Mirror Reflectivity Test Station

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- Procedures
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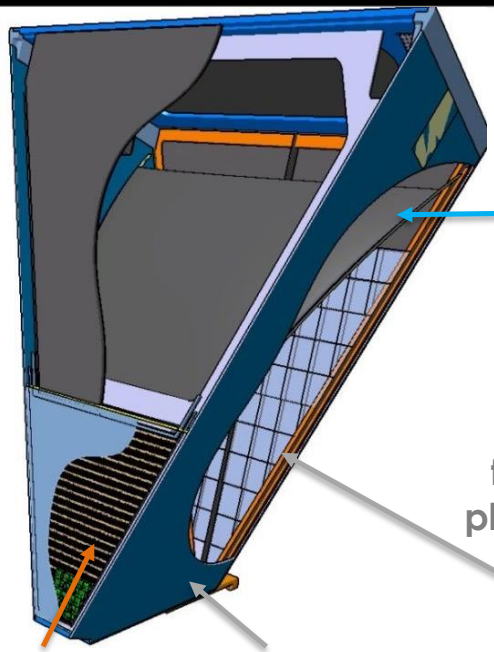
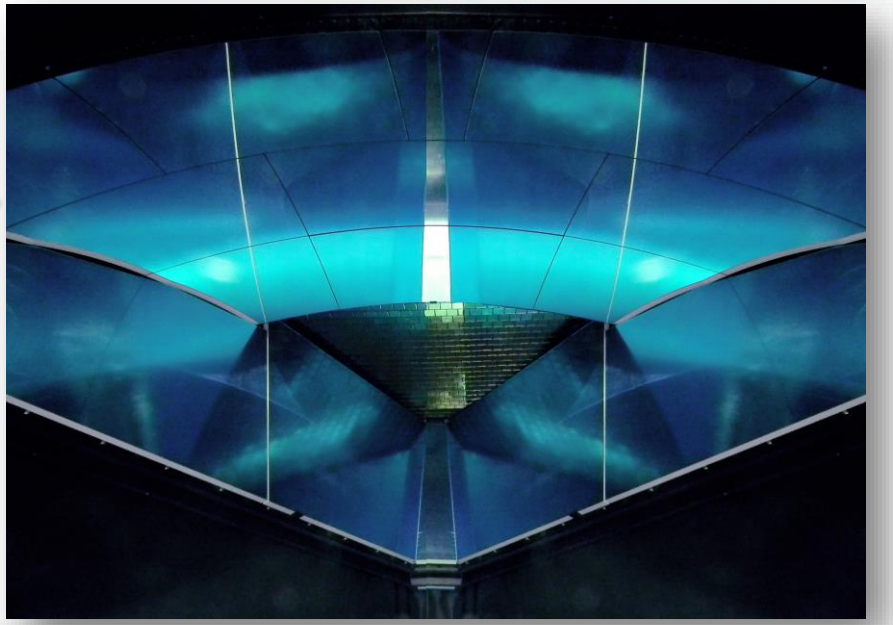
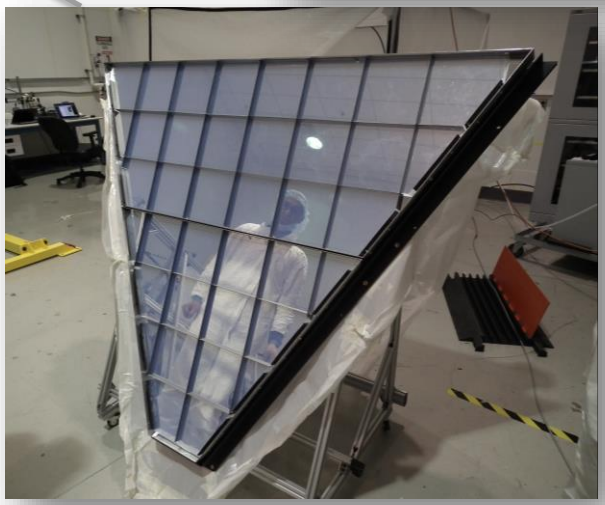
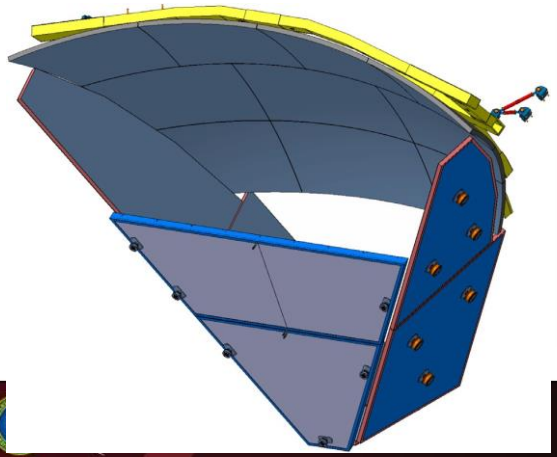
CLAS12 RICH mirror system





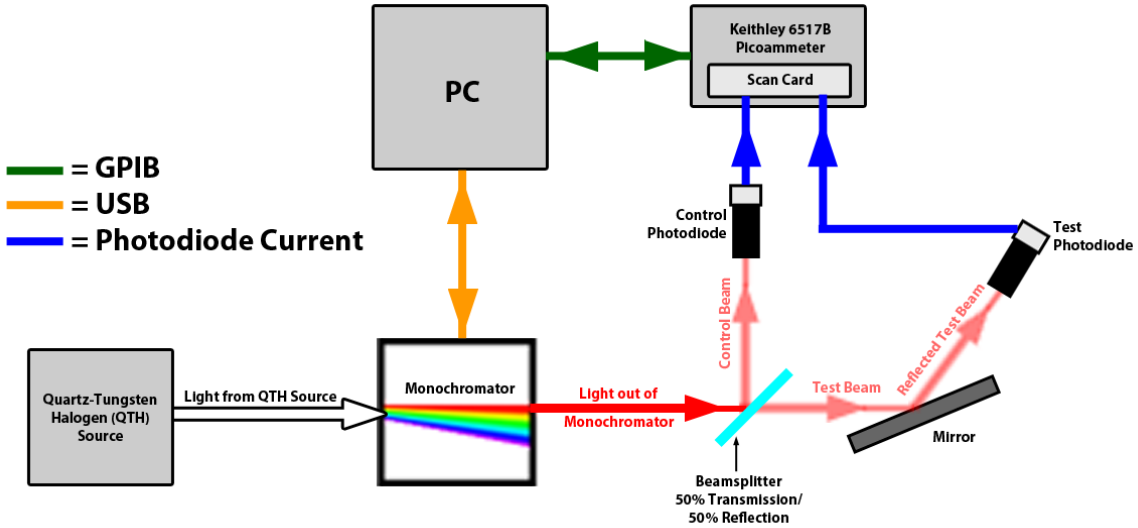




- 10 spherical mirrors (~3.6 m^2)
- 7 planar mirrors (~6.5 m^2)

- The mirrors must have a reflectivity greater than or equal to 90%, per specification.

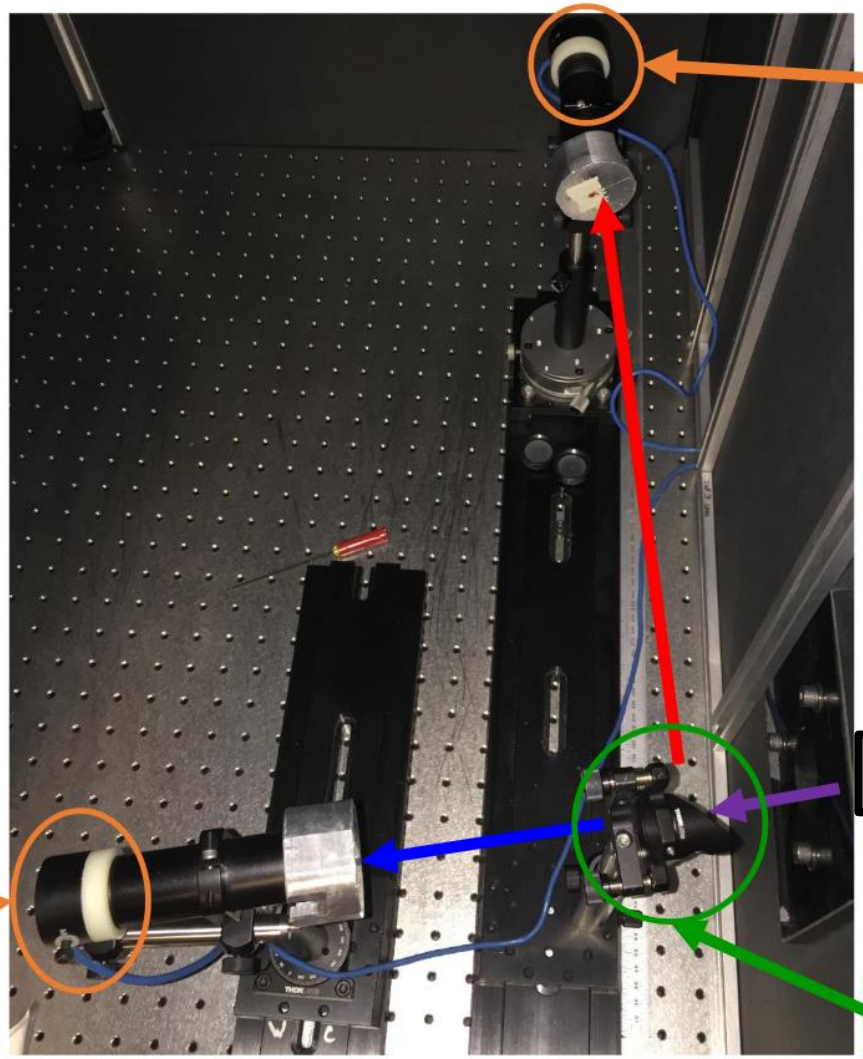
Present Mirror Reflectivity Test Station



- Test station located in the EEL 125 "semi-clean room"

- Quartz-Tungsten Halogen Lamp
- Monochromator provides light of a specified wavelength
- Using beam-splitter, light splits into control beam and test beam
- Test beam reflects off mirror
  - For calibrations, test photodiode is positioned so that test beam directly hits test photodiode
- Control beam's and test beam's power are measured by separate photodiodes
- Photodiodes' current response measured by Keithley picoammeter

Present Test Station



Present Test Station: Test Procedure

A. Calibration of the test photodiode

1. Move test photodiode and its mount to calibration rail in test station
2. Remove test photodiode from its mount and attach collimators to tube on mount
3. Place alignment laser inside monochromator box and turn on
4. Align light from laser so that it passes through both collimators
5. Turn off laser, remove it from monochromator, and replace monochromator lid
6. Remove collimators from mount and re-install test photodiode on its mount
7. Run program in calibration mode

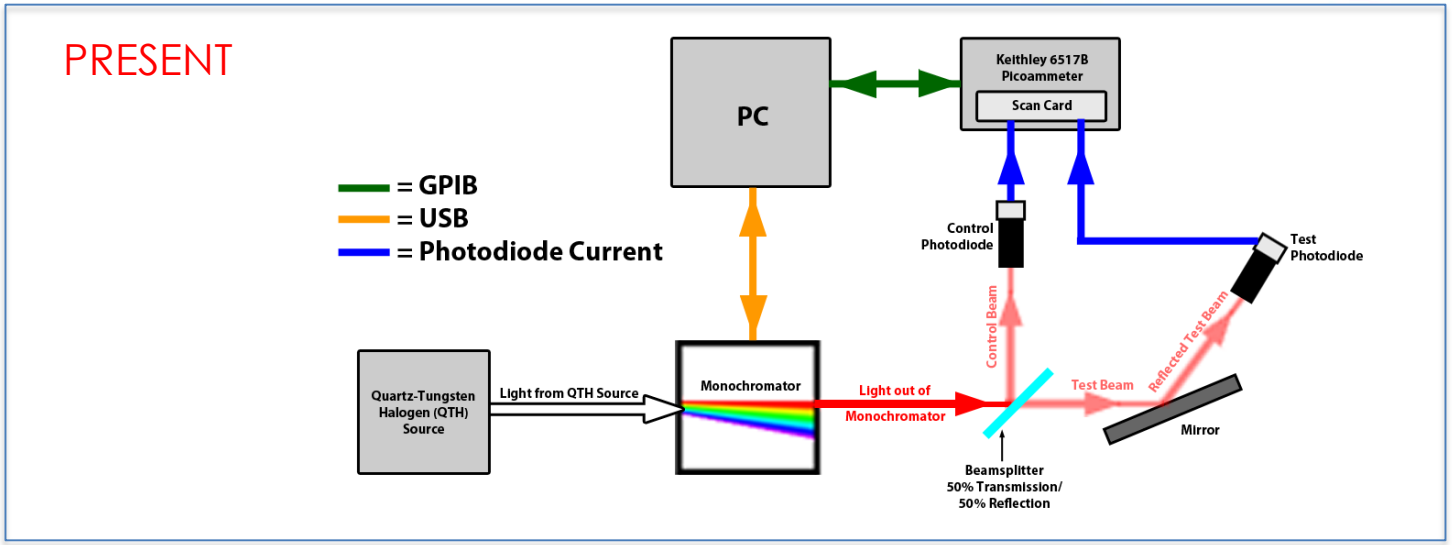
B. Measurement of mirror reflectivity

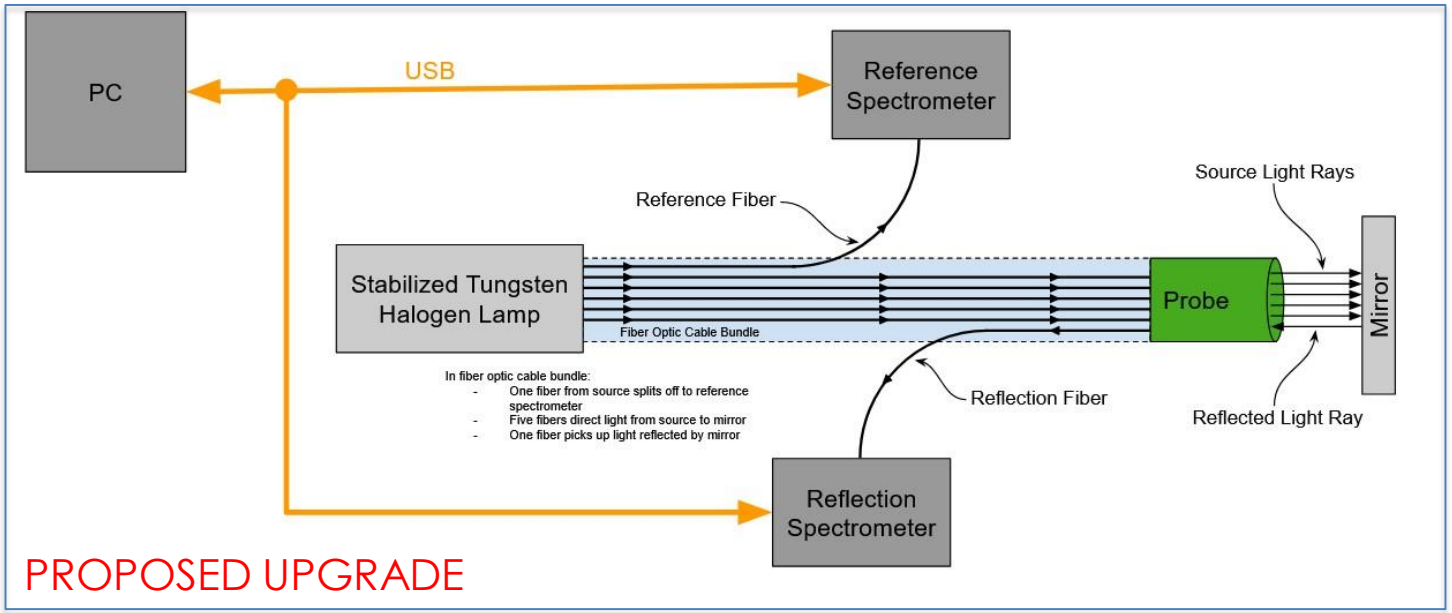
1. Move test photodiode and its mount to measurement rail in test station
2. Remove test photodiode from its mount and attach collimators to tube on mount
3. Place alignment laser on monochromator box and turn on
4. Align mirror so alignment laser reflects off of mirror and to test photodiode mount
5. Align test photodiode so reflected beam from laser passes through both collimators
6. Turn off laser, remove it from monochromator, and replace monochromator lid
7. Re-install test photodiode on its mount
8. Run program in measurement mode

Red items are steps with largest potential to cause error in measurement

- Calibration must be repeated several times throughout day to compensate for changes in light source's power over time

Proposed Upgrade Mirror Reflectivity Test Station



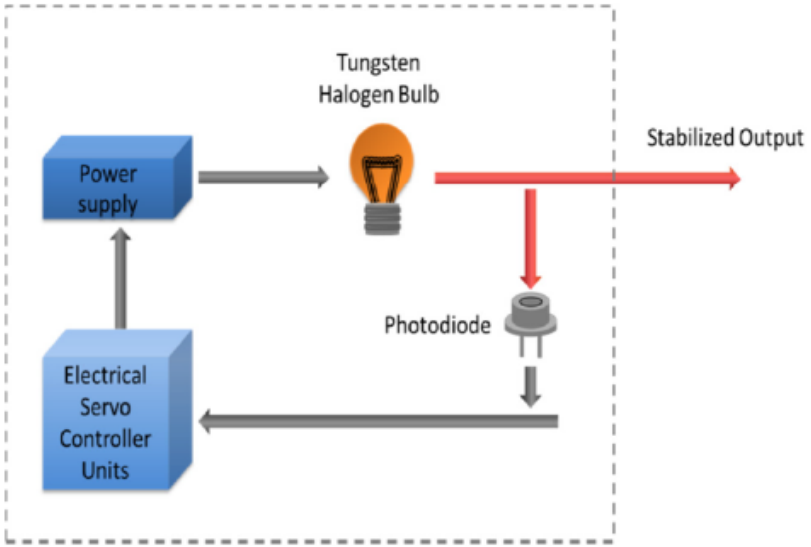


- Use for measurements:
  - stabilized source
  - fiber optic reflection probe
  - compact spectrometers
- Limits alignments required

Upgrade Components
Stabilized Tungsten-Halogen Broadband Source

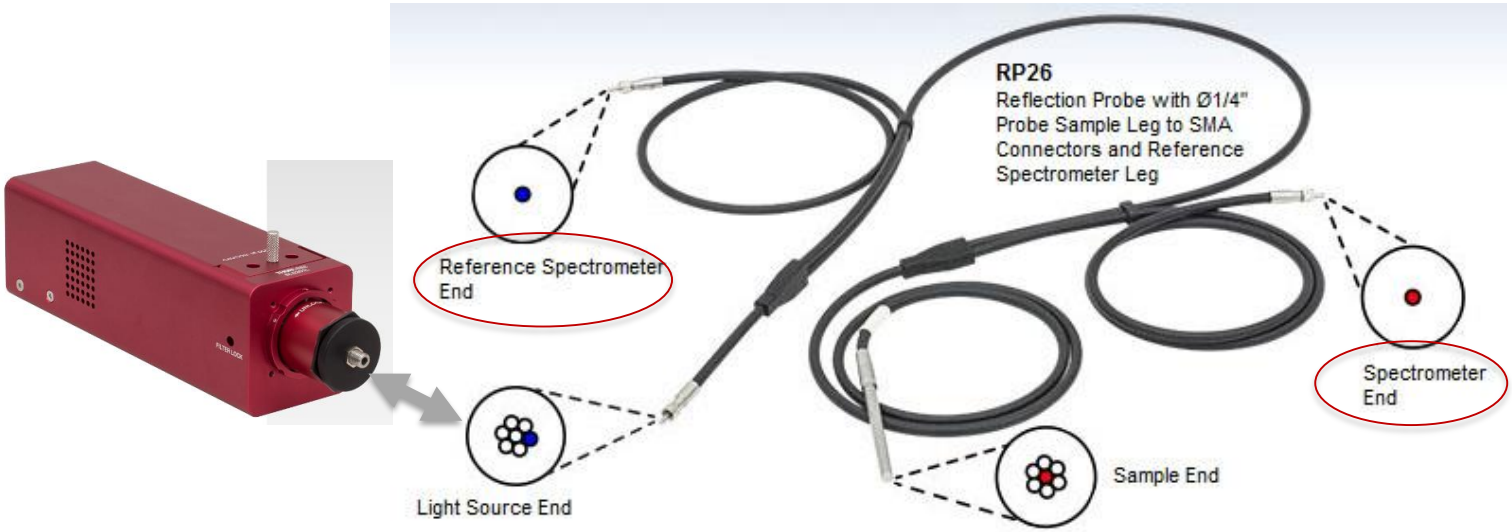
- Thorlabs part # SLS201L
- Output: 360 nm – 2600 nm "white light"

- Has built-in output stabilization circuit that ensures output power is steady



Output stabilization circuit

Upgrade's DAQ Components – Fiber Optic Reflection Probe



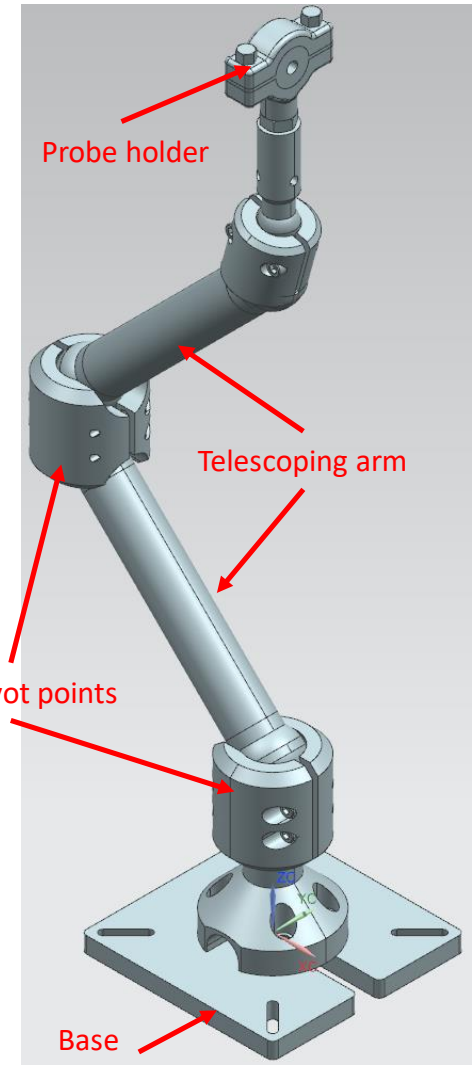
- Thorlabs item # RP26
- Seven-fiber, fiber optic cable bundle
- Sample end has 0.25" diameter probe
- Source, reference, and measurement ends have SMA connectors
- **Flexible fiber optic cable eliminates need to align reference light with detector**
- Only alignment needed is probe with mirror

Upgrade Components
Compact USB Spectrometer

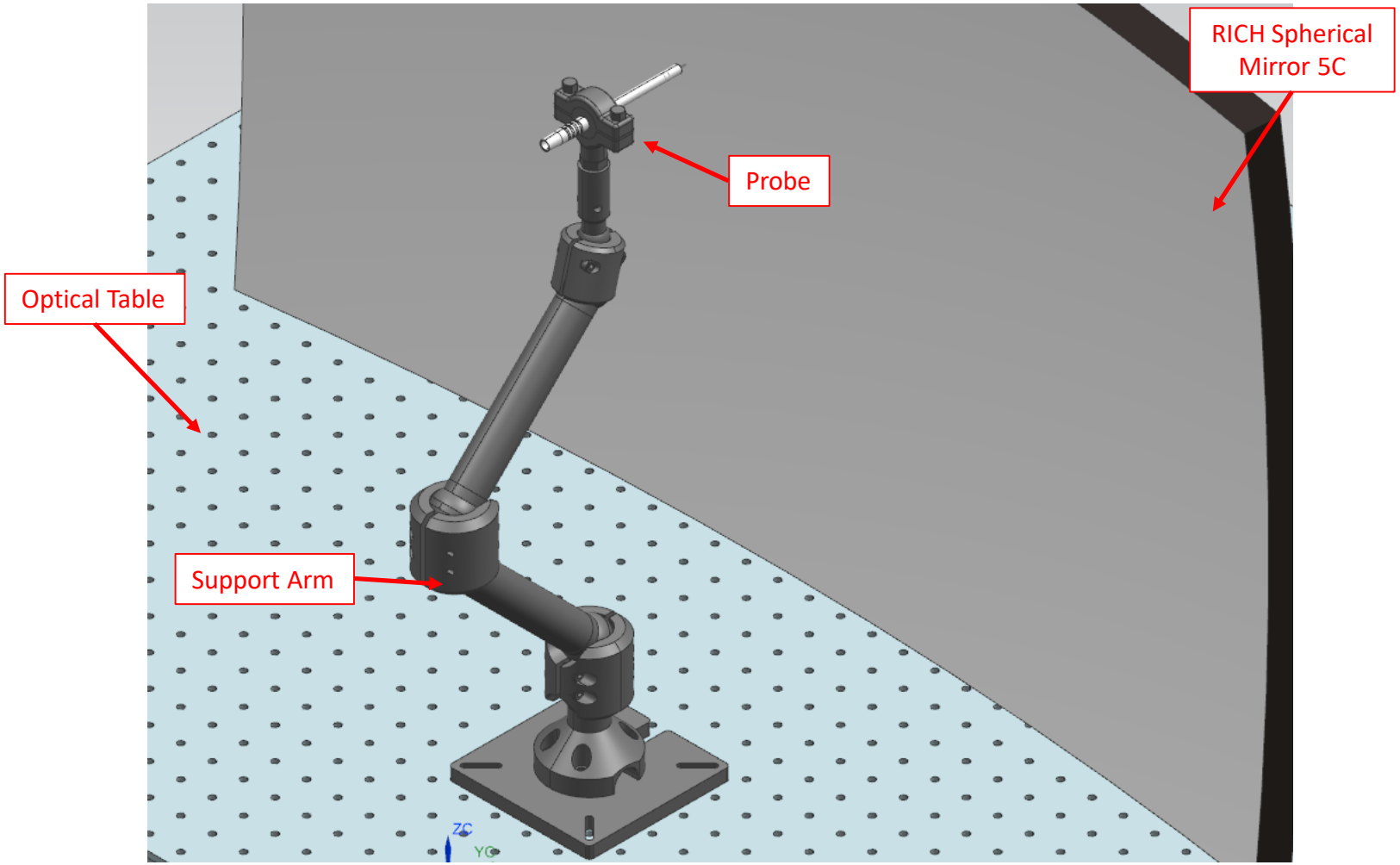
- Thorlabs part # CCS200
  - Two required
- Measures power across full spectrum of input light
  - Analyzes all wavelengths at once
  - 200 nm – 1000 nm analysis range
  - 2 nm spectral accuracy
- Includes DAQ program and full suite of LabVIEW drivers

Manual Alignment Probe Support Arm NX Model

- Probe must be securely held over mirror for measurements
  - McMaster-Carr heavy duty, ball grip, positioning arm proposed for support arm
- Base to secure support arm to 1" grid on optical table
- Two 90° pivot points
  - Can also swivel 360°
- Two telescoping arms
  - Extends from 6.75" to 10.75"



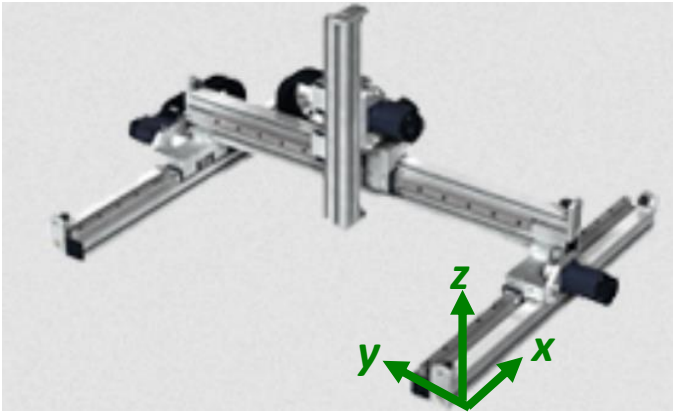
NX Model of Manual Alignment Test System with RICH Mirror



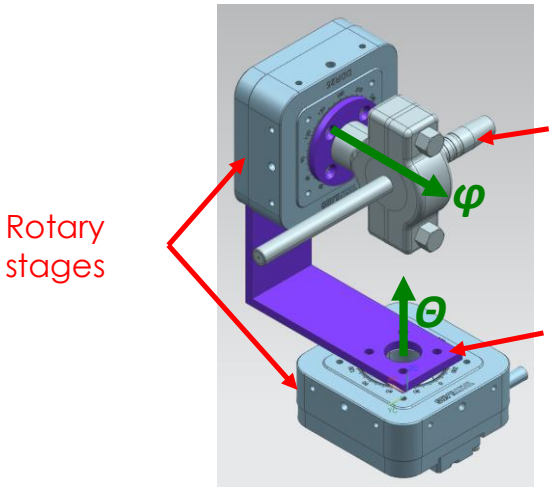
NX model of entire proposed setup. RICH Spherical Mirror 5C is largest spherical mirror.

Automated Gantry Option

- To fully-automate test-station, five axes of movement are needed
  - X, Y, and Z linear motion
    - Quote requested from two companies for a "gantry system" of stages
  - θ and φ rotation
    - Because mirrors are spherical, probe will need to be angled to be perpendicular to mirror surface if moved
    - Thorlabs rotary stages with a designed bracket could be used



Sales photo example of three axes gantry stage



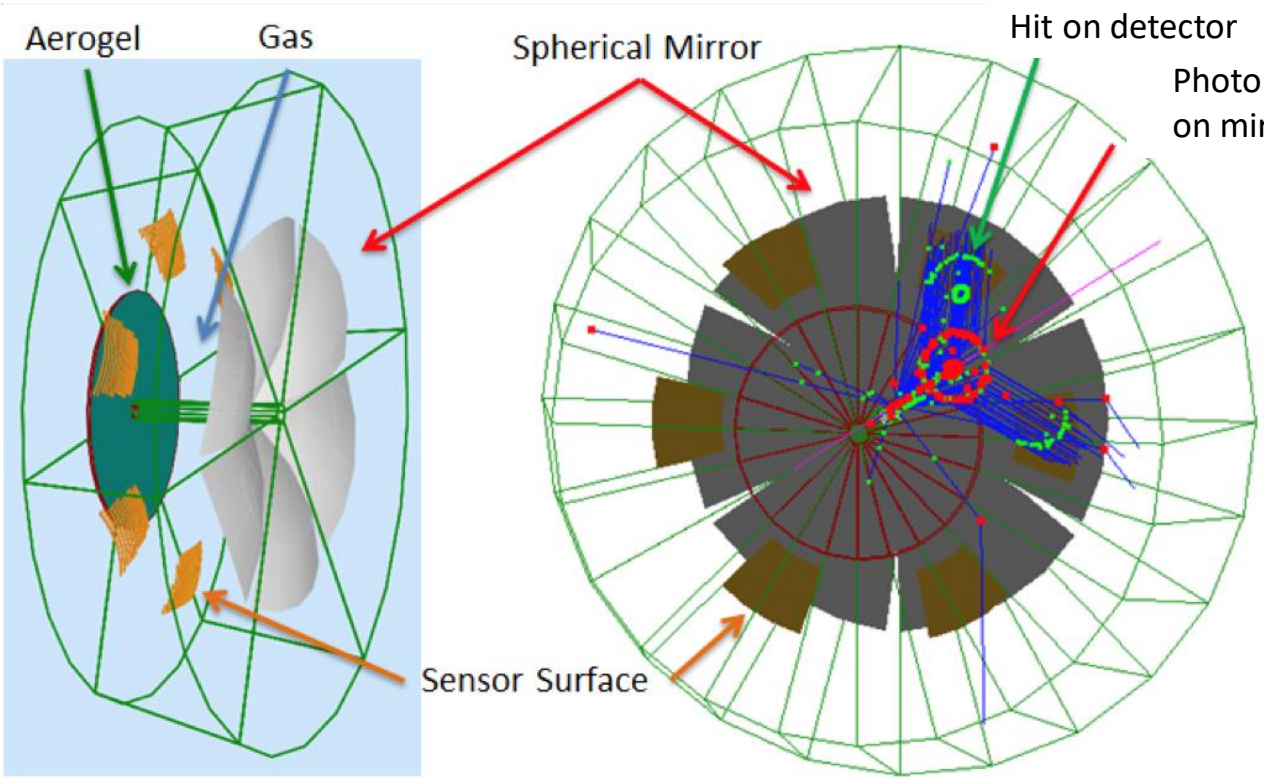
Probe model on two rotary stages

Expansion of Upgraded Test Station Capabilities

- Adding a second UV light source expands test station to UV spectrum

- Can be configured to test transmission properties of aerogel

Looking forward: EIC



dRICH is part of the reference detector

- Radiators: Aerogel (n~1.02)+Gas (n~1.0008)
- ~12 m^2 mirrors (~2m^2 per sector)

Conclusion

- We will improve reflectivity test station using fiber optic probe, compact USB spectrometers, and a stabilized light source
- New test station advantages
  - Expedite testing
  - Decrease sources of errors
- Test station can be used for future EIC needs