

FORWARD DRIFT CHAMBER PROGRESS REPORT

Outline:

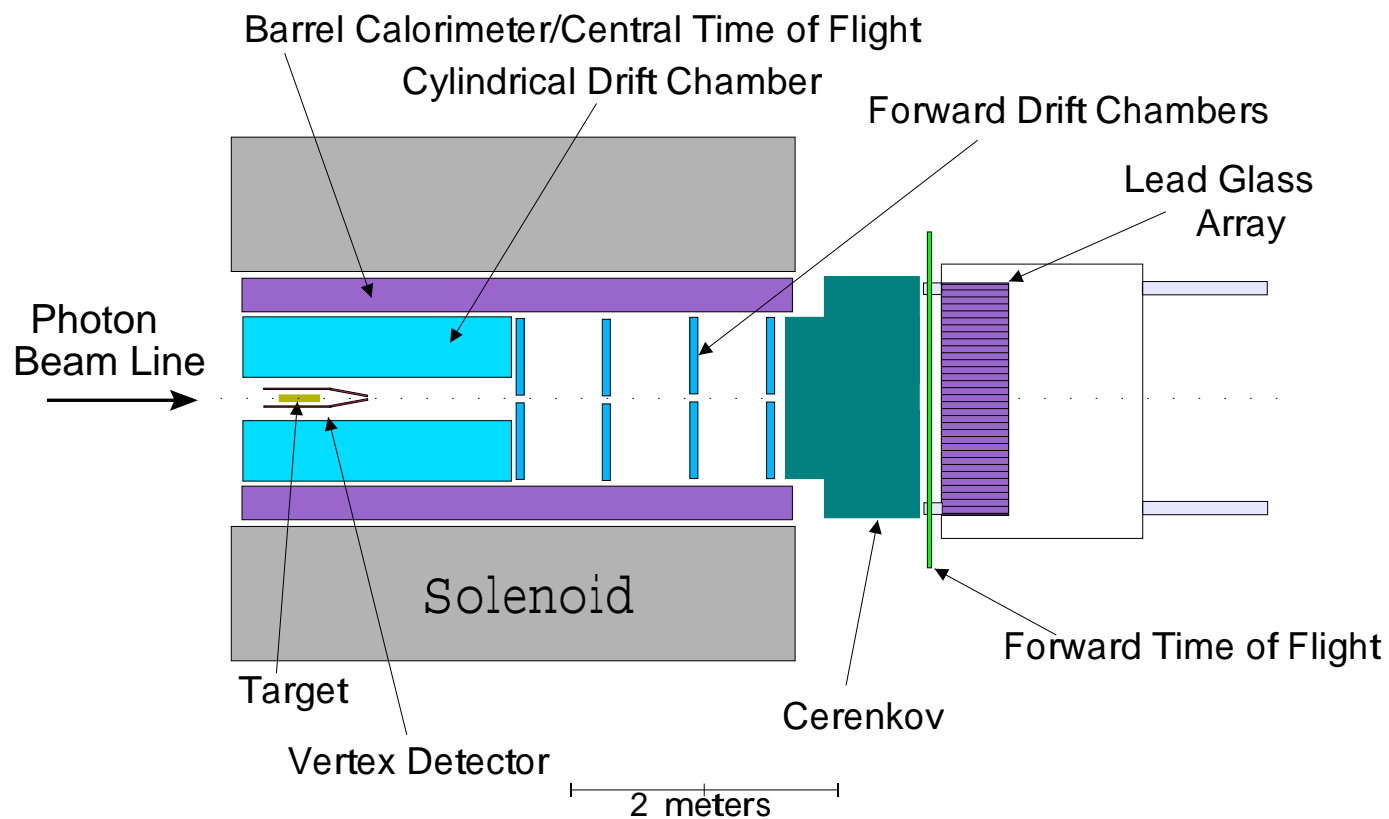
- Subsystem overview
- Design questions
- Status
- Ongoing studies
- Upcoming work
- Summary

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Ohio University

GLUE *X* CITATIONS
PERIMENT

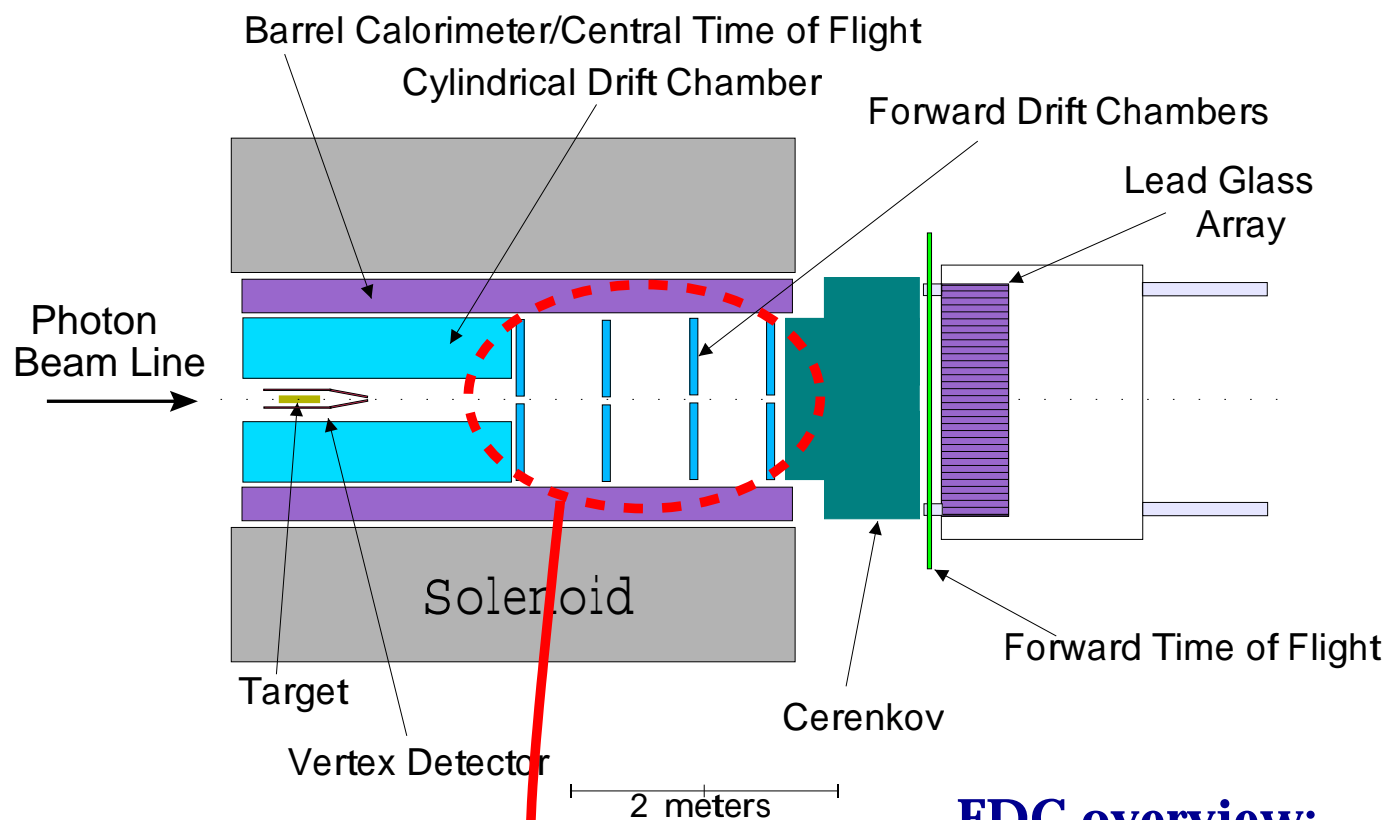
Forward Drift Chambers

(Overview)



Forward Drift Chambers

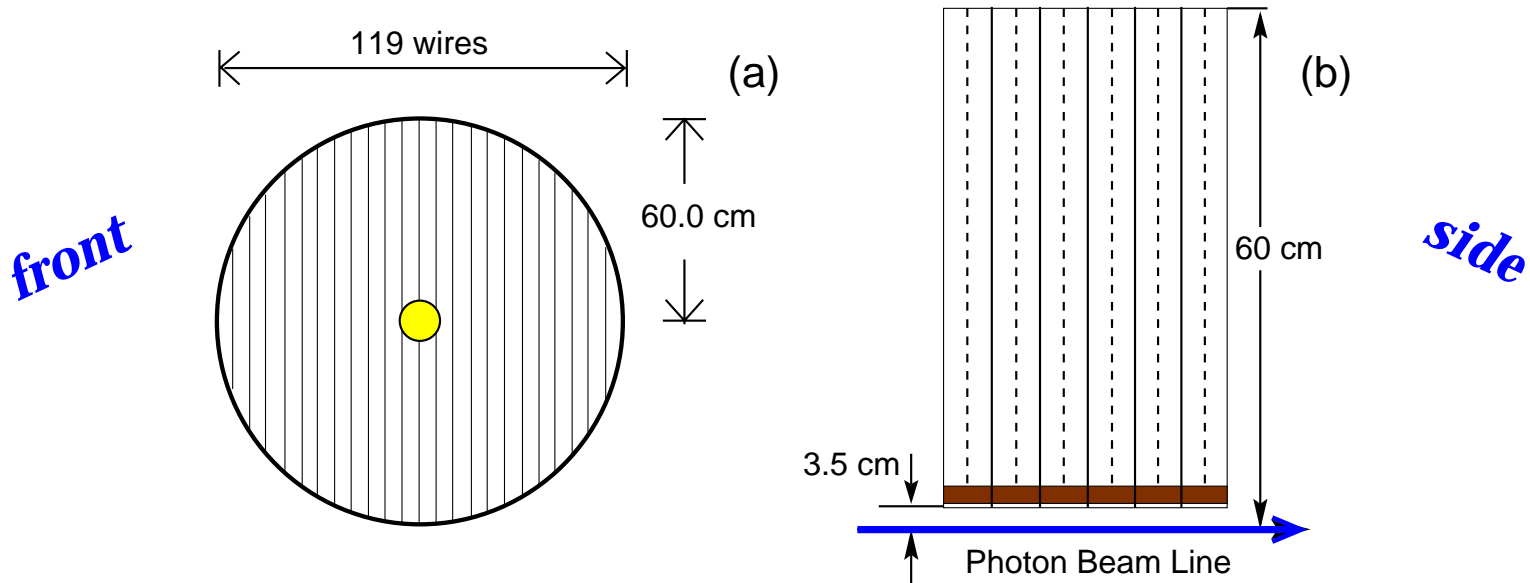
(Overview)



FDC overview:

- *Four separate detector packages.*
- *Tracking out to 30 degrees.*
- *Position resolution 150 microns.*
- *Six wire planes, each between two cathode strip readout planes.*

Forward Drift Chambers



From the GlueX/Hall D CDR:

Each package contains:

**6 planes with 119 wires/plane.
238 cathode strips/plane.**

Inner / Outer radius: 3.5 cm / 60.0 cm

$z_{\min, \max} = 210 - 400$ cm

DESIGN STILL VERY RUDIMENTARY

Development Issues



Construct a tracking detector that:

- * *meets the required design specifications*
 - * *has a long life time*
 - * *has a uniform and predictable response*
 - * *has large noise immunity*
 - * *has a high efficiency*
 - * *is serviceable in case of component failure*
-

> Prototyping FDC design:

- *Cathode strips are the essential new aspect to study.*

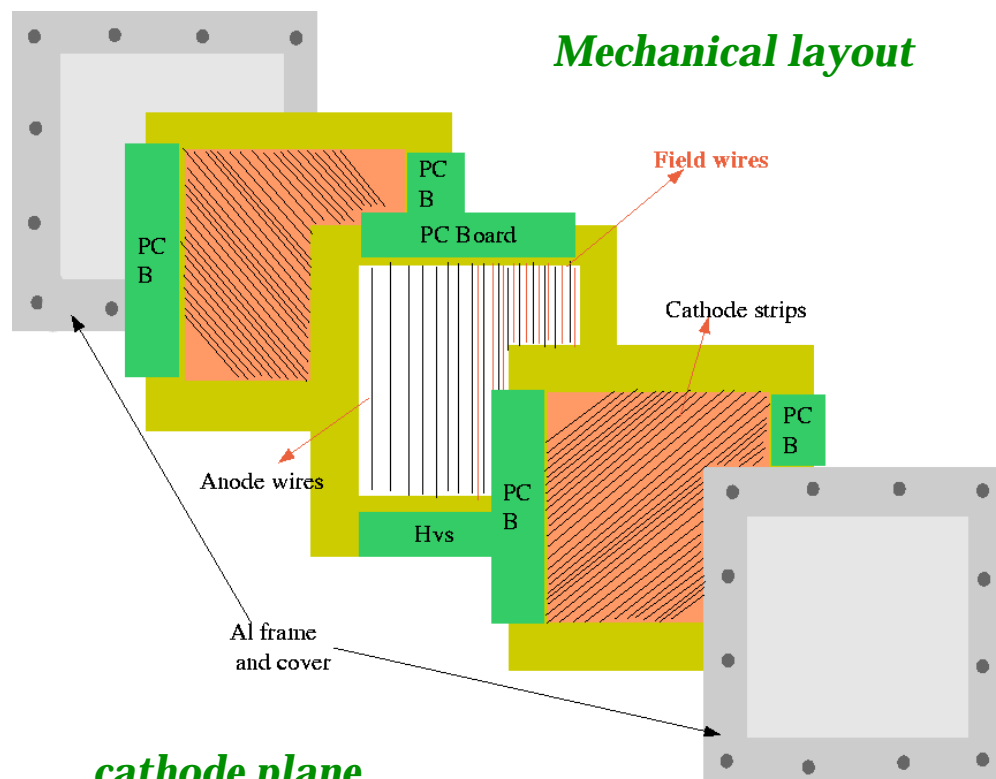
> Monte Carlo studies:

- *Finalize the # of packages and planes; determine z-positioning.*

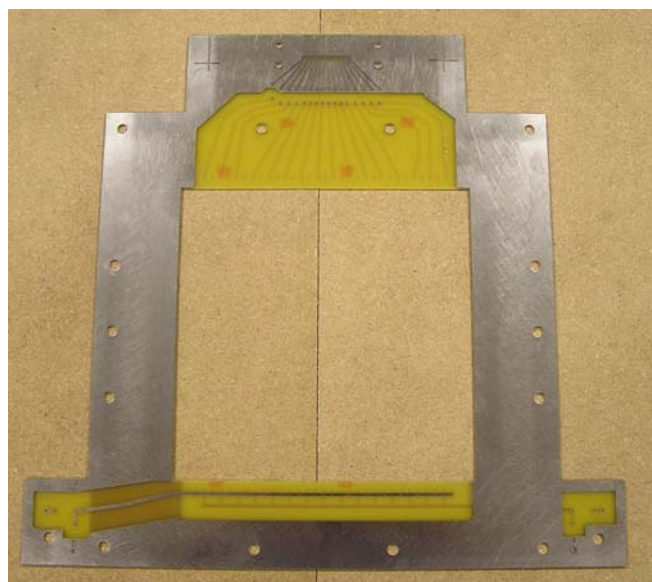


FDC Prototype

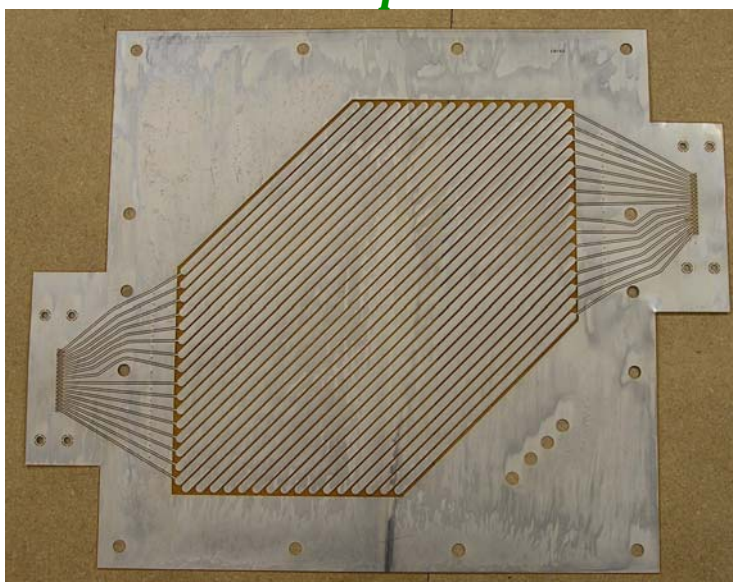
- *Prototype design work completed in June 2003.*
- *All boards and frames are in-hand.
wire stringing at FNAL*
- *Assembly underway.*
- *Full test plan developed.*



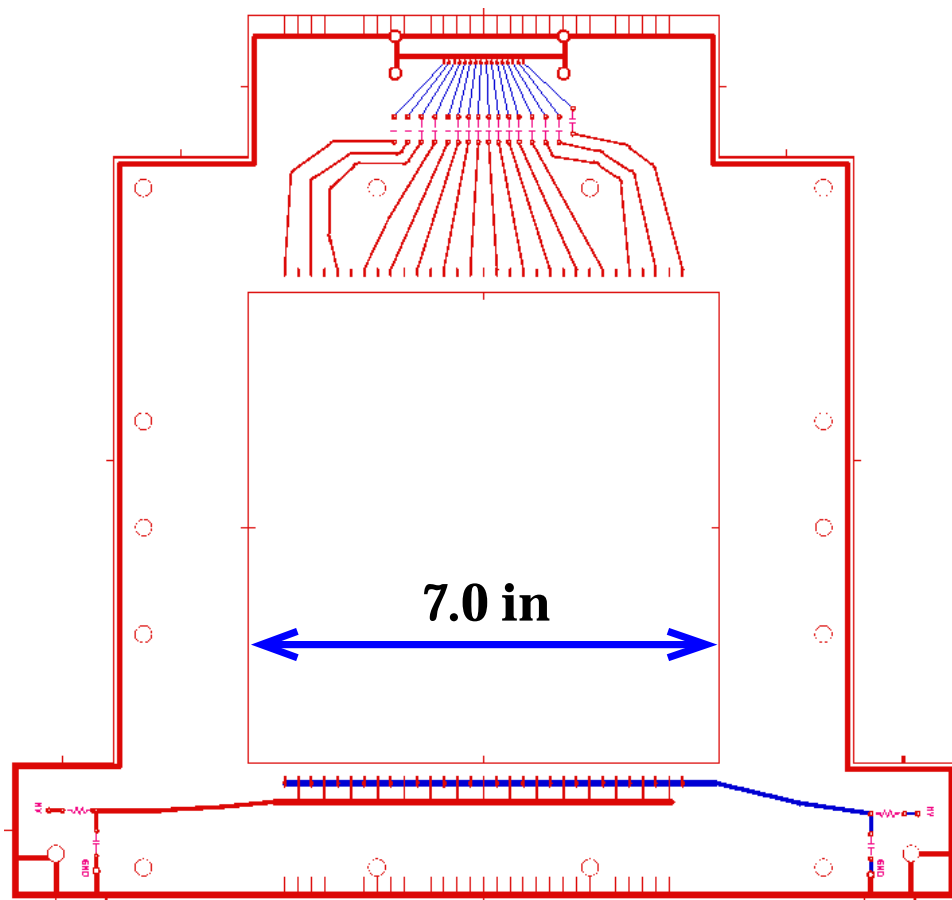
wire frame



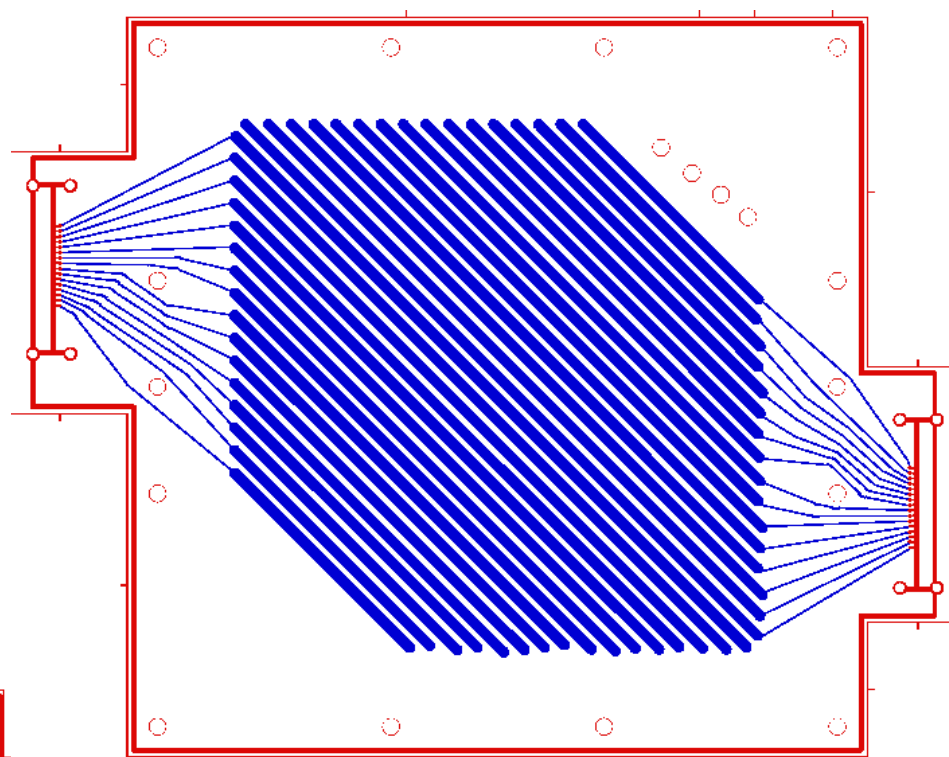
cathode plane



FDC Prototype

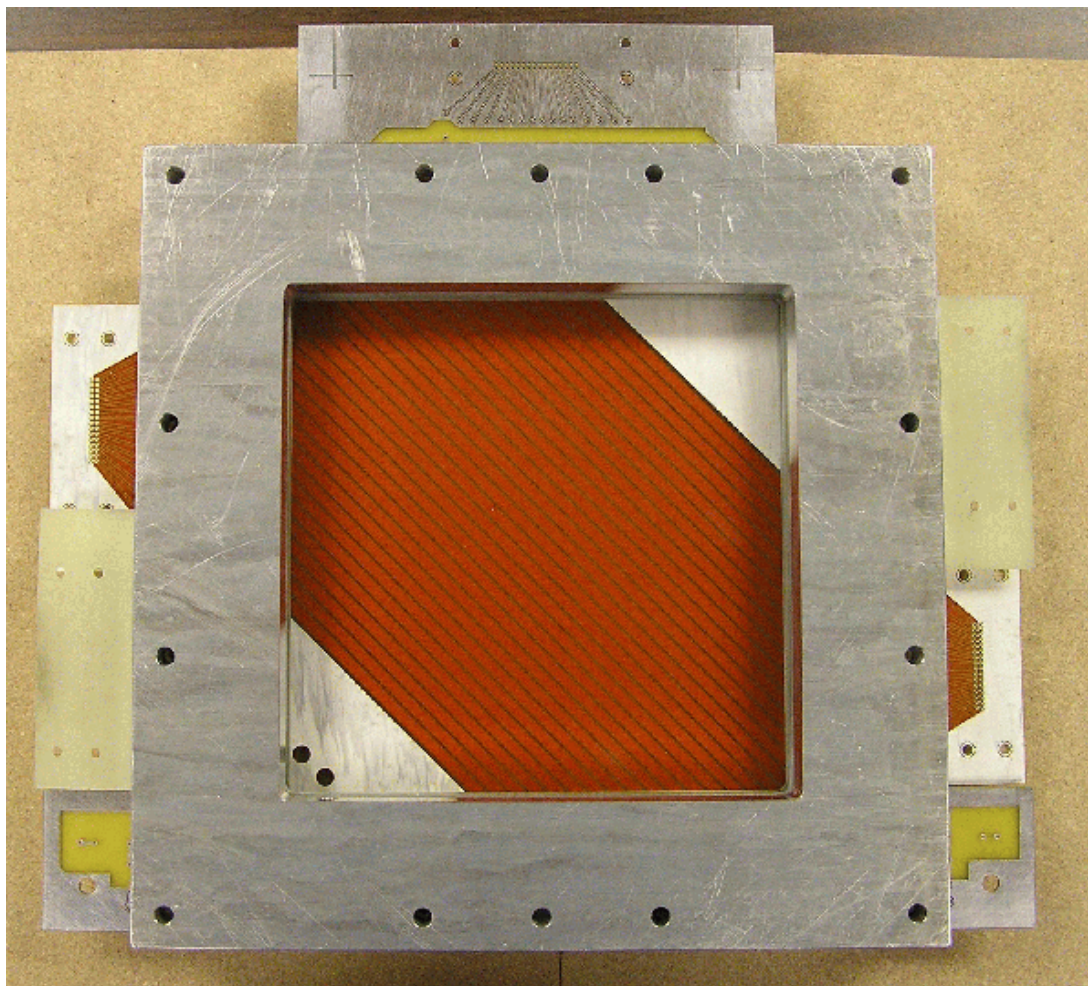


Wire frame

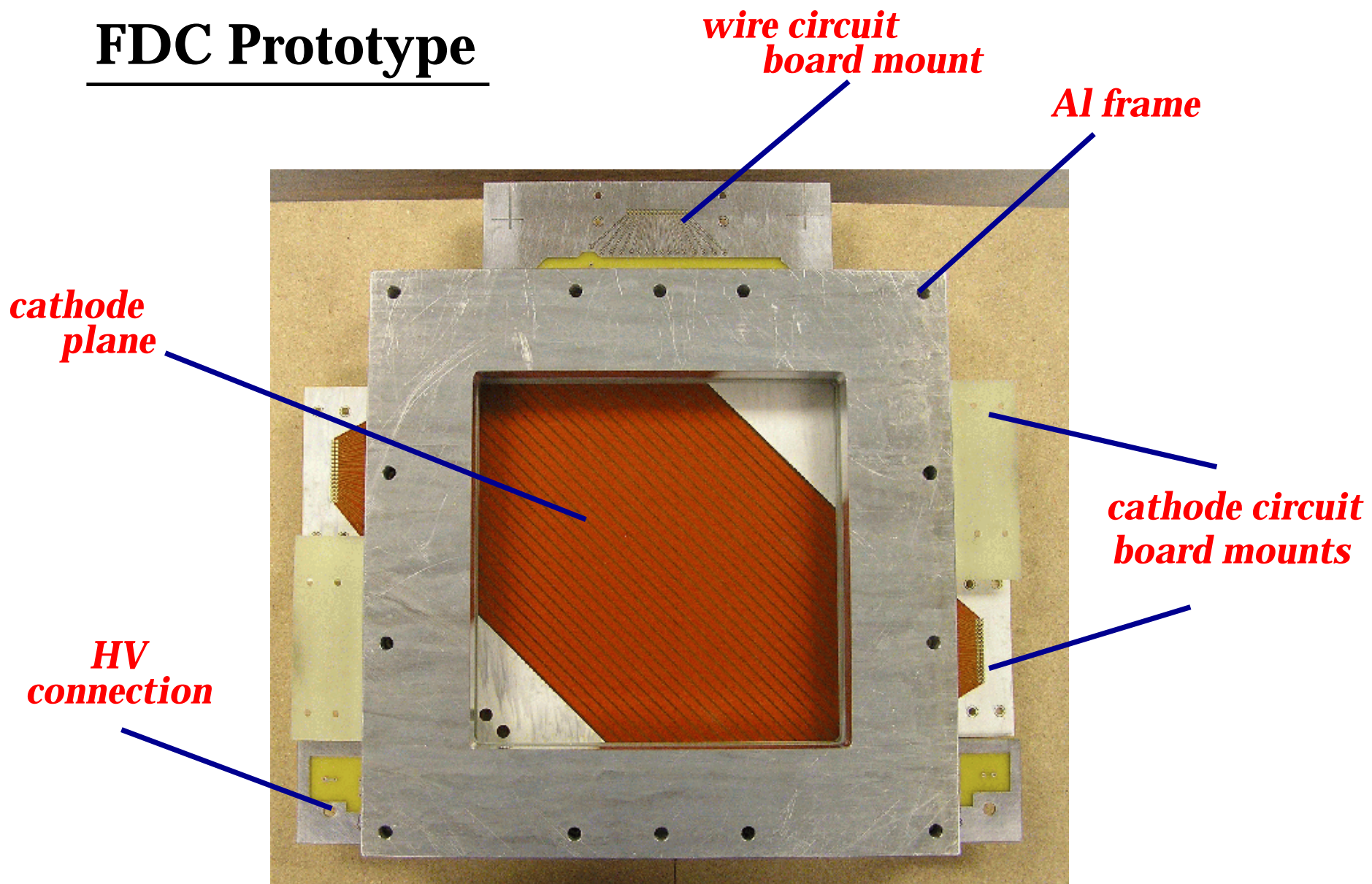


Cathode plane

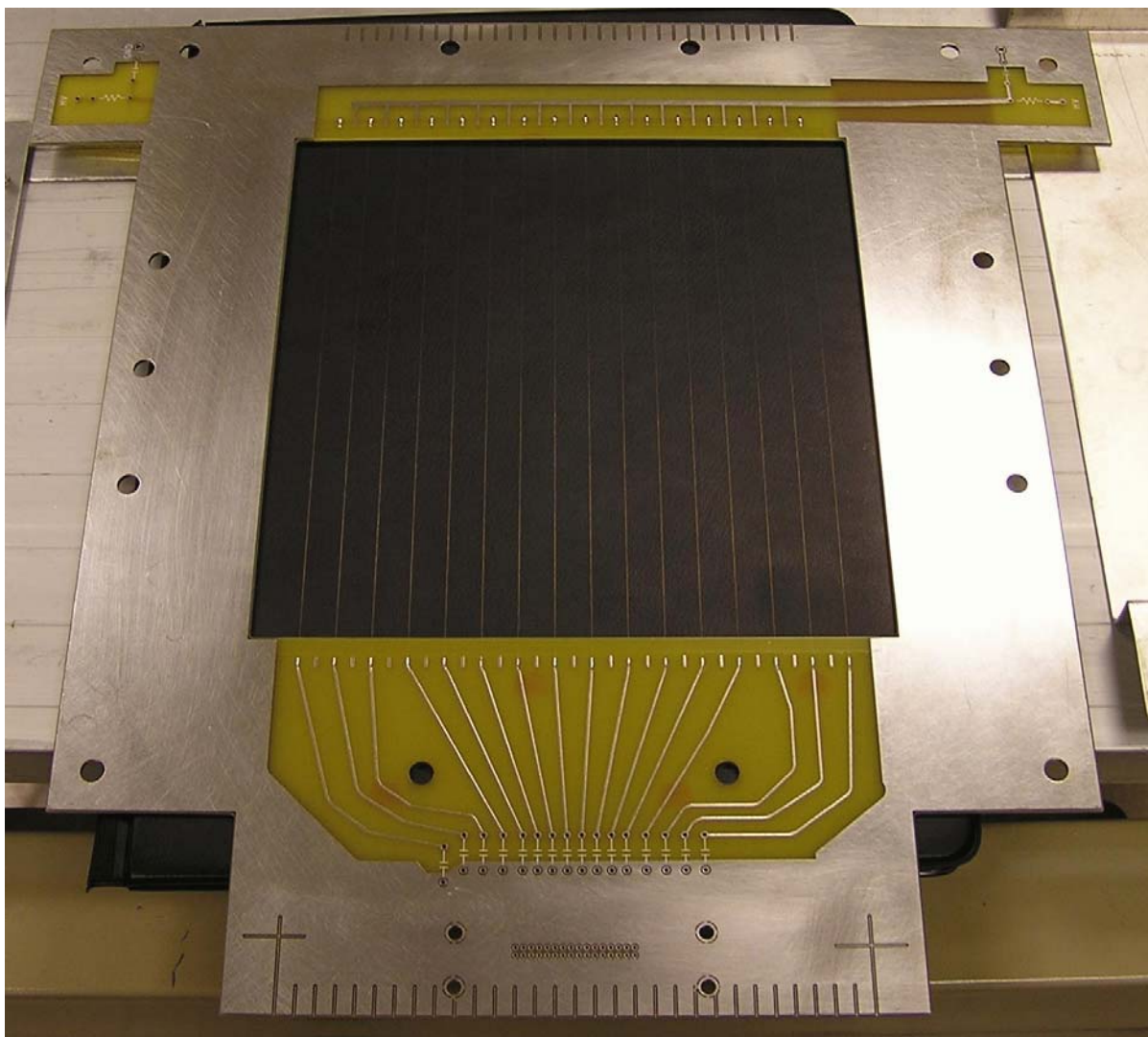
FDC Prototype



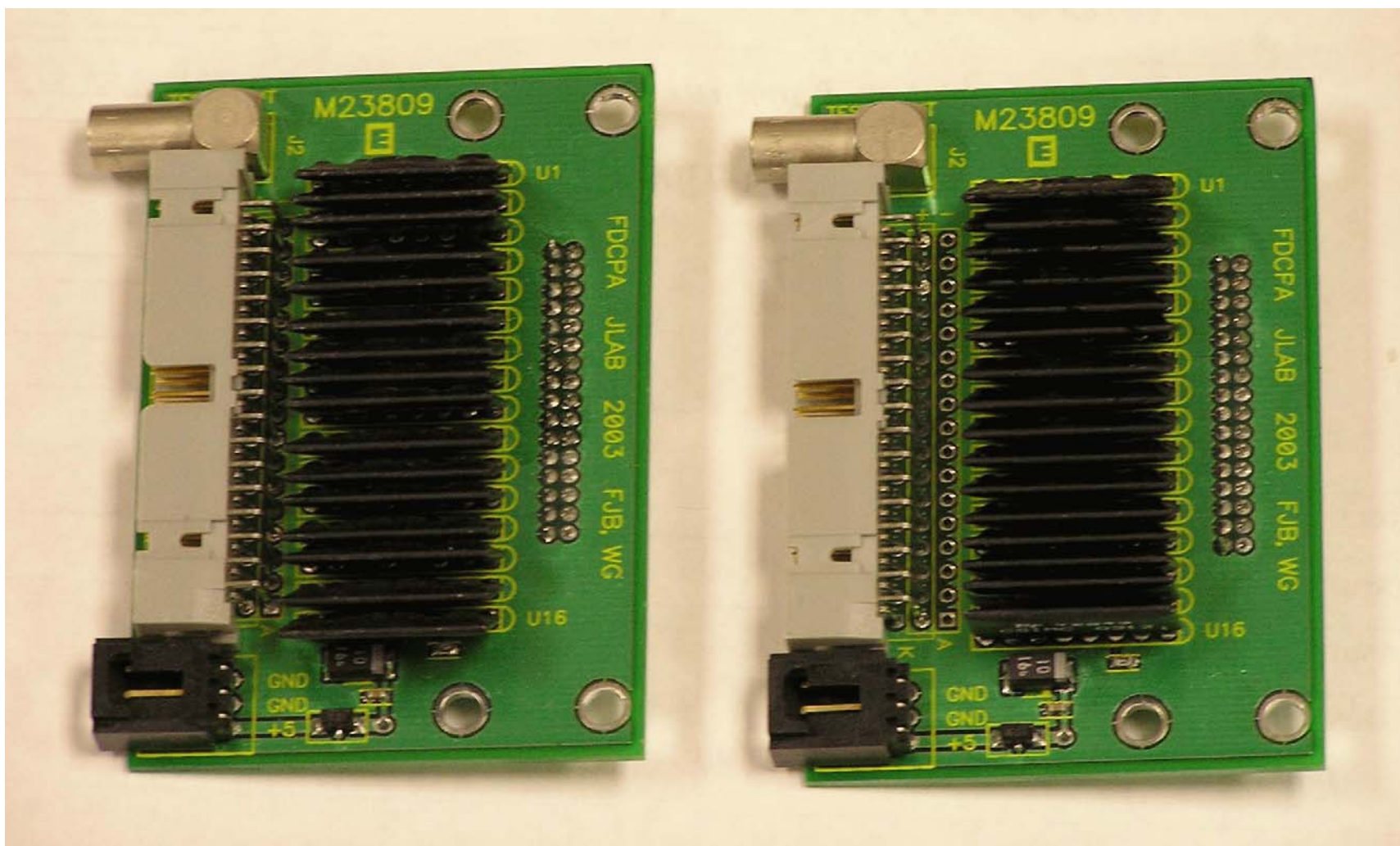
FDC Prototype



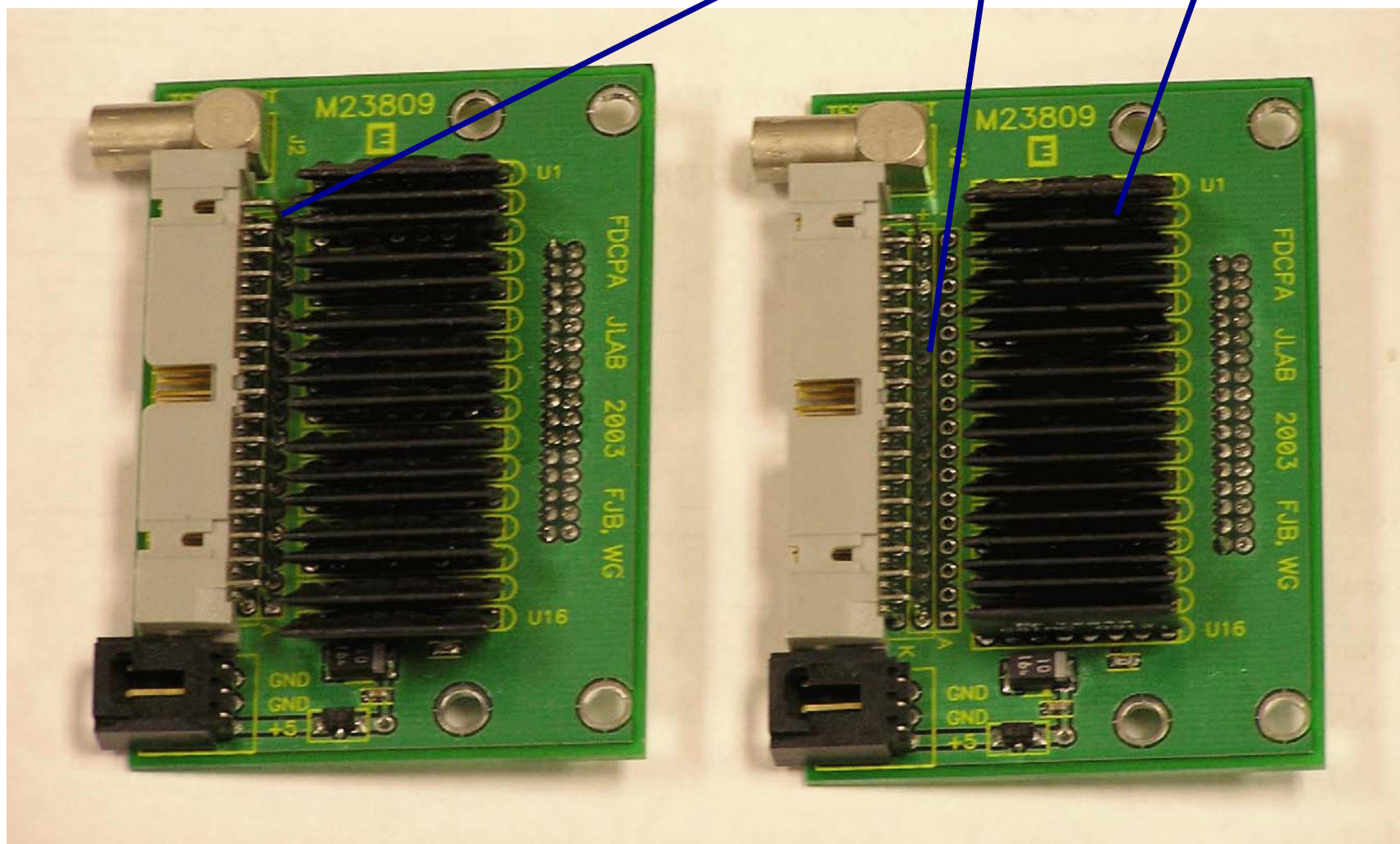
FDC Prototype



FDC Pre-Amp Boards



FDC Pre-Amp Boards



FDC Test Plan

- A full and complete test plan for the FDC prototype has been posted as GlueX Note #68.

➤ **Prototype Assembly**

- *chamber cleaning*
- *wire plane stringing*
- *electronics mounting*
- *stack assembly*

➤ **Resolution Studies**

- *cosmic-ray telescope*
- *single track resolution*
- *two-track resolution*
- *electrode configurations*
- *cross talk measurements*
- *efficiency*

➤ **Bench Testing**

- *short checking*
- *gas flow*
- *HV plateau*
- *gas gain measurements*
- *noise measurements*

➤ **Miscellaneous**

- *magnetic field studies*
- *wire deadening*
- *RF noise pickup*
- *alignment & positioning*
- *internal chamber supports*

Electrode Configuration

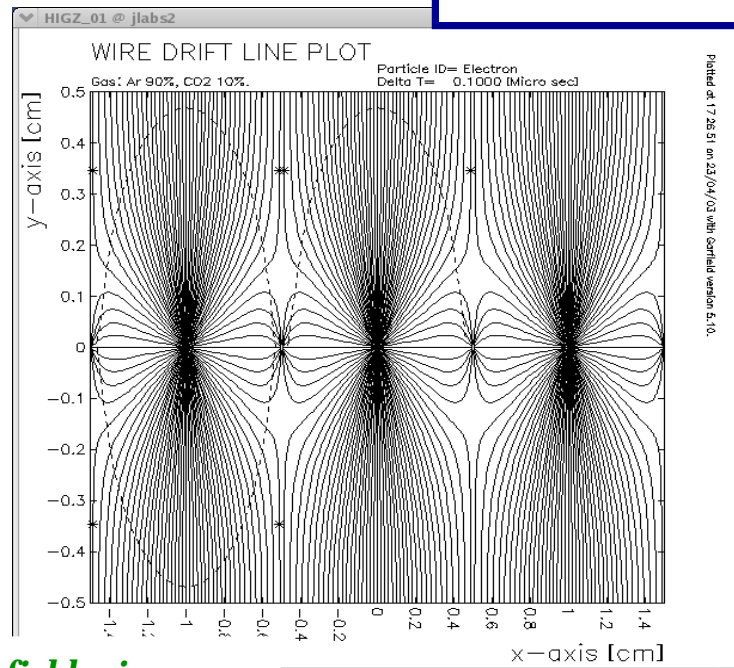
- Understand trade-offs between position resolution at the cathode plane and timing resolution at the wire plane.

Basic electrode structure

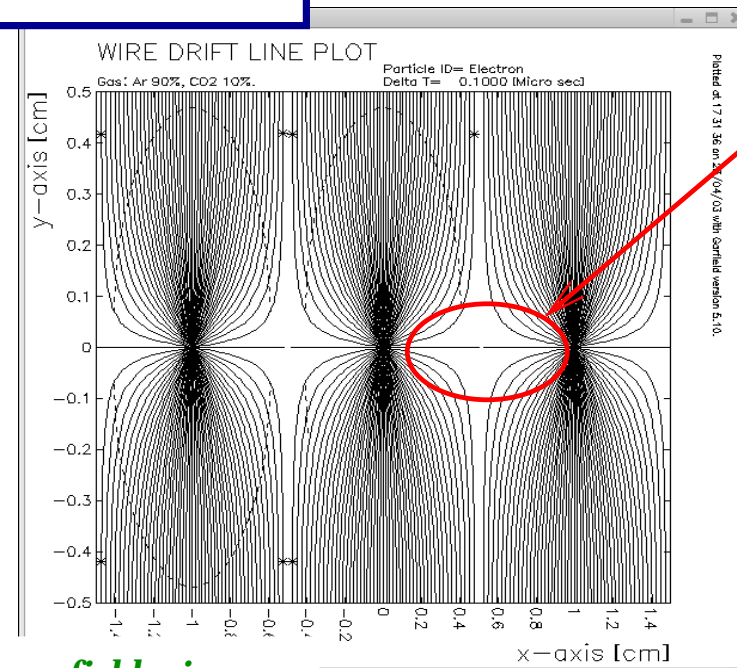
Cathode pitch and separation

Need for field shaping wires

GARFIELD Simulations



field wires



no field wires

poor time resolution

Electrode Configuration

- ❑ Understand trade-offs between position resolution at the cathode plane and timing resolution at the wire plane.

Basic electrode structure

Cathode pitch and separation

Need for field shaping wires

The FDC prototype has been designed with two different wire plane configurations:

- 1). All anode wires, separated by 1 cm.*
- 2). Alternating anode and cathode field wires separated by 0.5 cm.*

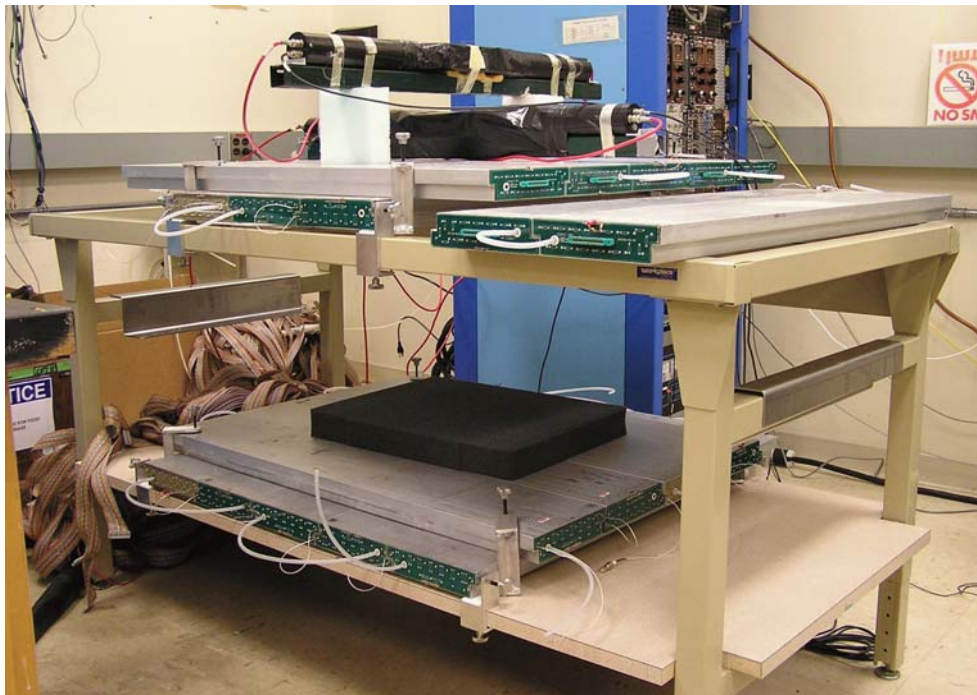
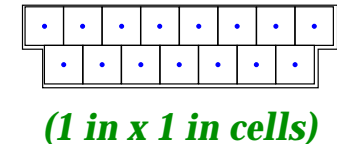
As well, several different cathode plane strip gaps will be studied for a given cathode pitch of 0.5 cm.

All configurations will be studied to optimize chamber design.

Cosmic Ray Test Stand

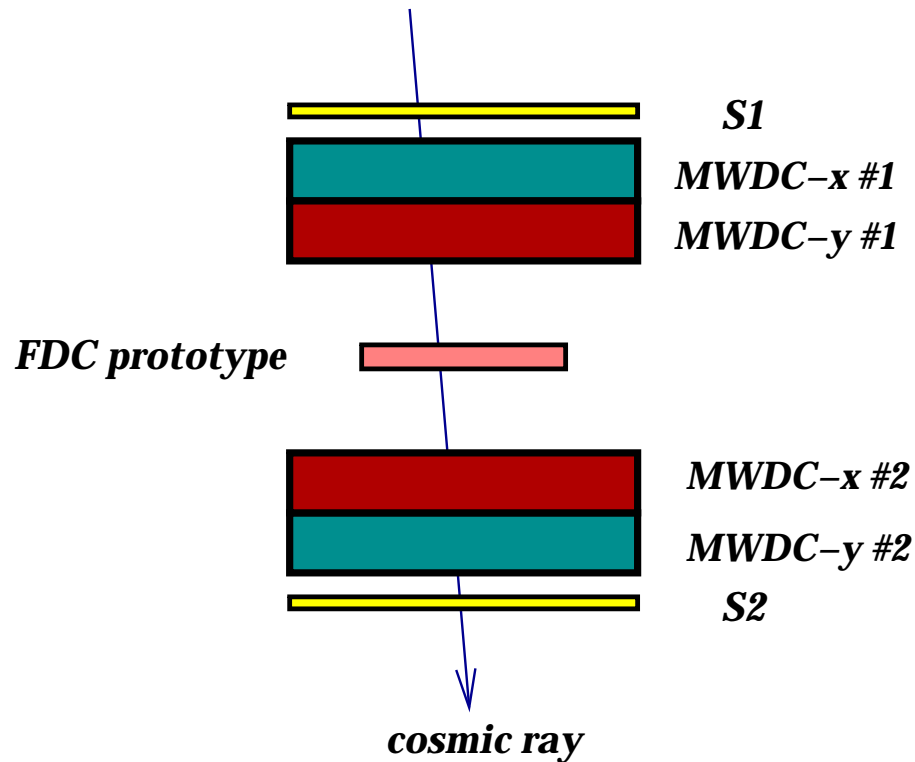
Test stand will be used to measure resolution of FDC prototype.

- *19 chambers on loan from the STAR group at IUCF.*
- *Chambers set up at JLab in EEL Room 126.*
- *Chambers reconditioned after long storage period at IU.*



- *DAQ system, readout, and electronics setup is ongoing.*
- *Support/alignment frame for chambers now being constructed.*
- *Test stand should be able to define charged tracks through FDC prototype with position resolution of better than 200 microns.*

Resolution Studies



- Initial resolution studies will proceed using the cosmic ray telescope triggered by cosmic ray muons.

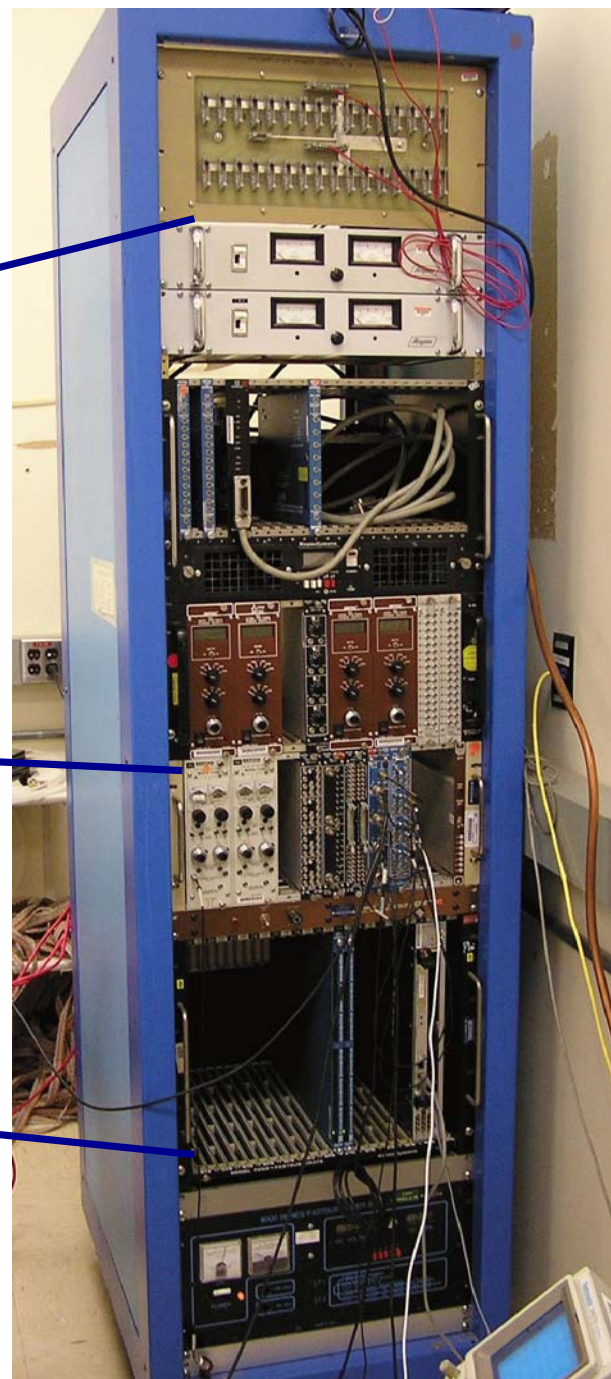
Additional detectors will be needed to probe below 200 microns.

Readout Electronics

*preamp power &
distribution center*

NIM logic

*FASTBUS
(ADCs & TDCs)*



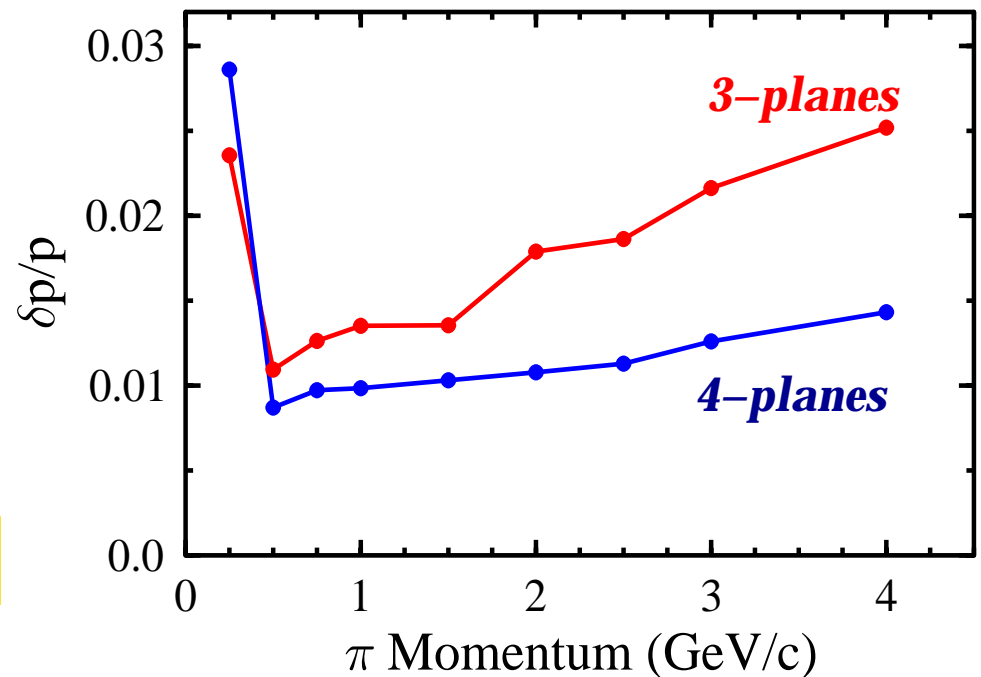
Number of FDC Packages

- Studies of the momentum resolution with FDC configurations of 3 and 4 planes have been carried out.

INGREDIENTS

- * FASTMC Monte Carlo program.
(Not all switches/settings understood)
- * Studies performed with $B=2.24$ T.
- * π^+ tracks reconstructed.
- * Chamber resolution $150\ \mu\text{m}$.
- * CDC 1-cm thick endplate.

Allowed momentum uncertainty??

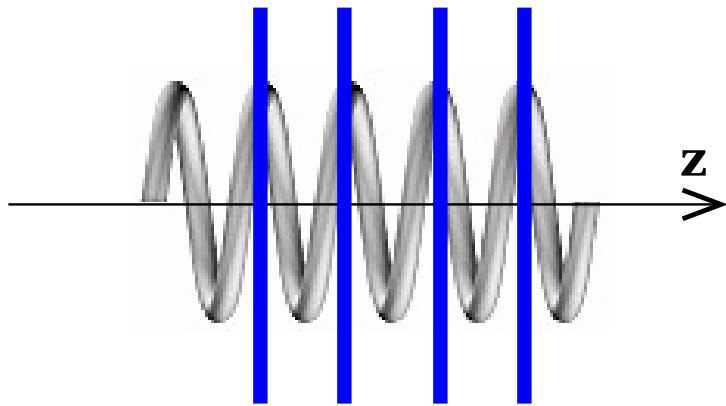


z-Positioning

- Current plans (in CDR) call for 4 FDC packages equally spaced along the beam line.

Preliminary Monte Carlo work indicates that this configuration may not be optimal for certain ranges of particle momenta.

e.g. If particle completes 1 full spiral between FDC packages, best fit is a straight line!!



More Monte Carlo is essential to understand this issue and when it is relevant.

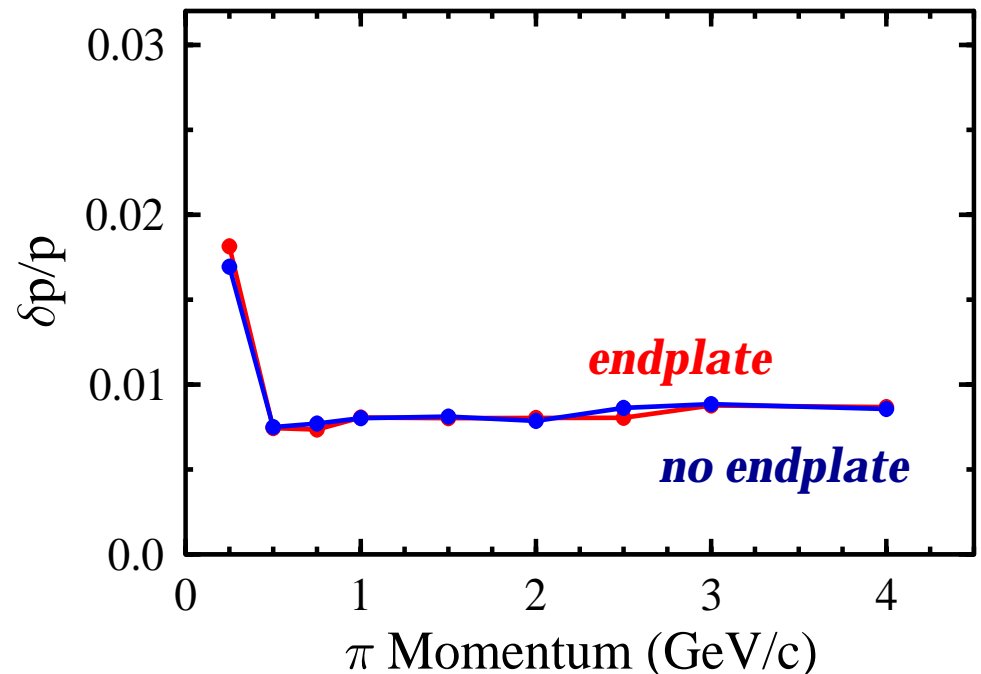
Affect of CDC Endplate

- Studies of the momentum resolution with 4-package FDC configurations with and without the CDC endplate have been carried out.

INGREDIENTS

- * FASTMC Monte Carlo program.
(Not all switches/settings understood)
- * Studies performed with $B=2.24$ T.
- * π^+ tracks reconstructed.
- * Chamber resolution $10\ \mu\text{m}$.
- * CDC 1-cm thick endplate.

No apparent affect!!



Manpower

- **Ohio University**

- *Daniel Carman*
- *Mehmet Bektasoglu (Hall D postdoc position ended 8/03)*
- *New postdoc (hopeful to fund new position for Hall D).*

- **Jefferson Laboratory**

- *Elton Smith*
- *Detector Group:*
- *Elliott Wolin*
- *Fernando Barbosa*
- *Vardan Gyurjyan*

Stan Majewski

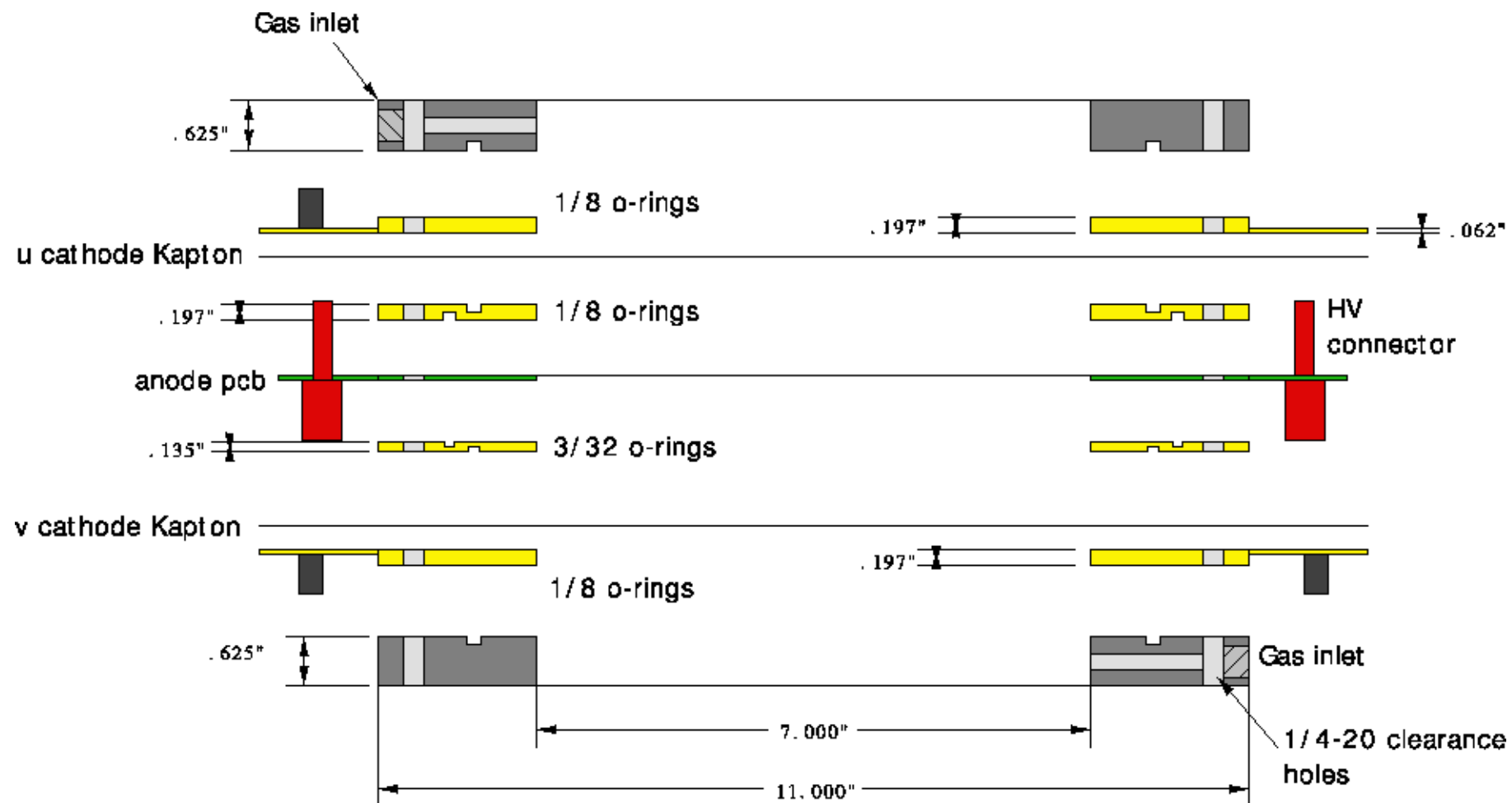
Brian Kross
Randy Wojcik
Benjamin Welch
Ravi Anumagalla

Summary

- Construction of FDC small-scale prototype underway.
 - *All boards and electronics in-hand.*
 - *Wire planes strung at Fermilab.*
 - *Cosmic ray test stand under development.*
 - *Electronics/readout set up nearly complete.*
- Careful design work needed on full-scale FDC chambers.
 - *Full-scale Monte Carlo studies needed.*
 - *No manpower yet identified for this task.*
 - *Not ready for serious outside review at this time.*



**Slow but steady progress,
but much work remains.**



PCBs are .062 in thickness

SIDE 1 View

R. Wojcik
 Detector Meisters
 Hall D test chamber V4
 5/9/03

