

# HKS Target Design and Status

David Meekins

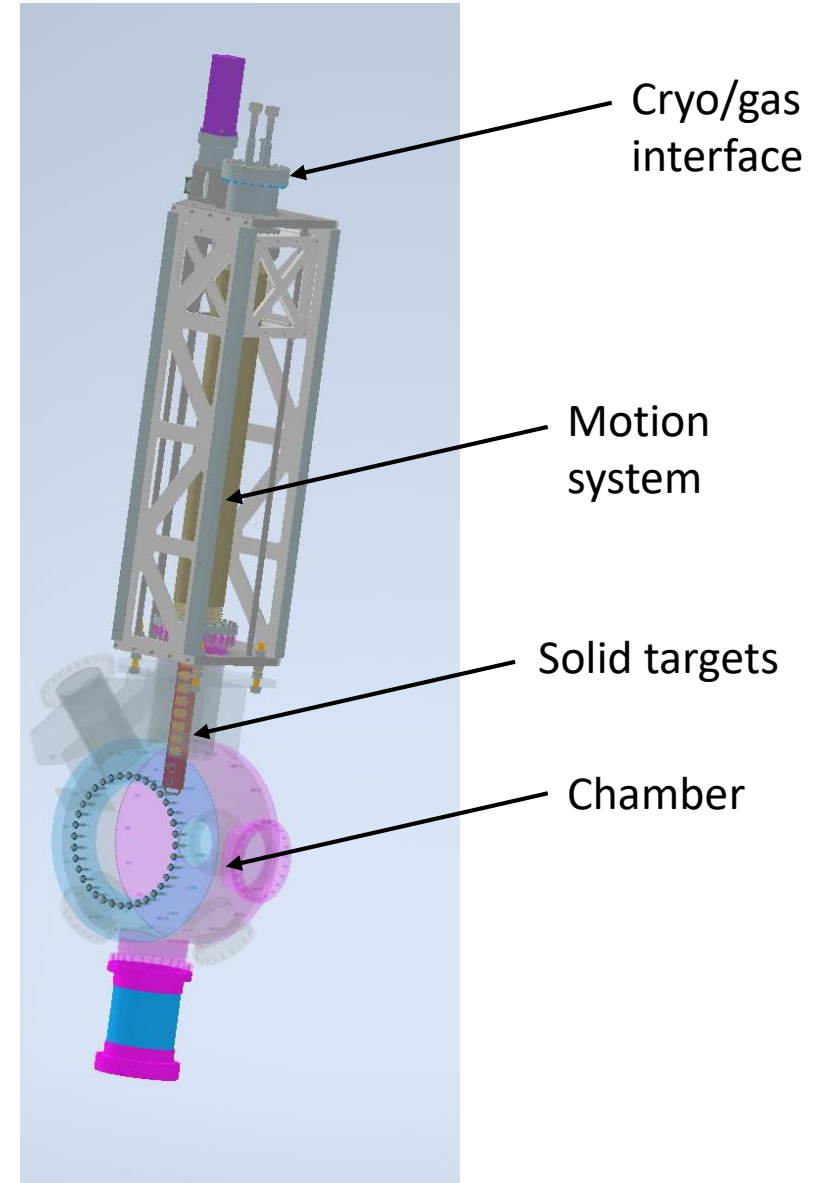
22 March 2024

# Design Status

- Design is in concept stage and will be for some time
  - Target group does not have resources to develop a comprehensive design at this time.
  - Solid target concept complete
  - Gas target concept is complete as well
  - Concepts will need to include backward angle acceptance requirements which have yet to be addressed.
- Best to design and fabricate one system
  - System with both solid and fluid targets
  - This is more work to install but could be done in two phases if needed
- Both systems require cryogenic cooling
  - Pb and Li both need this to meet beam current requirements
  - He and Hydrogen gas cells will need it to reach proposed densities
- Fluid systems are designed to appropriate Codes and Standards
  - Somewhat limiting for the cell design (wall thickness)

# Concept Design

- There has been no real progress here
- Base motion system and top end design on PREX/CREX target
  - Plenty of range for all targets needed for
- Custom chamber will be needed
- Long transfer lines will be needed.
  - Base this design on existing design for PREX
- Cooled solid target ladder/heat exchanger
- Cooled cells (not shown)
  - Fed gas from gas panels in Hall C



# “Original” Proposal (circa 2022)

- Solid targets
  - Some basic solid targets (these targets are relatively easy)
    - C, Al, B<sub>4</sub>C etc.
  - More Challenging (these targets require special handling/cooling)
    - Lead, Ca<sub>40,48</sub>, Li<sub>6</sub>, Pb etc.
- Gas Cells
  - H<sub>2</sub>, He<sub>3</sub> and He<sub>4</sub>
  - Tuna can with vertical axis perpendicular to the beam
  - Diameter is 20 cm
  - Total Al thickness 162 mg/cm<sup>2</sup>
  - Gas pressures low

# Optimization of the Cells

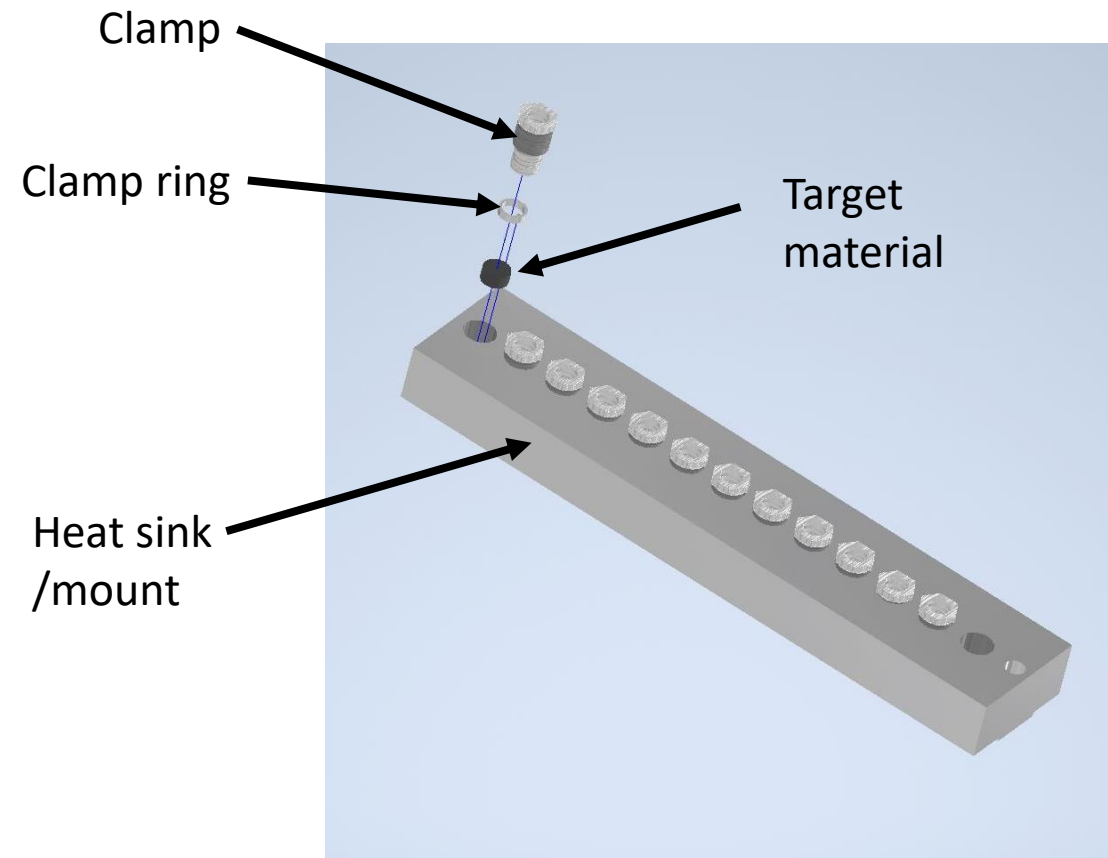
- Assumptions for improvement
  - Thinner cells walls
  - Higher fluid densities
  - Smaller diameter
- Plan to use actively filled cells
  - This is contrast to the tritium target were the cells were filled with a static pressure
  - Two gas isotopes can be used concurrently
  - One gas species at a time (e.g., H<sub>2</sub> and D<sub>2</sub> **OR** He<sub>3</sub> and He<sub>4</sub>)
- Requires gas handling system
  - This might need to be in a second phase as schedule permits

# Solid Targets

- Lead and calcium will present challenges
  - Lead will need to be cryogenically cooled with good thermal conductivity
    - Realistic thickness will need to be at least 0.1 mm
  - Ca and Li targets will need special handling
    - Ca48 stock at Jefferson Lab is highly compromised
    - Recommend purchasing new Ca48 foil (\$50K to \$100K)
- Other solid targets are relatively simple to work with
  - Proposed thickness are OK
  - Multi-foil: reduce to +/- 5 cm to closer match cell length
- Design path:
  - Combine latest Hall C solid target ladder with PREX/CREX motion system and T2 target style heat sink.

# Solid Target Ladder

- Solid target design concept
- All components are aluminum 7075
- Target material is clamped into the frame with sufficient force to ensure good Kc
  - Threaded clamp screws into heat sink
  - Nuclear grade anti-seize is used to enhance Kc and prevent galling
  - Clamp ring prevents spinning of the target foil
- Proven to work with all targets except lead
  - Preliminary calcs show design is acceptable for lead as well
- **This design does not meet the backward angle acceptance requirement and will have to be adjusted.**



# Time Line

- Currently the Target Group is over committed
  - We are working to increase our staff but this will likely not have a positive near term affect
- It **MAY** be possible for some Target Group design team members to work with Hall C designers to develop **SOME** designs.
  - Possibilities include scattering chamber and support structures
- **Cannot give any firm estimates at this time**



# Summary

- A completely new cryogenic target will be required to be located ~11 m downstream from the nominal pivot.
  - Current gas handling panels should be sufficient for HKS target
  - New electrical installations will be required
  - New gas lines will be needed
- The cryogenic distribution system will require some new transfer lines in excess of 40 ft. These will need to be fabricated somewhere (JLAB or ???)
- We will need to work with Hall engineers/designers to layout target services and design the scattering chamber.
  - Hall C design team has already reached out.
- At the moment the target group does not have the resources to complete a final design or substantially develop the concept
  - It is not clear when the resources will be available either although some design resources may be available near the end of 2024.