Adapting Hall C CPS design for Hall D

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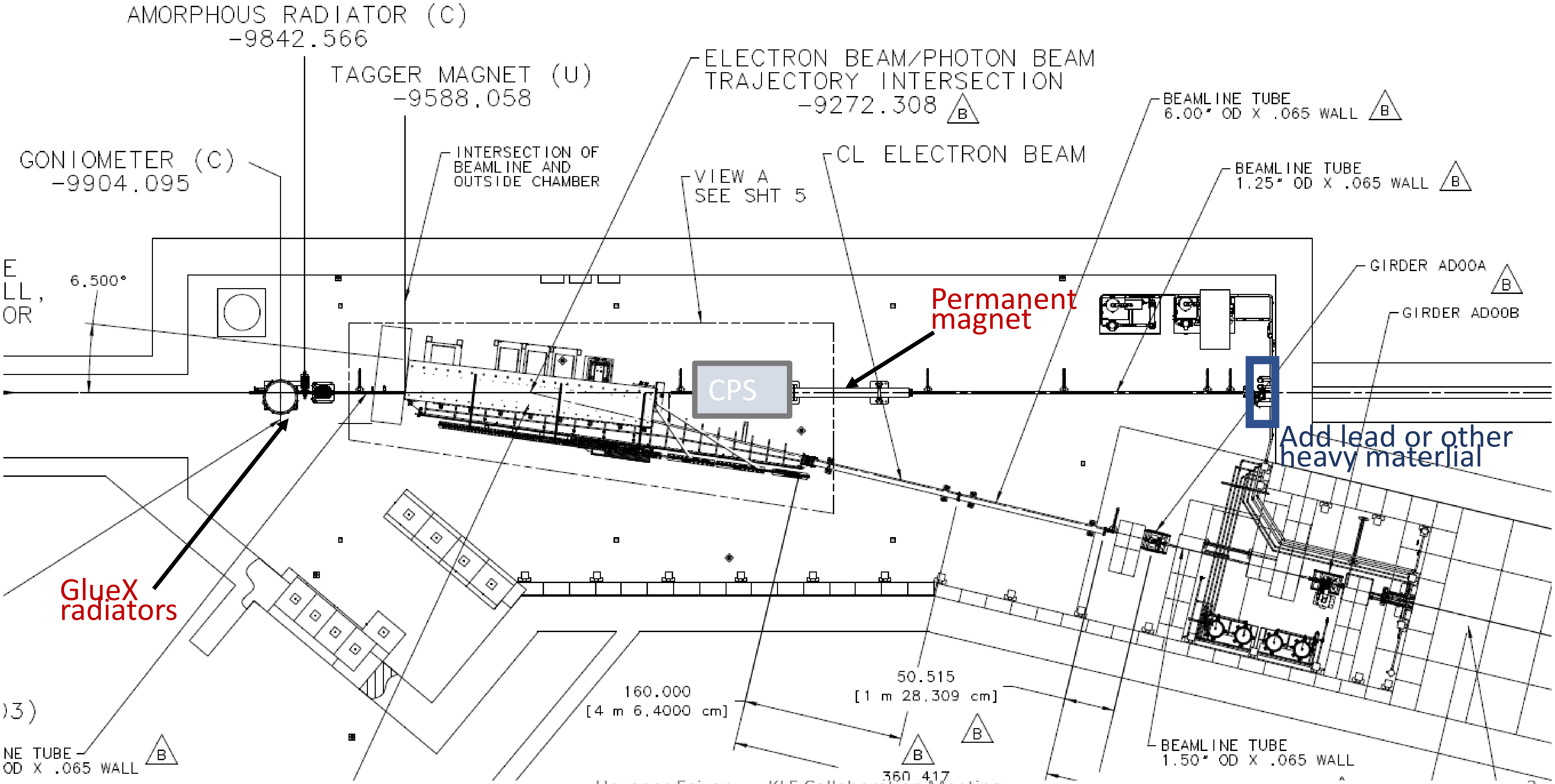
Tagger Hall Layout



Hall C Design

- The design is in pretty advanced stage
- Hall C is receiving tungsten and tungsten/copper bricks
- Engineers are working on a design of a (prototype) magnet
- The 11 GeV beam is rastered within 1mm x 1mm square uniformly
  - KLF requires 12 GeV beam, likely to be 2D Gaussian distribution
- Design beam current in Hall C is 3μA, total power about 30kW
  - KLF requires 5μA, total power is about 60kW

Ideas for modifications

- Do not change anything
  - Just reduce the beam current to match Hall C design specs
- Increase the horizontal size of the beam-hole and the beam size
  - Limited by the shape of the magnet gap (Cu-core is only 8mm wide upstream)
  - Leave the gap the same
- Increase the vertical size of the beam-hole and the beam size
  - Cu-core is 80mm tall, the limit would be due to the magnet length
  - Too much increase may lead to increase of the length of the magnet
    - Will require quite a bit of work to redesign Hall C CPS magnet

Priority tasks

- We have FLUKA input file from Gabriel
  - Hall C design version from around September 2021
    - We should get the updated version.
    - Copper core is represented as a single block although may be broken into multiples pieces in the real implementation.
- Vitaly started simulations with version in hand
  - Generate power deposition profile in the copper core and copper-tungsten shielding region.
  - Calculate the temperature distributions for various cooling scheme
    - We may need to interact with Hall C engineers (Steve L.)
  - Change CPS design and beam properties to see the impact on the temperature in the copper core.
- Try to verify that spreading the beam without magnet modification is sufficient to accommodate a factor of two in total power increase.
  - If not, then more efforts are needed to design the magnet

Some details

- Hall C uses 0.9mm x 0.9mm square flat beam size in their FLUKA simulation.
  - 0.9mm length corresponds to 0.26mm in RMS
- One can assume that doubling the spread of the energy deposition in X will help with keeping the temperature the same for twice the beam power.
- Doubling the beam spread in both directions will correspond to 0.52mm beam profile RMS
  - We need to use Gaussian in both X- and Y- directions in Hall D
    - A 0.52mm RMS for Gaussian translates to 1.2mm in FWHM which is needed in FLUKA
    - Assuming 0.52mm RMS, 99.2% of the centered beam will fit through the 3mmx3mm beam-hole
  - Doubling the spread in Y does not exactly translate in doubling the spread of the energy deposition is Z (along the beam path), but should for X (horizontal).
  - GlueX beam has usually σ_x ~0.8mm and σ_y~0.5mm at the radiator, and is rarely smaller than 0.4mm at the focusing point in both direction, therefore we need to be comfortable with this size of the beam.
- Doubling the beam size may require an increase of the beam-hole to avoid the tails and the beam-halo scraping right at the entrance of the gap.
  - This does not necessarily mean increasing the magnet gap or length.
- Vitaly started doing FLUKA simulations
  - He already has some plots for FWHM 0.45mm (or RMS=0.2mm)
  - Some question about the direction of the photon beam arise at this time.
  - Direction of the magnet field needs to be checked.