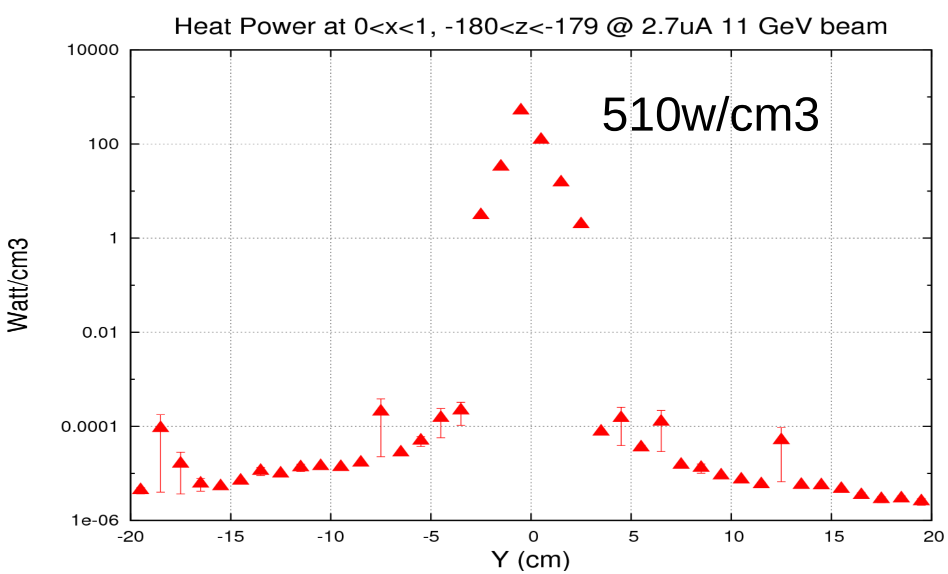
1000 hours of 2.7uA beam @ 11 GeV

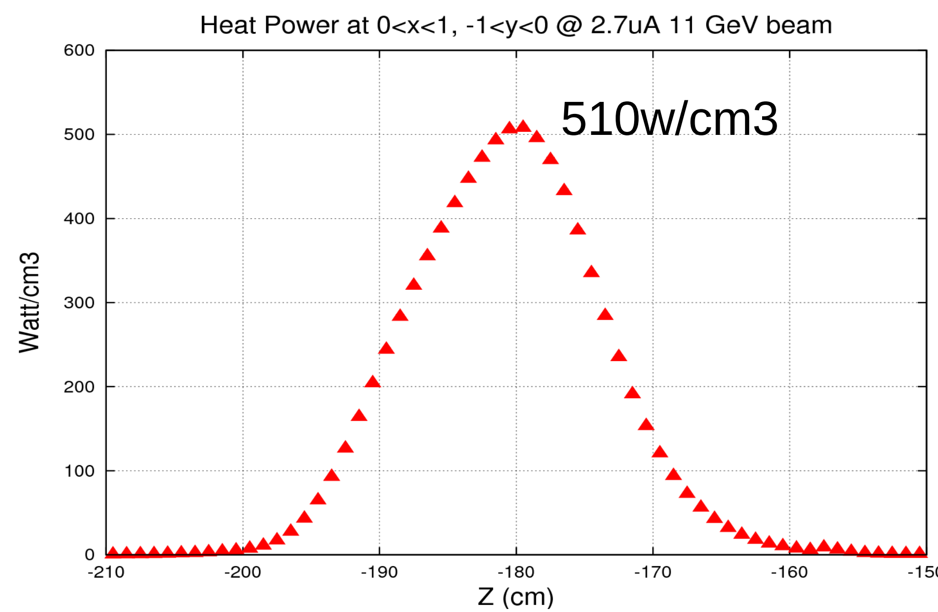


Heat Power









2.7uA beam @ 11 GeV

Summary

1) FLUKA simulation has been performed assuming 1000 hours of 2.7 uA electron beam at 11.0 GeV. In this setup, the pivot is 215 cm to the 10% radiator. The core is made of pure copper.

2) The maximum heat density in the core is ~510 watt/cm^3.

3) 10 cm borated plastic shielding is very helpful to reduce neutron flux.

4) After 1000 hours, the accumulated 1-MeV-Nu damage to silicon at pivot (z=0) is less than 10^13 at 20cm away from beam line. Outside the borated plastic layer is several 10^11.

5) Dose rate from activation after the beam is shut down for 1 hour: at the pivot is ~70 mrem/h, 1.0m away from pivot is ~5mrem/h, at 1.0m away from the dipole is about 10 mrem/h.