

# Photocathode characterisation device

## Status

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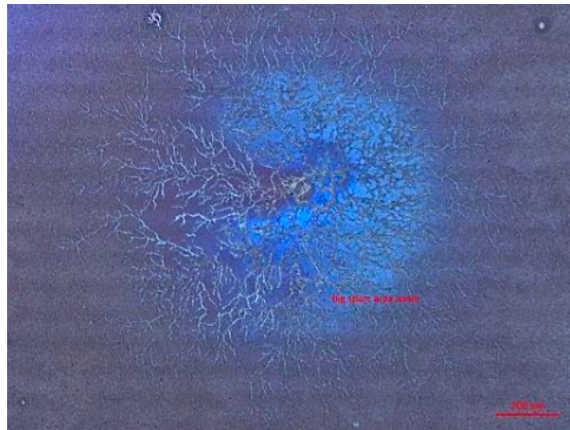
on behalf of the CERN EP-DT-DD GDD group

September 26, 2017

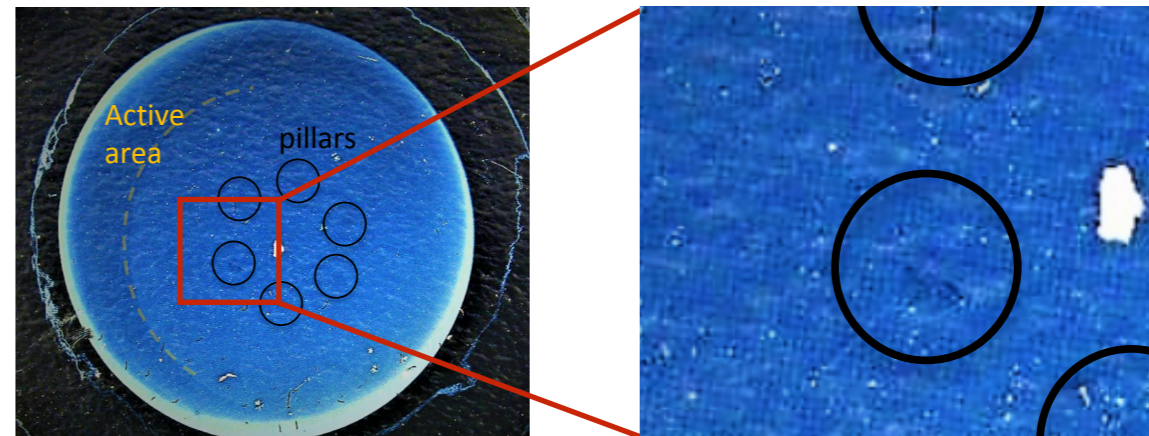
# New materials

## Photocathodes

### Spark on CsI photocathode



### Ion feedback on CsI photocathode



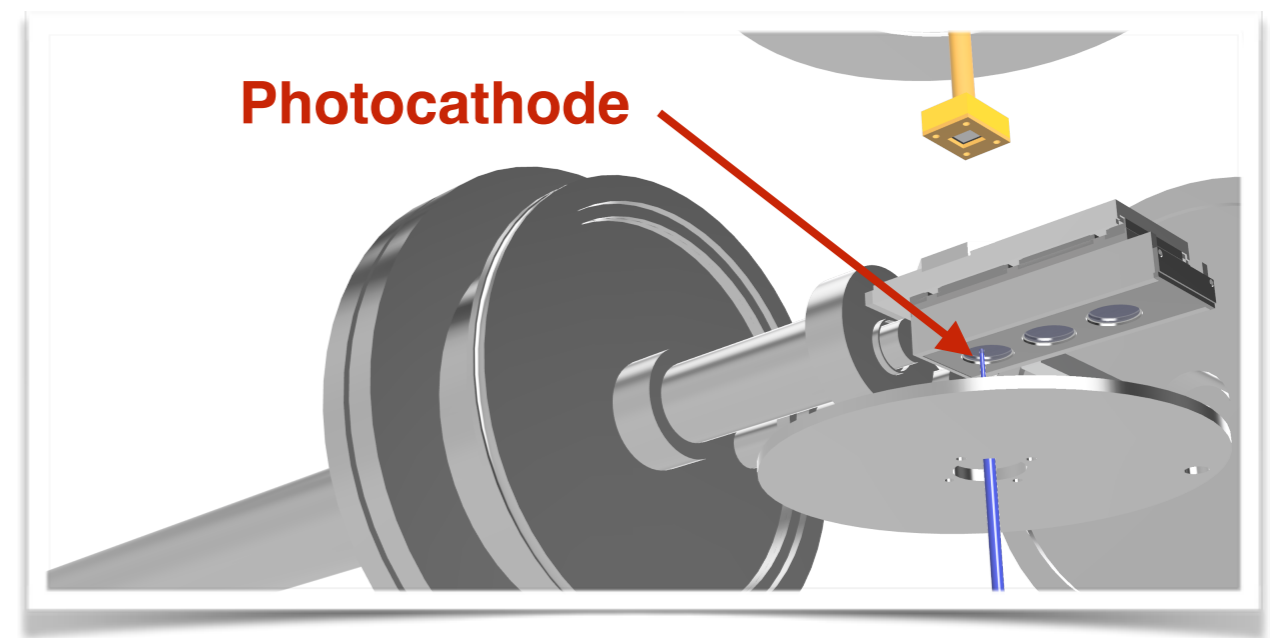
CsI photocathodes are sensitive to **sparks** and ion **bombardment**

### Robust photocathode:

- Diamond as photocathode
- DLC photocathode
- Purely metallic photocathodes
- Chromium, aluminum already tested

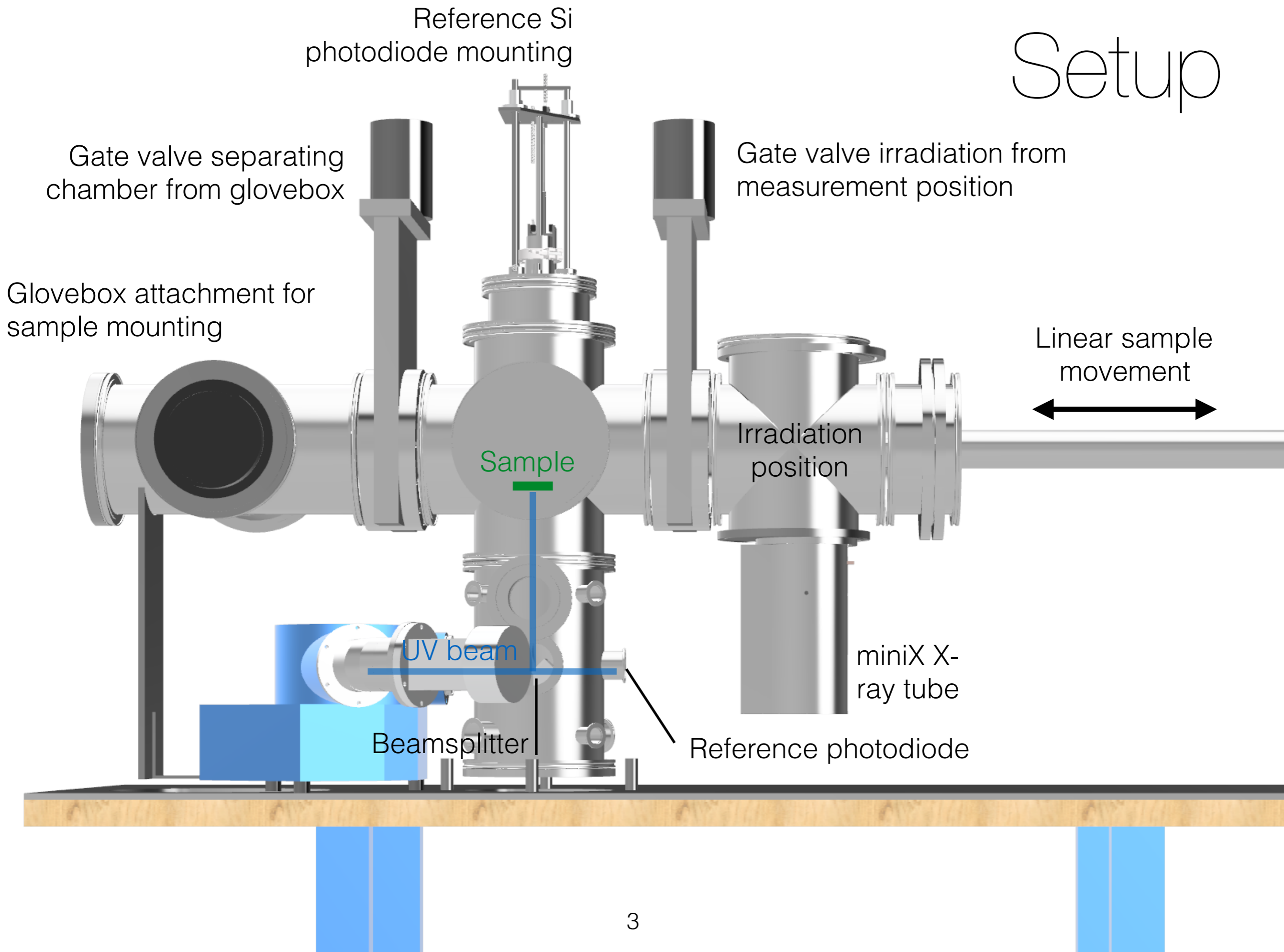
### Protecting CsI photocathode by:

- Thin layers applied by ALD
- LiF protection layer
- Graphene as protection layer



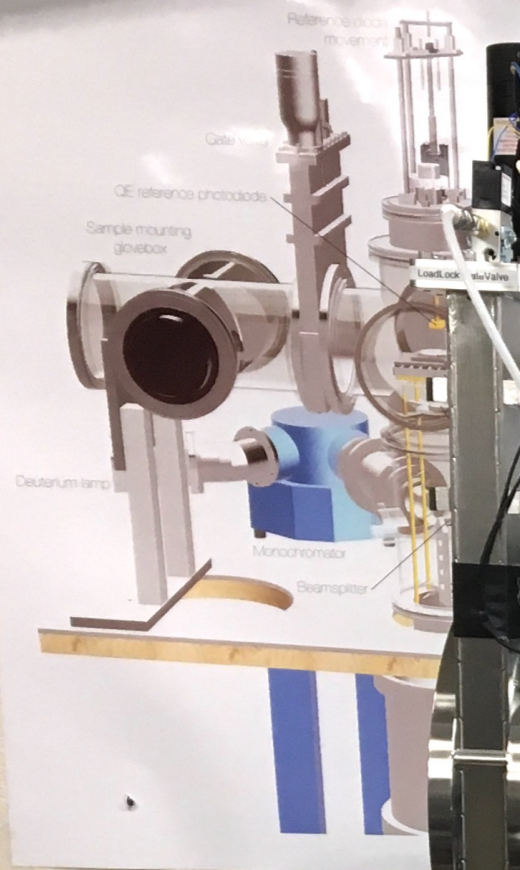
Development of photocathode characterisation device (ASSET) to study QE after **ion bombardment** and influence of **protection layers**

# Setup



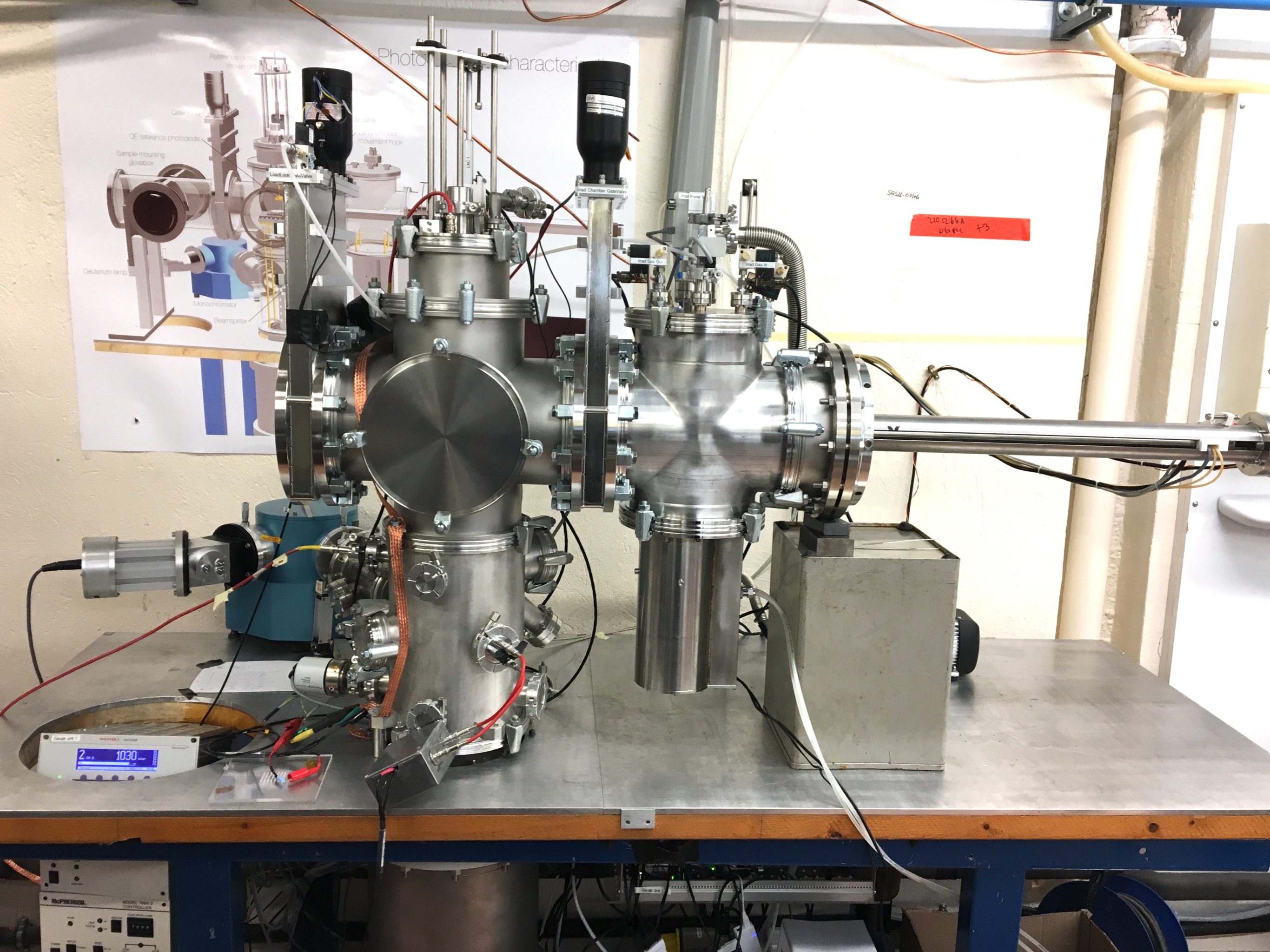


Photoelectron Characterization



S65L-00164

710.02.66A  
U6A.FIL #3



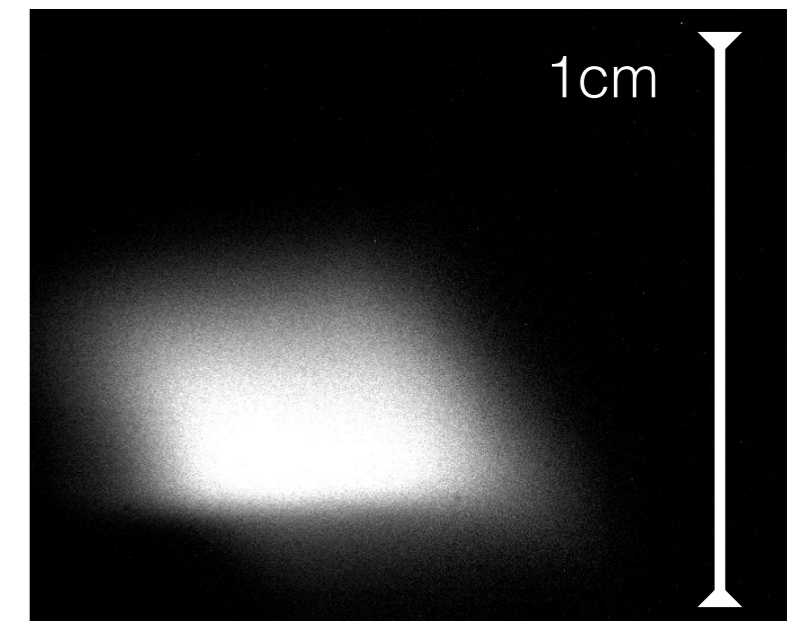
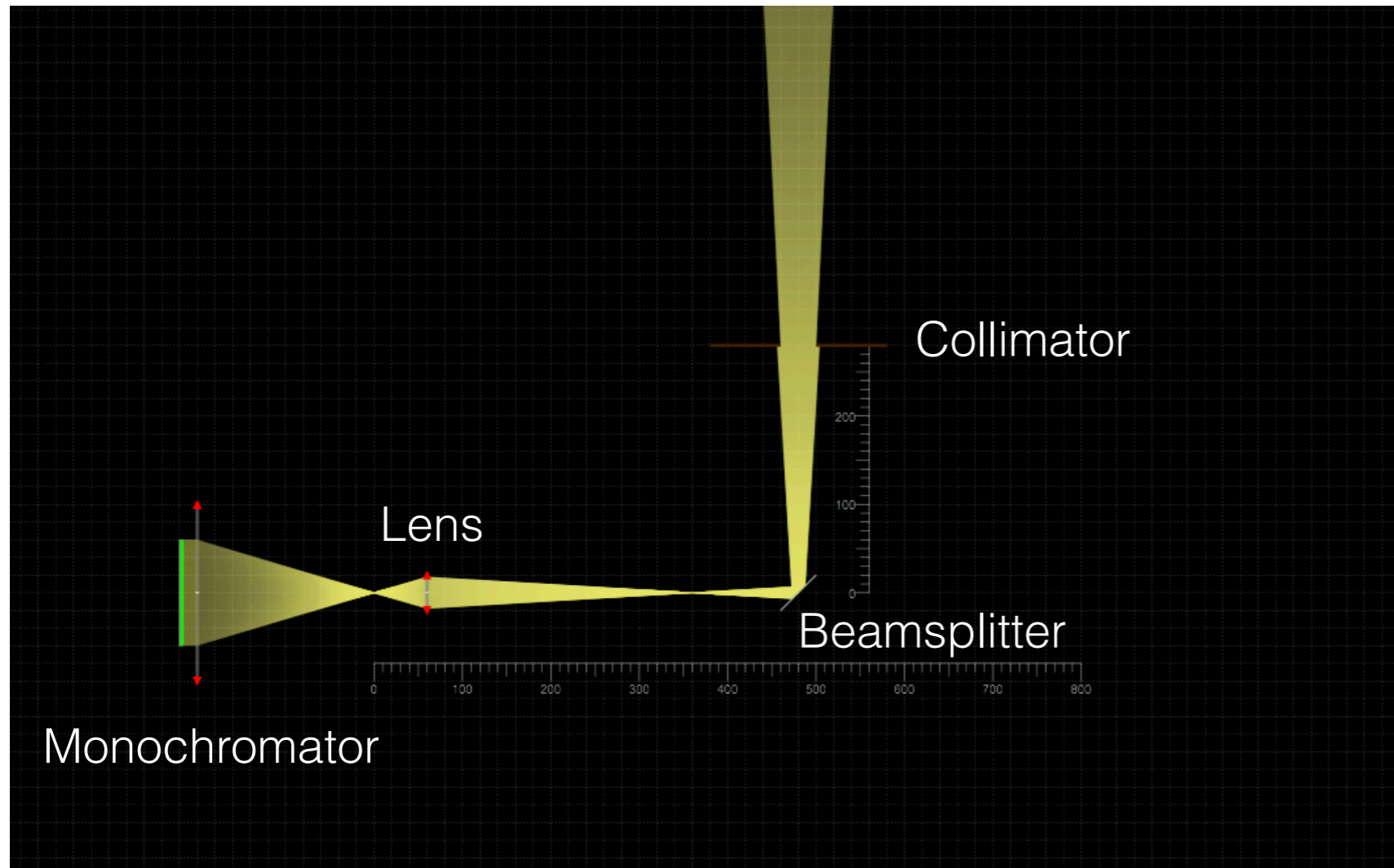
Georg Unit 1  
 PREPARED 1000M  
 2.03 1030

McPHERSON  
 MODEL 788A  
 FILTER  
 CONTROLLER



# UV beam

UV light path through lens and beamsplitter

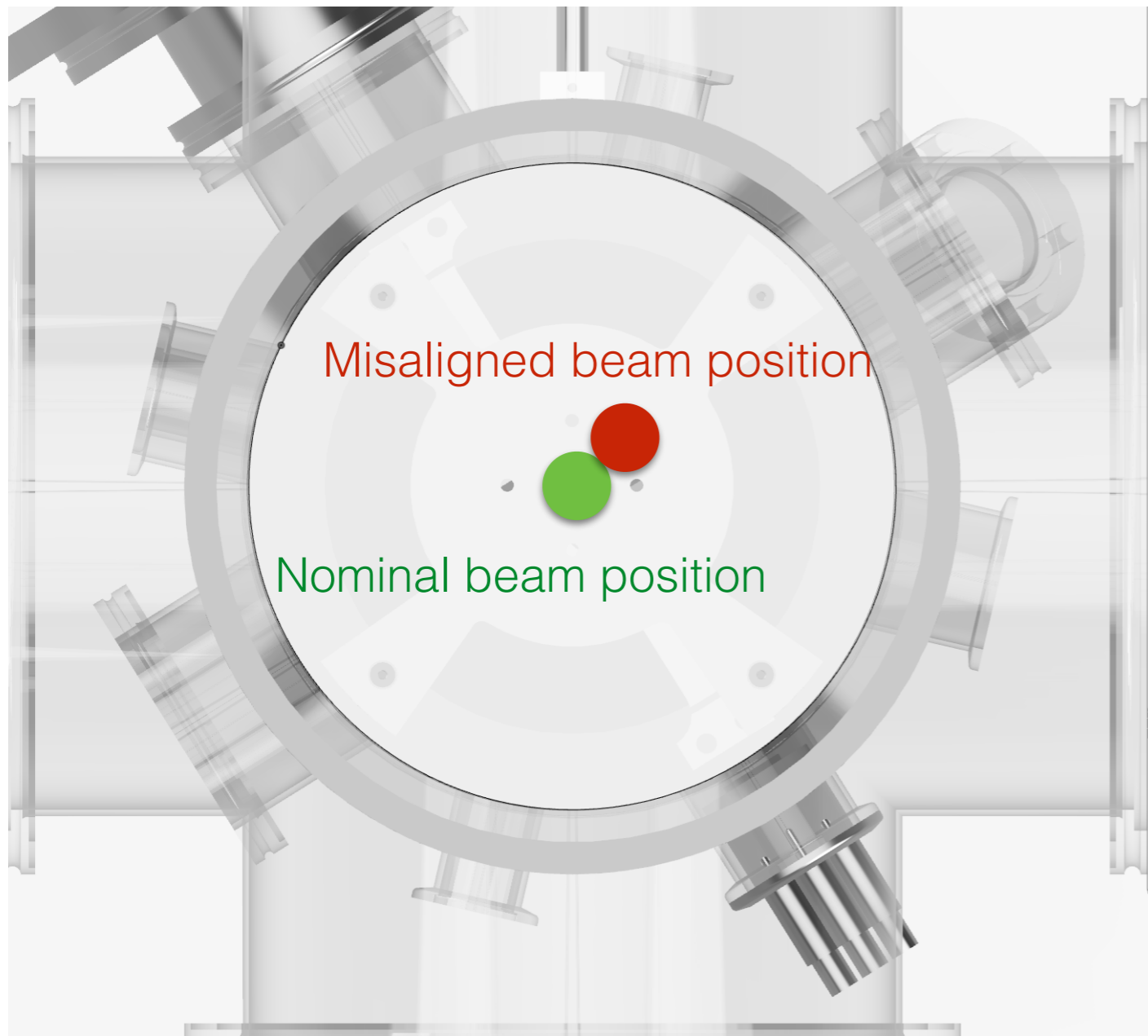


UV beam (uncollimated)  
focused to  $\approx 5 \times 5$  mm size

**UV light beam profile**  
Recorded on CCD sensor



# UV beam



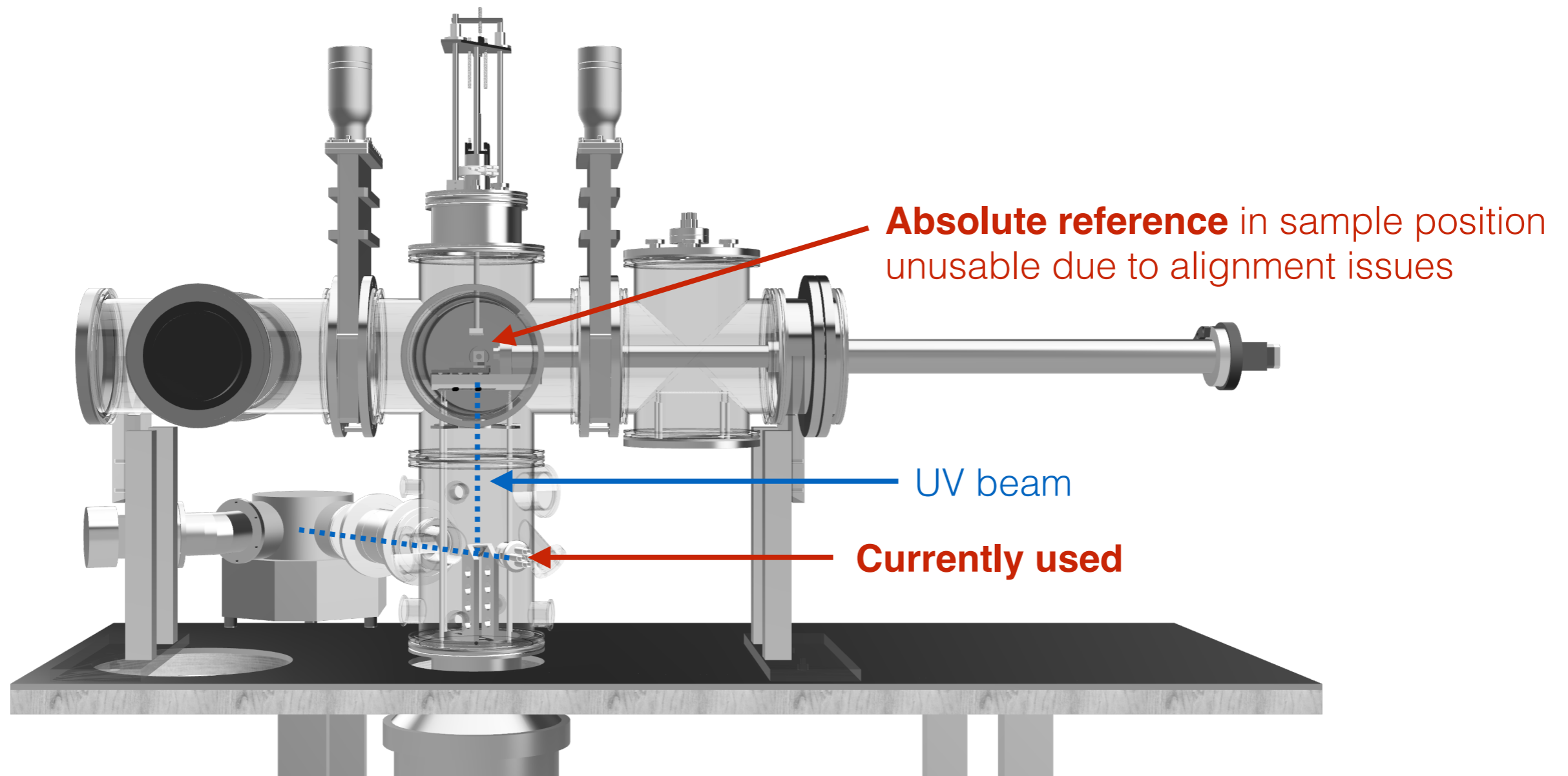
Alignment issue prevents using photodiode for absolute reference

About 1cm **misalignment** from axis to the back-right



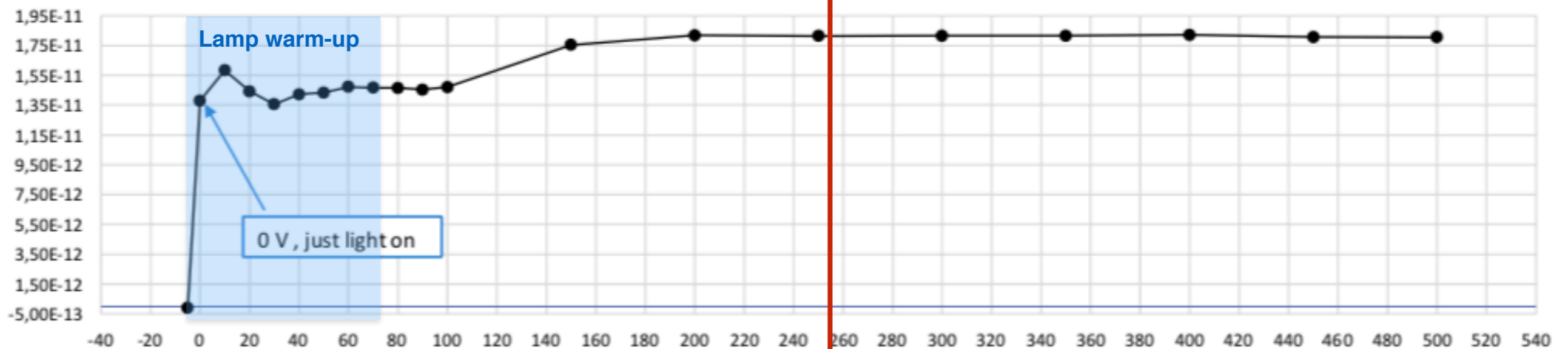
# First relative measurements

Alignment issue prevents using photodiode for absolute reference





# Extraction efficiency



**500 V/cm**

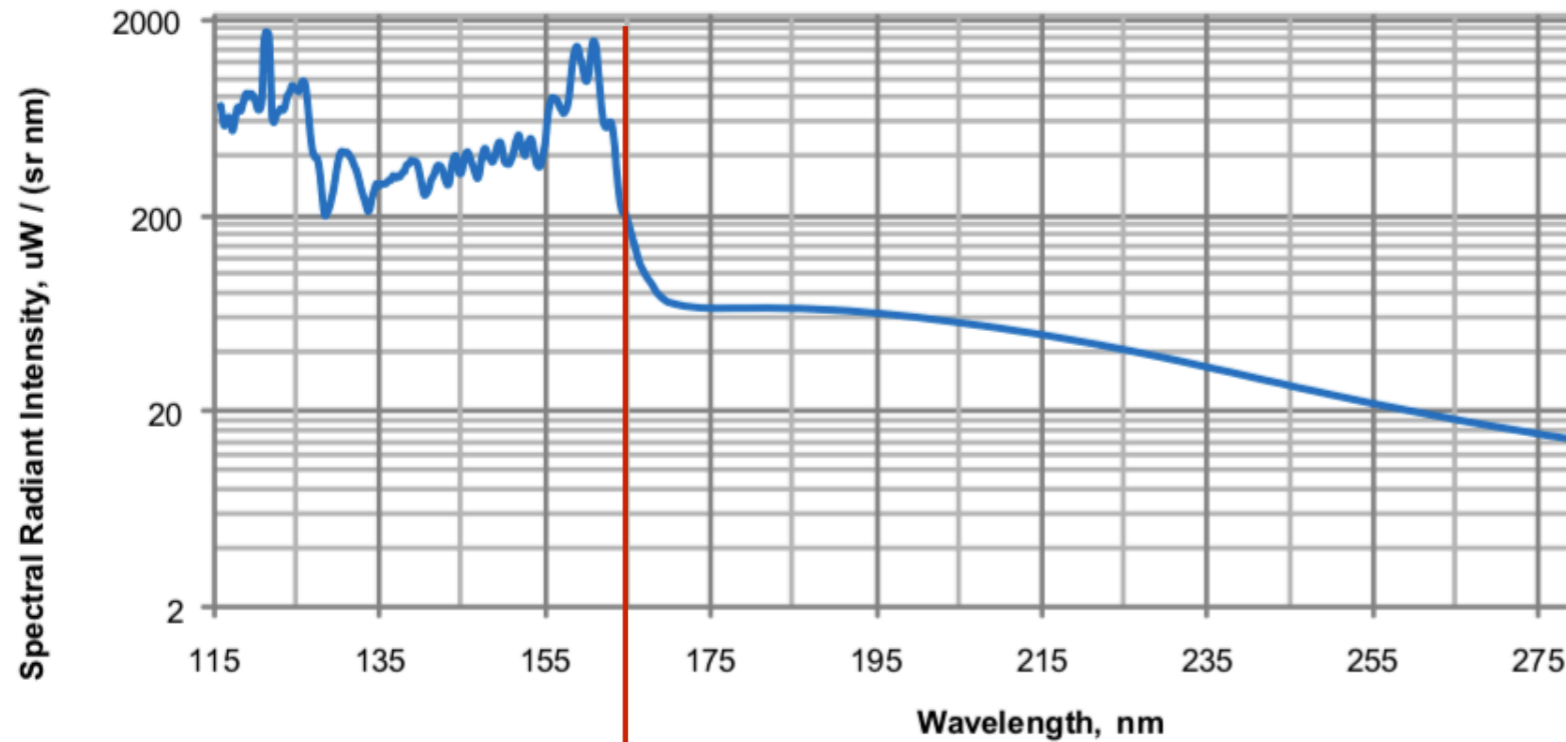
Extraction field across 5mm gap chosen for measurements

Initial rise not reflecting more extraction but attributed to warming-up period of lamp after switching on

100V to 160V range to be remeasured with more data points

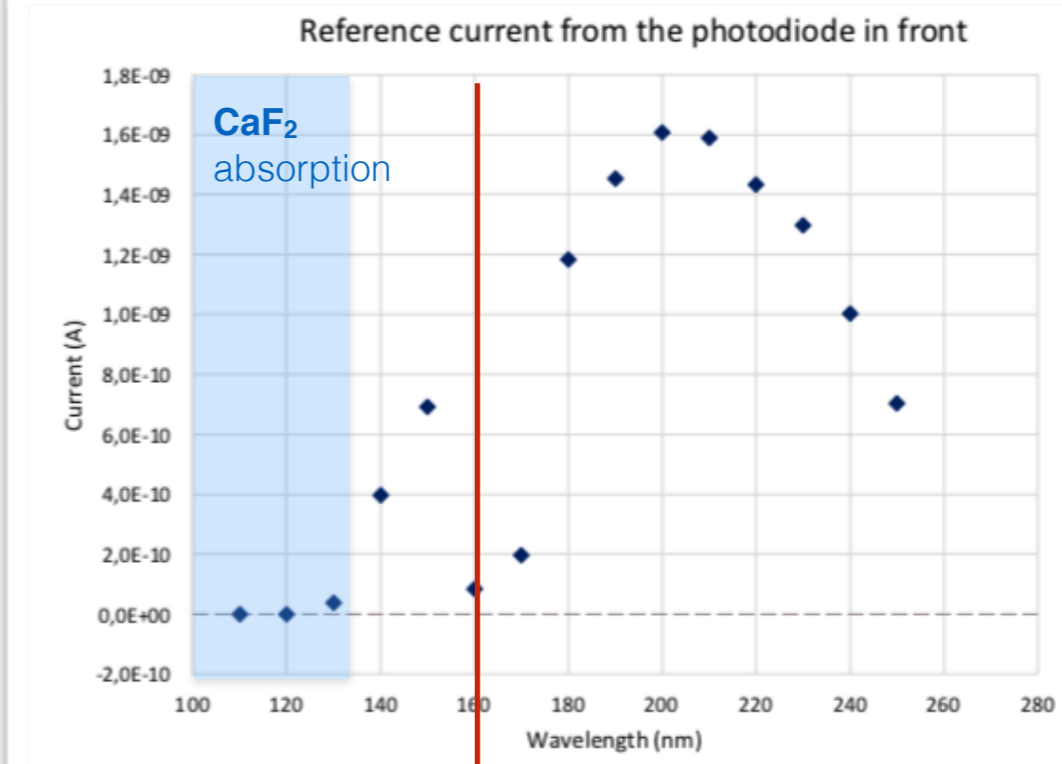
# Light spectrum

Lamp output spectrum



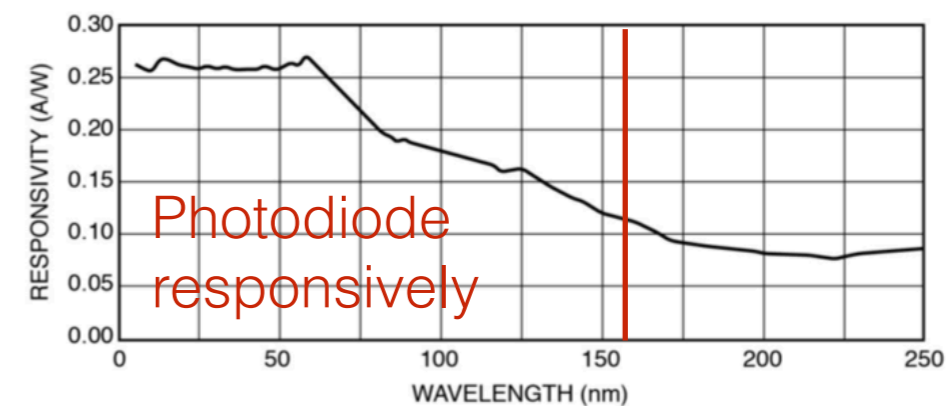
High output at 160nm

Measured photodiode response



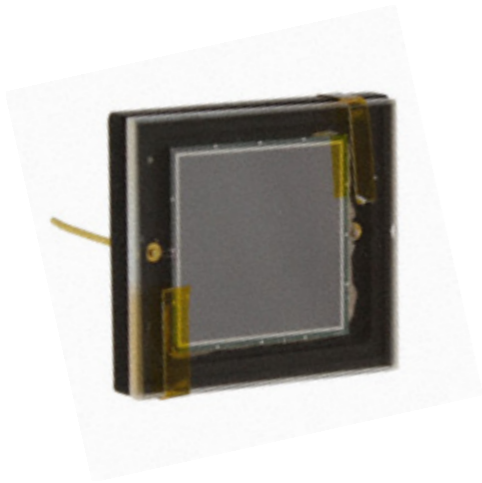
≈ no signal at 160nm

Measured photodiode current as function of wavelength does not match expected lamp spectrum

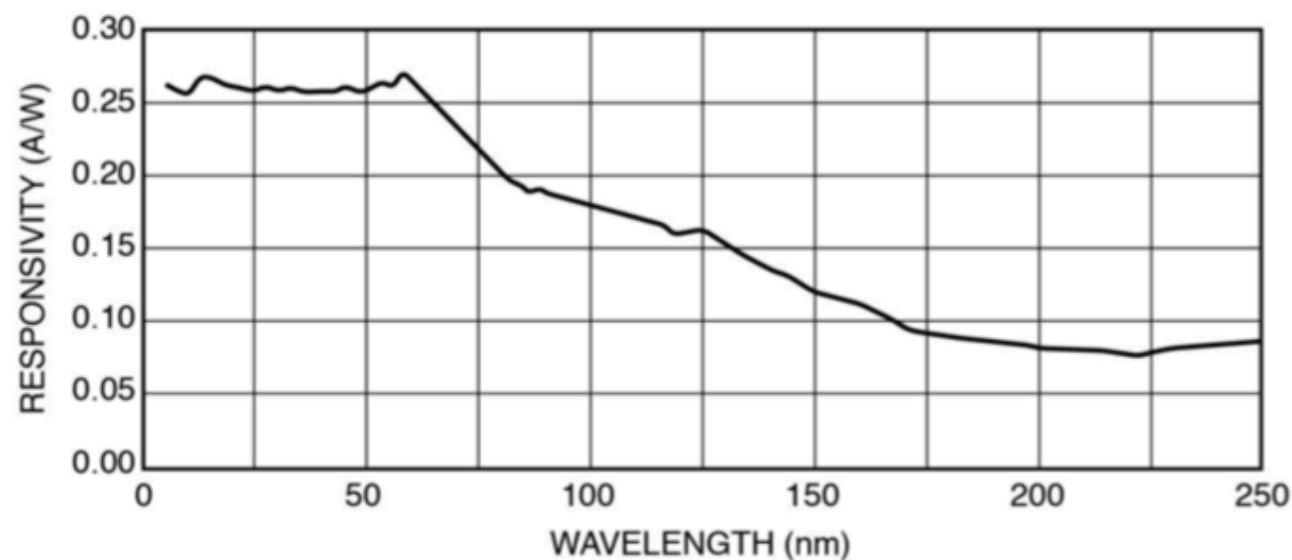




# Photodiode responsivity



Responsivity of photodiode converted to quantum efficiency to determine incident number of photons



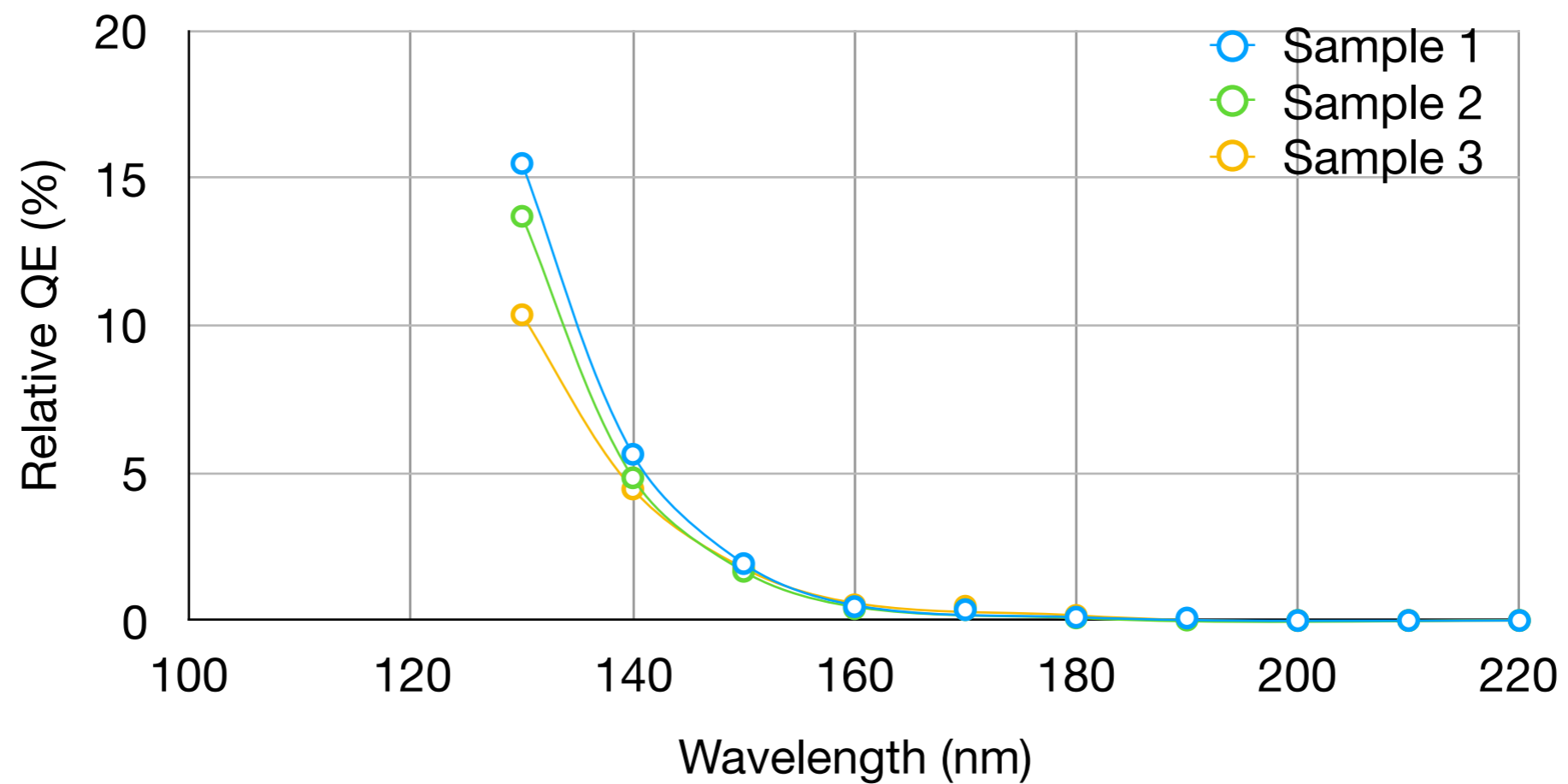
$$QE_{\lambda} = \frac{R_{\lambda}}{\lambda} \times \frac{hc}{e} \approx \frac{R_{\lambda}}{\lambda} \times (1240 \text{ W} \cdot \text{nm}/\text{A})$$

Dividing recorded photocurrent (number of electrons) on extraction mesh by incident number of photons

# First relative measurements

**3 CsI photocathodes** (previously used in PicoSec test beam)

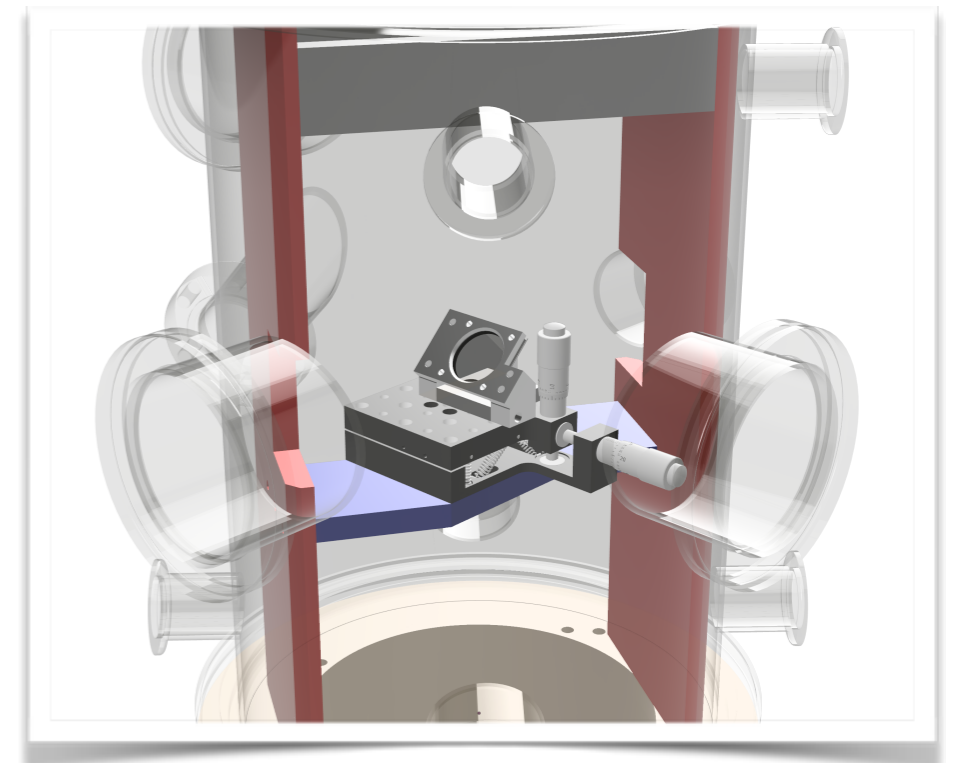
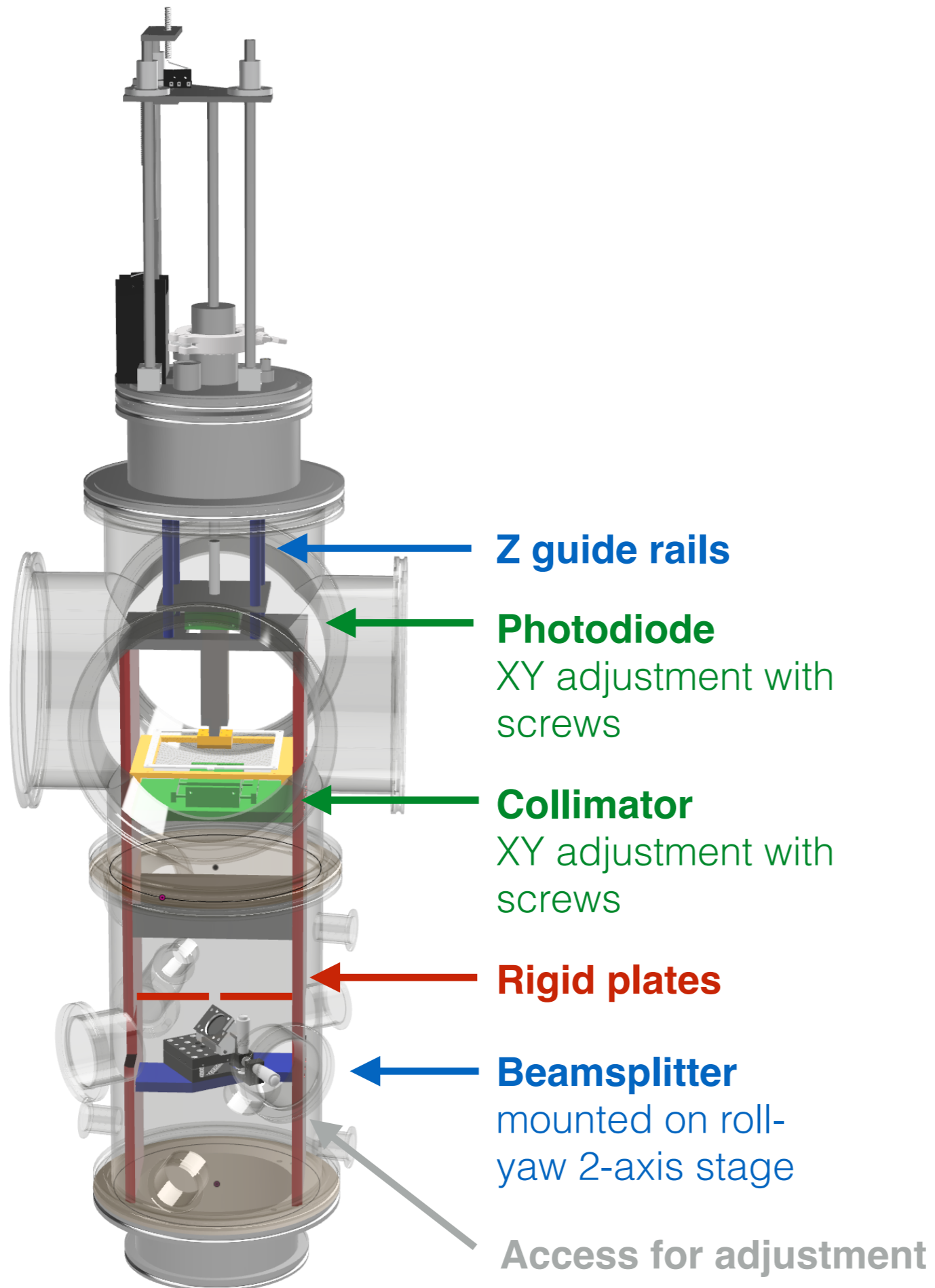
3mm MgF<sub>2</sub> window + 3nm Cr + 18nm CsI



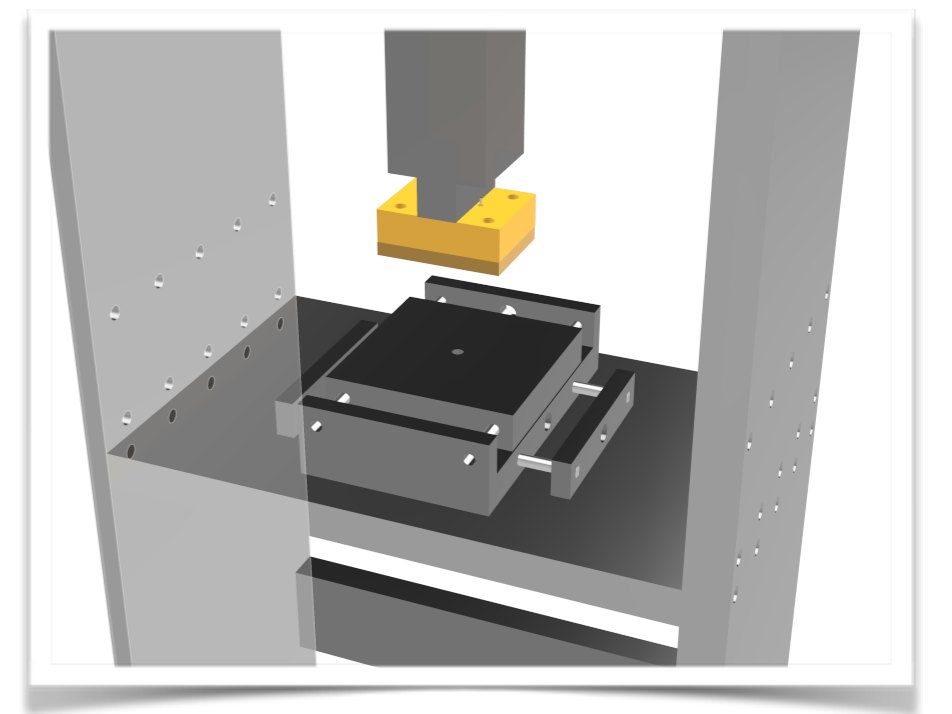


Next steps

# Optical axis

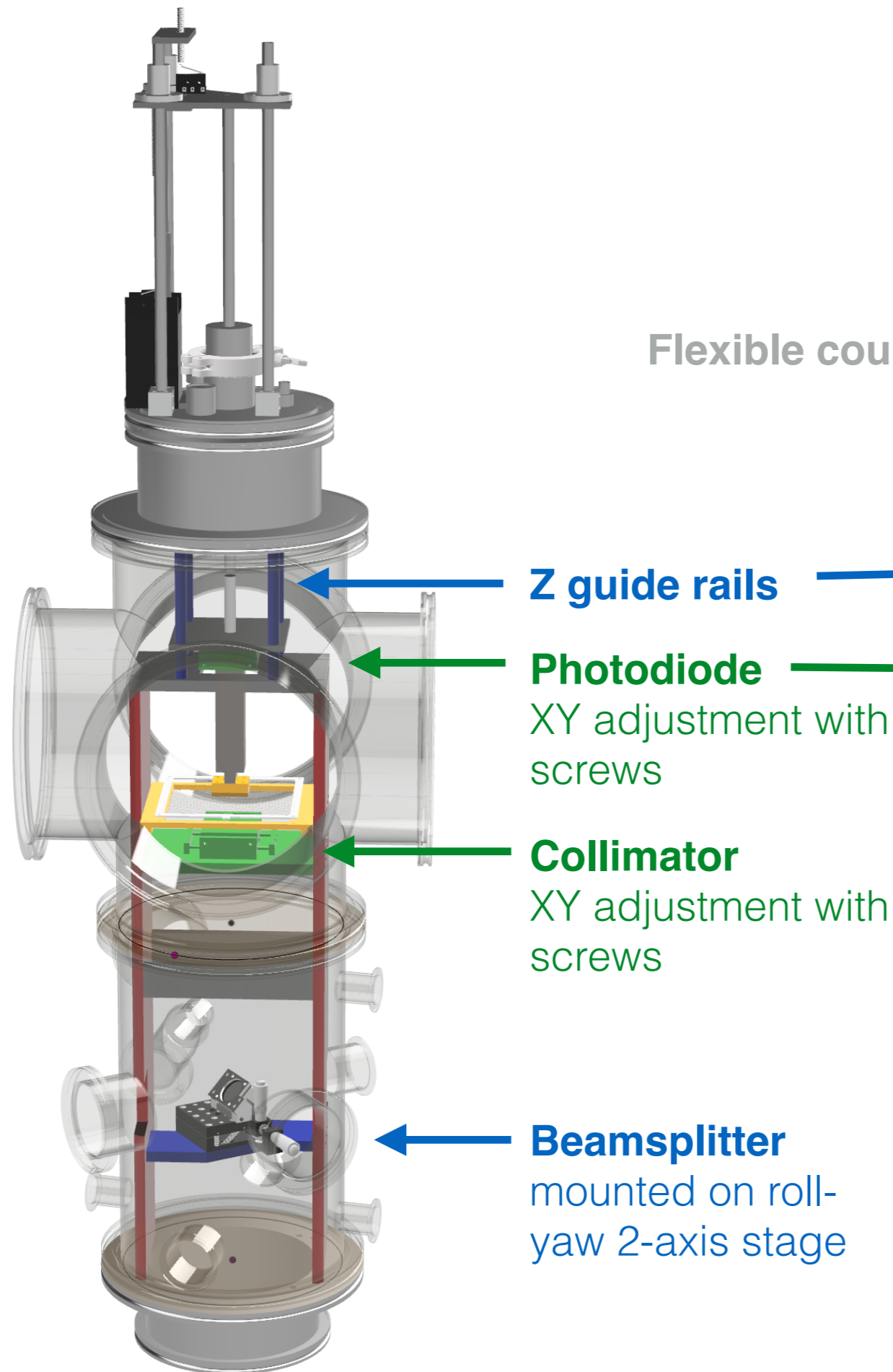


Roll-yaw 2-axis beamsplitter movement

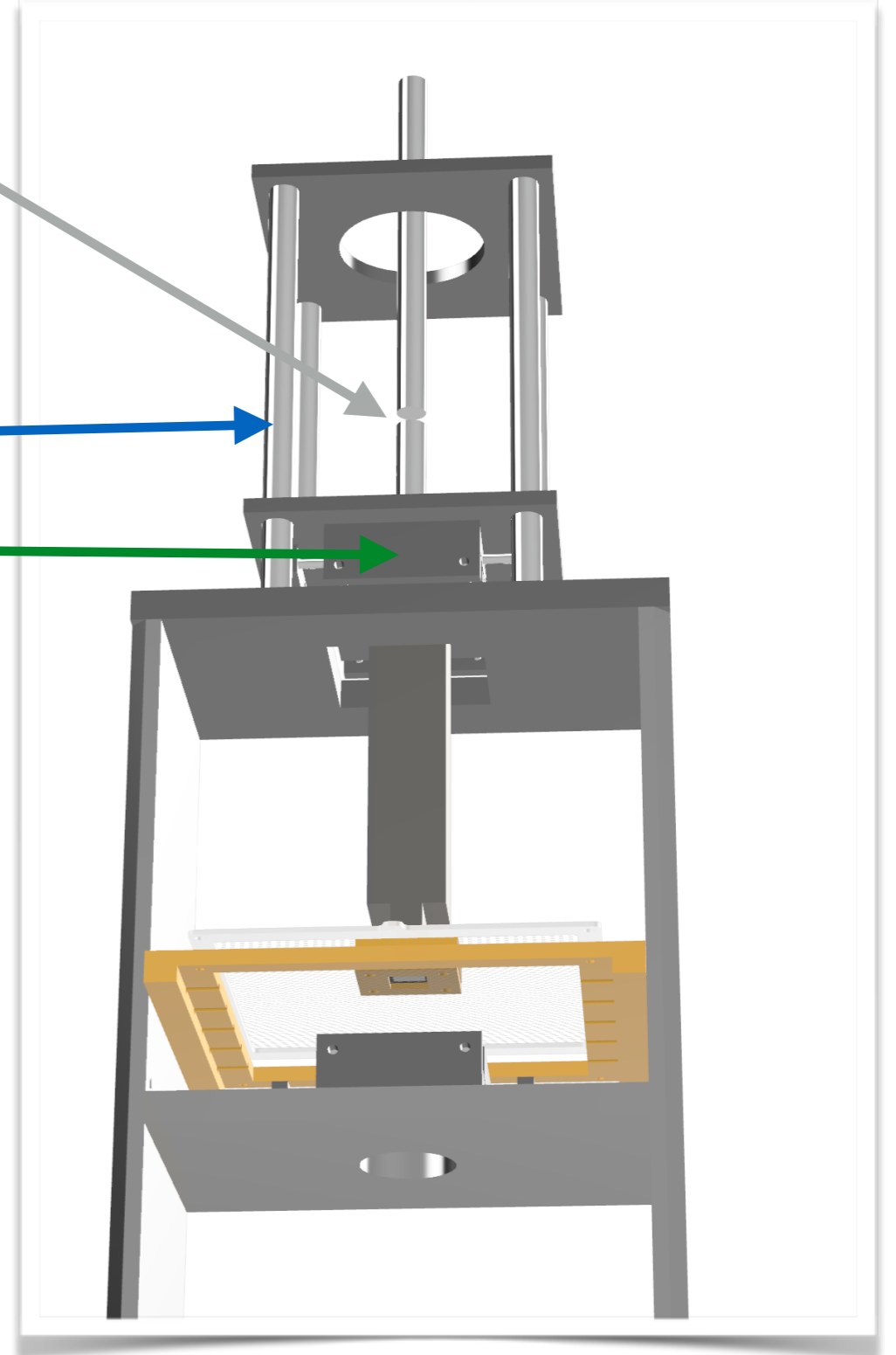


XY collimator movement

# Optical axis

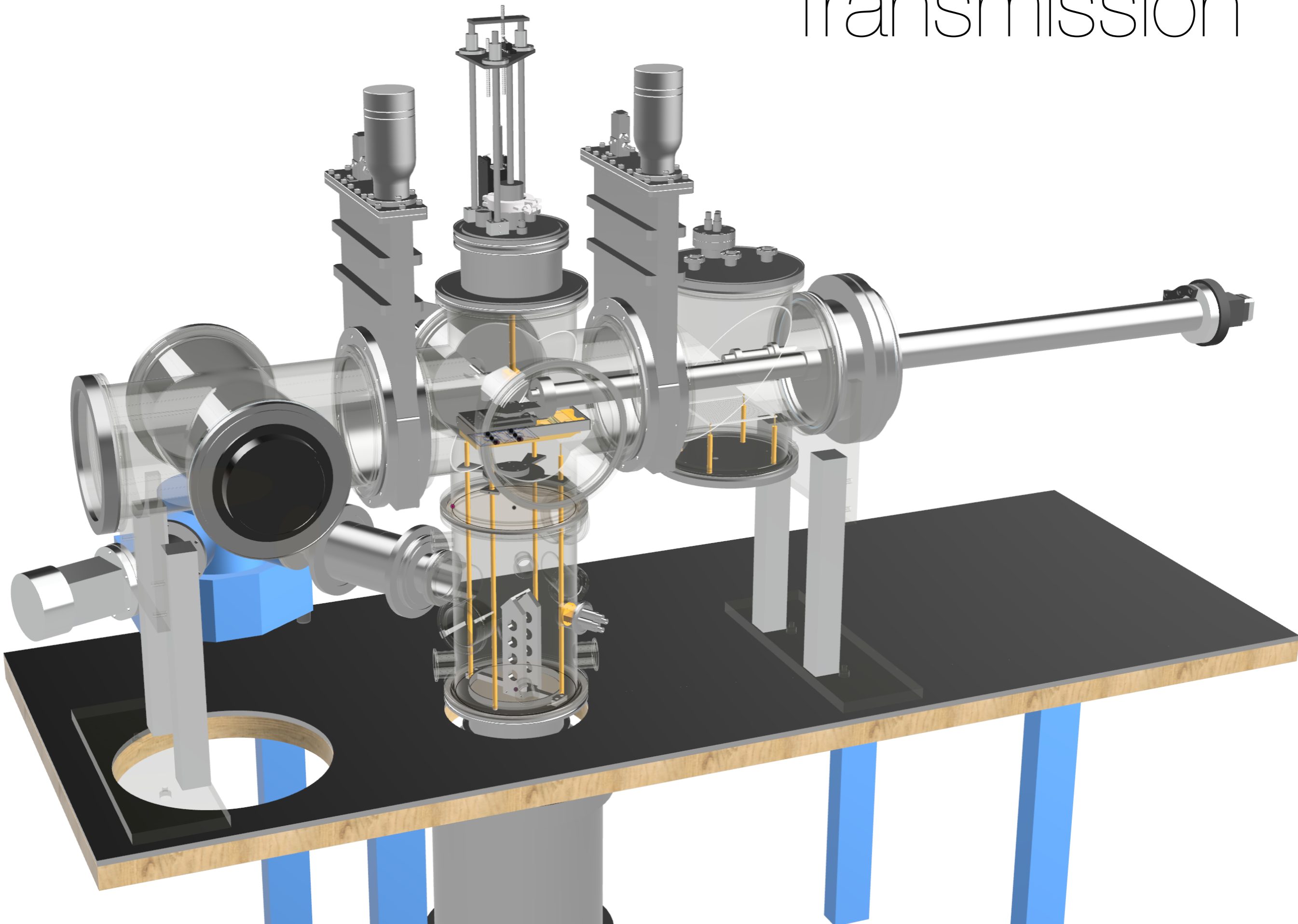


Flexible coupling

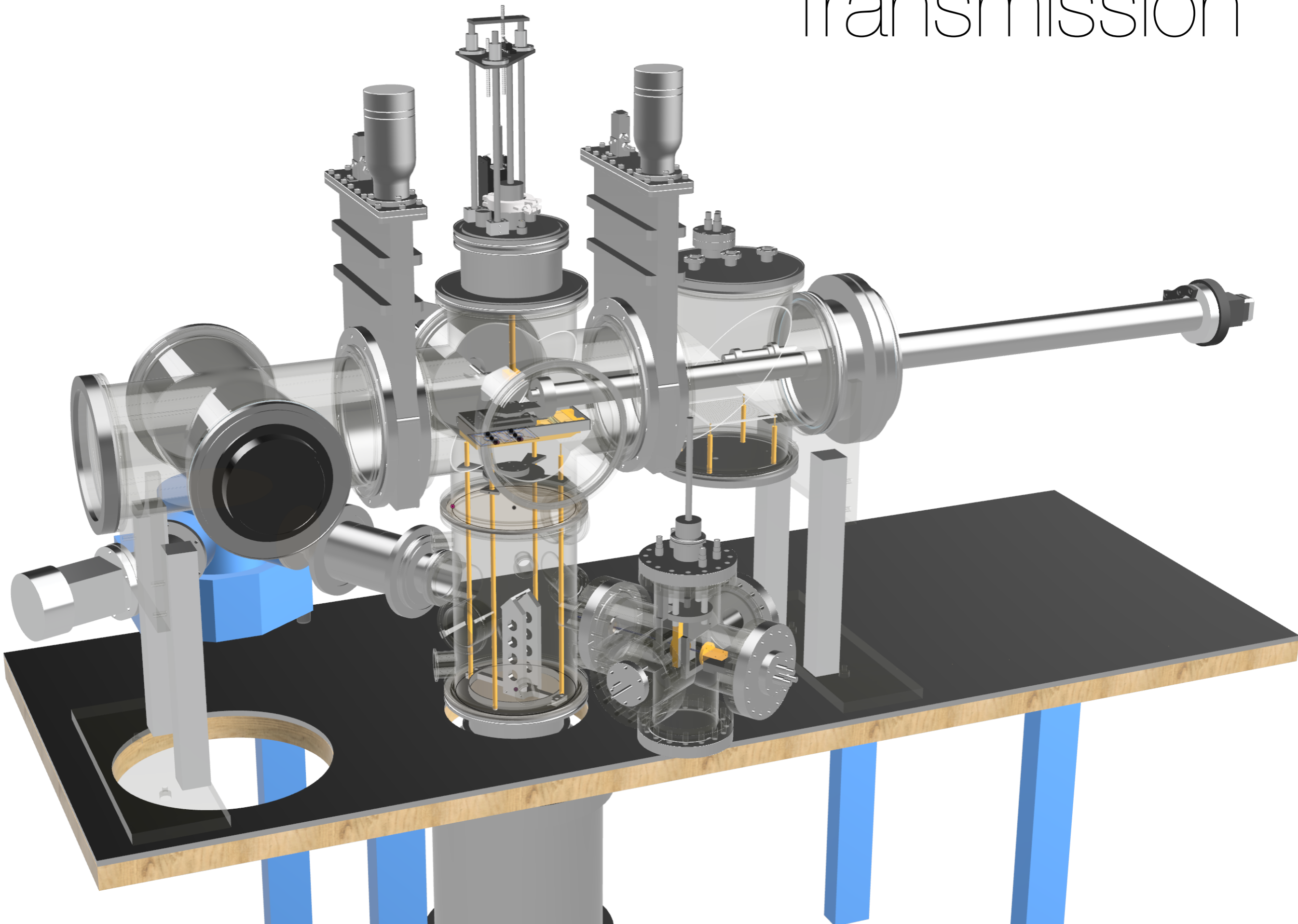




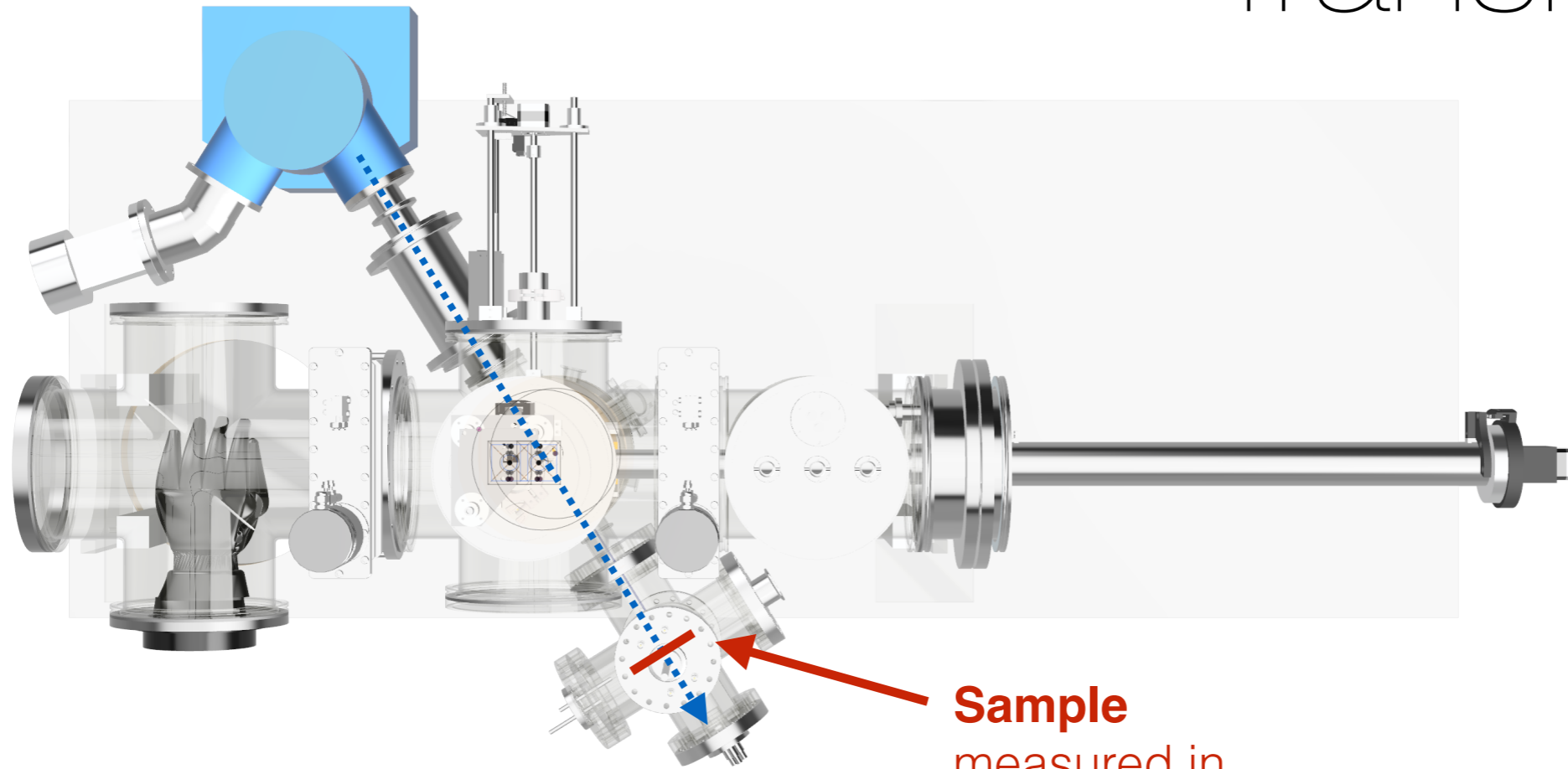
# Transmission



# Transmission

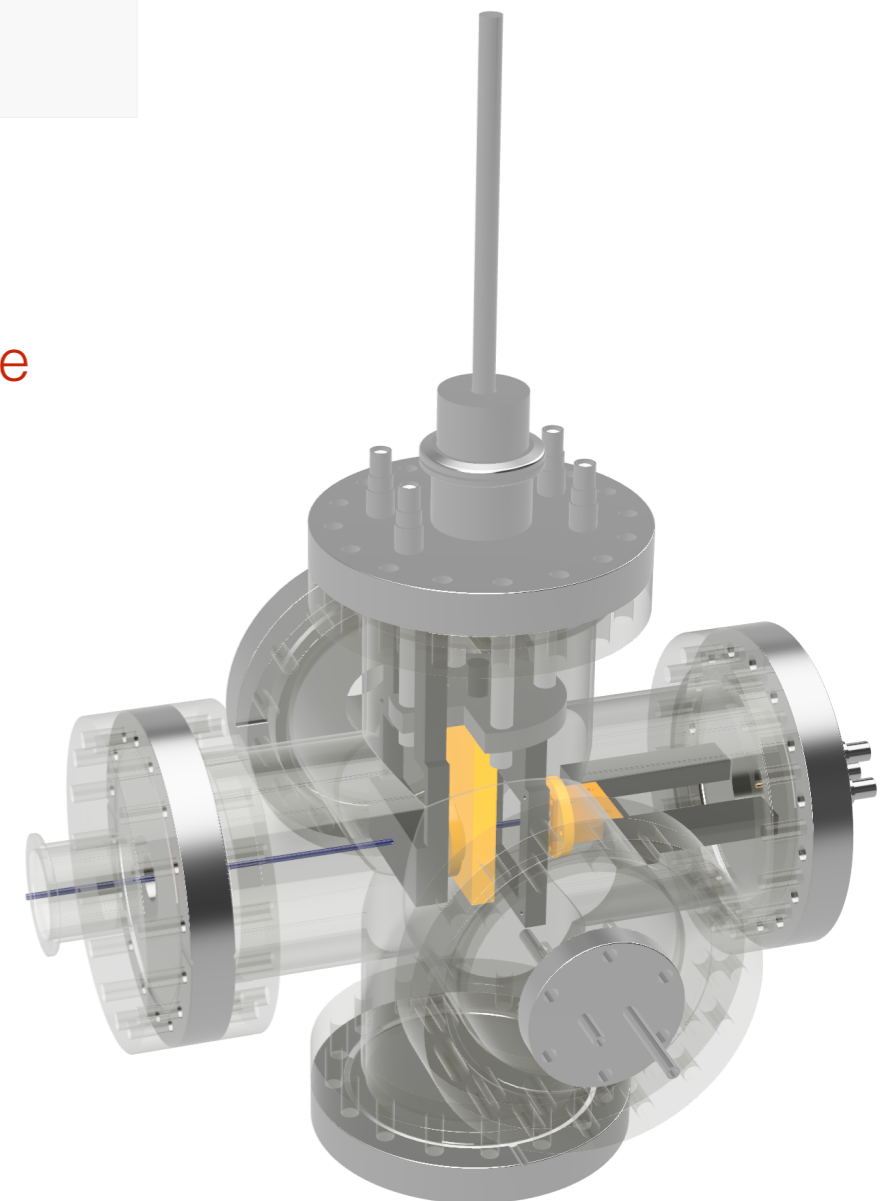


# Transmission



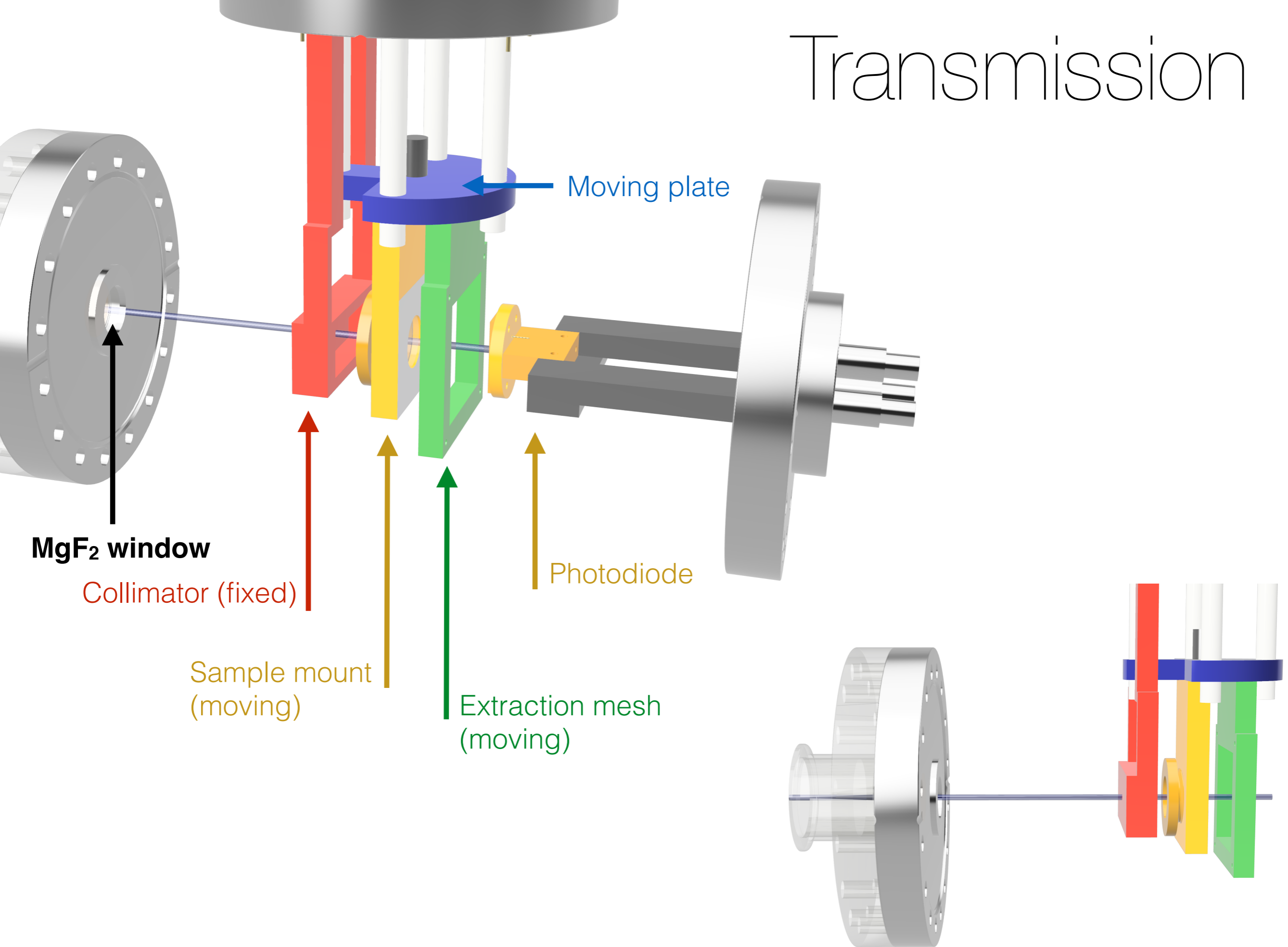
**MgF<sub>2</sub> window**  
to separate volumes and preserve  
vacuum in main chamber

**Sample**  
measured in  
transmission mode





# Transmission



# Calibration PMT

## CsI PMT

with  $\text{MgF}_2$  window, calibrated response as absolute reference

May be mounted instead of reference photodiode

