NPOI Vacuum Manifold

Wyatt Clark | Cydny Clark | Alex McClinton

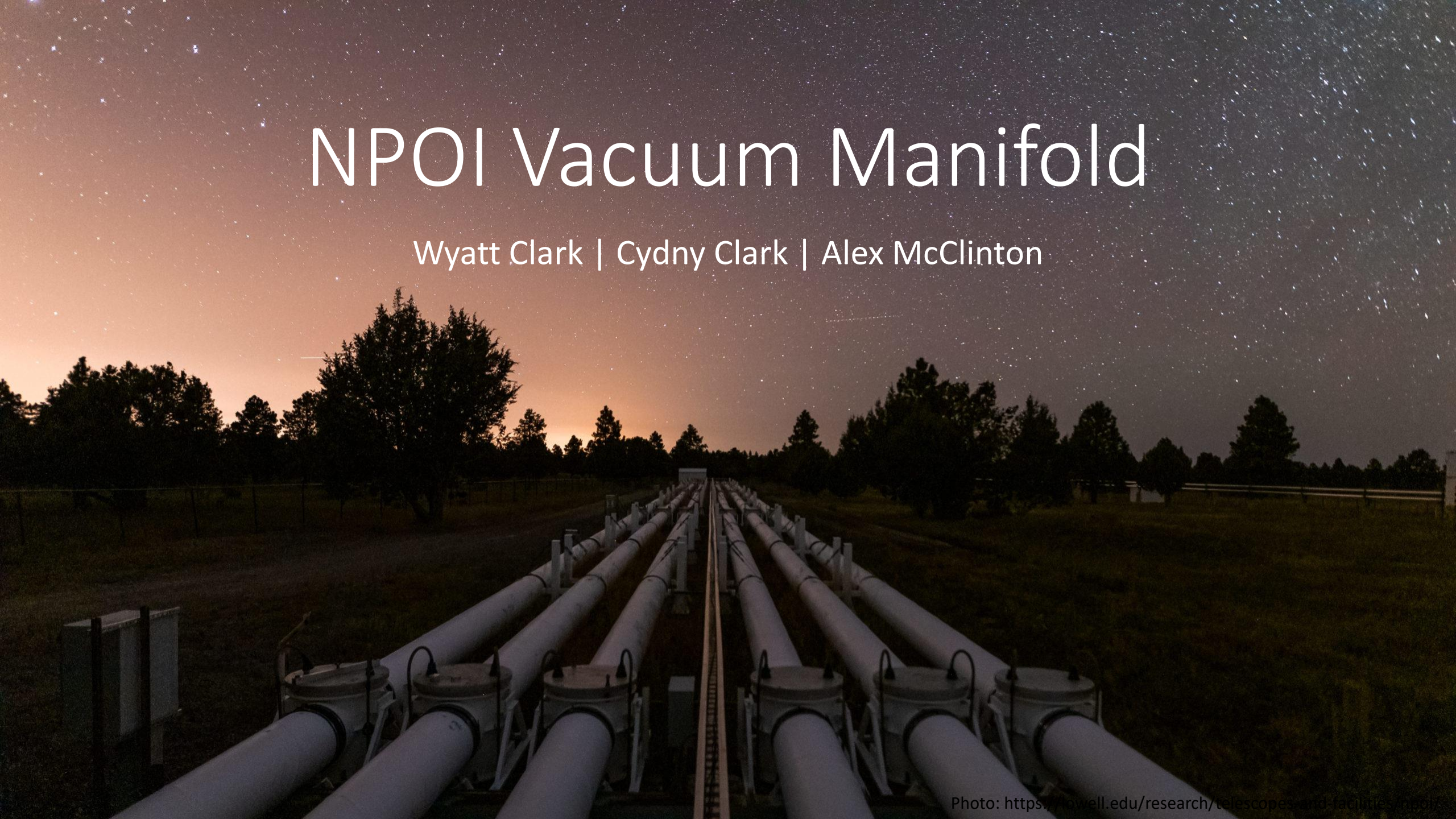


Photo: https://lowell.edu/research/telescopes-and-facilities/npoi/

QFD

Factor of Saftey					
Project Cost		3			
Minimize Downtime			1		
Leak Rate				3	
		Technical Requirements			
CustomerRequirments	**Customer Weights**	Factor of Saftey	Project Cost	Minimize Downtime	Leak Rate
Saftey	9	9	9		1
Cost	3	9	9	1	9
Ease of Use	3		1	9	9
Relyability	9	9	3	9	9
Repairability	9	3	3	9	3
Longjevity	3	9	1	1	3
Future Project Integration	1		1	1	
Technical Requirement Units		N/A	USD	Hours	Days ≤30mTorr
Technical Requirement Targets		2.5	10000	2	5
Technical Requirement Tolerance		±.5	±4000	±1	±1
Absolute Technical Importance		243	169	196	180
Relative Technical Importance		1	4	2	3

Design Requirements

- Customer Requirements (CR)
  1. Safety
  2. Reliability
  3. Maintenance accessibility
  4. Within budget
  5. Easy to use
  6. Future project integration

- Engineering Requirements (ER)
  1. Factor of safety
  2. Project Cost
  3. Minimize Downtime
  4. Leak Rate

Top Level Testing Summary

Experiment / Test	Relevant Design Requirement
1. Front Plate Disassembly Time	CR3, CR5, ER3
2. Leak Rate Test	CR2, ER4
3. Cable Passthrough Setup	CR3, CR5, ER3
4. Cable Continuity Test	CR1, CR2, ER3
5. Pressure Gauge Calibration	CR2,CR3, ER3

Front Plate Disassembly Time

- Purpose
  - Determine time needed to do remove plates for regular maintenance of FDLs
- Procedure
  - Follow the previously established procedure for removing “snoots” from FDL tanks. Proceed to use crane to move front plate from tank. Time process.
- Expected Result
  - Time to do this should be quicker then before as manifold does not need to be removed anymore.

Front Plate Disassembly Time

Leak Rate Test

- Purpose
  - Evaluate ability of manifold to maintain vacuum when pump system fails
- Procedure
  - Pump FDL tanks to standard operating pressure. Isolate tank from vacuum pump. Record time taken to reach 30mTorr from isolation.
- Expected Results
  - Client asked not to preform this test due to excellent performance of new manifold in keeping new record low vacuum. If tested it should be the same or better, then original manifold.

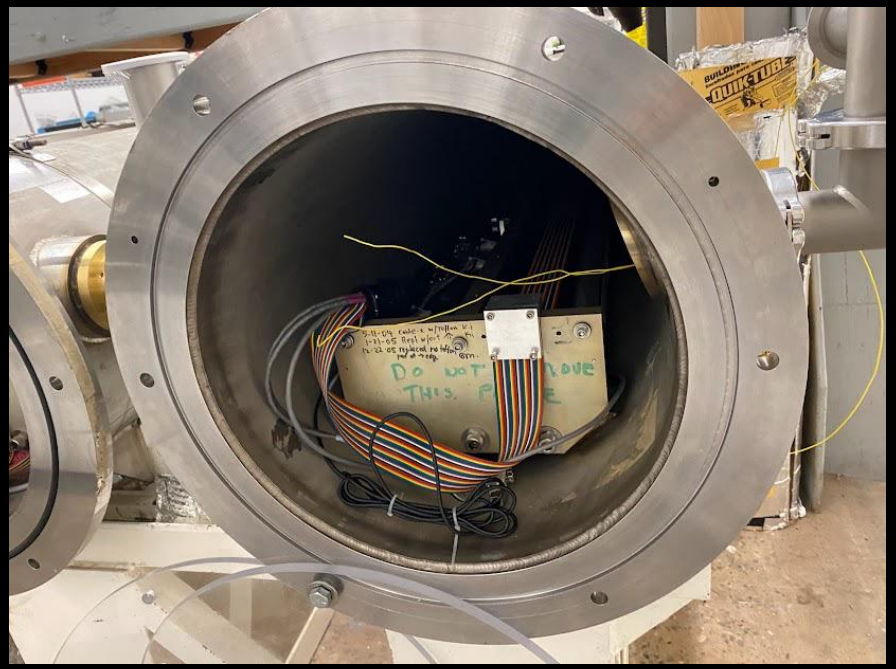
Leak Rate Test

	current
fdl1	2.500
fdl2	2.800
fdl3	5.600
fdl4	5.800
fdl5	6.200
fdl6	6.700

Cable Passthrough Setup

- Purpose
  - Understand time needed to disassemble and remove the cables for regular maintenance of FDLs.
- Procedure
  - Once the snoots and front plates have been removed, the process of disassembling the cable connection and removing the cable that resides in the manifold will be timed.
- Results
  - The time it took to disassemble and the cable connection was ten minutes for one manifold.

Cable Passthrough Setup



Cable Continuity Test

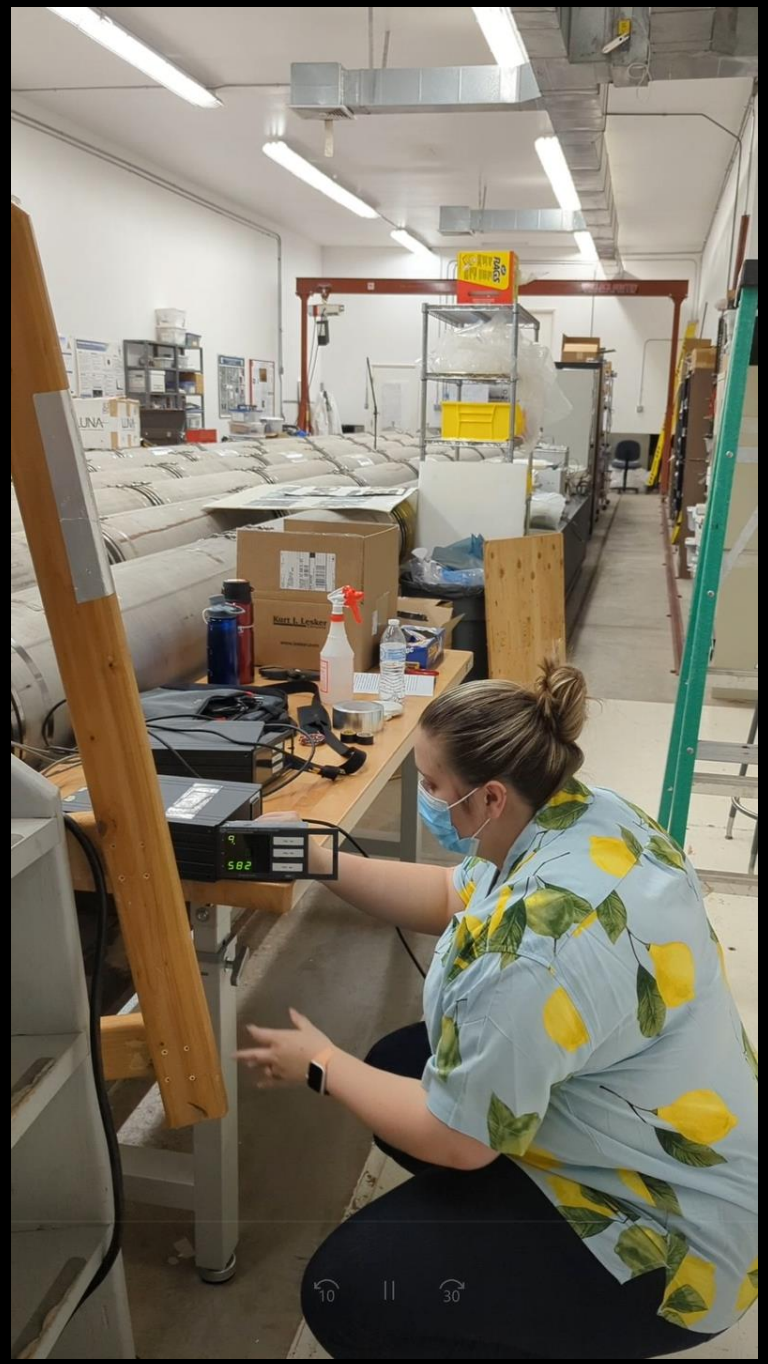
- Purpose
  - Ensure cables are built correctly and will be able to function with the FDL carts
- Procedure
  - 2-person job. Requires testing at one end of outer cable and testing at the other end of inner cable. Using a digital multimeter each person will touch lead to one of 36 pins at the same time, starting at pin 1 and moving in ascending order.
- Results
  - Each cable was built correctly and where able to move operate FDL carts

Cable Continuity Test

Pressure Gage Calibration

- Purpose
  - Ensure accurate data is being recorded.
- Procedure
  - Each gauge is placed on the mass-spectrometer that produces 10^{-5} torr vacuum. Reading on display box is adjusted until it reads zero. Gage is then brought back to atmospheric where its box is adjusted until it reads 585 torr. This process is repeated to ensure values displayed are still correct.
- Actual Results
  - Each gage was successfully calibrated and was able to have data collected properly.

Pressure Gage Calibration



Final Results

Customer Requirement	CR Met (✓ or X)	Client Acceptable (✓ or X)
CR1 - Safety	✓	✓
CR2 - Reliability	✓	✓
CR3 - Maintenance	✓	✓
CR4 - Cost	✓	✓
CR5 - Ease Of Use	✓	✓
CR6 - Future Integration	✓	✓

Engineering Requirement	Target	Tolerance	Measured /Calculated Value	ER Met (✓ or X)	Client Acceptable (✓ or X)
ER1 - Factor Of Safety	2	±0.5	>10	✓	✓
ER2 - Cost	10000$	±4000$	11678.04 $	✓	✓
ER3 – Minimize Downtime	2 hr	±1 hr	30 min	✓	✓
ER4 – Leak Rate	5 days	±1 day	NA	UKN	✓

Questions

Photo: https://lowell.edu/research/telescopes-and-facilities/npoi/