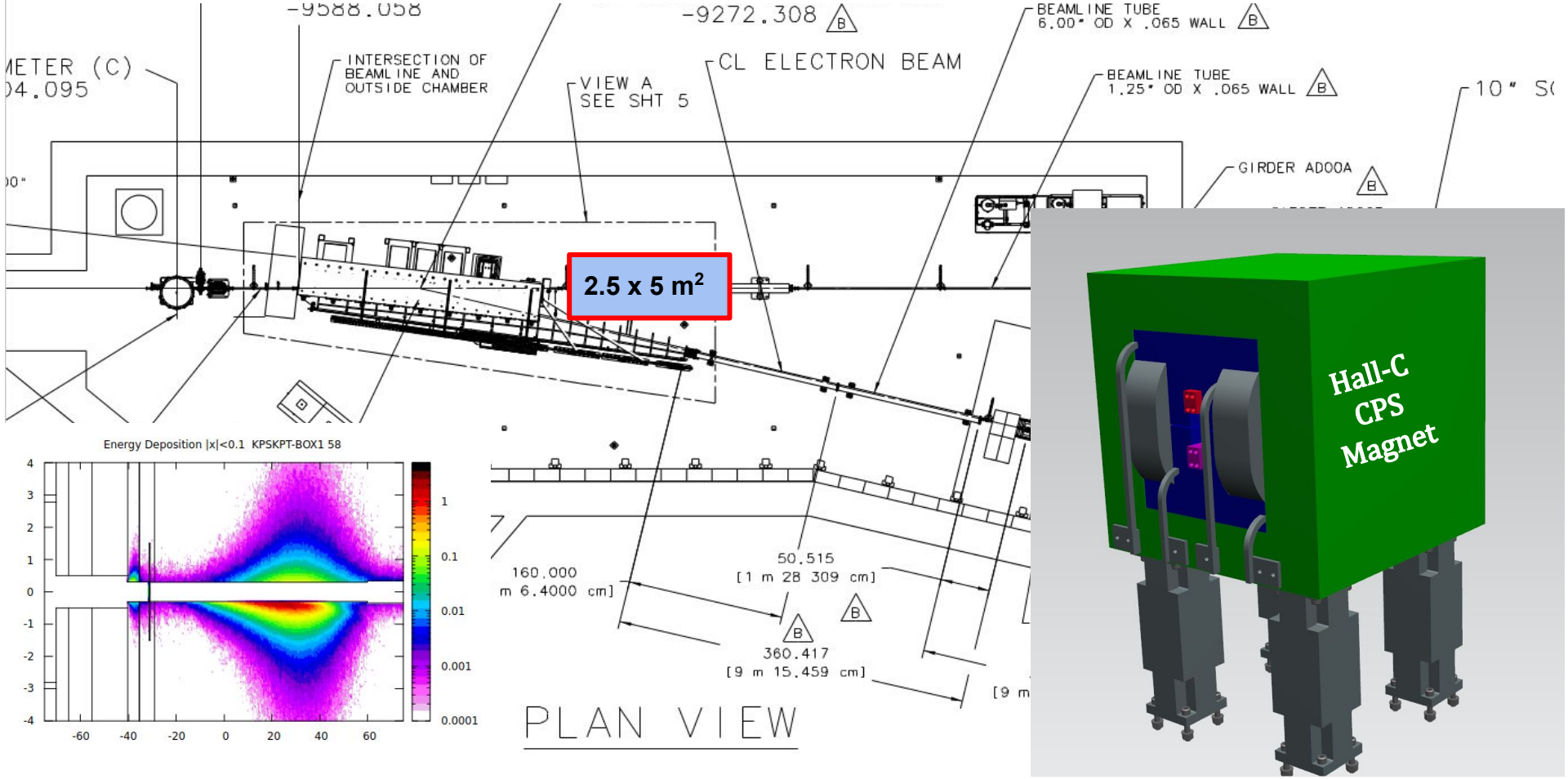
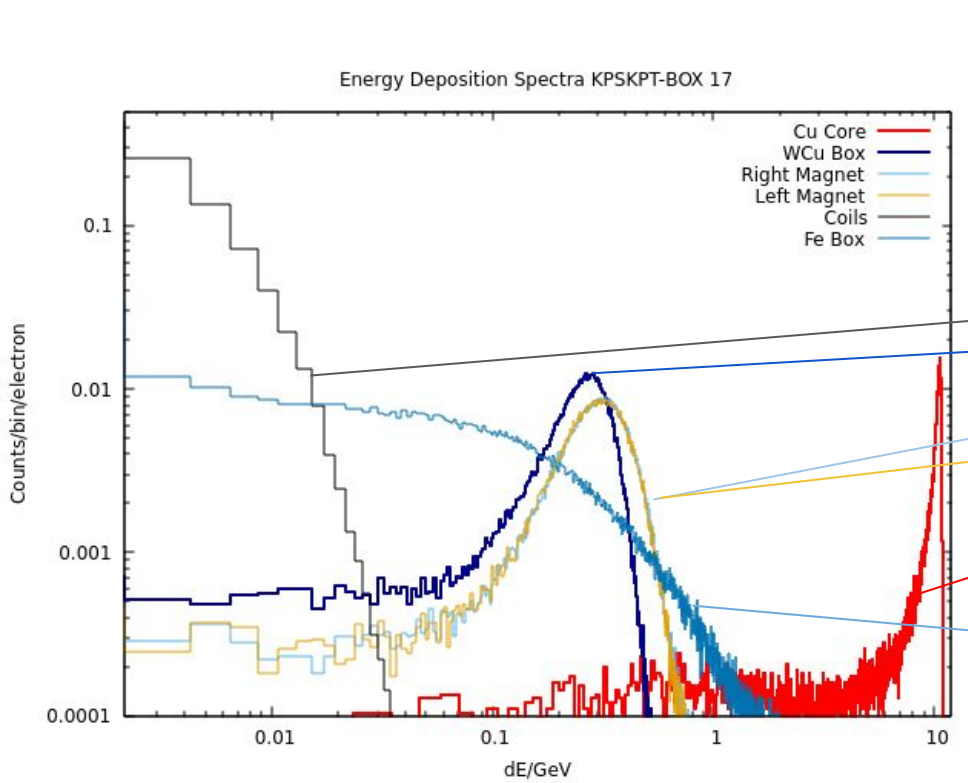
Hot spot Temperature and Energy Deposition
vs
Magnet Length and Materials
May 20 2022

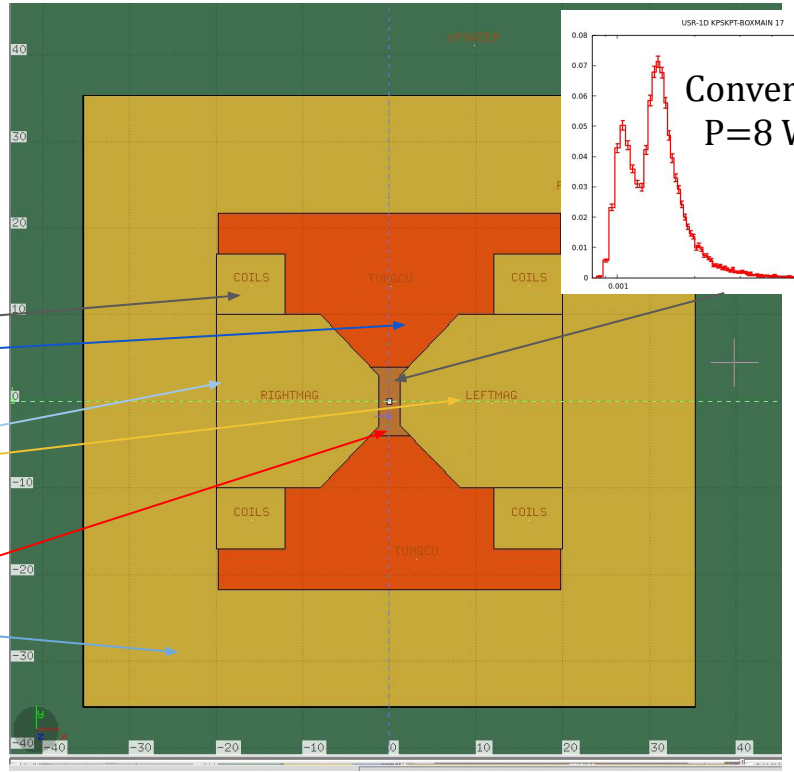
Beam FWHM=0.25 cm. Holes $1\times1\ \text{cm}^2 \rightarrow\ 0.6\times0.6\ \text{cm}^2$

Possible location for CPS. Magnet for Hall-C design.



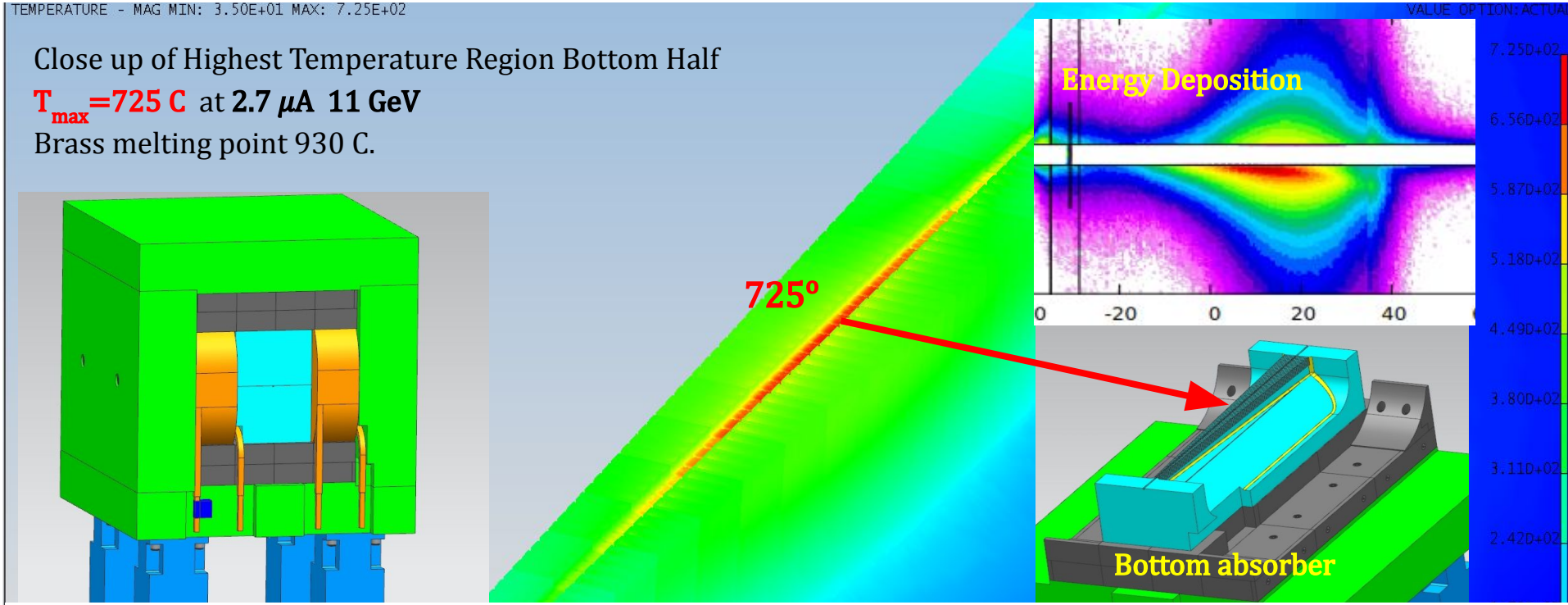
Energy Deposition Spectra in parts of CPS from Hall-C at 12 GeV.





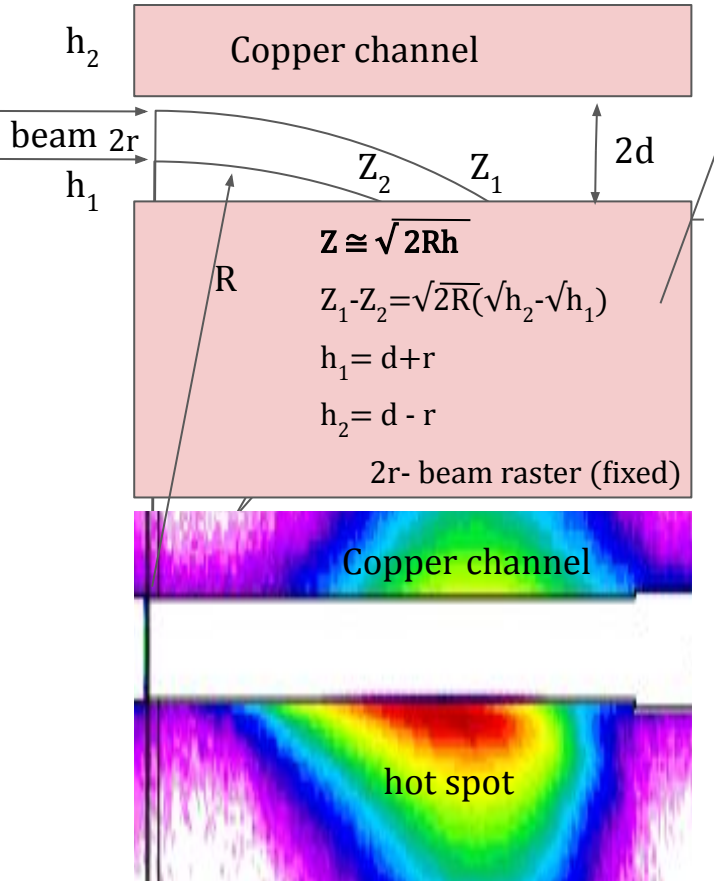
- Total Power in Cu core: P[W]=**1.E+10[eV/e]**1.6E-19[J/ev]0.6E+19[e/A/s]5.E-6[A] =**50 kW.**
- It is 80% of: P[W] = 1.2e+10 [V] 5.E-6[A]=**60 kW**. The rest of **10 KW** - in WCu and magnet poles.

Hot Spot Temperature. CPS design from HALL-C .



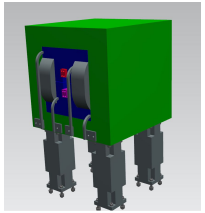
- What temperature (~1400 C ?) we expect at **5 μA of 12 GeV** e-beam for the same CPS design ?
- Can we use such design? To be addressed ASAP.
- It not, then how can we **respond to** a potential **challenge**?

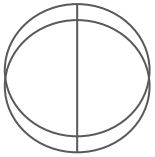
Maximum Energy Deposition vs Dipole Magnet Length and Filed

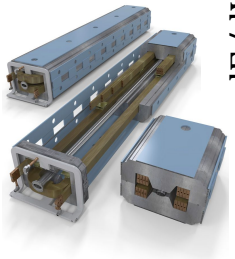


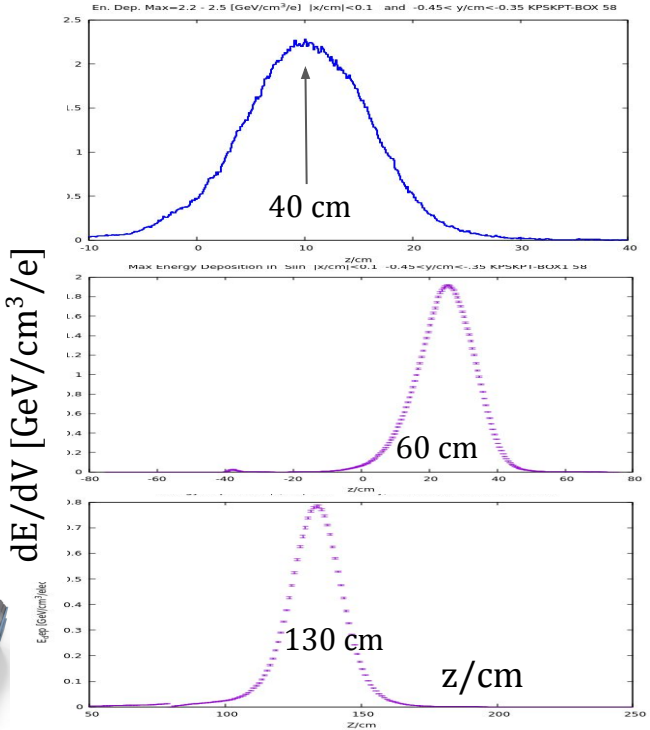
Focusing effect: partially compensated by z-dependent B(z).

Obvious conclusion: to make the hot spot wider reduce "B" (=> increase "L") and decrease "d" if possible; already at the minimum; beam size.







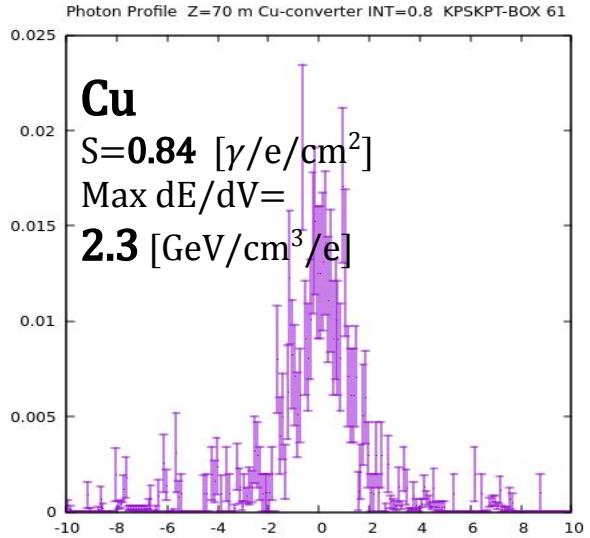


Reference Magnet
0.75m*3T
Max dE/dV=
=2.3 GeV/cm³/e

1.5m*1.2T
Max dE/dV=
=1.8 GeV/cm³/e

3m*0.35T
Max dE/dV=
=0.8 GeV/cm³/e

Maximum Energy Deposition and Photon Yield vs Converter Material.



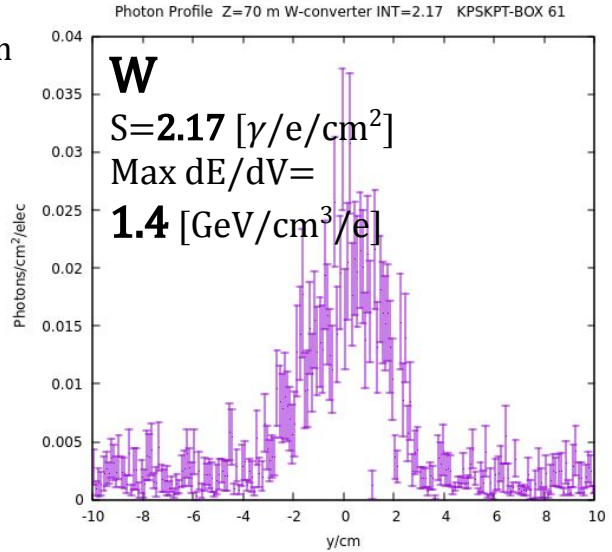
At 5μA current of e-beam

dE/dV=1. GeV/cm³/e

translates to

dP/dV = 5. kW/cm³

=5 W/mm³



- Seems W-converter provides ~ **twice lower** dE/dV in the hot spot and **tripled yield** of photons.
- However photon beam is about **twices wider**. What is photon **energy spectrum**?
- We may have **factor 3 × 2 (field × conv.)** to **scale down** dE/dV in "hot spot" .
- Photon **yield to KPT** and **E-spectrum** to be studied. If OK - additional factor ~2 from lower **beam intensity**.

Hall-C CPS Updated April 26, 2022

What we learn from the presentation of Steven Lassiter

- If **top half of absorber** does not make good **thermal contact** with **bottom half**, temperature **rises** in bottom half up to **1140 C** !
- **Boundary conditions** are not realistic, waiting on **Fluent models** to determine proper BCs.
- **Bottom half will be sitting** on W-Cu blocks. **Top Half** will have W-Cu blocks **on top** also.

What to do ASAP.

- **Thermal Map and Stress** to be addressed by Hall-D ASAP.
- A simplified **FLUKA model** and exported ***.scad** file is prepared.
- **Cooling lines** to be included. **Mesh** for T-map to scale in *mm* (beam size).

Absorber Bott Half of Absorber. NO good thermal contact with Top Half.