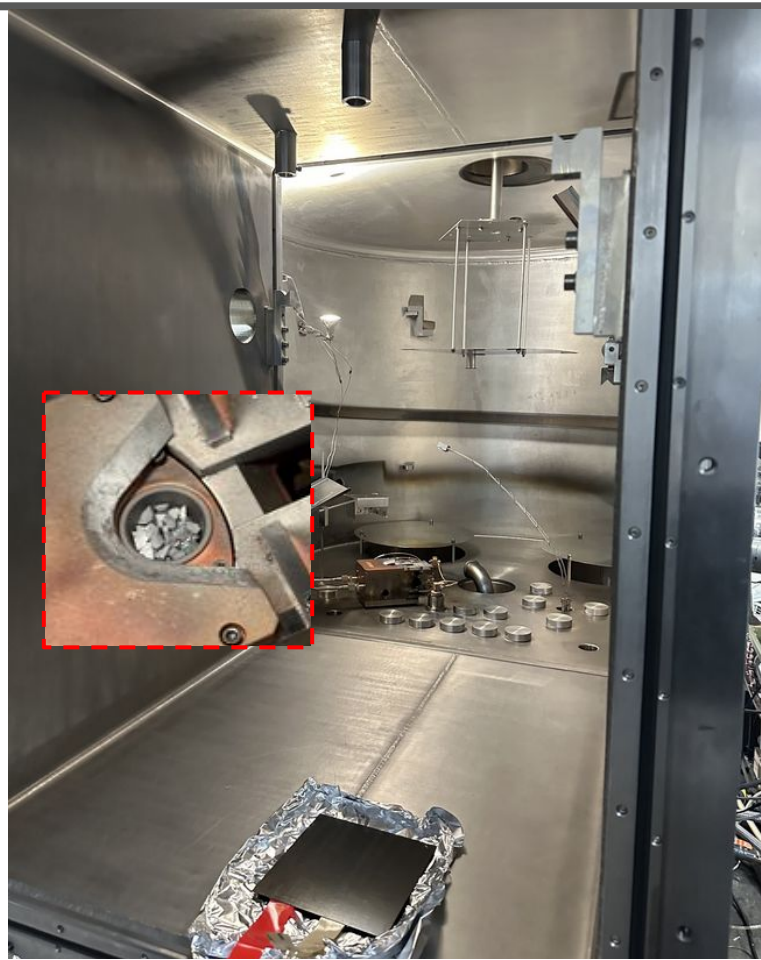
Mirror Coating Updates

Nov 19, 2023

Where are we? How ready are we?

- **Water cooling system Stability** ✓
  - 24 hour continuous operation
- **Vacuum quality** ✓
  - $3x10^{-6}$ Torr (current configuration limit)
- **Tape stability** ✓
  - Stickiness and outgassing test
- **Rotation Motor** ✓
  - Continuous 1 hour operating ~ 1 rev/s



Documentation

- **Coating Documentation:**
  https://docs.google.com/spreadsheets/d/1qd2DJs3Ms1QuVJTnB4B2kjaaJST8t2qY7ZGq4mlvHr0/edit?usp=sharing

- **Coating Plan:**
  https://elog.cfnssbu.physics.sunysb.edu/SoLID/17

- **elog to keep track of the progress:**
  https://elog.cfnssbu.physics.sunysb.edu/SoLID/

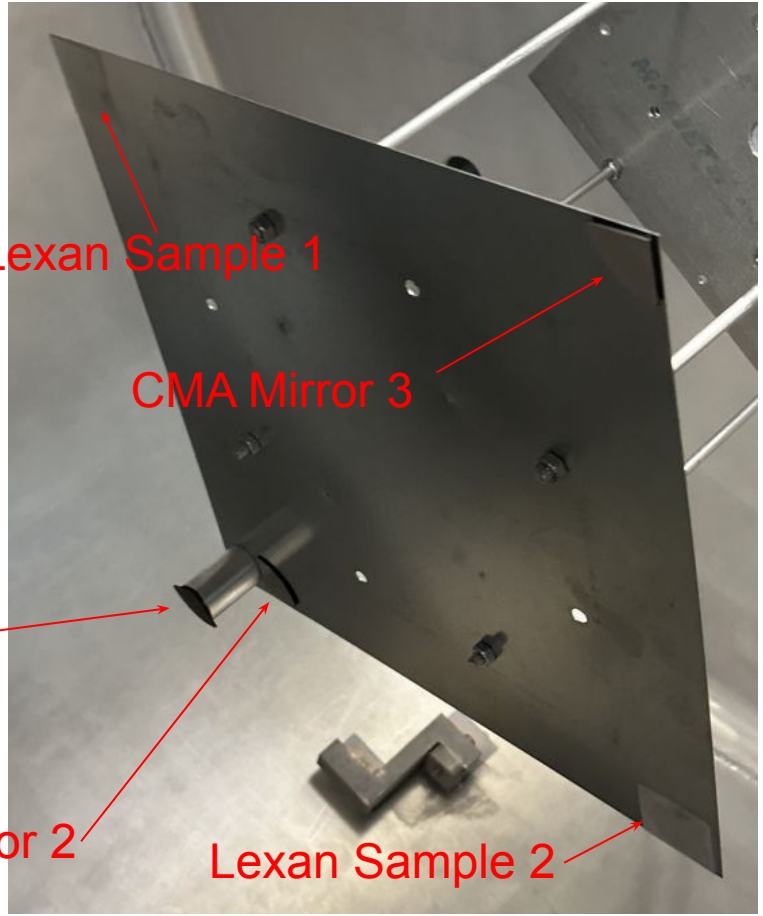
- **First coating preparation:**
  https://elog.cfnssbu.physics.sunysb.edu/SoLID/

Sincere Gratitudes for SPhenix Colleagues

- To **Ross Corliss** and **Vassu Doomra** for their patience and guidance in preparing and setting up the evaporator.

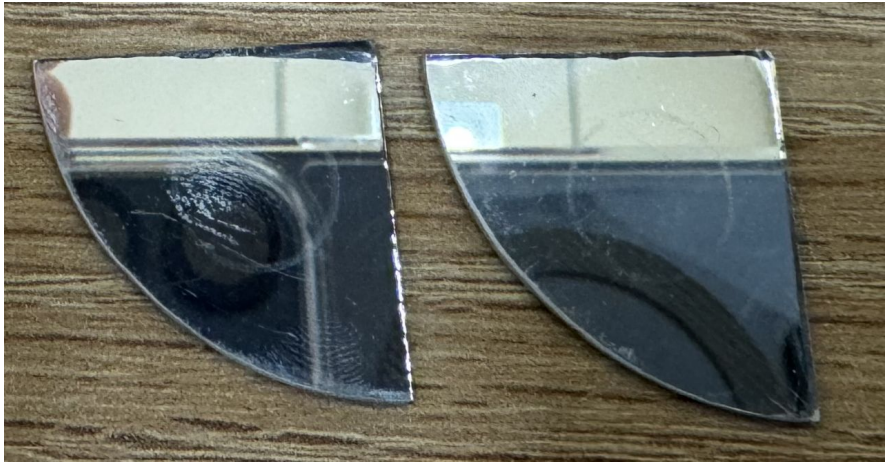
What did we coat?

- **Three CMA Mirrors (quarter samples)**
- **Two small Lexan 8010 samples**



First coating

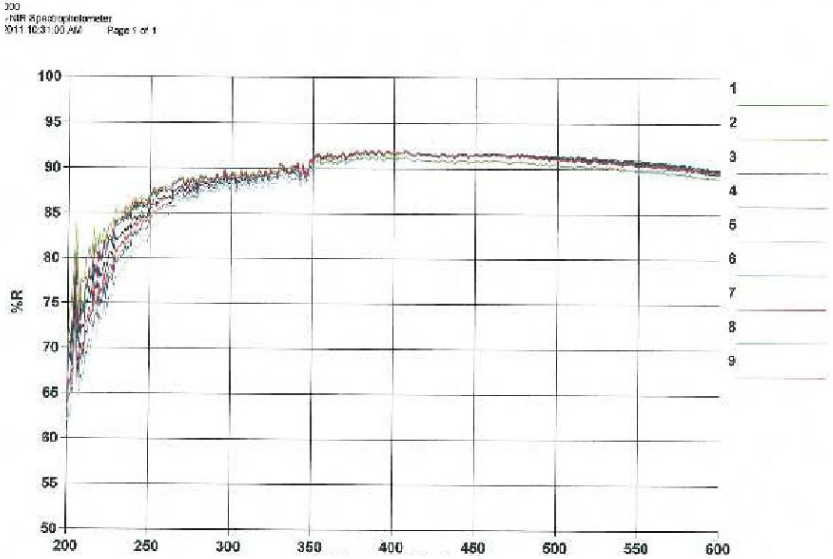
CMA Mirror sample 2



CMA Mirror sample 3

- **Three CMA Mirrors (quarter samples)**
- **Two small Lexan 8010 samples**

High quality reflectors



- 1.5cm in diameter, Coated by ECI

What did we learn?

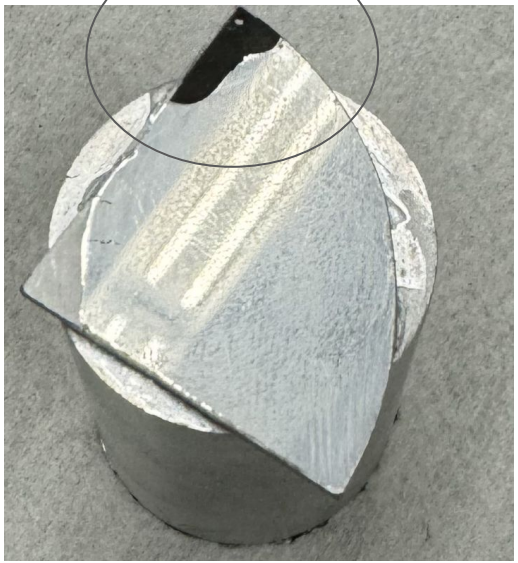
- **We mis-understood our lexan sample all this time!**
  - Sample has a layer of coating above!
  - Request to Andy: please remeasure the surface roughness after peeling off the coating
  - Samples will be recoated

- **e-Gun operating at 6.6K, 180mA**
  - Coating rate is proportional to the loaded material mass
  - 1g (33%) of Al lost during the evaporation process
  - 3g Al is capable of supporting 50 min deposition operating

What we don’t understand

- Why did the CMA Mirror Sample 1 go bad?

Non reflective chipping



Immediate Next Step

- **Initiate 2nd round of coating**
  - **Coating Purdue mirror substrate samples**
- **Luxan samples without the coating**
- **Introduce substrate cleaning process (partial implementation)**
  - **Difficulty (requires resources to address):**
    - **No professional gloves, No professional lens paper, No lint-free cleaning fabric**
    - **No clean bench top for optics work**
  - **Improving the handling**

Immediate Next Step

- **Introduce substrate cleaning process**
  - **Difficulty (requires resources to address):**
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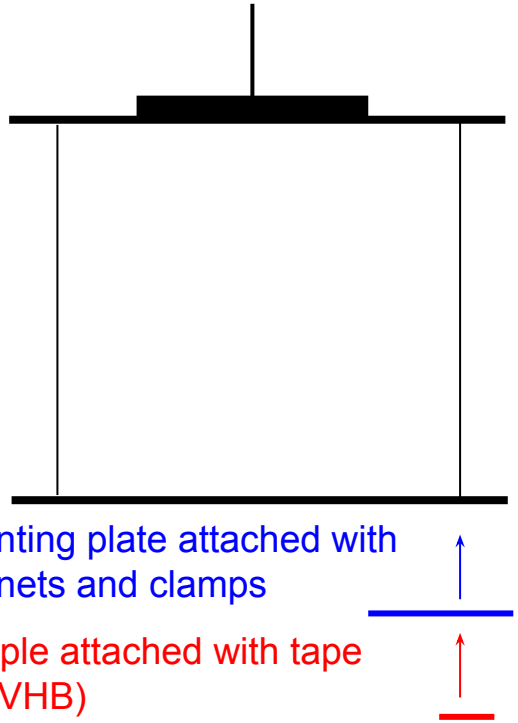
  - **Improving the handling**

- **Easy mount/unmount scheme using magnet**

An ungraded mounting scheme



Finger tighten fasteners

Metal wire-mesh to safeguarding the turbo and cryopumps

lint free knee pads (clean room)

Assisting guiding rail for large mirror installation

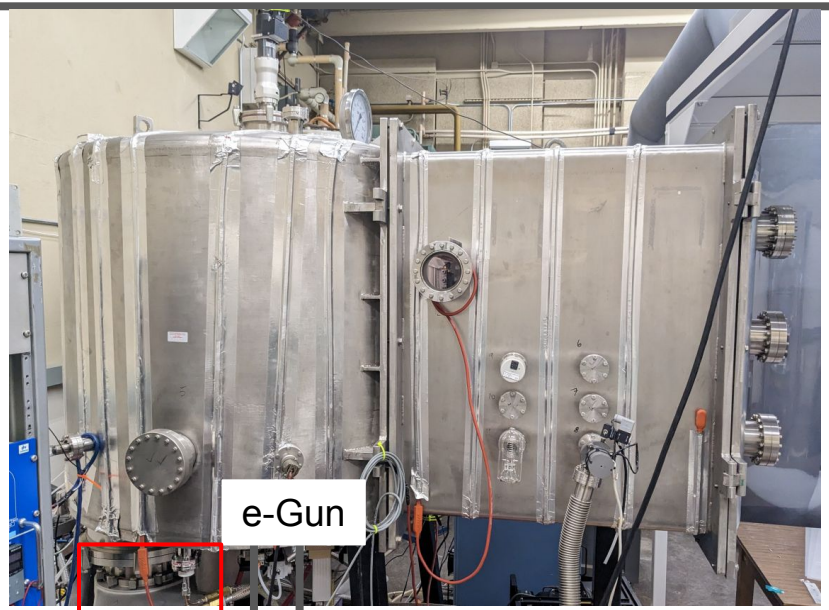
Proposed Landscaping

#1 Water Chiller
#2 Portable Clean Room
#4 Rotational Stage
#5 Dry box

#3 D2 Lamp

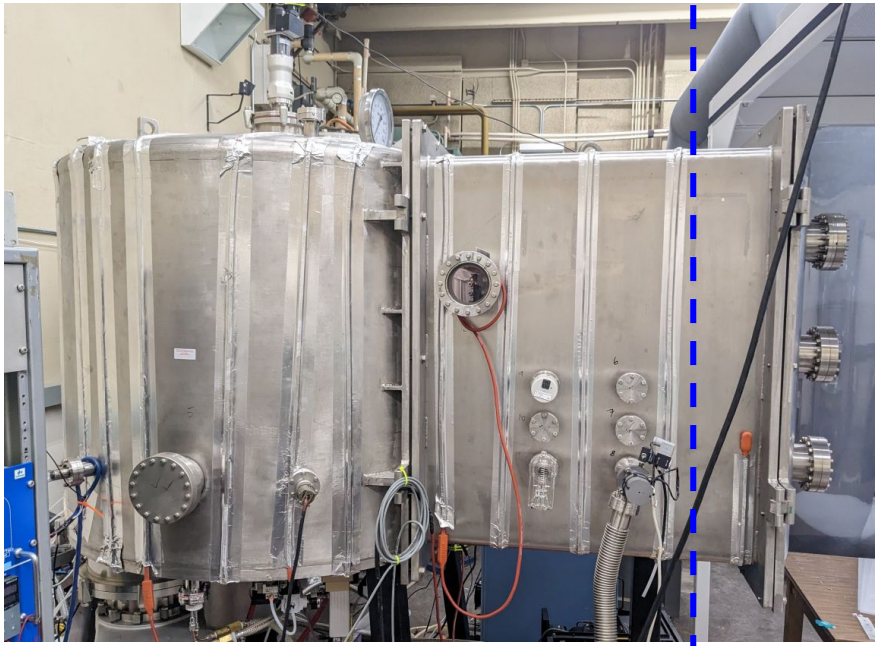
#3 Shelf for Storage

A New Water Chiller



- **Two Water chiller loops**
  - Loop 1 cools e-Gun
  - Loop 2 cools turbo
- **Currently, Loop 2 Chiller is broken**
  - Motor is burnt
  - under repair
- Can we evaporate without cooling the turbo?
  - **Yes. But we should never risk the turbo!!**
- **Recommendation:**
  - **We need a reliable water chiller (Item #1) immediately**
  - **Old repaired chiller will serve as a spare.**

A Clean Space for Staging and Mount/Dismount Mirrors



Enclosed clear area (item #1)

- **Mount/dismount mirror from mounting fixture before/after coating.**
  - On a stainless steel bench top.
- **Accessing to the dry box (item #6) for load to the e-gun.**
  - Minimize the exposure to the ambient dust and moisture

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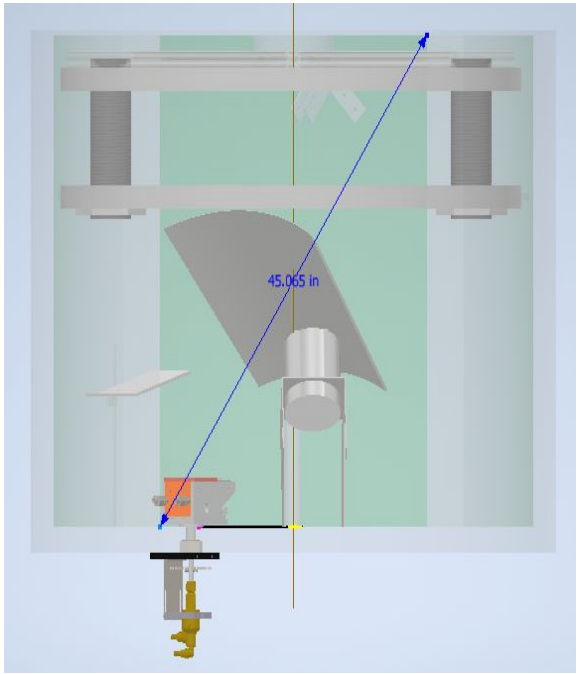
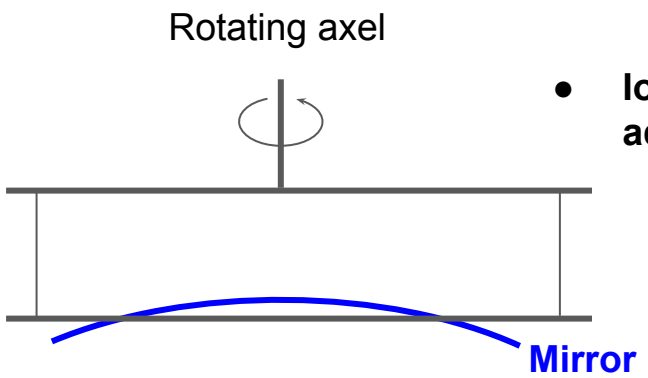
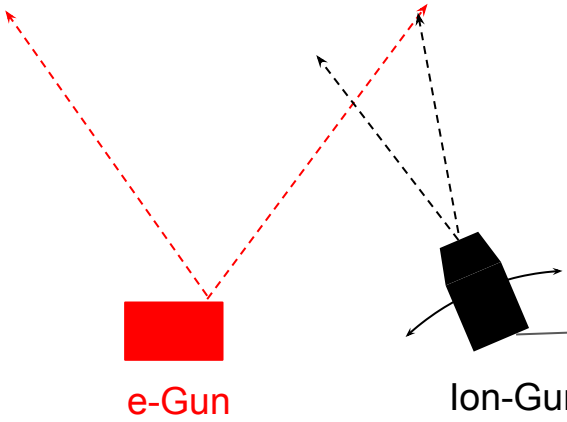
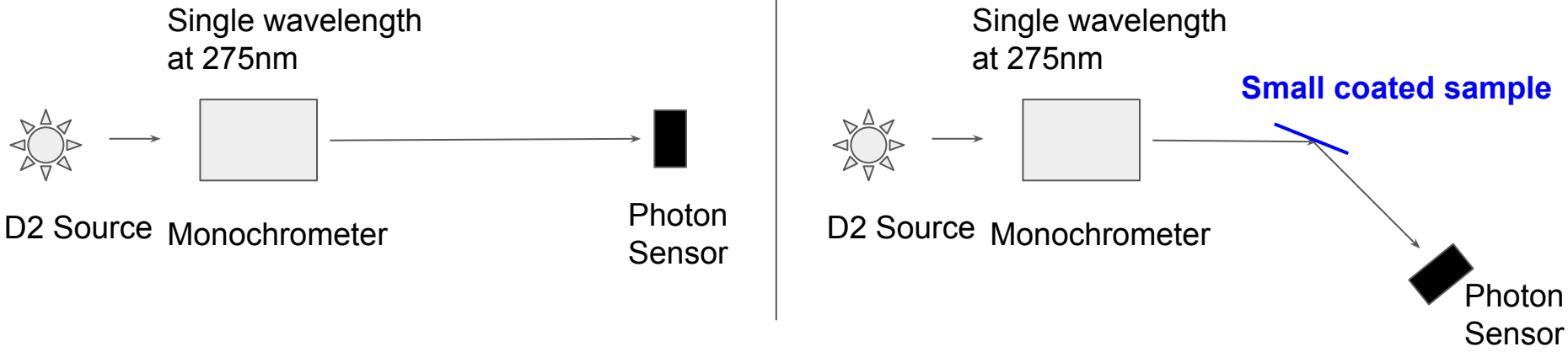




- **Ion source required pitch adjustment under high vacuum**
  - A remote control vacuum compatible stage is a must for large size mirrors
  - Thanks to mirror rotation, yaw angle is not needed



Quick validation of the coating



- A quick validation stand near the evaporator to validate the result at 275 nm wavelength
  - A significant time saver
  - A must have during the production
- **It doesn't replace the full characterization!**
  - **After the quick validation, the coated product will be sent to Bob and Grag for full characterization**
- **Only D2 source is missing**
  - Optical bench, darkbox, photon sensor and monochrometer will be SBU in kind constribution

Final Remarks

Item Description	Specification	Cost Description
#1 Water Chiller	1HP, 6000 - 9000 BTU (cooling power)	$4,000
#2 Portable Clean Room	(6' x 8'): $10,000	$10,000
#3 Shelf for Storage	For the mirror storage	$600
#4 Rotational Stage	For mounting the Ionized Argon source	$4,000
#5 D2 Lamp	Stabilized Deuterium UV Light Source (150-500nm)	$3,500
#6 Dry box	Storing sensitive coating material: chromium, Al, crucible	$1,200

- **Item #1,2 and 6 are needed ASAP for the prototyping**
- **Item 3, 4 and 5 are needed for the full production**

The refurbishment is separate

- The refurbishment cost shouldn’t be mixed for the production estimate
- The maintenance, consumable and one time setup numbers are estimated separately

	Proto-type	Final assembly	Notes
Maintenance cost	$2,000	$4,000	Maintaince cost for the final assembly is estimated assuming one pump failure/two mantainace services cost
Cosumable cost	$800	$4,800	Assuming 8-12 segments plus spares, x6 times of the prototype comsumeble cost
Mounting fixture cost	$2,000	N/A	Klaus: why not use the exisitng from SoLID?
Triangular rib mirror rob mater	$900	$3,600	
Machineshop cost cutting	$500	$2,000	
Attachment tape	$200	$600	
Total	$6,400	$15,000	

Proposed Refurbishment Items

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Immediate Next Step

- **e-Gun**
  - **Voltage: 6.6 kV**
  - **Maximum current: 180 mA**

Next Step

- **First coating projected at Friday morning Nov 16th.**
- **Reflectivity measurement at BNL will follow.**
- **Tighten up the protocol on “clean” coating condition.**
  - We are coating in a dirty environment
  - Requested PED fund to help with this.
- **Practice and optimize the coating parameter**