Status of New Equipment

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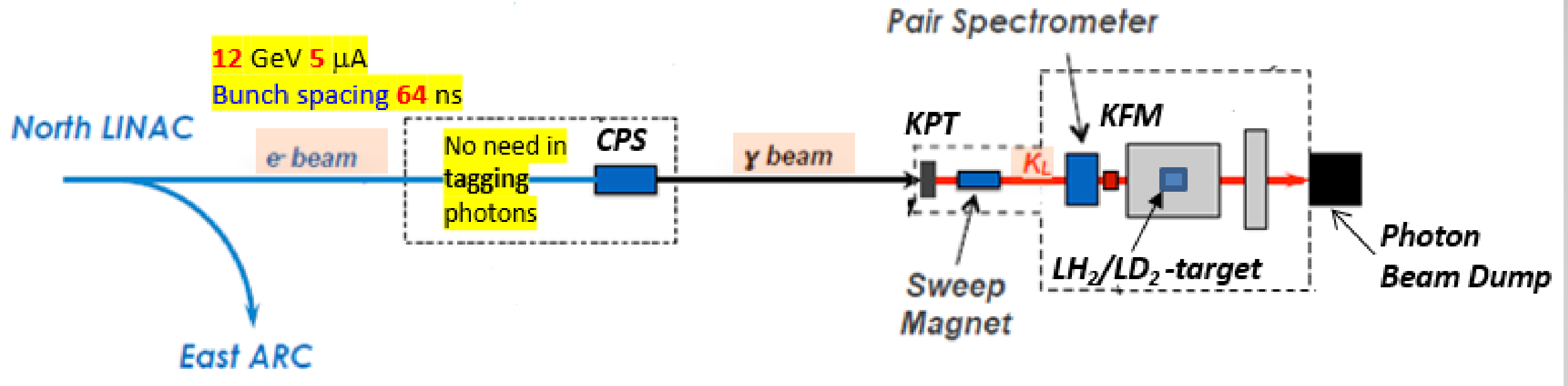
Overview

- Electron Beamline
- Compact Photon Source
- Kaon Production Target (kaon source)
- Kaon Flux Monitor
- Liquid Hydrogen and Deuterium Target (real event source)
- Summary

KLF Equipment



- Tertiary beam of K-longs will be created in the hall.
- Beamline will require two converters (CPS and KPT).
- Flux monitor for kaons, possibly other beam monitoring equipment.
- New cryogenic hydrogen and deuterium production target.
- May need to start installation in 2025.

Electron Beamline

- Electron beam requirements:
  - 5μA average beam current at 12 GeV is 60kW of power.
  - 64ns between bunch spacing (equivalent to 80μA 499MHz current).
    - We would be interested in 128ns to even more reduce beam bunch overlaps.
  - Imaginary electron beam will focus on KPT such that the imaginary beam spot size is < 4cm in full width.
  - The beam spot size at the radiator should be determined by the heat dissipation and by the CPS design requirements.
- All electron beamline instrumentation and diagnostics is usually provided by the accelerator division.
  - New APEL appointed for Hall D
    - See talk by Edith Nissen from CASA
- Accelerator division is aware of KLF requirements.
  - Current plan is to use wider electron beam instead of beam raster magnets
    - More reliable during operations, according to Todd S.
  - The beam spot on the CPS radiator is expected to be between 1mm to 4mm in σ .
    - No major beam spot constraints from focusing requirements, according to Todd S.
    - No need for expensive quadrupole magnet upgrades, according to Todd S.
  - New procurements for KLF are unlikely this FY2021, according to Todd S.
  - CASA and OPS may start testing of the KLF electron beam tuning during the next run.
- We may need a plan to verify that the beam is centered on the radiator of CPS.
    - Put a stripline BPM closer to the CPS entrance.
    - Accelerator's super-harp-style wire scanner in front of CPS.
    - Need to have all beamline instrumentation well surveyed.

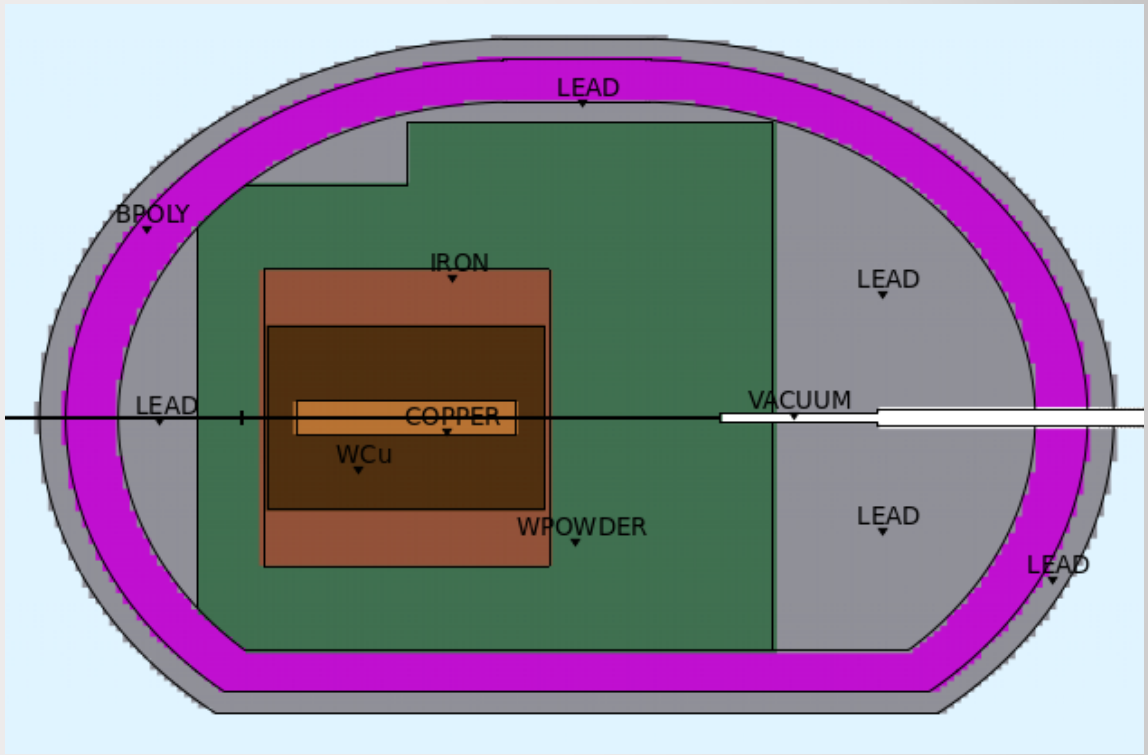
Photon and Kaon Beamlines

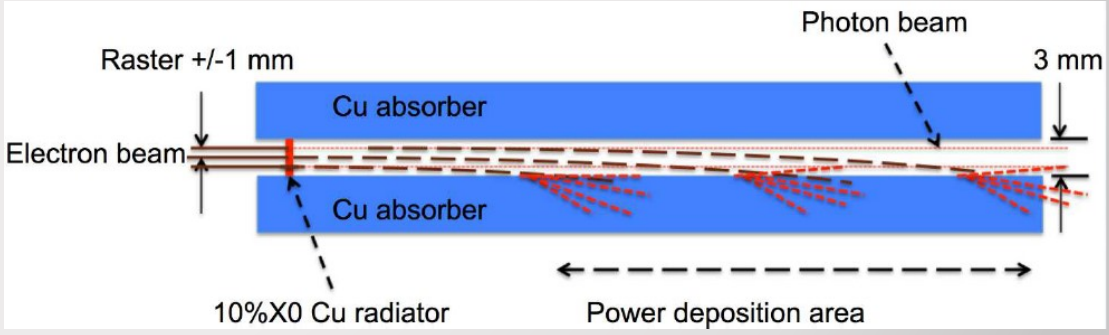
- Photons will be produced in the radiator of CPS
  - 10% RL radiator will create a secondary beam at a rate of 5×10^{12} photons/s with $E_\gamma > 1.5$GeV .
- Photons will travel approximately 67m to reach KPT in the collimator cave.
  - Most of it is a 10" underground pipe between tagger vault and Hall D.
- Parameters of the photon beam pipes need to be optimized.
  - Need to be careful with the radiation.
- We will need photon beam diagnostics equipment in front of the beryllium target to characterize the photon beam.
  - Something similar to the beam profiler used in GlueX photoproduction.

- K^0_L will be produced on Be target at a rate of 10^4 Kaons/sec.
- Kaon beam will travel approximately 24m to reach GlueX main target.
  - There are some concerns about the length of the kaon travel distance.
  - Need simulation to determine if there is any significant bunch overlaps in the energy range of interest.
- Kaon beam flux and the transverse distribution is expected to be determined by KFM as a normalization monitoring tool.
- Do we need an extra, more invasive, kaon beam diagnostics tool?

Compact Photon Source

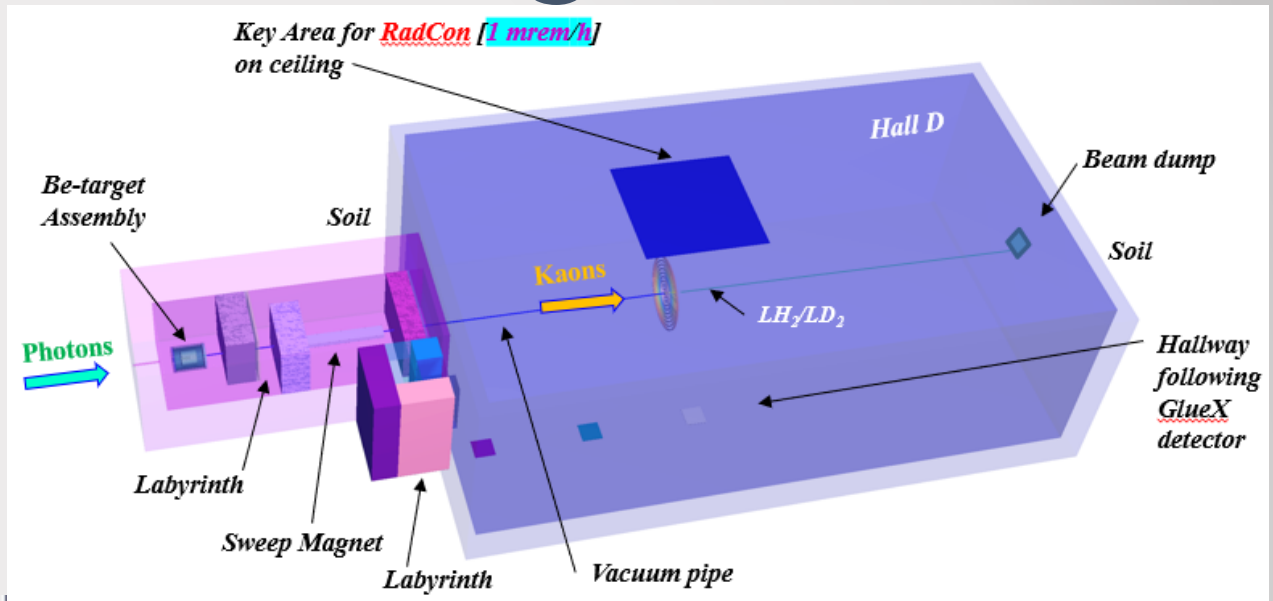
- Currently considering a photon beam source containing the radiator, the magnet, and the beam dump.
  - Allows for narrow photon beam with high intensity .
  - Low prompt and post-operational radiation levels.
  - No photon tagging possible.
  - Expensive, original estimate ~$2.7M.
- The plan is to use a design similar to Hall A/C CPS.
  - Hall D version needs to accommodate twice amount of beam current, that is twice power dissipation is required.
- CPS design is in progress
  - Regular meetings are held to discuss the details of the CPS design and construction.
  - No final design or cost estimate within 25% is available.
- CPS will be placed somewhere behind the Hall D tagger magnet.
  - May need to move the permanent magnet.

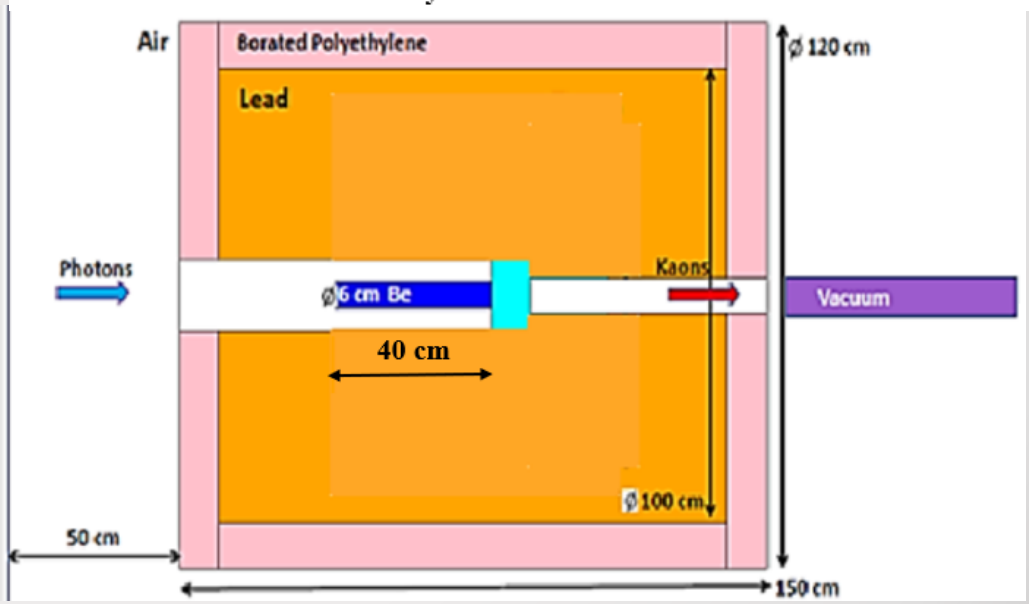




Kaon Production Target

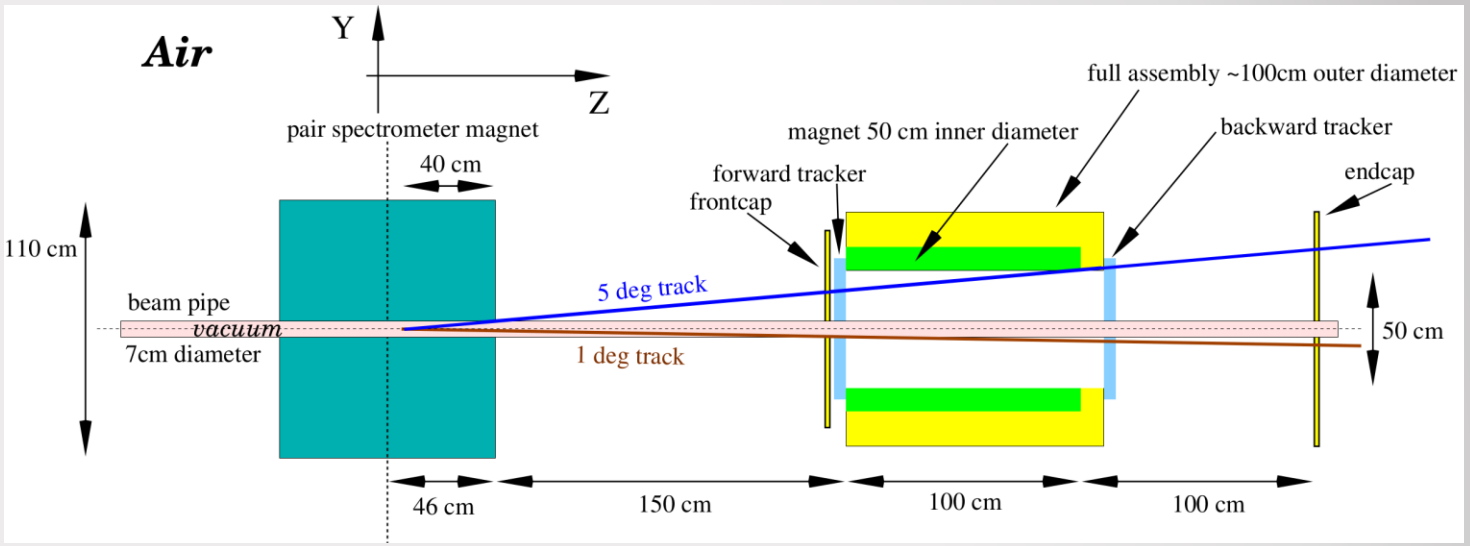
- Use Beryllium target to create 10^4 K/sec beam.
  - Neutron rate is expected to be around $6x10^5$ n/sec .
- Almost all photon beam energy ~6kW, is deposited in the collimator cave.
  - Radiation levels have been estimated using MCNP6 program and the components have been optimized (Igor).
    - No radiation problem is expected in the hall key areas.
    - No significant radiation damage is expected to SiPMs in the Hall (dose rate ~5mrem/h).
  - Heat removal from the W-plug can be achieved using similar technology used in beam dumps.
- Charged particles are expected to be swept away by the sweeping magnet in the cave.
- The kaon target assembly needs to be movable for an easy transition to photon beamline
  - Still need to be designed by engineers .
- Conceptual design is complete.
  - Ready to be discussed with the engineers and designers.
  - Toal cost at around $260K .

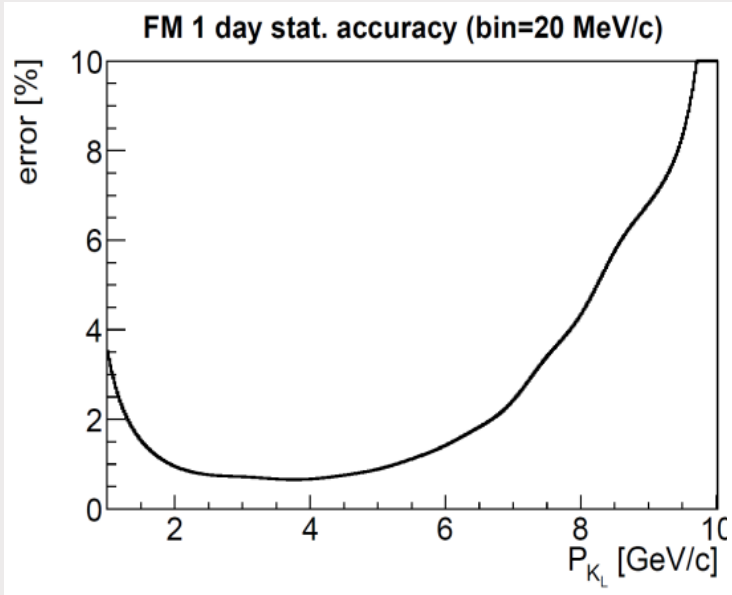


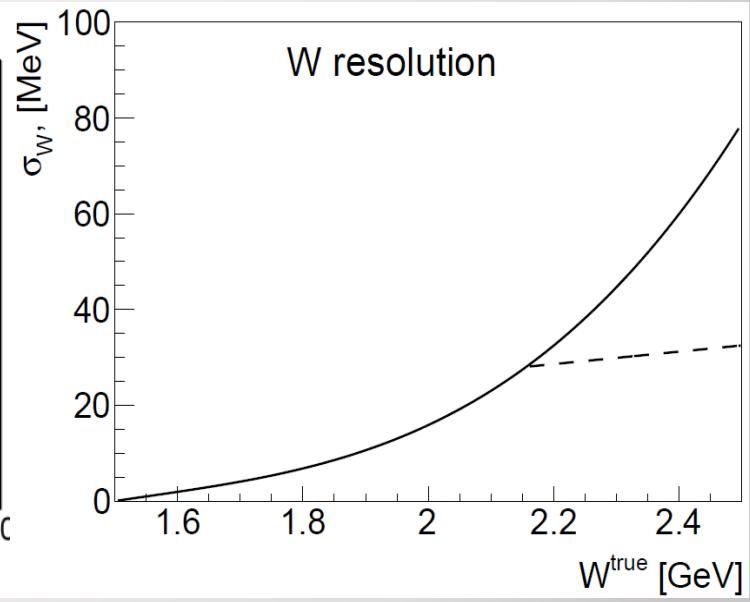


Kaon Flux Monitor

- Measure K^0_L flux using decays to $\pi^+\pi^-\pi^0$, $\pi\mu\nu$, $\pi e\nu$ within 2m downstream of PS magnet and upstream of KFM setup.
  - aiming at precision of 5% in the kaon flux.
  - σ_p/p ~ a few % for $p < 2$ GeV in momentum resolution
- Currently Considering either "cryogen-free" magnet option
  - An old "free" MRI might still be an option.
  - Need good interfacing with Hall D engineering group.
- Considering various options for acquiring tracker and TOF system.
  - Used trackers might be available from WASA/JEDI FPC or PANDA/HADES straw tubes.
  - There different designs for brand new tracker.
- The costs (~$1M material and labor) are expected to be covered mostly by UK collaborators.
  - JLAB will take care of installation.
  - York U. applied for a grant to build TOF prototype.
- Construction could be completed in one year.
- See Stuart's presentation.

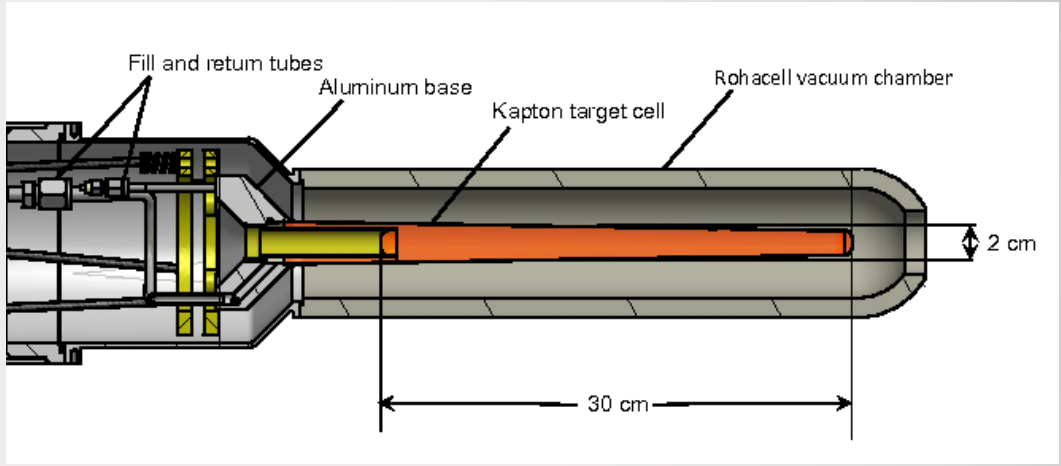




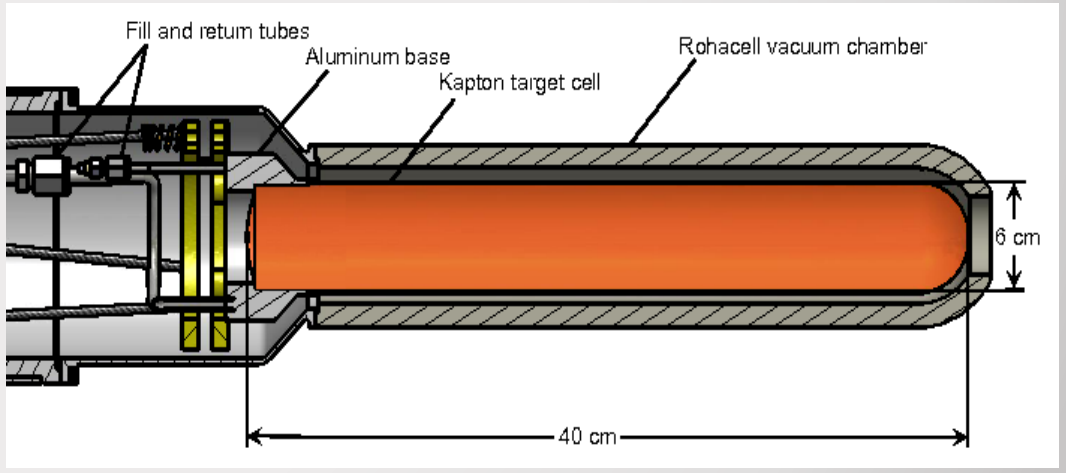


Liquid Hydrogen/Deuterium Target

- KLF target is similar to GlueX photoproduction LH2 target
  - Taken care by JLAB target group
- The KLF target cell will be longer (40cm) and wider (6cm) to accommodate a wider kaon beam.
- GlueX has not used deuterium target yet
  - The changes from LH2 to LD2 will not be so significant unless rapid switching between targets is required.
- JLAB target group considers it very feasible.
  - Larger target cell will increase cooling, filling and emptying times.
  - Somewhat ticker walls to handle larger diameter.
    - Higher minimum detectable recoil momentum
  - 1-2 years of effort by the group.
- See presentation by Chris Keith.



GlueX γ-production experiments



KLF K-production experiments

Summary

- KLF is starting to concentrate on the real design of the new equipment.
- JLAB accelerator division is aware of the requirements and will be working with us on it.
  - Quadrupole upgrades that would cost $1.5M by some estimates are unlikely.
  - CASA and injector group are considering the possibility of 64ns and 128ns beam time structure.
- We are working on CPS design with Hall A/C group as a CPS collaboration.
- Started thinking about the beamline components for photon and kaon beams.
- Kaon production target has a preliminary design
  - Can start discussions with the Hall D engineering group.
- Kaon flux monitor is still in the design stage
  - Preliminary design options are being optimized and evaluated.
- Liquid hydrogen and deuterium target is feasible
  - JLAB target group will provide the cryotarget similar to GlueX target.
- Nothing is in construction stage yet.
  - We may need to start major installation in 2025.
- A lot of work ahead!