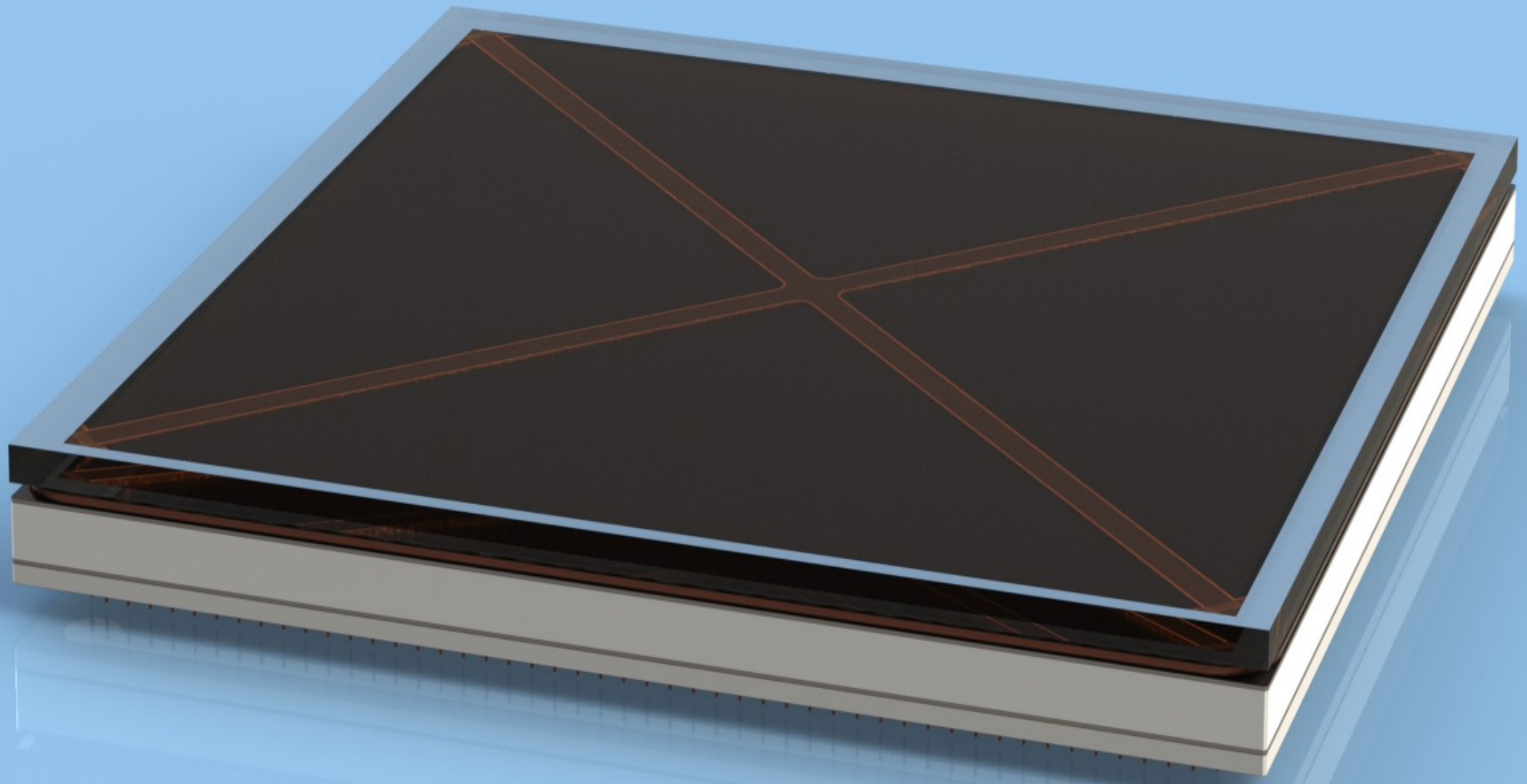
20cm Tube Assembly at Berkeley

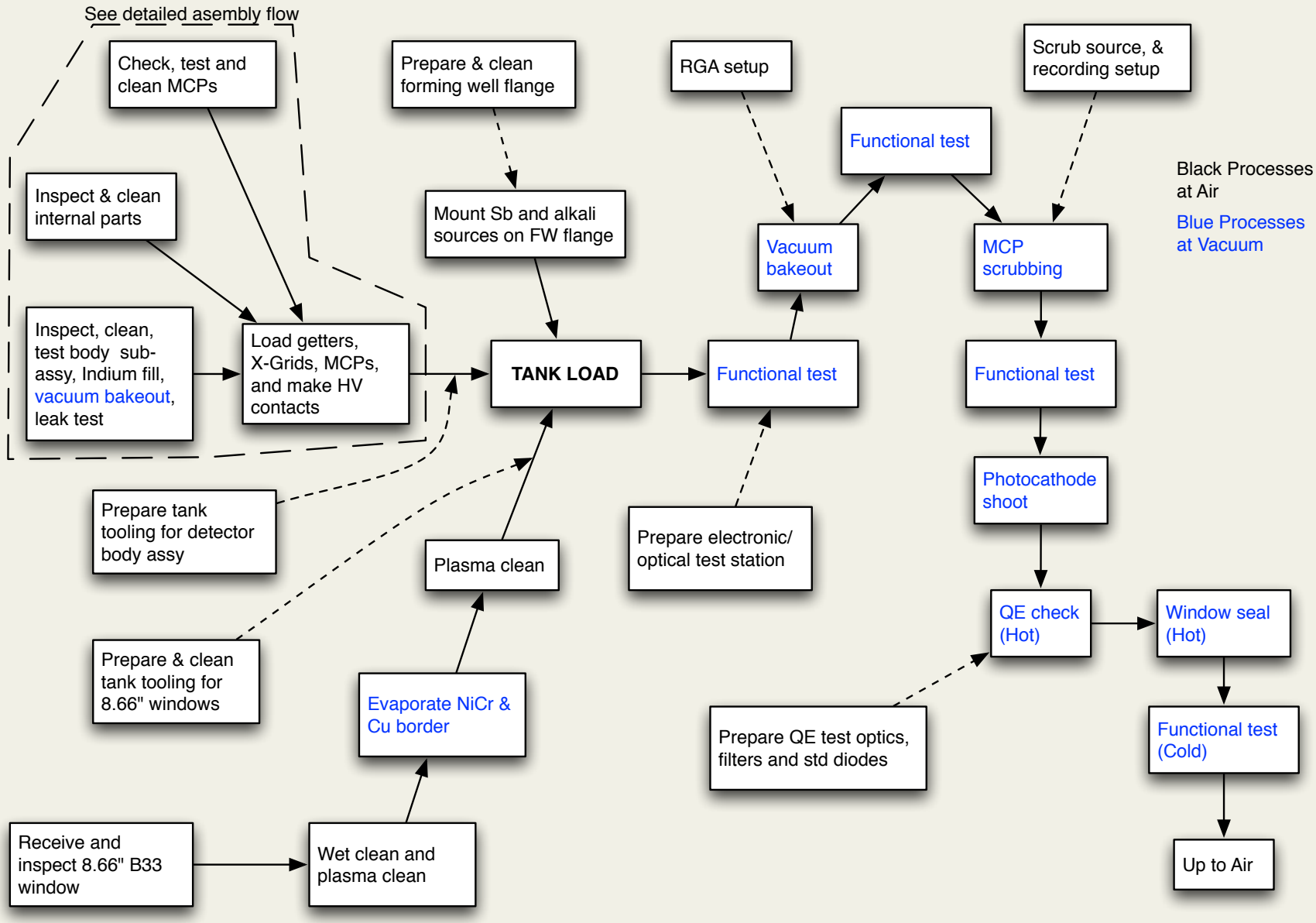


Jason McPhate & Oswald Siegmund

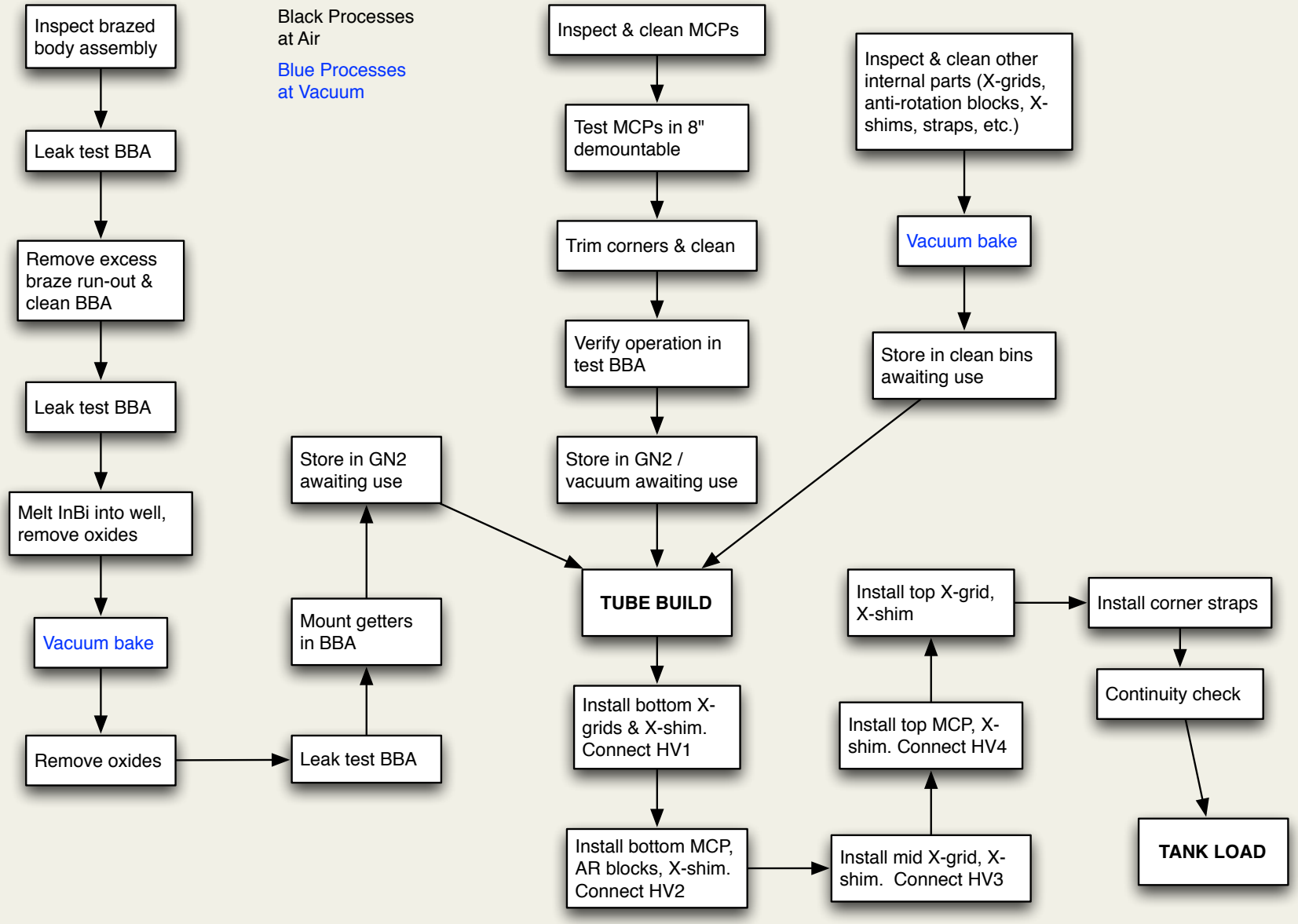
LAPP Photocathode Godparent Meeting

10 July 2012

8” Tube Process Flow

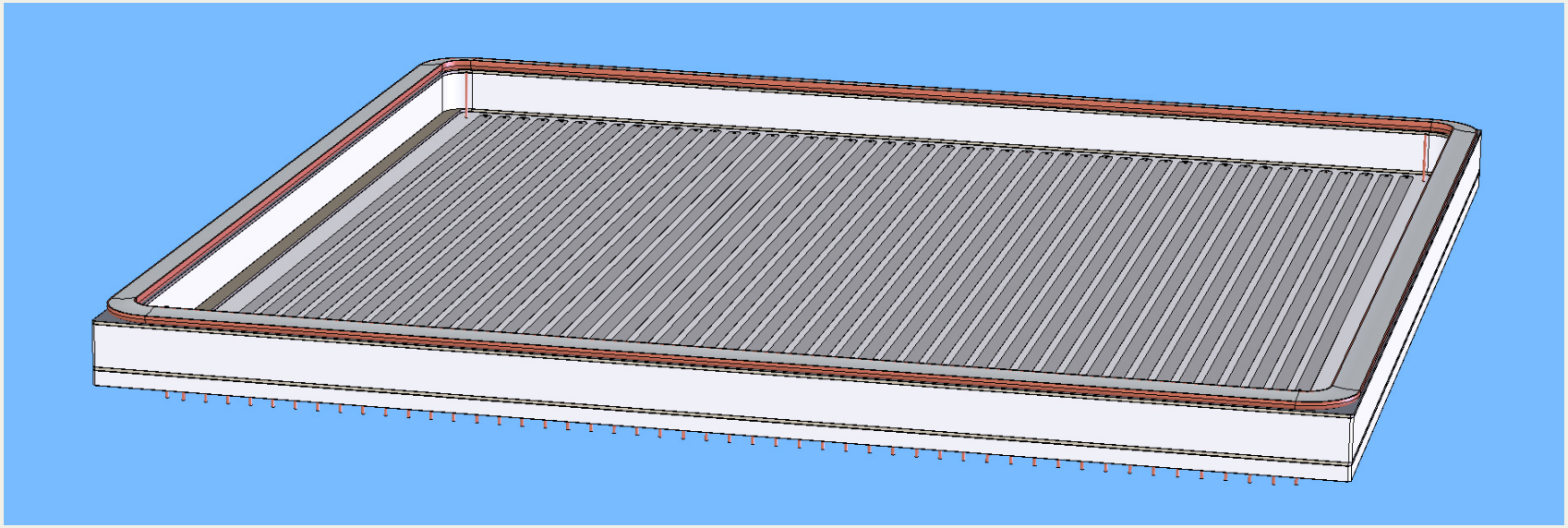


8” Tube Assembly Flow



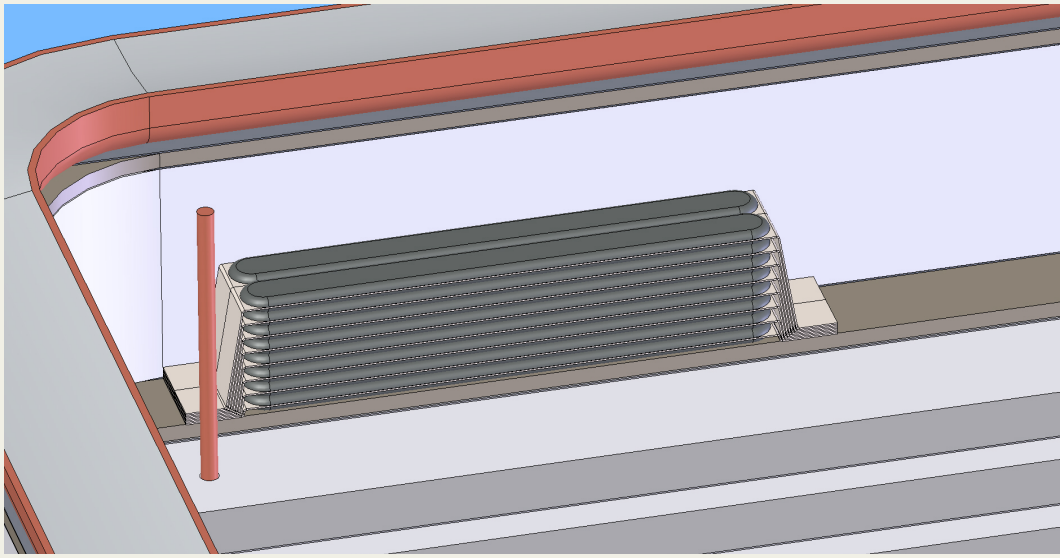
Brazed Assembly Pre-Process Preparation

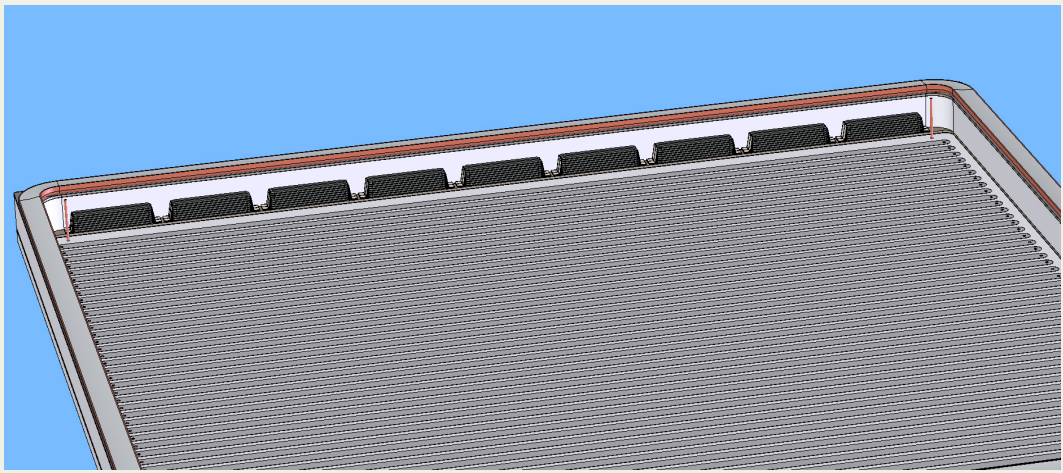
- Leak check (requires support jig)
- Remove excess braze run-out
- Clean
- Load InBi alloy in cup
- Remove oxides
- Vacuum bake at ~350°C
- Leak check again
- More oxide removal if needed
- Install getters
- Ready for tube build



Getter Placement and Installation

- SAES St-122 getter strips
  - Getter material bonded sintered onto .002” Ni shim
  - Passively activated by 350°C tube processing temperature
- Spot weld to kovar/stainless strips attached to anode
- Total of ~300 getter strips
  - N_2 pumping speed ~30 l/s, (CO & H_2 better)
  - Using Dean’s 8” MCP outgassing rate -> tube pressure ~ 10^{-10} torr
- Robust design, if labor intensive
- Top getters well clear of bottom MCP





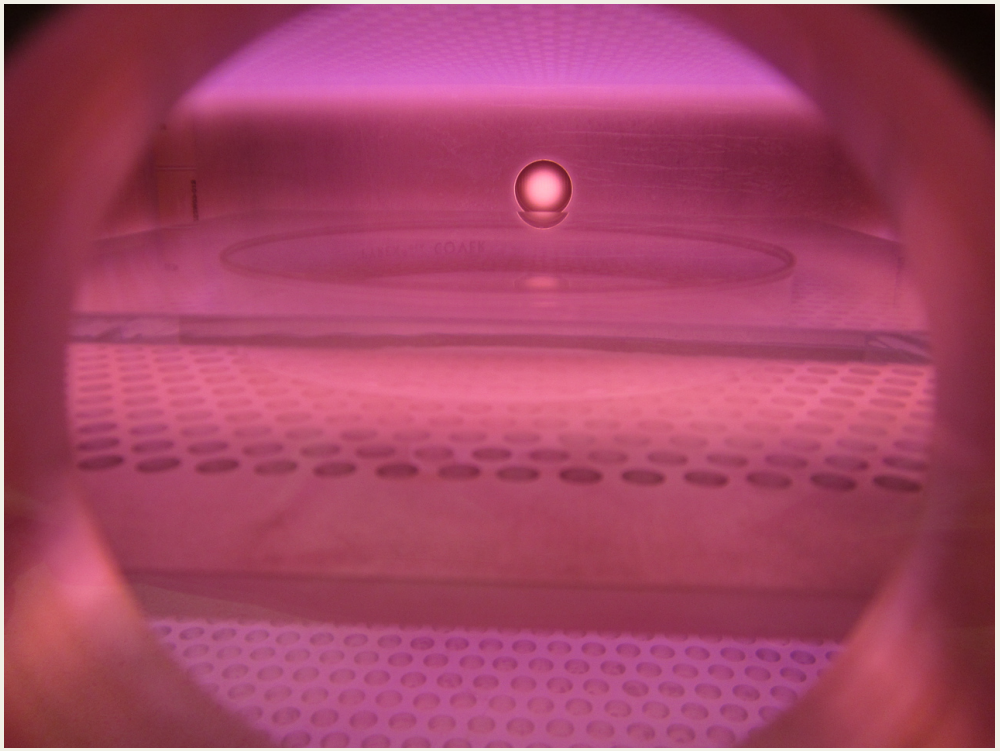
Tube Internal Parts Preparation

- MCPs after demountable testing
  - Trim corners for anti-rotation blocks
  - Ultrasonic clean in 50/50 Iso/Methyl mixture
  - Air bake (~100°C) or vacuum bake (~50°C) to dry
- Other components (X-grids, X-shims, AR blocks, etc.)
  - Standard wet clean process
  - Vacuum bake (~350°C)
- Alcohols are Nano-Grade to minimize residues and particulates

Tube Window Preparation

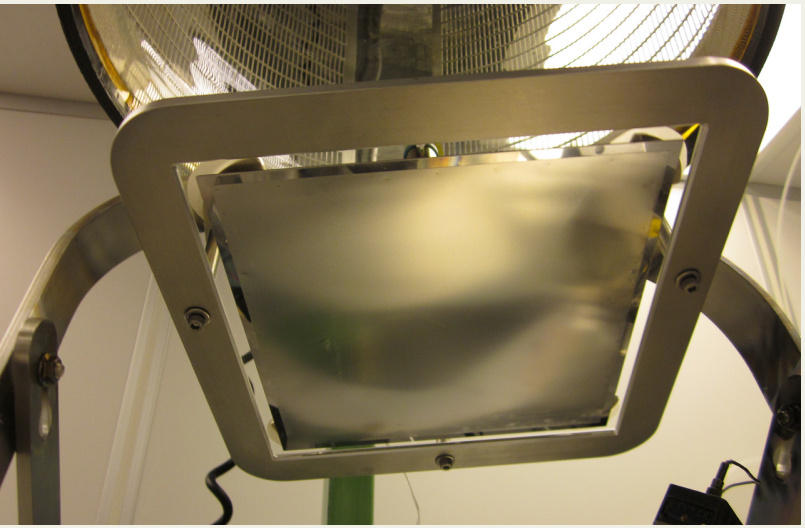
Large plasma asher installed in clean room.

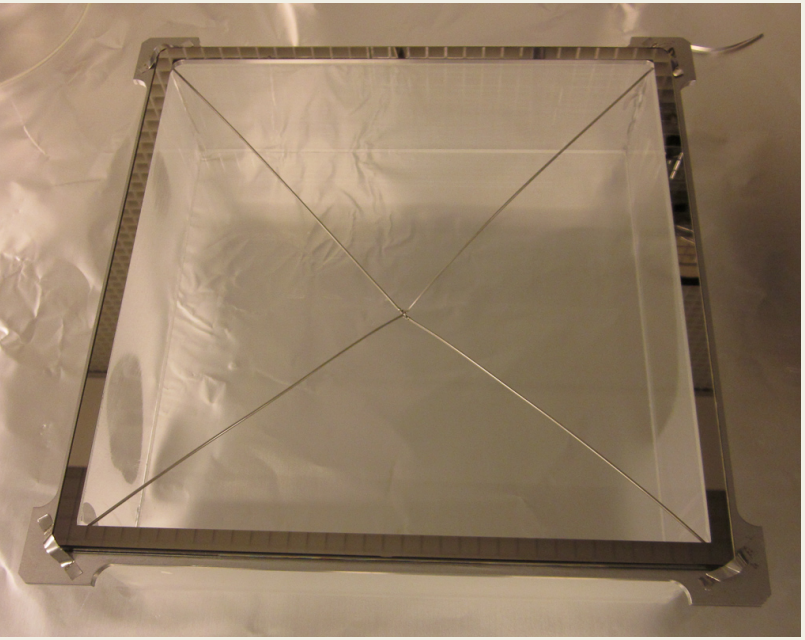
- Standard wet cleaning
  - Add mechanical scrubbing with calcium carbonate slurry to get water break if needed
- Plasma clean



8” window being plasma cleaned

Tube Window Preparation (cont)

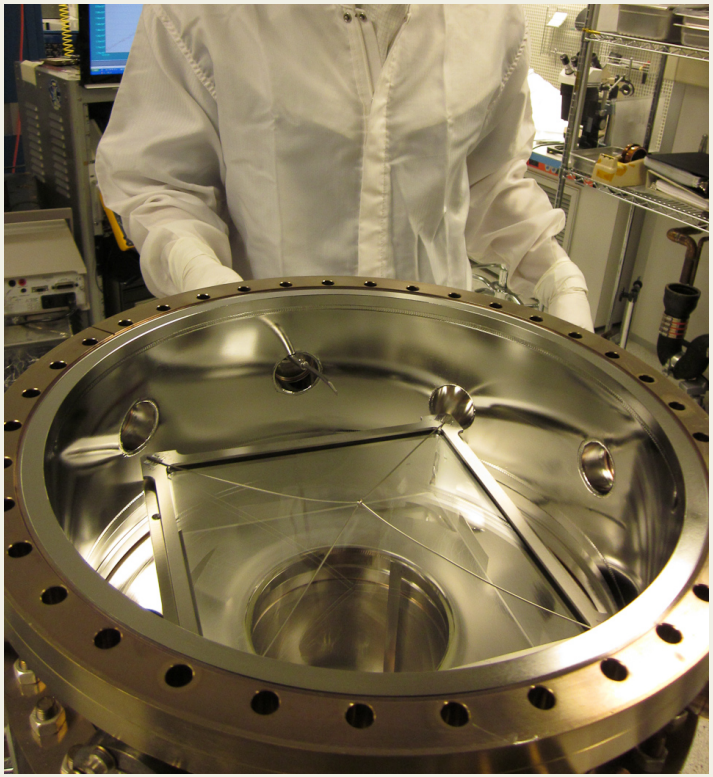




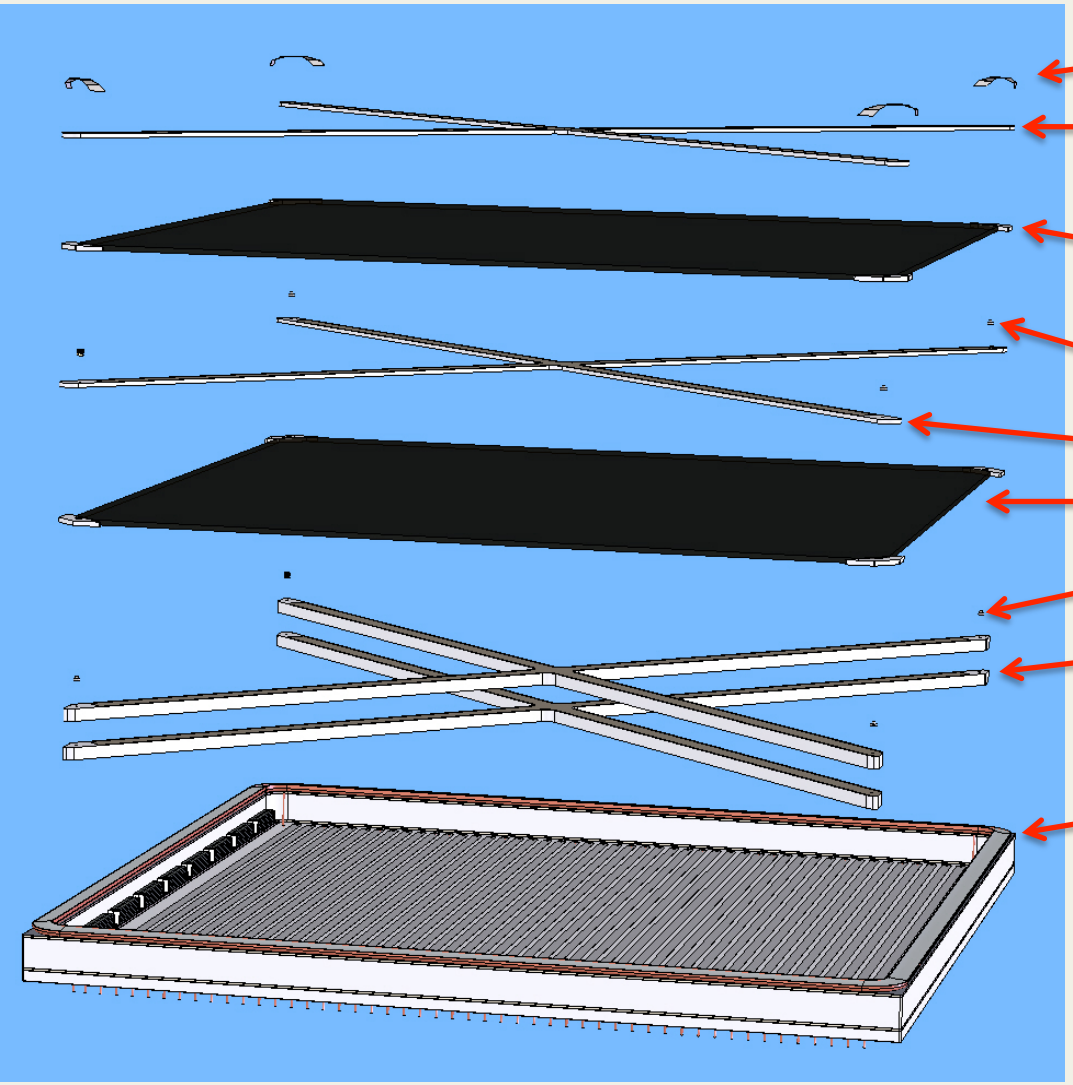
- Apply metallic border with sputtering system
  - NiCr first for adhesion to glass and photocathode contact
  - NiCr "X" across window (not shown) for improved conduction
  - Cu border for indium seal wetting
- Plasma clean
  - Protect Cu from O_2 plasma
- Install into transfer fixture
  - For manipulation in the process chamber
- Ready for installation in process chamber
  - Ideally finish plasma clean just before chamber load

20cm Tube Window Nest

- Square, stainless chimney for forming well in large chamber.
- Unlike throated, glass chimney in PC chamber will allow full corner-to-corner photocathode coverage on window



Detector Internal Stack Assembly



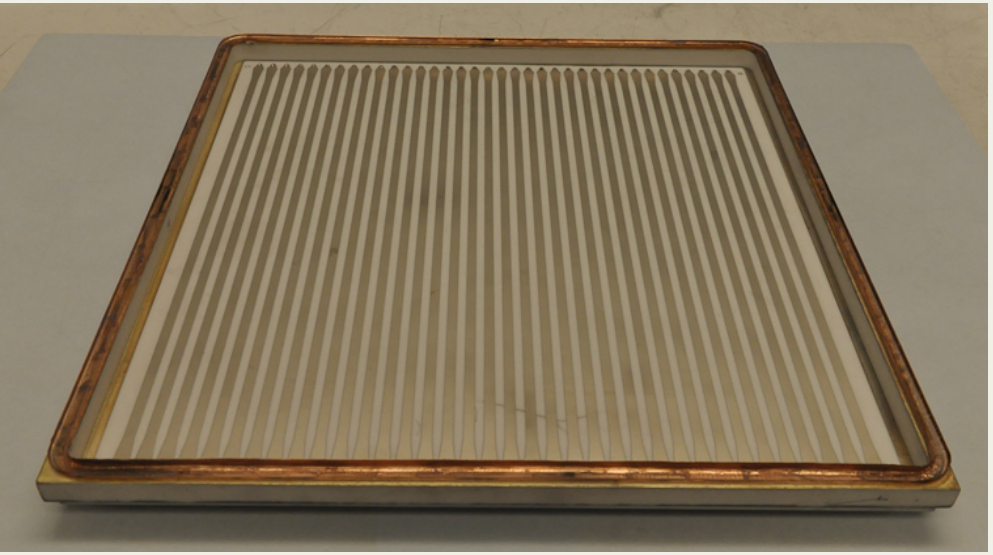
- Stack hold-down straps
- Top X-Grid – .060” thick plus ~.002” X-shim to adjust stack height
- Top MCP – with anti-rotation blocks at corners
- HV contacts
- Middle X-Grid – .060” thick
- Bottom MCP (w/ AR blocks)
- HV contacts
- Anode gap X-Grids - .060” ea plus ~.020” X-shim to adjust stack height
- Prepared BBA (indium and getters)

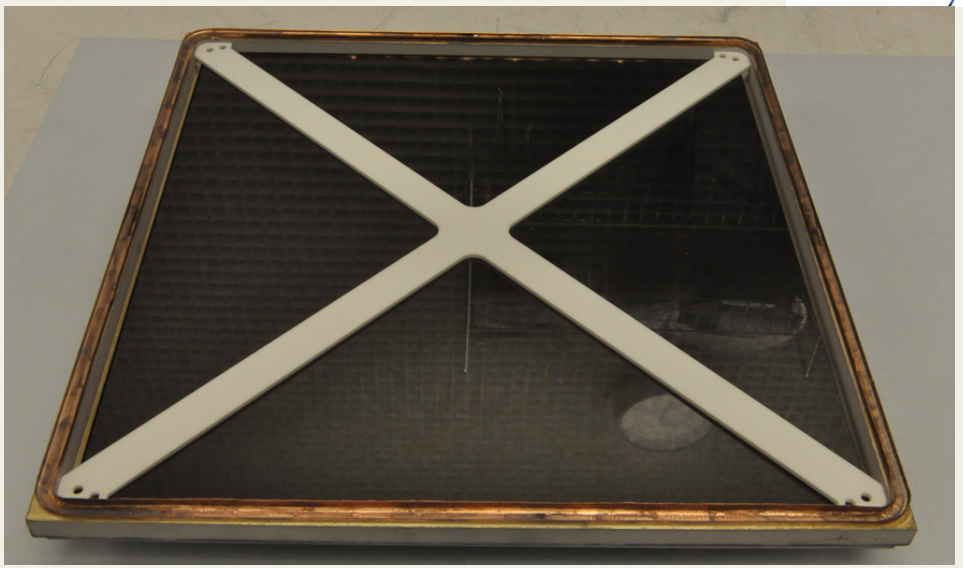
- Internal stack height .003”–.006” shorter than walls to ensure seal

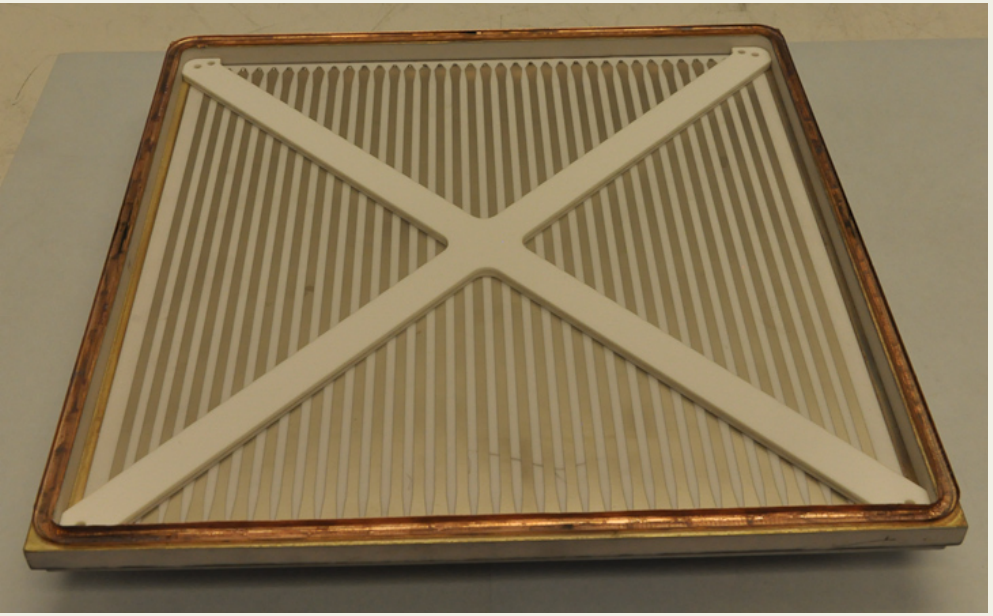
High Voltage Contact Scheme

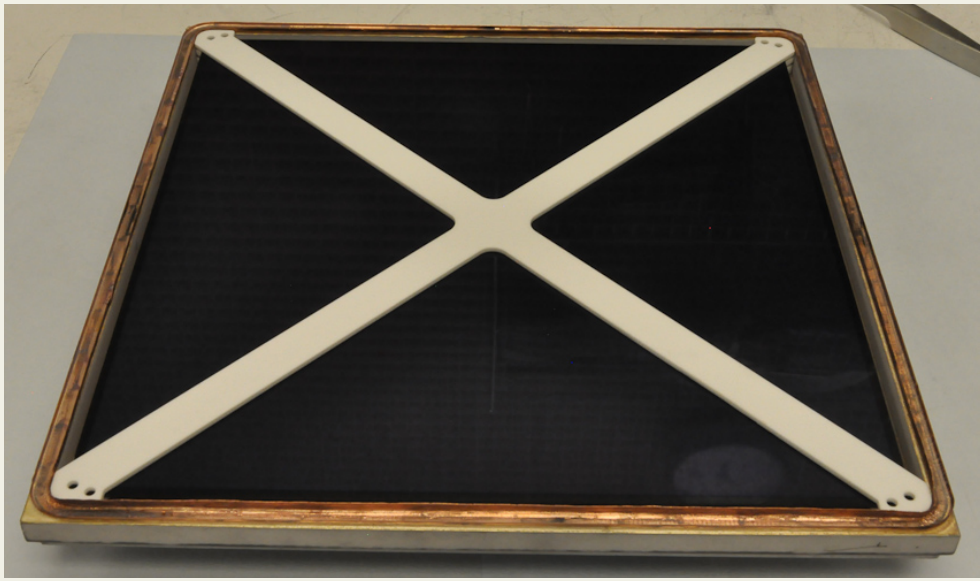
- Four HV pins through anode (one in each corner) for MCP HV's
- Cathode HV provided externally
- Each of the lower X-grids have locating holes in the ends of the arms
- Top-hat washer spot-welded to all pins at all levels to hold down stack
- Each X-grid is metalized (evaporated NiCr, or X-shim) and oriented to provide unique contact of each MCP surface to only one pin
- Contacts to MCP top surfaces (X-grid bottoms) made by miniature Ni bellow contact
- Top X-grid lacks holes to provide insulation between cathode and HV pins
- Top of stack "strapped down" to the top Kovar flange with two overlapping, spot welded .001" thick stainless shims (at all corners)
- X-shims at top of anode (thick) and cathode (thin) gaps to allow stack height adjustment.

Trial Full Detector Stack-up



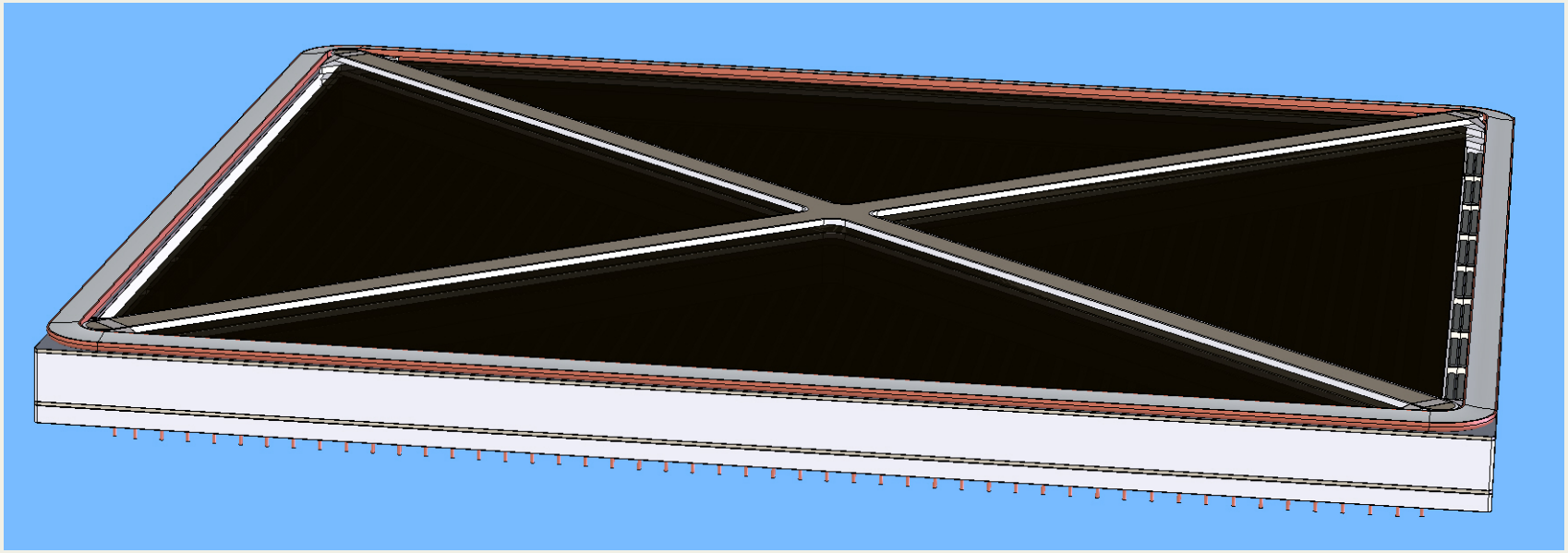




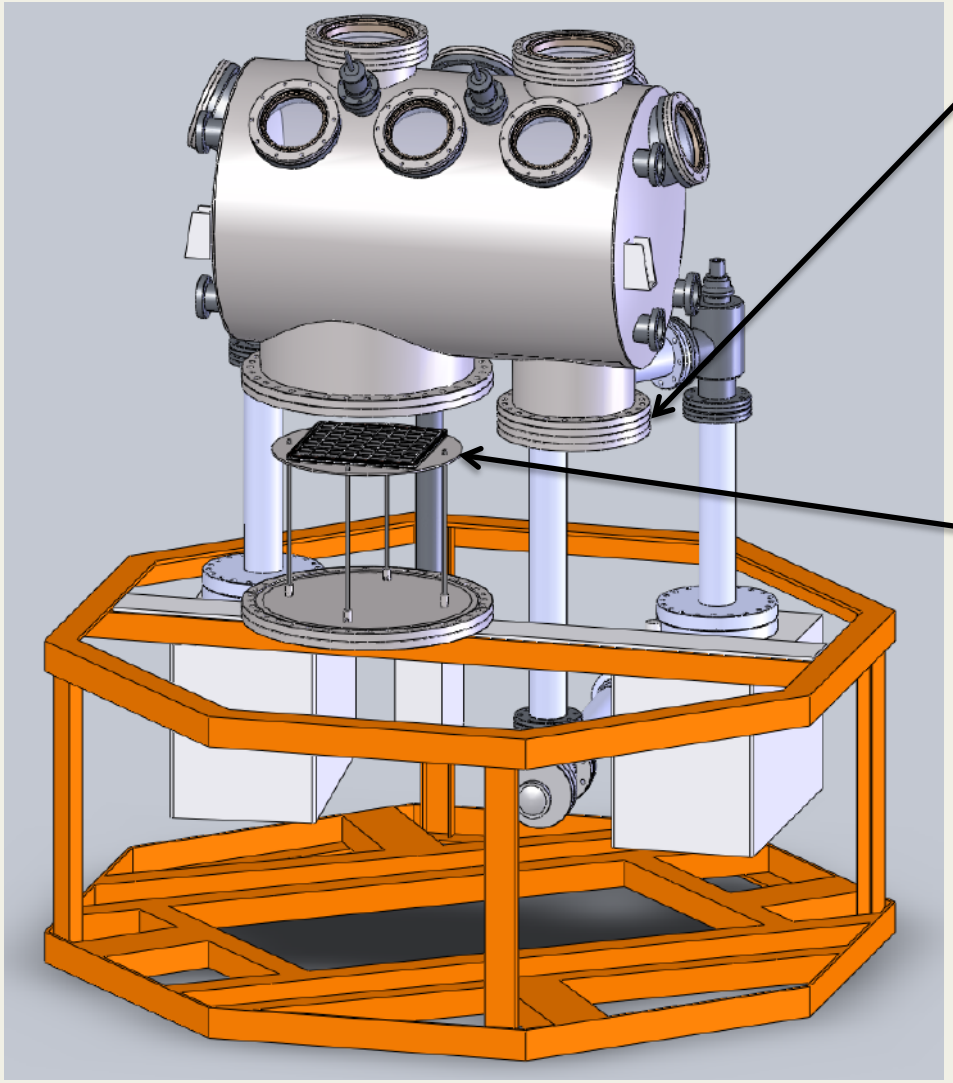


Tube Ready for Processing

- Verify nothing is protruding above the seal seat
- Carefully inspect for any dust on the MCPs
- Verify electrical contact to the MCPs from the exterior pins
- Verify the MCP resistance is as expected
- Check for short circuits
- Anything else that might cause a vacuum break?
- Ready for chamber load

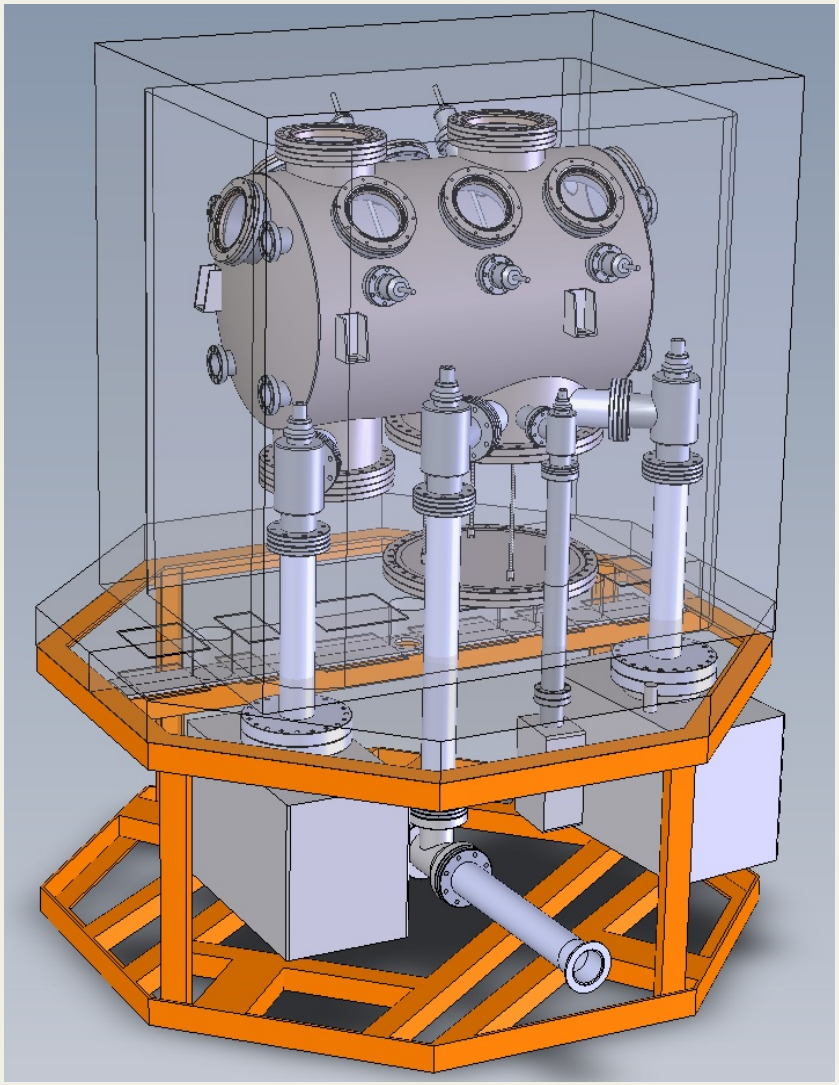


Process Chamber Load



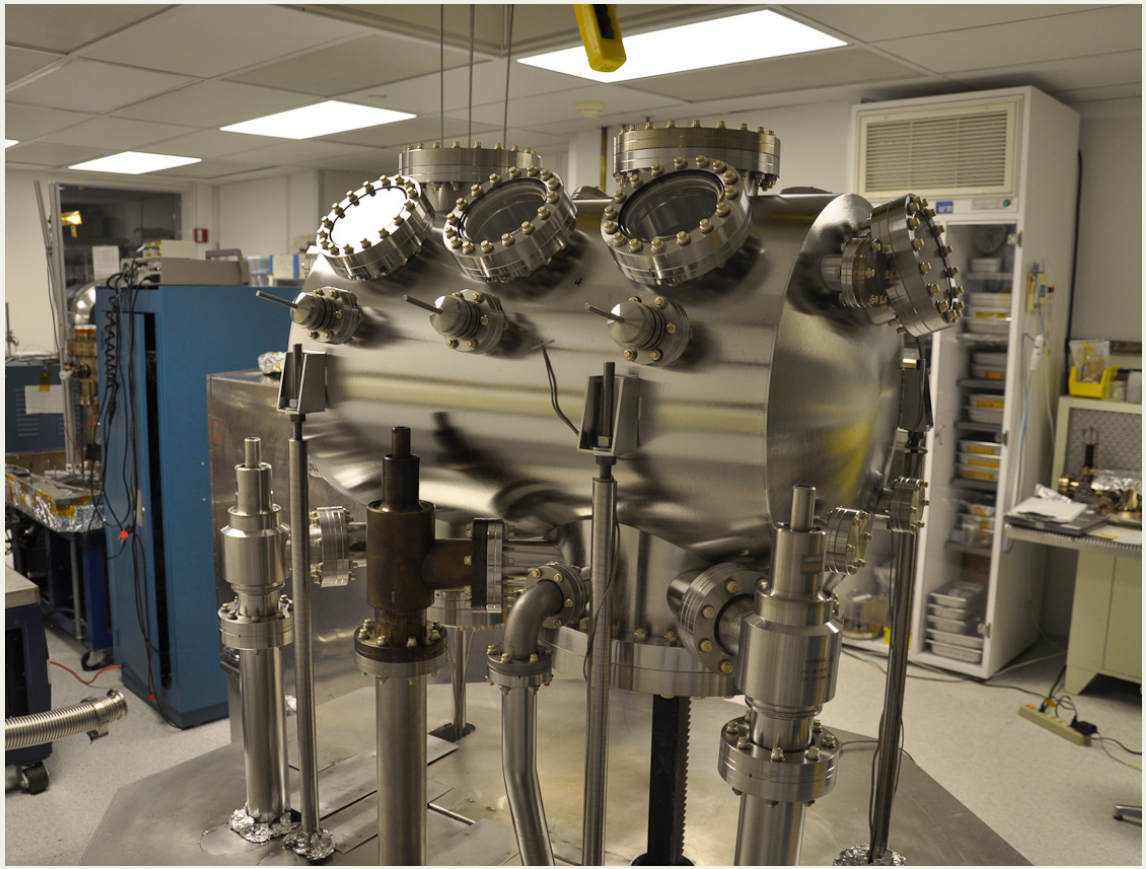
- Cathode materials loaded in the forming well
- Tooling needed during process in the chamber
- Window on handling fixture loaded
- Tube loaded onto support flange
- Test conductivity from the tube to outside the flange
- Seal chamber and evacuate
- Functional test the detector

Sealed Tube Processing



- 350°C utility bake (12-24 hours) on turbo
- Functional test detector
- Switch to ion pumps
- Scrub the MCPs (3-4 days?)
- Shoot photocathode at elevated temperature (~190°C)
- Measure QE while hot
- Seal the tube on the cool down
- Once cool measure the QE again
- Last at vacuum functional test (but with window on now)
- Vent chamber
- Monitor tube for signs of leakage

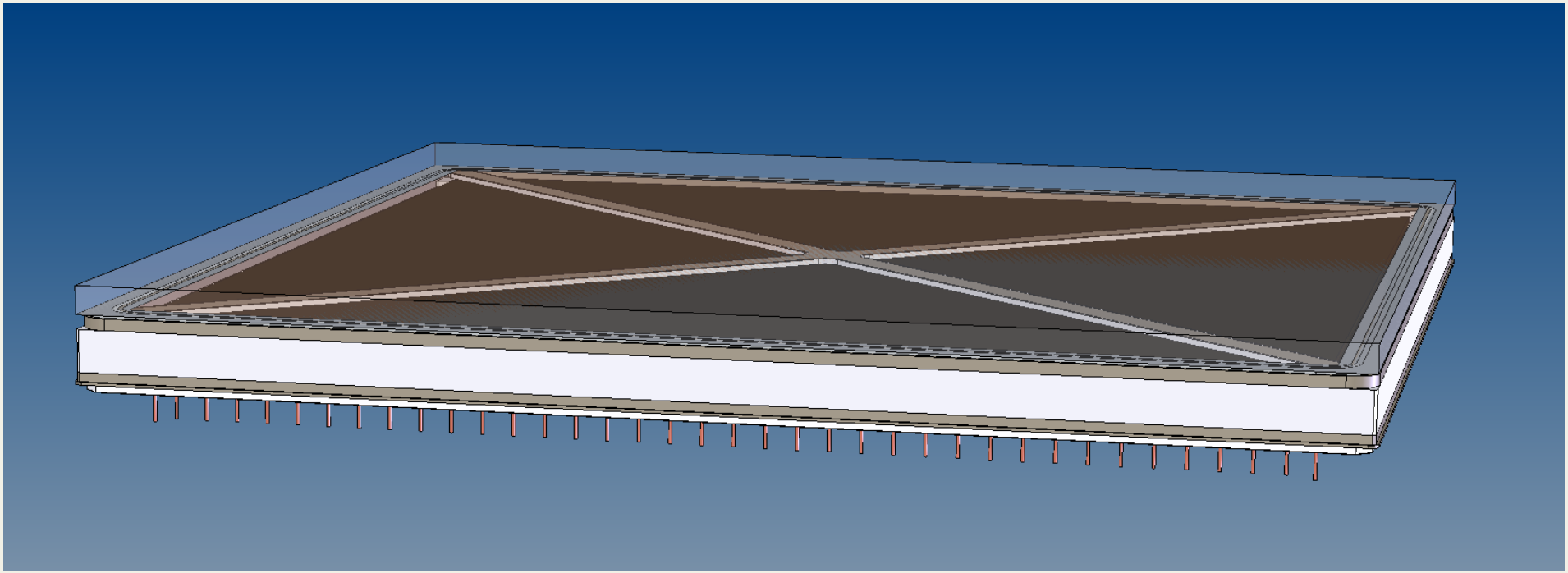
Large Tube Process Chamber



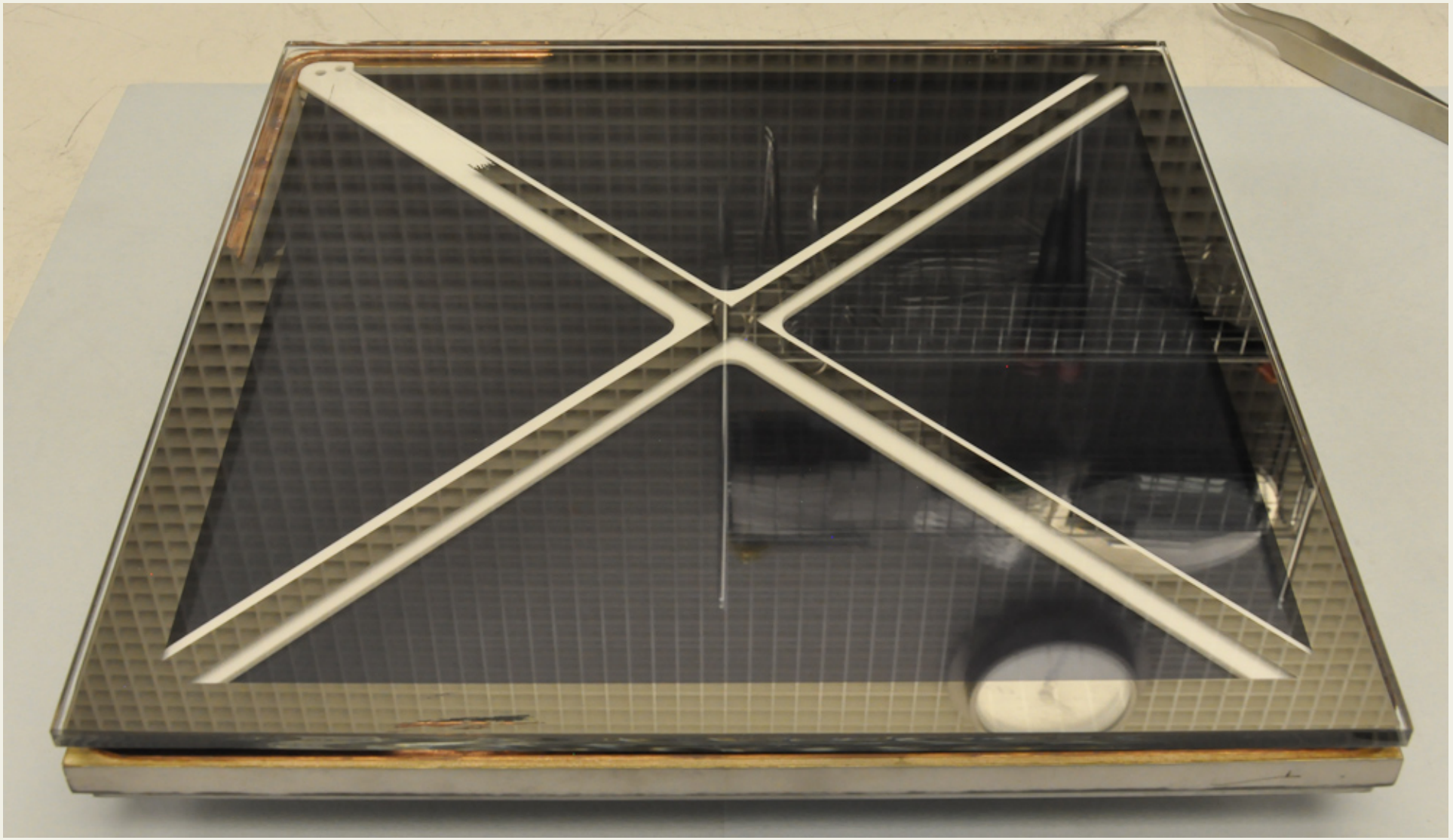
Process chamber for 8” tubes is in its H_2 bake-out. Current temperature is 250-300°C, and H_2 partial pressure is decaying rapidly.

Finished Brazed Assembly Sealed Tube

- Remove tube from process chamber
- Integrate with test setup for more detailed functional testing
- Perform “normal” image and gain characterizations
- Ready for integration with electronics



Trial Detector Stack-up



Electronics Packaging Baseline

- Conductive epoxy ground pin arrays to tube back ground plane
- Analog cards, four channels per card
- Interconnect to digital board with readout interface

- HV supplied separately for now – resistive bridge and single supply or multiple supplies