Outline:

- Subsystem overview
- Design questions
- Status
- Ongoing studies
- Upcoming work
- Summary
Forward Drift Chambers

Barrel Calorimeter/Central Time of Flight
Cylindrical Drift Chamber

Photon Beam Line

Target

Vertex Detector

Solenoid

Lead Glass Array

Forward Drift Chambers

2 meters

Cerenkov

Forward Time of Flight

D.S. Carman, Ohio University

Hall D/GlueX Collaboration Meeting -- Dec. 11–13, 2003
Forward Drift Chambers

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.
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

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

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FDC Prototype

Wire frame

Cathode plane

7.0 in
FDC Prototype
FDC Prototype

- Al frame
- Wire circuit board mount
- Cathode plane
- HV connection
- Cathode circuit board mounts

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FDC Prototype
FDC Pre–Amp Boards
FDC Pre-Amp Boards

Different polarity readout
Hall B – SIP preamps
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**

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**GARFIELD Simulations**

- Poor time resolution

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D.S. Carman, Ohio University

Hall D/GlueX Collaboration Meeting — August 4–6, 2003
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.

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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.
* $\pi^+$ tracks reconstructed.
* Chamber resolution 150 $\mu$m.
* CDC 1–cm thick endplate.

Allowed momentum uncertainty??
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.

\textit{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.
- $\pi^+$ tracks reconstructed.
- Chamber resolution 10 $\mu$m.
- CDC 1–cm thick endplate.

No apparent affect!!

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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:
    - Stan Majewski
    - Elliott Wolin
    - Fernando Barbosa
    - Vardan Gyurjyan
    - 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