

Overview of Glass Package

for the LAPPD2 Collaboration
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Hermetic Packaging Godparent Review
Wednesday 03 April 2013

All Glass Option

Goals: (as outlined 22 Oct 2010)

- ▶ 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
 - **demonstrated double-ended readout with Demountable with all components fabricated by LAPPD collaboration from Al photocathode to PSEC-4 readout with central control card (see talk by Wetstein)**

Constraints:

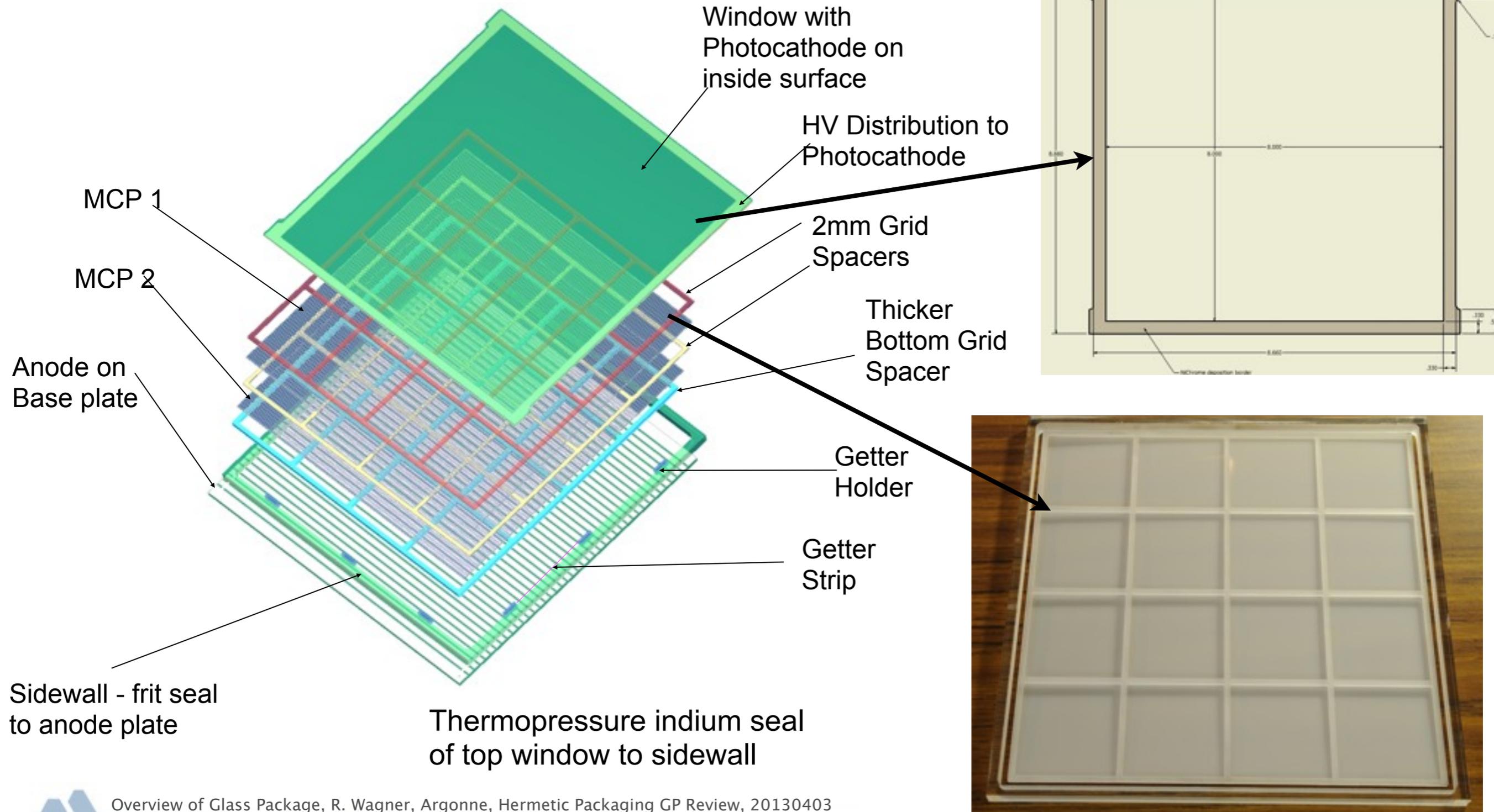
- ▶ Support vessel against implosive atmospheric pressure (**demonstrated**)
- ▶ Top photocathode window seal at low temperature ($<120^{\circ}\text{C}$) (**in progress; see talks by Kupfer & Elagin**)
- ▶ ~10 year stability for seal with small leak rate (**only established few day stability to date**)
- ▶ Minimize handling steps in fabrication (**process step outline in progress**)
- ▶ Avoid particulates in vacuum space (**have upgraded Argonne clean handling abilities**)
- ▶ Materials chemically compatible with alkali metal photocathode

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All Glass Option --- ALD Coated Grid Spacer Design

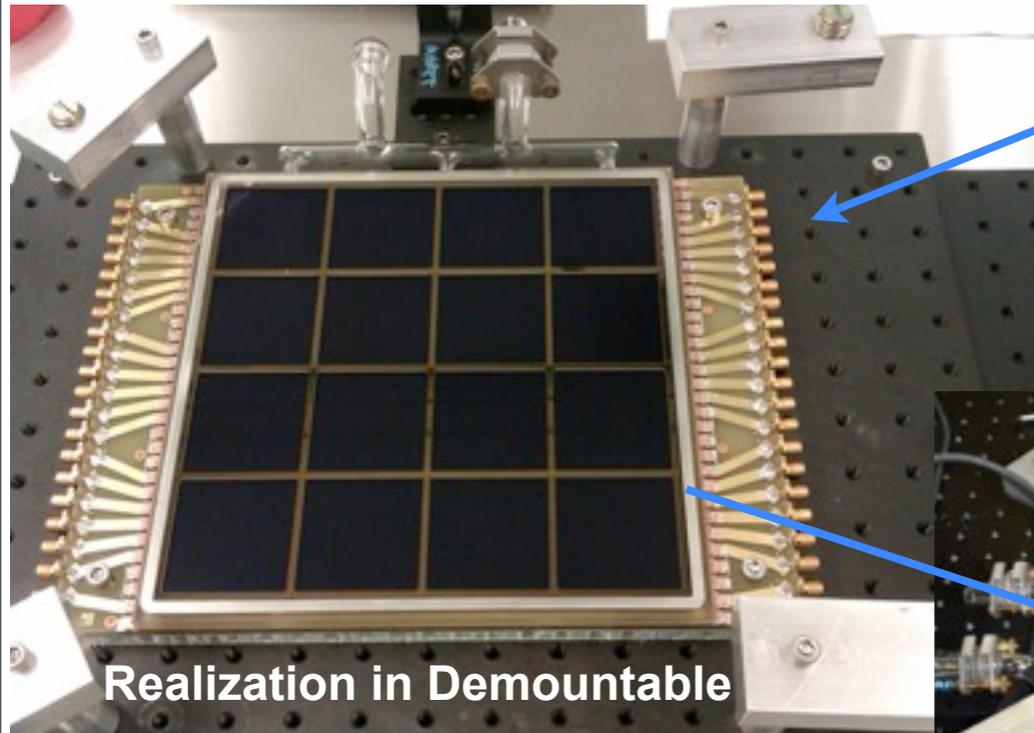
Essentially unchanged from 2010 design



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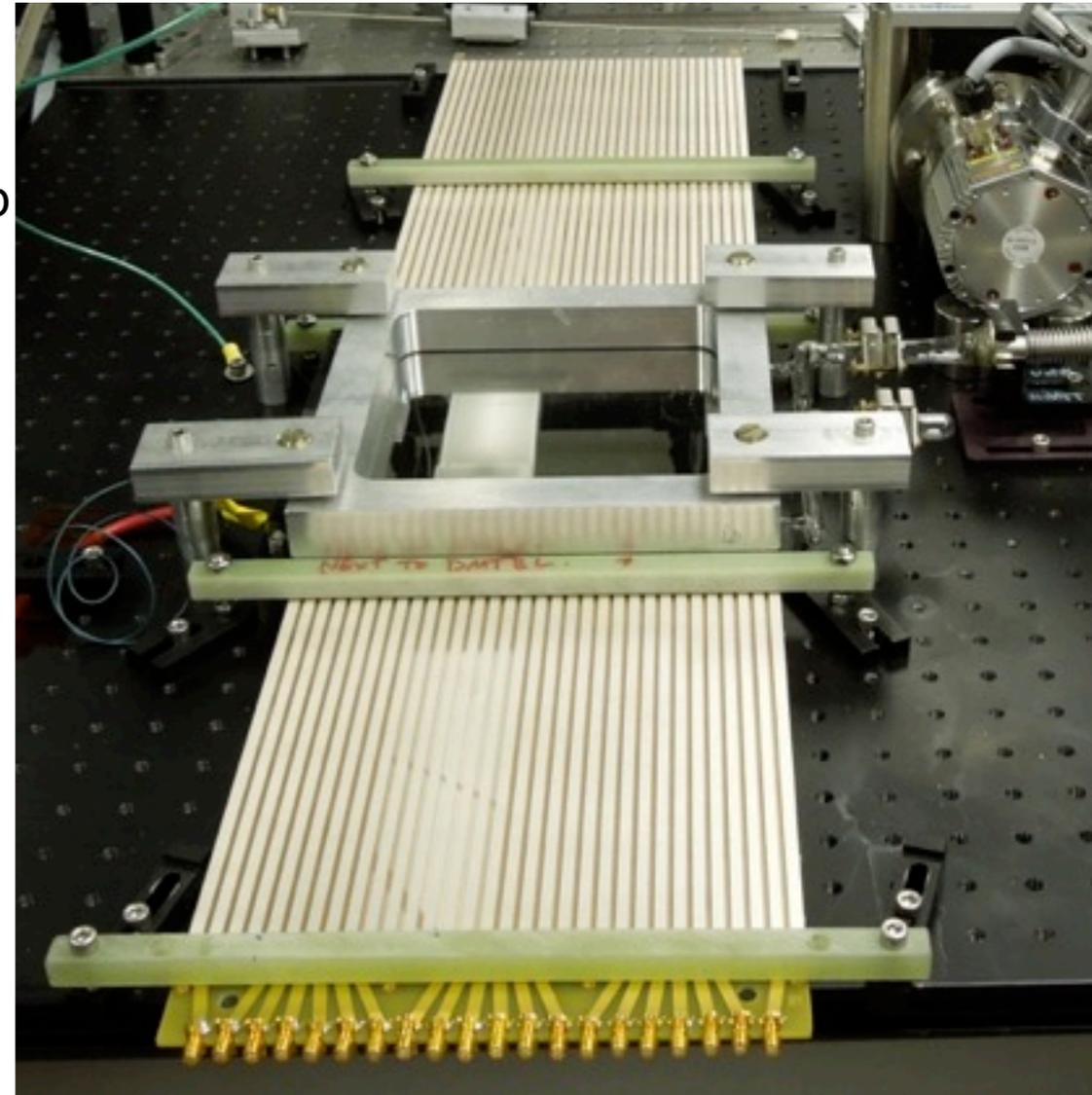
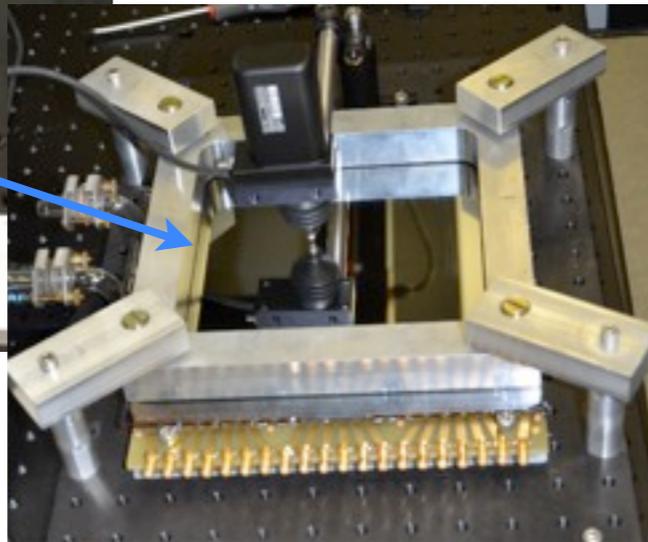


Realization of Hermetic Glass Package in Demountable



Assembled in ALD Lab Clean Room

Transported to APS UV Laser Test Setup



Realization in Demountable

Demountable is o-ring sealed tile:

- Continuously pumped
- MCP pair: Chem. 2 + MgO SEE
- Al photocathode on quartz window
- ALD grid spacer for HV distribution
- 30-strip anode to fanout board

Allowing internal stack to provide “stop” for top window provides compressive support to avoid breakage from atmospheric pressure

What Can Go Wrong --- Contingencies (Oct, 2010)

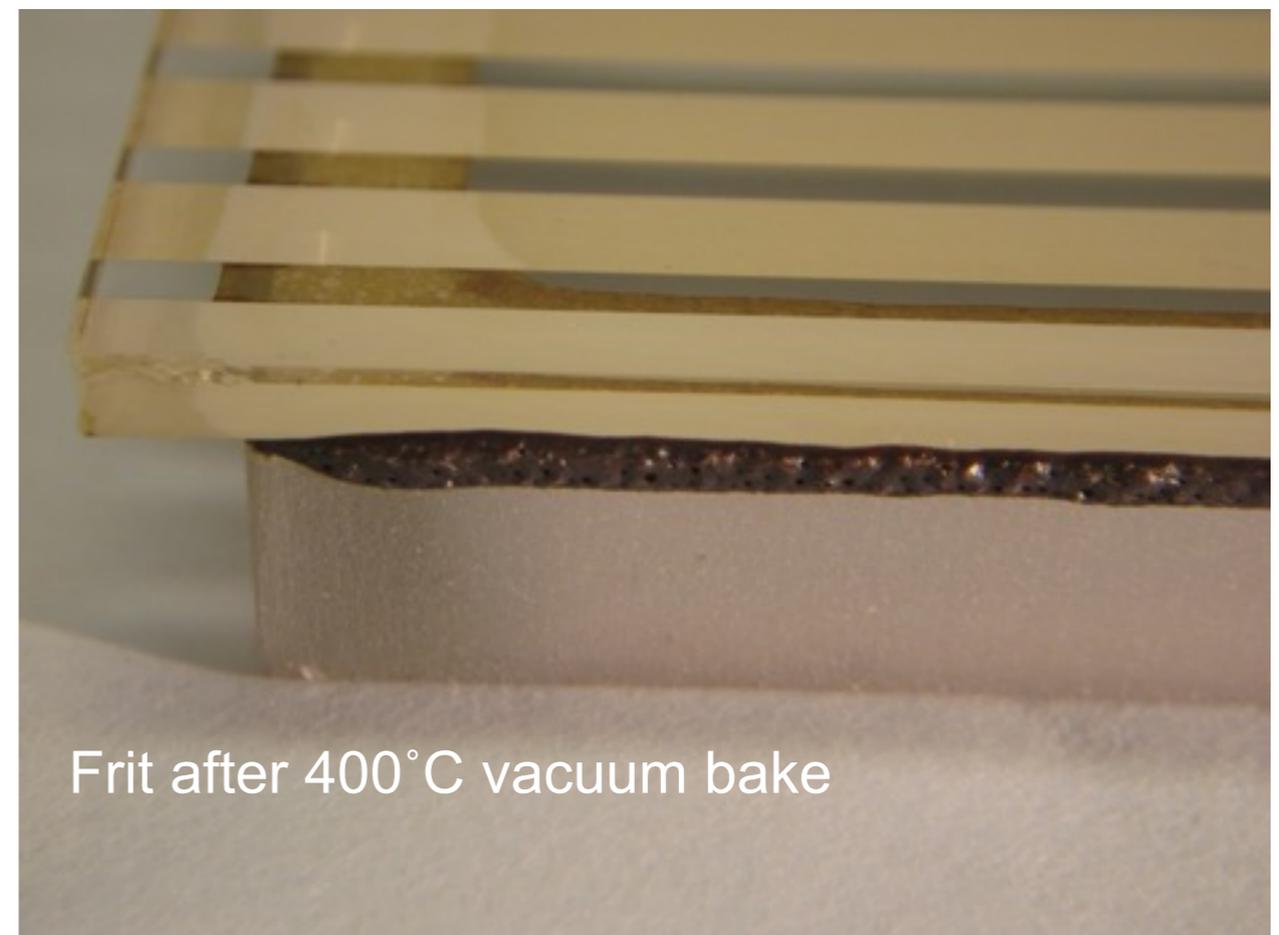
- ▶ Grid ribs trap residual gas and/or MCP outgassing
 - **Contingencies:** cut “channels” through grid ribs
 - **DONE** for bottom grid spacer. Still potential problem due to large impedance through MCPs
- ▶ Fragility of channels in grid ribs gives poor yield due to cracking
 - **Contingencies:** Don't know
 - **Has not been a problem with 3.9mm & 4.45mm thick bottom grid spacers**
- ▶ 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
 - **0.5mm grid spacers were big problem with near zero yield**
 - **Changed to two 2mm grid spacers; top and middle**
- ▶ Expense added to cut channels and metallize grid contact to photocathode
 - **Contingencies:** None. Shouldn't price it out of contention
 - **Channel cuts are negligible extra cost**
 - **Metallization of grid spacer top & bottom surface has been problematic and may be unnecessary**

Current Status of All-Glass Package(s)

- ▶ Has evolved to 3 designs
 - Original 8" all glass design as previously shown
 - Will be produced in 8" Single Tile Processing System
 - 3" all glass design for 6cm Single Tile Processing System (STPS)
 - scaled down version of 8" package with same anode stripline width & pitch
 - SSL modification of 8" package
 - milled rounded groove in sidewall for indium well
 - possible higher sidewall for large MCP to anode distance (greater electron cloud spread)
 - possible modified high voltage scheme to allow individual control of MCP HV
 - Would be produced in SSL Process Tank
- ▶ Need to provide design for MCP stack compression during pre-conditioning (scrubbing)
 - Initial scheme for 6cm STPS ([see Dean Walters talk](#))
 - Exploring possible alternatives compatible with SSL Process Tank ([next session](#))
- ▶ Recent progress on hermetic, stable indium seals at Argonne and UChicago
 - Subject of later talks ([Marc Kupfer & Andrey Elagin](#))

Current Status (cont.)

- ▶ Original frit for sidewall/anode seal appears not to survive 400 °C vacuum bake
 - Possible mitigations
 - Lower bake-out temperature.
 - 350 °C may be sufficient but need to study vacuum behavior of frit at this temp.
 - Alternative frits with higher softening temperature
 - 2 candidates on order from Schott
 - Need to re-qualify frit bonding process
 - Need to verify silver strip line signal properties are unchanged by higher temperature firing



Conclusions & Discussion Points

- ▶ All Glass Hermetic Package Design has been a success to date
 - Demountable has produced signals providing good time resolution
 - Hermeticity of frit seal demonstrated
 - Evacuated package survives atmospheric pressure load
 - Repeatable fabrication
- ▶ Challenges to Be Addressed
 - Vacuum bake survival of existing seal frit or alternatives
 - Possible high temperature changes to silver anode striplines
 - Stack compression mechanism during vacuum processing
 - Final top seal methodology
- ▶ How to best prioritize emphasis on alternative glass designs as well as ceramic package



BACKUP SLIDES

