

All Glass Option - Overview & Contingencies

for the LAPPD Mechanical Group
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Hermetic Sealing Godparent Review
Friday 22 October 2010

All Glass Option

Goals:

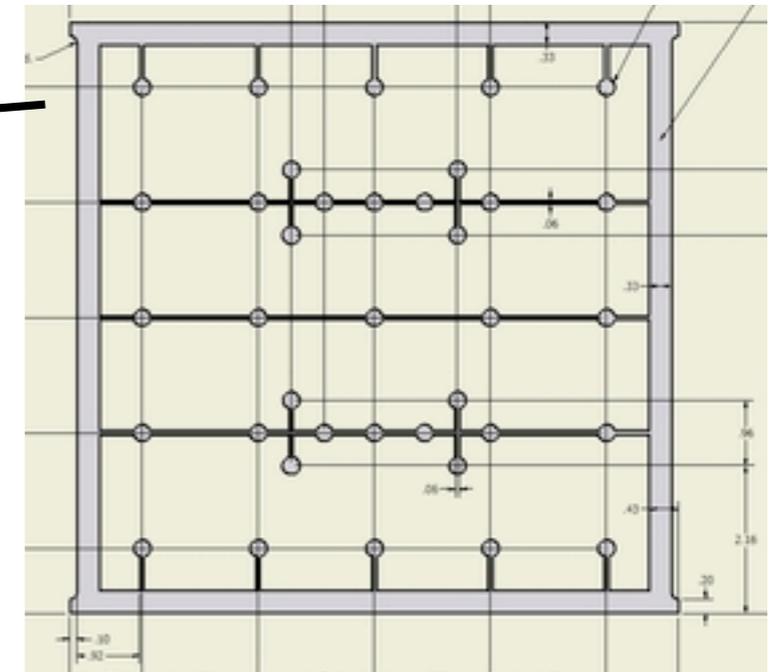
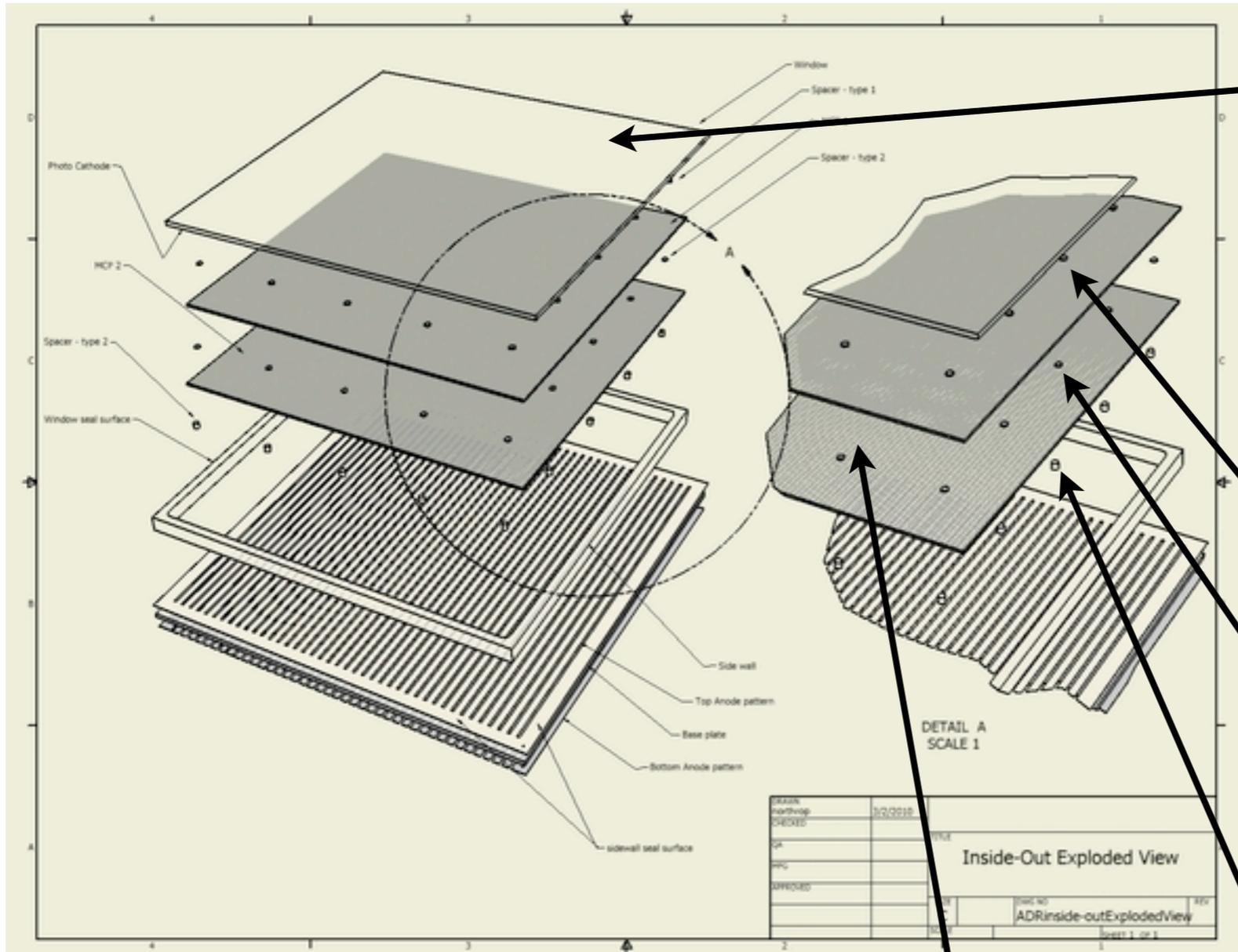
- ▶ Use **inexpensive** borosilicate glass for containment vessel
- ▶ Avoid use of pins penetrating glass for HV and signal
- ▶ Cheap, reliable, reproducible containment vessel fabrication
- ▶ Demonstrate feasibility with partially active mock-up

Constraints:

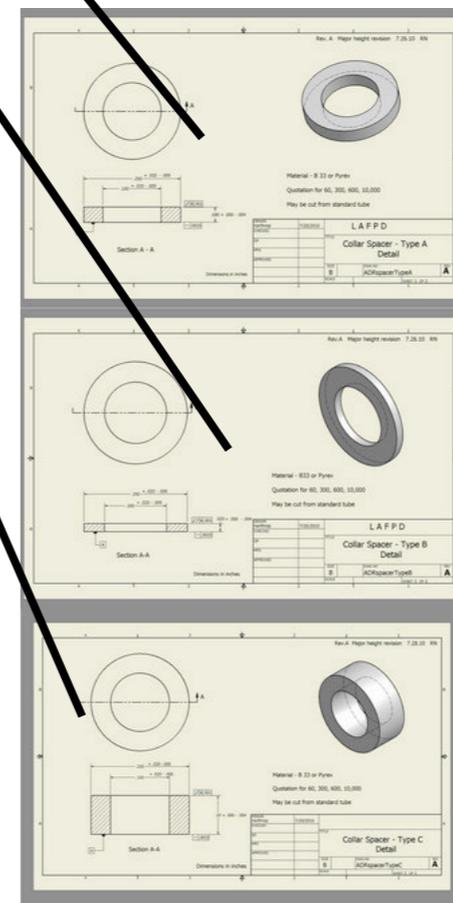
- ▶ Support vessel against implosive atmospheric pressure
- ▶ Top photocathode window seal at low temperature ($<120^{\circ}\text{C}$)
- ▶ ~10 year stability for seal with small leak rate
- ▶ Minimize handling steps in fabrication
- ▶ Avoid particulates in vacuum space
- ▶ Materials chemically compatible with alkali metal photocathode



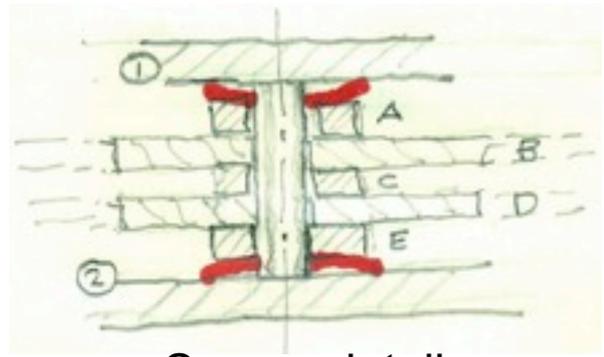
All Glass Option -- Pin Spacer Alternative



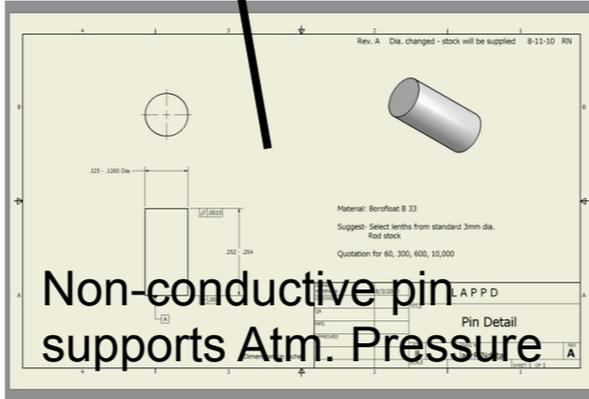
Photocathode Top Window
HV distribution through strip pattern



Conductive spacer collars set HV distribution through MCPs & to anode ground



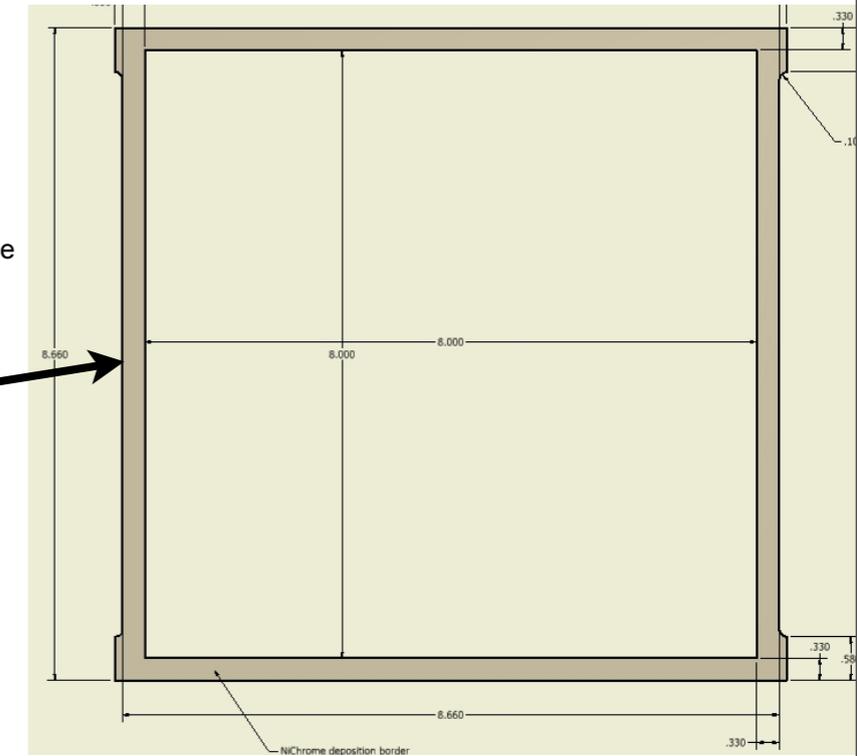
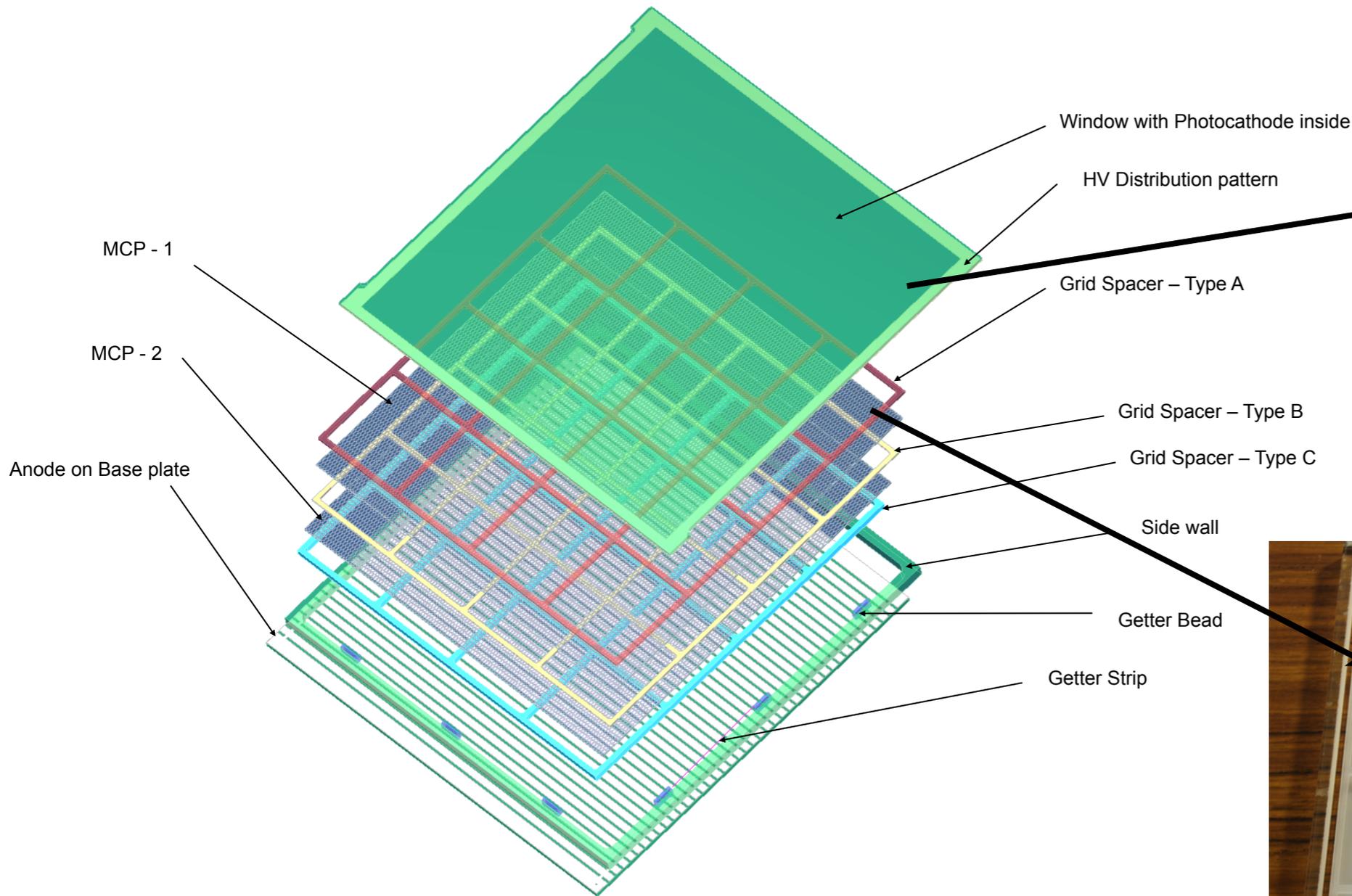
Spacer detail



Non-conductive pin supports Atm. Pressure



All Glass Option --- Grid Spacer Alternative



What Can Go Wrong --- Contingencies

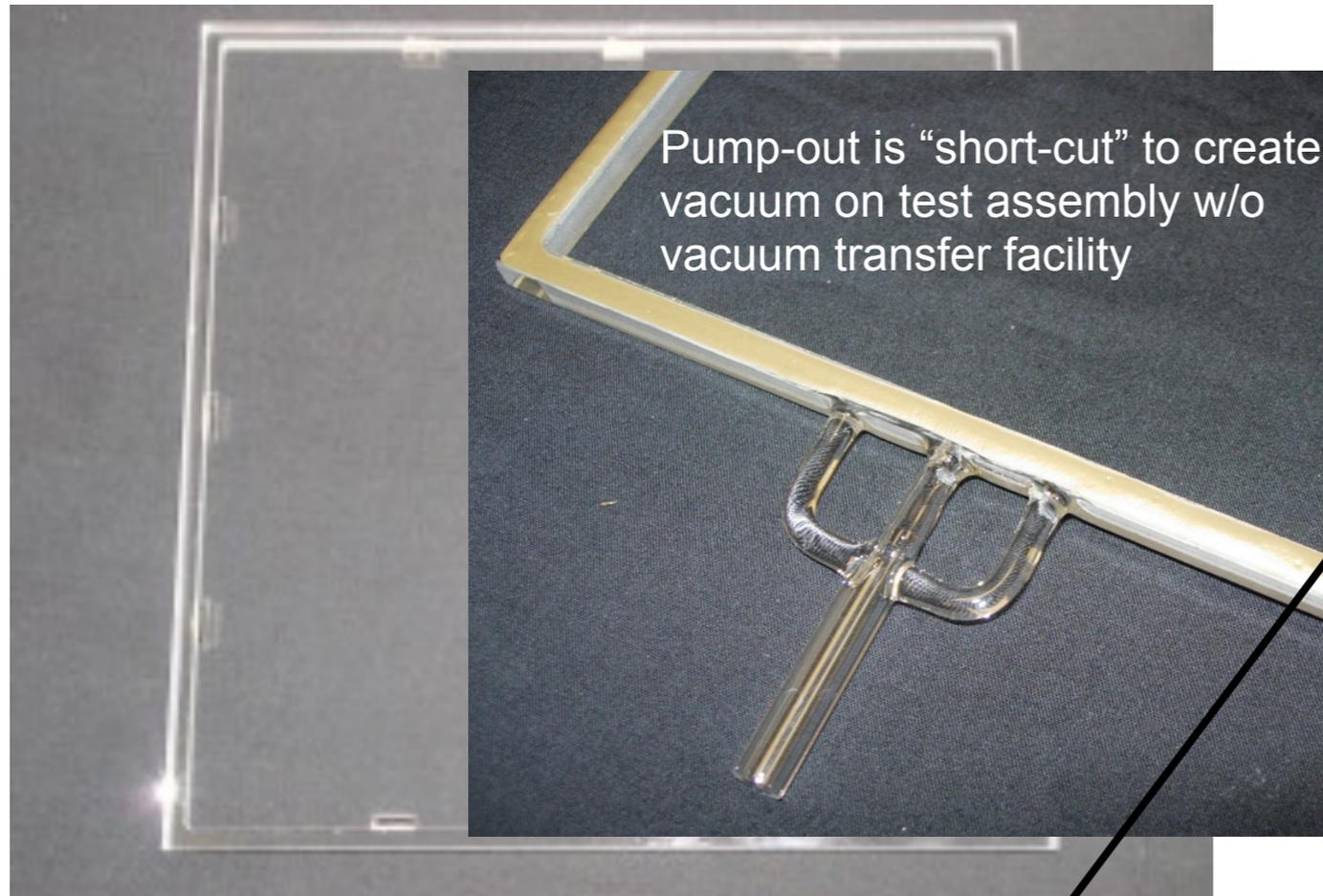
Pin Spacer Alternative:

- ▶ Local stresses near pin crack either glass plate or pin
 - **Contingencies:** grid spacer or larger diameter pins
- ▶ Fragility of glass collars gives poor yield
 - **Contingencies:** grid spacer or ceramic collar
- ▶ Silver traces on top window poison photocathode
 - **Contingencies:** nichrome traces applied by evaporation or sputtering

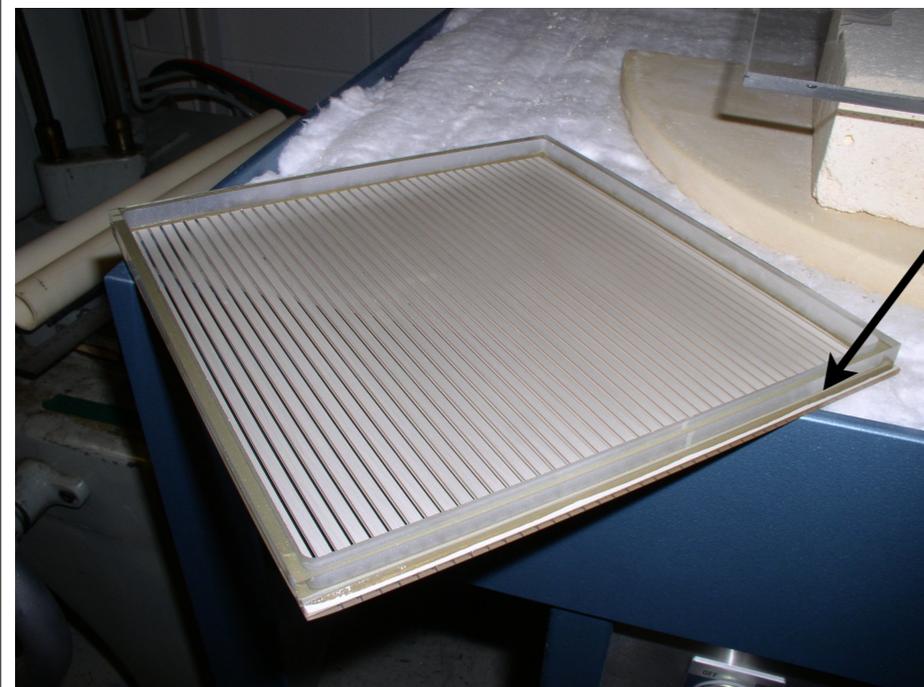
Grid Spacer Alternative:

- ▶ Grid ribs trap residual gas and/or MCP outgassing
 - **Contingencies:** cut “channels” through grid ribs
- ▶ Fragility of channels in grid ribs gives poor yield due to cracking
 - **Contingencies:** Don't know
- ▶ Fragility of MCP gap grid (0.5mm thick) gives poor yield due to cracking
 - **Contingencies:** Set MCP gap to zero and increase height of remaining two grids
- ▶ Expense added to cut channels and metallize grid contact to photocathode
 - **Contingencies:** None. Shouldn't price it out of contention

Tile Base Assembly -- Anode Bottom Plate & Sidewall



- Develop technique to reproducibly bond sidewall to bottom anode plate
 - Center sidewall frame w.r.t. bottom plate; 2 sides flush, equal overhang on anode ground strips
 - Attach getter holder tubes



Sidewall bonds along thin silver strip
Extension of strip past sidewall for bridging grounds between tiles

Problems with Metal Tile Base Fixture

- ▶ **Heavy!**
- ▶ Choice of hard steel (avoid warping) gives oxidation of fixture
- ▶ Springs in spring clamps not high temperature -- have Inconel 750 replacements
- ▶ Locator pins bond to frit squeezed from joint
 - Causes chipping of pins
 - Cracks glass during cooling

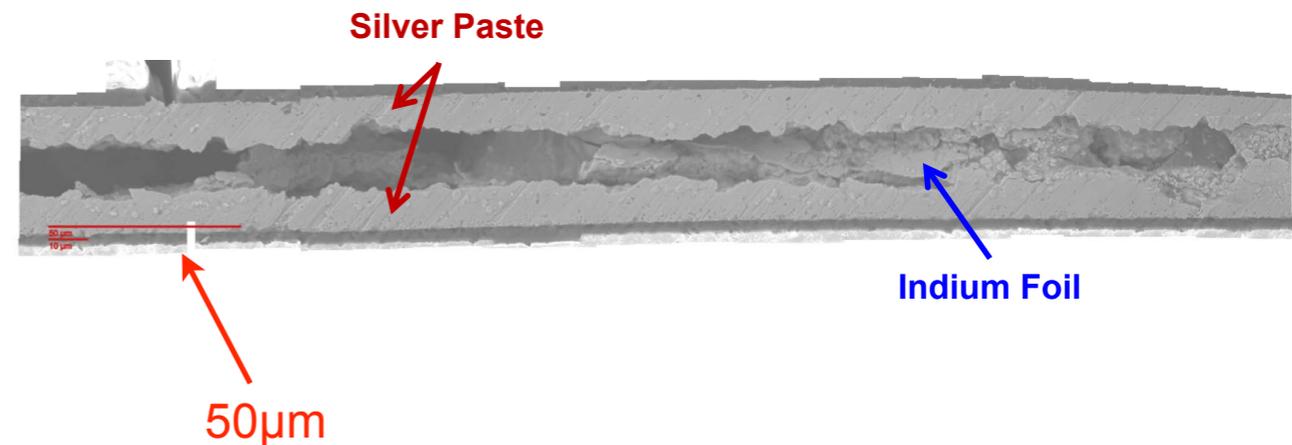
Developing all glass fixture:

- ▶ Need to avoid bonding tile base to glass locator pins
- ▶ Can we achieve accuracy needed for bottom/sidewall alignment and uniform tile base thickness
- ▶ Avoid slippage of bottom plate w.r.t. sidewall in absence of spring clamps
- ▶ Yet to try bonding new anode pattern plate to sidewall

Indium Thermopressure Top Window Seal

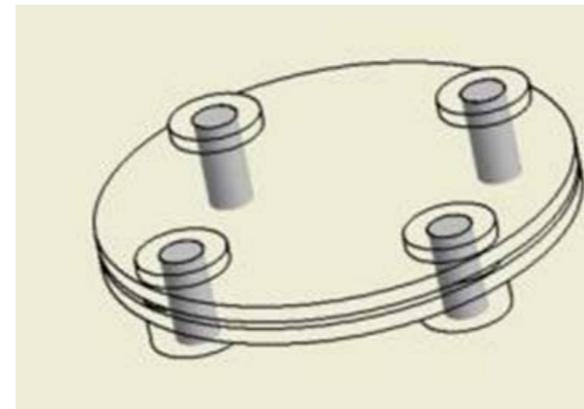
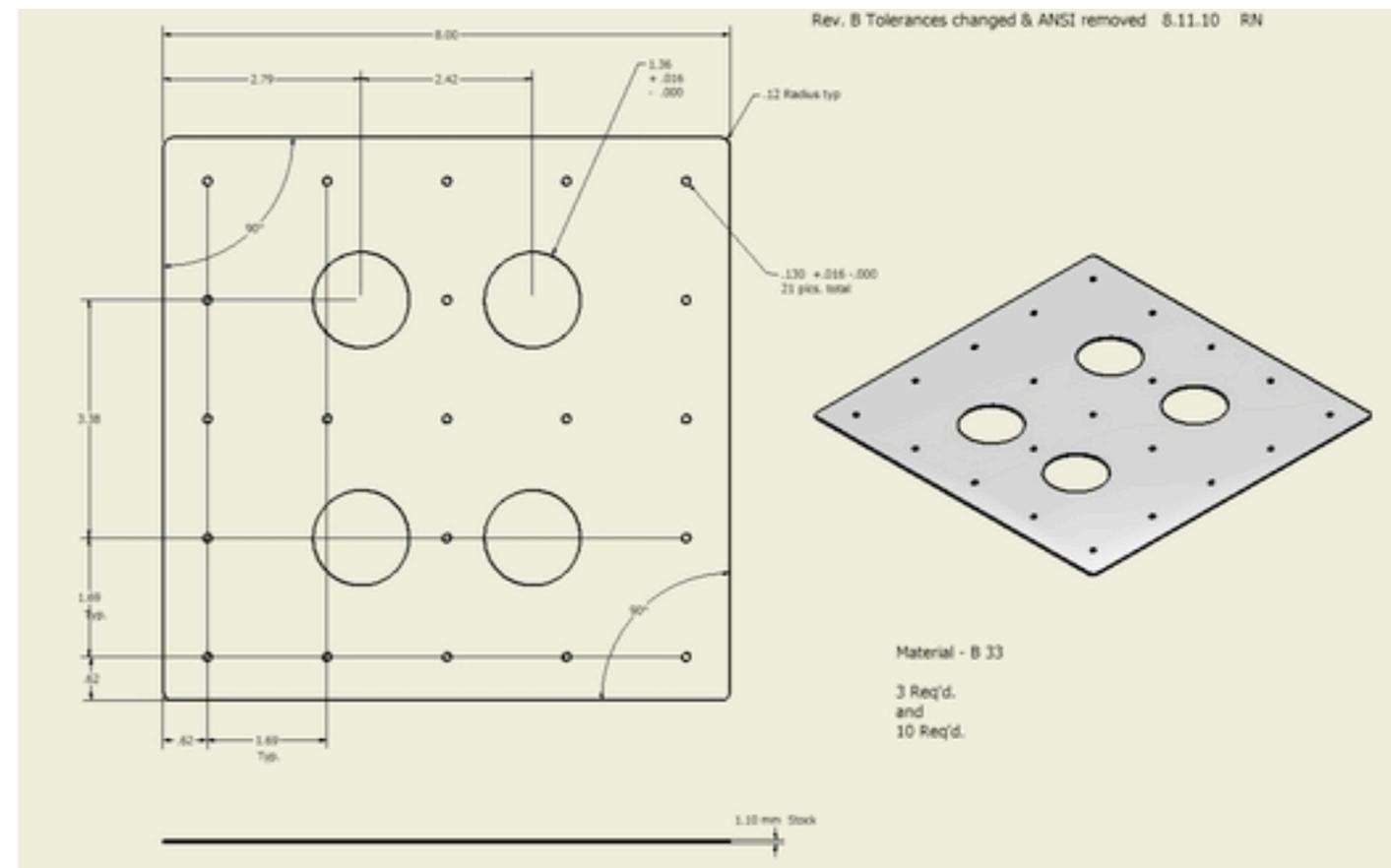
- Collaborative effort with Univ. of Illinois- Chicago (Ernesto Indacochea, Alcides Raraz, Marc Kupfer)
- **Bonding of top plate to sidewall must be low temperature ($\leq 120^{\circ}\text{C}$) to avoid damage to photocathode**
 - Test indium cold/warm press seal to silver, chromium, or nichrome films on glass
- First tests tried with 1"×1" sidewall frames painted with silver ink to glass windows with silver ink using indium foil. Leak rate was high
- Will evaporate nichrome onto similar small sidewalls and windows for next tests.
- Concerns:
 - Can we achieve acceptable leak rate
 - What material to use
 - What pressure can tile base withstand
 - Scaling to full-size window
 - Long term stability

Successful Glass-Ag-In-Ag-Glass seal
1"×1" silver ink printed glass coupons
1000psi for 5 min., 160°C

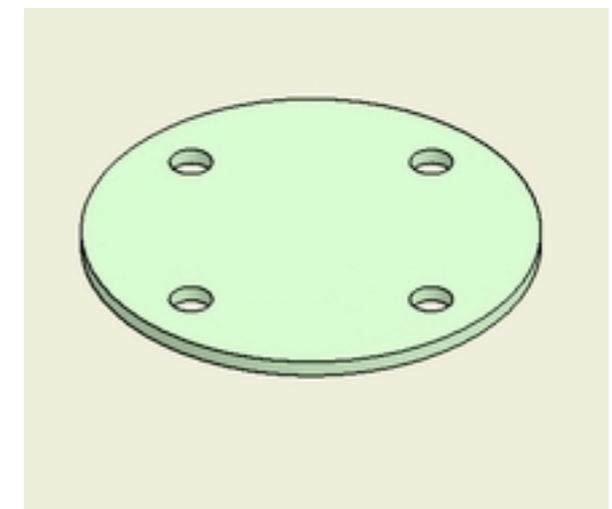


Mock Tile Fabrication

- ▶ Short-cut to testing full assembled large area MCP-PMT
- ▶ Glass 8"×8" mock MCP w/4 holes for 33mm functional MCP pairs: "Oreo Cookies"
- ▶ Use tile bases with pump-out port on sidewall & standard anode bottom plate
- ▶ Top window with no photocathode or Au photocathode
- ▶ Top seal with glass frit (like bottom seal)
- ▶ Cold In seal if technique successful



Oreo Cookie



Mock Tile Fabrication -- Issues, Questions

- ▶ Have all parts in hand for 2 Mock Tile assemblies with Pin Spacer Alternative
 - Possibly can do 2 Mock Tile assemblies with Grid Spacer (stack height??)
- ▶ Tile base assembly needs to proceed with glass fixture
- ▶ Final assembly in Glass Shop for frit top seal. Can we keep things clean enough?
- ▶ Will soon be ready to test “Oreo Cookies” at APS UV laser facility
- ▶ Need to complete setup for testing assembled mock tile at APS UV laser facility
- ▶ Need to proceed with assembly and ALD of Oreo Cookies
 - Resistive coating of collars
 - Can we use 0.5mm alumina collar substitute to avoid breakage?
 - Electroding of 33mm disks with spacer holes ready to proceed?
 - Have method of occluding holes with m2 screws and nuts



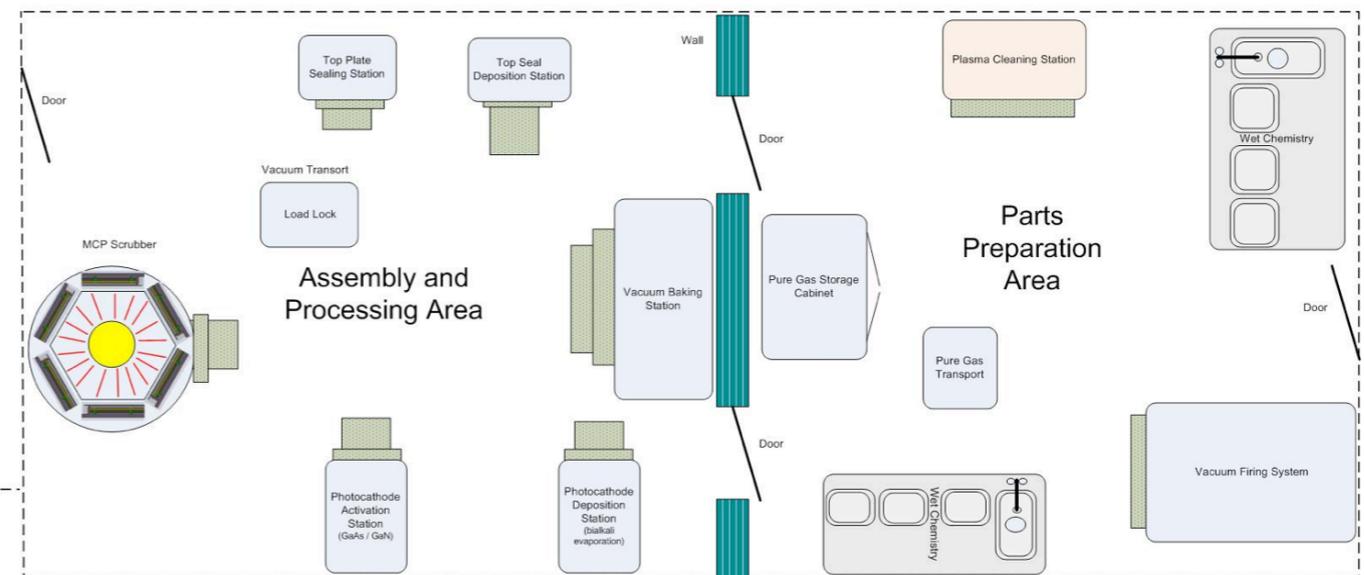
BACKUP SLIDES



Tile Production Facility Development

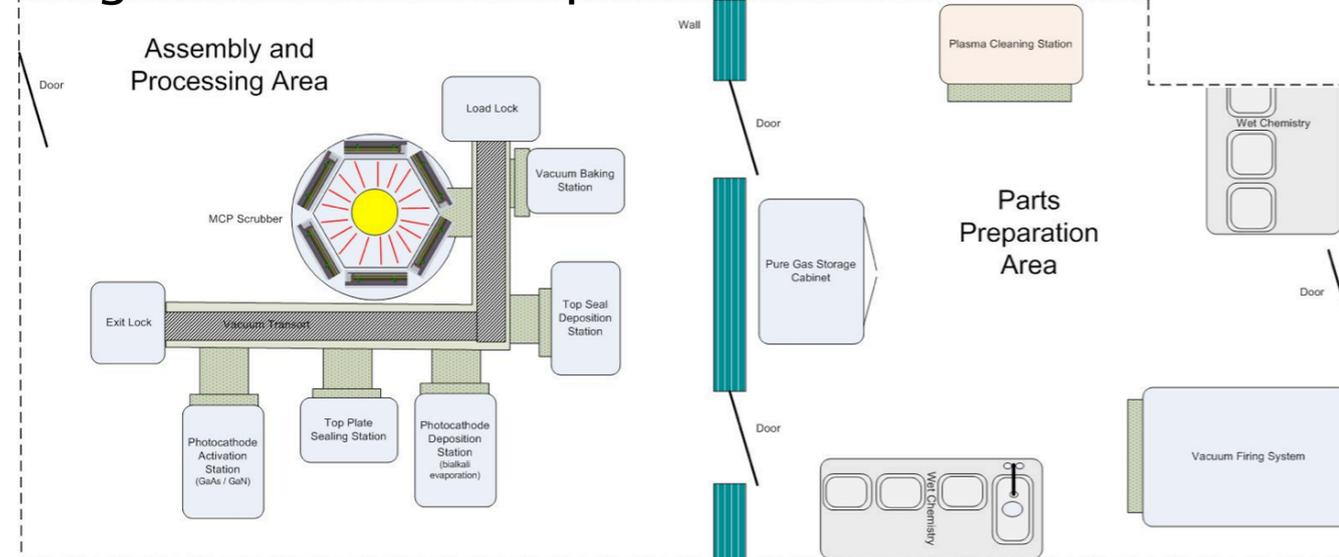
- ▶ **Goal:** Produce all glass MCP photodetector tiles in quantity; ultimately want to produce one supermodule/week (2×3 tiles)
- ▶ Demonstrate beginning-to-end process technology
- ▶ Initially pursuing two alternatives for vacuum handling in parallel
- ▶ Wet chemistry area identical & common to PC Growth Facility

Lab Layout #1



Lab Layout #2

Single Vacuum Transport to Task Pods



Instrumentation "Islands" serviced by Vacuum Transport Cart