

MOLLER High-Power Target

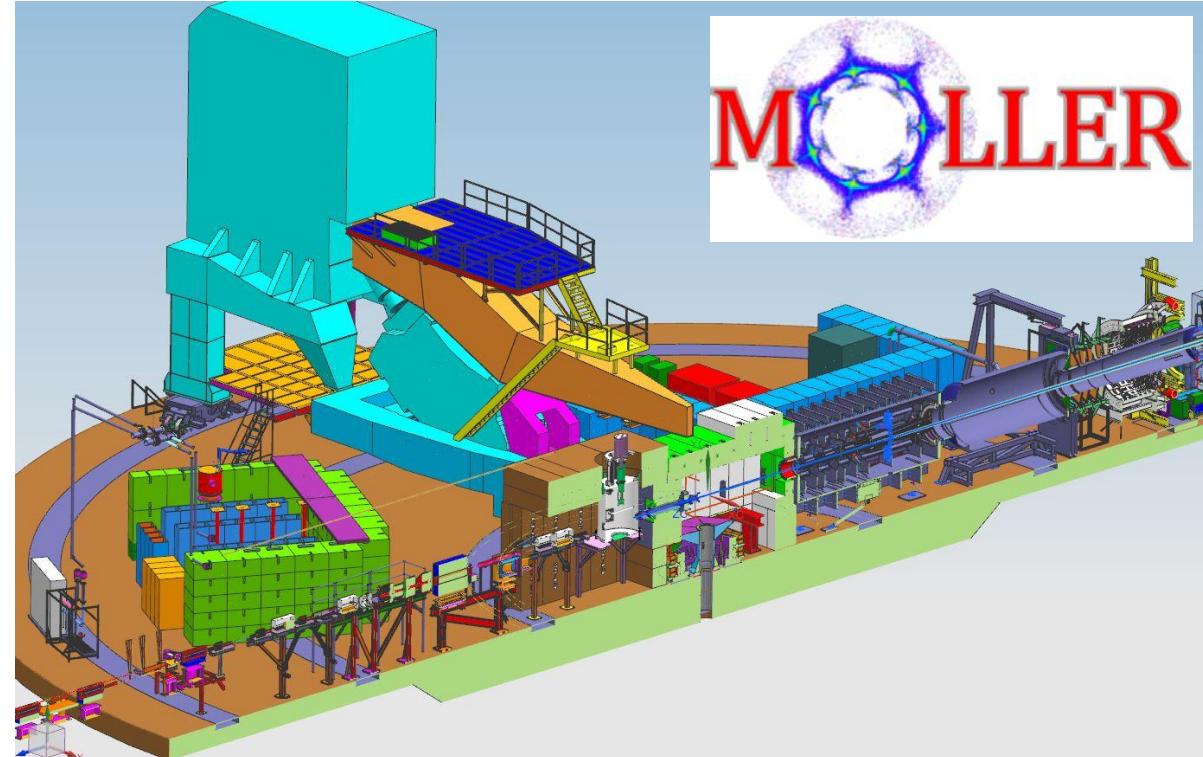
- Overview
- Team
- Status
- Summary

Silviu Covrig Dusa

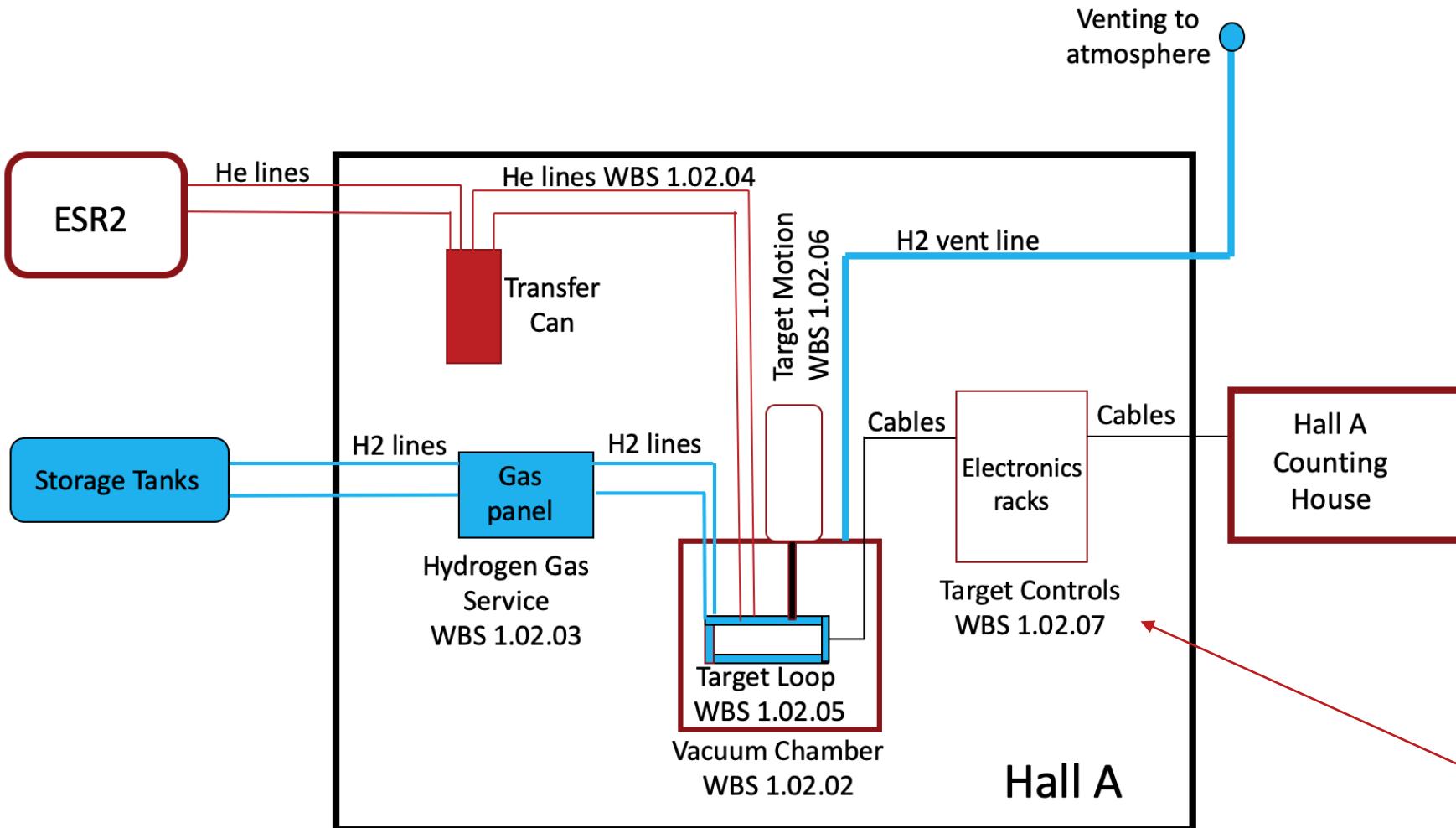
Jefferson Lab

Hall A Collaboration Winter Meeting

January 21 - 22, 2026



Target overview and project scope



- 1.02.02 Vacuum System
 - Target vacuum chamber and stand
 - Vacuum pumping stations
- 1.02.03 Hydrogen Gas Service
 - Storage vessels, piping
 - Gas panel
 - Hydrogen exhaust
- 1.02.04 Helium Gas Service
 - He Lines
 - He Cryostat
- 1.02.05 Target Loop
 - Liquid Hydrogen Pump
 - Heat Exchanger
 - Cell and plumbing
 - High Power Heater
 - Solid Targets
- 1.02.06 Target Motion
 - Vertical lifter and alignment
- 1.02.07 Target Controls
 - Software and Hardware controls and instrumentation

The Target is WBS 1.02 of the MOLLER Project

MOLLER Target Team

- L2 Managers:
 - Control Account Manager: Silviu Covrig Dusa, Jefferson Lab
 - Technical Lead: Dave Meekins, Jefferson Lab
- Technical contributors:
 - Casey Flanagan, MD, Jefferson Lab
 - Daniel Akers, ME, Jefferson Lab
 - James Brock, ME, Jefferson Lab
 - Paul Hood, Tech, Jefferson Lab
 - Mark Hoegerl, Tech, Jefferson Lab
 - Chris Carlin, CS, Jefferson Lab
 - Dave Griffith, Tech, Jefferson Lab
 -

MOLLER Target physics requirements

Target		Beam	
Cell Length	125 cm	I_{\max}, E	70 μA , 11 GeV
Cell Thickness	$> 8.4 \text{ g/cm}^2$	Raster area	$< 25 \text{ mm}^2$
Al windows in beam	$< 0.25 \text{ mm}$	Beam Spot	$> 100 \mu\text{m}$
p, T (cold)	35 psia, 20 K	Helicity Flip Rate	1920 Hz
θ, φ Acceptance	5-20 mrad, 2π	Cell alignment tolerance	0.5 mm
LH2 pump flow	$< 25 \text{ l/s}$		
Target Power	4500 W	Max Beam Power	3200 W

LH2 density reduction $\Delta\rho/\rho < 1\% @ 70 \mu\text{A}$

LH2 density fluctuations $\delta\rho/\rho < 30 \text{ ppm} @ 960 \text{ Hz}$

0.6x Qweak $\delta\rho/\rho$ @ 1.5x beam power

Deliverables and KPPs

Deliverables

- Vacuum chamber and associated vacuum system
- Helium gas handling circuit
- Hydrogen gas handling circuit with storage, gas panel and piping, hydrogen emergency venting circuit
- Cryogenic target loop (125 cm cell, hydrogen pump, heat exchanger, high power heater, solid targets)
- Lifting mechanism for bringing various targets in beam
- Instrumentation and software to monitor, control and operate the target

Key Performance Parameters

- Liquid hydrogen (LH2) target operation at **1.4⁽¹⁾ kW / 3.1 kW** (threshold/objective)
- KPPs will be demonstrated by operating the high power heater at the KPP power value with the target loop filled with LH2 in stable nominal operating conditions (at 20 K and 35 psia)

MOLLER Target budget is \$4.6M

The Target is 88% complete at 31-Dec-25

⁽¹⁾ ESR1 maximum cooling capacity

Target Vacuum Chamber



Vacuum chamber test fit completed early Jan-25
Components have been re-crated for storage in Physics facility



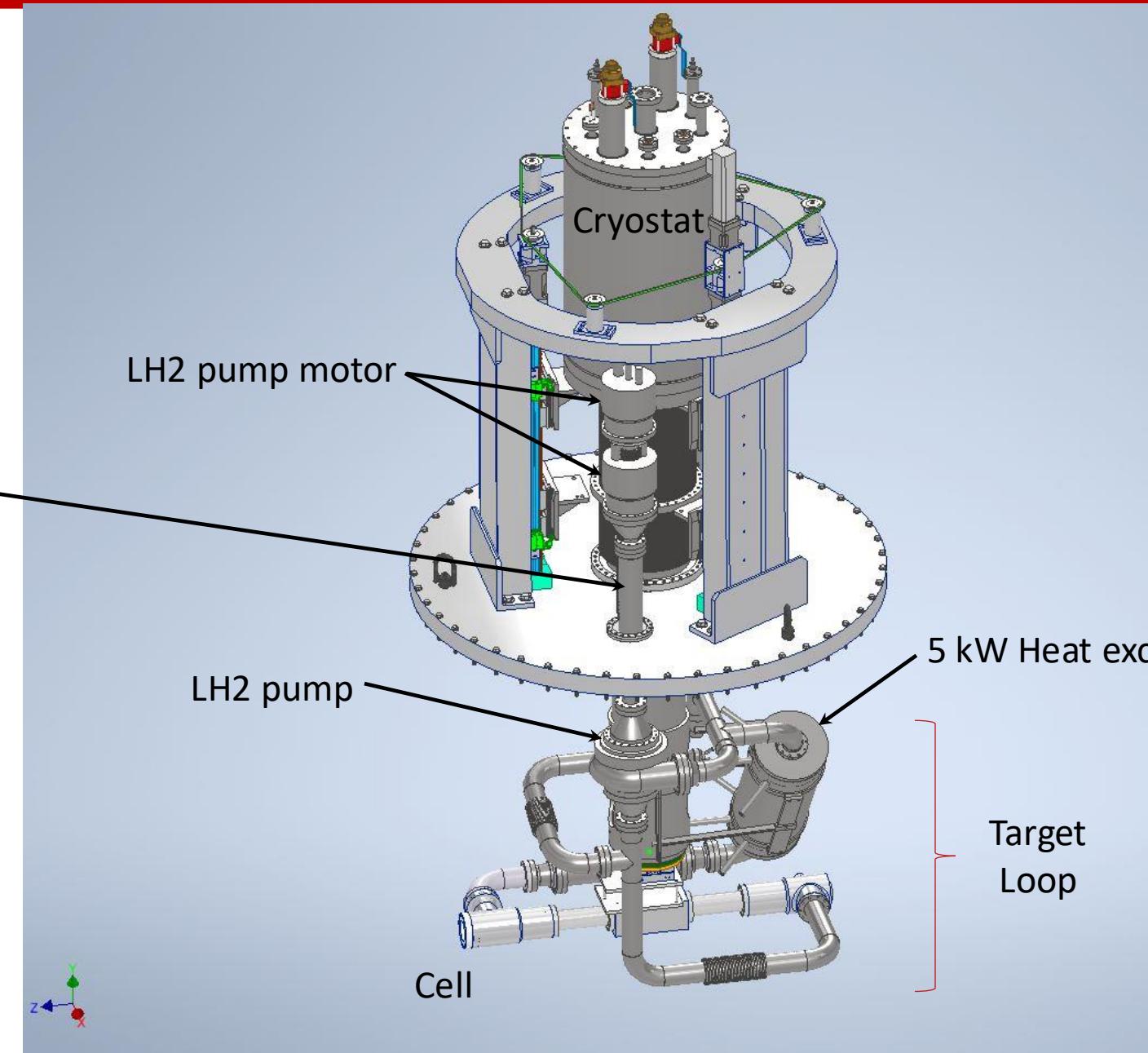
Vacuum chamber is made of two shells, the seal between shells to be done with an O-ring

The chamber shells are about 166 cm ID and 121.9 cm height, each

Target Loop and Cryostat

LH2 pump long shaft and bearings assembly will allow to operate the pump motor in "air" and separate its heat load from the target loop

High-power Target



The target loop volume is about 56 liters for LH2

Target Cell

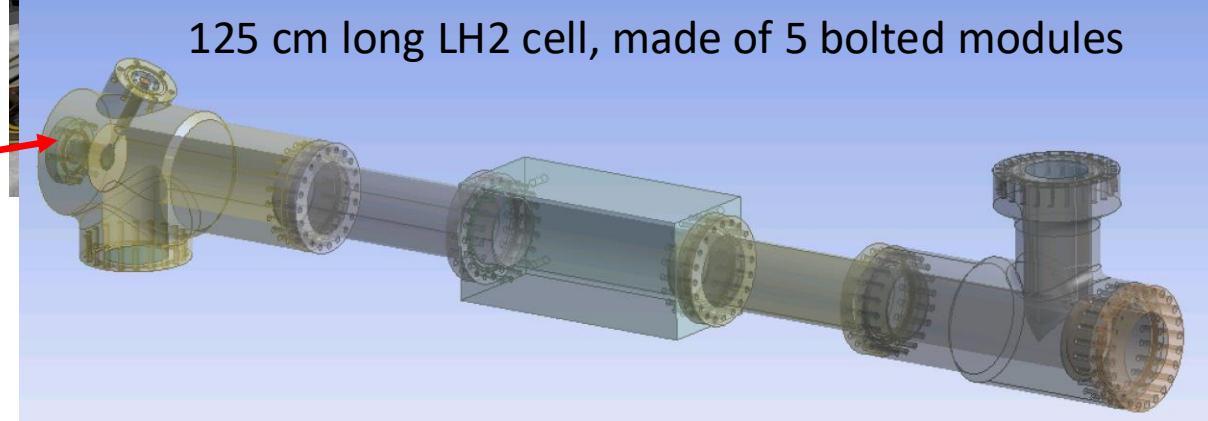


Alignment
mechanism

Cell US
manifold



125 cm long LH2 cell, made of 5 bolted modules



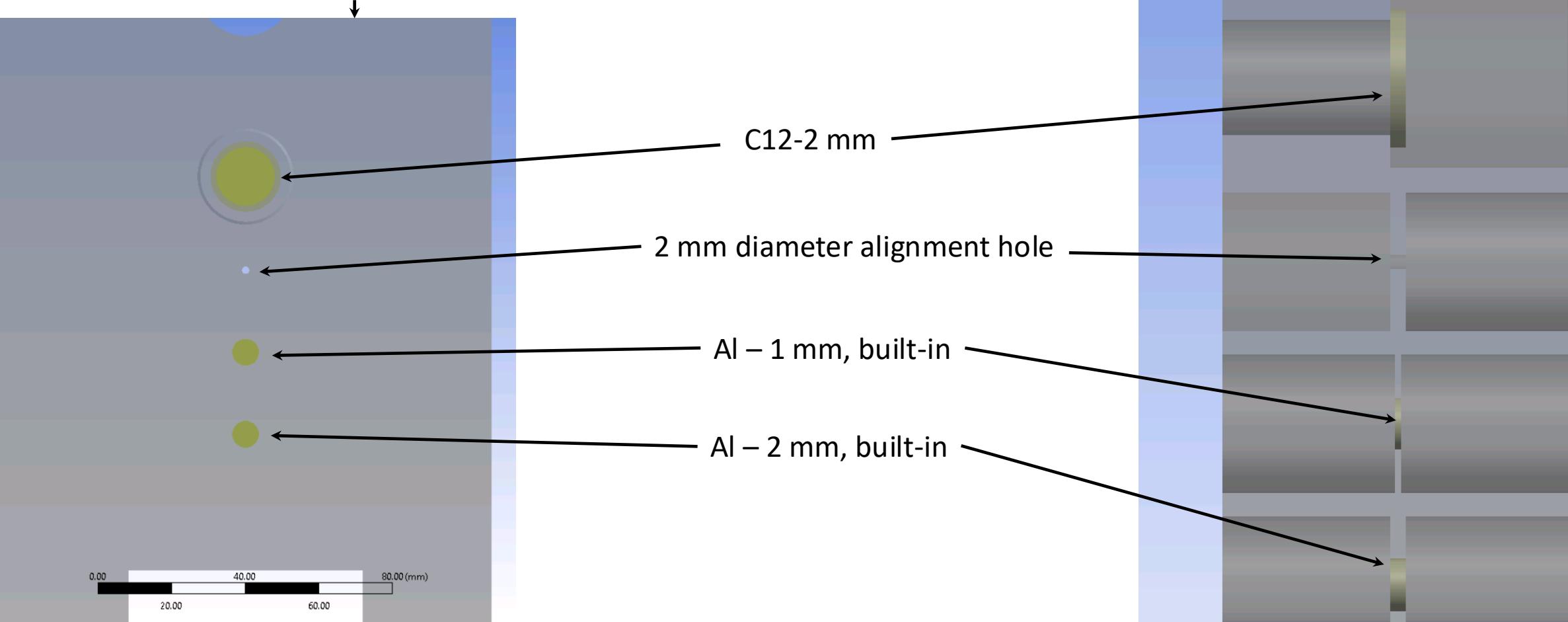
Completed Cryostat Components



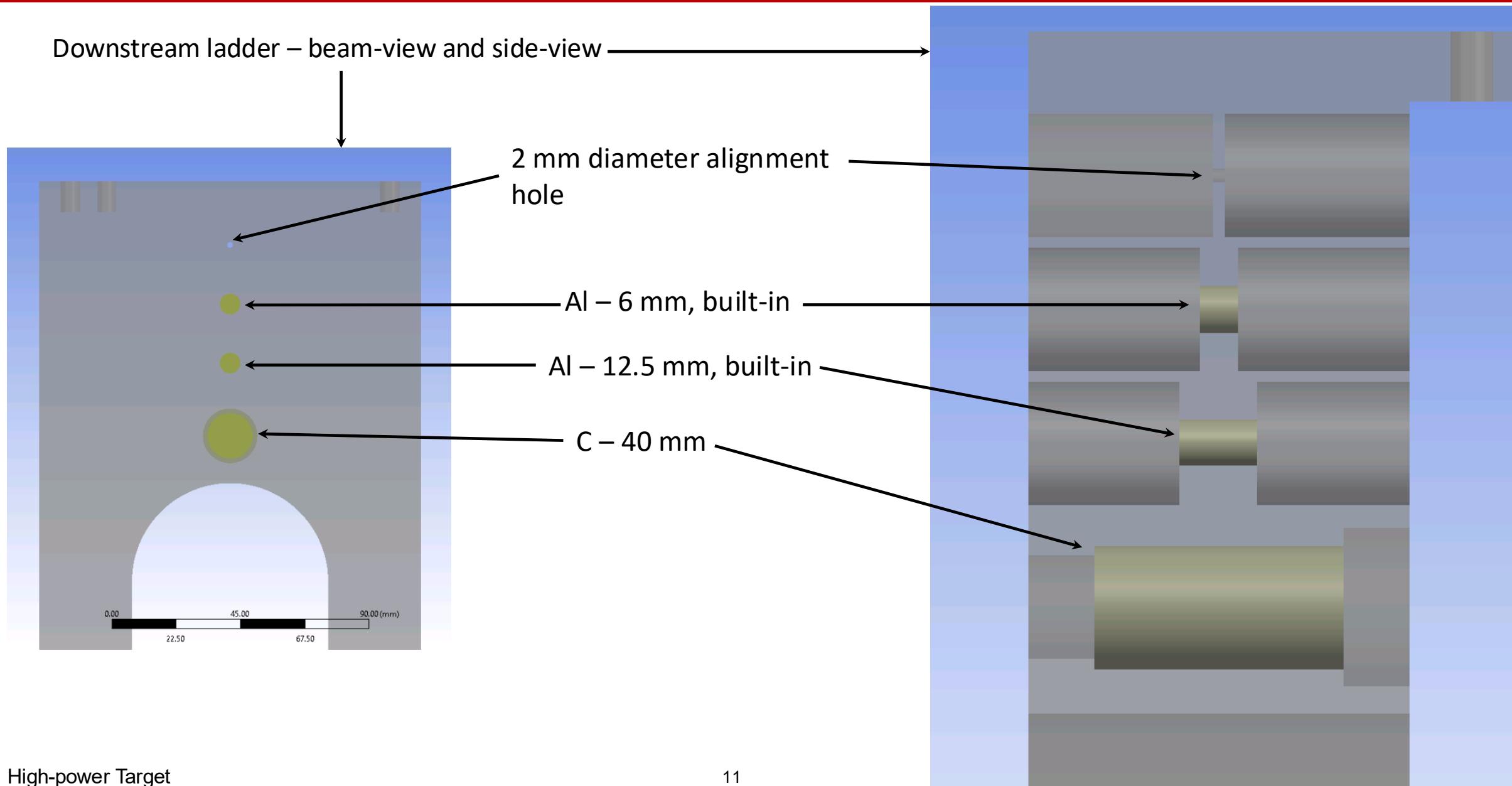
Components have been test fit. Disassembled for fit-up with lifter components.

Target Ladder US

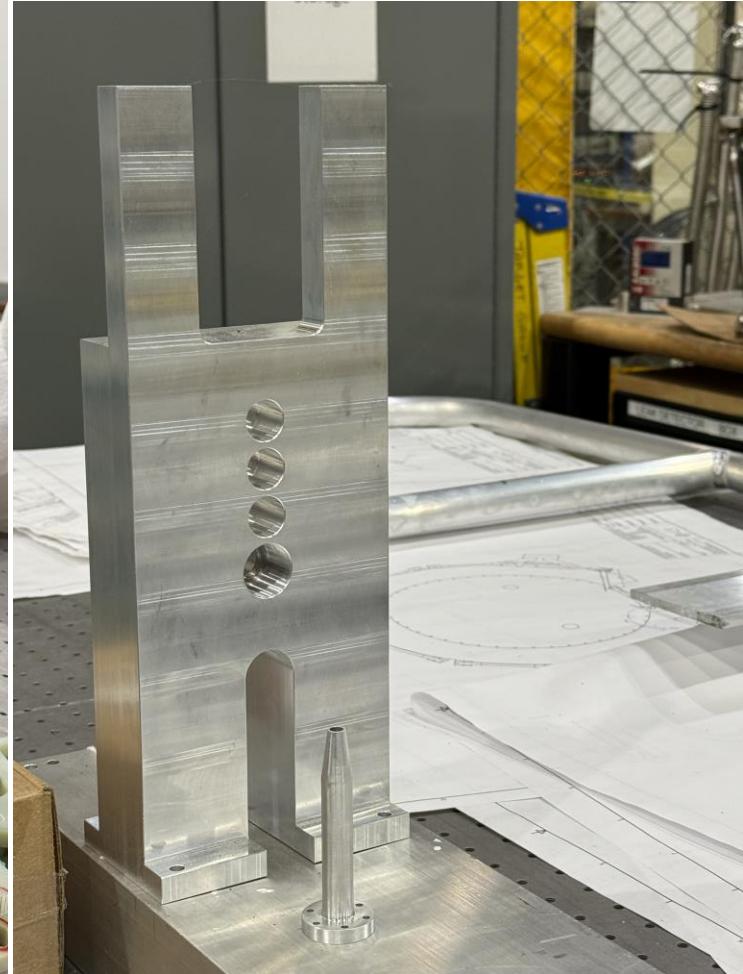
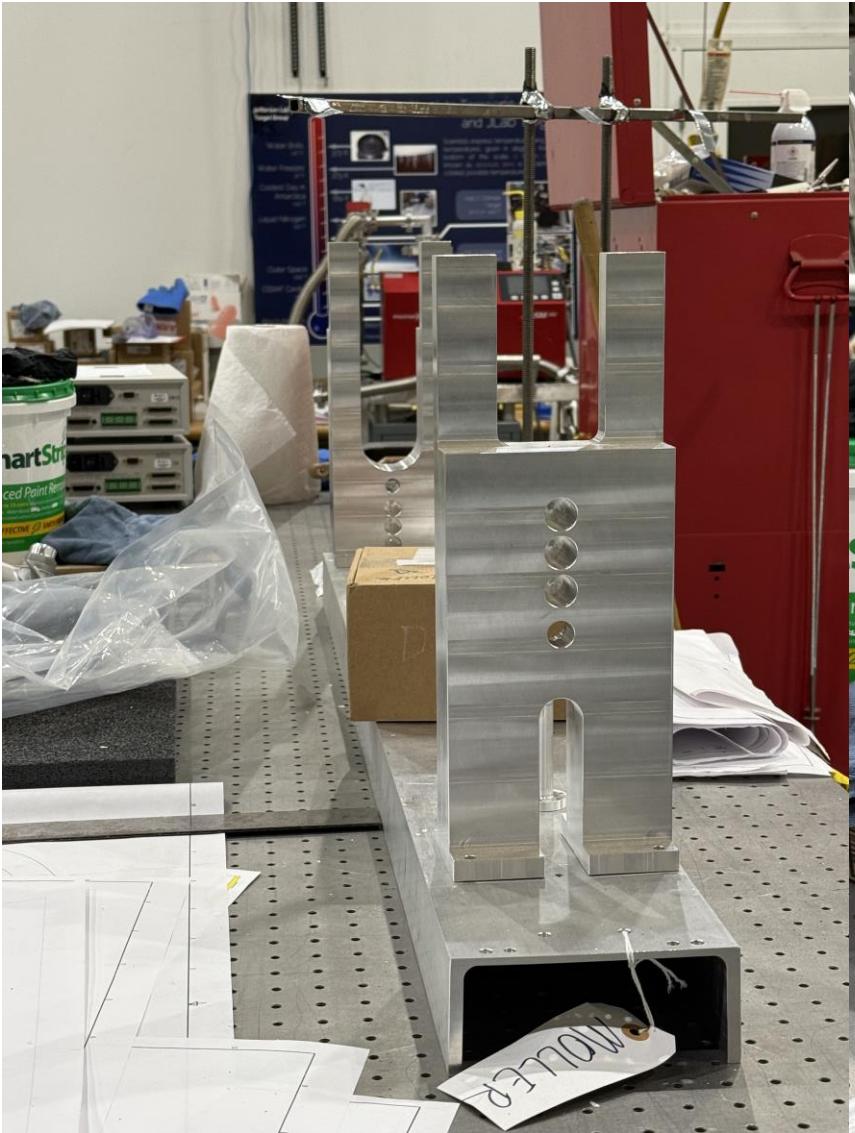
Upstream ladder – beam-view and side-view



Target Ladder DS



Target Ladder Components



High-power Target

Gas Distribution Systems (H₂ and He)

He distribution can

He service lines

H₂ service lines

H₂ gas panel

Target Controls

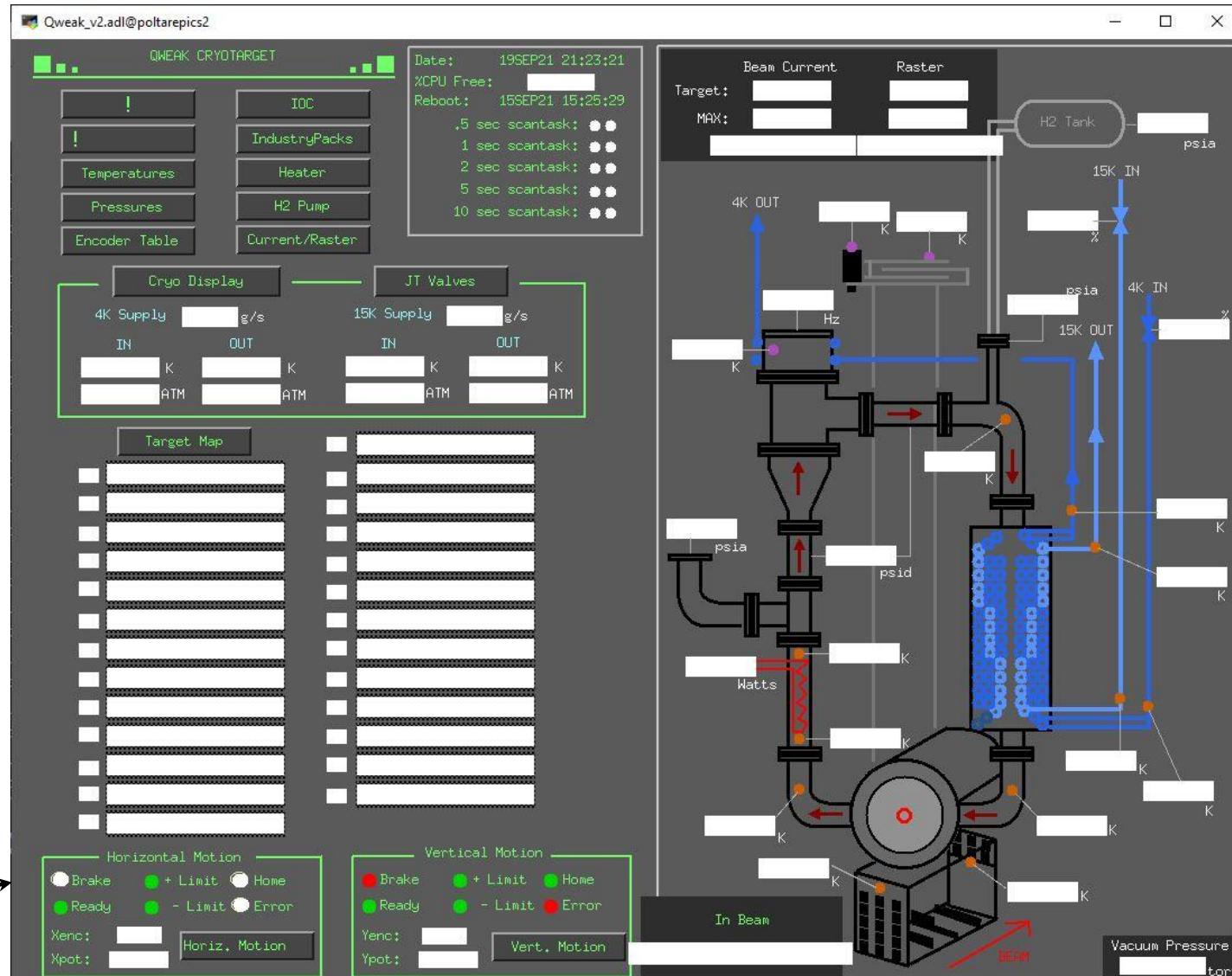
Slow Controls

- EPICS shall be used for target slow controls
 - DB runs on single board computer (IOC)
- EDM shall be used for the User Interface
 - Similar to other cryotargets
- All components have been selected/specified

Safety Systems are Integrated

- Logic for FSDs defined in Statement Of Work (SOW)
 - Drawing: TGT-1060-4001-0001
- Logic for instrument shutdowns is defined in SOW
 - Drawing: TGT-1060-4001-0002
- Integration with fire protection

The MOLLER Target user control GUI will be similar to the Qweak target control GUI



Summary

- Completed 88% of project scope for the MOLLER Target
- Vacuum chamber and cryostat assembly test completed
- Target loop assembly in progress
- LN2 test of the LH2 cell to be done spring 2026
- The Target should be ready for Hall installation spring-summer 2026
- Hall installation is now part of WBS 1.08

