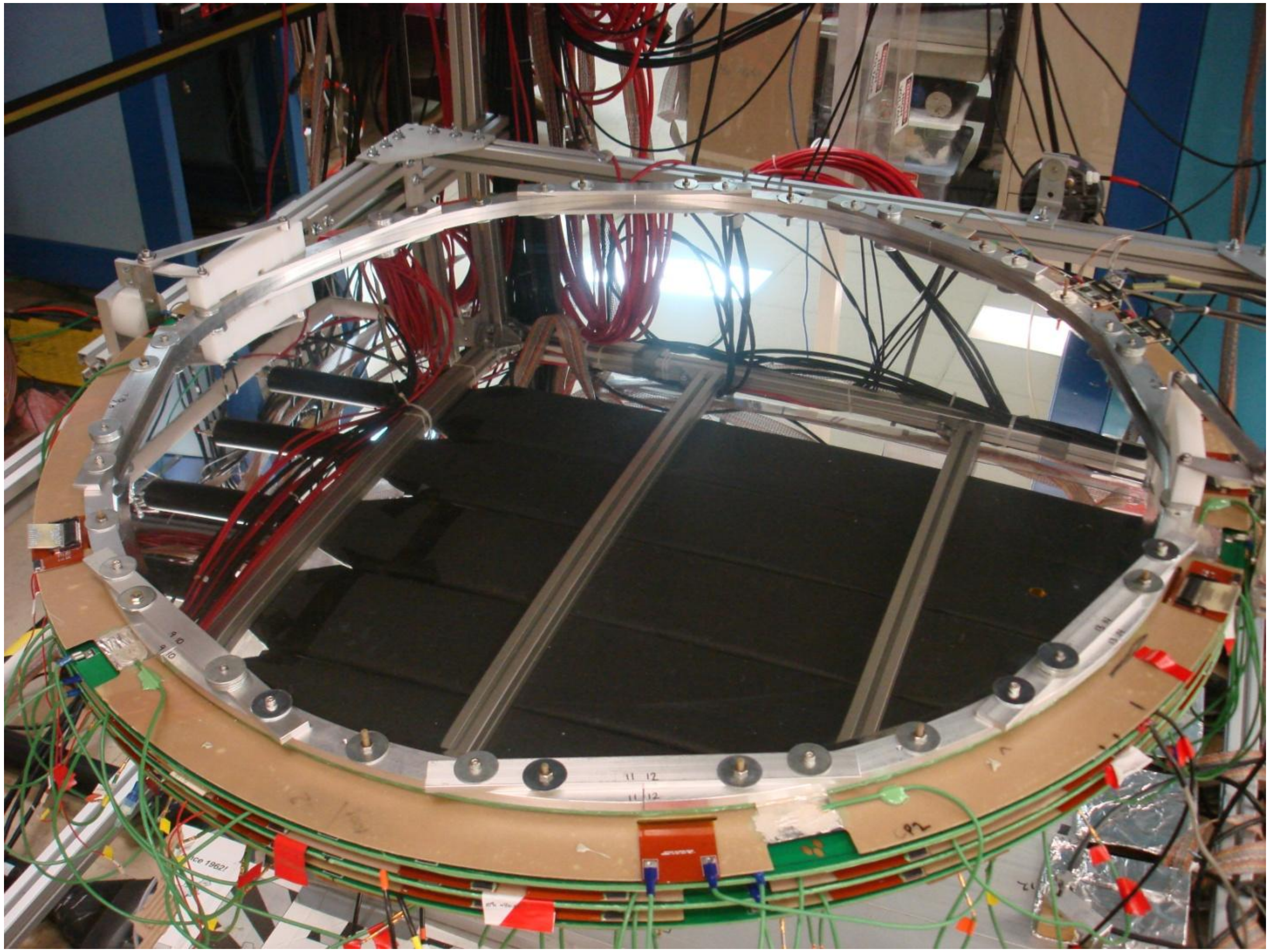
FDC update



May 2010 GlueX Collaboration Meeting

L.Pentchev for the FDC group

Outline

- Lessons learned so far from the full-scale prototype: HV problems, gas leakage, wire winding problems, electronic noise
- Design Modifications: frame, PCB, cathodes, beam hole size
- Production planning: wire stringing, off-site production area

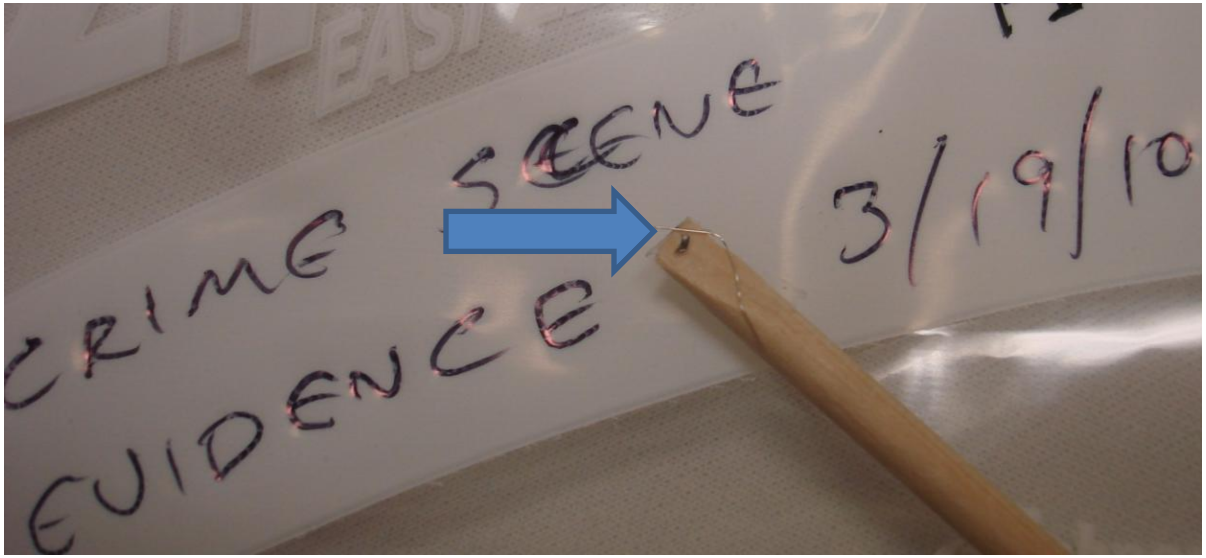
Lessons learned: HV problems

- Limited number of HV sectors could be used in the tests with the two-layer configuration with ^{90}Sr source: high currents, often trips (changing the polarity of sense and field wires helped in some of the cases)

- We opened the chamber and investigated the HV problems for each layer:

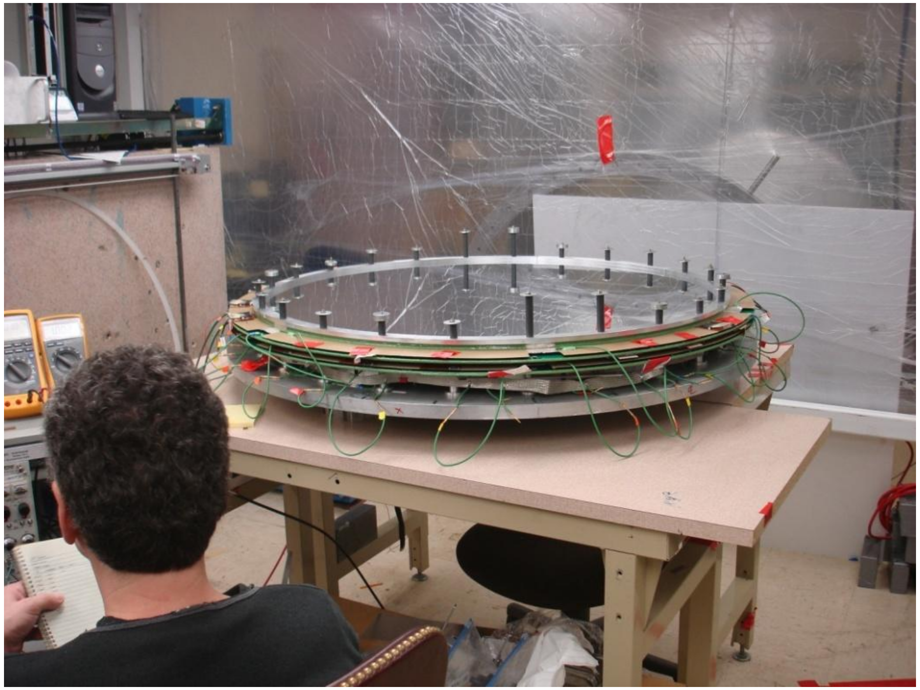
  - found on the cathodes and wires a lot of dust, fur, even wire pieces

  - observed corona discharge on the wires and mostly on the PCBs (wire soldering pads)



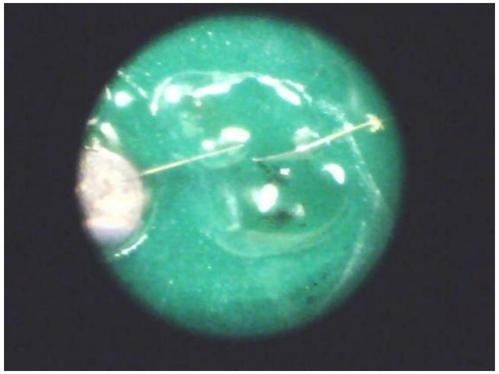
Lessons learned: HV problems

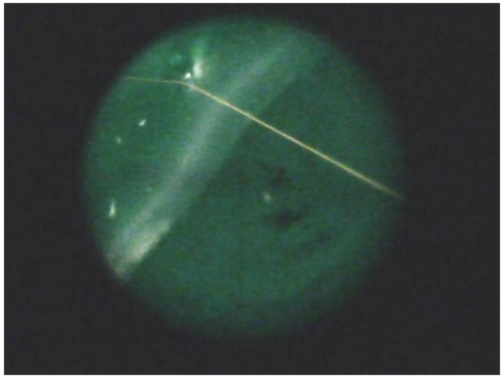
- all wires cleaned with alcohol, tried to remove as much as possible fur, dust, etc. from the cathodes (difficult to work between the wires!)
- cleaning the wire boards with alcohol, especially at the places showing corona discharged helps: the discharge disappeared
- HV tests in situ (Beni) layer by layer and both:
  - with chambers opened so that one can easily fix the problems
  - chambers closed and filled with gas

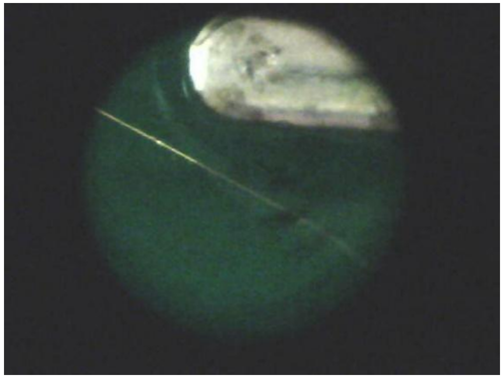


Lessons learned: wire winding problems

- typical wire winding problems found on third layer:
    - wires not properly trimmed; tip of the wire creates high potentials and HV problems
    - wires not touching soldering pads: resulting in most of the connectivity problems
    - boards not clean, solder traces under epoxy; source HV problems, corona discharge
- third wire frame refurbished: Casey made 55 fixes, 5 wires not reparable (without replacing the whole wire)

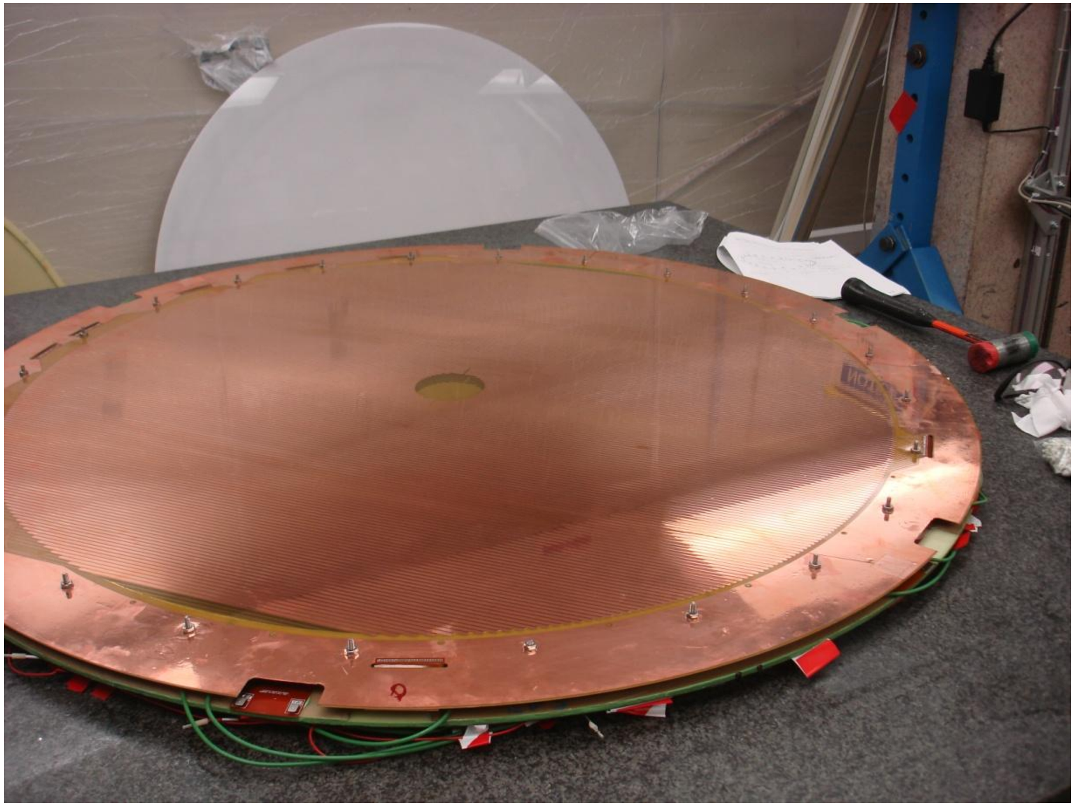






Lessons learned: gas leakage

- In addition to the gas leakage problems identified before (frame deformations, leakage through rohacell, PCB vias):
    - Leakage through the ground plane (confirmed for layers 2 and 3)
- Third prototype layer re-sealed (Mark and Casey) and tested for leakage



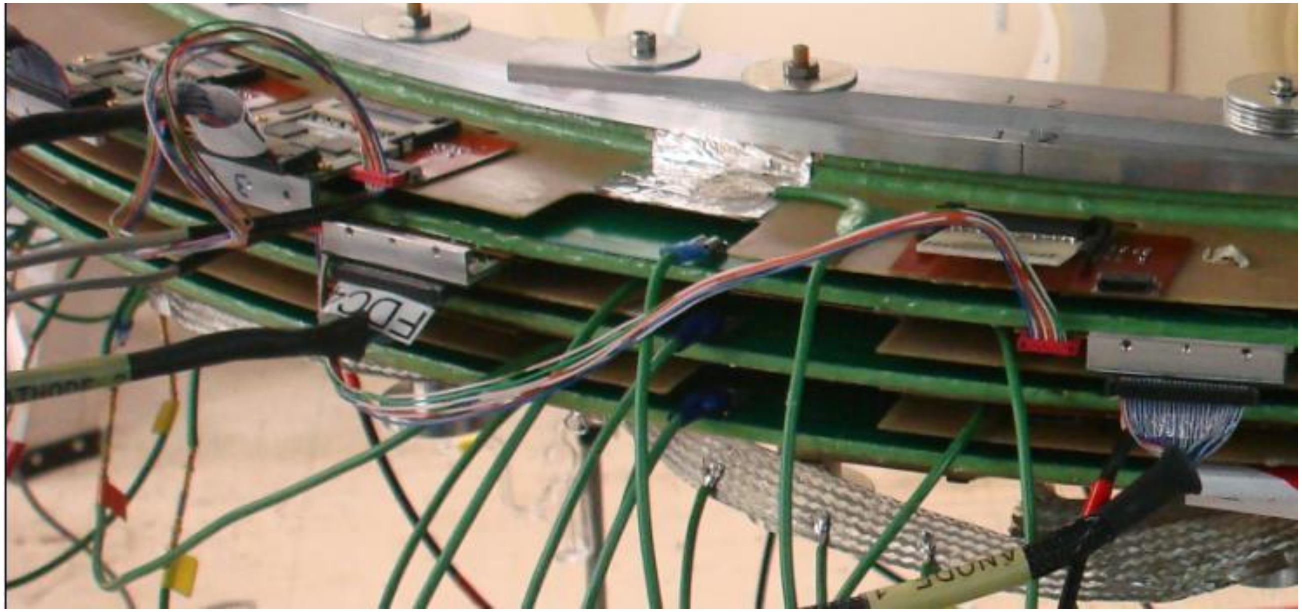
Lessons learned: gas leakage

For the first time all three layers of the full-scale prototype were assembled together and bubbling (at 210 cc/min)

Because of the leakage between layers, the trick is to adjust (using bubblers) the pressure in the three gas volumes to be similar

- O-ring is not a source of leakage
- main leakage paths through rohacell
- the reason for the leakage through the ground plane not yet fully understood

Lessons learned: electronic noise



• for the cosmic tests of three-layer configuration: 5 new boards (4 for cathodes one for anode) with cables and splitter board

• the new cathode boards oscillate at ~50 MHz when connected to the chamber (the old cathode board had ~8% lower gain)

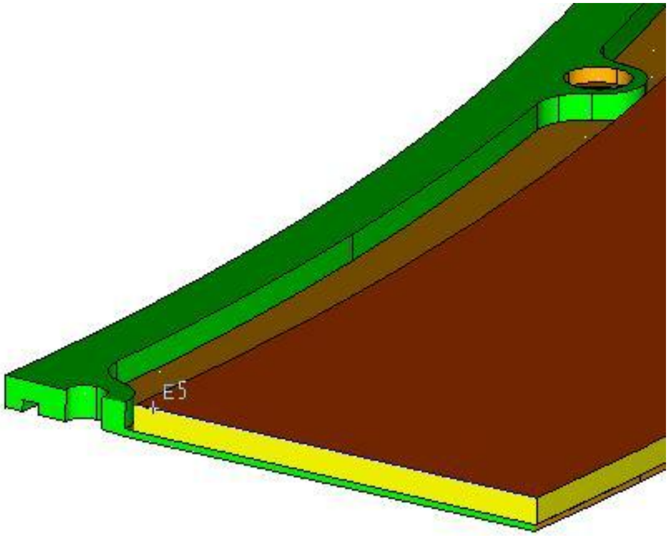
• the only solution found so far was to reduce the gain from 3.2 to 2.6 mV/fC

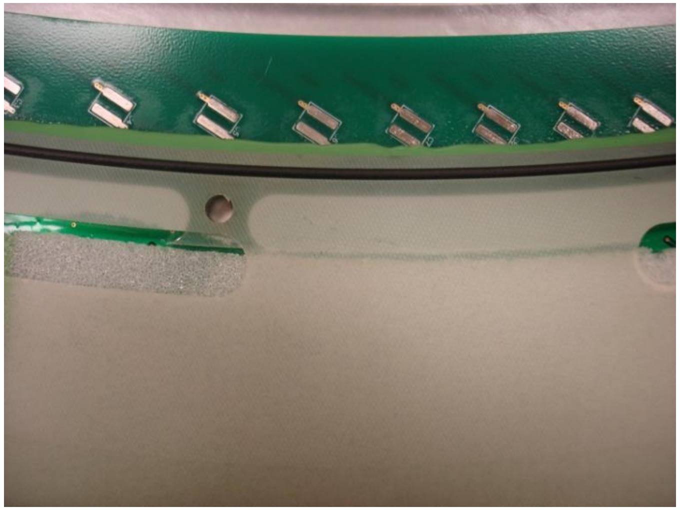
• with 6 layers we may need further gain reduction: will require some modifications of the pre-amps

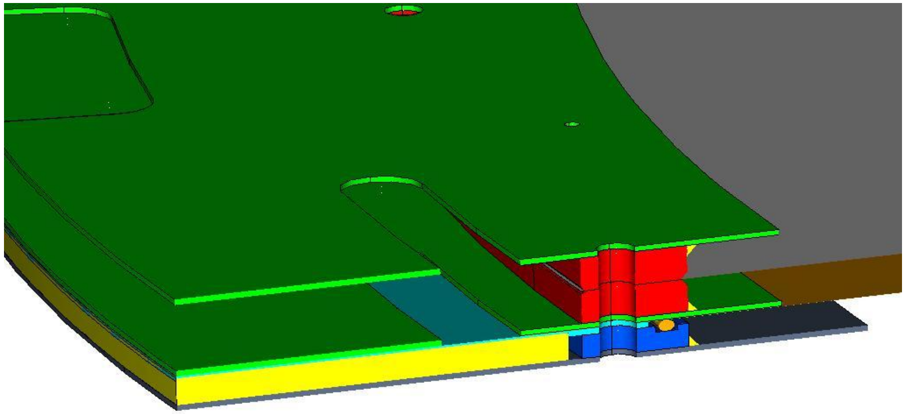
• need to improve the grounding

Design modifications: frame redesign

- to prevent flexing and leakage the wire frame is made out of one solid g10 piece
- cathode sandwich with g10 ring and no rohacell
- “cathode – ground – cathode” sandwich can be separated in two pieces “cathode – ground” and “cathode with O-ring” so that the ground plane can be repaired/ replaced: make sure short ground connections are still there!

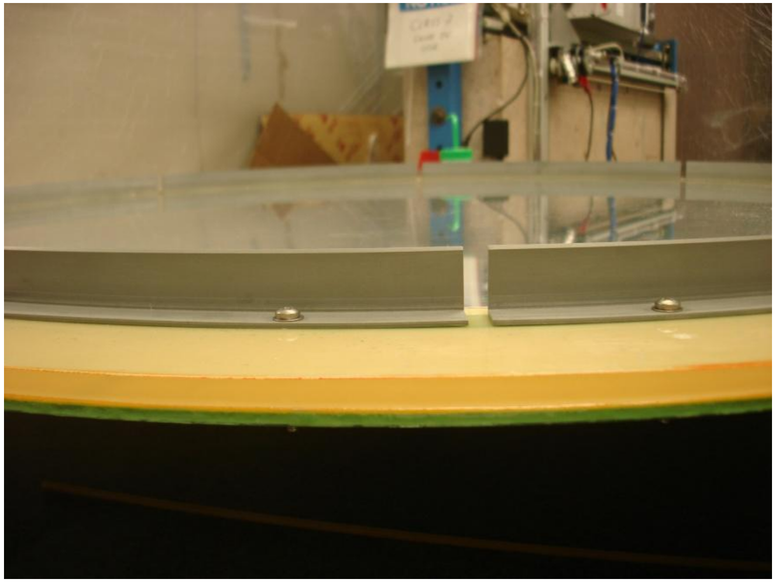


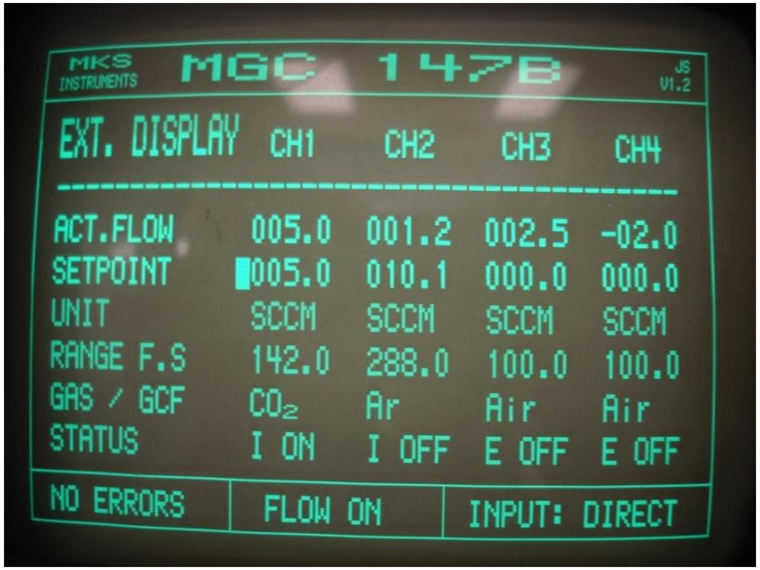


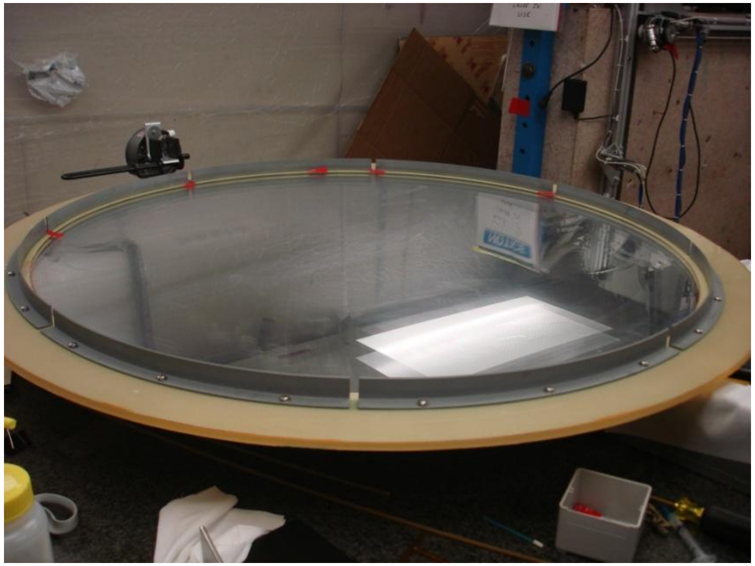


Design modifications: frame redesign

- mechanical prototype of the modified frame was produced
- tests showed extremely good gas tightening: bubbling at 5cc/min

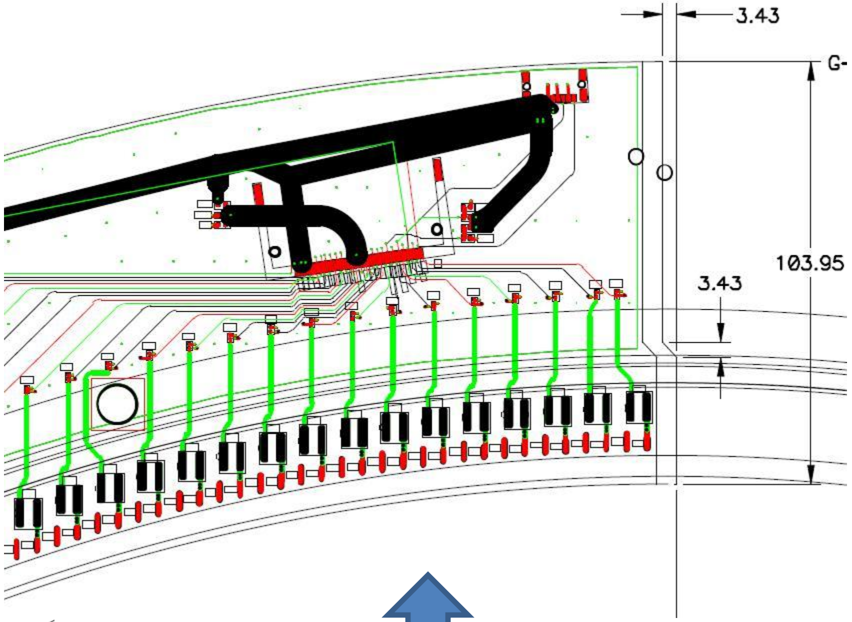




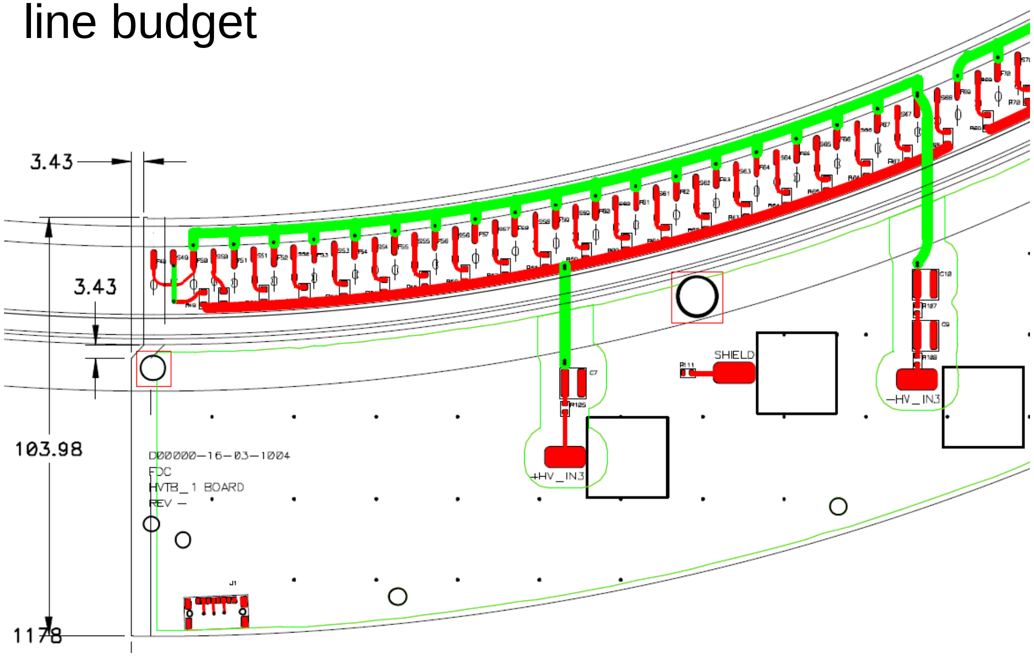


Design modifications: PCB redesign

- modifications to resolve HV issues and gas leakage:
  - no traces crossing the O-ring
  - 5mm minimal distance between traces/elements at different HV
  - all vias filled
- Kim finalized PCB design; info sent to vendors: estimates are lower than base-line budget



Readout board

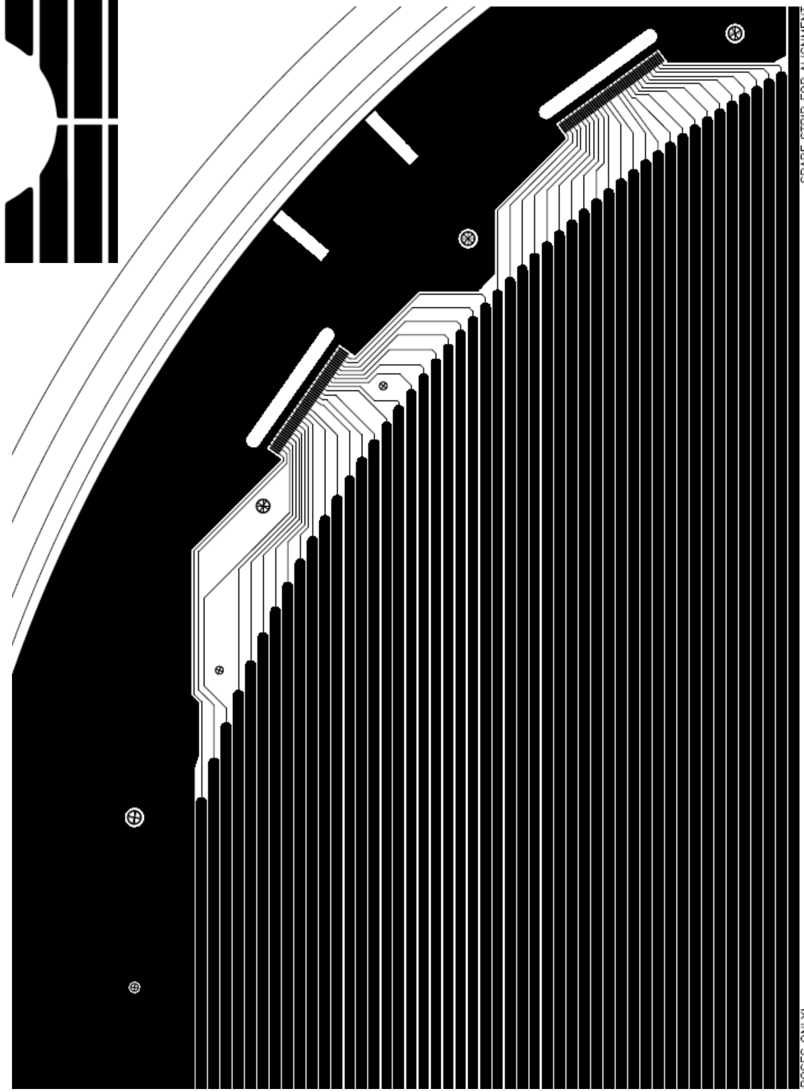


HV board

Design modifications: cathode redesign

- Roger is close to the final design
- Same beam hole size (1.3 cm radius) on all packages

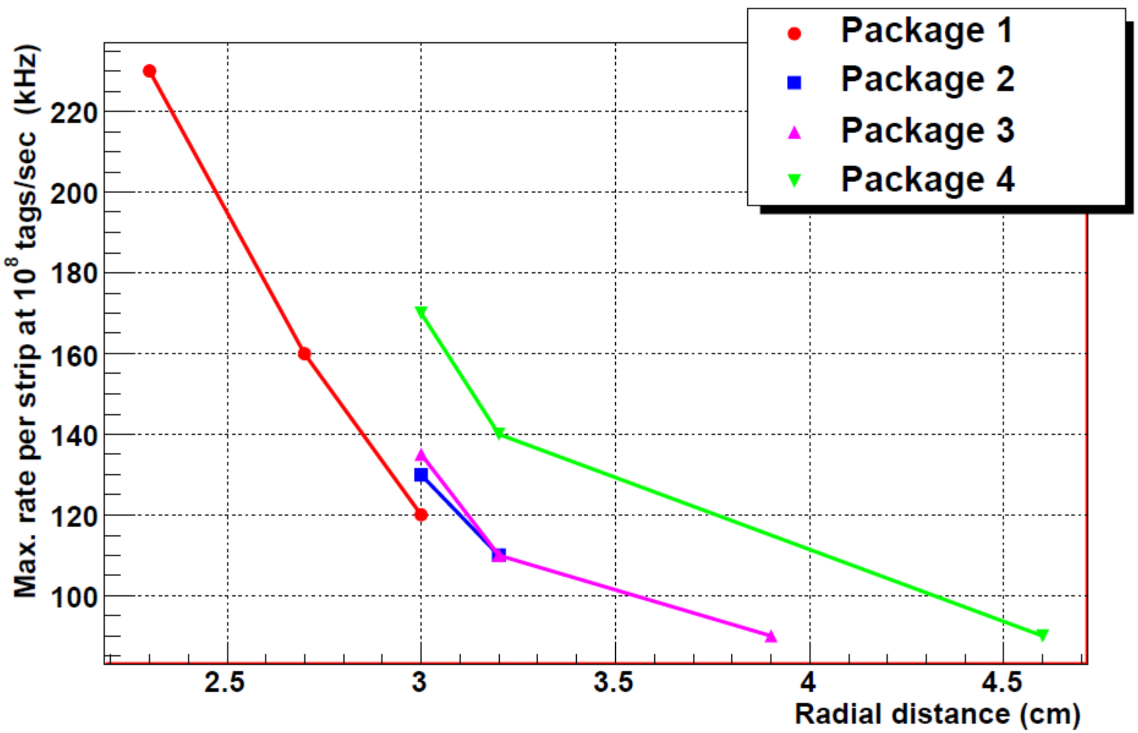
- Alex simulated the effect of the beam hole size (down to 1.3 cm radius) on detector rates: no effect
- strip material (2μ Cu) is ~20% of total target thickness in rad. lengths
- cathode modifications to reflect the frame redesign, reduce the areas not covered with Cu layer



- soldering to 2μ Cu is challenging and requires training and failure rate studies (dummy connector pads on the unused sides of the foil)

Design modifications: insensitive beam hole size

- Defined by the size of the wire deadening area
- We can make final decision later
- Alex simulated the rates on the strips as function of hole radius:

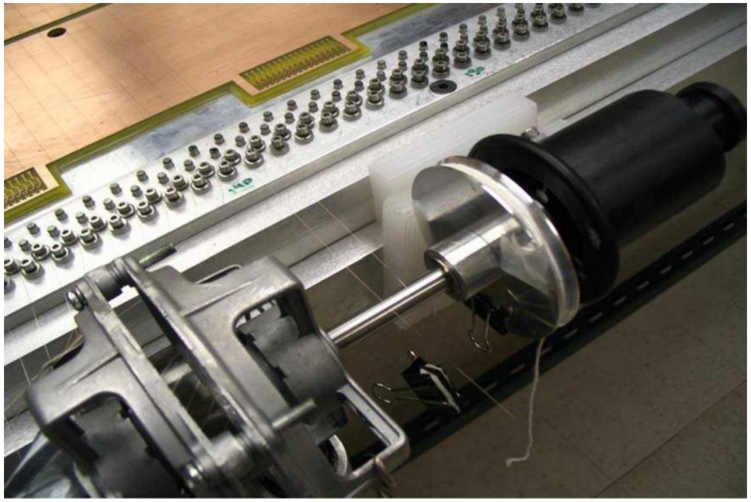


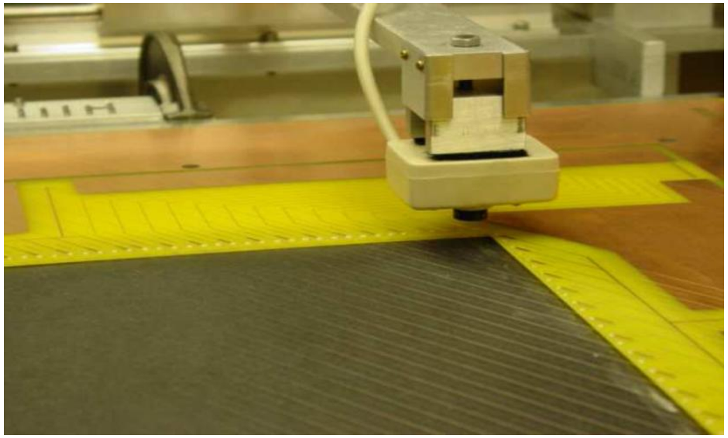
Production planning: wire winding

- Three options were considered:
  - Wire winding at IUCF
  - Wire stringing at JLab using UVA equipment and expertise
  - At JLab refurbishing old SSC winder (the intention was to create common JLab wire winding facility)
- Several criteria taken into account:
  - proven ability to produce operational wire chambers
  - cleanliness of the production space
  - efforts needed to modify the equipment for the FDC wire winding
- Despite of the significant progress made with IUCF and advanced stage of negotiations (preliminary version of phase 3 contract), the facility there doesn’t meet the above criteria
- No other projects (except Detector group) are interested in Jlab winding facility; modifications of the SSC winder not estimated
- The plan is to re-use UVA equipment

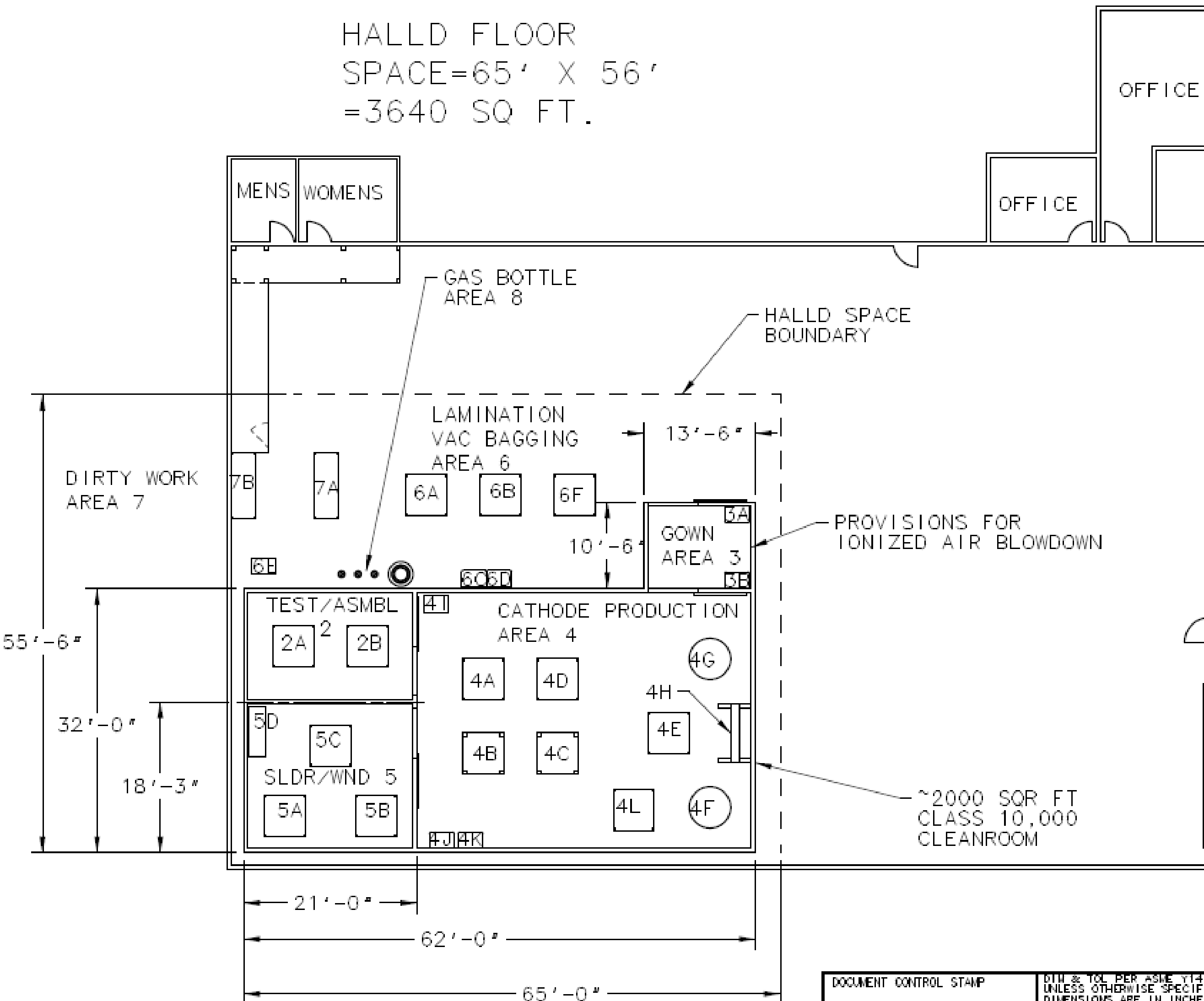
Production planning: wire stringing with UVA equipment

- Procedure:
  - Wire stringing/tensioning using precise pin rails (5mm pitch), wire fixed with epoxy
  - Position measurements using camera and possibly correction the wire positions
  - Wire soldering and cleaning
  - Tension measurements
- We can re-use the pin rails and position measurement system (UVA agreed)
- Some mechanical work (table/ strong-back) has to be done; tension mesuring system to be developed
- UVA intent to join the GlueX collaboration and help with summer students





Production planning: off-site space in 727 B.C.



TEST/STACK ASSY AREA 2
2A-FORMICA TABLE
2B-FORMICA TABLE

GOWN AREA 3
3A-STORAGE CABINET
3B-STORAGE CABINET

CATHODE PRODUCTION AREA 4
4A-FORMICA-INSPECT/TEST
4B-GRANITE-CUT FOILS
4C-GRANITE-GLUE FOILS
4D-FORMICA-GLUE TRANSFER RING
4E-FORMICA-CUT HOLES,ETC
4F-TENSION AND GLUE
4G-TENSION AND GLUE
4H-FLATNESS SCAN
4I-GAS PANEL RACK
4J-STORAGE CABINET
4K-STORAGE CABINET

5A-FORMICA- LAZY SUSAN
5B-FORMICA- LAZY SUSAN
5C-GRANITE-WIRE WIND
5D-FLUX CLEANING

LAMINATION AREA 6
6A-FORMICA
6B-FORMICA
6C-STORAGE CABINET
6D-STORAGE CABINET
6E-HV RACK
6F-FORMICA

DIRTY WORK AREA 7
7A-WORKBENCH
7B-BANDSAW,DRILLPRESS,SANDER

GAS BOTTLE AREA 8

DOCUMENT CONTROL STAMP	DIM & TOL PER ASME Y14.5 - UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMAL ANGLES	TRACKING NO. N/A	United States Department of Energy — Jefferson Lab, Thomas Jefferson National Accelerator Facility

Summary

- The recent progress in FDC development is result of the contributions of many people: Fernando Barbosa, Bill Crahen, Beni Zihlmann, Kim Shinault, Roger Flood, Brian Kross, Mark Stevens, Casey Heck, Simon Taylor

- Special thanks to Dan Carman who led the project many years