PRad-II Gas Target Status

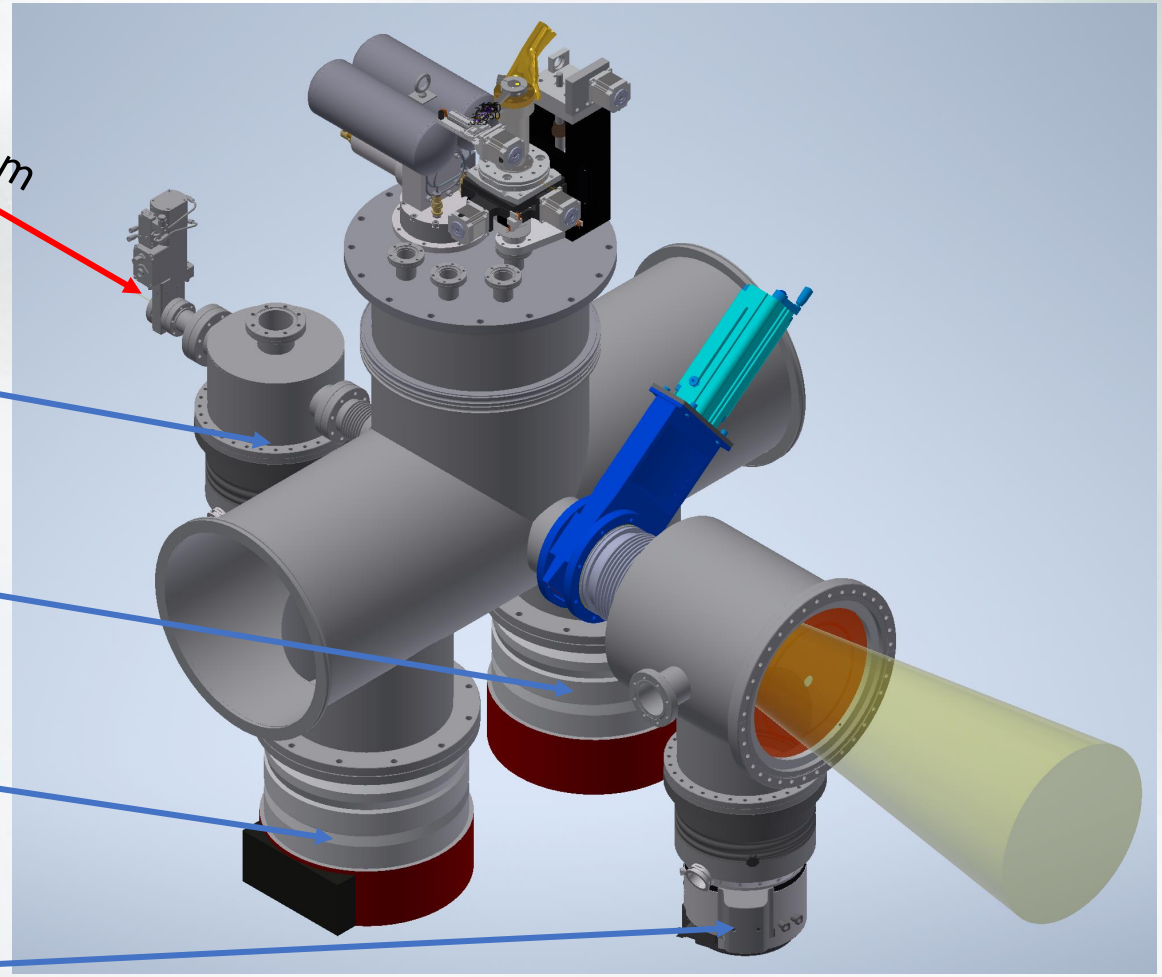
Xiangdong Wei

Jefferson Lab

PRad-II/X-17 collaboration Meeting

03/03/2025

Target Designs



Upstream Pump
1450 l/s

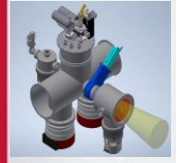
Beam-Left Pump
2700 l/s for H_2

Beam-Right Pump
2700 l/s for H_2

Downstream Pump
1450 l/s

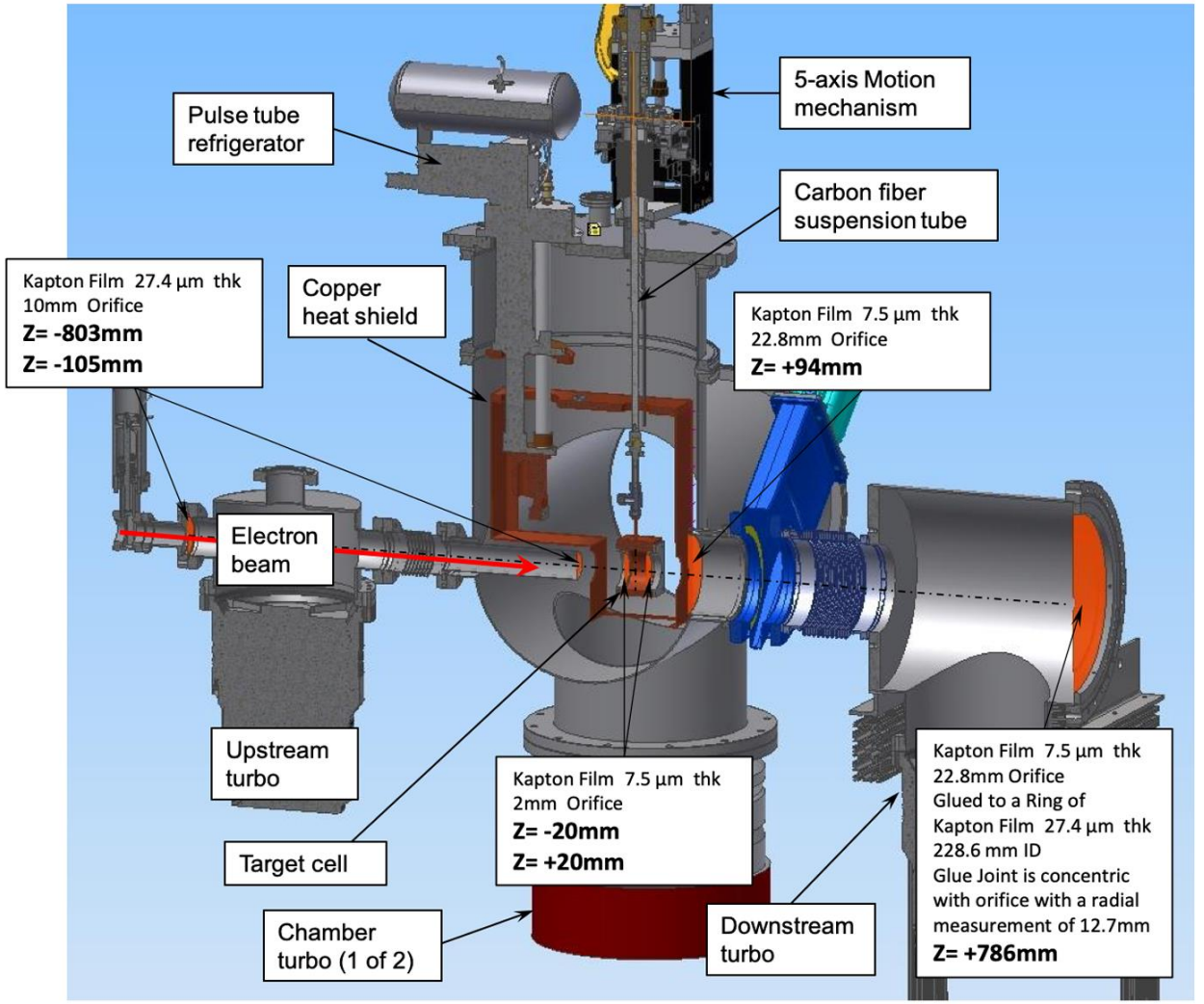
5 Turbo pumps around the target:

Both 2700 l/s turbo pumps are backed by a 1900l/s turbo pump and then fed into a multi-stage roots pump.

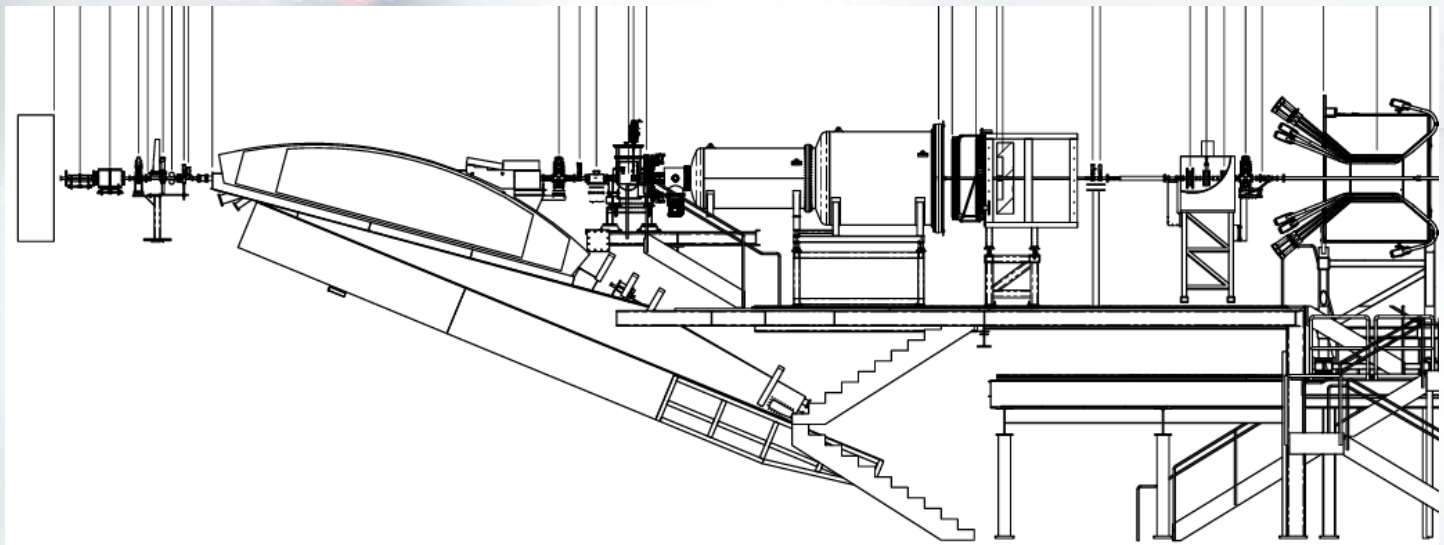


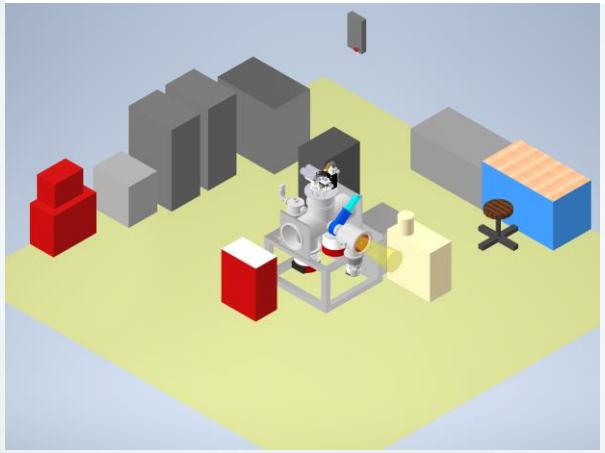
Target Parameters

- **Target cell**: 75 mm x 75 mm x 40 mm,
- **Thin end walls**: 63mm dia. by 7.5µm thick polyimide foils,
- **"Windowless"** ---Beam enter and exits via 2 mm holes on the center of Kapton foils,
- **Target Material**: High-purity hydrogen gas (>99.99%),
- **Target Length**: 40 mm,
- **Target Pressure**: 0.63 mBar,
- **Target Temperature**: Regulated at 20K,
- **Vacuum Vessel Pressure**: 6.8 x 10^{-4} mBar.

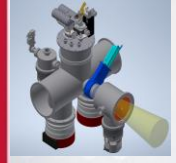


Brief Target History





- **Used for PRad experiment in 2016,**
- **Major components were kept in a storage place with for future use,**
- **Some components were repurposed,**
- **The components were moved the ESB,**
- **The target were reconnected for testing.**



Short Term Plan (11/11/2024)

Jefferson Lab

- Powering up all components,
- Testing each pump separately (to avoid rushing for long lead time repair works),
- Running all pumps and leak check the target setup,
- Establishing remote control for the hall operation (needs help),
- Testing target performance with ^{4}He (use 2 x flow to compensate low H_2 pumping rate),
- Adding Scintillators and testing vacuum performance (under Youri's guidance and help),
- Ready for ERR in Q2 FY2025,

Status Today—completed task

- All components were connected and powered, except a few gauges (April arrival),
- Water chillers have been operational and provide adequate flows for the pumps,
- Original power distributor is in use while Big Bertha is modified for covering all pumps,
- All pumps were tested (with interlock bypassed) for <1 hour,
- All components can now be controlled by the PC (thanks to DSG),
- DSG is now working with Chris Carlin on the Labview control program,
- Motors for the target position controllers.

Status Today—ongoing and later tasks

Jefferson Lab

- Waiting for arrival of long lead components (middle April delivery),
- Working on the Labview control program (DSG, target group),
- Working on interlock system,
- Run the entire target system with local PC, and later remote PC,
- Sending target operation parameters to EPIC system,
- Testing target system with veto counter assembly,
- Preparing for Hall-B installation.

Status Today—Target Team

- **MSU:** **Bhesha Devkota,**
- **JLAB:** **Phillip Dobrenz,**
  Tsuneo Kageya,
  Pablo Rojas,
  Anil Panta,
  Donald Williams,
  Xiangdong Wei,
- **UMass:** **Andrew Schick.**

Team members work on the target system at 5% ~ 50%.

Target Schedule without Veto Counter

Jefferson Lab

TIMELINE

Sun 9/1/24 — Today — Wed 11/12/25

Oct '24 | Nov '24 | Dec '24 | Jan '25 | Feb '25 | Mar '25 | Apr '25 | May '25 | Jun '25 | Jul '25 | Aug '25 | Sep '25 | Oct '25

Start Mon 9/9/24 — Defining Testing Tue 9/10/24 - Thu — Setting up Test Mon 11/25/24 - Fri — Finish Fri 10/17/25

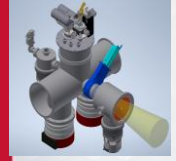
GANTT CHART

	Task Mode	Task Name	Duration	Start	Fi
3		**Defining Testing Space**	**48 days**	**Tue 9/10/24**	Tl
4		**Making a list of components**	**6.25 days**	**Tue 9/10/24**	W
9		**Preparing the floor and moving equipment**	**32 days**	**Wed 10/2/24**	Tl
16		Initiation Processes COMPLETE	0.1 days	Fri 11/15/24	Fr
17		**Setting up Test**	**44 days**	**Mon 11/25/24**	Fr
18		ePas for setting up target	2 days	Mon 11/25/24	Tu
19		Collecting vacuum hoses	2 days	Mon 11/25/24	Tu
20		Connecting vacuum Parts	2.4 days	Tue 11/26/24	Fr
21		Setting up helium Gas manifold	0.5 days	Mon 11/25/24	M
22		Leak Checking	2 days	Mon 2/3/25	Tu
23		Connecting Cables	2 days	Mon 12/2/24	Tu
24		Connecting LCW	0.25 days	Mon 12/2/24	M
25		Connecting 4He Gas	5 days	Mon 2/3/25	Fr
26		Connecting Powers	0.25 days	Wed 12/4/24	W
27		Setup Processes COMPLETE	0 days	Wed 12/4/24	W
28		**Testing the Target**	**99.13 days?**	**Thu 1/30/25**	Tl
29		**Powering the Target**	**50.42 days?**	**Thu 1/30/25**	Tl
30		ePas for Testing Target	3 days	Thu 1/30/25	M
31		Powering all components	2.85 days	Tue 2/4/25	Th
32		Establishing computer Control	18.9 days	Thu 2/6/25	W
33		Establishing remote operations	5.67 days	Wed 3/5/25	Th
34		Sending data to EPICS	4 wks?	Thu 3/13/25	Th
35		**Testing the Target**	**85.28 days?**	**Thu 2/6/25**	M
36		Testing indivdiual components	11.13 days	Thu 2/6/25	Fr
37		**Long lead parts arrival**	**14.13 days**	**Fri 4/4/25**	Tl
45		Testing interlocks	1 day?	Thu 4/24/25	Fr
46		Running altogether	5 days	Fri 4/25/25	Fr
47		ERR	1 day	Fri 5/2/25	M
48		Measuring vessel pressures	20 days	Fri 5/2/25	M
49		Testing finished	0 days	Mon 6/2/25	M

Qtr 4, 2024 | Qtr 1, 2025 | Qtr 2, 2025 | Qtr 3, 2025 | Qtr 4, 2025

Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct

Donald W.[25%],Phillip D.[25%],Xiangdong W.[25%]
Donald W.[25%],Phillip D.[50%]
Donald W.[50%],Phillip D.[25%],Xiangdong W.[10%],Andrew S.[50%]
Donald W.[10%]
Donald W.[50%],Xiangdong W.[25%],Andrew S.[50%]
Xiangdong W.[25%],Andrew S.[50%],Donald W.[50%],Phillip D.[10%]
Donald W.
Donald W.
Donald W.[50%]
12/4
Phillip D.[50%]
Donald W.[20%],Andrew S.[50%],Phillip D.[10%]
Phillip D.[5%],Andrew S.[10%],DSG
Phillip D.[5%],Andrew S.[25%],DSG
Anil P.[25%]
Andrew S.[50%],Xiangdong W.[10%],Donald W.[10%]
Phillip D.[25%],Xiangdong W.[25%],Donald W.[50%]
Donald W.[10%],Andrew S.[50%],Xiangdong W.[10%],Ph
Phillip D.,Xiangdong W.,Tsuneo K.[50%]
Andrew S.[1%],Xiangdong W.[1%],Tsuneo K.[5
6/2



Target Schedule with Veto counter

Jefferson Lab

TIMELINE

Sun 9/1/24 — Today — Wed 11/12/25

Oct '24 | Nov '24 | Dec '24 | Jan '25 | Feb '25 | Mar '25 | Apr '25 | May '25 | Jun '25 | Jul '25 | Aug '25 | Sep '25 | Oct '25

Start Mon 9/9/24 — Defining Testing Tue 9/10/24 - Thu — Setting up Test Mon 11/25/24 - Fri — Finish Fri 10/17/25

GANTT CHART

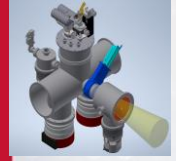
	Task Mode	Task Name	Duration	Start	Fi
16		Initiation Processes COMPLETE	0.1 days	Fri 11/15/24	Fr
17		**Setting up Test**	**44 days**	**Mon 11/25/2**	**Fr**
28		**Testing the Target**	**99.13 days?**	**Thu 1/30/25**	**Th**
29		**Powering the Target**	**50.42 days?**	**Thu 1/30/25**	**Th**
30		ePas for Testing Target	3 days	Thu 1/30/25	M
31		Powering all components	2.85 days	Tue 2/4/25	Th
32		Establishing computer Control	18.9 days	Thu 2/6/25	W
33		Establishing remote operations	5.67 days	Wed 3/5/25	Th
34		Sending data to EPICS	4 wks?	Thu 3/13/25	Th
35		**Testing the Target**	**85.28 days?**	**Thu 2/6/25**	**M**
36		Testing indivdiual components	11.13 days	Thu 2/6/25	Fr
37		**Long lead parts arrival**	**14.13 days**	**Fri 4/4/25**	**Th**
45		Testing interlocks	1 day?	Thu 4/24/25	Fr
46		Running altogether	5 days	Fri 4/25/25	Fr
47		ERR	1 day	Fri 5/2/25	M
48		Measuring vessel pressures	20 days	Fri 5/2/25	M
49		Testing finished	0 days	Mon 6/2/25	M
50		Modifying downstream chamber	1 wk	Mon 6/2/25	M
51		**Testing with new detector**	**77.13 days?**	**Mon 3/3/25**	**Th**
52		ePas for installation	2 days	Mon 3/3/25	Tu
53		Waiting for Veto counters	12 wks?	Mon 3/3/25	Fr
54		Connecting vacuum hoses	1 day	Mon 6/9/25	Tu
55		Pumping target vessel	2 days	Tue 6/10/25	Th
56		Testing motion	0.25 days	Thu 6/12/25	Th
57		Leak Check	2 days	Thu 6/12/25	M
58		Check the minimum pressure	3 days	Mon 6/16/25	Th
59		Test Processes COMPLETE	0 days	Thu 6/19/25	Th
60		**Closing Processes**	**0.1 days**	**Thu 6/19/25**	**Th**
61		Close Project	0.1 days	Thu 6/19/25	Th
62		Project COMPLETE	0 days	Thu 6/19/25	Th
63		Installation in Hall-B	10 days	Mon 10/6/25	Fr

Things might affect the schedule

Jefferson Lab

- **Building Irradiation Cryostat and prepare additional vent line at CEBAF Injector for preparing polarized LiD target for PAC approved experiment, and for DOE funded Polarized Fusion Project.**

- **Veto counter delivery time will drive the final test schedule, which may impact the Hall-B installation schedule.**



Forward Thinking

- **The target performance is relied on the 2 existing Pfeiffer HiPace 3400 turbo pumps (no long available on the market). A spare turbo pump is purchased by Duke University.**

- **The 1900 l/s turbo pump and the multi-stage roots pump (Pfeiffer A 803H) can be replaced by a larger multi-stage roots pump with 2 X pumping speed (Pfeiffer A 1804H). Discussions with the vendor for detailed clarification and quoting are ongoing.**

- **All turbo pumps and the cold head compressor need chilled water to run, therefore a spare chiller might be a reasonable thing to have. It can also be used for backing up the HyCal chiller.**

Summary

- **The target is set up in the ESB for recommissioning,**
- **The performance test without Veto counter package is scheduled to finish in May, before ERR (05/09/2025),**
- **The hall installation will start at the beginning of the next SAM.**
- **Spare equipment has been purchased or being discussed.**