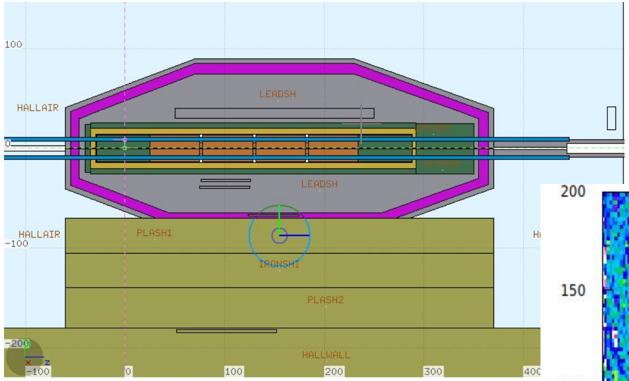
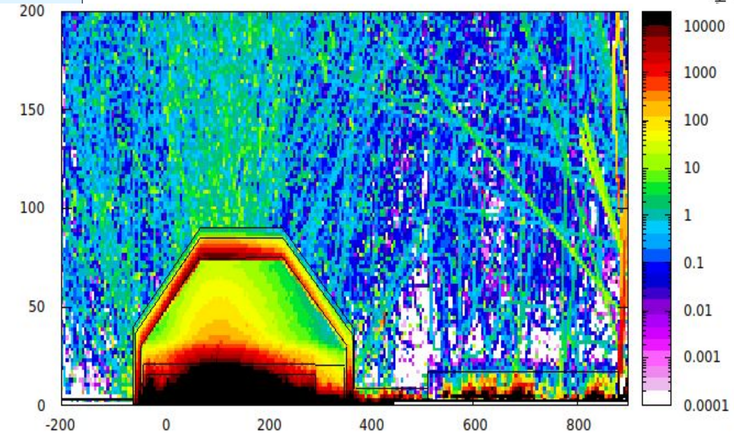
Reference design updates

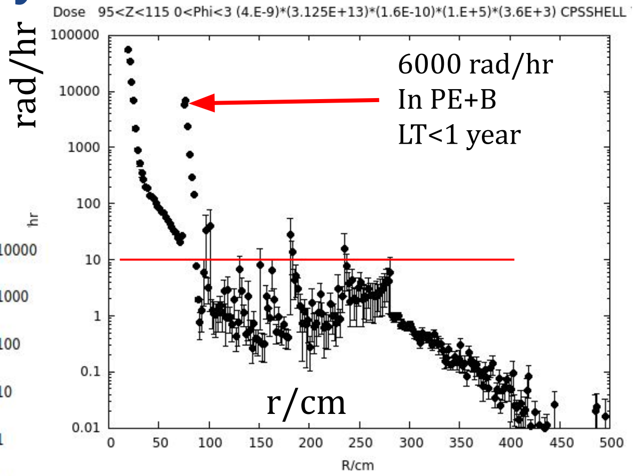
1. Optimized CPS and Polyethylene lifetime.

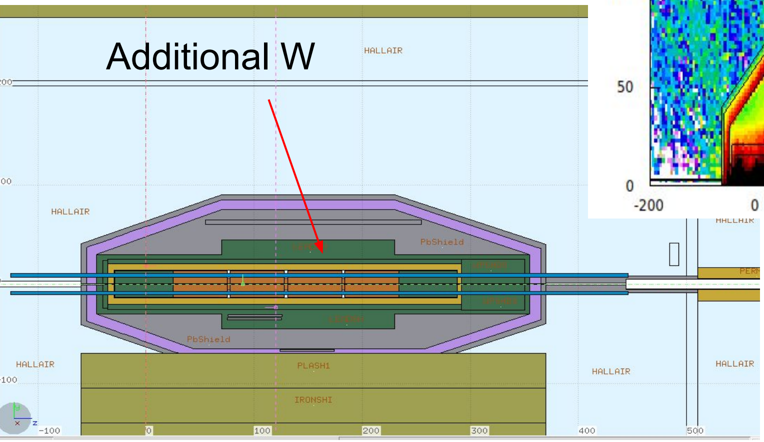
2. “Photon gun” with no Tungsten.

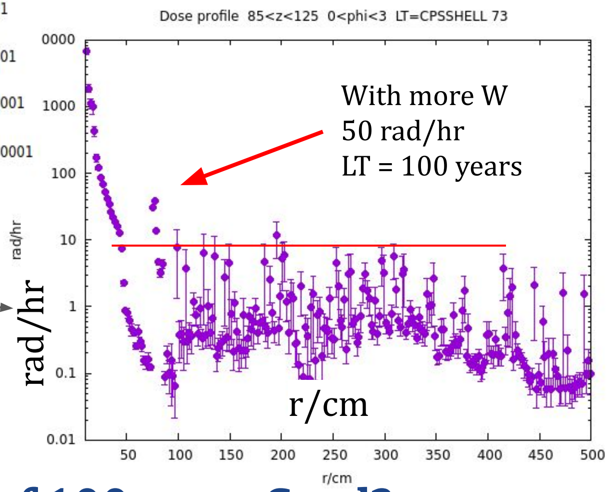
“Optimized” CPS . Prompt dose and Polyethylene lifetime .

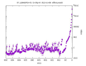








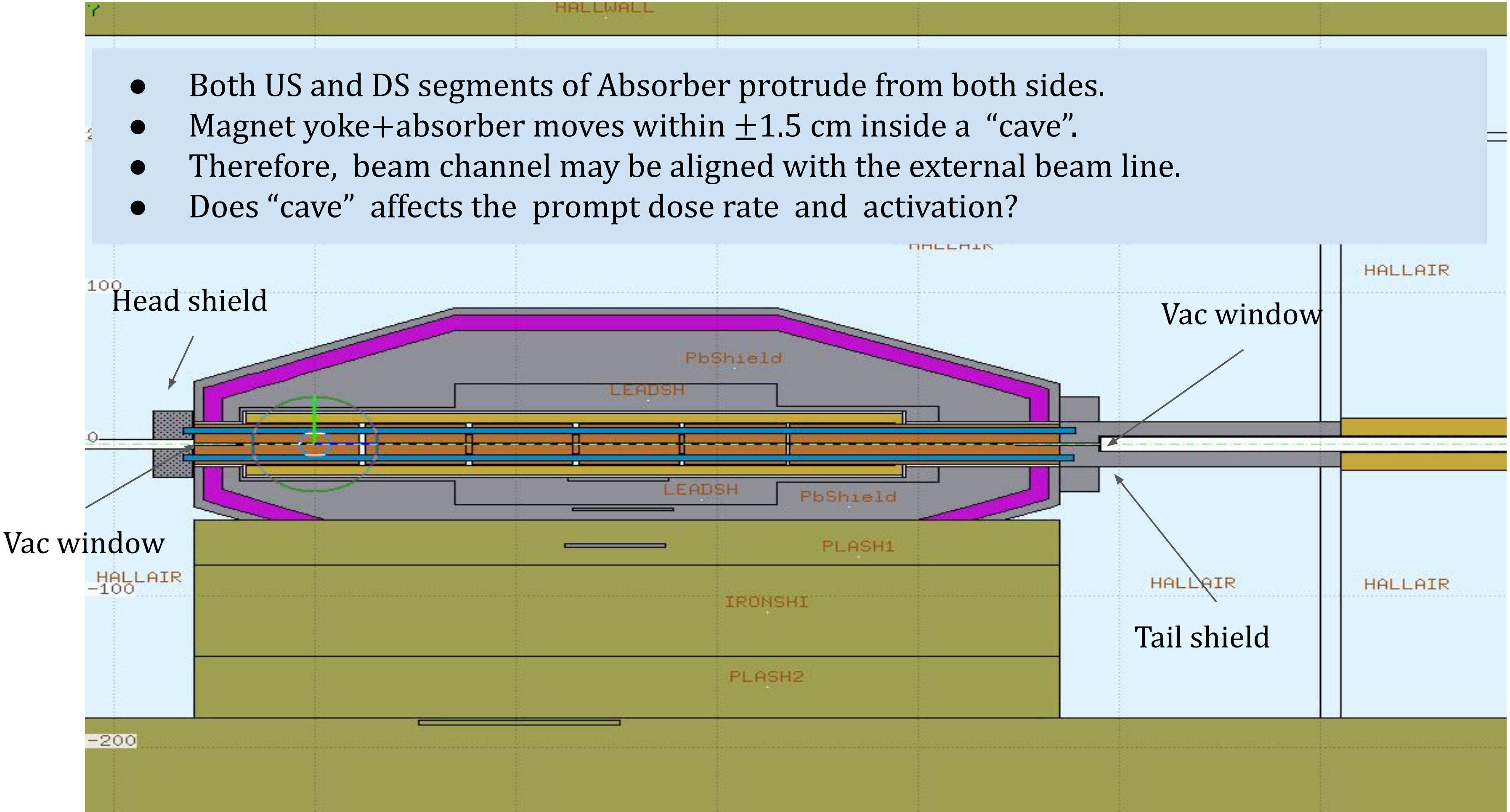




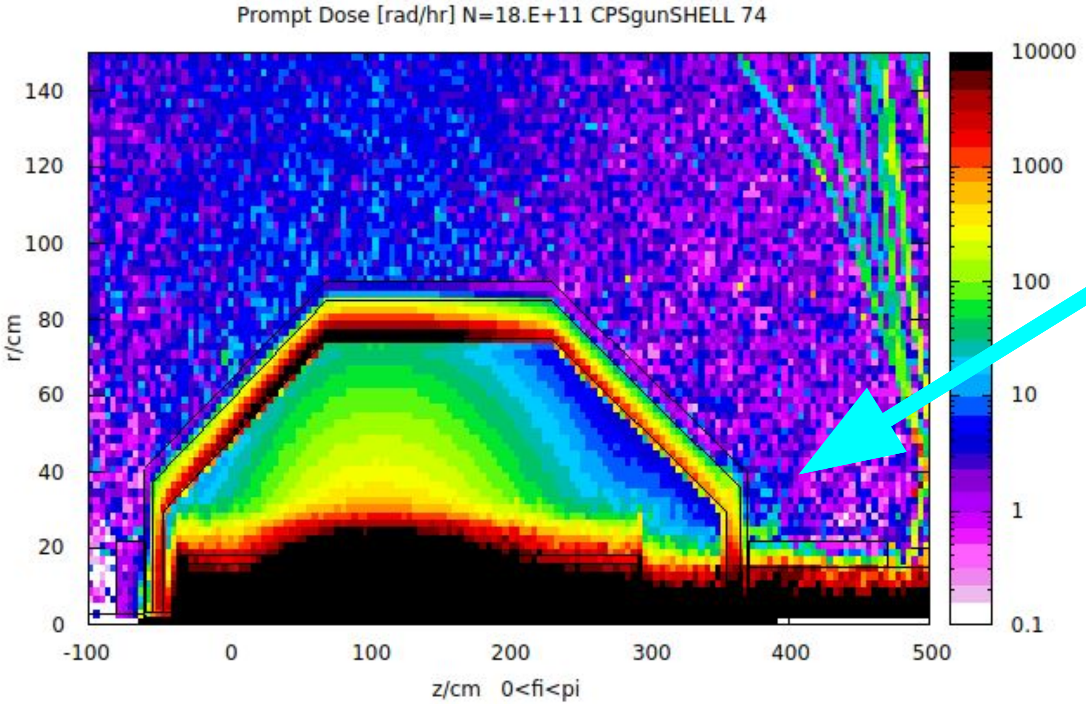
- **Additional Tungsten shield results in PE lifetime of 100 year. Costl?**

“Photon gun”. Lead on place of Tungsten. Air inside. Vacuum Windows.

- Both US and DS segments of Absorber protrude from both sides.
- Magnet yoke+absorber moves within ±1.5 cm inside a “cave”.
- Therefore, beam channel may be aligned with the external beam line.
- Does “cave” affects the prompt dose rate and activation?



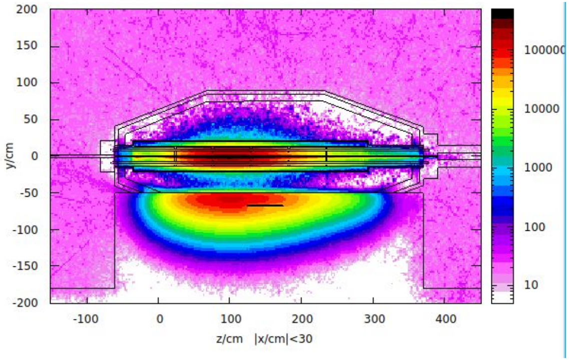
“Photon gun”. Prompt Dose rate in rad/hr.

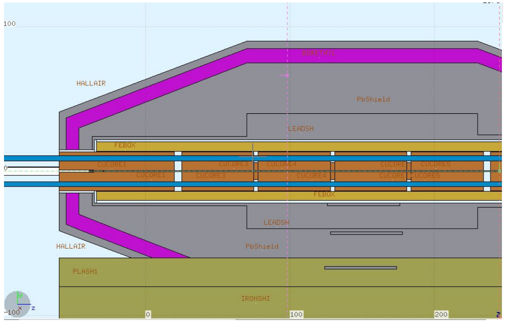


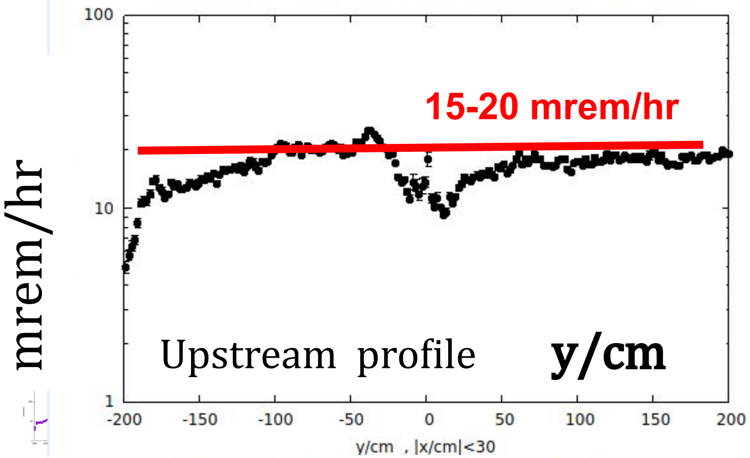
Tail shield Effect: low prompt dose

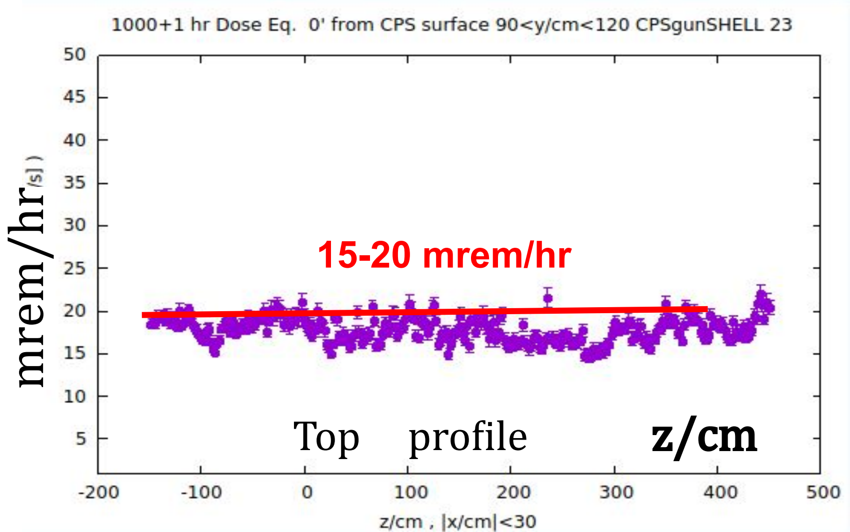
- Prompt dose around CPS below 10 rad/hr, as specified in “CPS Technical Note”.
- Power in Absorber as specified in “CPS Technical Note” – $P_{max} = 1.7\ kW/cm^3$ (200º C)
- In the alternative model $P_{max} = 7\ kW/cm^3$.

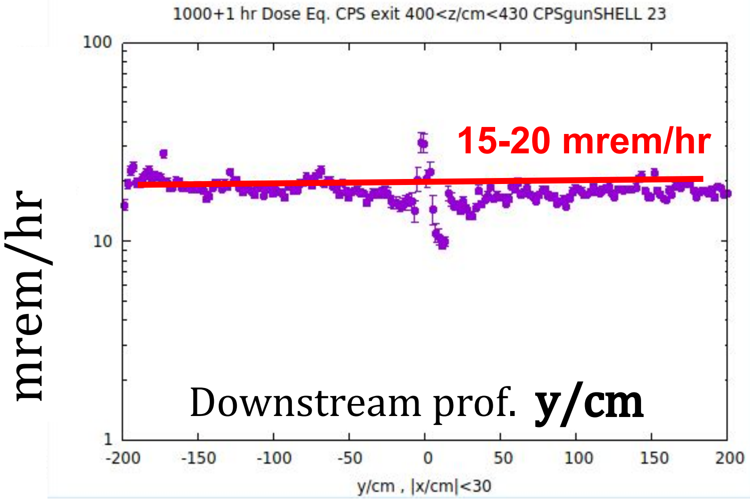
“Photon gun”. Activation after 1000+1 hr. Dose eq. and human safety.



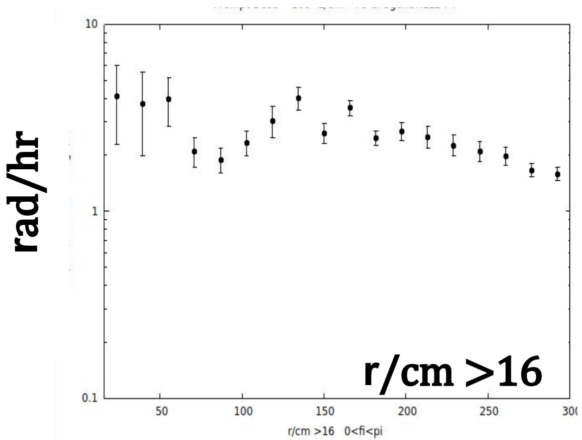


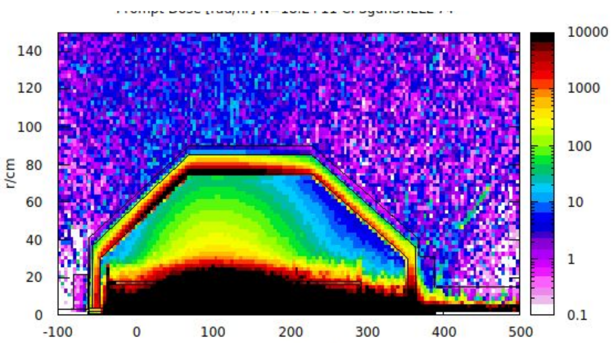


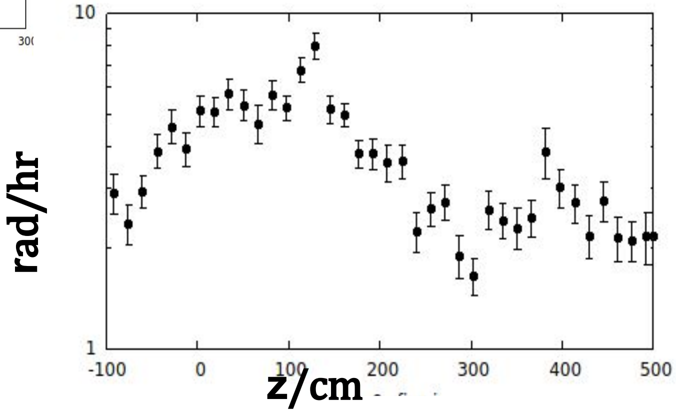


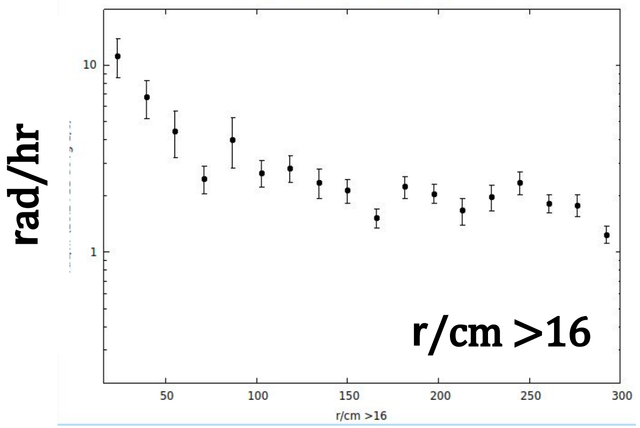


Photon “gun”. Prompt Dose profiles and CPS materials lifetimes.





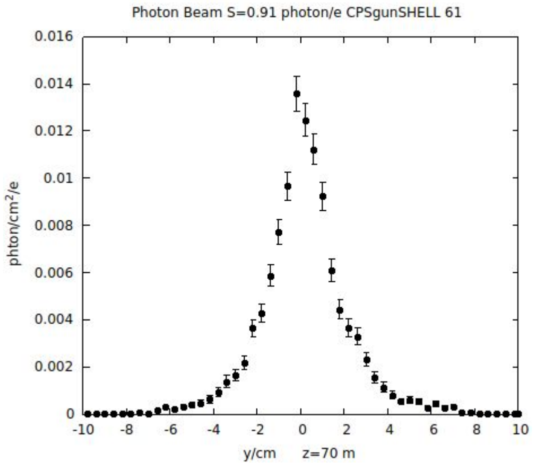




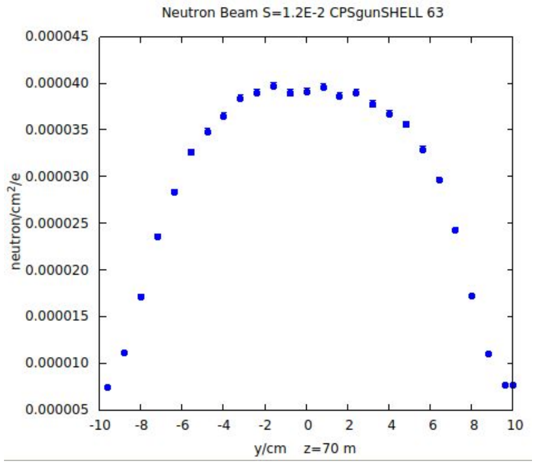
- Prompt dose < 10 rad/hr => Lifetime of materials as in CPS tech. note.

Photon Gun. Air in beam channel. Beam quality.

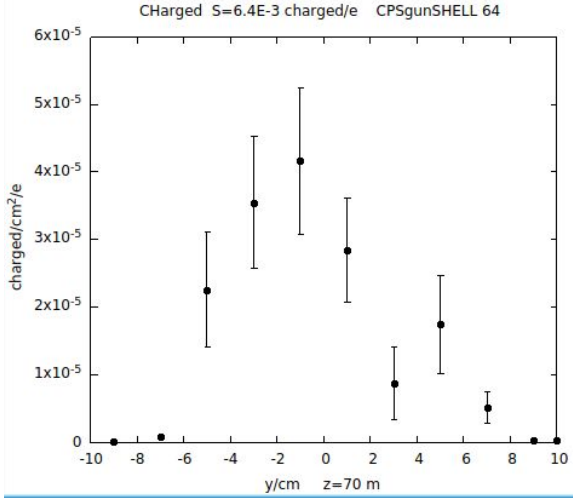
S=0.91 γ /e



S=1.2E-2 n /e



S=0.6E-2 n /e

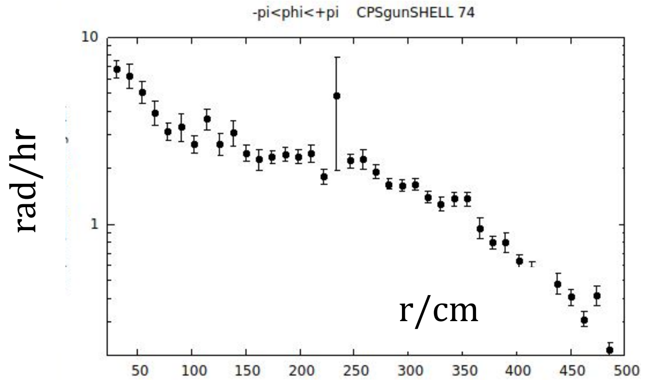


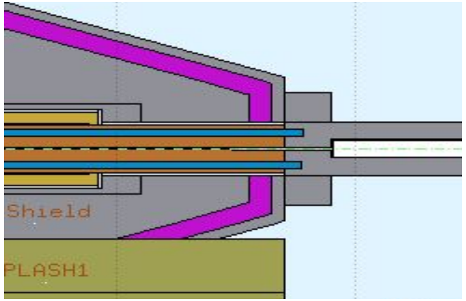
- Slightly lower yield of photons due to vacuum windows (0.2 mm Al).
- Slightly higher backgrounds of neutrons and charged particles.

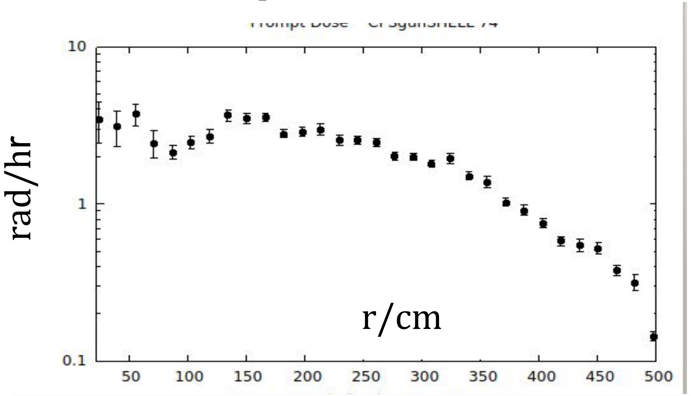
“Photon Gun” vs Ref. No vacuum in beam channel. Prompt Dose rates.

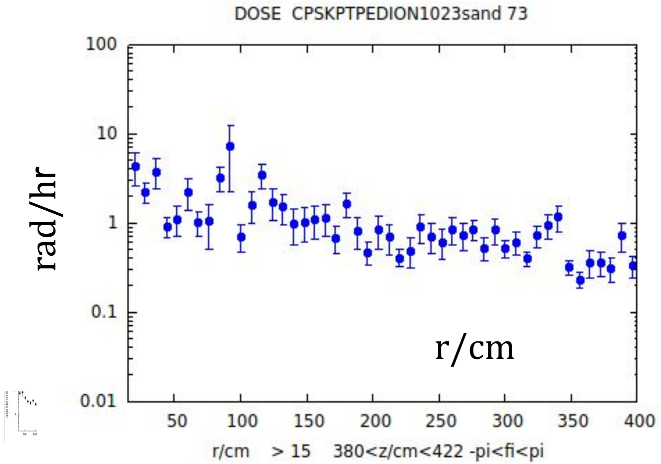
Downstream CPS

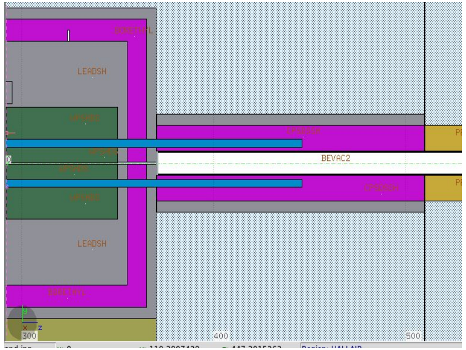
Upstream CPS

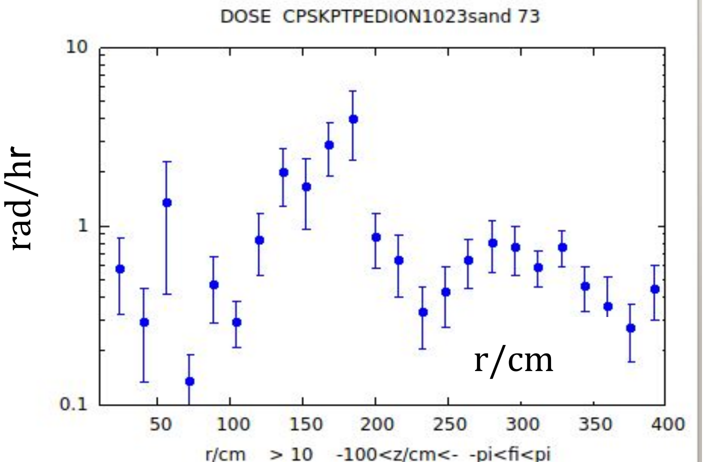






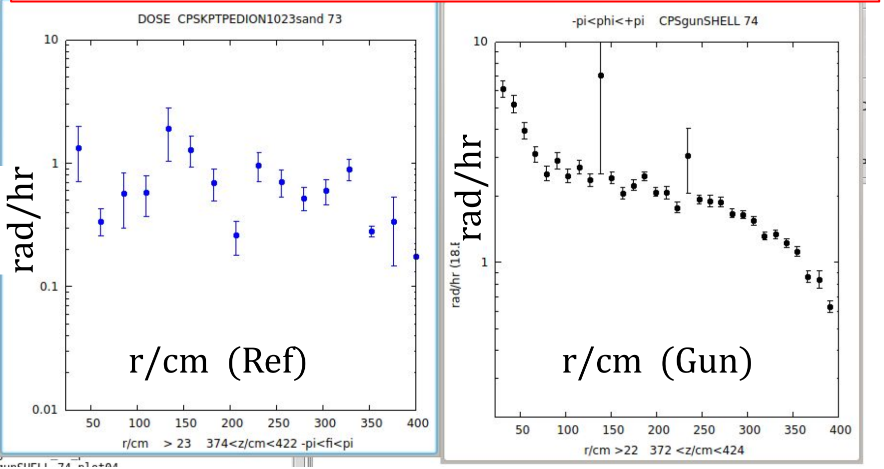




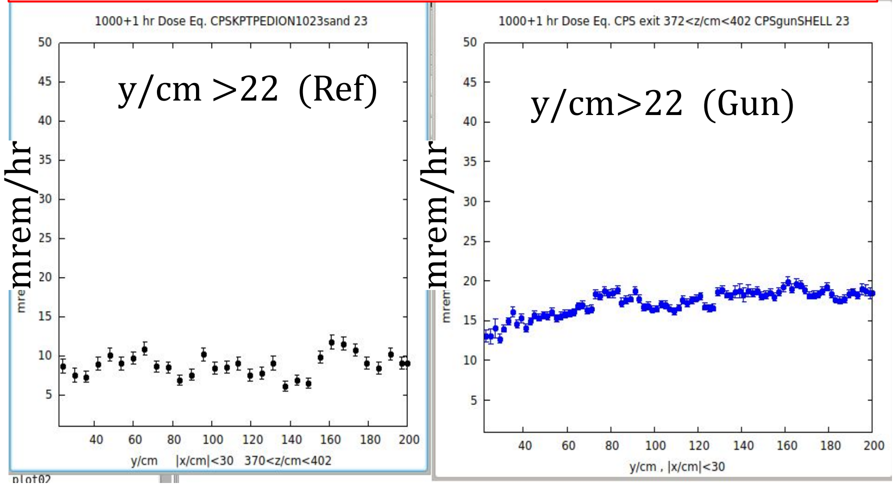


Reference CPS with W-shield vs “Photon Gun” with no W.

Prompt dose 1’ downstream CPS

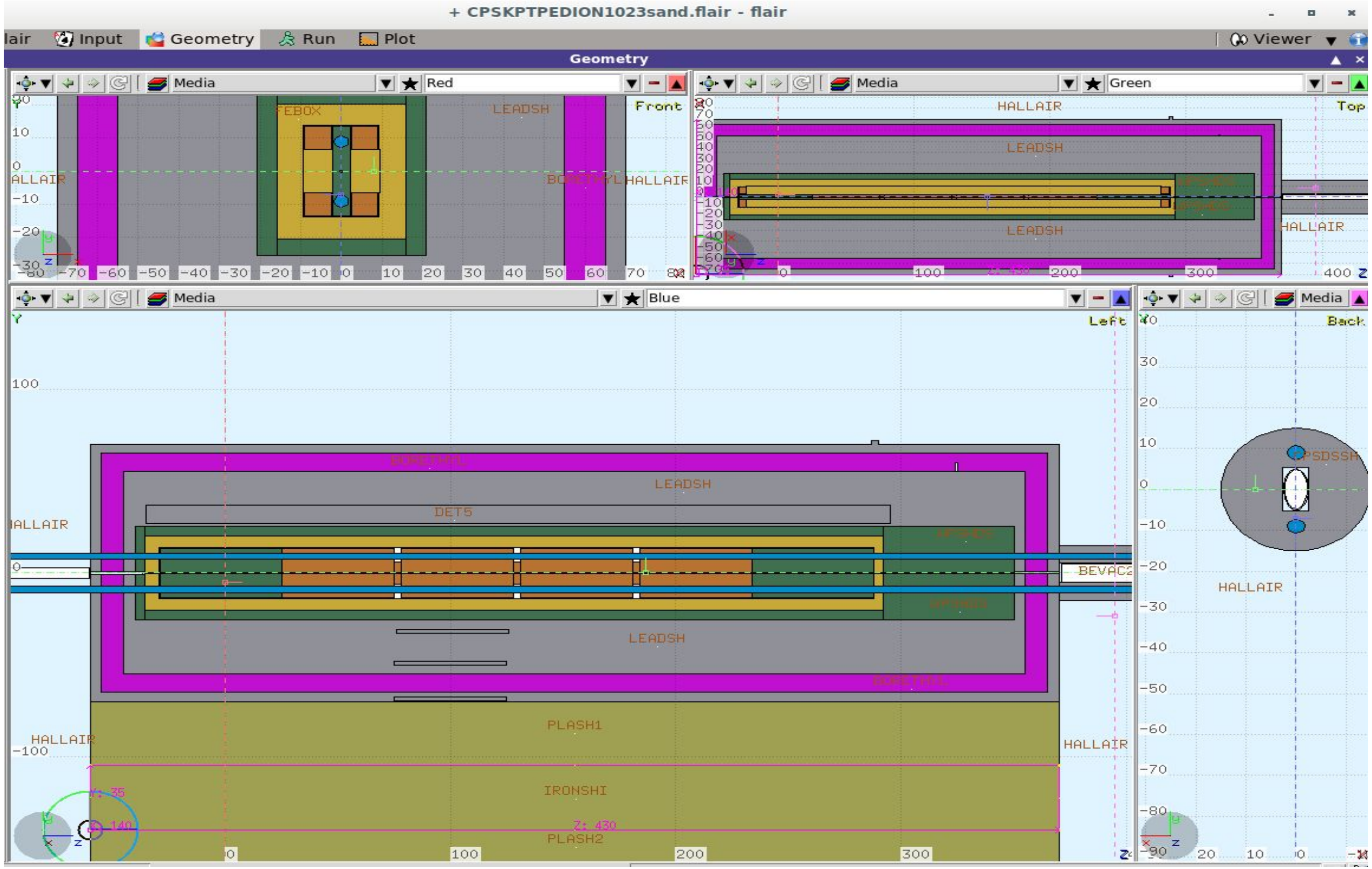


Activation dose eq. 1’ downstream CPS

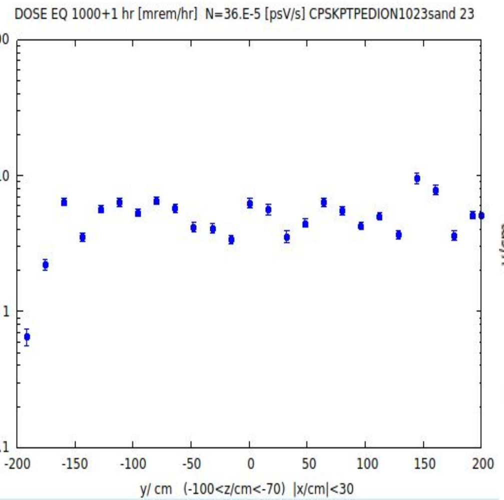


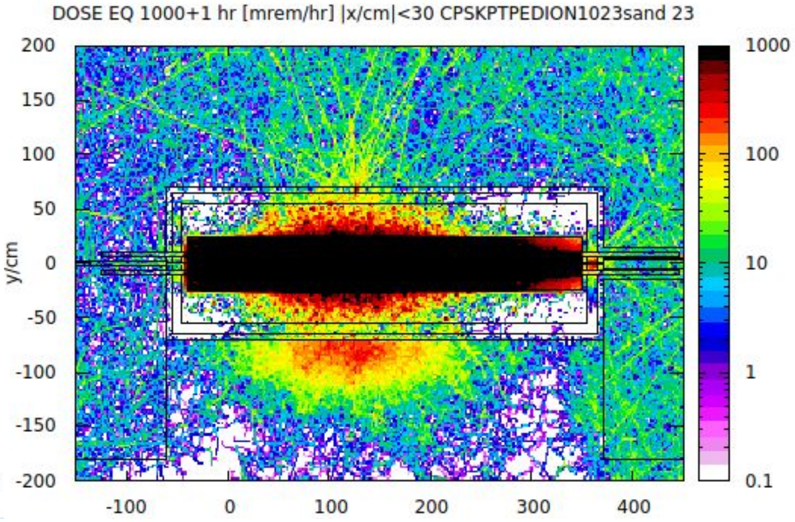
- Prompt Dose effect - ~2 times higher for “Photon Gun”.
- Activation effect - ~2 times higher for “Photon Gun”.

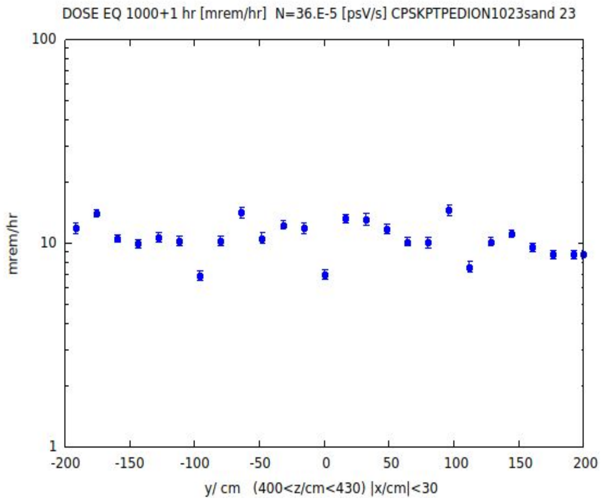
Reference design. Air iside CPS. Vac. pipes outside.

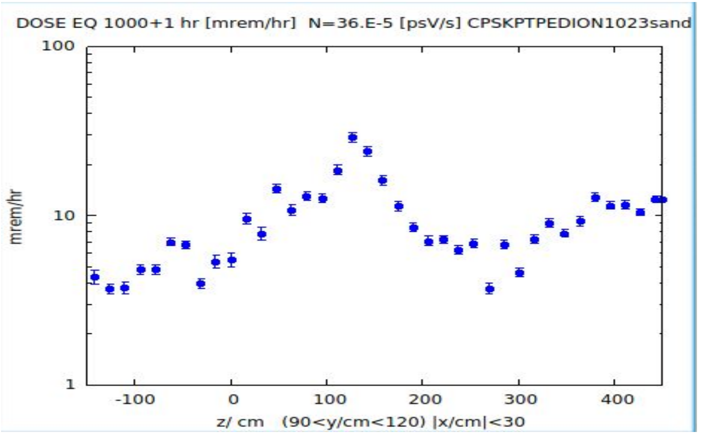


Activation after 1000 +1 hr.   Air inside CPS. Vacuum pipes outside.









Conclusion

Borated Polyethylene:

- Open question: what is the Lifetime of B-Polyethylene block under mechanical stress?
- May be saved with more Tungsten -cost!
- May be replaced with with BPE (+water) in container/tank, or B-acid, or B-concrete-design!

Photon Gun. Advantages:

- No tungsten – lower cost – but may be used to improve all parameters.
- Still low P_{max} =1.7 W/cm^3 (vs 7 W/cm^3).
- Adjustable beam channel.
- Variable magnetic field (In alternative model B-map is dictated by the absorber geometry).
- Ceramic insulation may be used incoils.

Temperature calculations:

- T-field at thermal contact via radiation <u>between lead blocks</u>.
- T-field at thermal contact via radiation <u>between water pipe and absorber</u> .