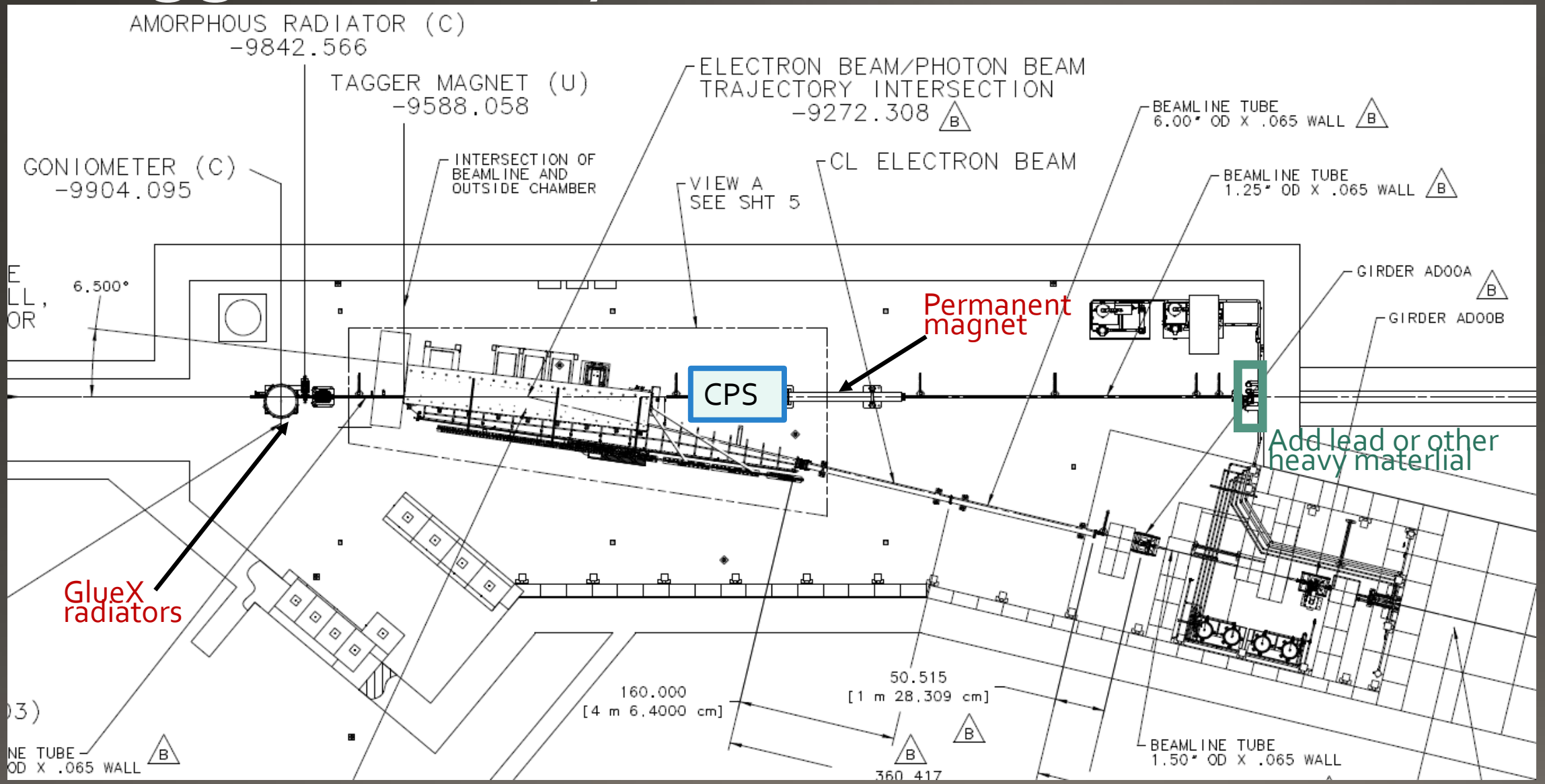
Hovanes Egiyan

Compact Photon Source Status

Overview

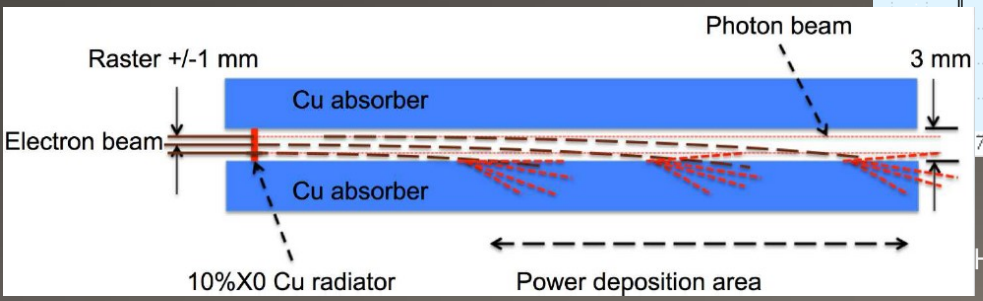
- Considering a photon beam source that would contain the radiator, magnet, and the beam dump.
  - Allows for narrow photon beam with high intensity
  - Low prompt and post-operational radiation levels
  - No photon tagging possible
- Joint CPS collaboration exists between Halls A/C and Hall D
  - Paper published NIMA 95, 163429 (2020)
  - Regular meetings held on Friday mornings
  - Almost all material in this talk is from Hall A/C efforts
  - The cost estimate for the proposal was $2.7M
- KLF is starting to evaluate modifications required for Hall D version
  - 60kW vs 30kW beam energy for Hall D
  - Different beam rastering schemes and beam sizes
  - Less space constraints in the tagger hall

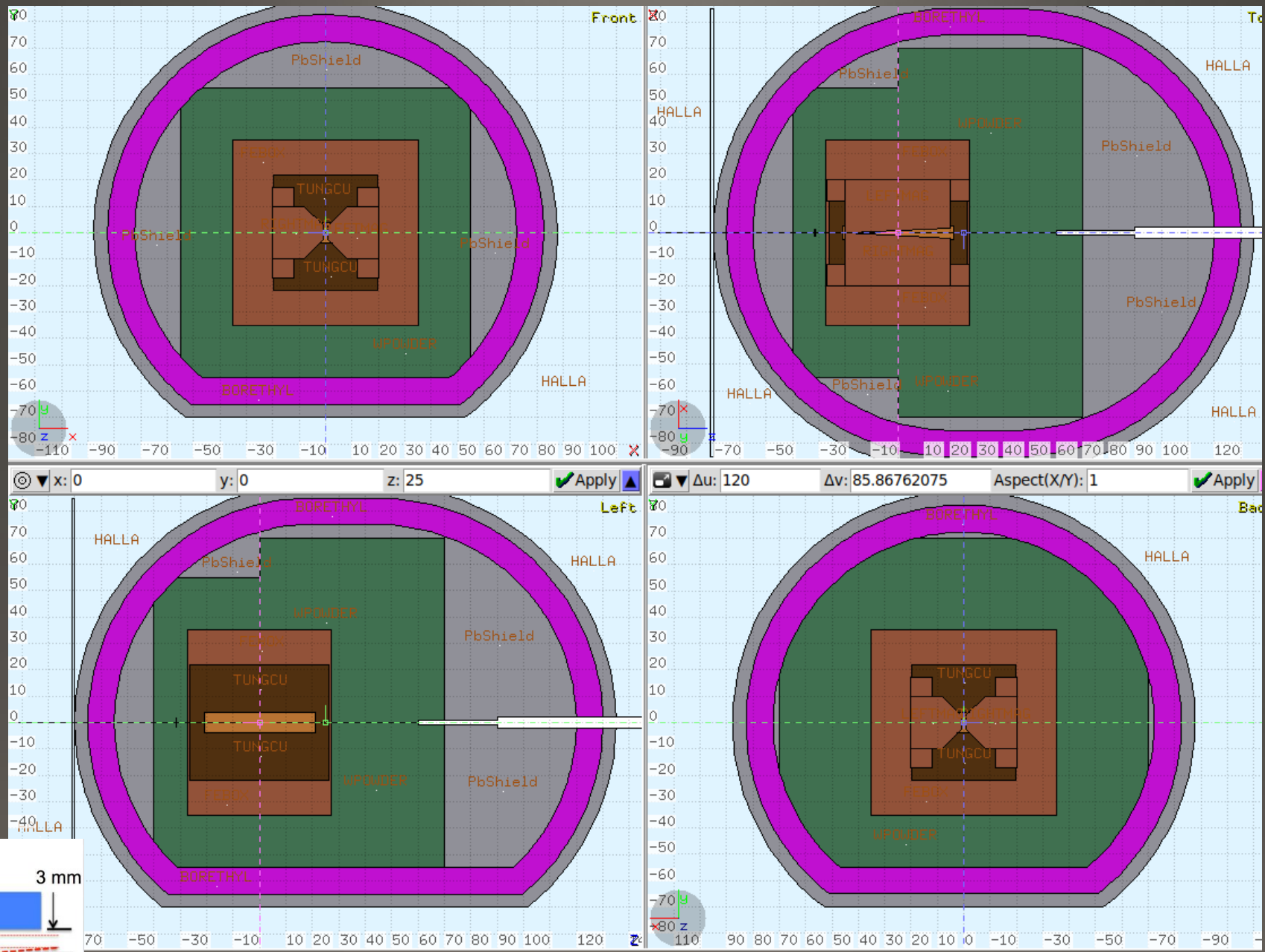
Tagger Hall Layout



Design

- Combine 10% RL radiator, cleanup dipole magnet and beam dump into the same device.
  - Expensive shielding, but less radiation in the hall.
- Dump the energy of the bent electron beam into a water-cooled copper core.
  - Heat dissipation needs to be controlled
- The photon beam exits the CPS assembly through a "narrow" channel at the other end.
  - Radiation leaking from the CPS proper needs to be acceptable to the lab.

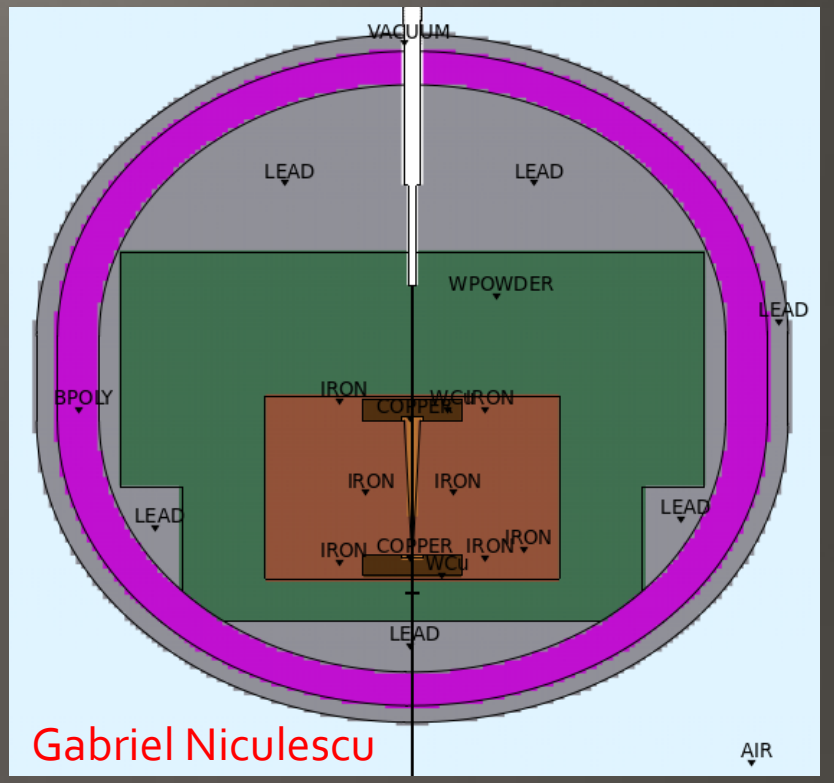


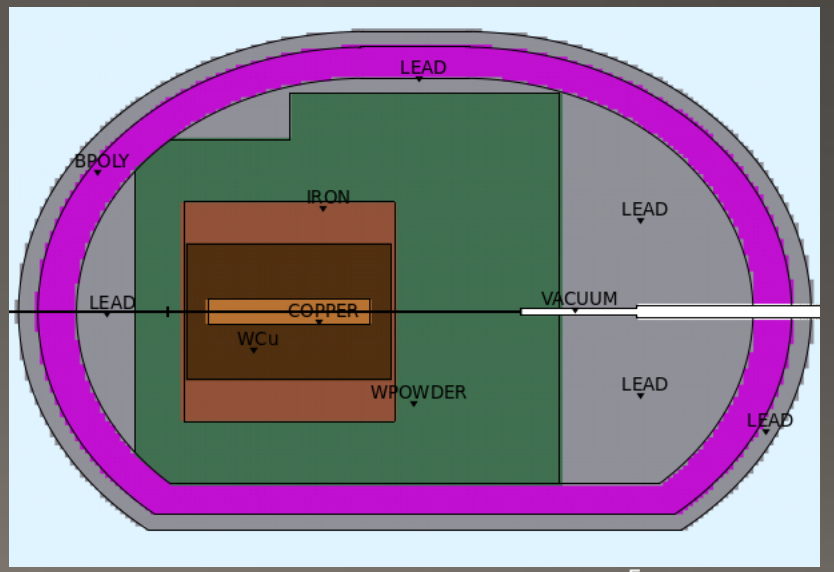


Gabriel Niculescu

Design

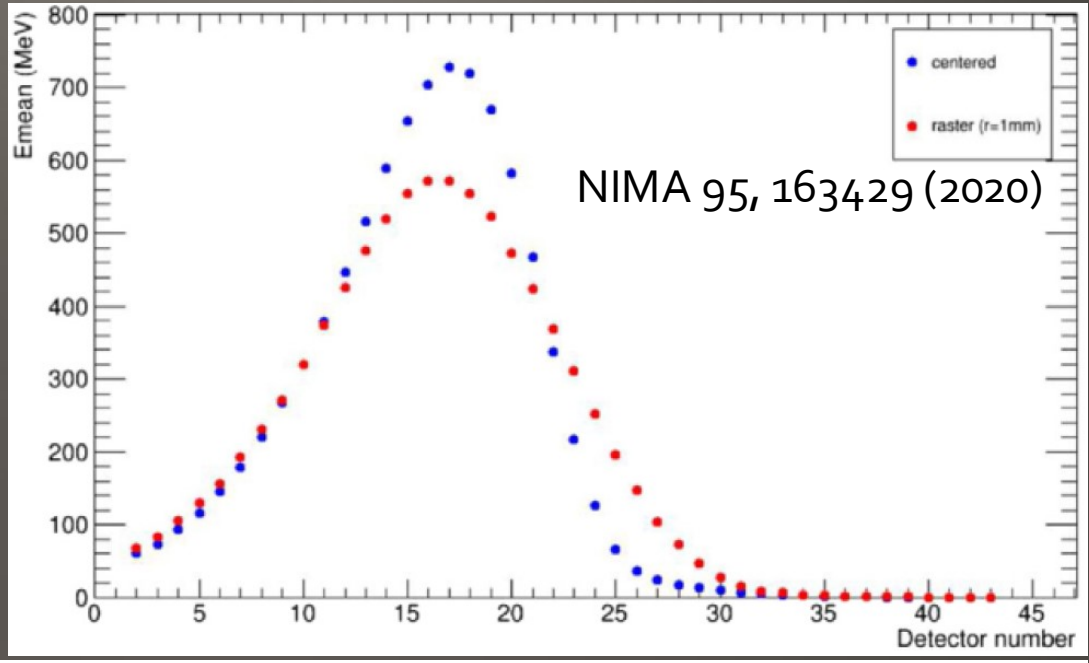
- There is a design of the 10 kG•cm magnet coils and poles (B. Wojtsekhowski)
  - My understanding is that the magnet design is not yet final.
  - Some of the features of the magnet may need to be modified.
- G. Niculescu maintains the Hall A/C versions of CPS geometry in FLUKA input files.
  - Good point for us to start with Hall D version.
  - We got his file and studying it.
- Hall D may try various modifications
  - Try to increase the horizontal beam size and widen the copper core to handle double the deposited energy.
  - We may also try to make the magnet longer and increase vertical beam size too.
  - We will likely increase the entrance hole to accommodate beam size.
  - We should consider reducing the exist hole size (>4cm in diameter now).
- We also need to plan on how to tune beam into the CPS opening.
  - May need to have a girder with a stripline BPM just before of CPS, or a wire scanner very close to the front of CPS.

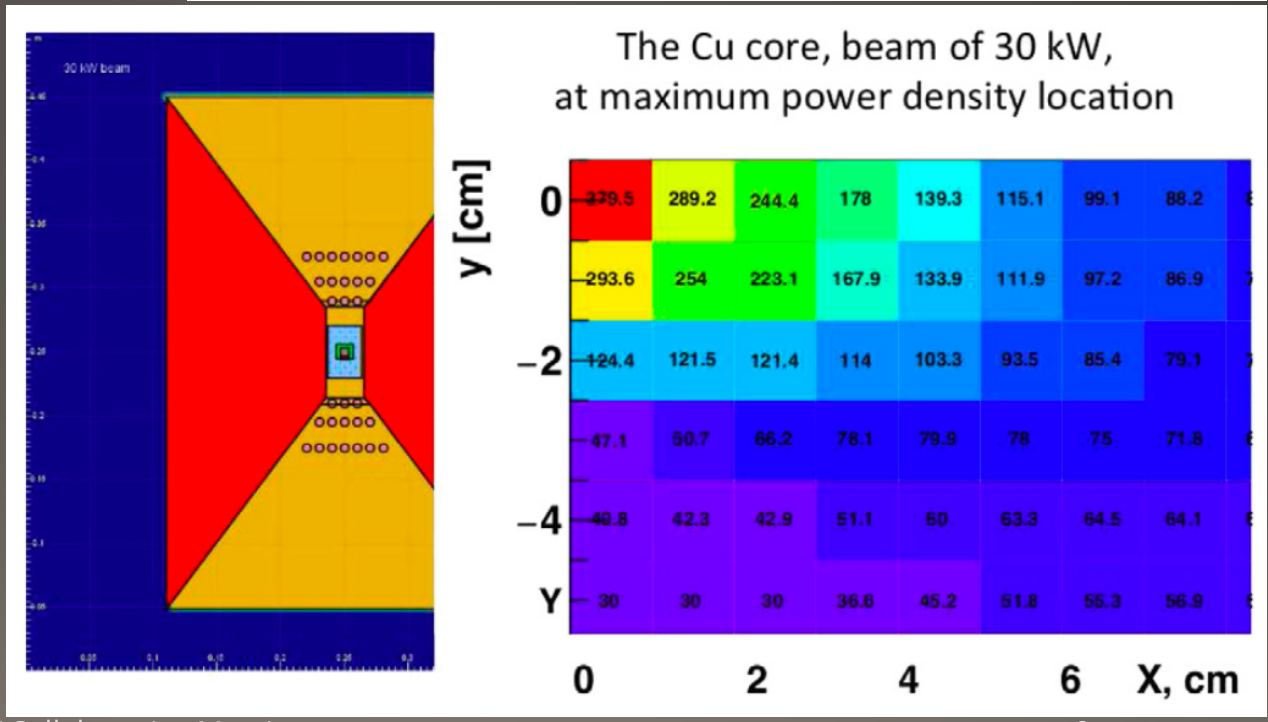




Heat Transfer

- The energy deposition for Hall A/C in the copper core is estimated using FLUKA by Gabriel.
  - I have his input file and learning how to use FLUKA with it.
- Temperature in the copper core has already been estimated for Hall A/C for the NIM paper.
  - The hottest spot would be at around 400° C.
- There has been a suggestion that the heat transfer problem is not done correctly and the temperature might be grossly underestimated.
- Amy Comer is working with ANSYS program to implement the CPS model and calculate the temperature distribution.
  - She needs an input as a formula or a table for energy depositions.
  - Work in progress.
  - The latest results seem to be consistent with the previous calculations.





Radiation Dose Rates

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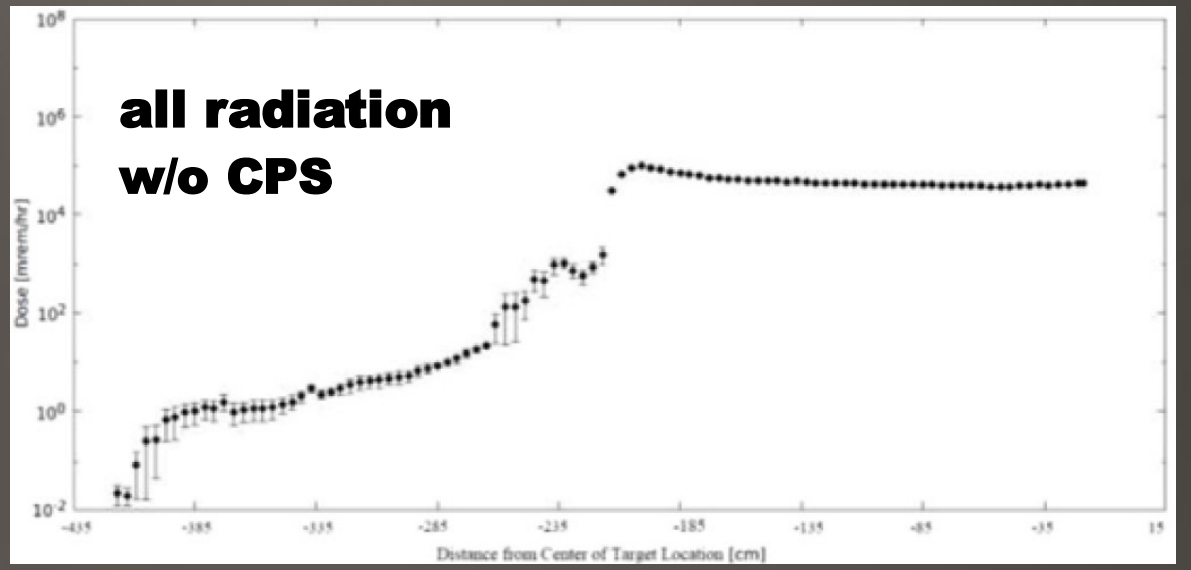
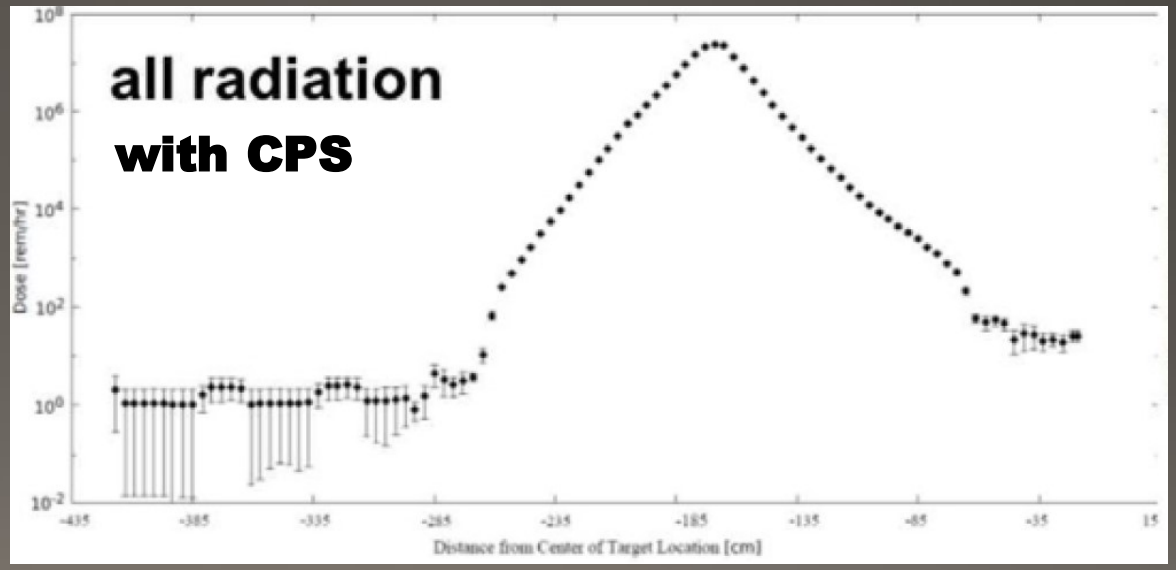
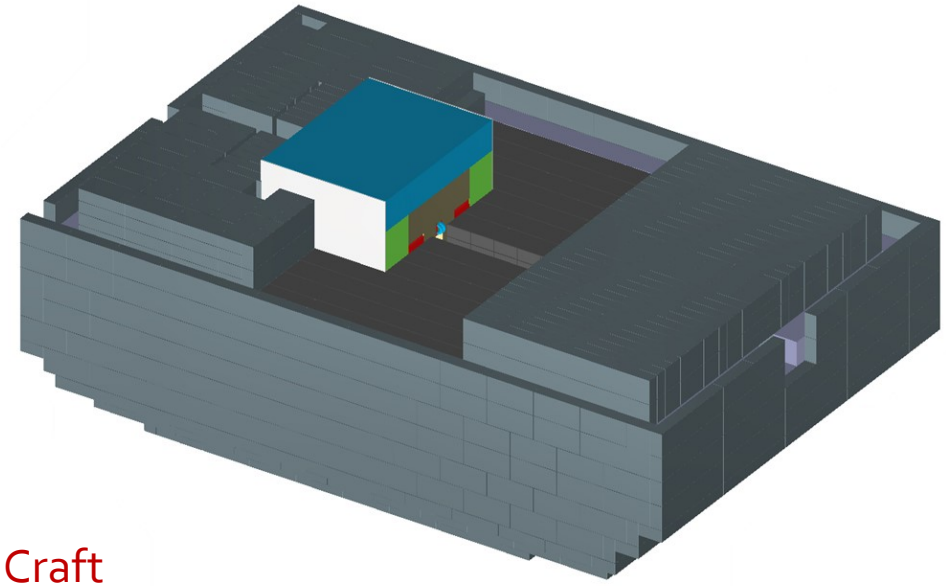
- Radiation rates has been studied with and without CPS shielding material
  - CPS shielding reduces the total prompt radiation >1000.
    - Resulting radiation dose rate outside CPS is a few rem/h , acceptable for the lab.
    - Indicates that the radiation level will be factor of x3 higher than during nominal running.
      - For PAC48 we estimated a factor x10 increase.
  - Activation dose rate after the run outside CPS will be acceptable for the lab.
  - Activation dose rate after the run inside CPS will be too high to disassemble CPS.
- Simulations from 2016 will need to be redone with the final geometry of CPS, when available.
  - Also need to include tagger hall geometry. The simulation in the proposal is for very different CPS.



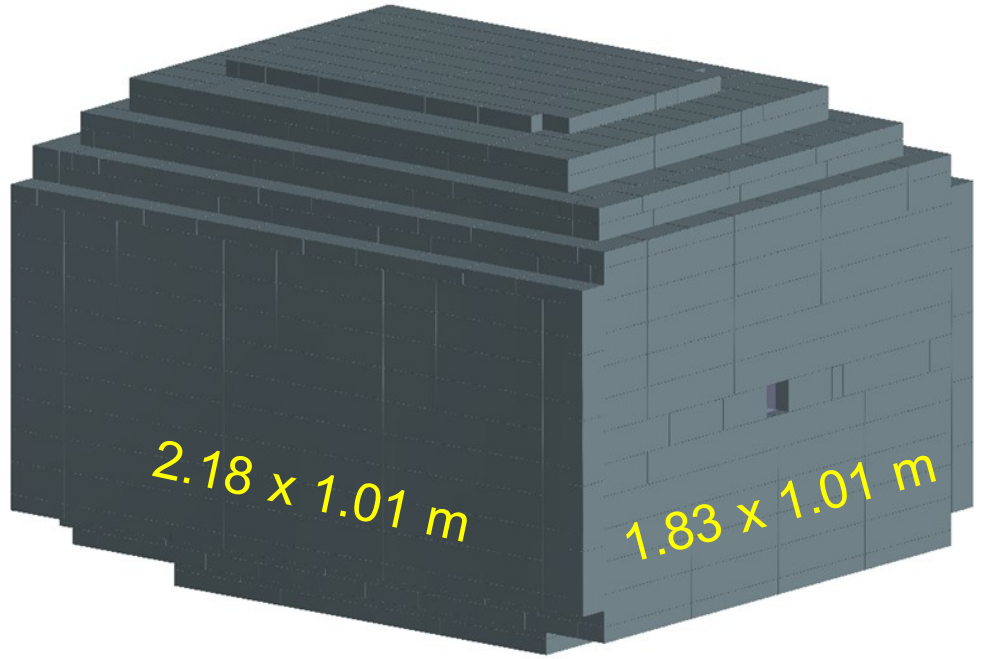


CPS Stacking

- Josh Craft (used to be a Hall D PrimEx graduate student) is working on a detailed plan for the stacking of CPS shielding.
- Currently he is modeling the shielding using lead bricks 2"x4"x8" and tungsten bricks 2"x2"x4".
- After stacking plan is complete, mechanical engineers need to design a support structure for it.
- Hall A/C version may need to be movable, but for Hall D we just need to be able to remove the radiator from the beamline.

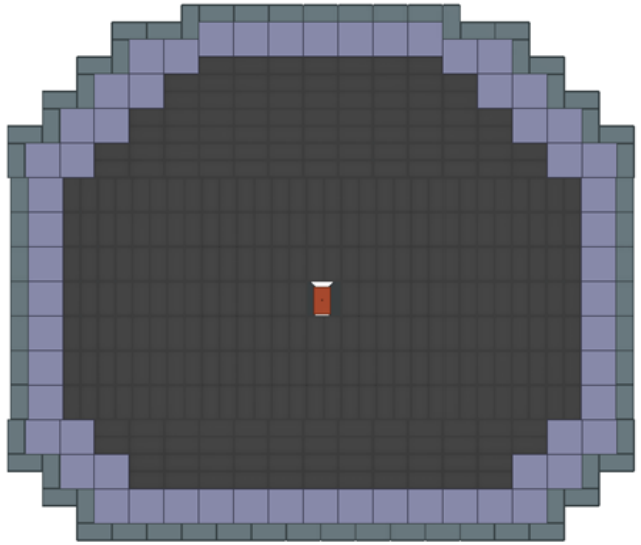


Josh Craft



CPS Shielding

- Multiple layers of shielding
  - tungsten bricks
  - lead bricks
  - borated polyethylene
- The estimated amount of Pb bricks:
  - 2391 --> 28.4 metric tons
- The estimated amount of W bricks:
  - 2109 --> 8.8 metric tons (a mistake???)
  - Factor of two less than the previous estimate
    - Big decrease in the cost
- Borated polyethylene layer is 4" thick.
  - Total weight of borated polyethylene is ~2 metric tons.
- The total weight of shielding is ~40 metric tons.
  - Again, might be underestimated by 10 metric tons.
  - 1 kg of tungsten is >$50, is very much dependent on the shape and quality of the material



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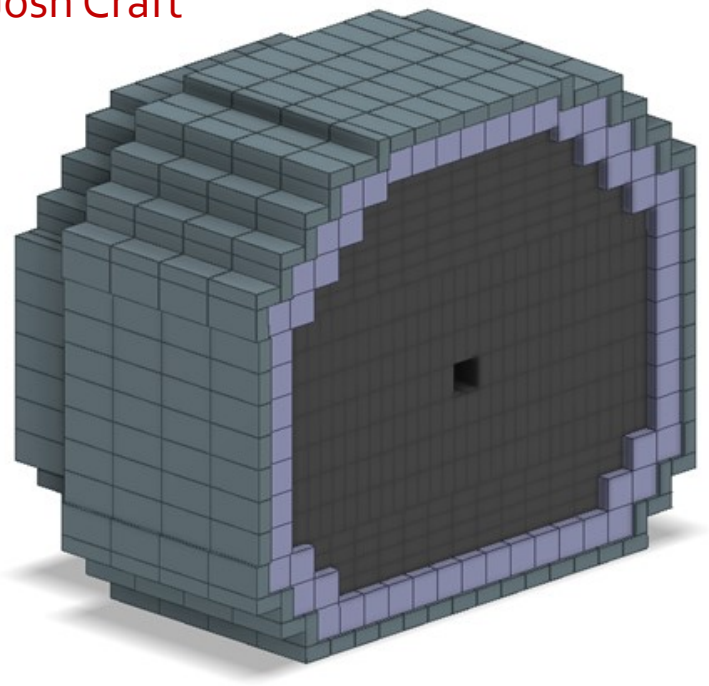

Summary

- The collaboration is making progress on Compact Photon Source design.
  - So far Hall A/C version is being developed
- There is a preliminary magnet design.
- Heat dissipation problem is being studied.
  - Need Hall D calculations
- Radiation shielding is shown to be sufficient for lab requirements.
  - Need Hall D version simulations in the tagger hall
- Work on stacking and engineering design is ongoing.
- No definite plan on procurement of shielding material yet.
- We started determining what modification Hall D CPS would require.