

# Determination of Access controls for PXIE cave during RFQ RF powered operation

T. Leveling

March 4, 2014

# Initial assumptions

- No radiation worker training required
  - Requires normal dose rate  $<0.05$  mrem/hr
  - Accident condition  $<1$  mrem/hr
- No access controls to cave with RFQ RF powered
- Source term per Steimel/Prost calculation

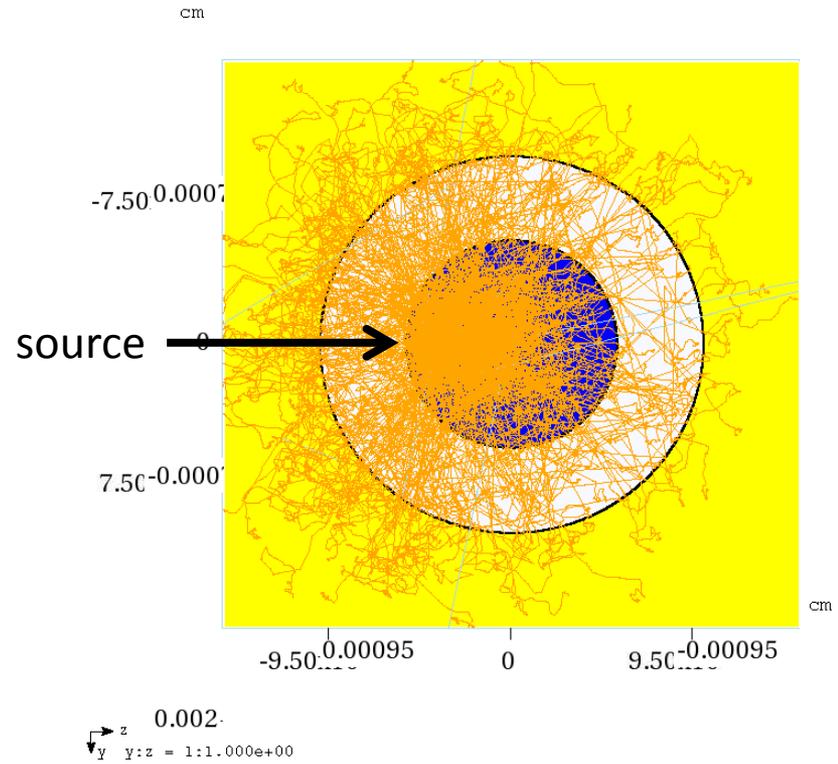
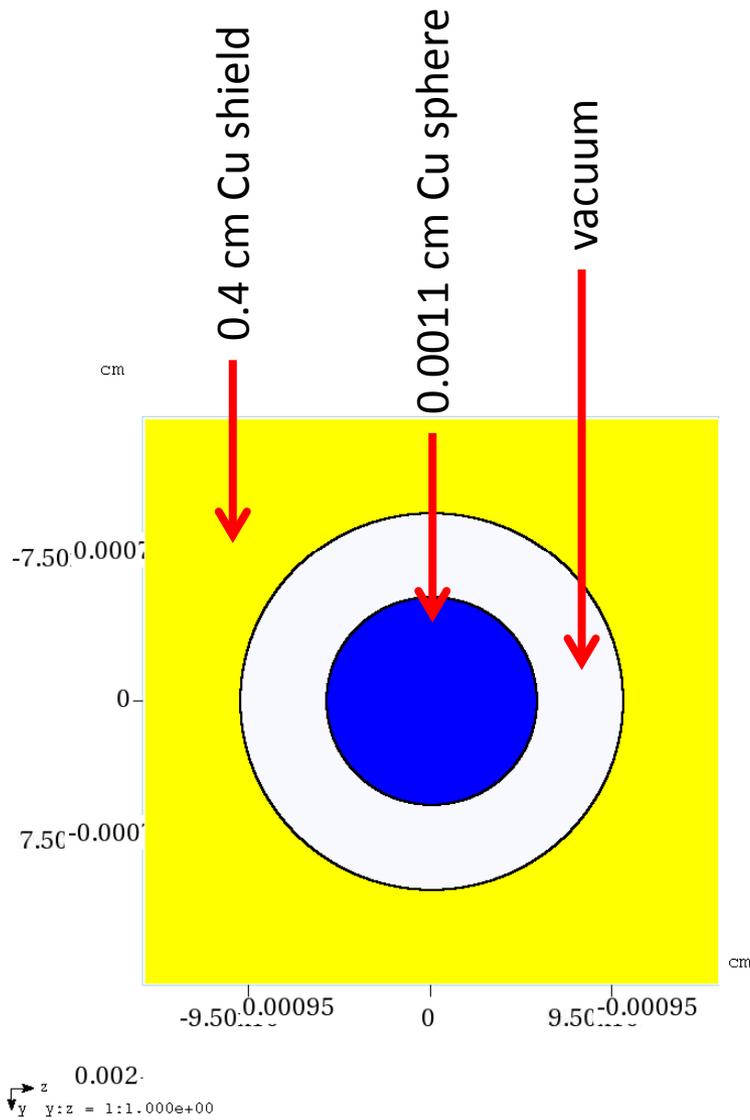
# procedure

- Use MARS with EGS5 to make a calculation
- Source term:
  - 85 keV
  - 1.75 A

# Range of electrons

- $R = 412 \times E^{(1.265 - 0.0954 \times \ln E)}$
- Where:
  - E is energy in MeV
  - R is range in mg/cm<sup>2</sup>
- For 85 keV electrons
  - R = 0.0011 cm in copper
    - Maximum x-ray production
    - Minimum shield

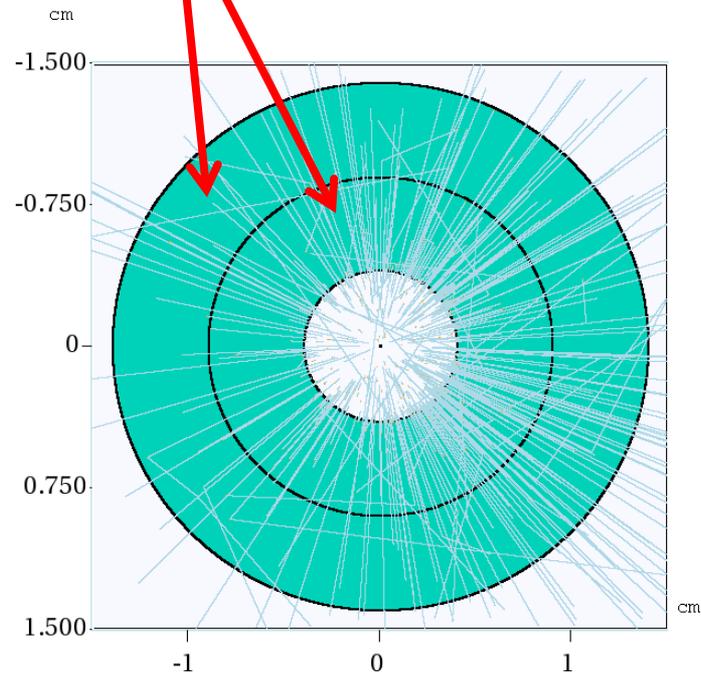
# Model Geometry



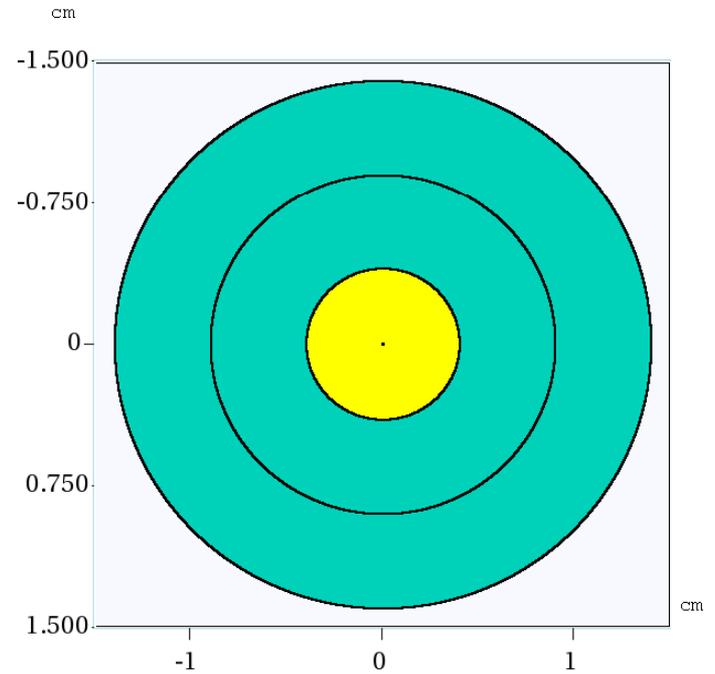
With electron and x-ray tracks

Detector volumes

# Full Model

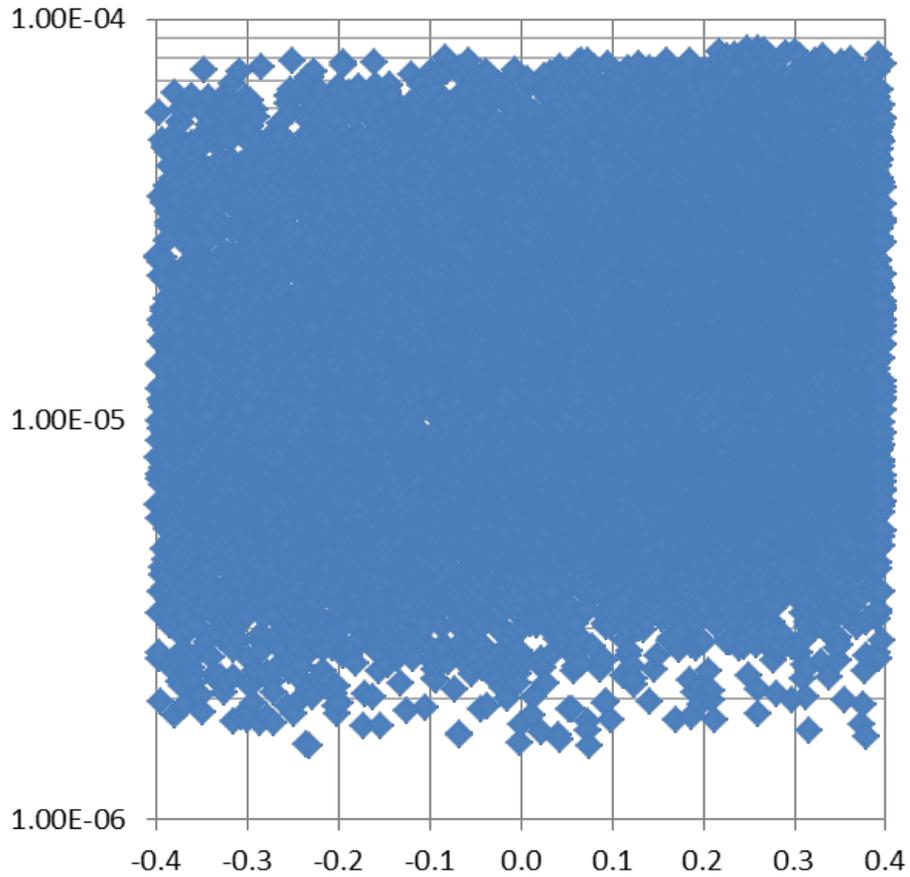


Without Cu shield

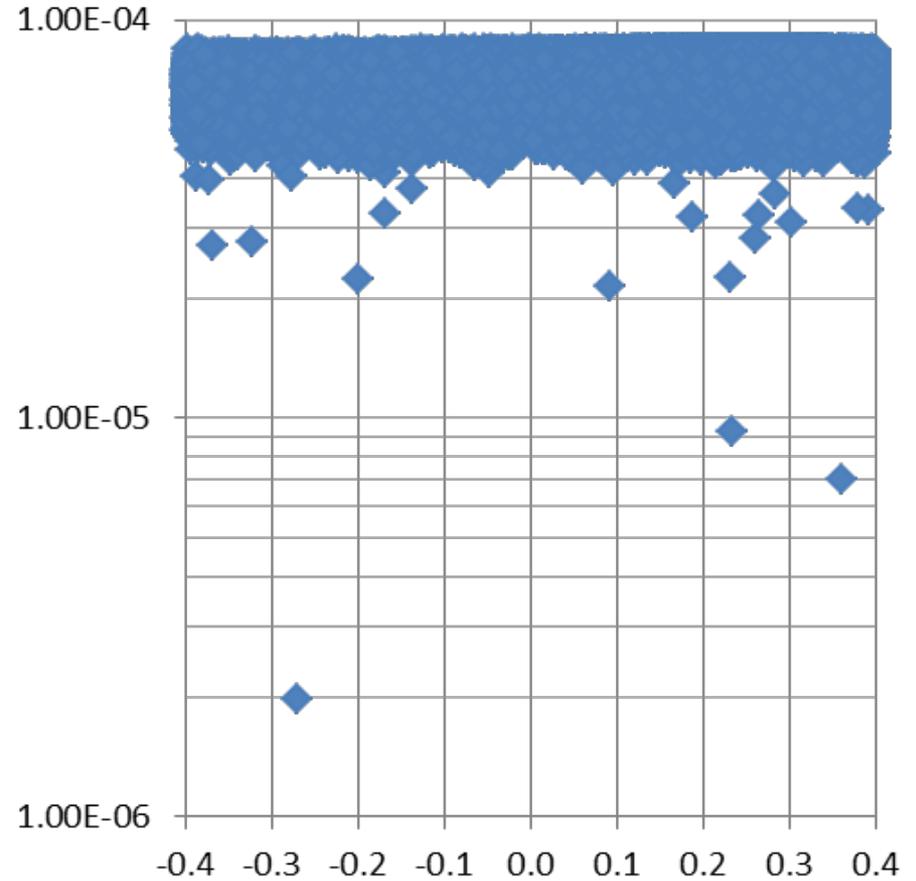


With 0.4 cm Cu shield

# X-ray spectra



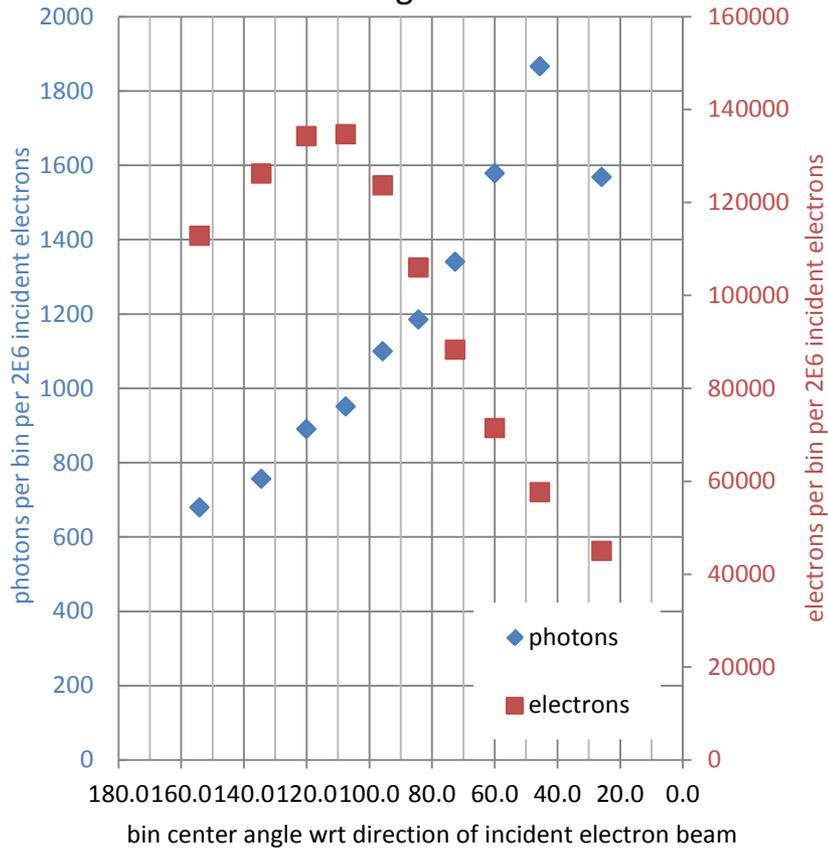
unshielded



0.4 cm Cu shield

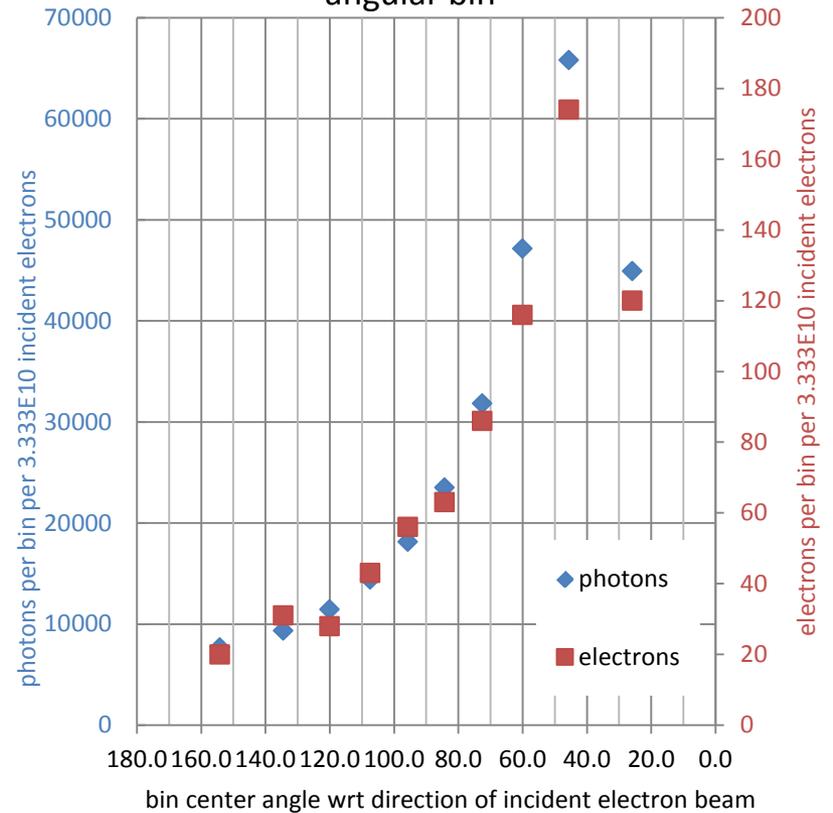
# Angular distributions

photon/electron yield as a function of angular bin



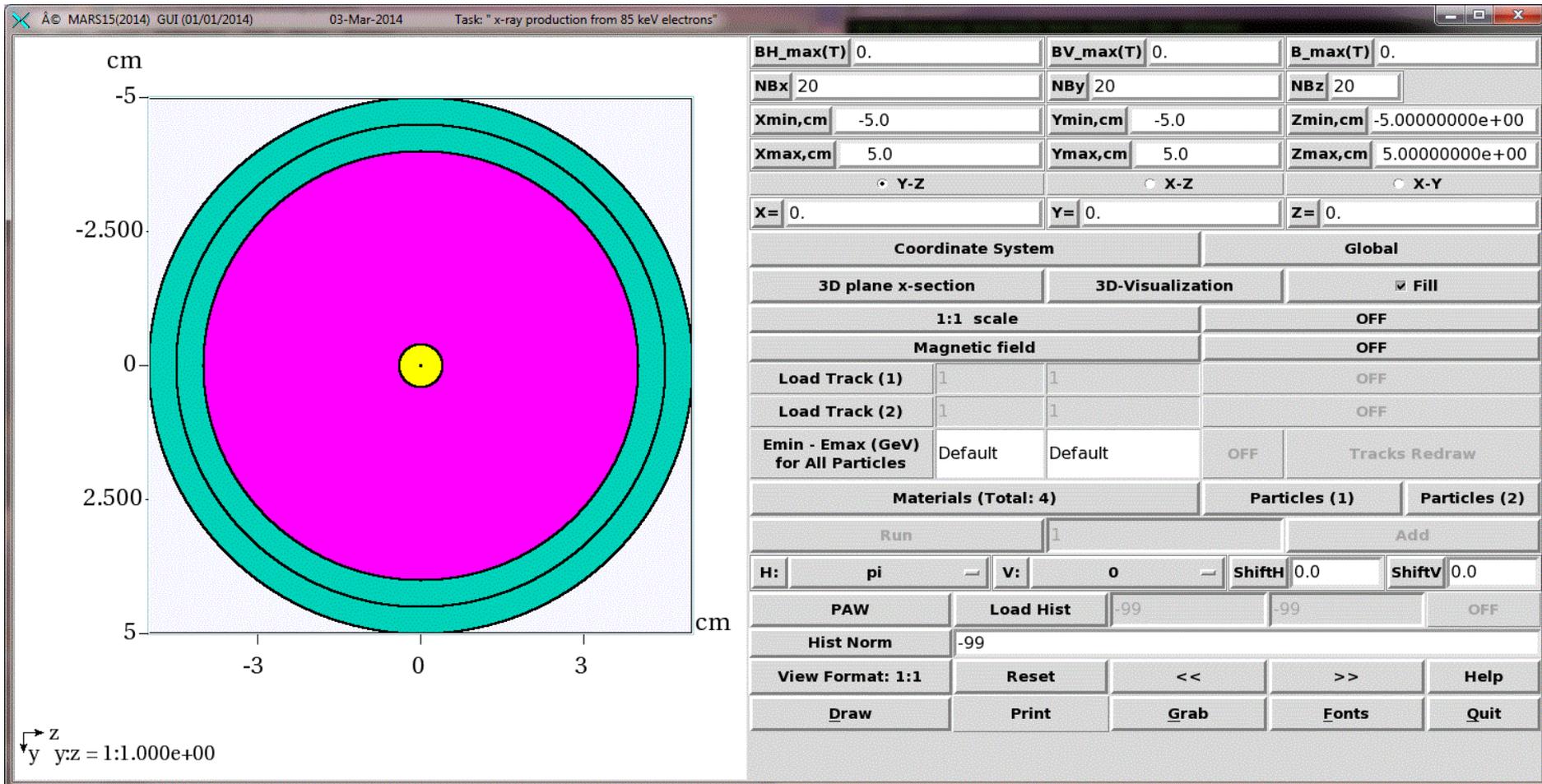
unshielded

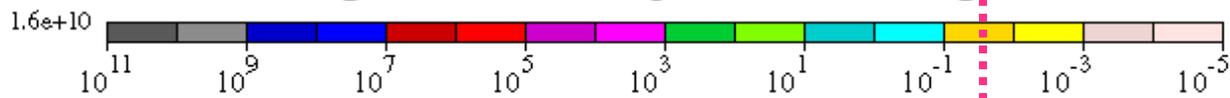
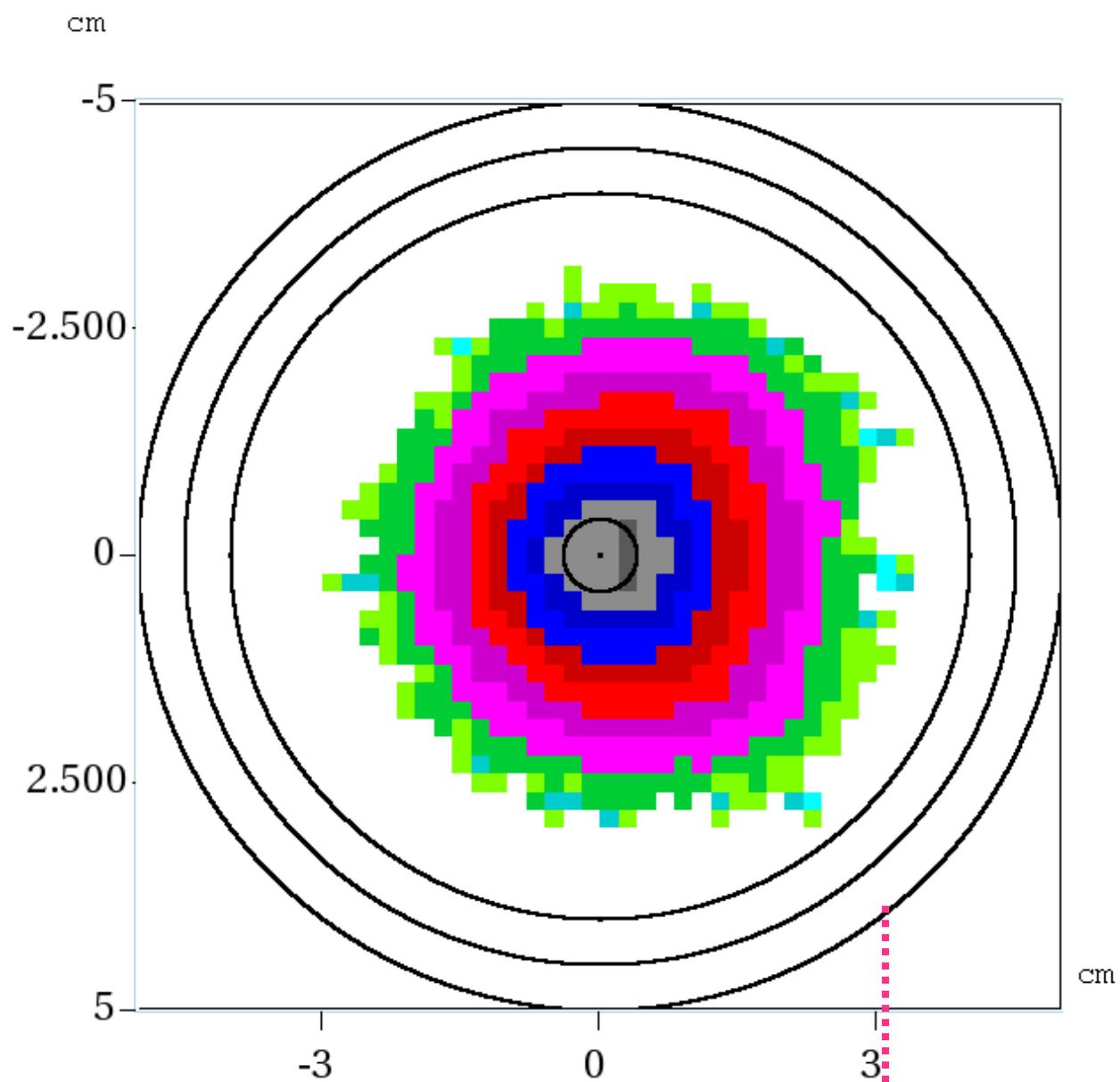
photon/electron yield as a function of angular bin



0.4 cm Cu shield

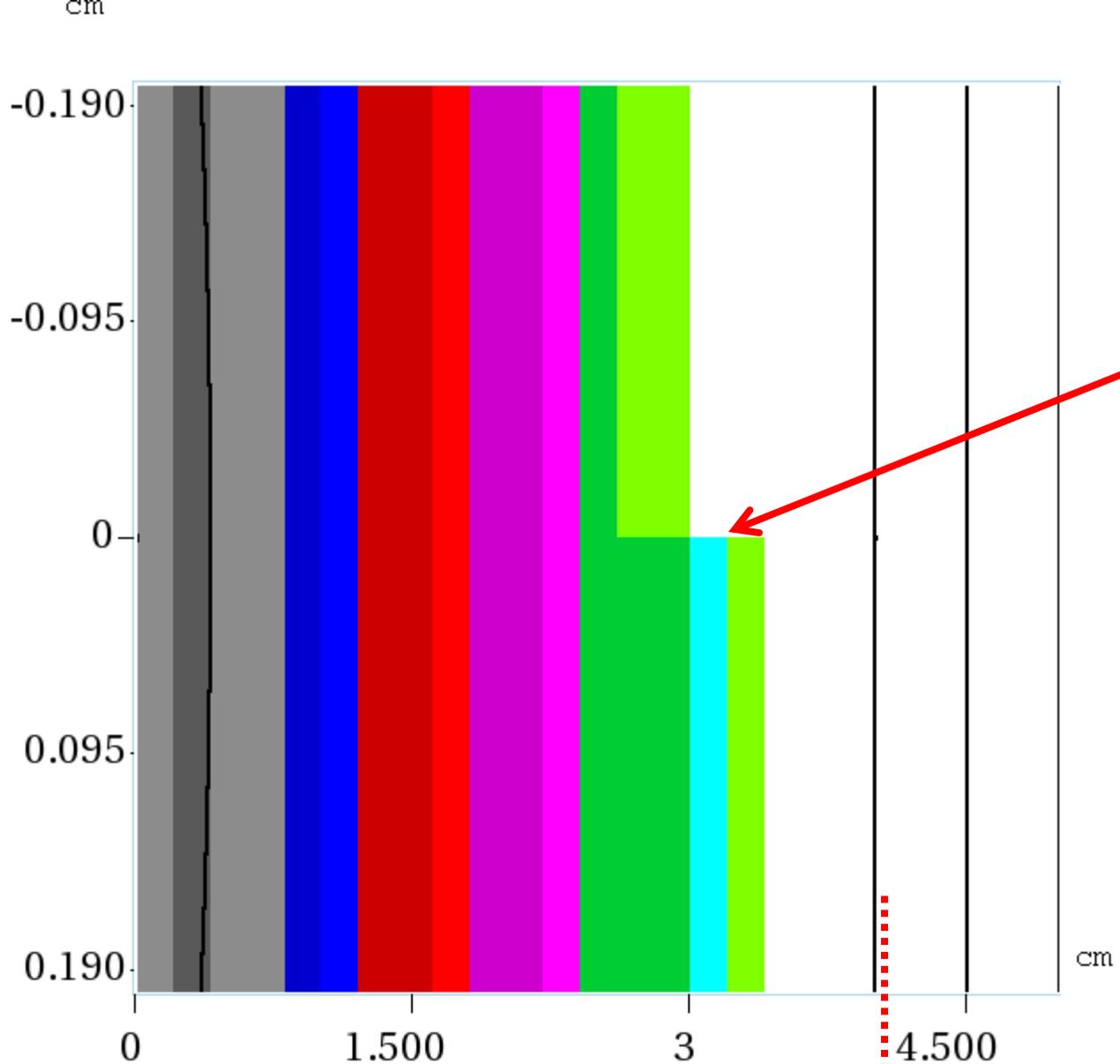
# Full model - 4 cm radius Cu shield





$\begin{matrix} \rightarrow z \\ \downarrow y \end{matrix}$ 
 $y:z = 1:1.000e+00$

For no access restrictions



$\begin{matrix} \rightarrow z \\ \downarrow y \end{matrix}$ 
 $y:z = 1:1.250e+01$

For no access restrictions

# Conclusion

- Initial assumptions are incongruous
  - Can't guarantee required dose rates can be observed, especially at vacuum ports and at couplers
  - Shielded cave with access controls should be used
    - Under normal operation – no personnel access to the cave while RFQ is RF powered

# RFQ Commissioning Cave Layout



- Add labyrinth to South end of cave, install gates and roof blocks
- All blocks in-house, ~ 3-4 weeks to install

