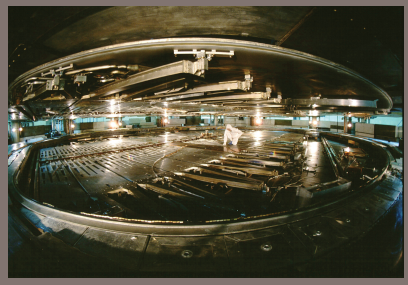
TRIUMF

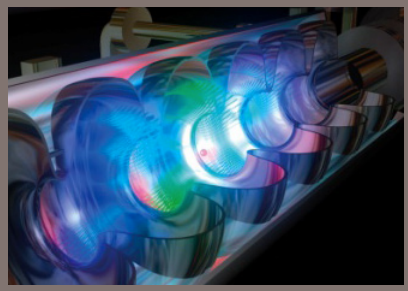
Canada's National Laboratory for Particle and Nuclear Physics
Laboratoire national canadien pour la recherche en physique nucléaire
et en physique des particules

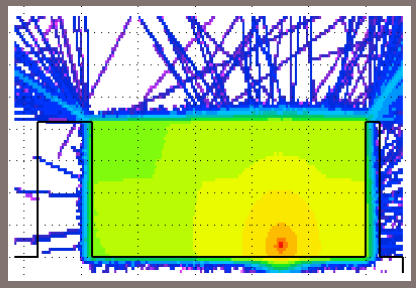
Shielding for TRIUMF's new High-Power Electron LINAC

1st FLUKA Advanced Course and Workshop, Portugal, 2010.

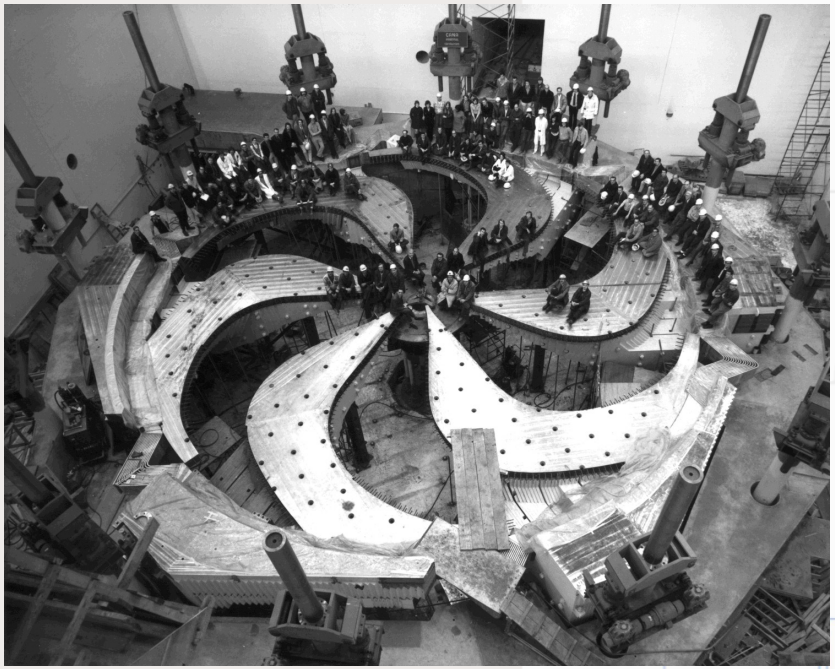
Mike Trinczek | TRIUMF

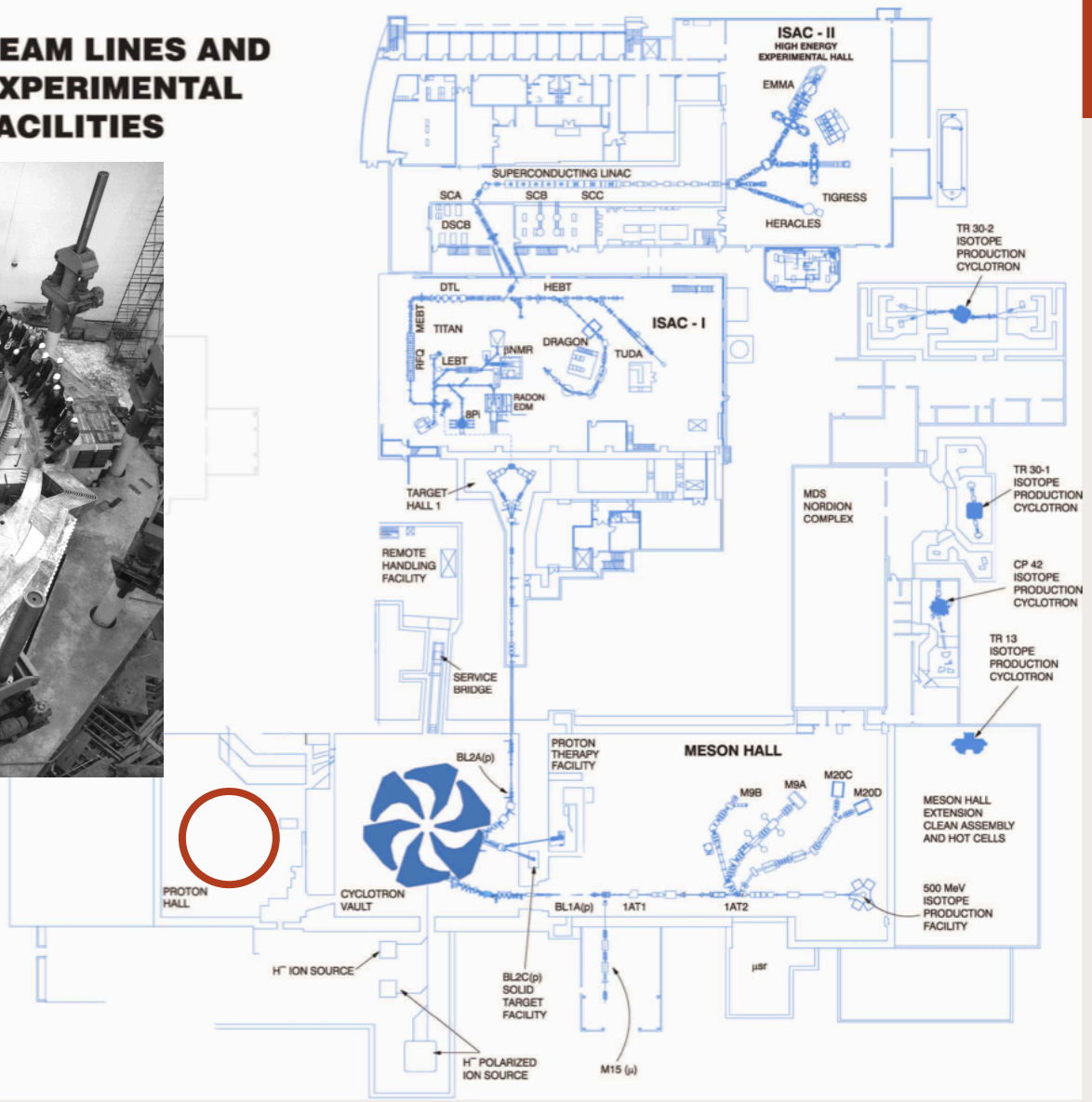




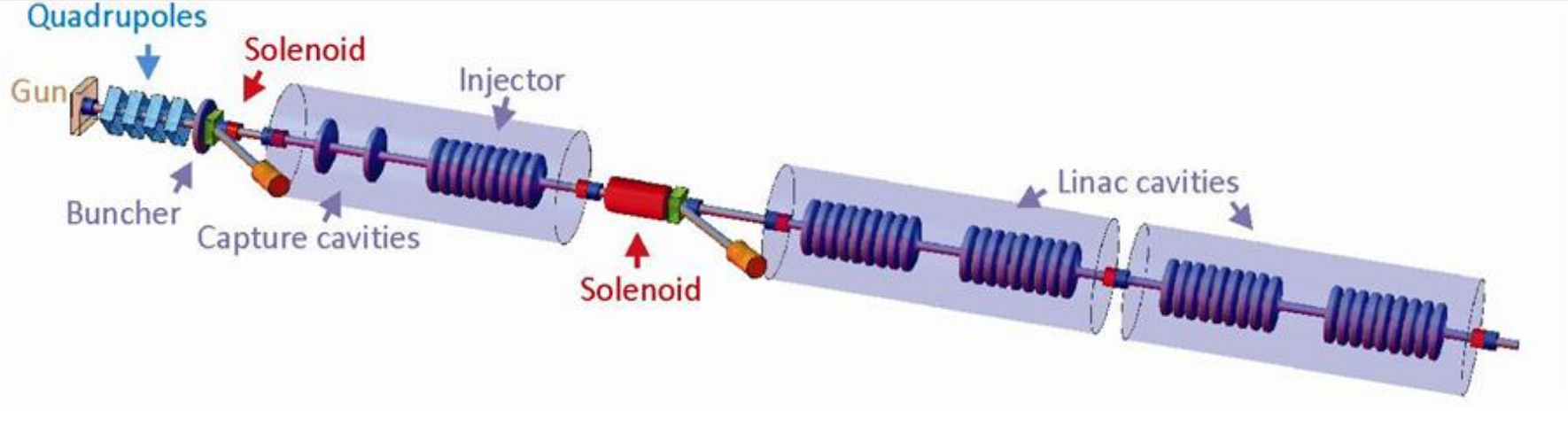


BEAM LINES AND EXPERIMENTAL FACILITIES



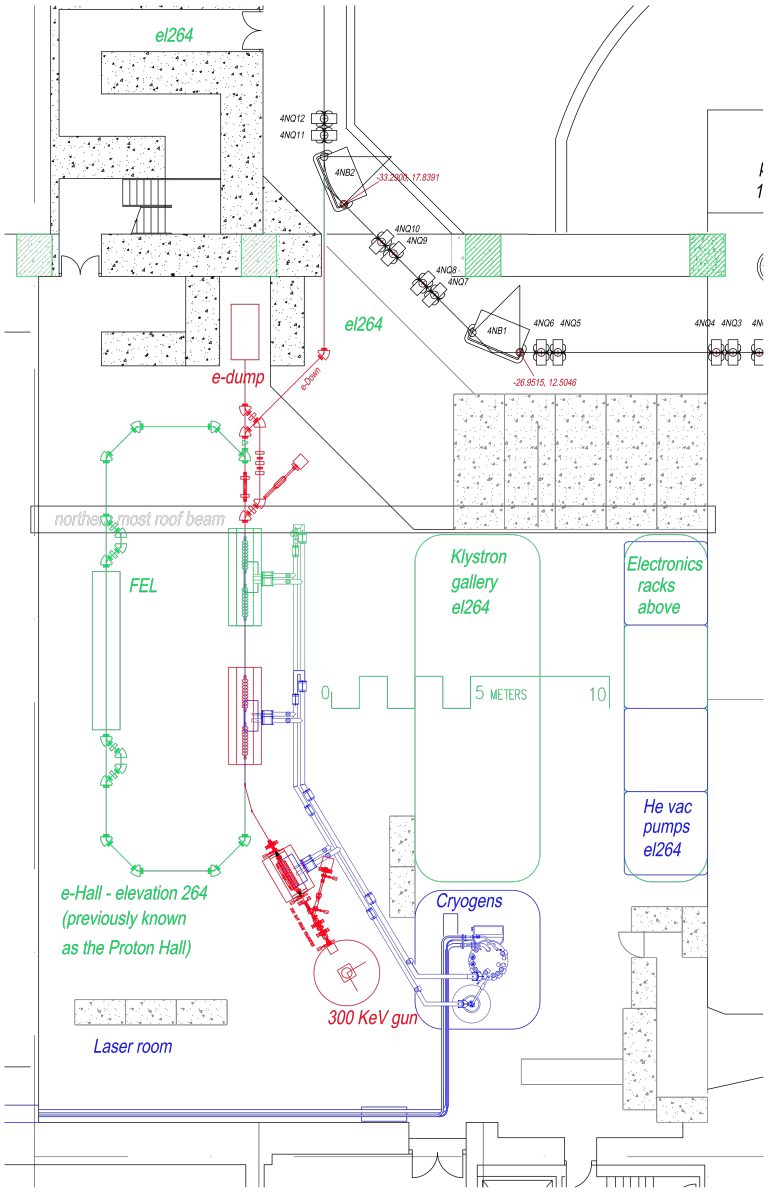


eLINAC



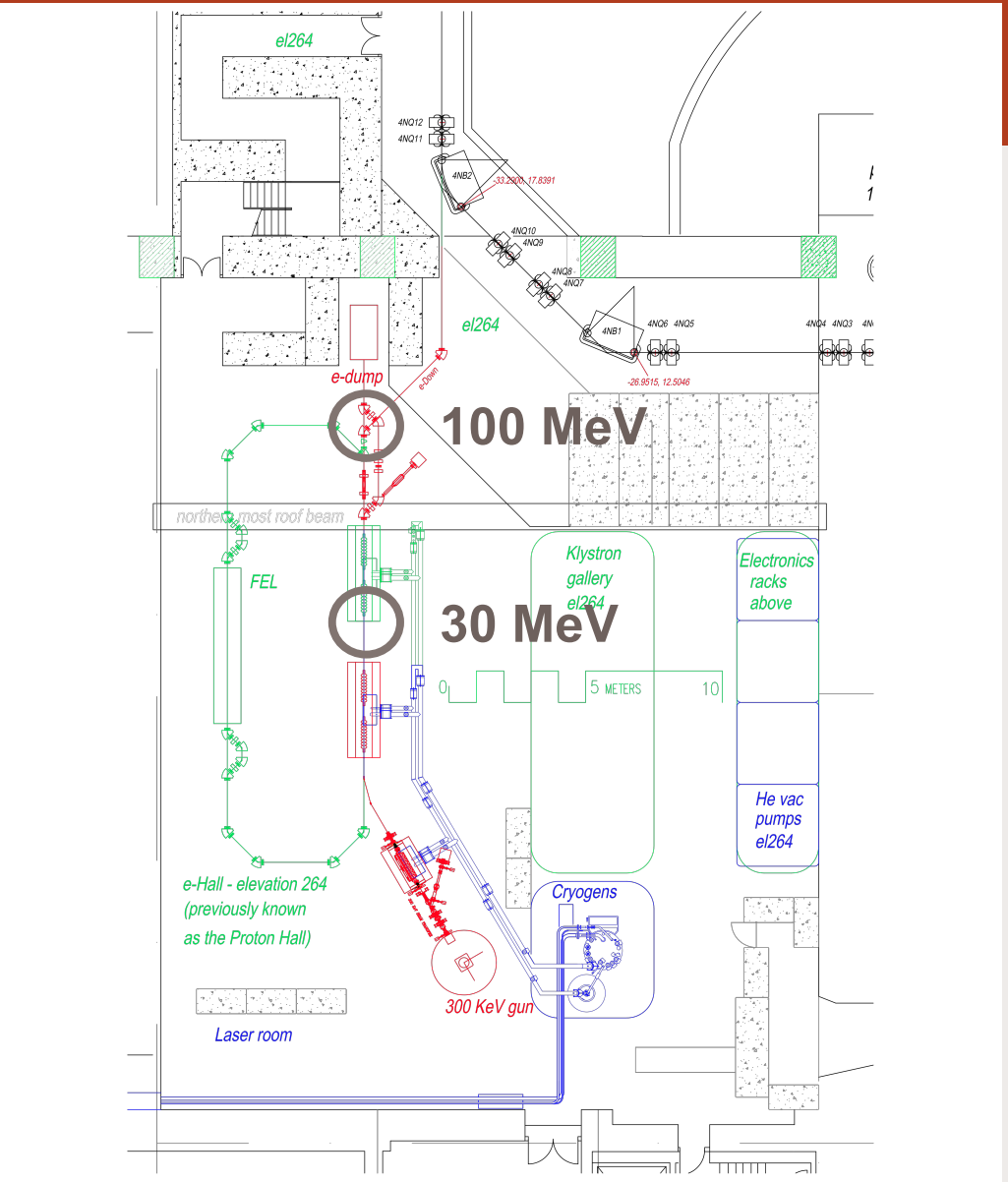
- 50 MeV, 10 mA, CW (100 MeV, 5 mA)
- 3-stage acceleration
  - 10, 30, 50 MeV
- 500 kW beam power

eLINAC Vault



- Placed into existing vault – needs to be upgraded

eLINAC Vault

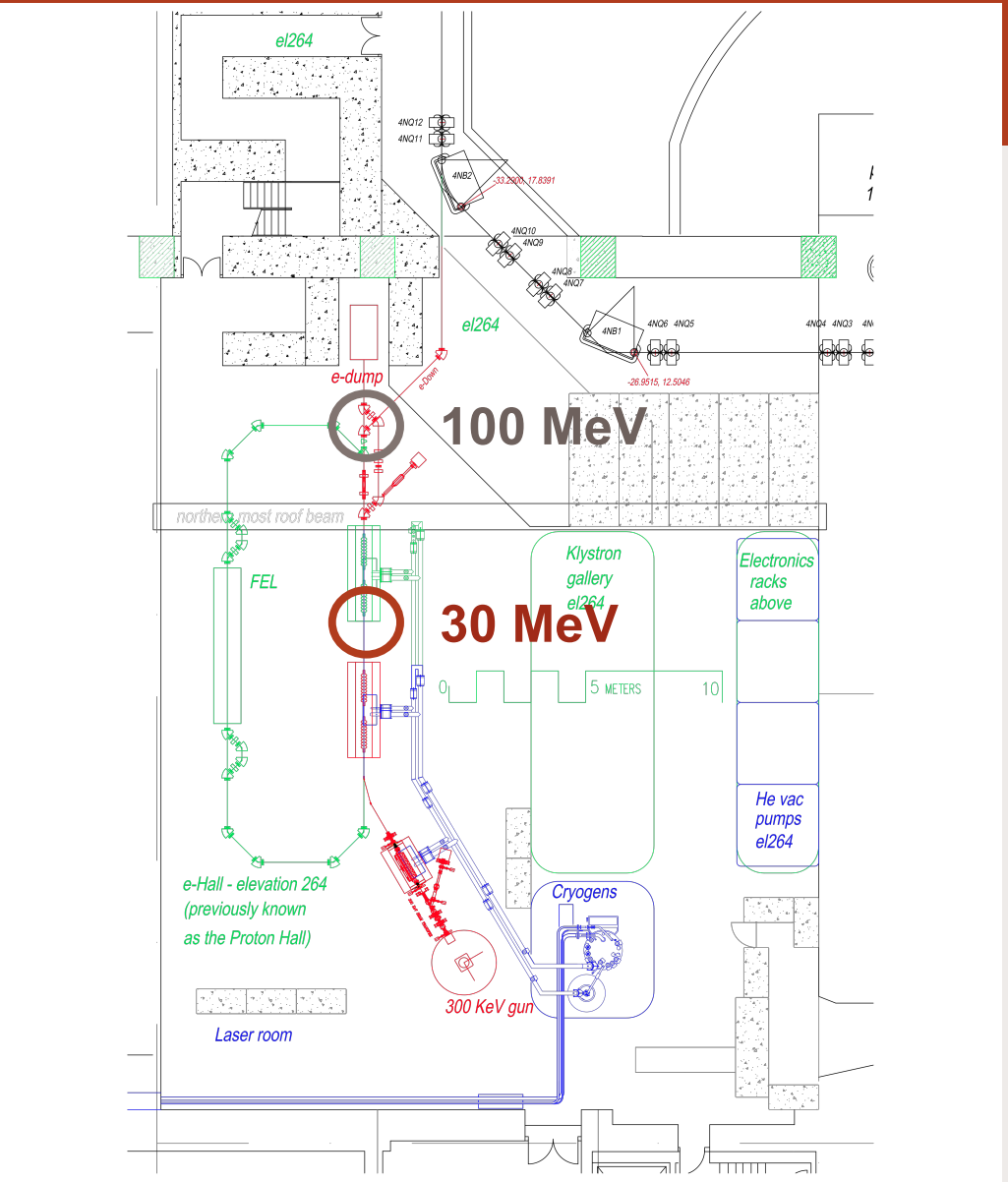


- 500 kW eLINAC
- Placed into existing vault – needs to be upgraded
- Two simulations:
  - 30 MeV
  - 100 MeV

Shielding Requirements

- TRIUMF policy:
  - Never higher than 1 Sv/hr (300 mSv/hr) at a potentially-occupied location
  - Occupancy level of 10 μSv/hr (5 μSv/hr)
  - Completely redundant monitoring system if a potentially-occupied location can exceed 50 mSv/hr
- Accelerator anticipated to have chronic losses better than 1 part in 10^4 (most likely 10^5)
- Shielding will be designed for accidental losses of ~50 mSv/hr and so will handle chronic losses of 5 μSv/hr

eLINAC Vault



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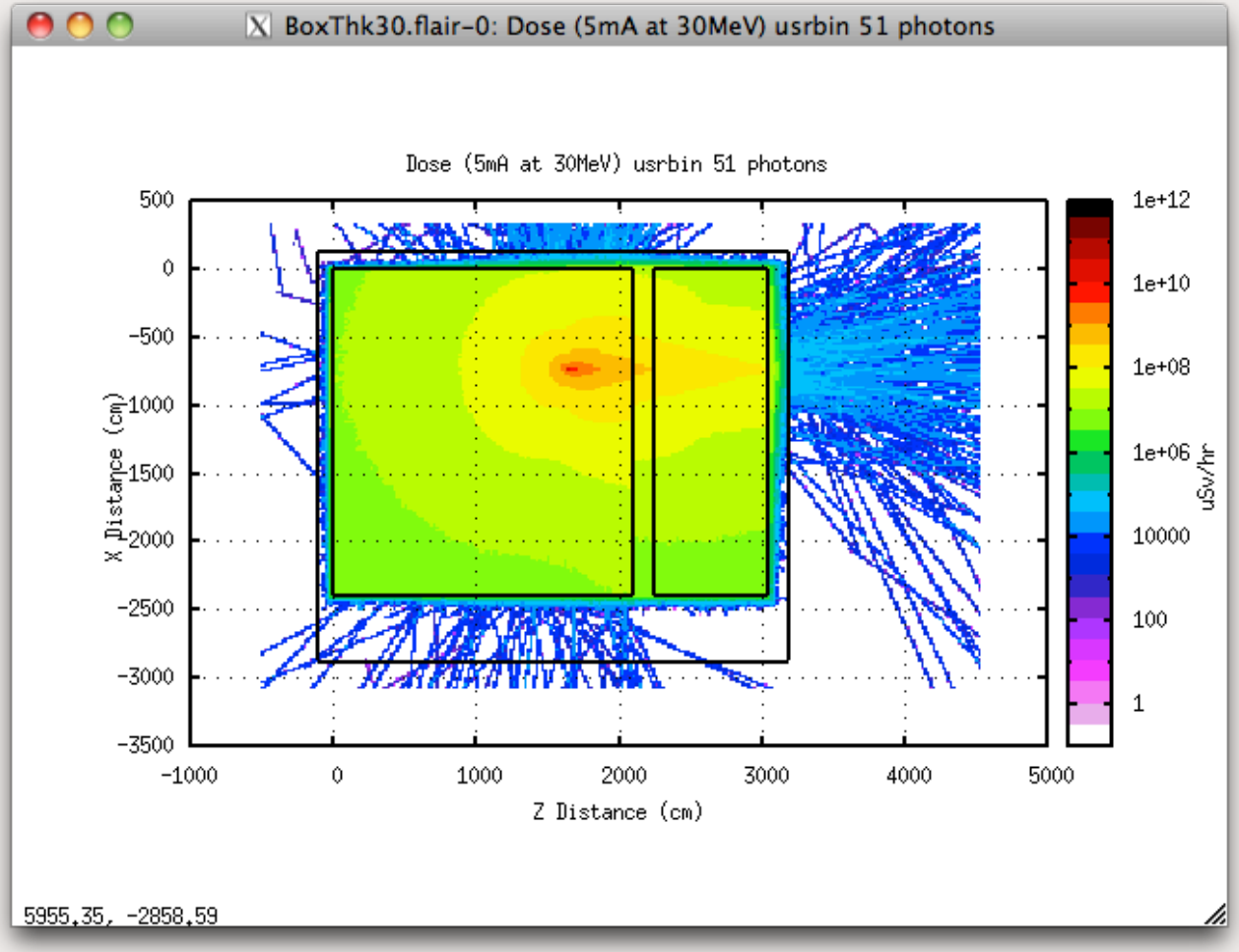
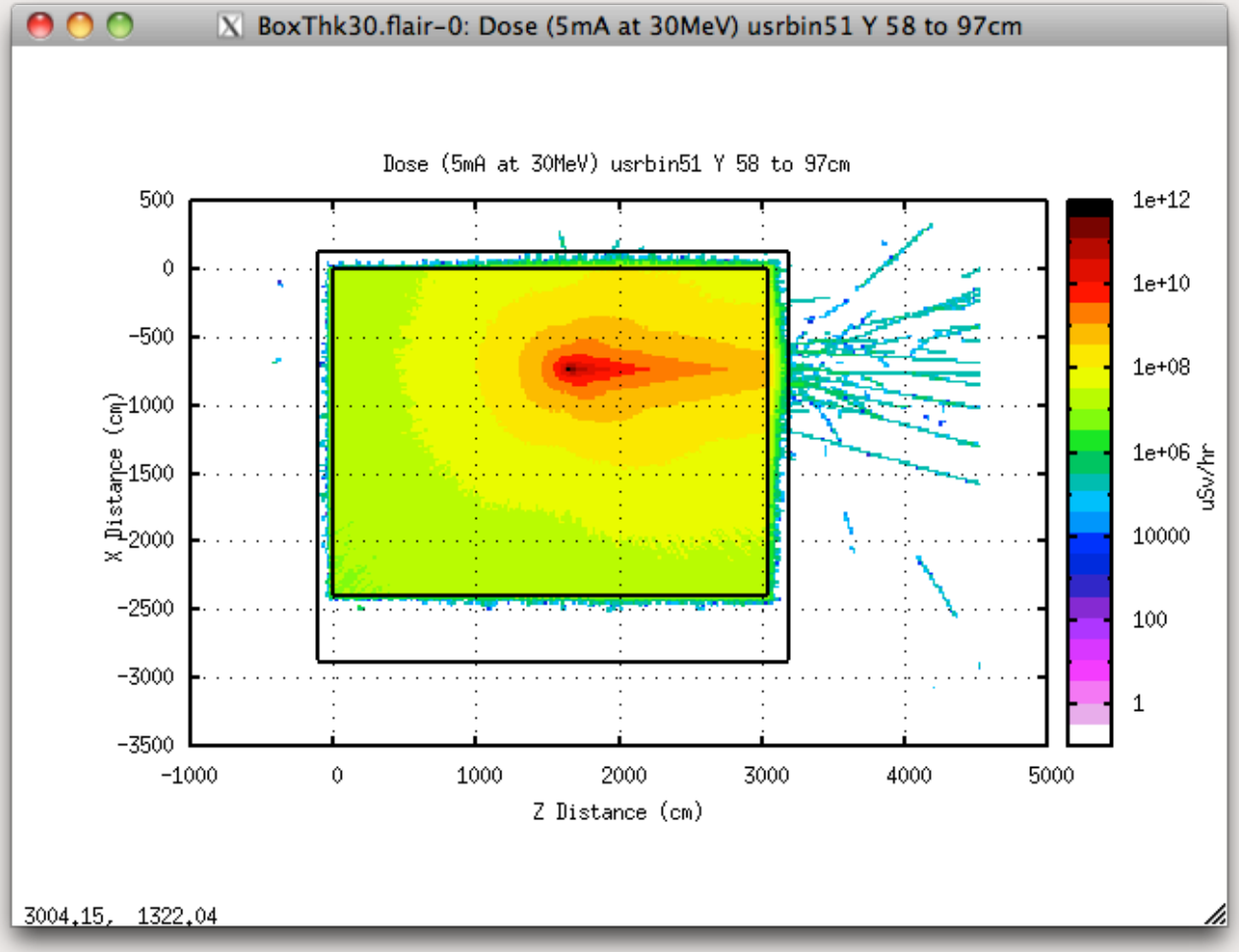
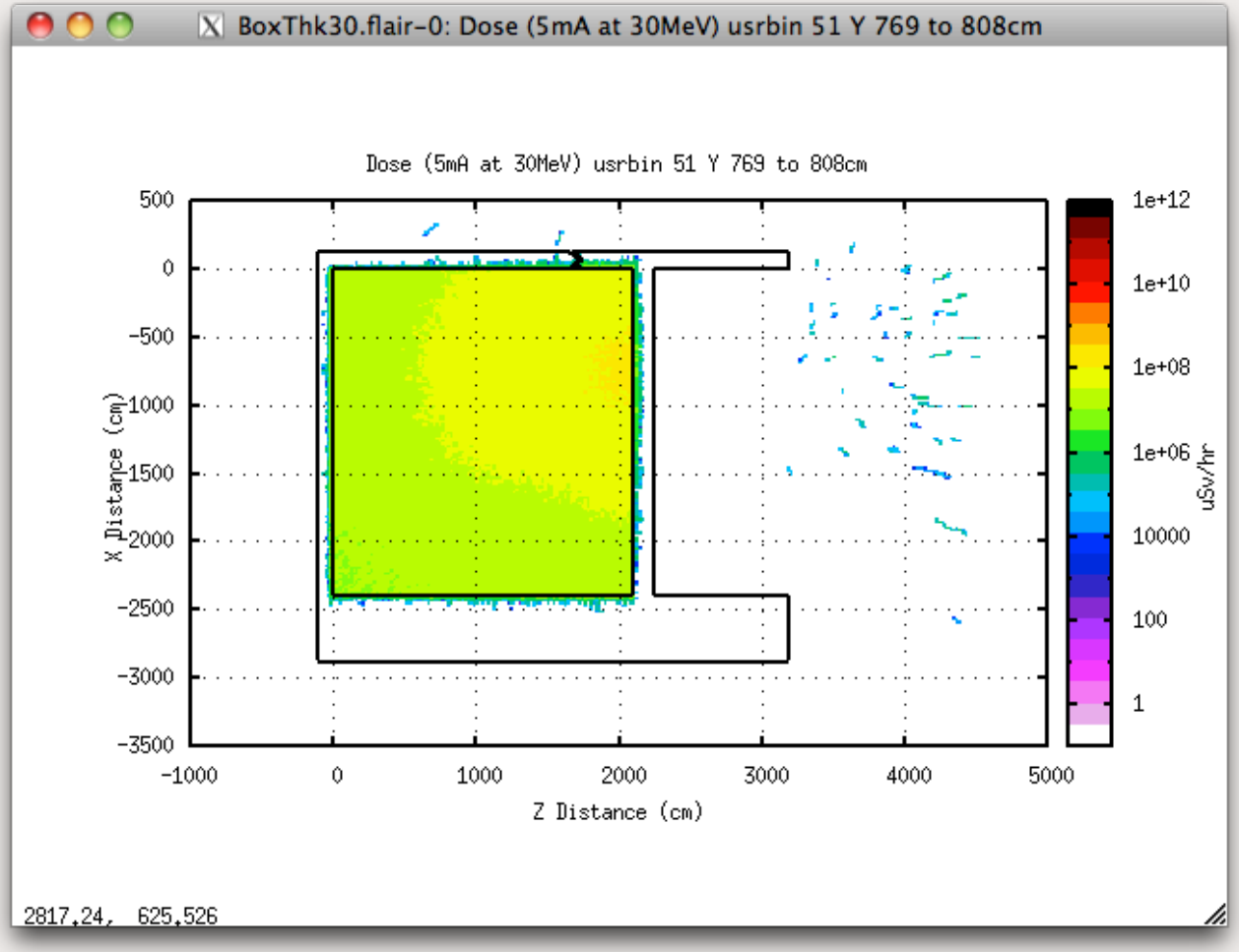
Top View 30 MeV



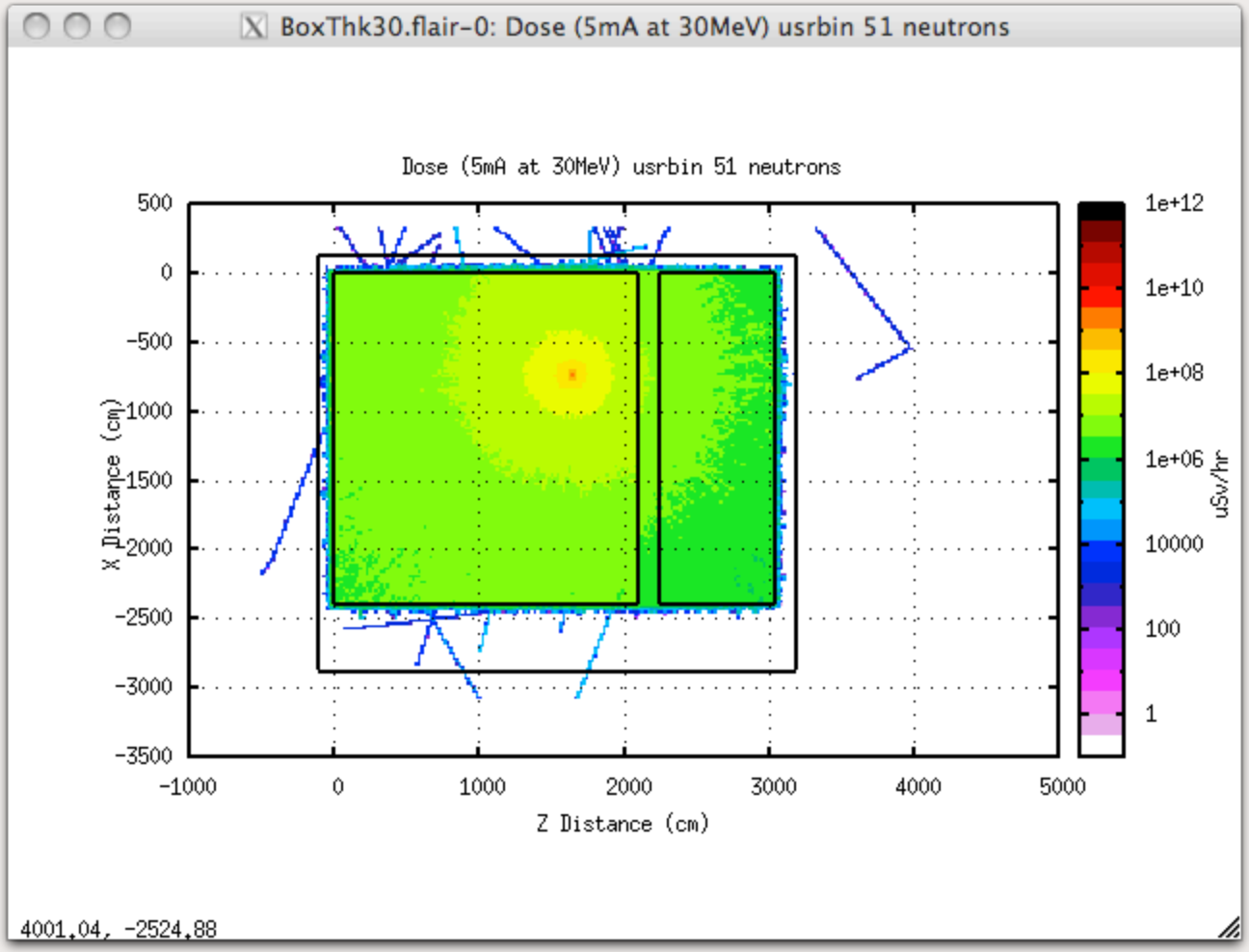
Top View 30 MeV



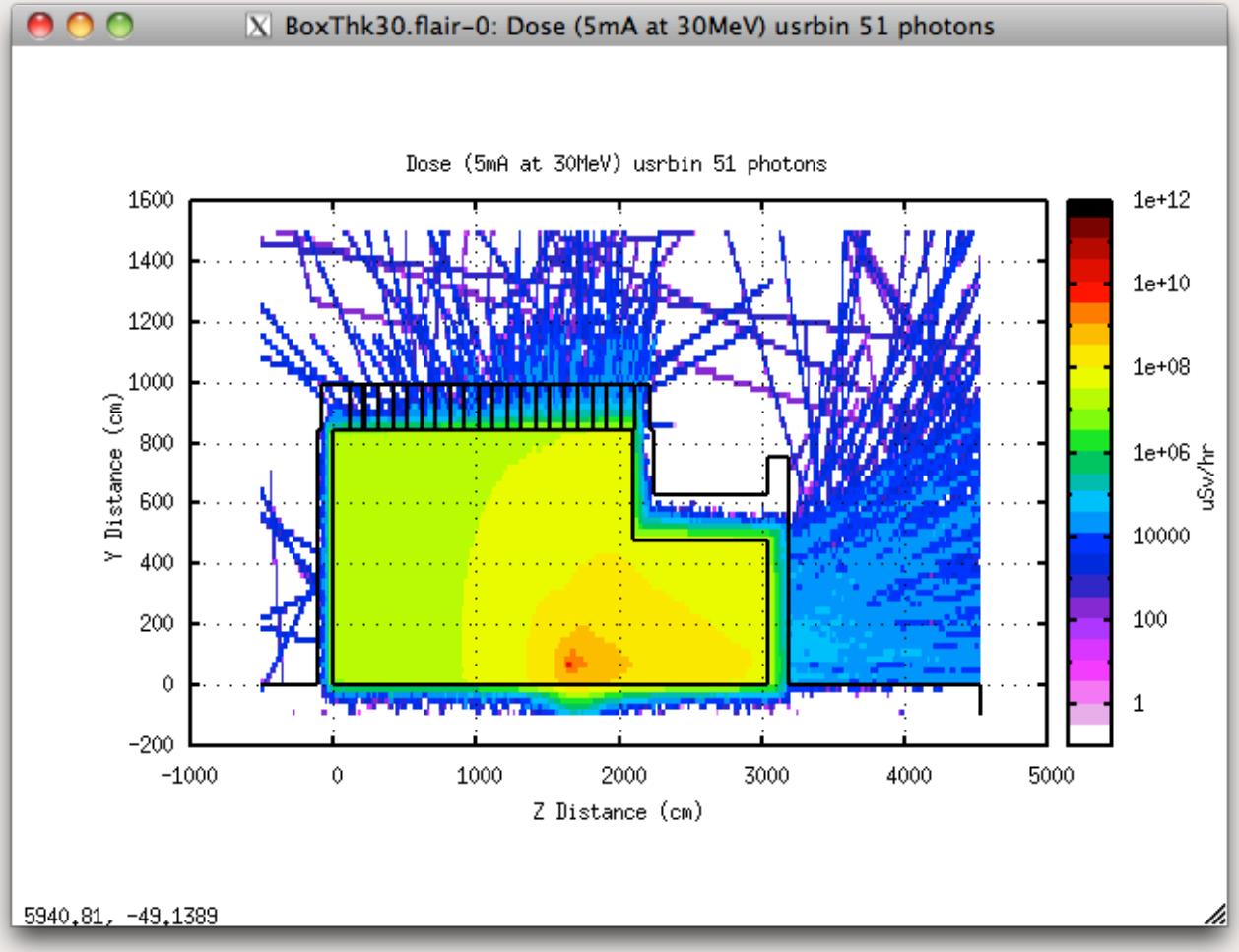
Top View 30 MeV



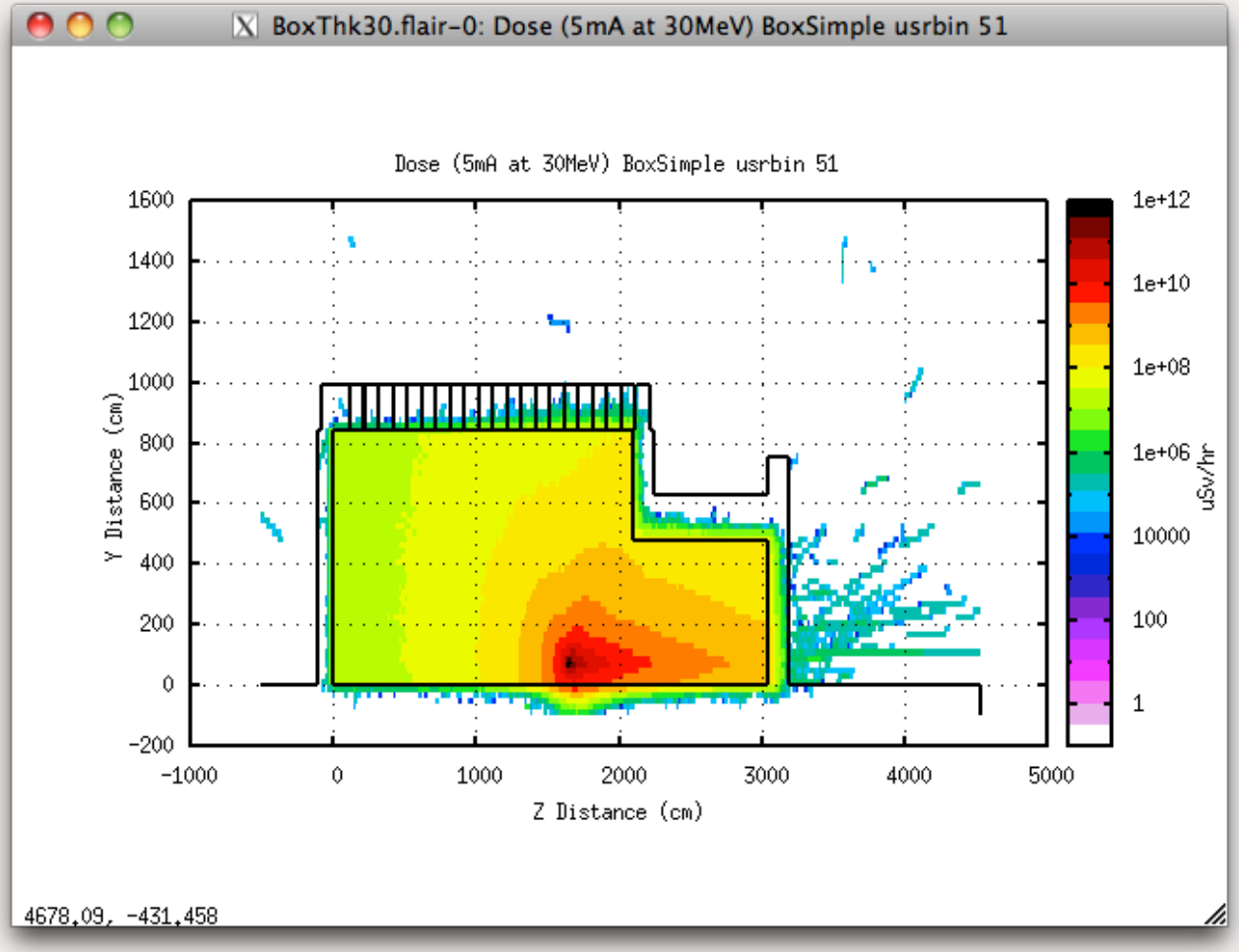
Top View 30 MeV



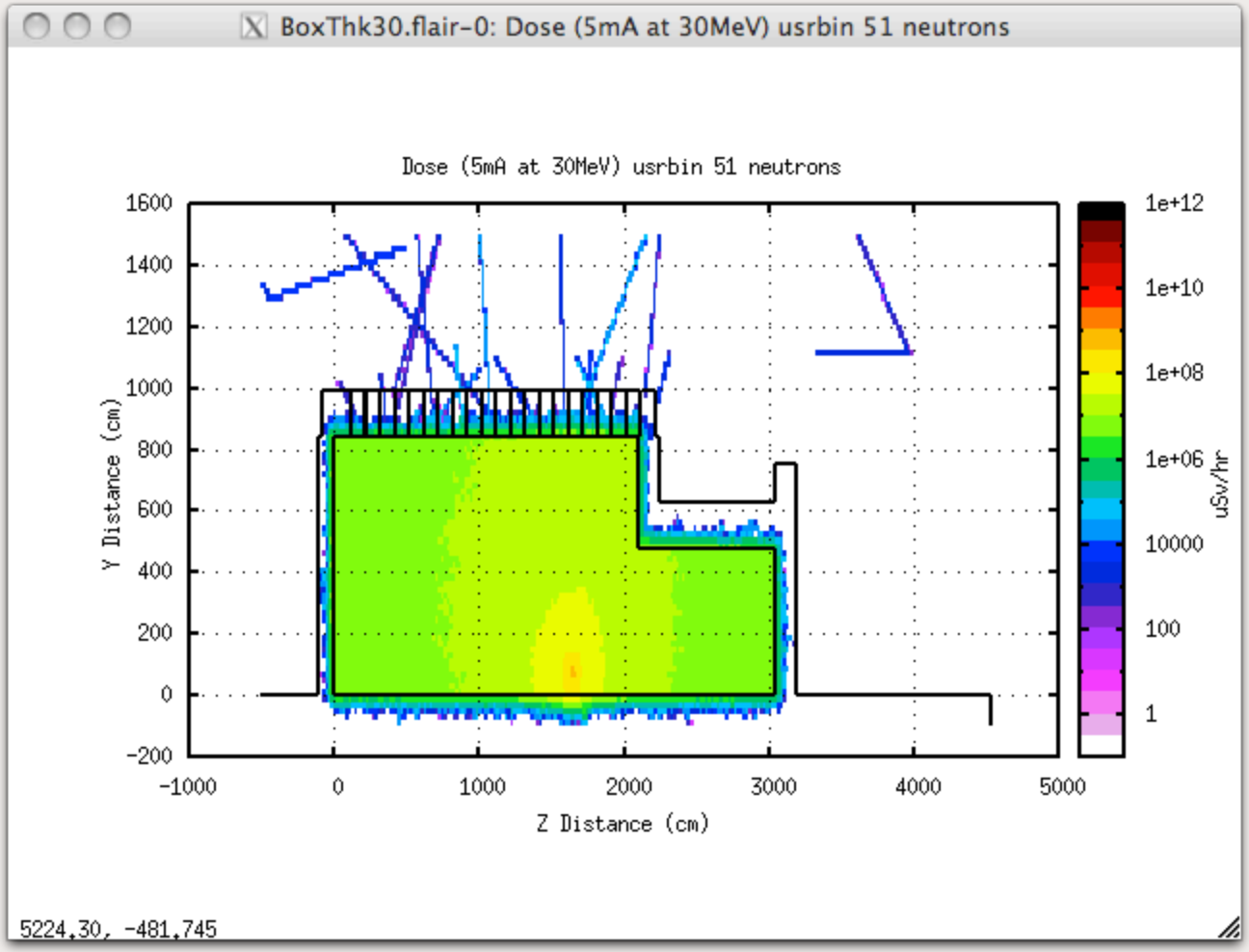
Side View 30 MeV



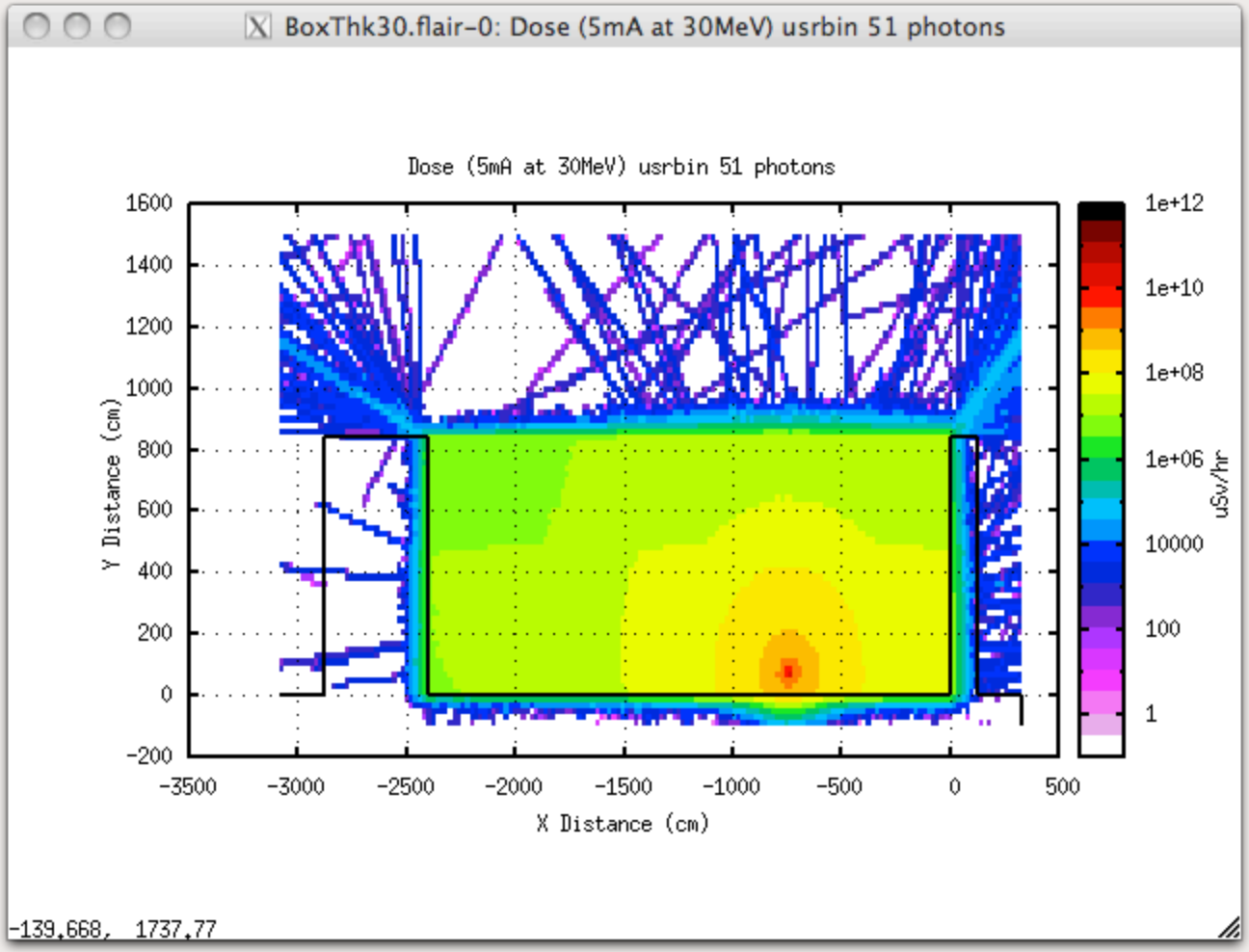
Side View 30 MeV



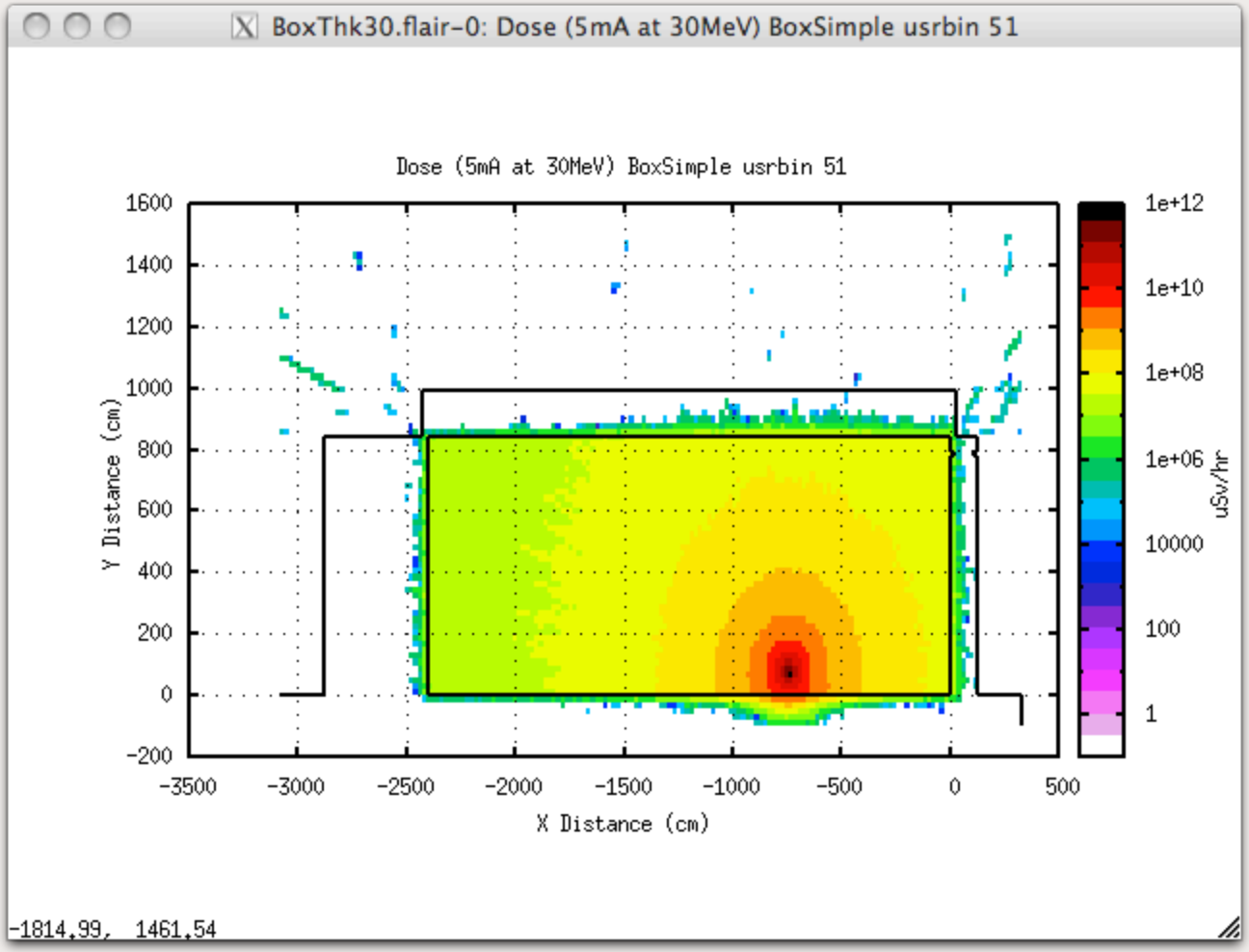
Side View 30 MeV



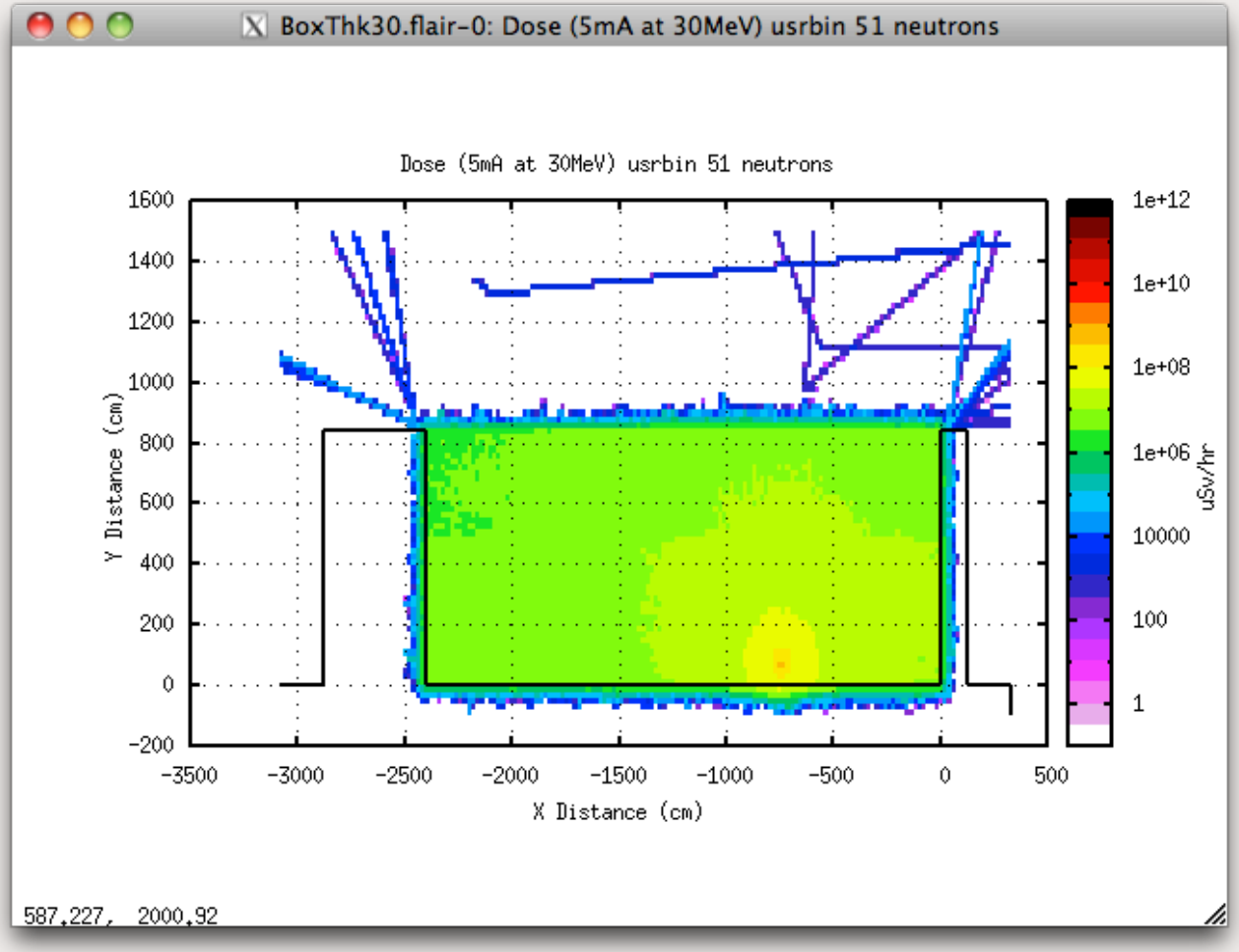
End View 30 MeV



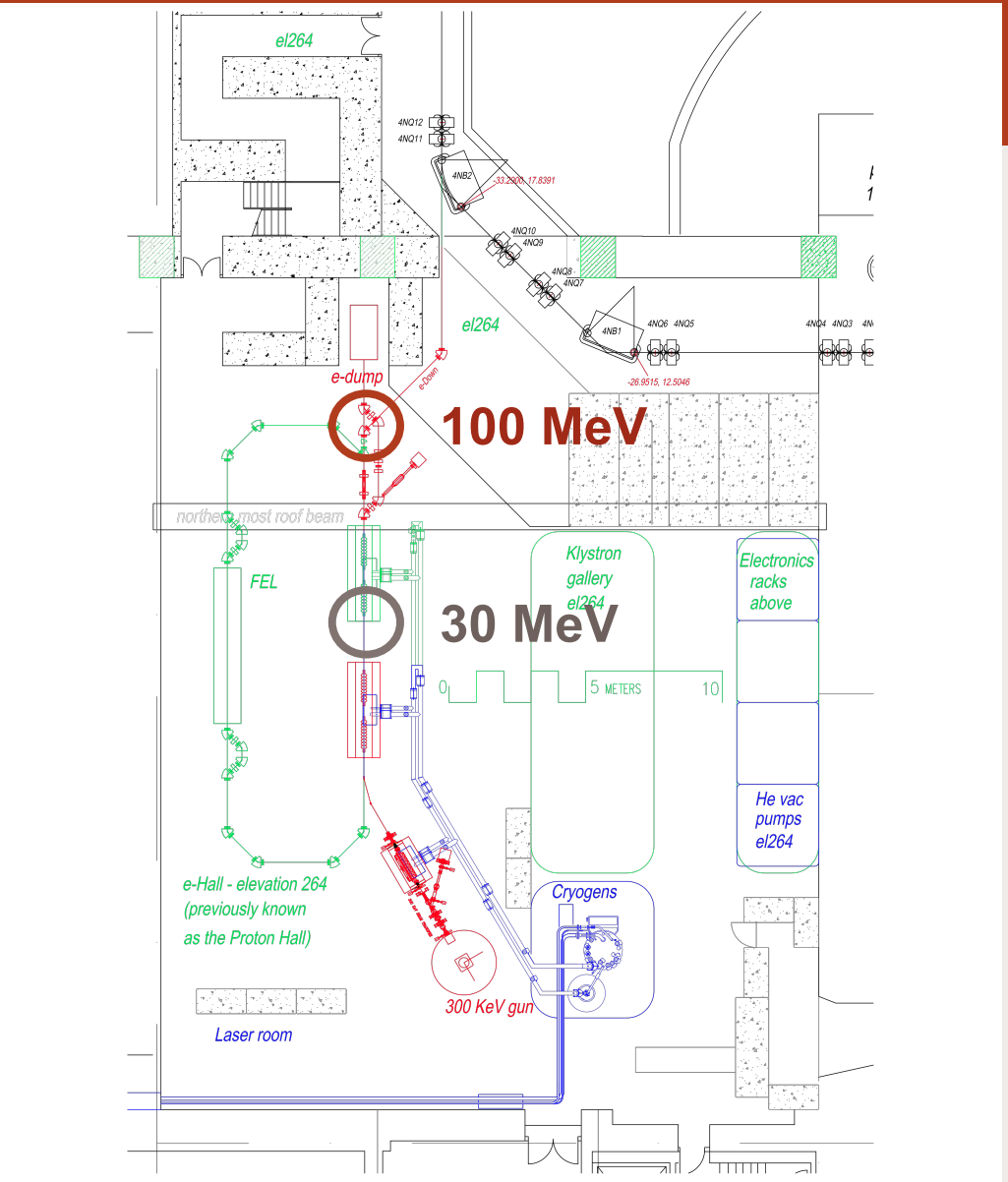
End View 30 MeV



End View 30 MeV



eLINAC Vault



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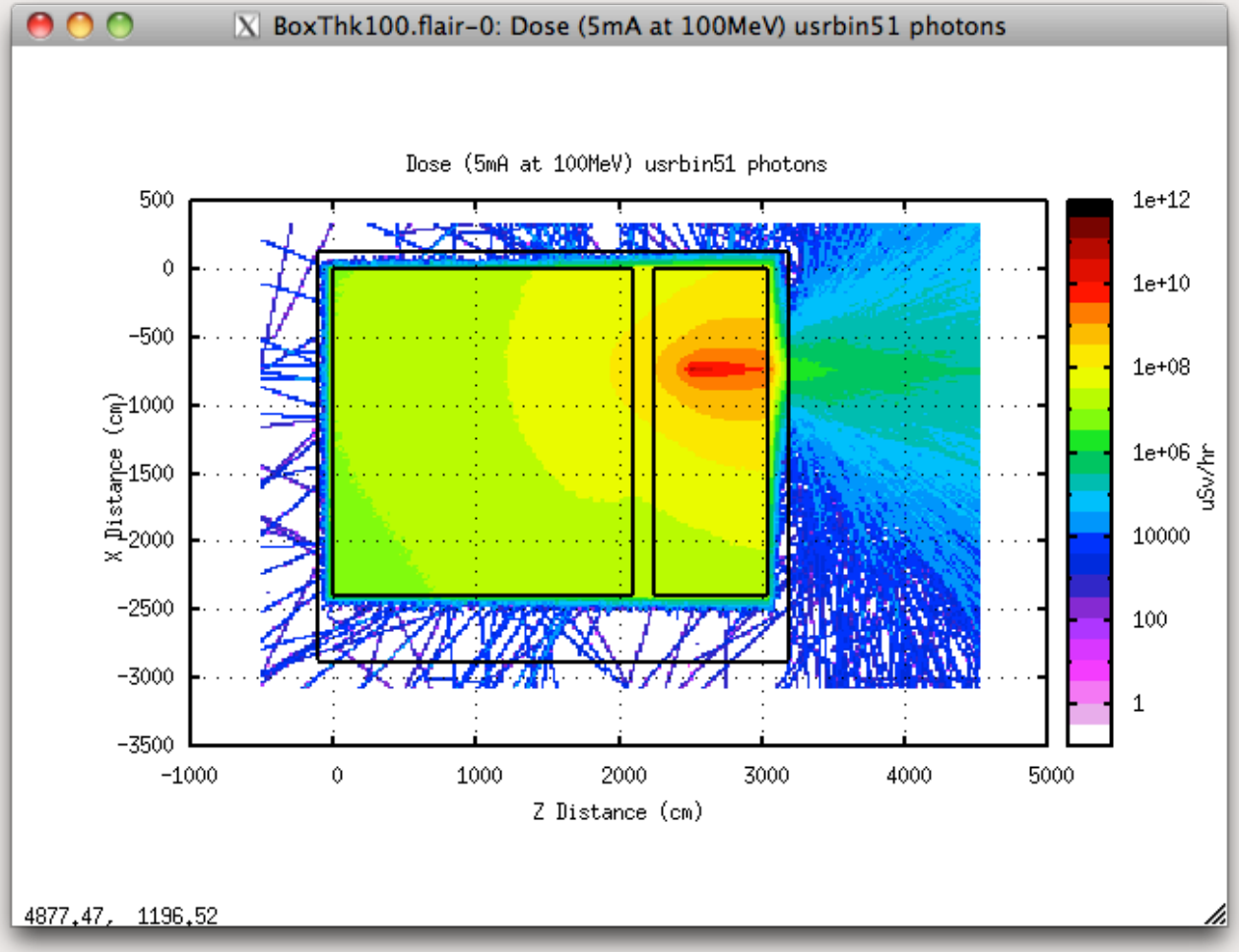
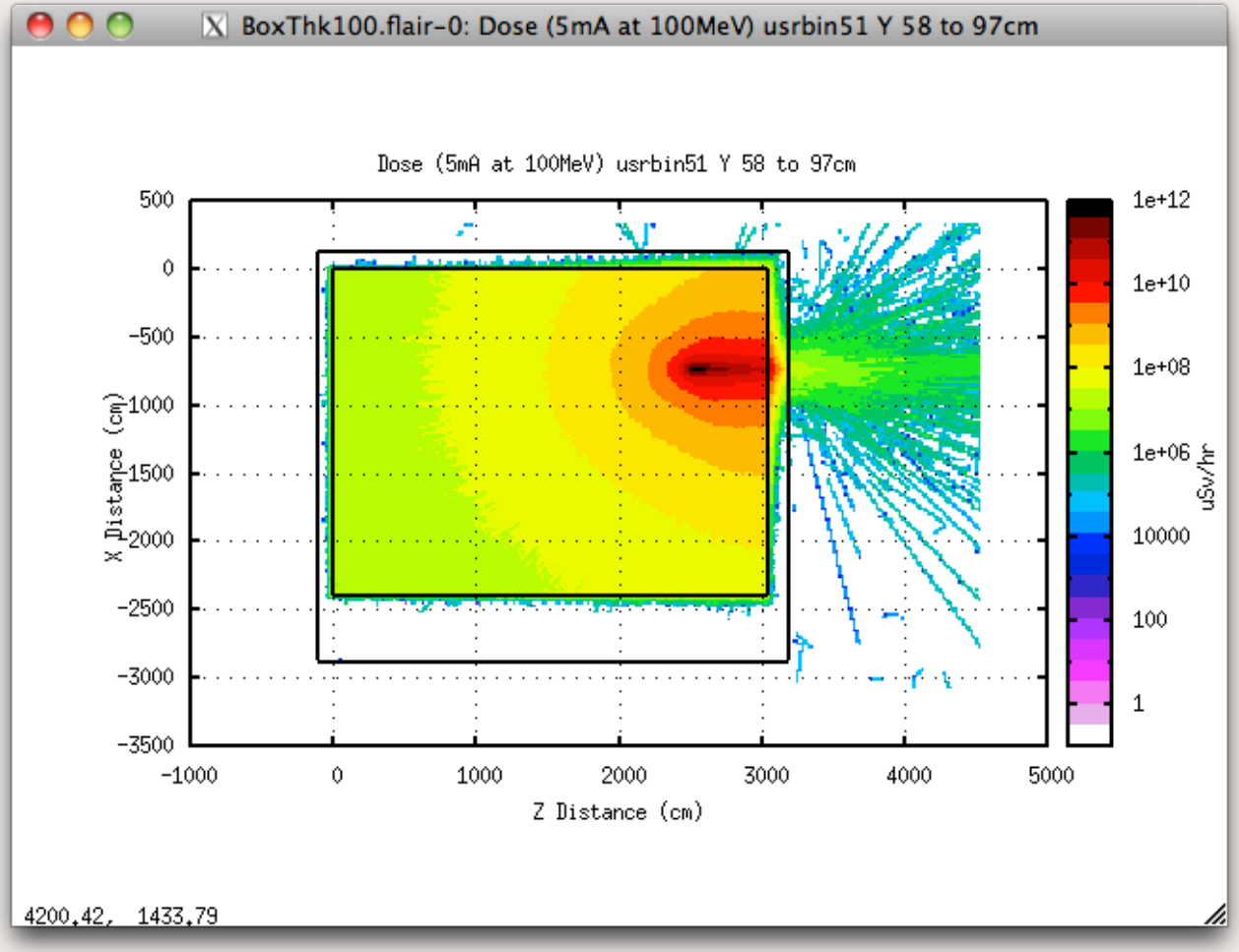
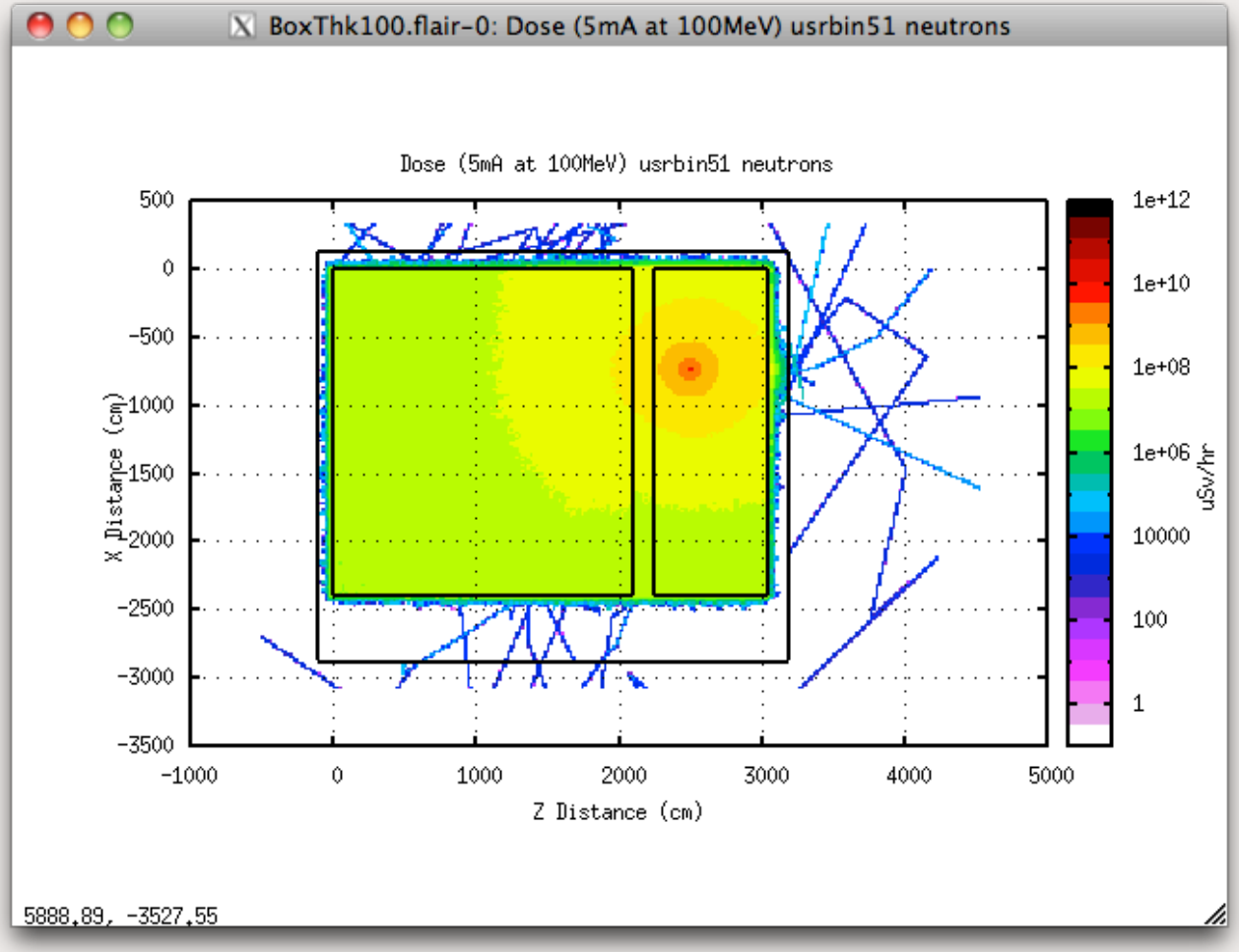
Top View 100 MeV



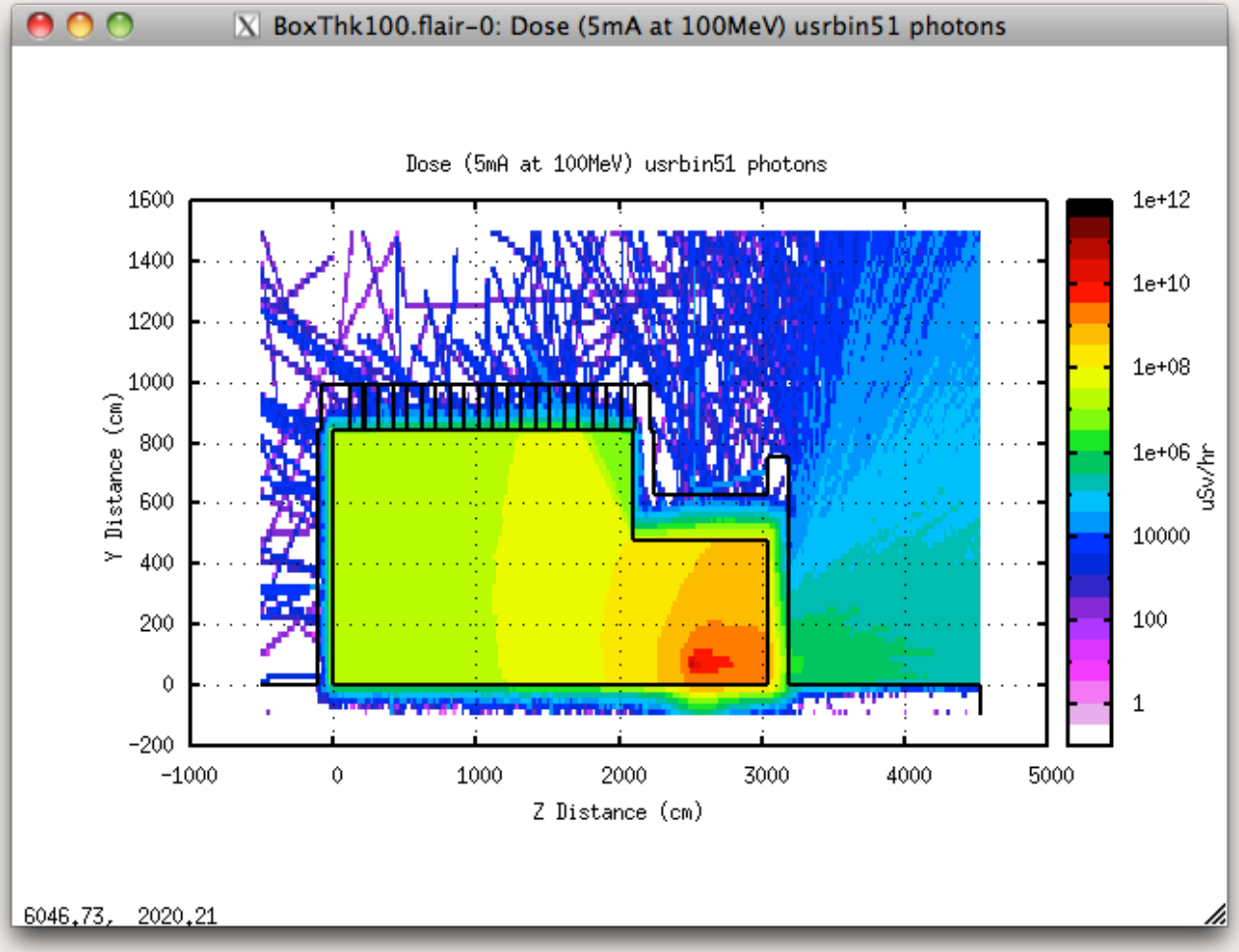
Top View 100 MeV



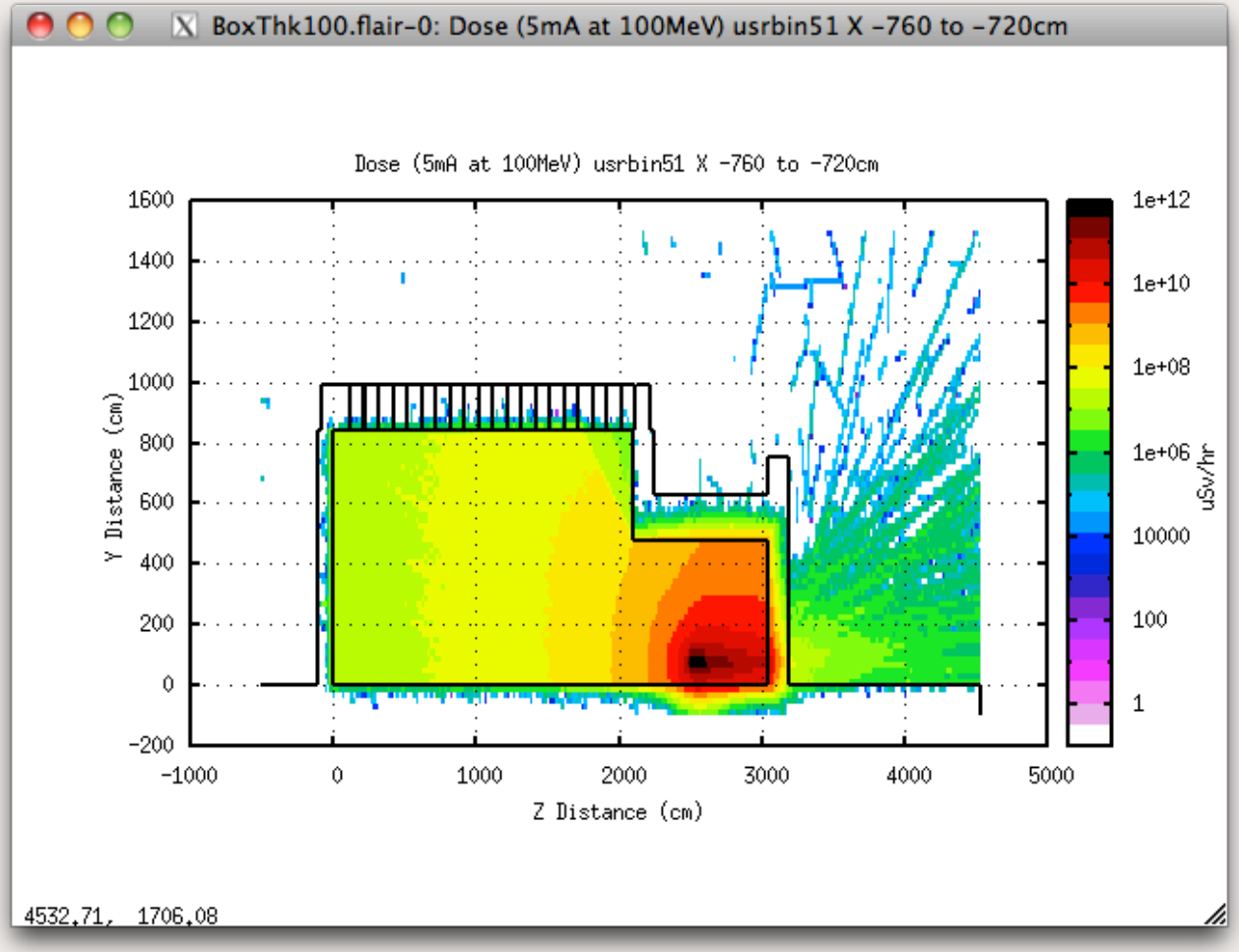
Top View 100 MeV



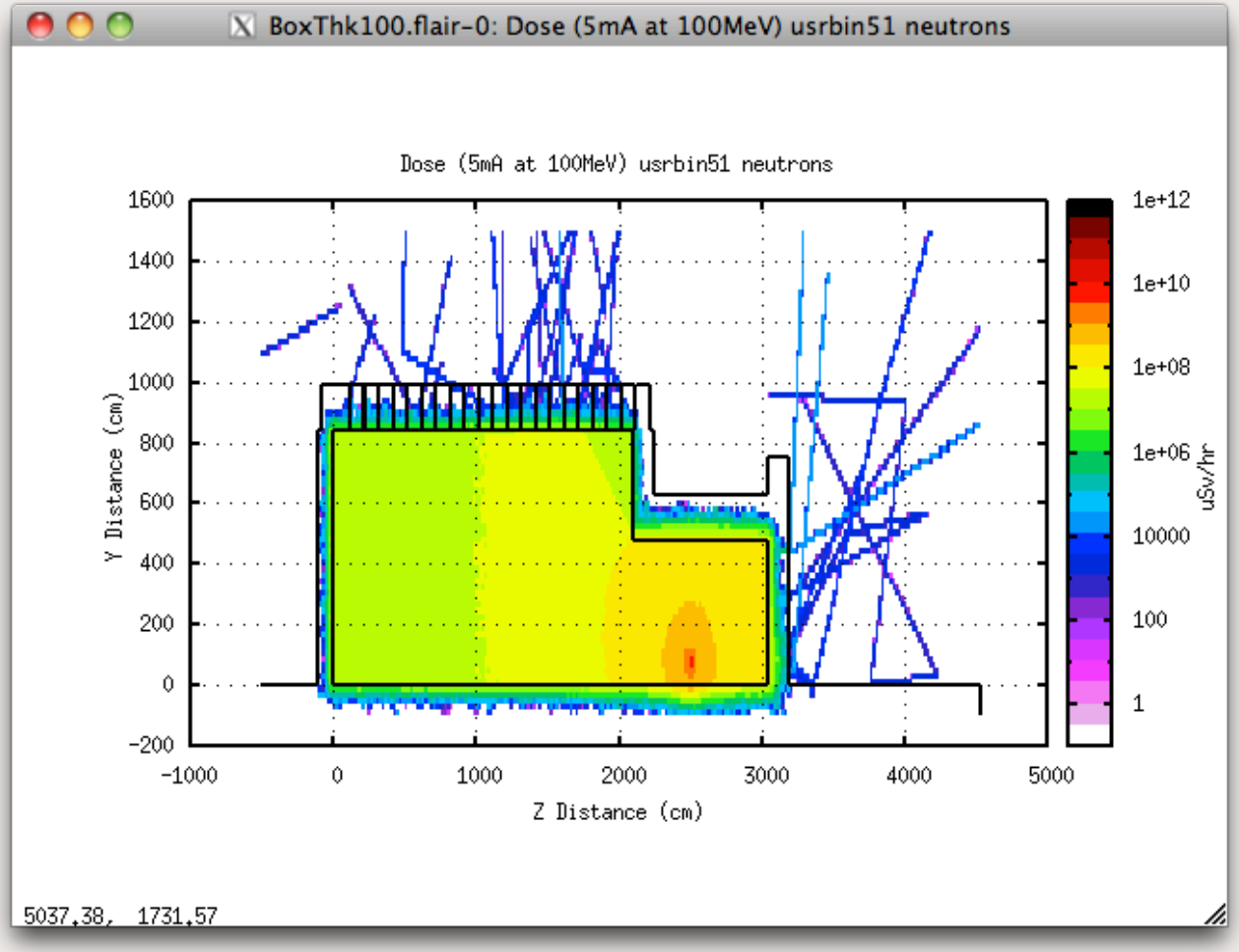
Side View 100 MeV



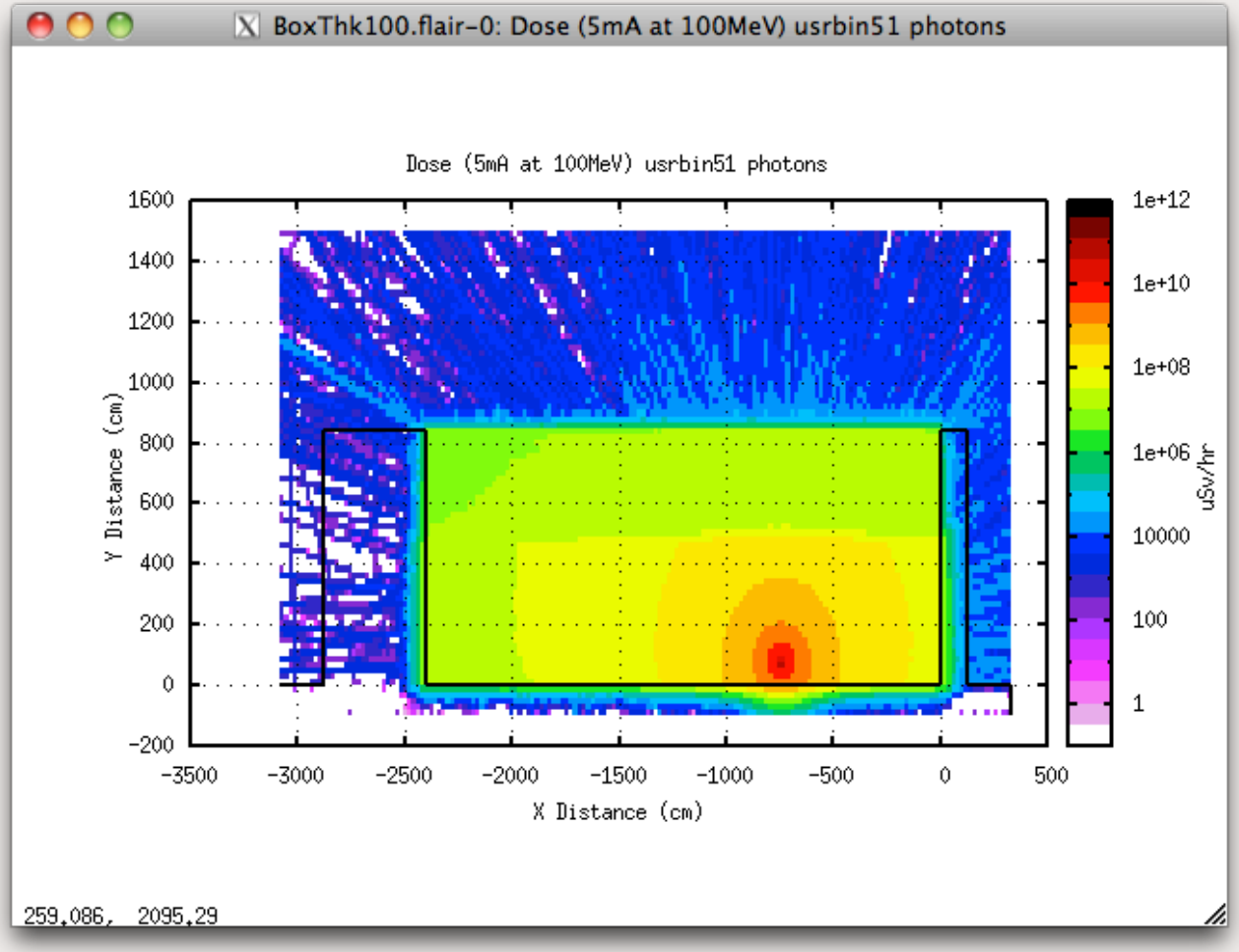
Side View 100 MeV



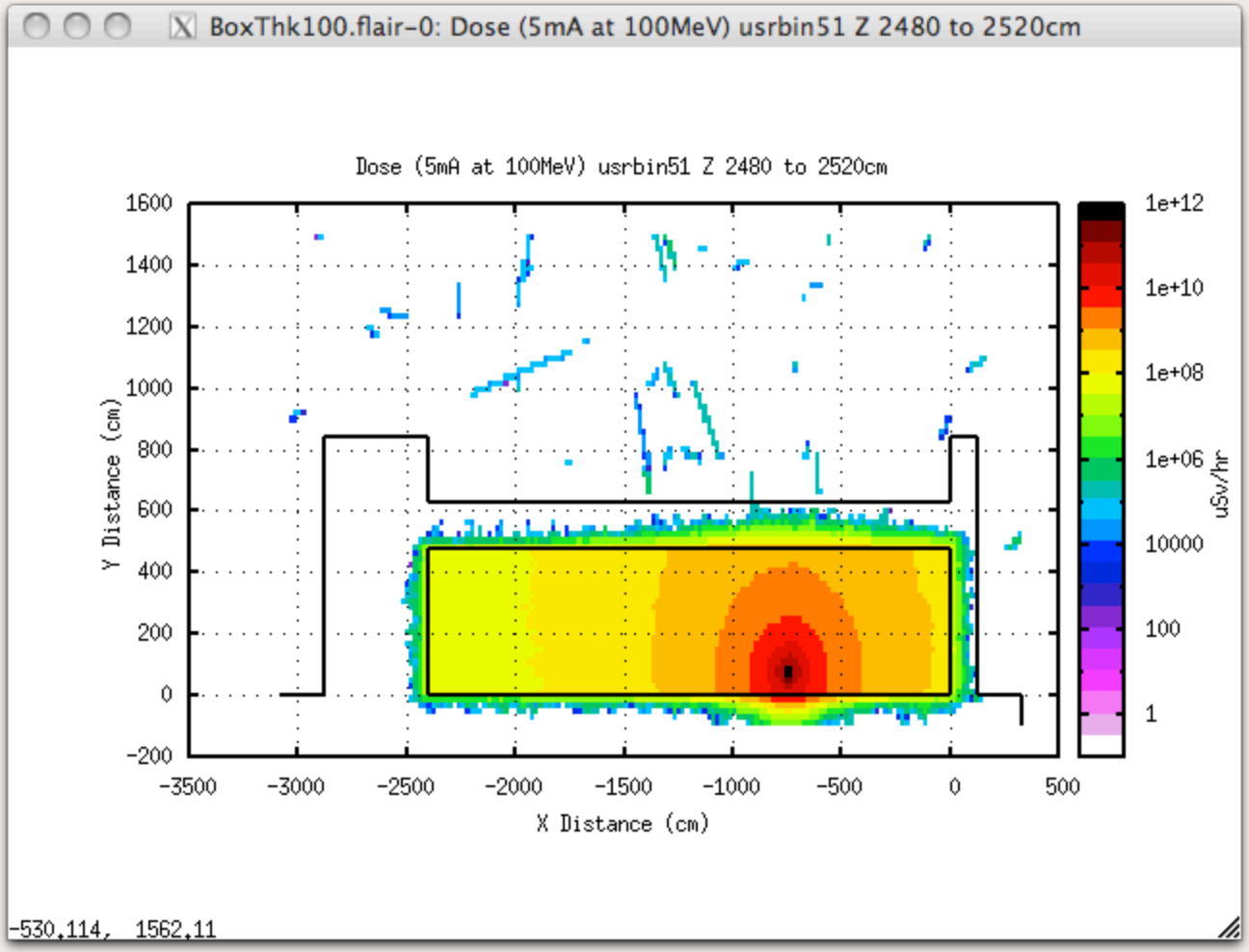
Side View 100 MeV



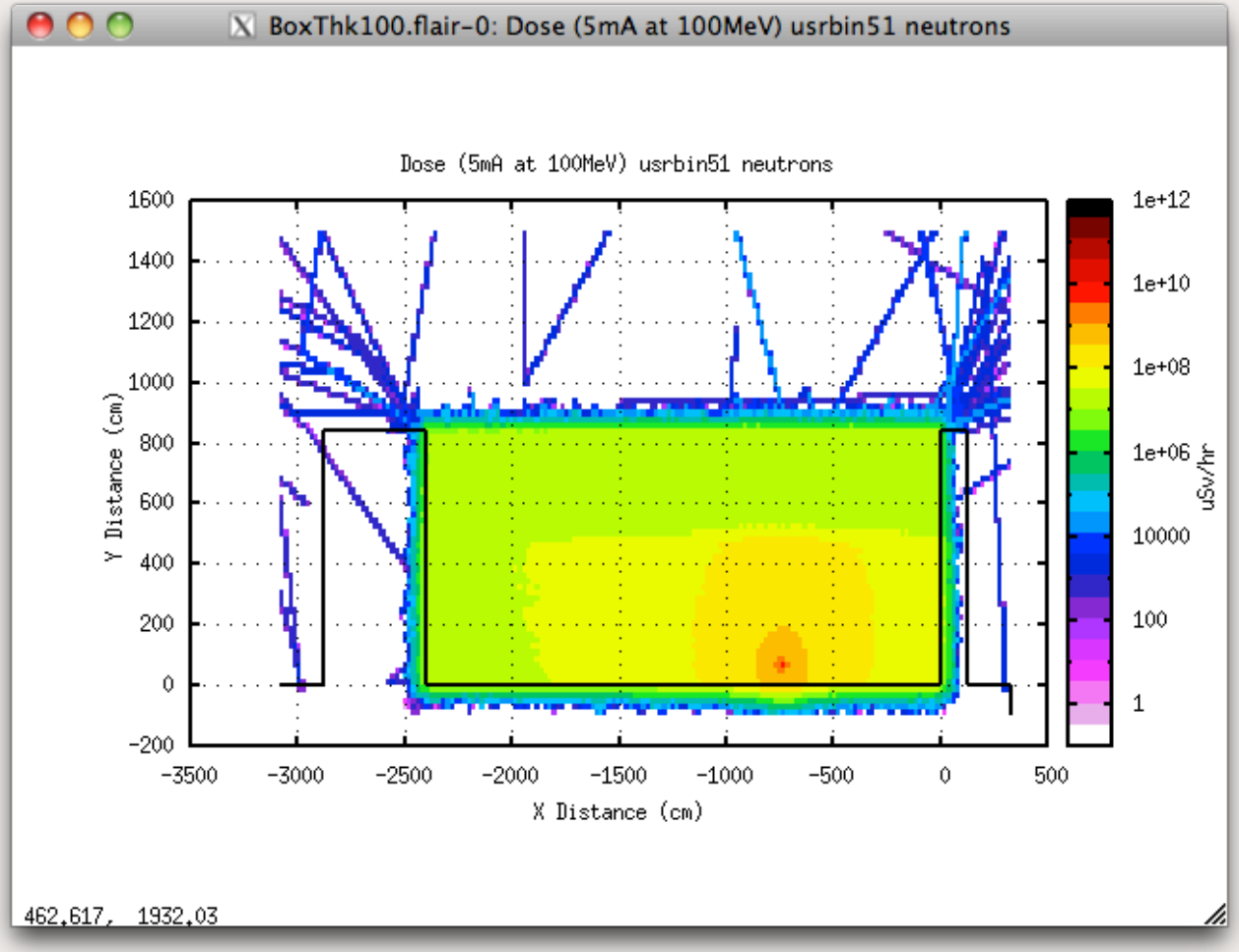
End View 100 MeV



End View 100 MeV



End View 100 MeV



Conclusions

- Lower-ceiling shielding of 5 ft concrete is okay for 30 MeV but not 100 MeV
- Roof beams with 0.5 cm gaps more of a problem for gammas than for neutrons
  - Need for a shroud above higher-energy section?
- Likely need second monitoring system over the roof beams, but since radiation is diffuse can get by with only a few monitors above the higher-energy section
- Need ~10 ft concrete for shielding gammas in the forward direction

Conclusions(2)

- Service chase mounted high on wall appears okay
- Corner overlap of roof beam on side walls is insufficient
  - Need 2 more ft of concrete

Future Work

- More statistics!
- Add in beam dump, stair well, and tunnel shielding in forward direction as designers converge on layout
  - What is the field at ground level in the forward direction?
- Look into adding a shroud (local shielding) in higher-energy sections
- More statistics!

Thank you!
Merci!

Anne Trudel, TRIUMF
Mohamed Benmerrouche, CLS