Argonne MCP-PMT R&D Facilities

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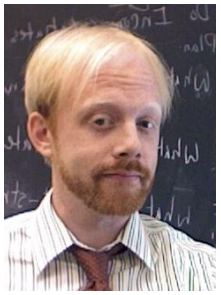
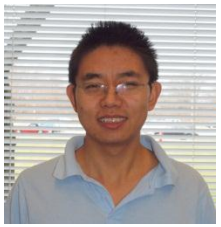
People at Argonne

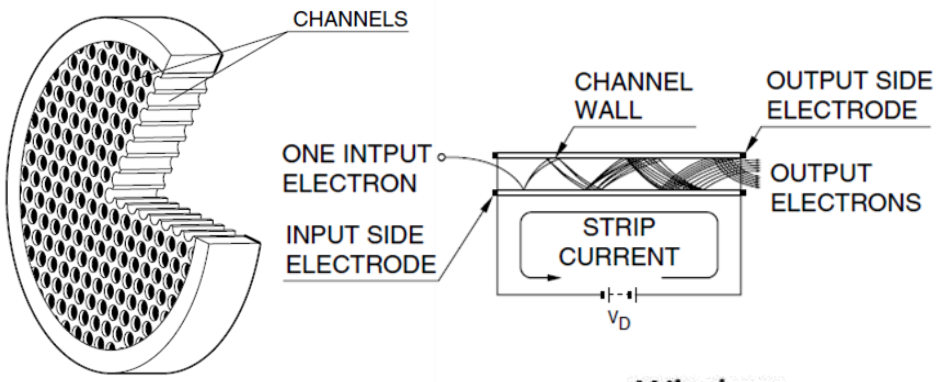
- Leading Scientists – ANL HEP
  - Marcel Demarteau
  - Karen Byrum
  - Robert Wagner
- MCP-PMT performance testing
  - Matthew Wetstein, U of Chicago
  - Bernhard Adams, ANL APS
- Photocathode development
  - Junqi Xie
- Glass blower
  - Joseph S. Gregar

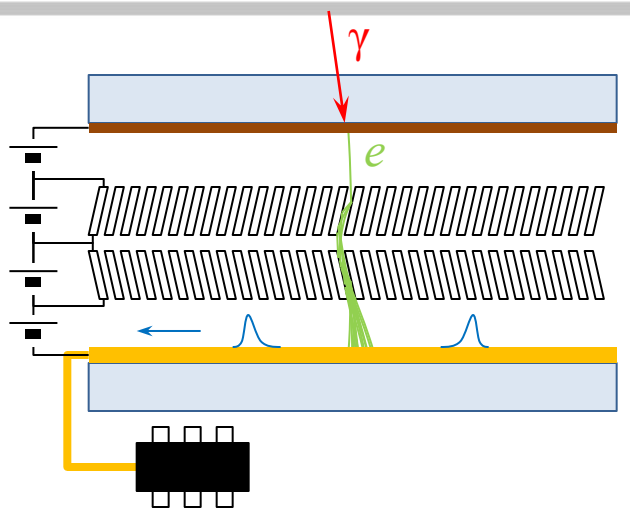


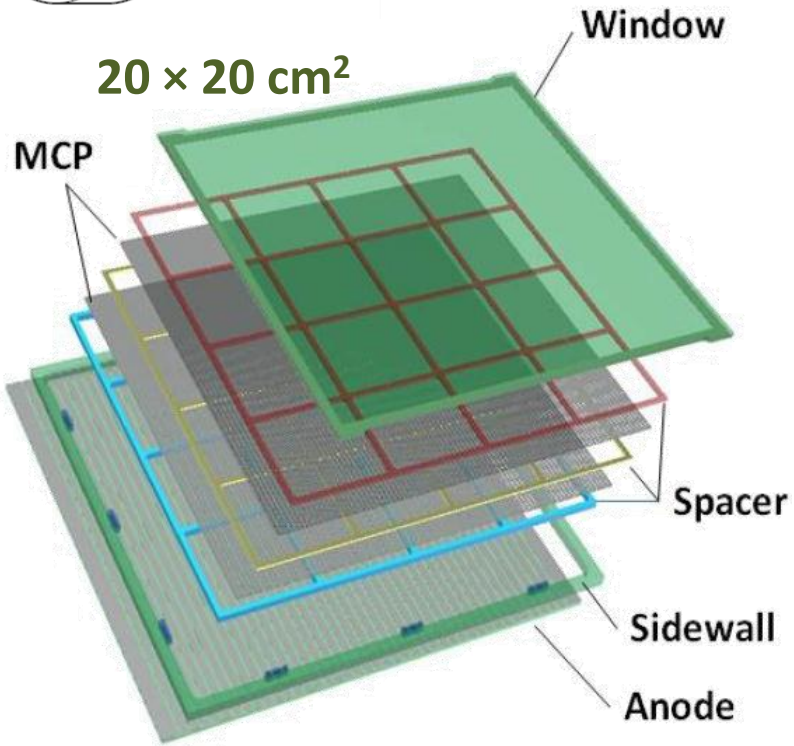





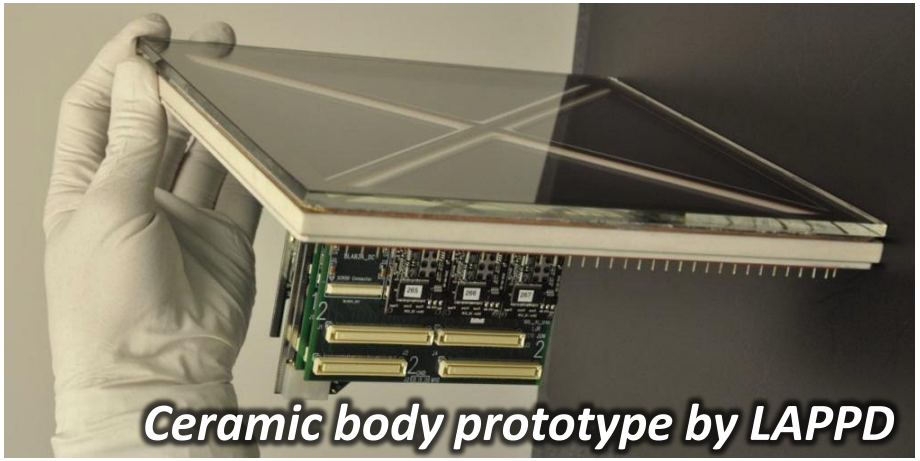

Micro-Channel Plate-PMTs



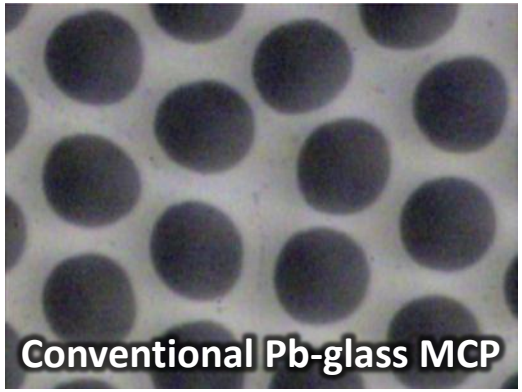




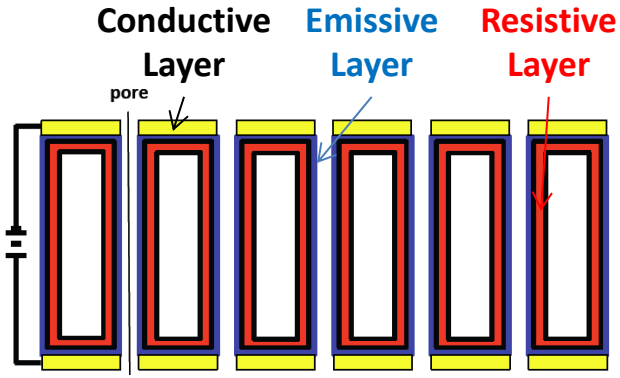
Compact size, good time resolution, expect good tolerance to magnetic field



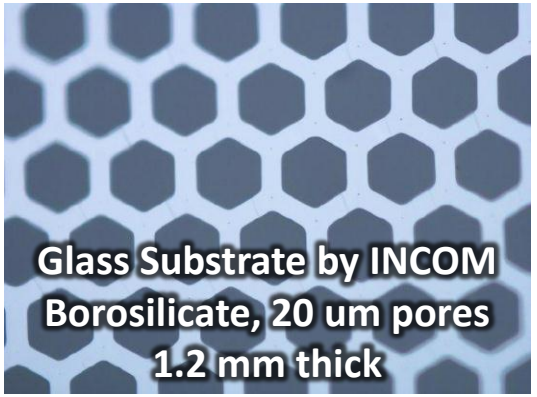
ALD Micro-Channel Plate by LAPPD



- **Conventional Pb-glass MCP**
  - Single material, three functions: pore, Pb-glass resistive layer, Pb-Oxide emissive layer
  - Higher cost
  - Space charge: rate limitation

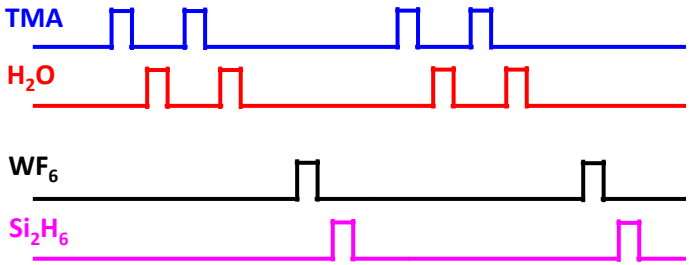


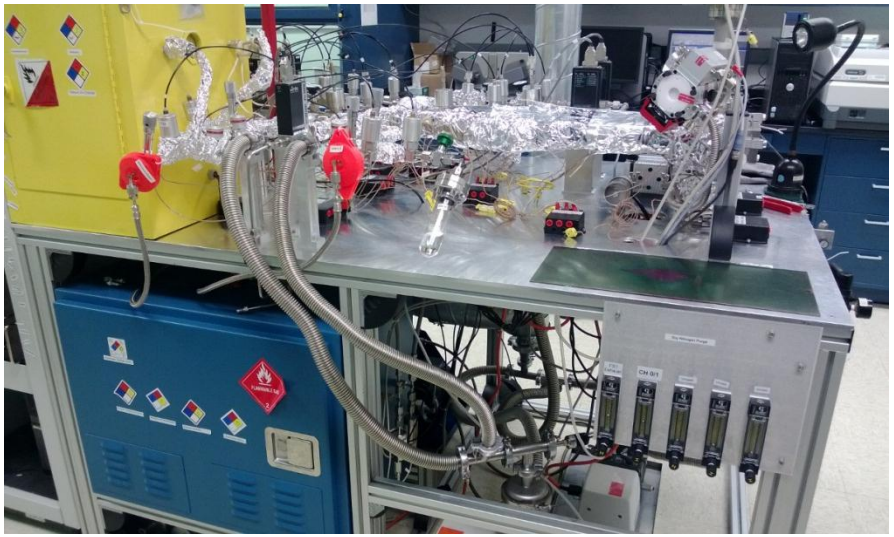
- MCP produced with ALD: Separate three functions, more freedom for optimization
  - Glass substrate with pores
  - Tuned resistive layer provides current for electric field
  - Specific emissive layer (Al_2O_3) provides secondary electron emission
- Good performance with lower cost
  - Gain > 10^7 for pair MCPs
  - Much longer lifetime >> 5 C/cm^2

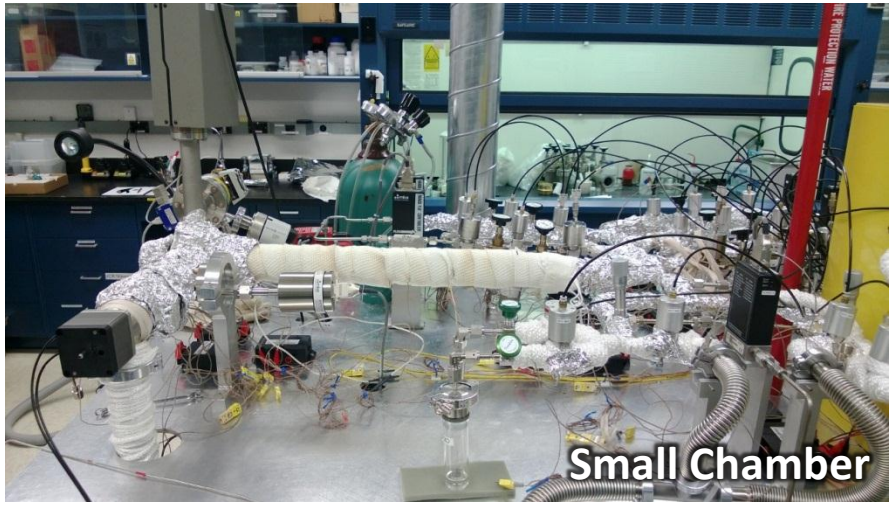


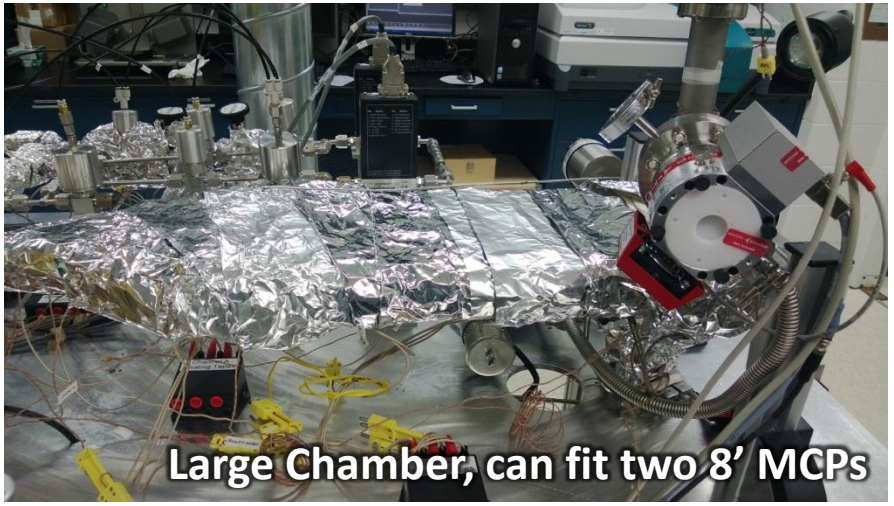
ALD Lab

- ALD of W-Al_2O_3 Composite Films
  - Combine 2 ALD processes:
    - TMA($(CH_3)_3Al$)/H_2O → Al_2O_3: insulator, ρ=10^{16} Ωcm
    - WF_6/Si_2H_6 → W: conductor, ρ=10^{-4} Ωcm
  - Tune resistivity with W/(W+Al_2O_3) cycle ratio

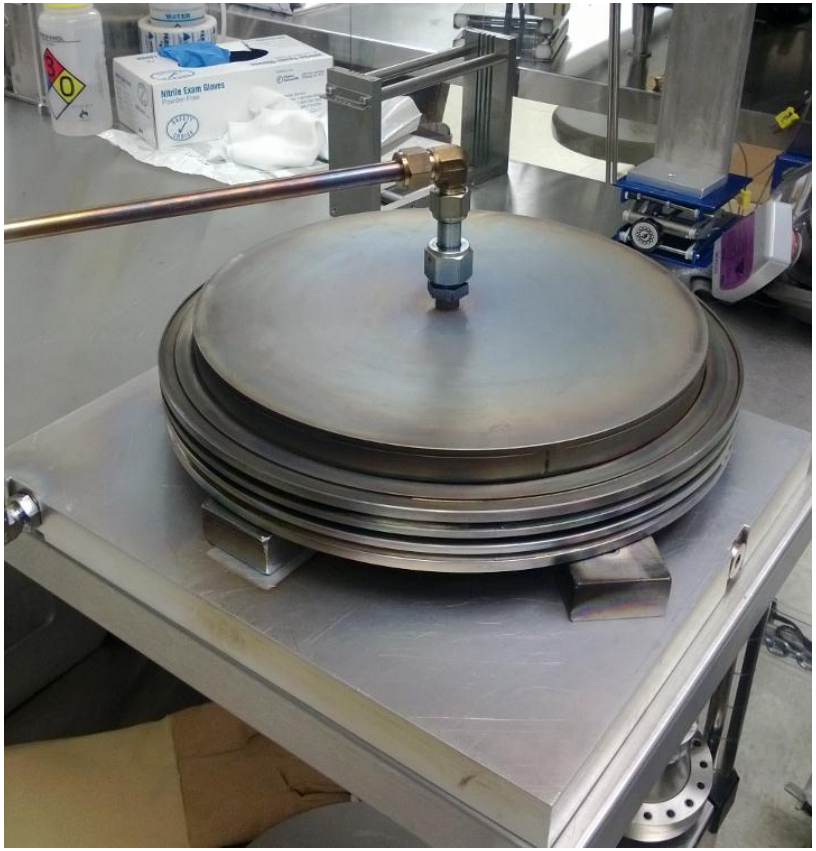




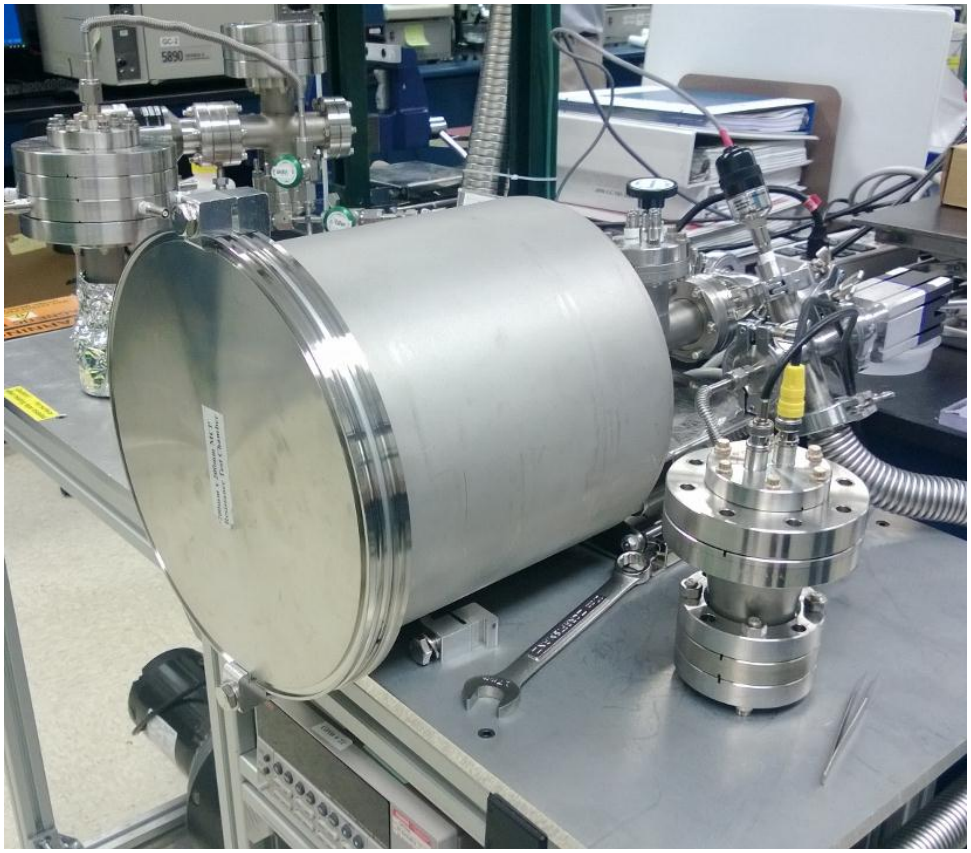




Cleaning and Resistance Measurement



MCP Cleaning Station



Resistance Measurement

Photo Cathode Lab

Photocathode Deposition Station from Photonis (Burle)

Home-made chamber for 8” photocathodes

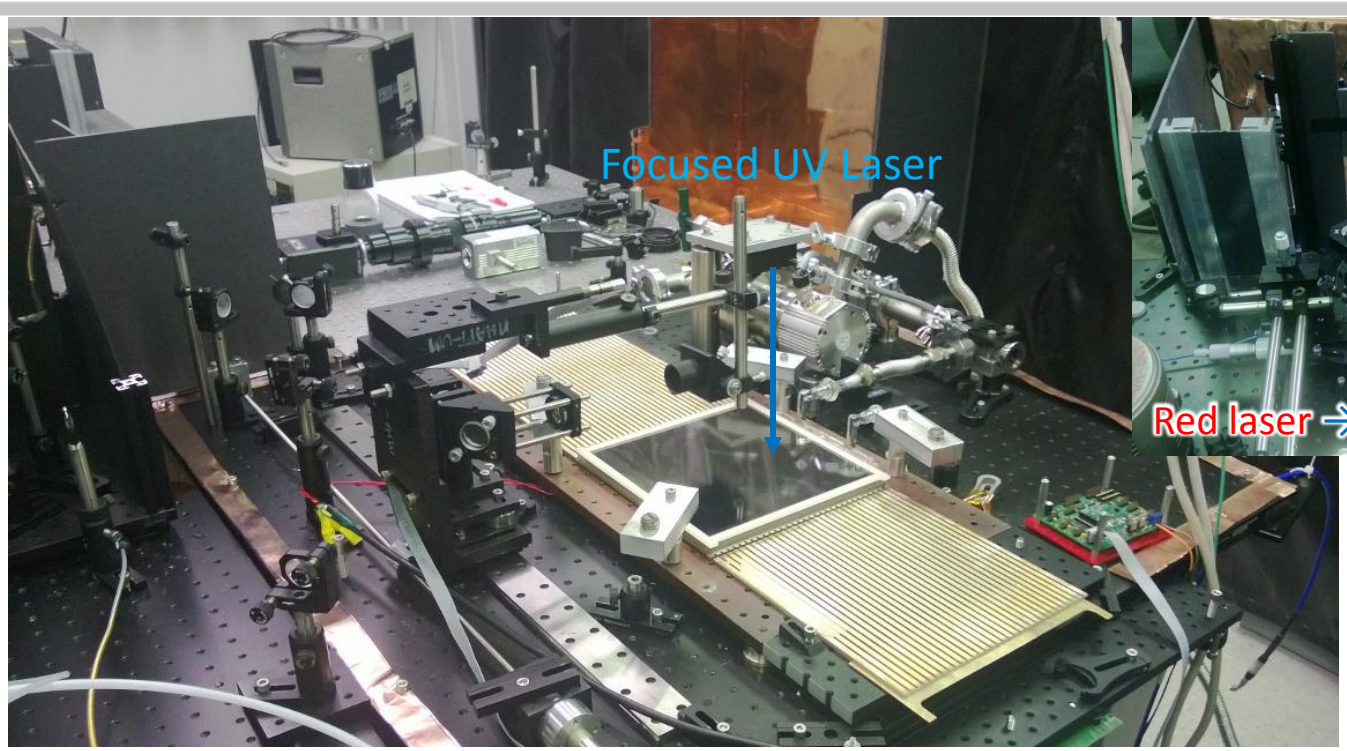
K_2CsSb
Q.E. (Photonis) ~ 15%
Q.E. (Small) > 25%
Thickness optimized for 400 nm

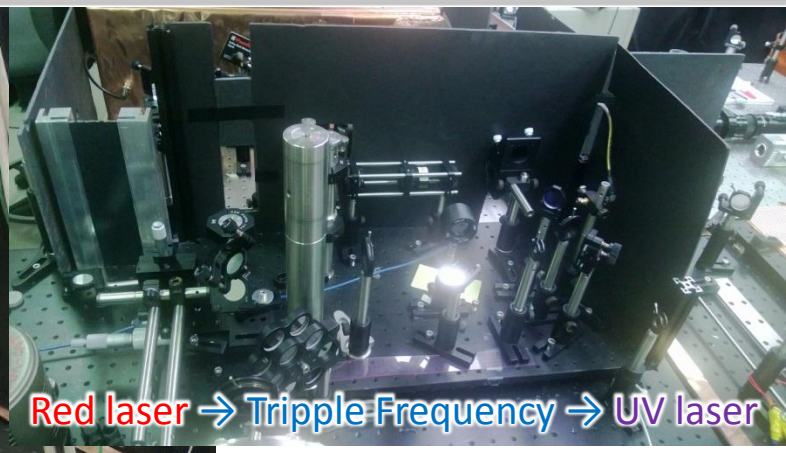
Small Deposition Station (Cleaner)

QE Measurement

- Calibrated light sources with different wavelengths
- Automatic setup for 2-D scan

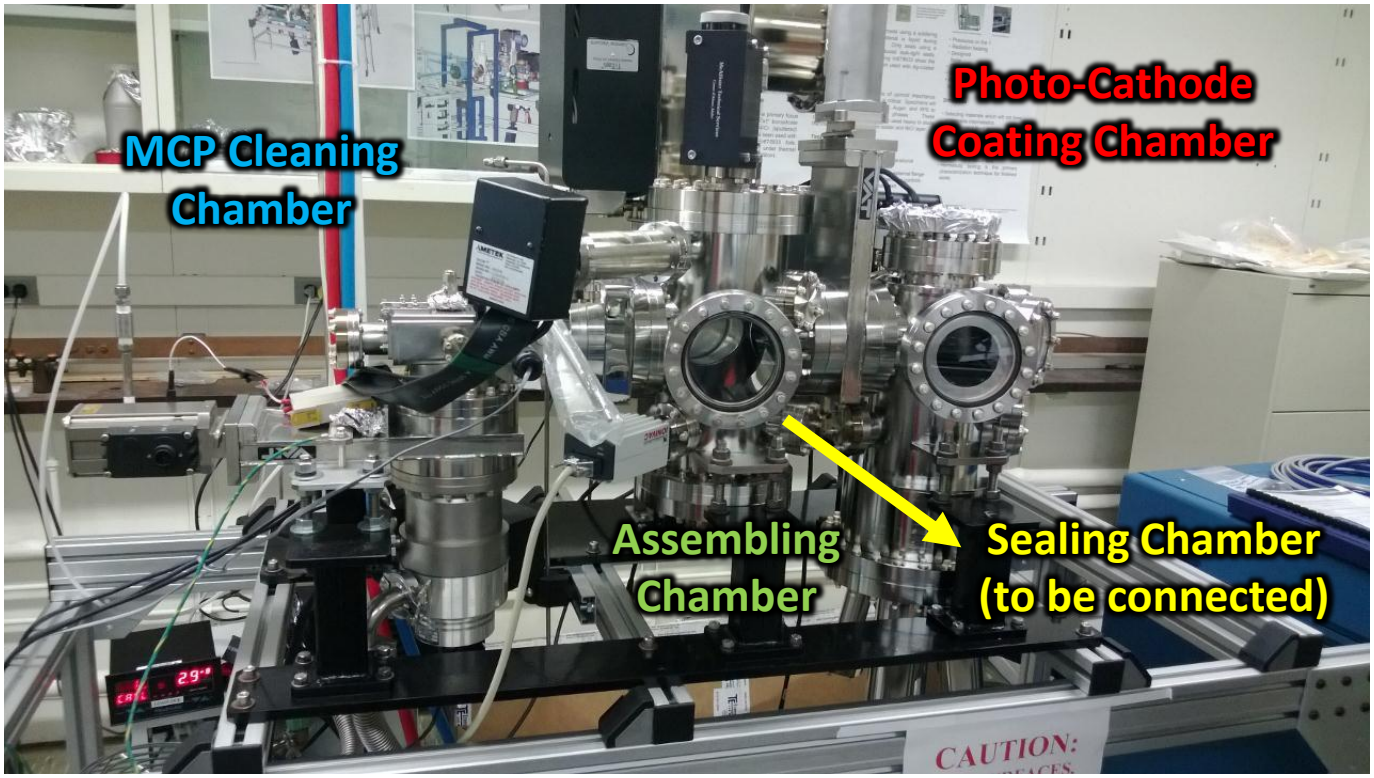
MCP-PMT Testing Lab





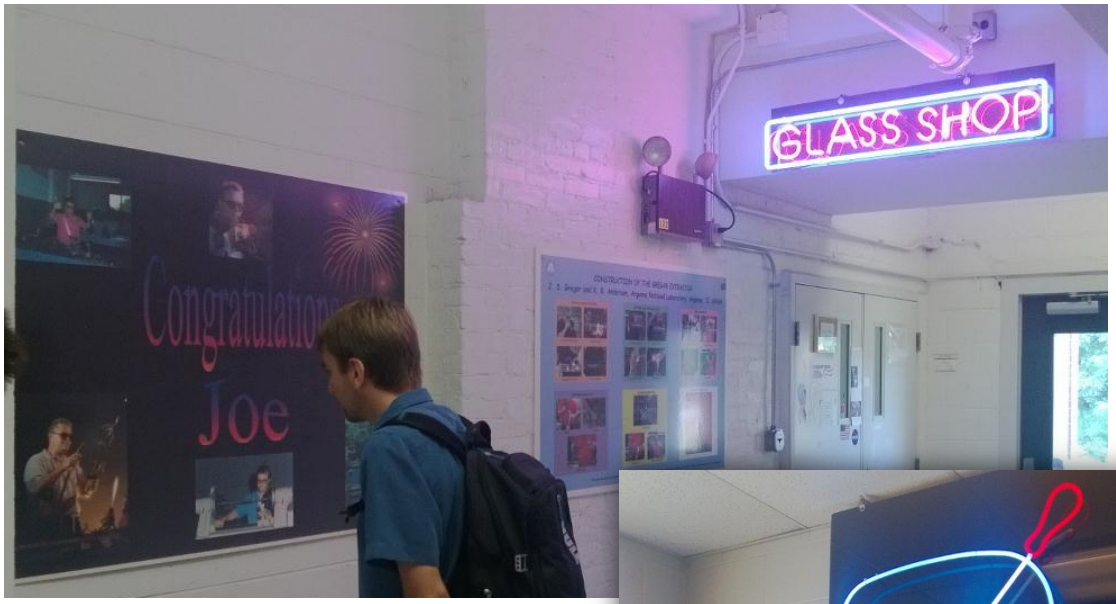
- Focused femtosecond UV laser, spot < 1mm
- Aluminum photo-cathode, press sealing with vacuum pump
- Differential time resolution: 17 ps/p.e.
- Absolute time resolution: 50 ps/p.e.
- Strips of MCP-PMTs can be chained to reduce readout channels

MCP-PMT Assembling Chamber



- Small vacuum chamber ready in a month to assemble 6×6 cm^2 glass MCP-PMTs
- Large vacuum chamber planned (needs more DOE funding)

Glass Shop

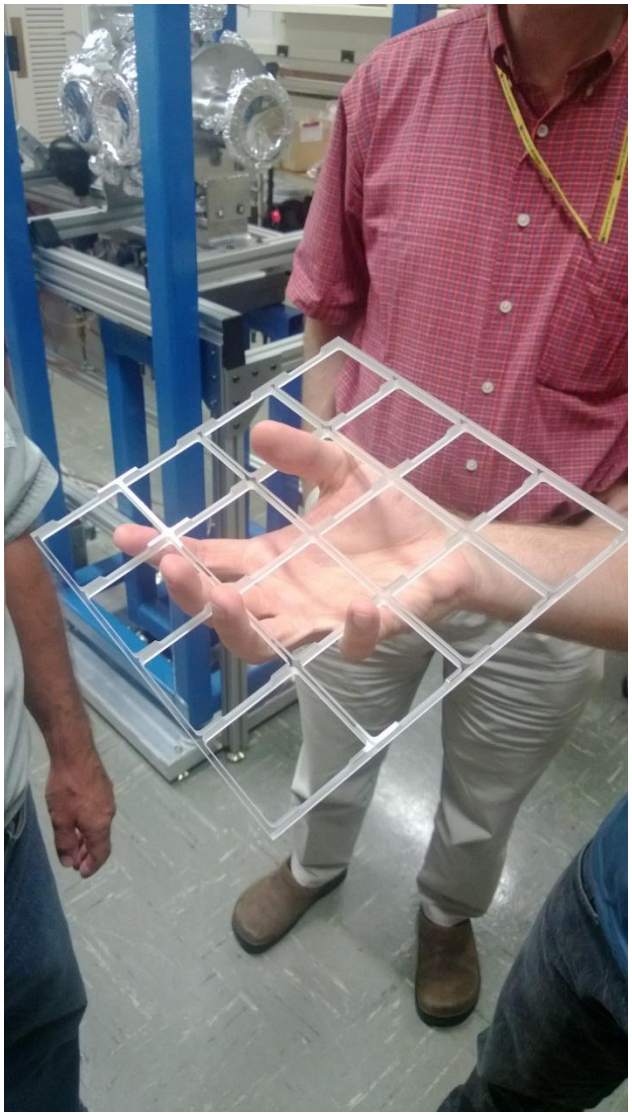


Joseph S. Gregar

one of very few scientific glass blowers

Some Components for 8” Detector

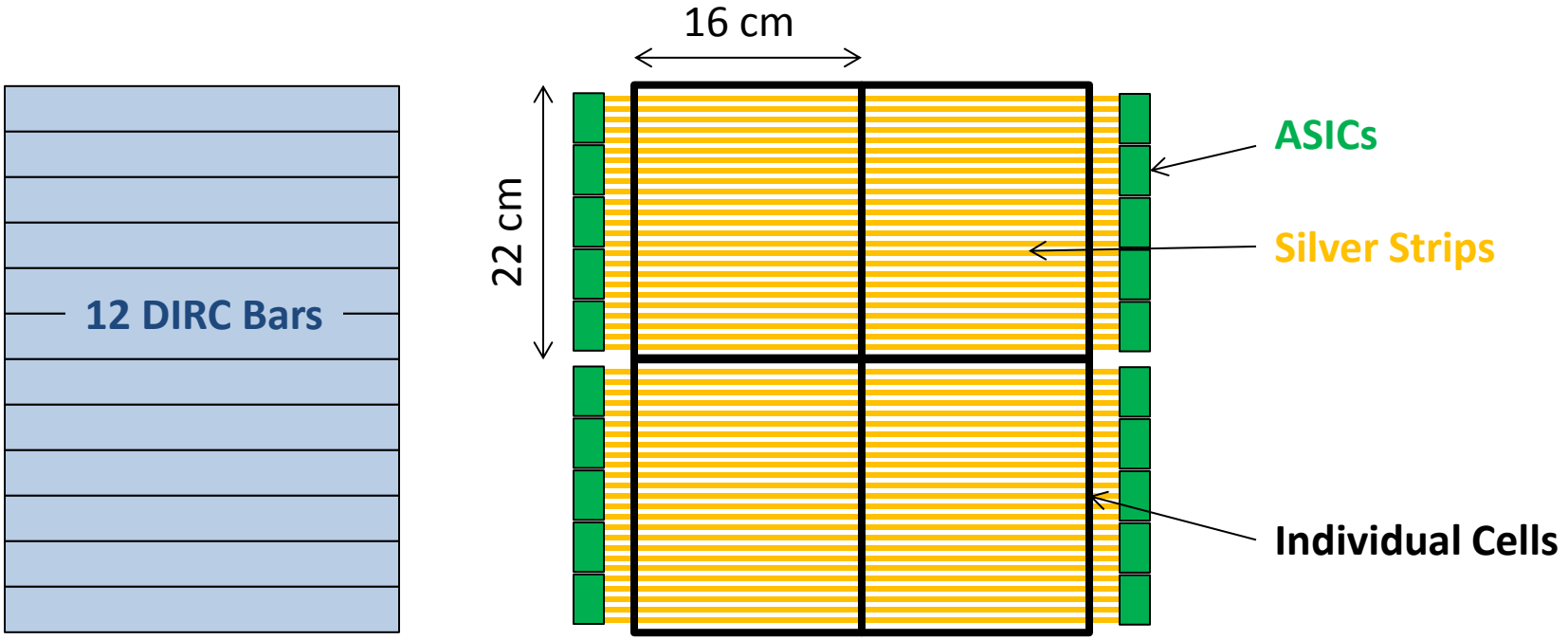
8” readout pad with frame



8” glass spacer

Integration to GlueX DIRC

- GlueX-DIRC requires 4 readout assemblies, 43×32 cm^2 coverage each, Argonne can easily modify the size of MCP-PMTs to fit GlueX geometry



- Material cost: $3,500×16(MCP-PMTs)+$1,500×8(Readout) = $68,000

Timeline

- All individual components ready
- DOE deadline for a working sample: end of 2013 calendar year
- Previous sealing attempt of a 8” ceramic chamber at UC Berkeley's Space Science Lab failed
- Will conduct another attempt at Argonne to seal a small (6×6 cm^2) chamber (no-photocathode coated) in September
- First working small MCP-PMT sealed in October
- Produce small samples every 1-2 weeks
- GlueX will receive earliest samples