KLF Design Meeting
October 31, 2024

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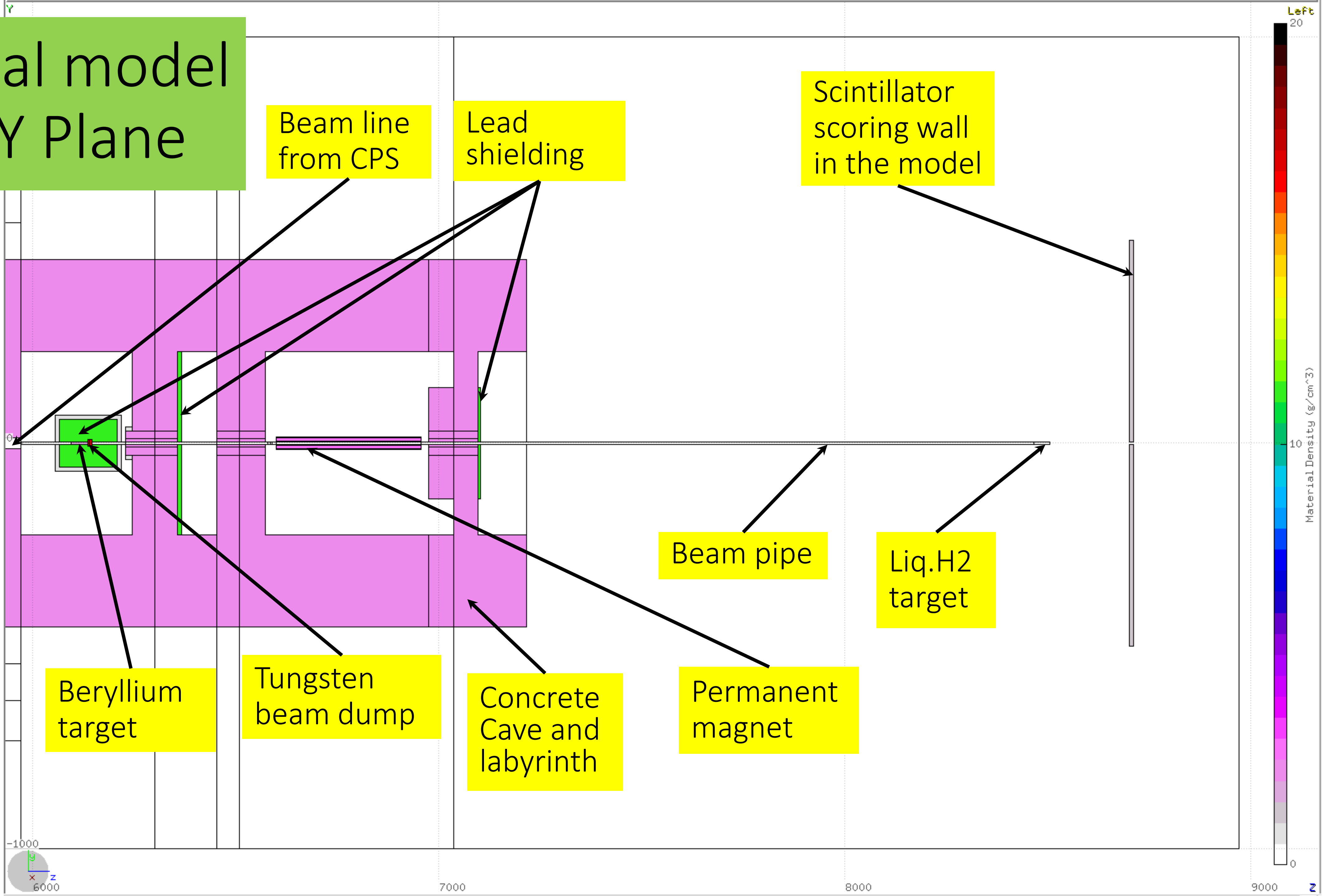
KLF Model Update – October 31st, 2024

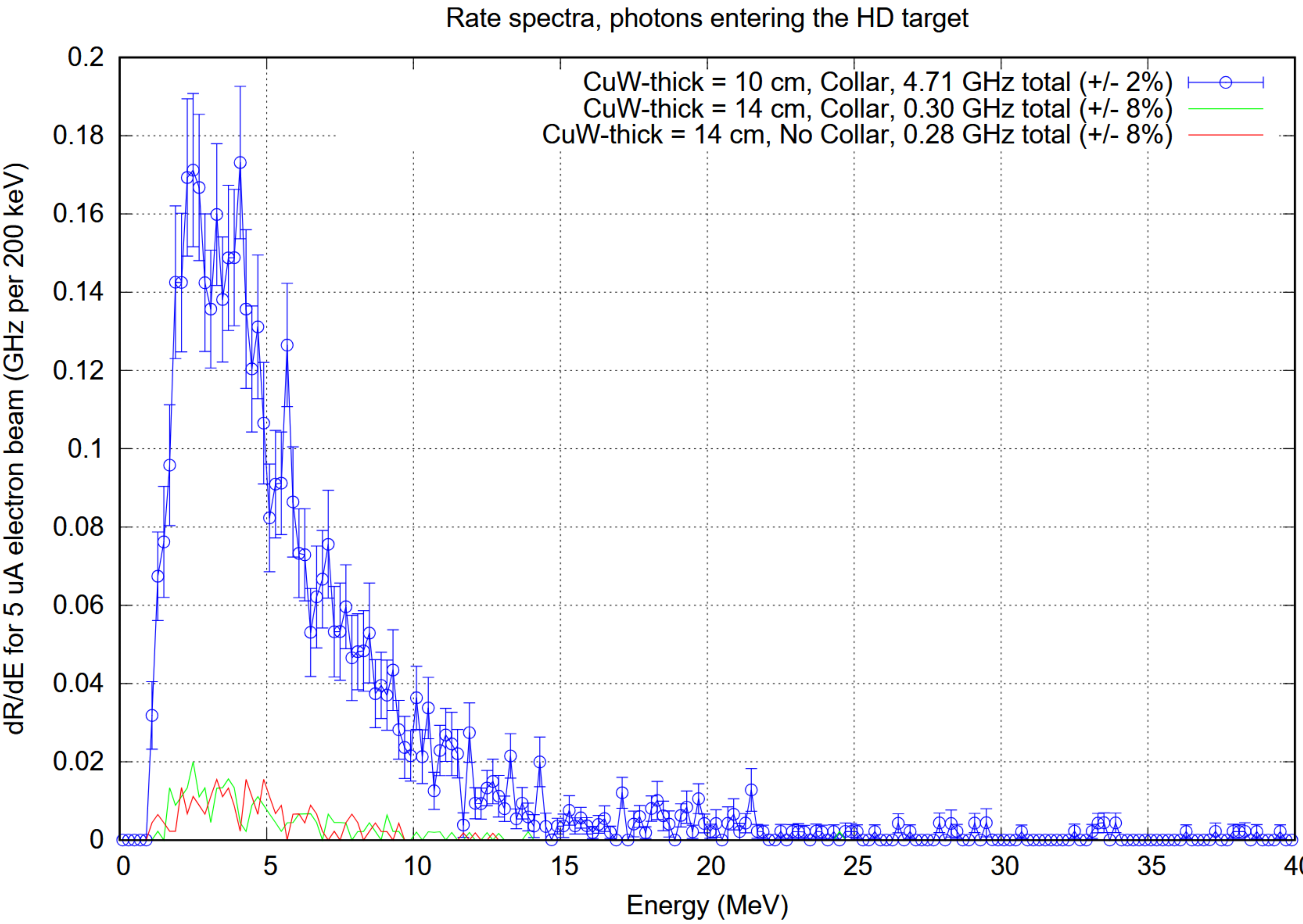
- Initial questions for me:
  - To confirm high flux of low energy photons at the target
  - To check if FLUKA can generate K_L and estimate the rate at the target
- FLUKA model: simple ‘almost’ cylindrically symmetric model of the Cave, including the Be target, Tungsten beam block, lead shield, labyrinth walls, the permanent sweeping magnet, plus the beam line and the target in the Hall
- Full simulation performed in the full range of energies (from thermal for neutrons, 1 MeV production and transport for anything else)
- High energy simulation for K_L estimate is done for transport and production threshold of 500 MeV for all particles except neutrons (20 MeV)
- Using cross section biasing for the photonuclear reactions and geometry regions biasing for shielding penetration calculations.

Initial model Z-Y Plane



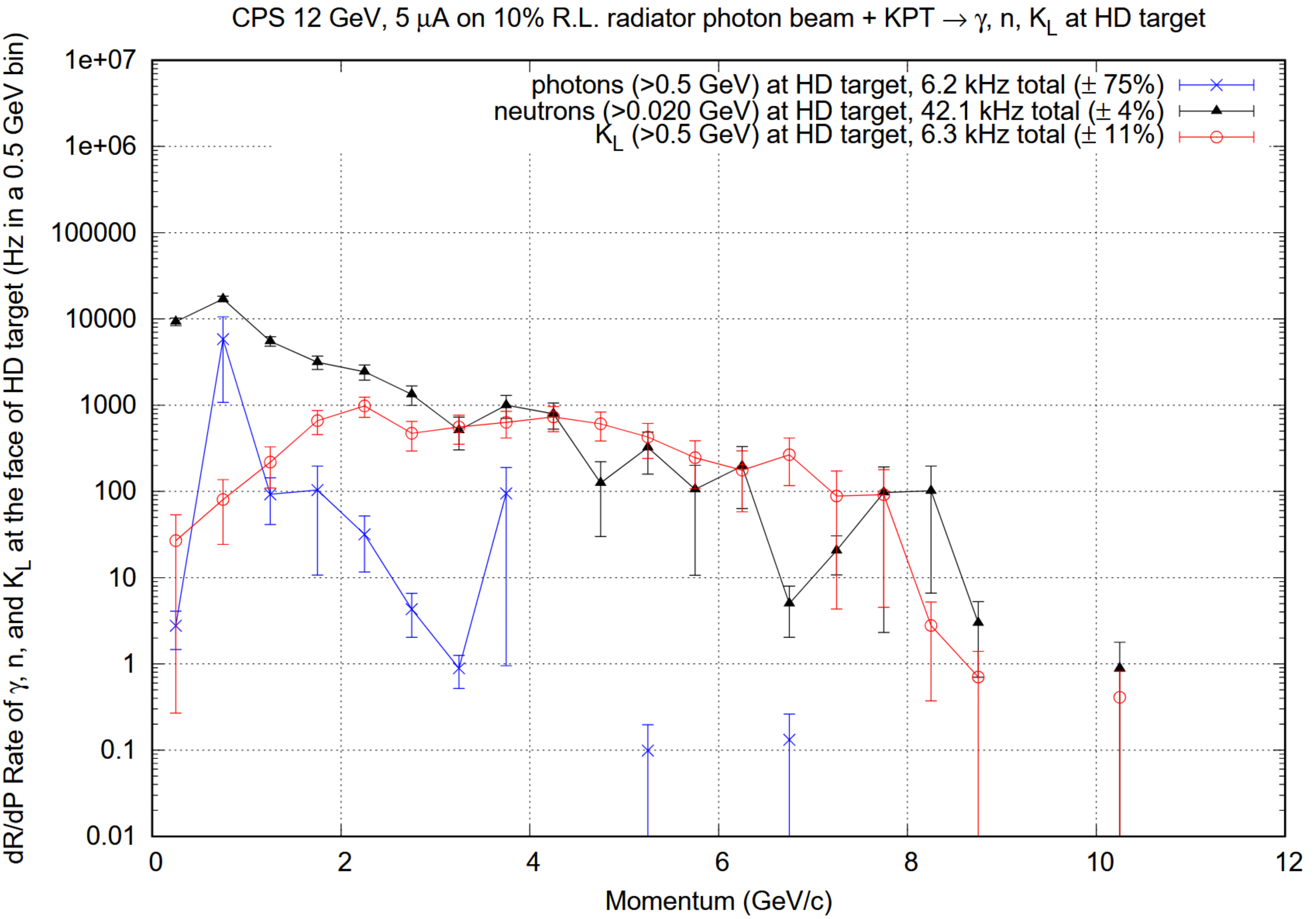
Full simulation photon spectra

CuW 10 cm and CuW 14 cm



High threshold simulation photon, neutron, and K_L spectra

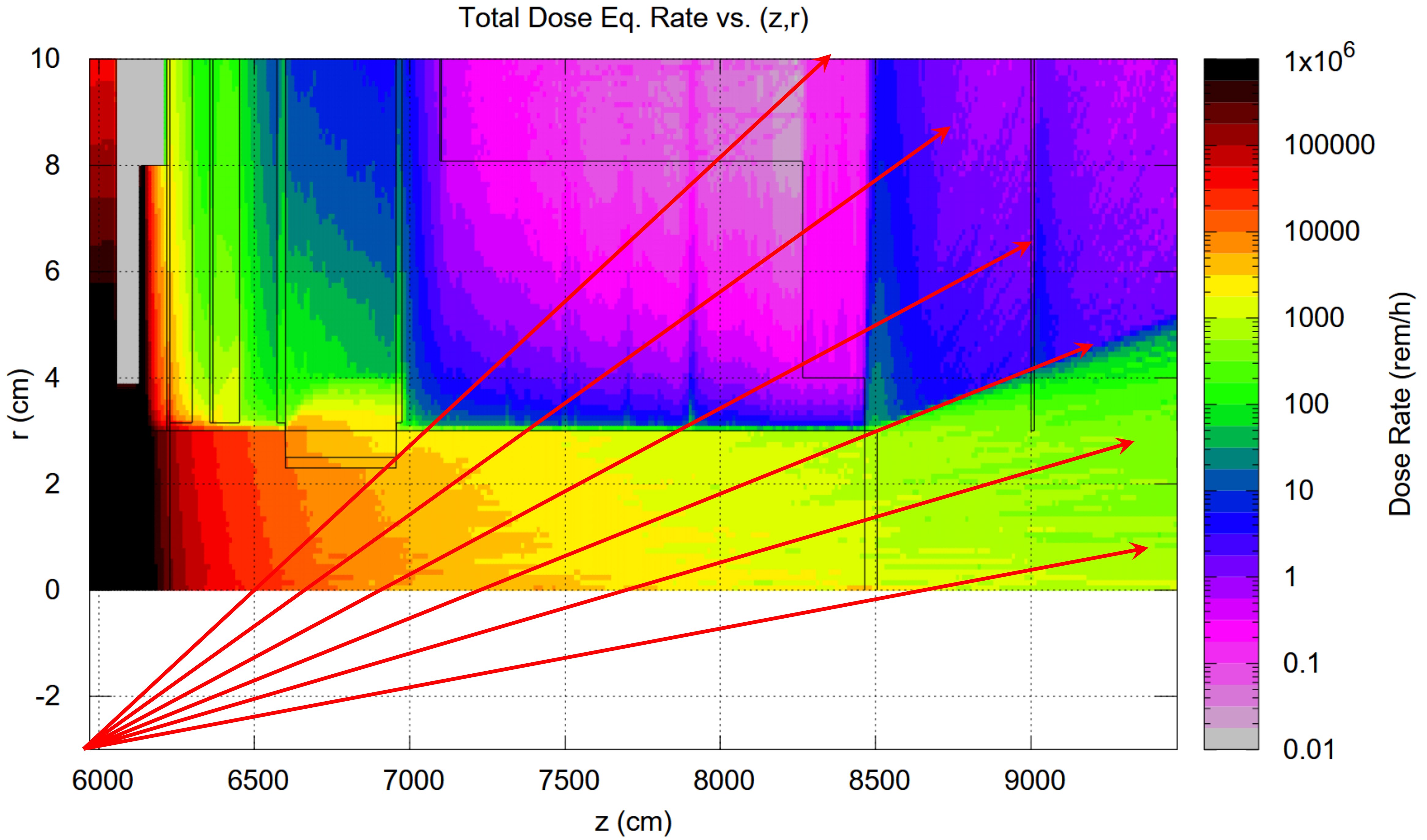
CuW 14 cm K_L ~25% lower than CuW 10 cm



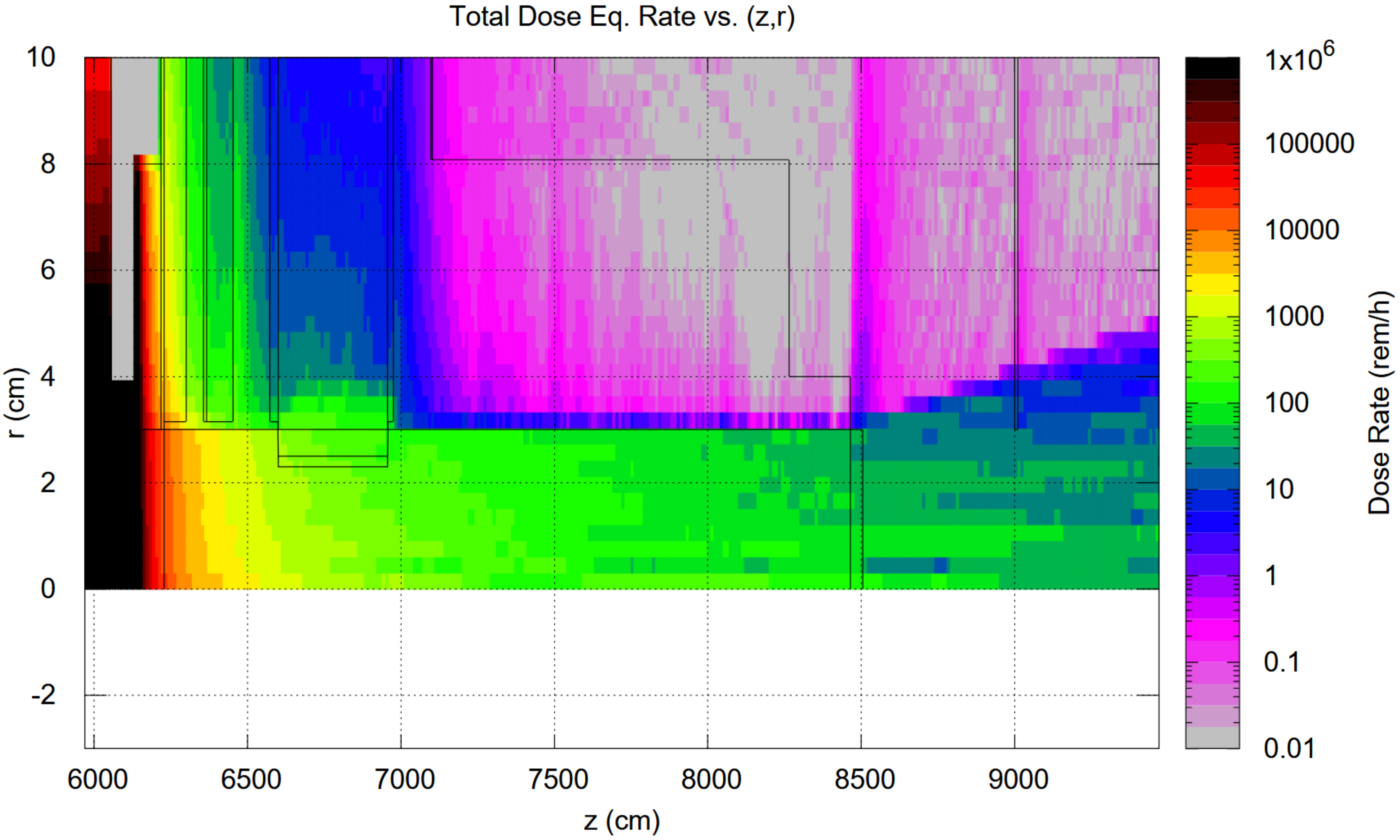
KLF Model Update – October 31st, 2024

- "Mission Accomplished" with the initial two questions
- Few considerations regarding the possible sources of high count rates in GlueX
- Possible sources of the noise
  - Low-energy photons and neutrons hitting the target (Optimizing CuW thickness works well)
  - High-energy forward-streaming particles penetrating through the concrete around the beam line in the Cave Labyrinth walls (using heavy materials around the pipe in the walls would help by a factor 2-5)
  - Diverging beam cascading in the beam line in the Hall (shield the beam line in the Hall either using thick-wall beam pipe, or installing the shielding around the pipe)
- Trying to find ways to optimize the solution:
  - Use Cu10W90 heavy core around the beam line close to the Beryllium target
  - Use extra iron cores in the second and third walls
  - Shield the beam line in the Hall (either using thick-wall beam pipe, or installing the shielding around the pipe)

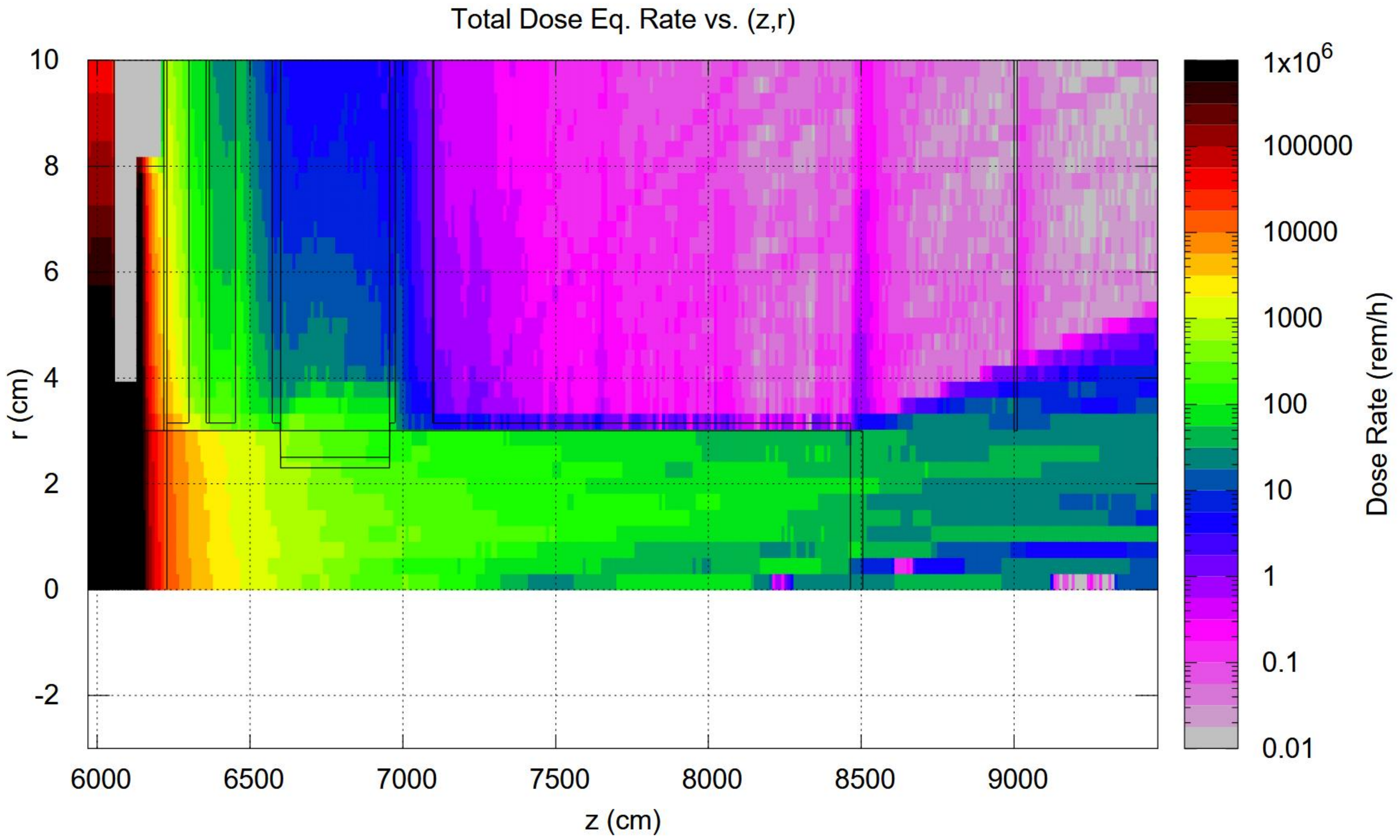
Low threshold, CuW 10 cm, Beam Line Shielding



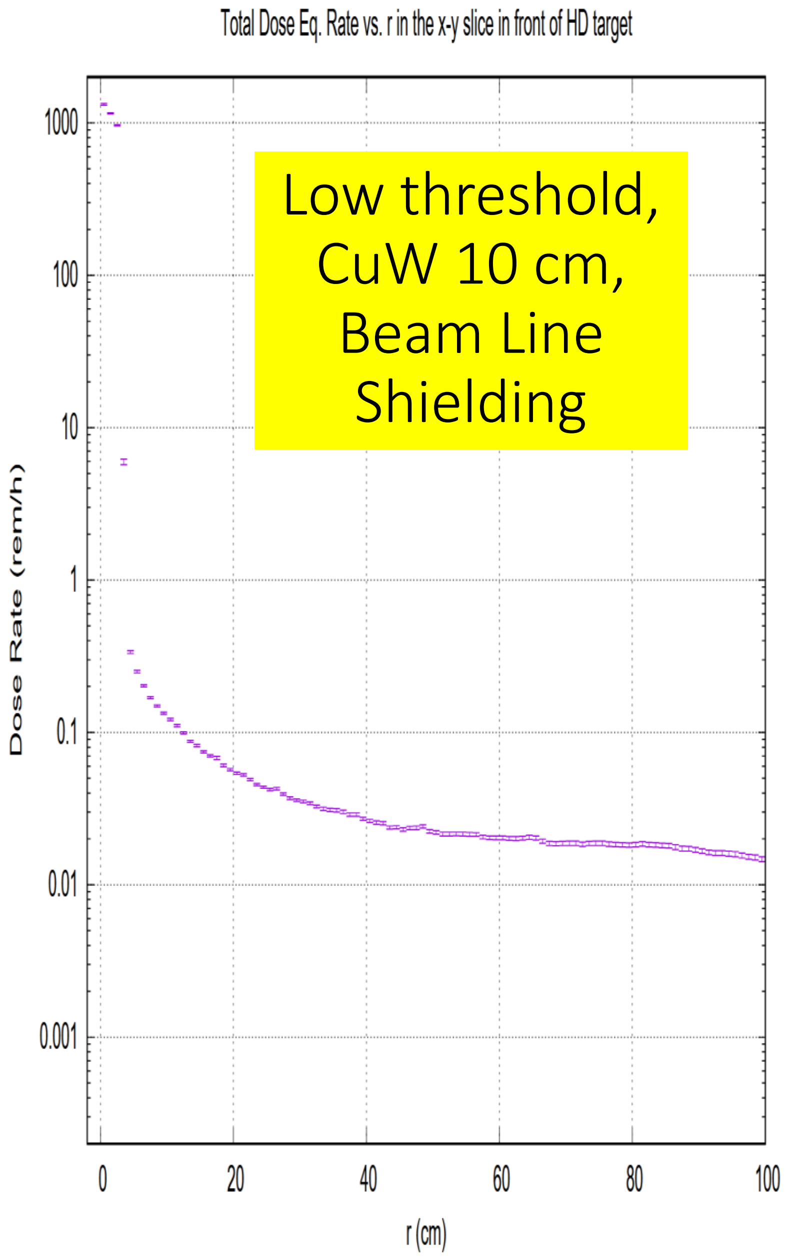
Low threshold, CuW 14 cm, Beam Line Shielding

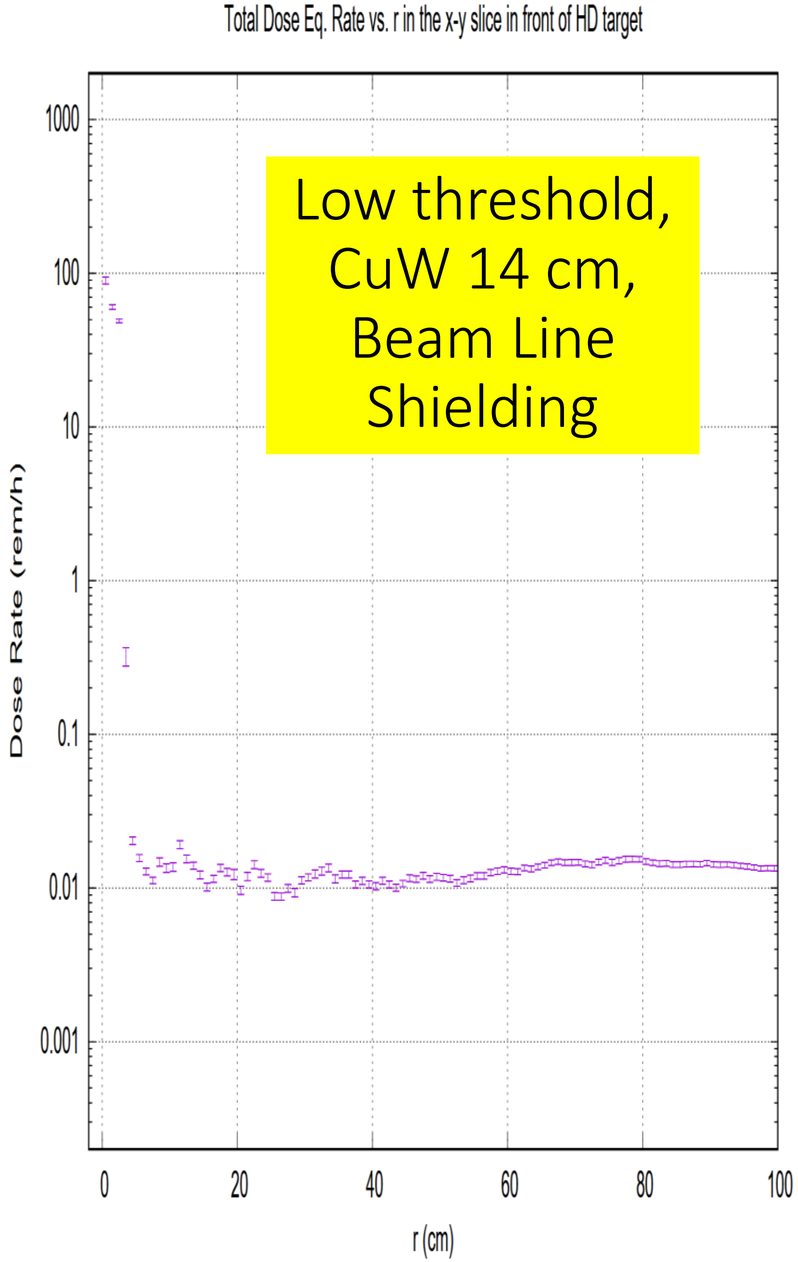


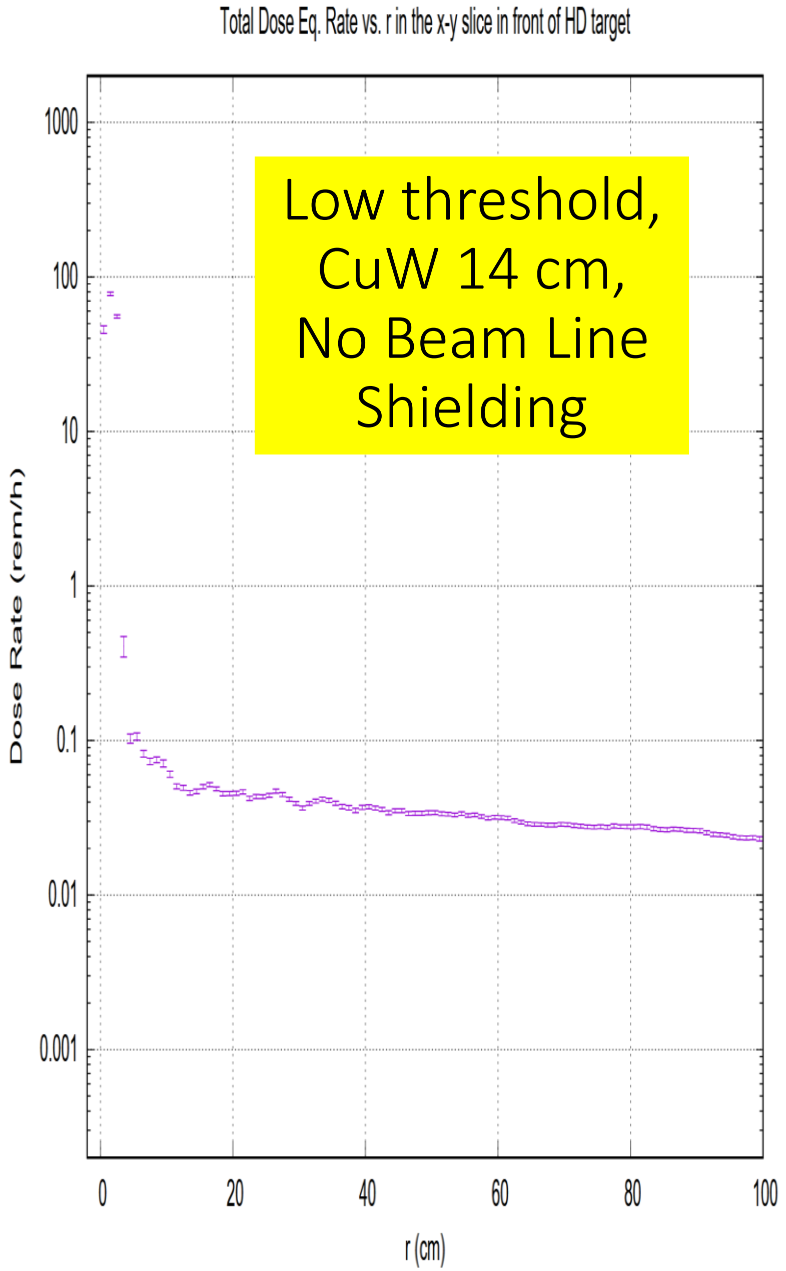
Low threshold, CuW 14 cm, No Beam Line Shielding



Dose-Eq Rate function of r, 2 m z-slice in front of target





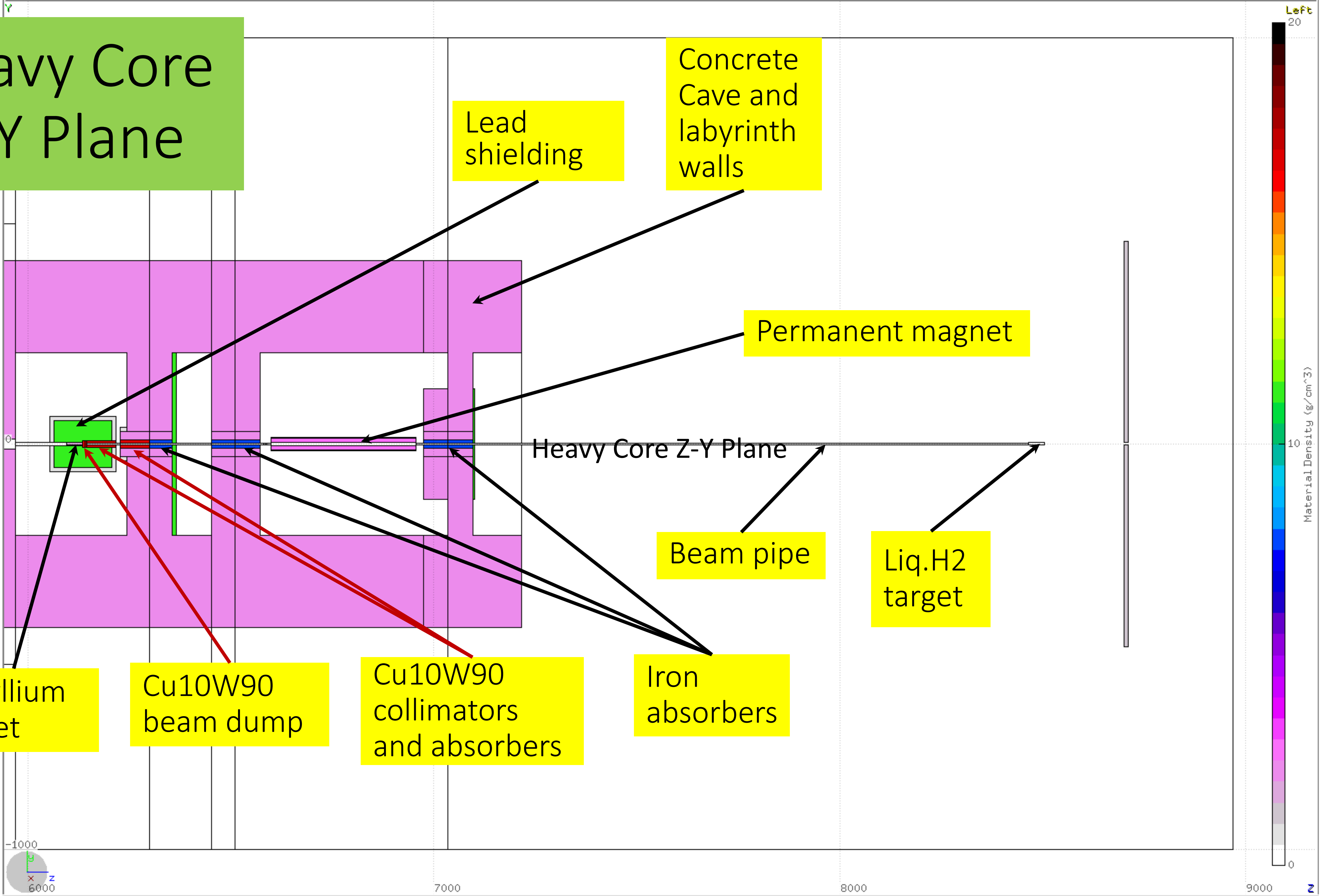


Highlights – October 31st, 2024

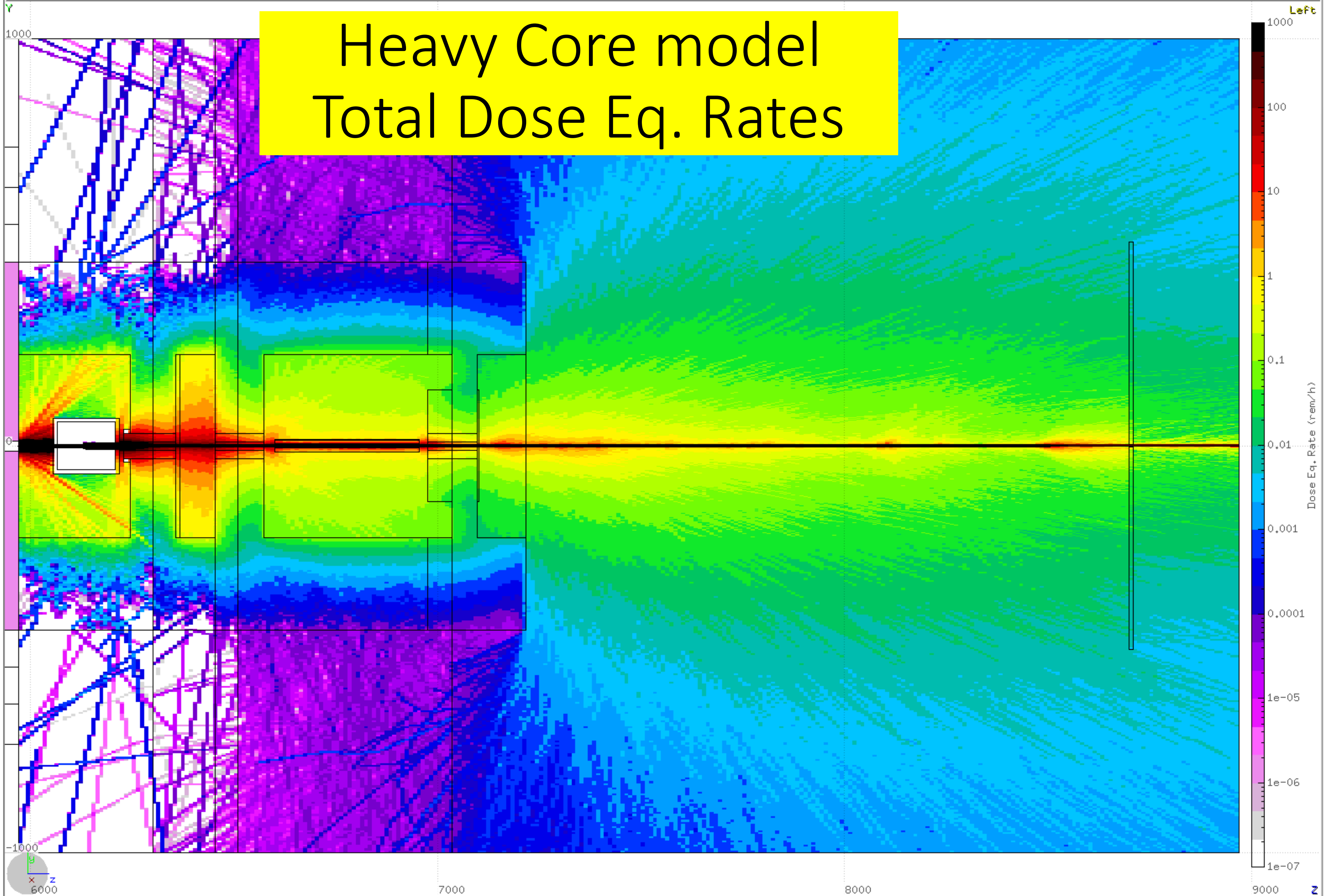
- Accomplished the initial task
- Considered possible sources for the GlueX backgrounds using the simple FLUKA model
- Performed few studies of possible shielding measures
- After suppression of the intense photon component in the beam, the next most intense component is neutrons
- Correct neutron spectrum in the beam may be important for the count rates.

Pages from the previous report

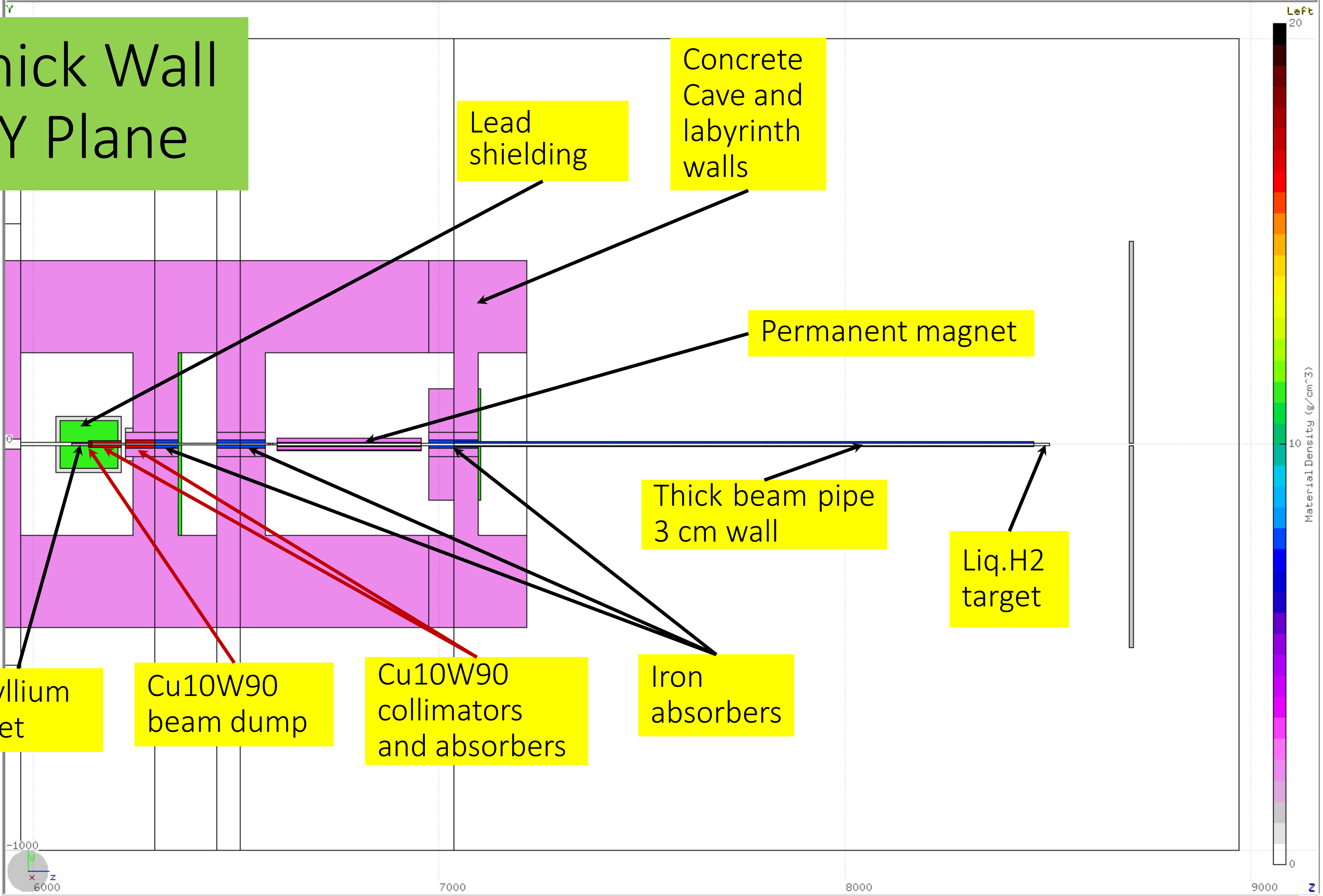
Heavy Core Z-Y Plane



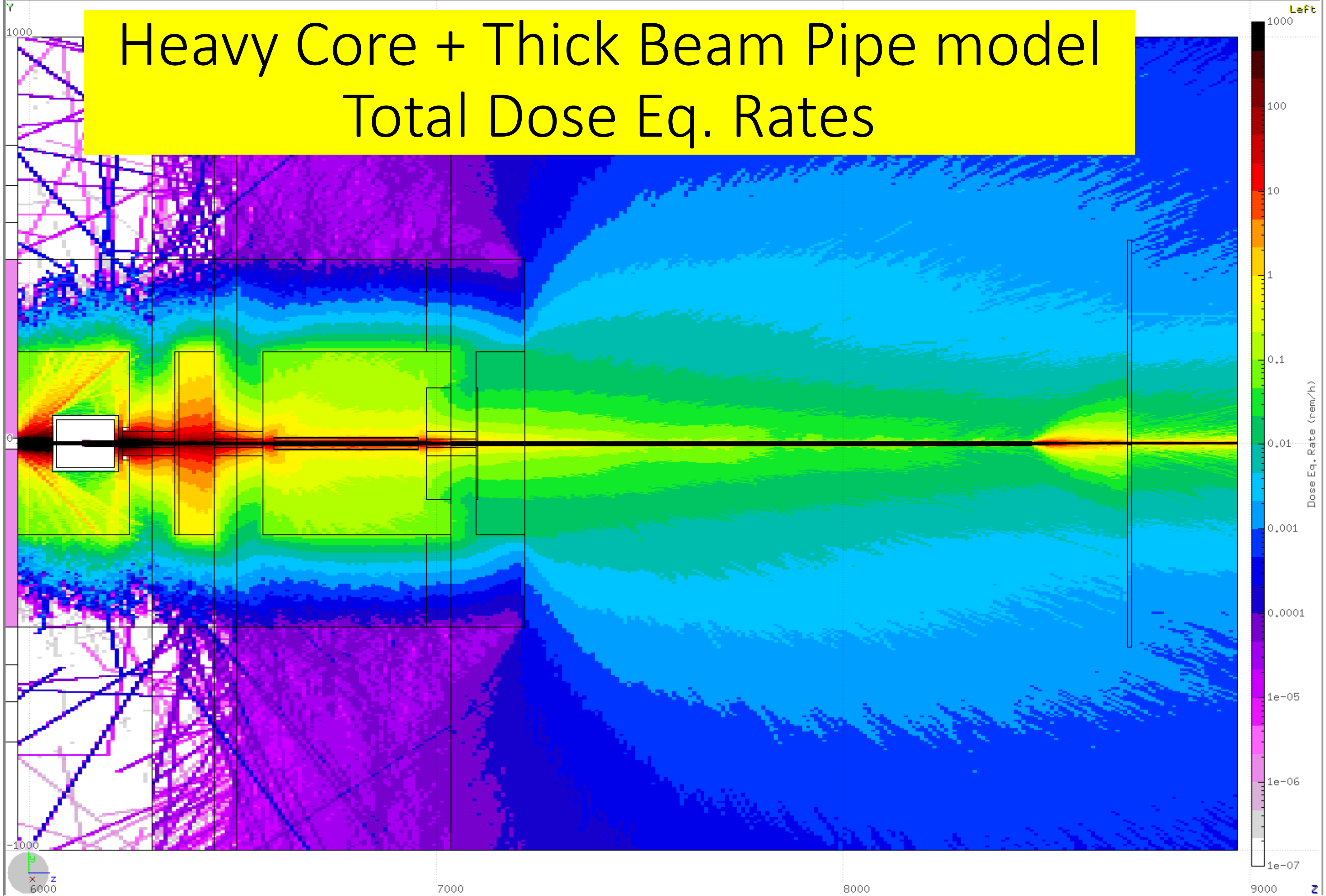
Heavy Core model
Total Dose Eq. Rates



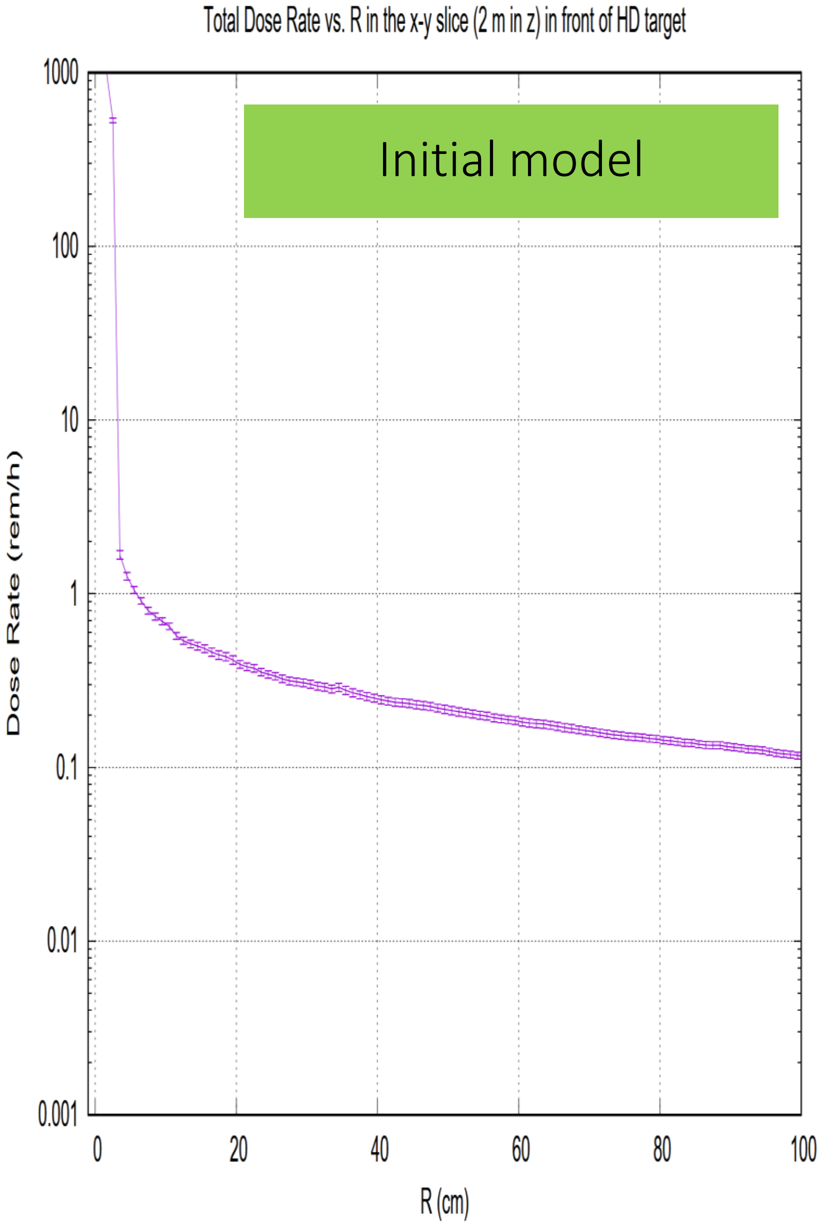
+Thick Wall Z-Y Plane

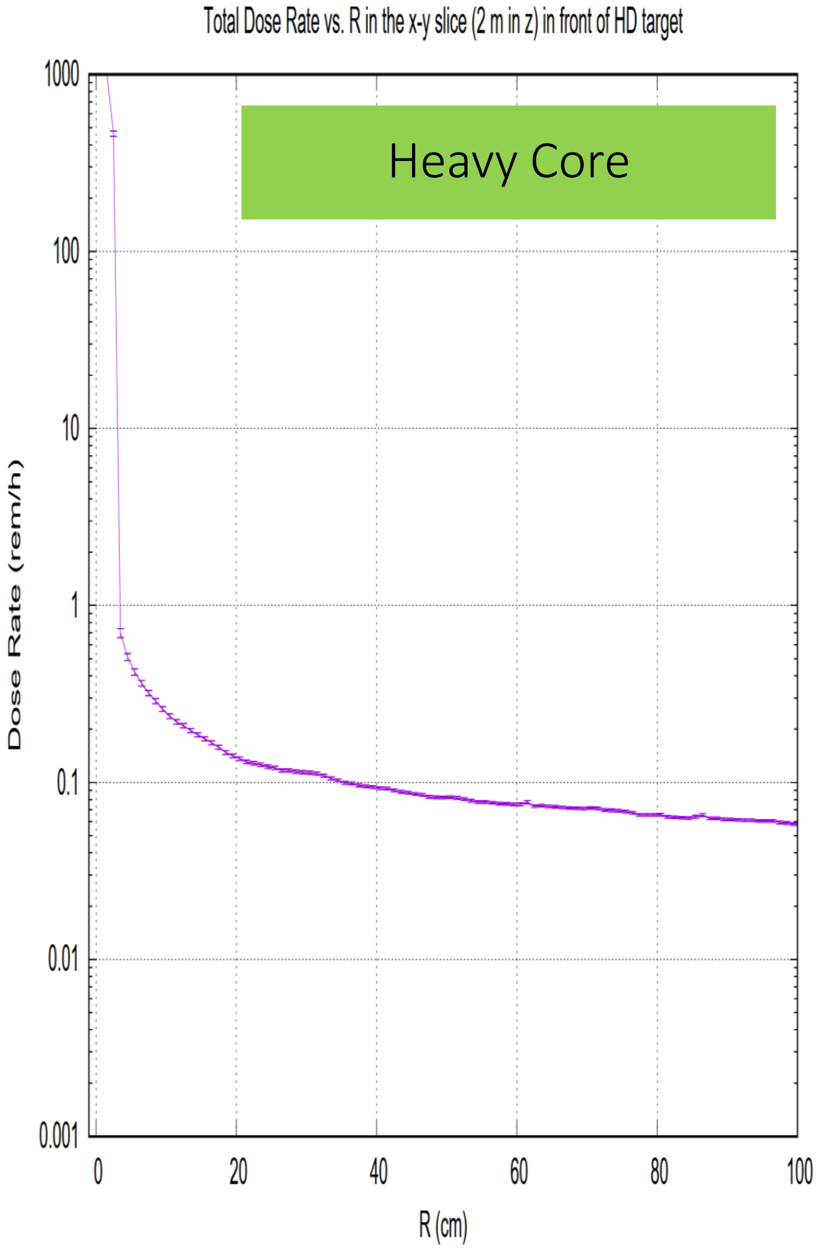


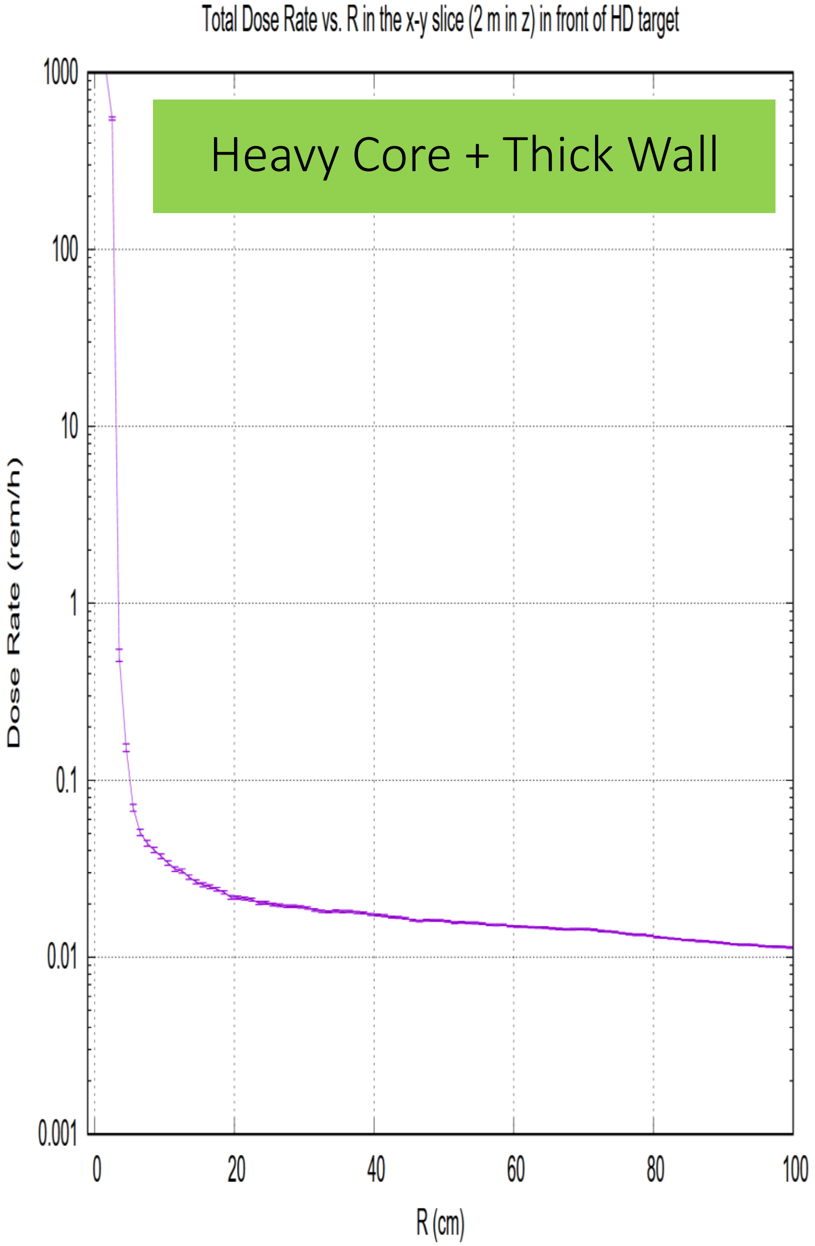
Heavy Core + Thick Beam Pipe model
Total Dose Eq. Rates



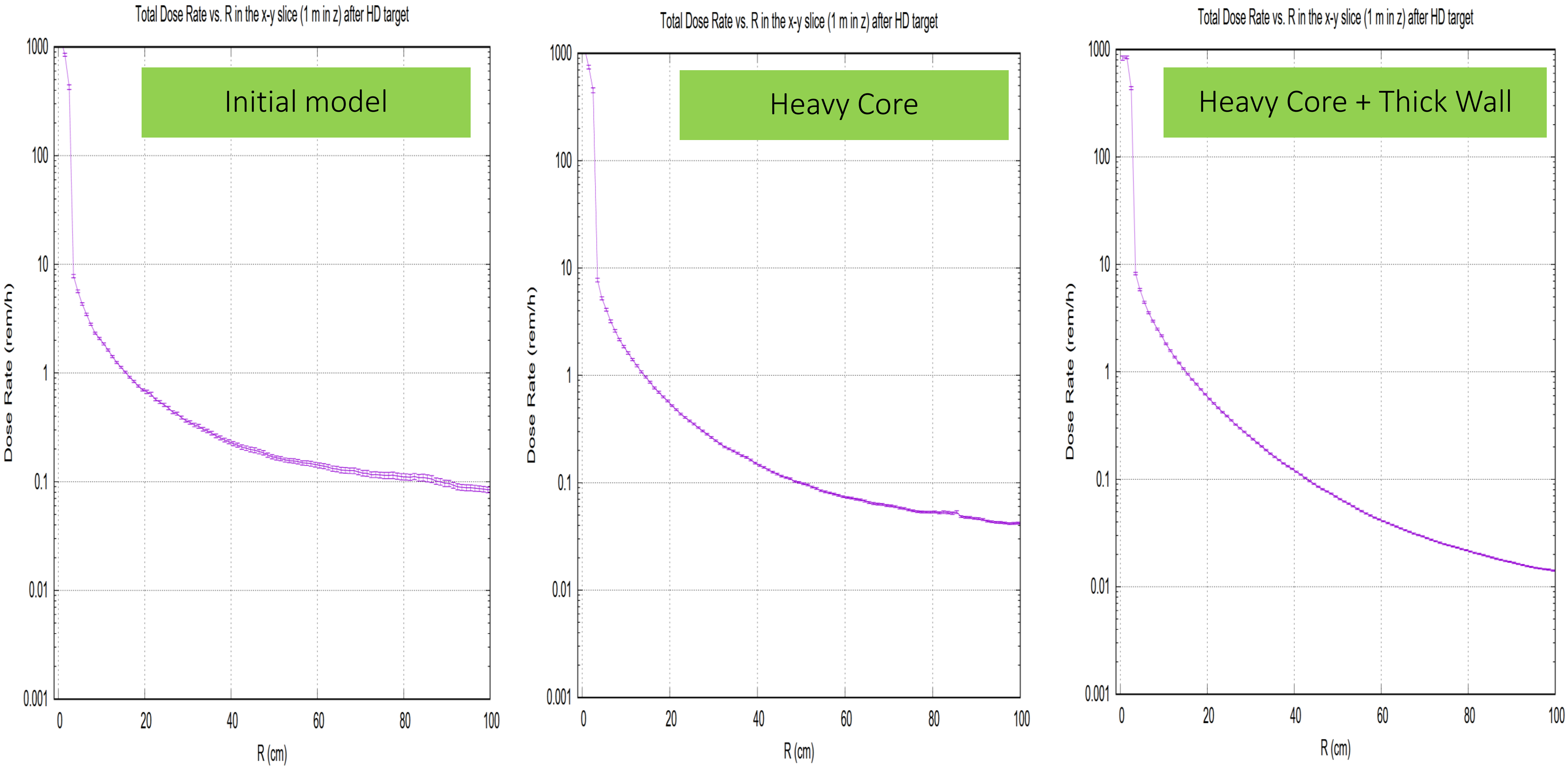
Dose-Eq Rate function of R, 2 m z-slice in front of target





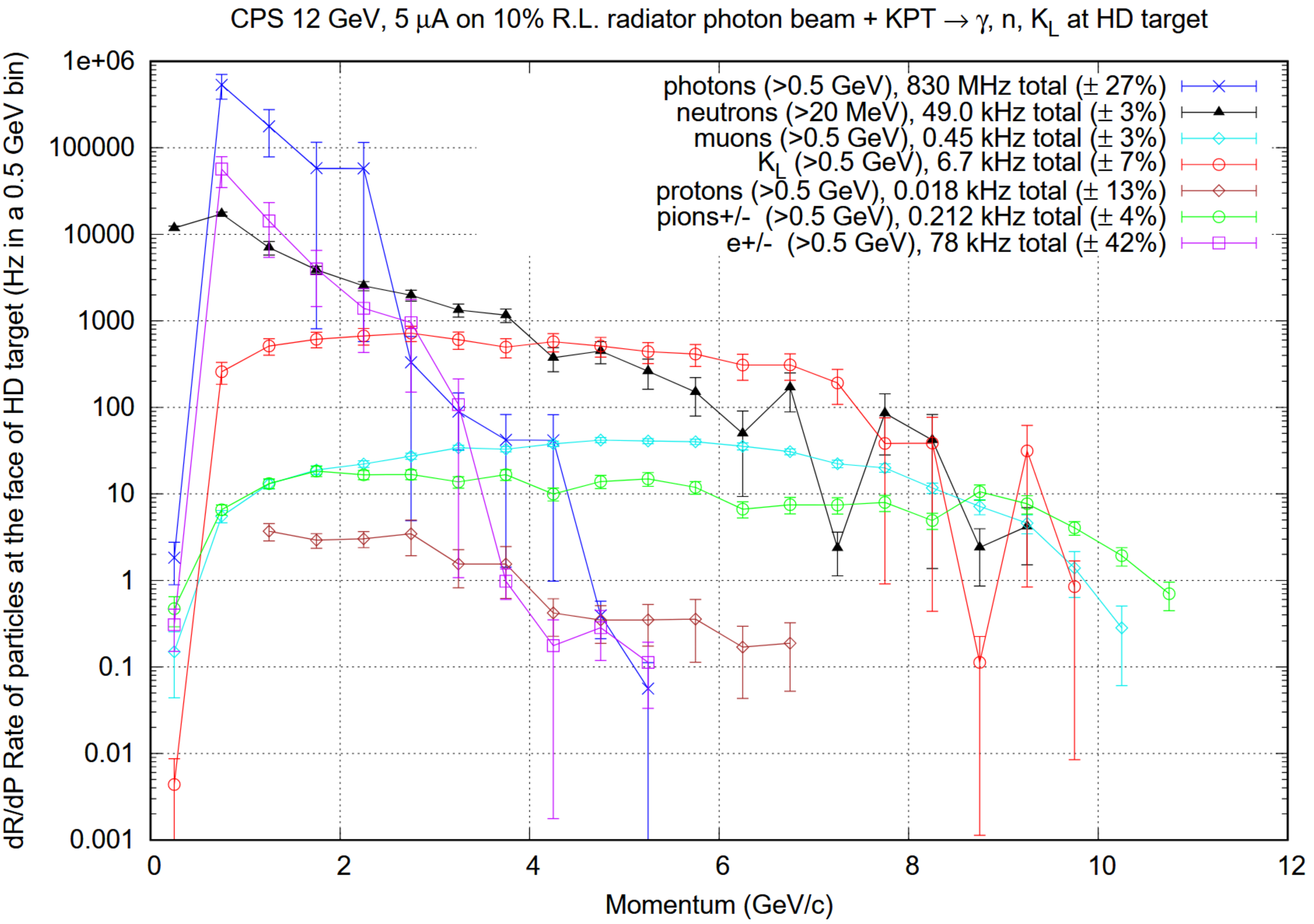


Dose-Eq Rate function of R, 1 m z-slice after target



Target Count Rates

High model threshold



Low model threshold:

~1 MHz n
~3 GHz γ

- At lower particle energies

Highlights – October 17th, 2024

- Continuing with efforts to understand high count rates in GlueX, trying to address the issues and find ways to optimize the solution
- The methods of heavy material shielding around the beam pipe in the Cave, and the method of shielding of the beam pipe in the Hall work to suppress dose rates in GlueX detectors.
- Correct implementation in the model the Pair Spectrometer magnet would help somewhat.
- The optimization parameters will also include the thickness of the Tungsten dump after Beryllium target, beam apertures, and possibly varying the radiator thickness