

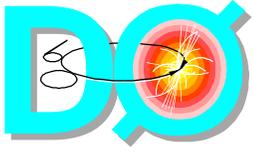
Fiber Tracker

WBS 1.1.2

Alan Cross

Outline

- ◆ Introduction and Overview
 - Physics and performance goals
 - Brief detector description
- Project organization
 - Institutions
 - Organization chart
- System Status
- Cost, Manpower, and Schedule
- Summary

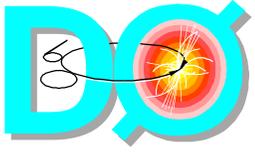


Technology Issues

- The technological challenges presented by the full detector system are formidable
 - ◆ Scintillating/Optical fiber
 - ◆ Mass-Termination Low-loss Optical connectors
 - ◆ Low-mass rigid/stable support structures
 - ◆ Precision mechanical assemblies
 - SOME CRYOGENIC
 - ◆ High efficiency photodetectors with high rate capability

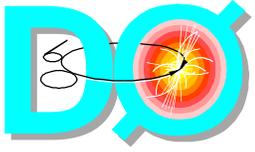
And most is being done on a large scale for the first time!

- We now have, however, solutions to all these technical problems



Institutions

- Fermilab
- University of Indiana
- University of Notre Dame
- Rice University
- University of Rochester



Tracker - Mechanical

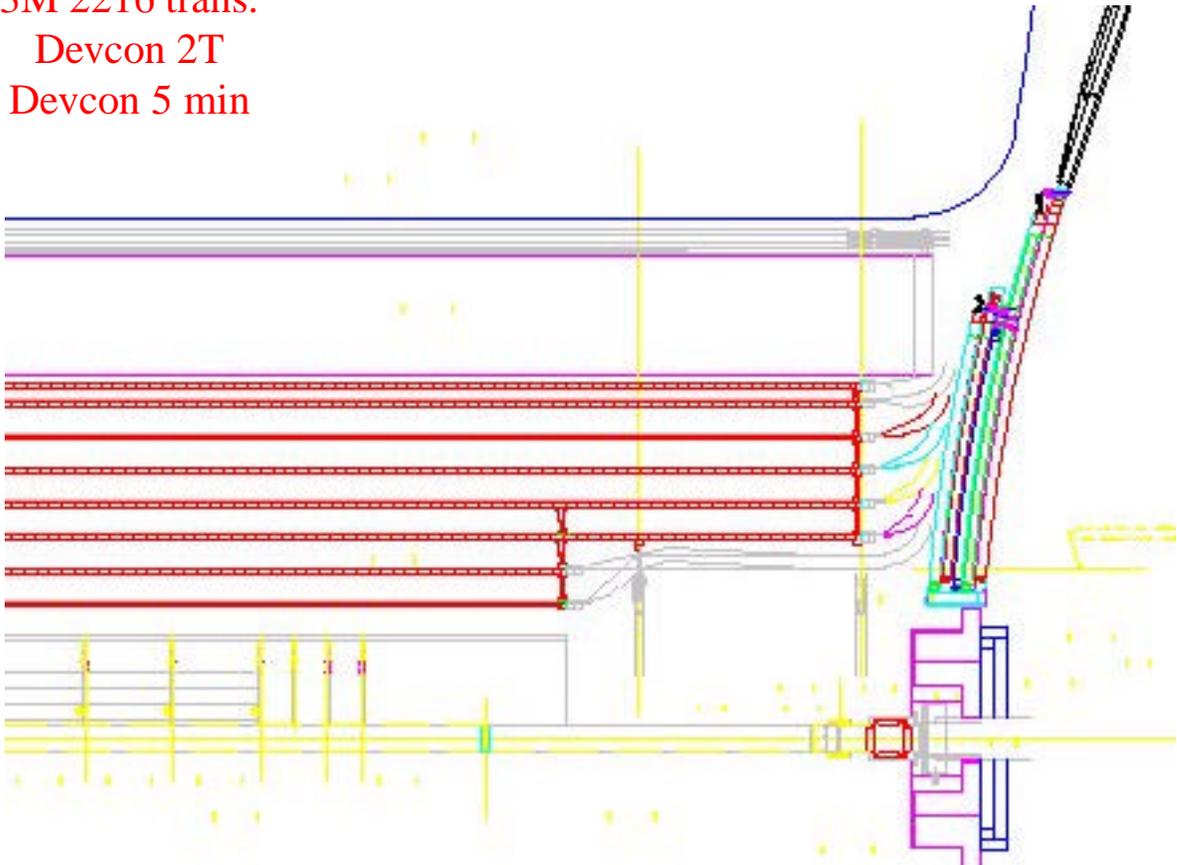
“To Boldly Glue Where No One
Has Glued Before”

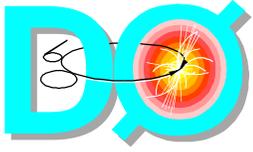
Adhesive

Bicron BC 600
Optodyne 2000
Masterbond EP29LPSP
Ciba-Geigy RP6400-1
3M Type 75
3M 2216 trans.
Devcon 2T
Devcon 5 min

Adhesive

Teflon release film
Lilly 225 mold release

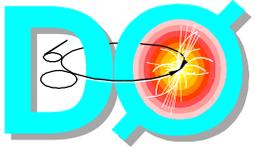




Scintillating and Clear Fiber

Title: PDG\$DISK1:[BROSS.URA]3HF_CLR.EPS;1
Creator: HIGZ Version 1.22/09
CreationDate: 01/02/96 15.20

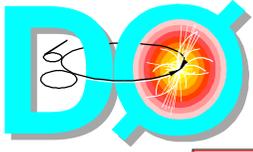
- **Fiber:**
 - ◆ High Yield (excellent attenuation properties)
 - ◆ Precise : Diameter → **835 μm \pm 1%**
 - ◆ Robust
- All scintillating and 850,000 m of clear fiber at Fermilab



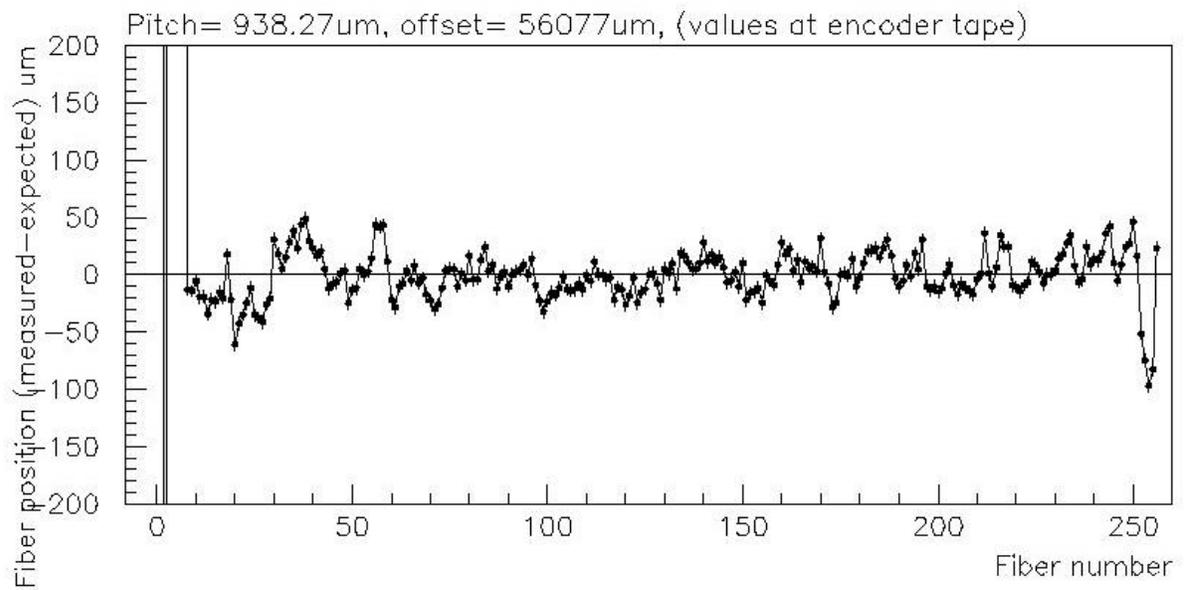
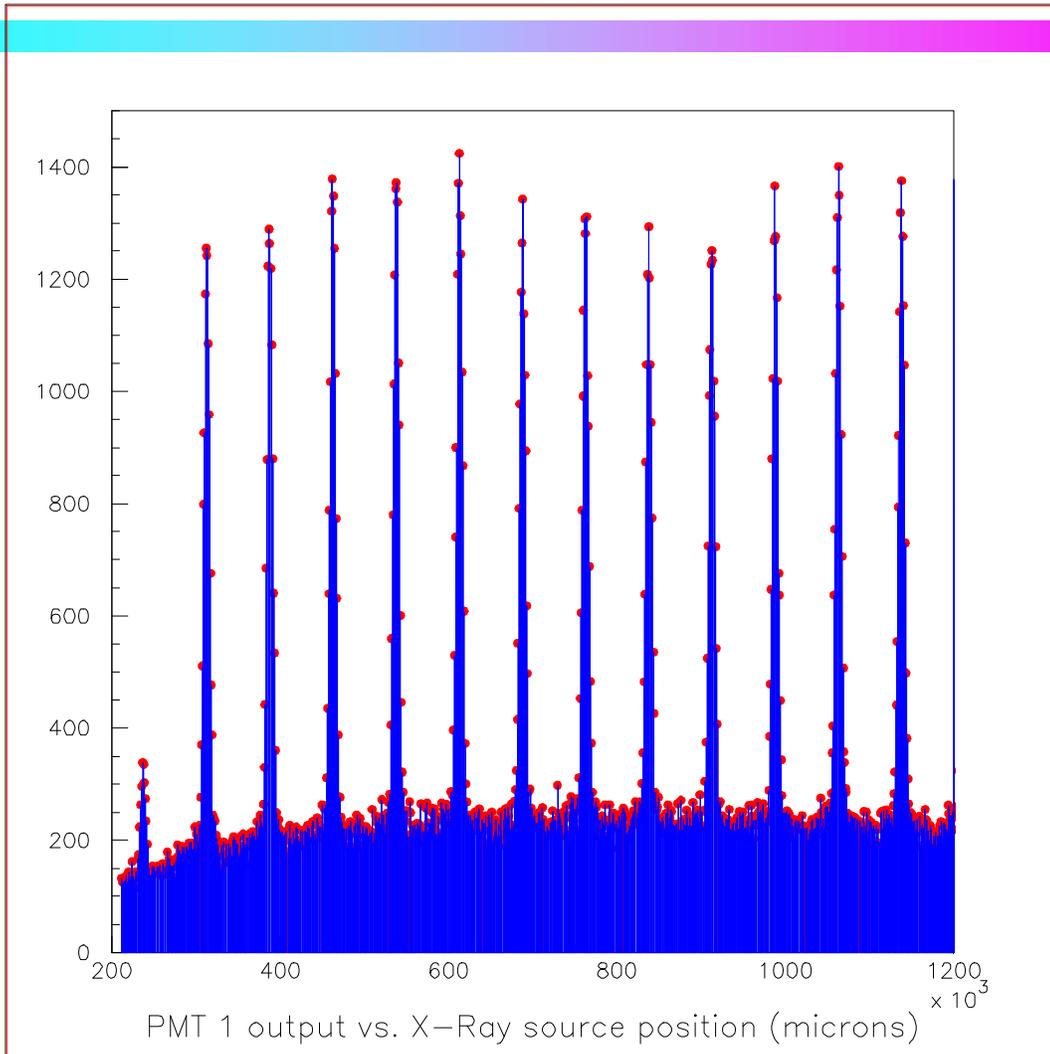
Photon Yield

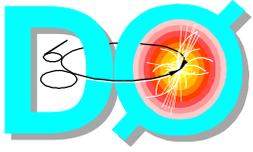
Title: USR\$ROOT4:[BERTRAM.PAPERS]DOUBLET_YIELD.EPS;1
Creator: HIGZ Version 1.20/11
CreationDate: 25/07/94 13.57

- Photo-yield from 1994 cosmic-ray-test was approximately 20 pe/doublet
- This level is 4 X that needed for full tracking efficiency

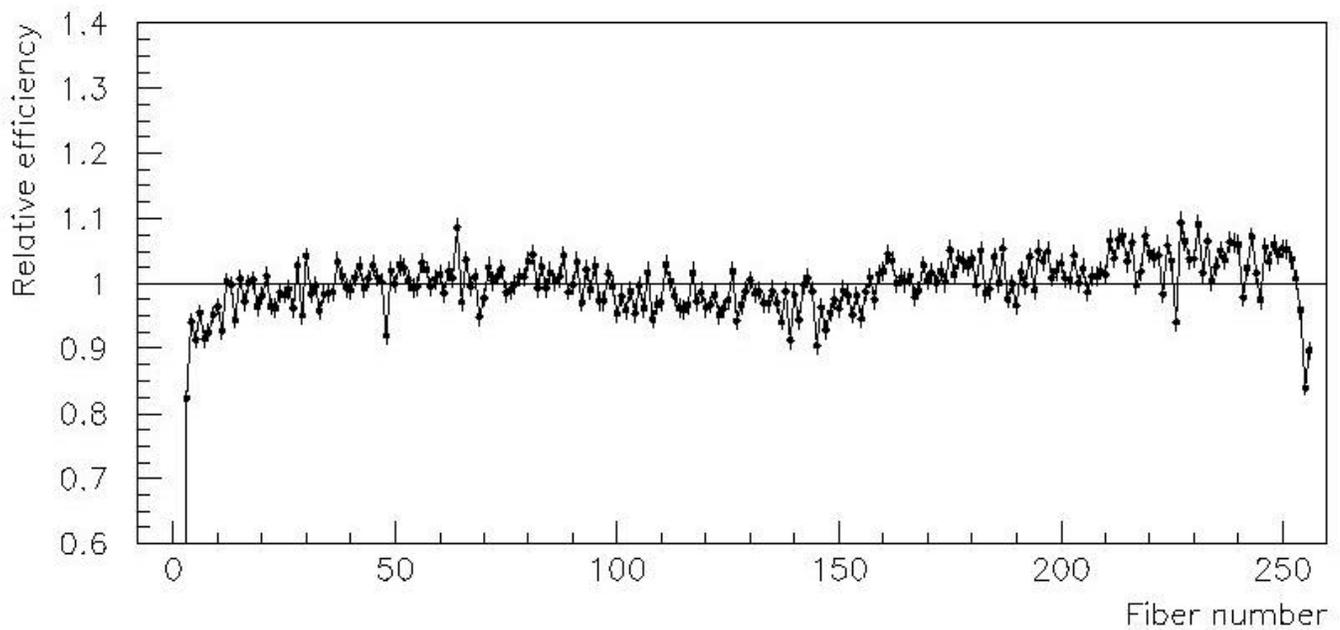
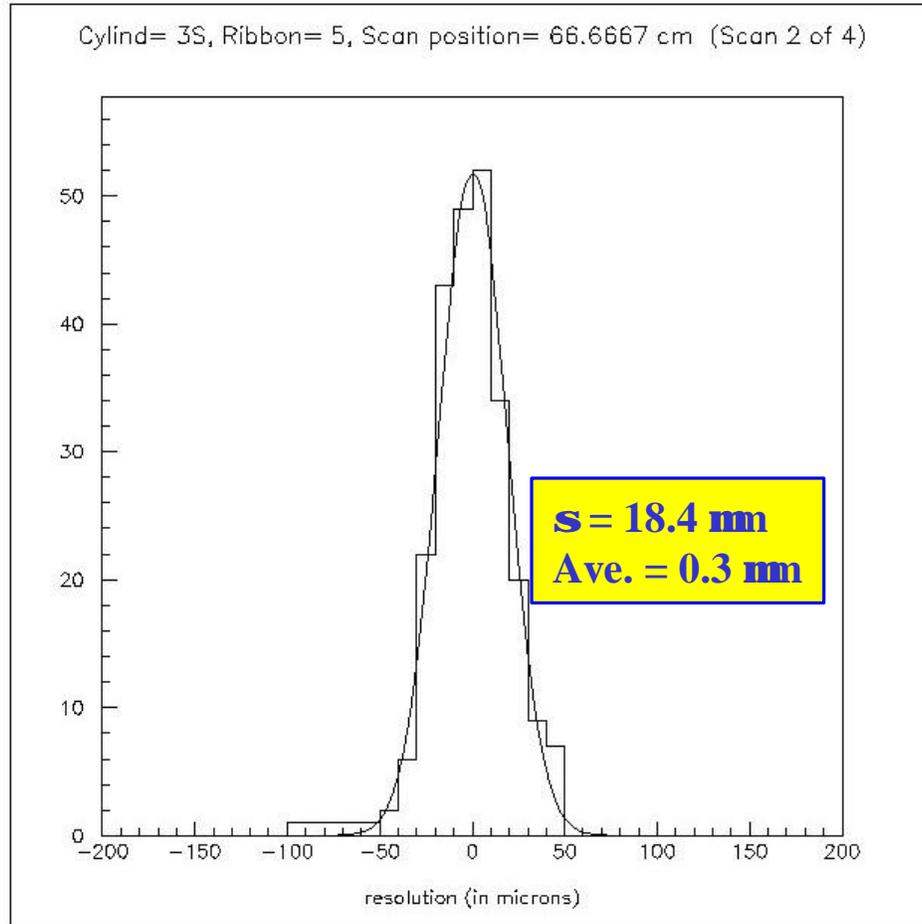


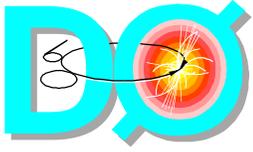
Ribbons



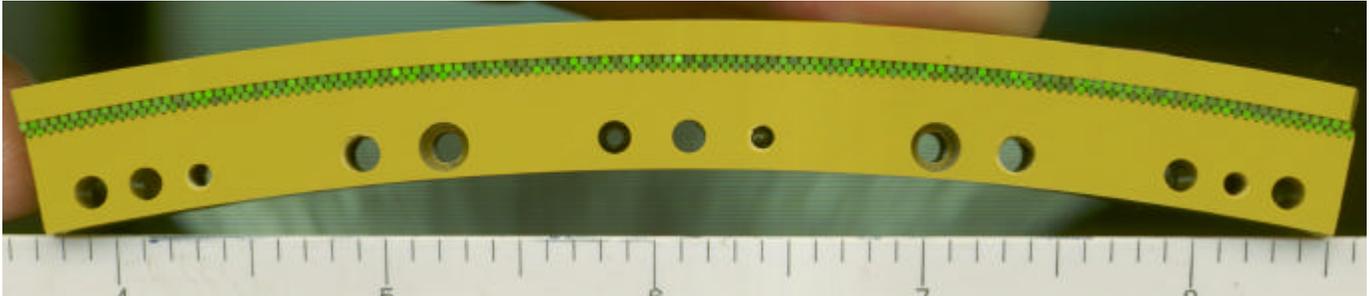


Ribbons

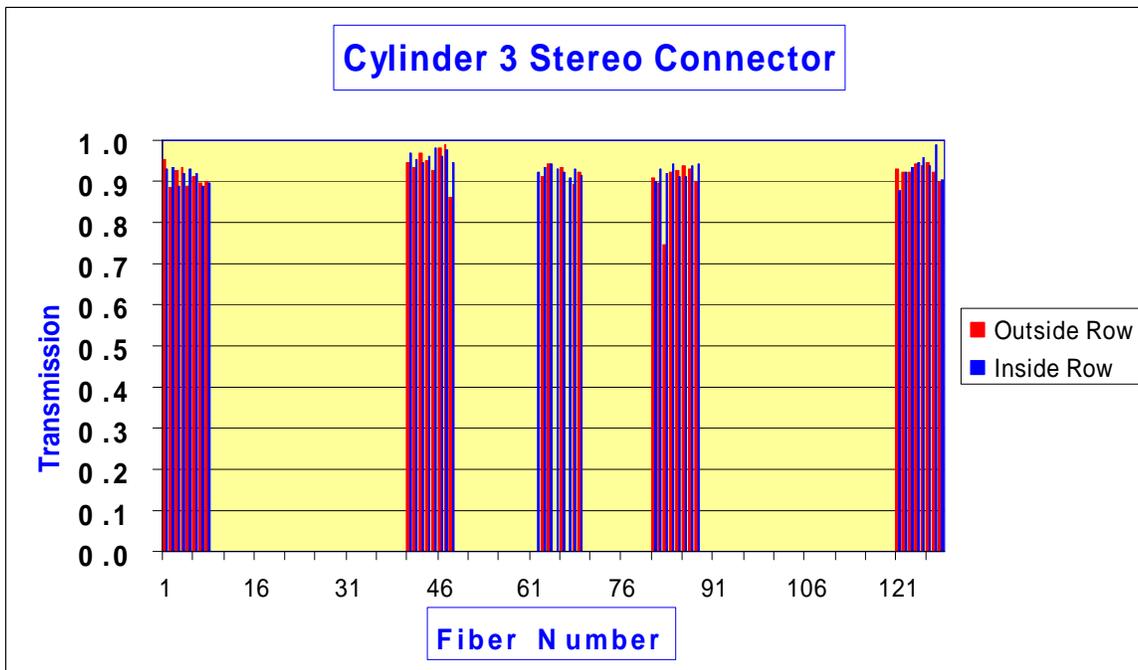
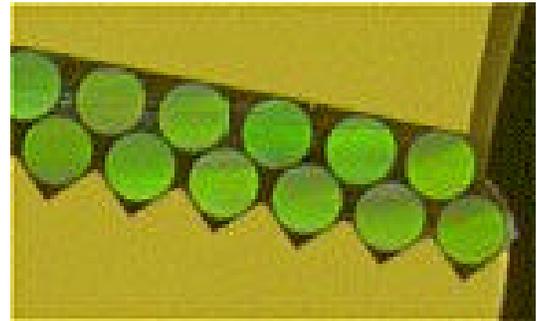


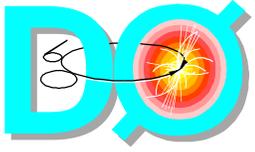


Ribbons - Optical Connectors



- Have now received $\approx 50\%$ of curved connectors
 - ◆ Material - Torlon
 - ◆ Optical coupling efficiency $> 90\%$



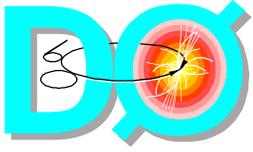


Mechanical Supports

WBS 1.1.2.7

Support Cylinders

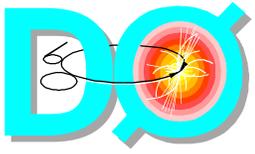
- Fermilab R&D has led us to choose a double-wall design
 - ◆ Two layers of $\approx 0.008''$ carbon fiber (55-105 MSI) separated by 0.25'' of Rohacell
 - ◆ (0/60/-60 R -60/60/0°)
- Very Strong
 - ◆ Beam loading
 - ◆ Local Stiffness - environmental stability



ANSYS Analysis of Fiber Tracker

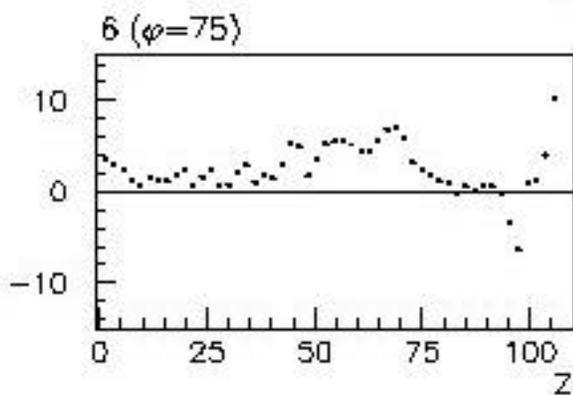
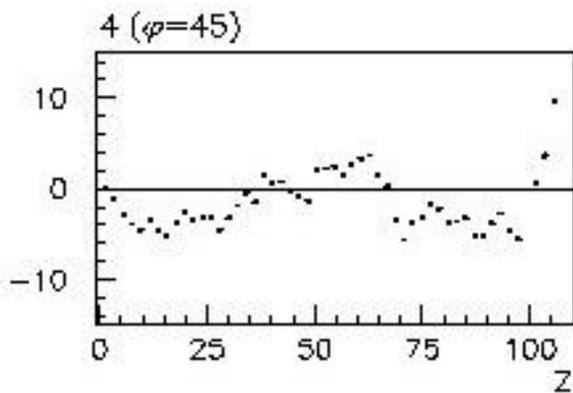
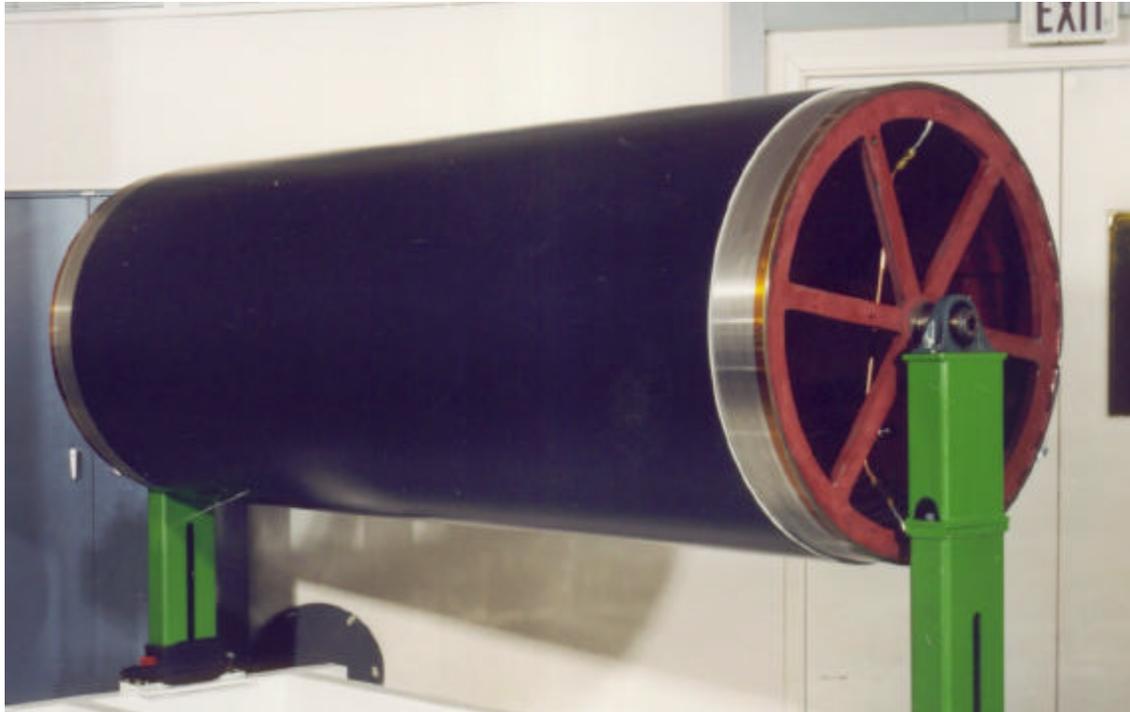
- A Full 3-D analysis of the fiber tracker system has been performed
 - ◆ All material properties
 - ◆ Sub-component specifications
 - ◆ All loading (including Si + beam pipe)
- Maximum Deflections all within required tolerance

<i>Cylinder Layer</i>	<i>Maximum Deflection (mils)</i>
<i>1</i>	1.48
<i>2</i>	1.50
<i>3</i>	1.51
<i>4</i>	1.37
<i>5</i>	1.18
<i>6</i>	1.07
<i>7</i>	0.98
<i>8</i>	1.02

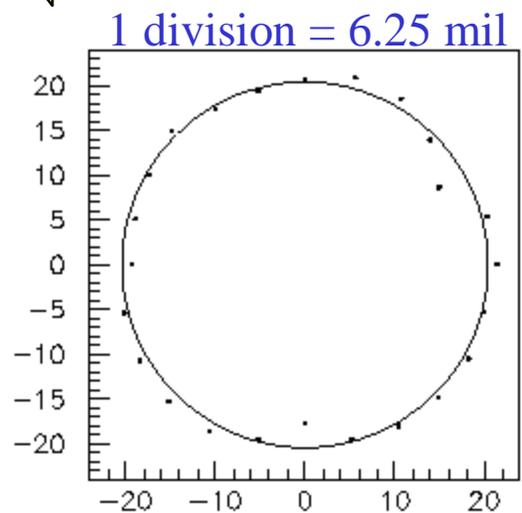


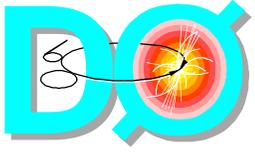
Mechanical Supports

WBS 1.1.2.7

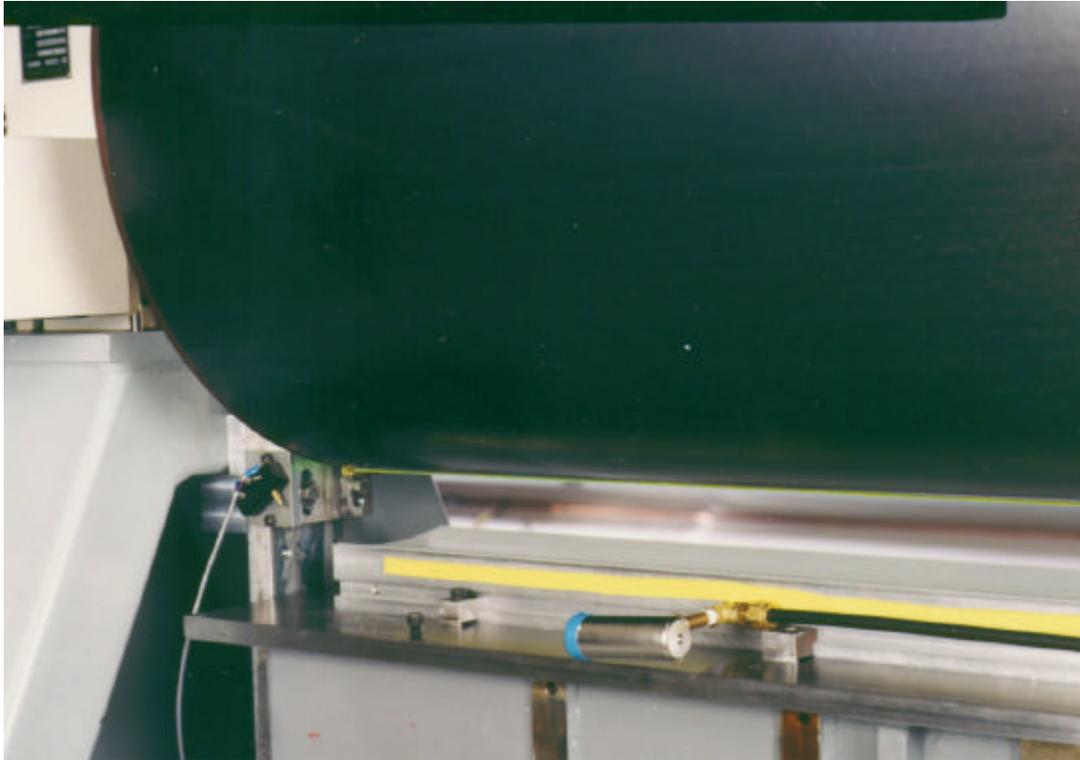


Cylinder 8
50 meas. Along L
3.5 mil RMS

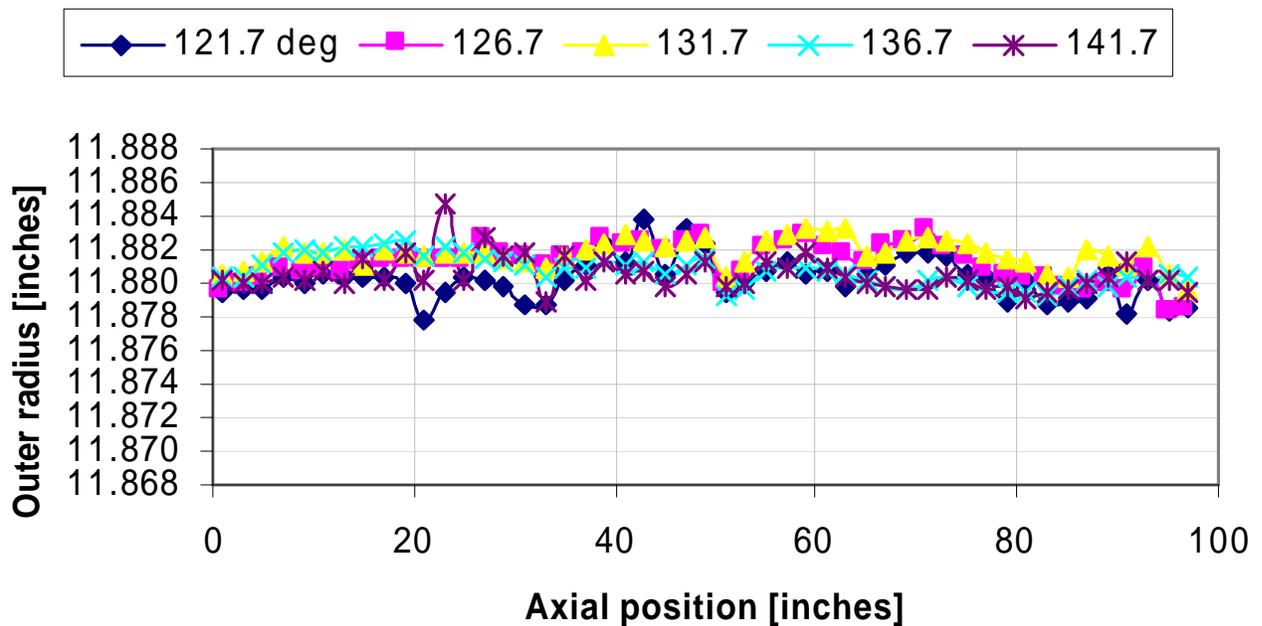


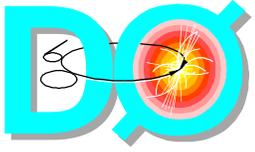


Ribbon Mounting

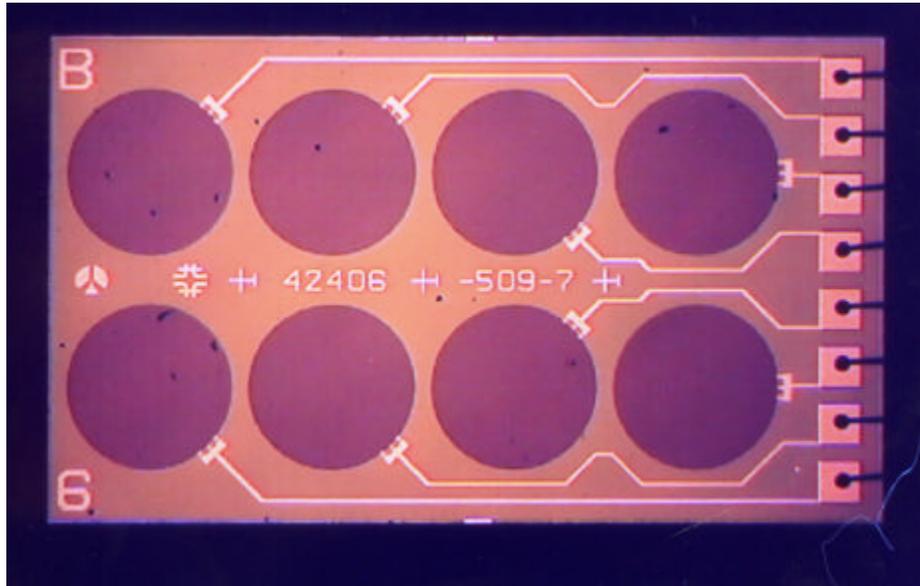


Ribbon 3S2 mounting radii



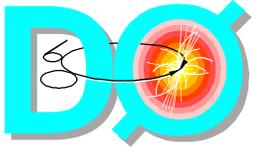


VLPCs



Production Complete!

- First 8 lots yielded **122k** pixels
 - ◆ Need 110K
 - ◆ May recover additional 6k from rejects
- 6 lots of epitaxial material are banked at Boeing



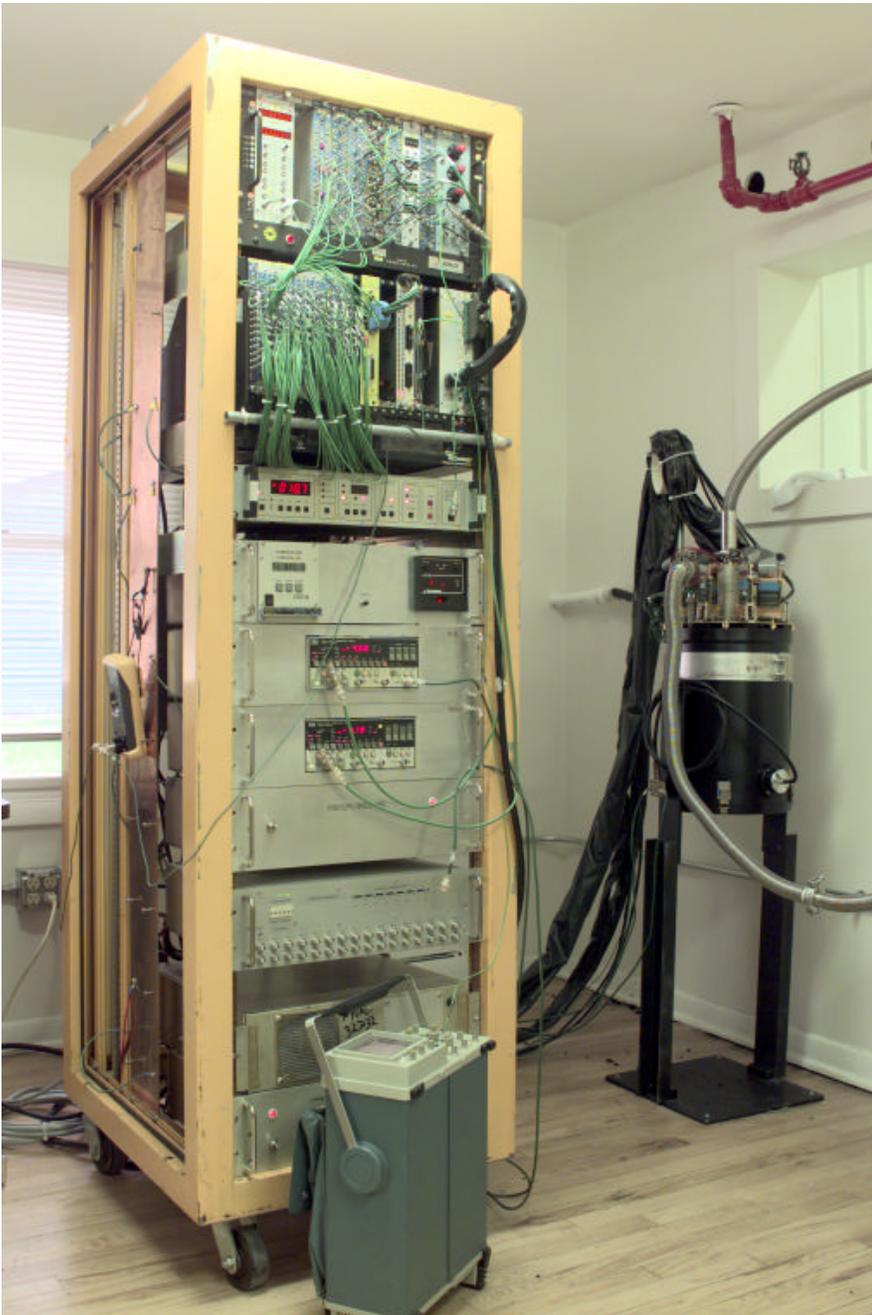
VLPC Testing

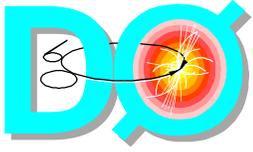
- Fermilab provided Boeing with Test stand, DAQ, and Online system

- ◆ Used with Boeing cryosystem
- ◆ PC based (NT) operating system
- ◆ QPA02 preamp
- ◆ 2249 ADCs
- ◆ CAMAC/VME electronics
- ◆ Jorway + BIT3 interfacing

Provides full test capability

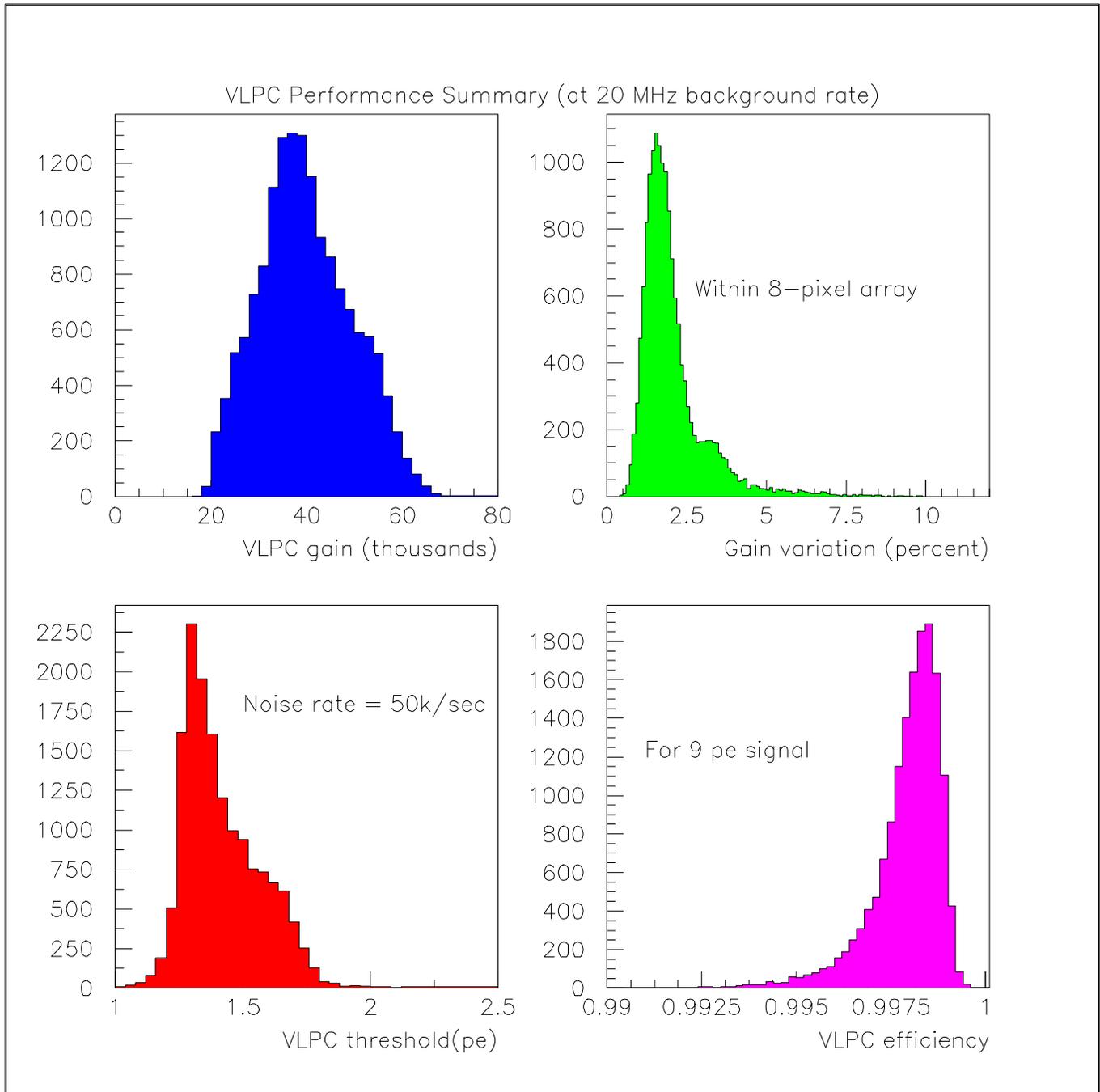
- **Tests at full background rate X3 (20 MHz)**

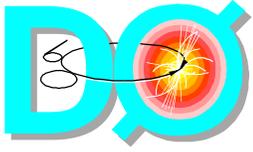




VLPCs

Device Performance





VLPC Cassettes

- Flex Circuits

- ◆ Procurement has been a problem

- ◆ Initial design and prototypes from LPC worked.

- Company bailed

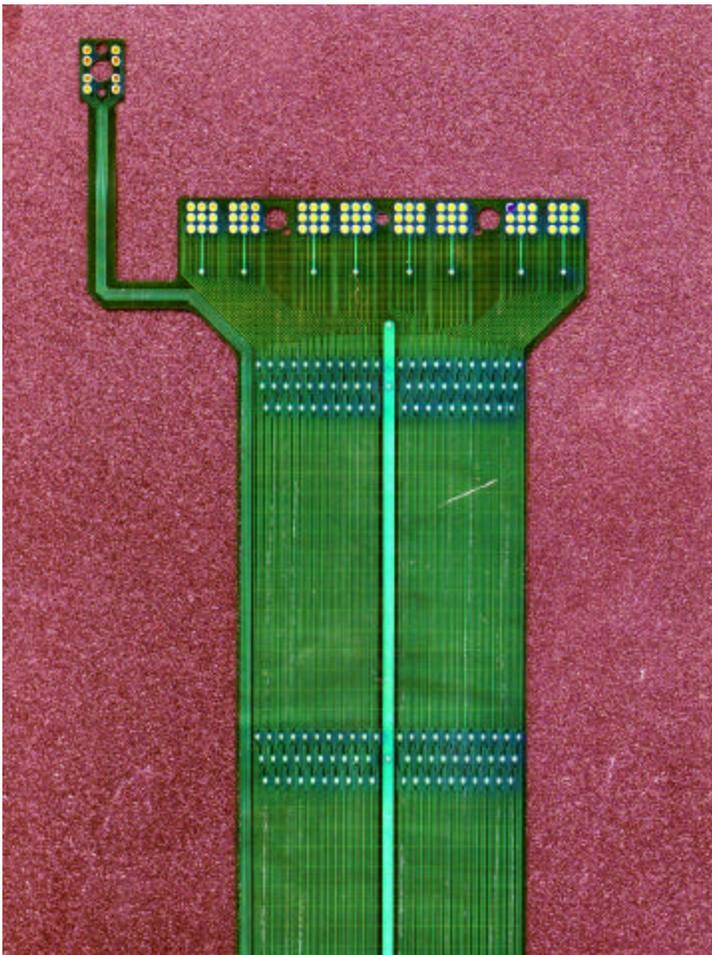
- ◆ For over 1 year we have been trying to qualify new vendor(s)

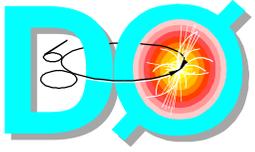
- ◆ Order now in place to Compunetics

- Technical and production capabilities excellent!

- ◆ Back-up solution

- ◆ Using Gore cable

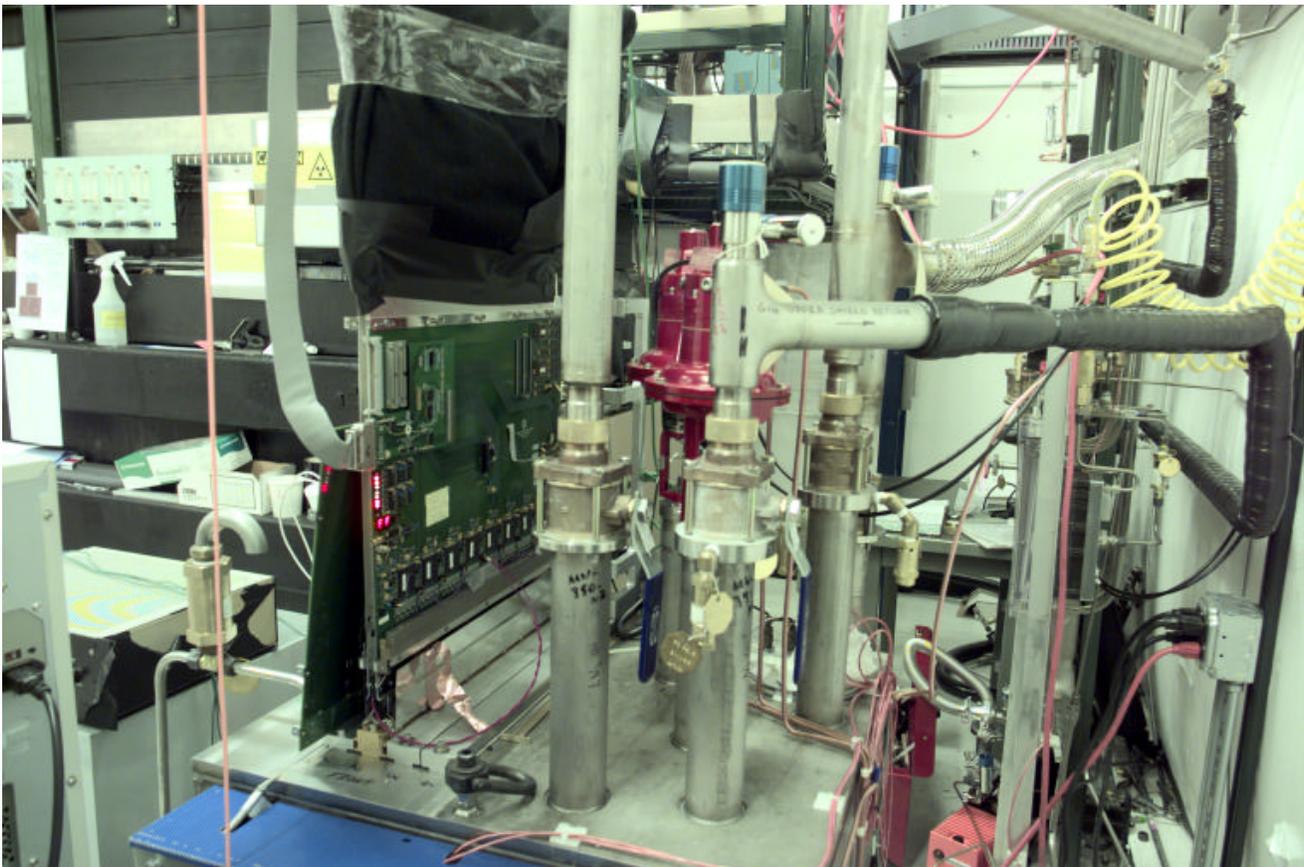


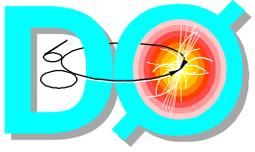


VLPC Cryo WBS 1.1.2.5

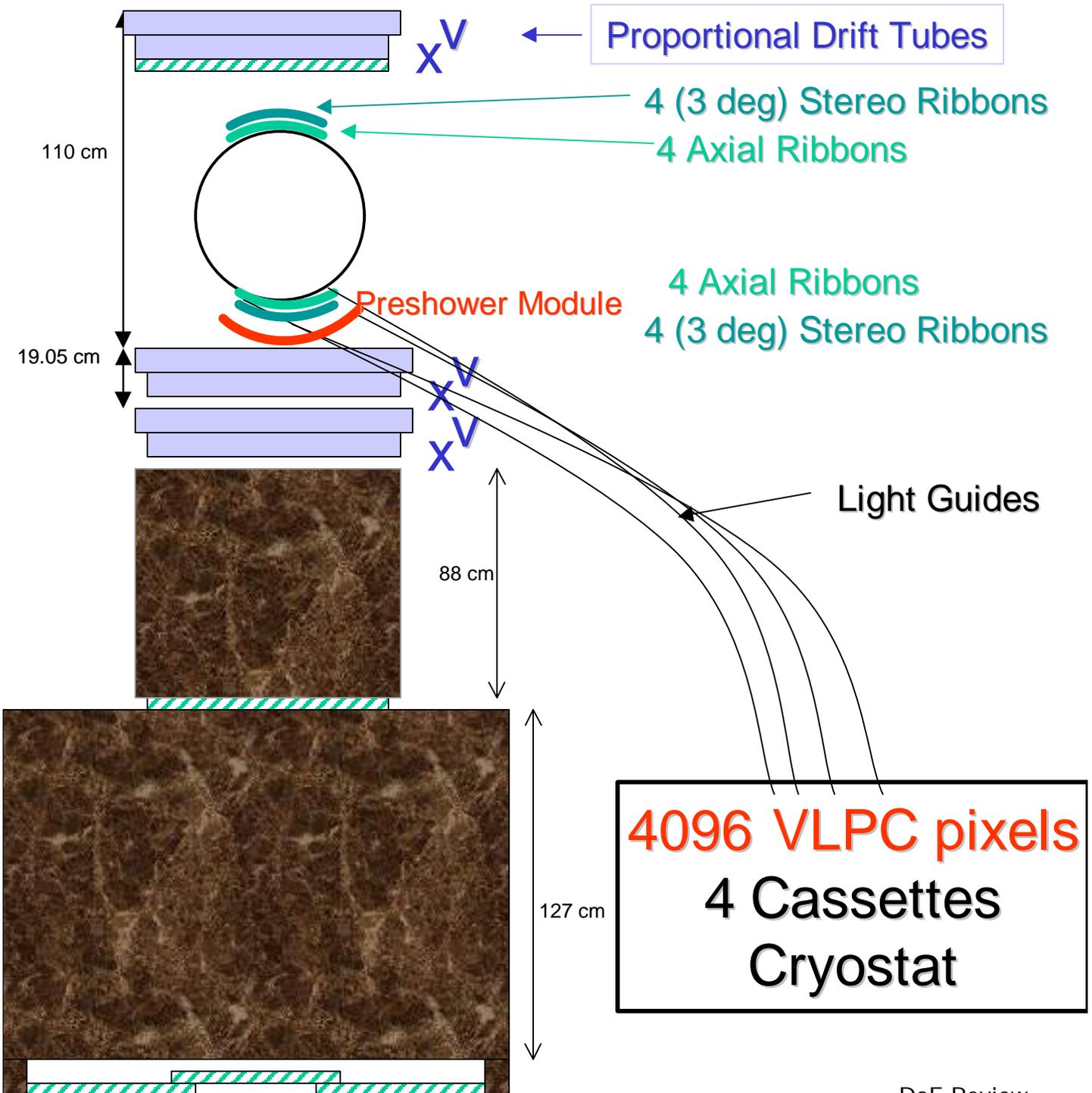
Test Cryostat - holds 4, full-size VLPC cassettes. Provides input to final cryo design

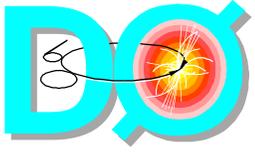
Fully Tested
Meets specification





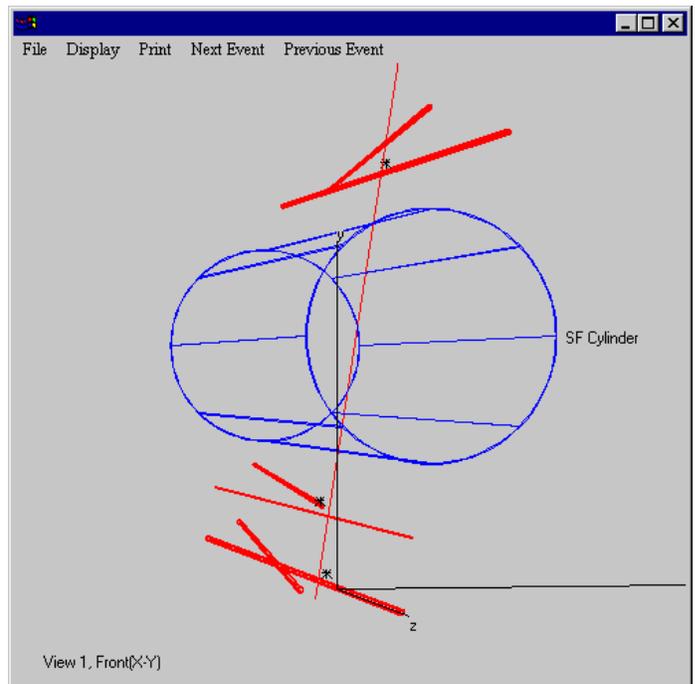
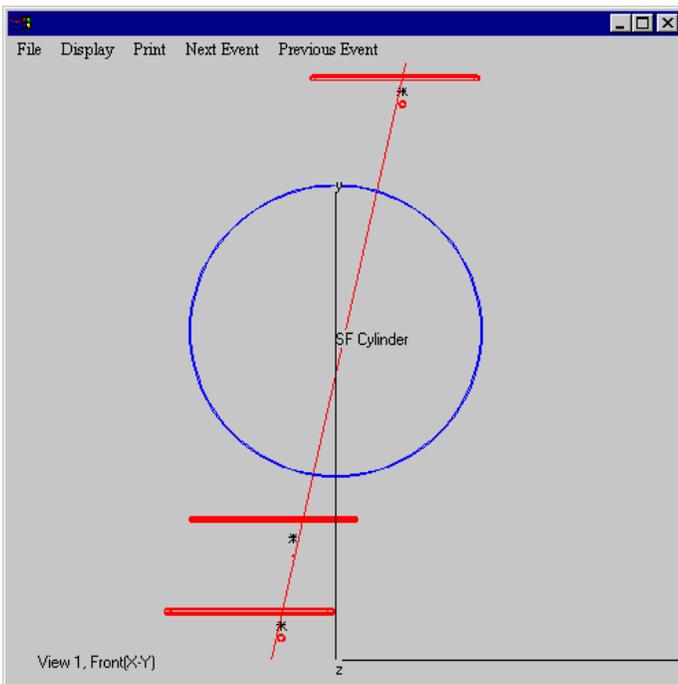
Cosmic Ray/System Test

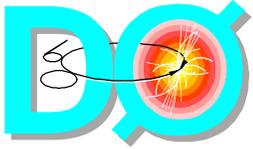




Cosmic Ray/System Test

- **Goals:**
 - ◆ Full System Test
 - ◆ Final Light Yield in Scintillating Fiber Tracker
 - ◆ Final Light Yield in Preshower Detectors
- External Proportional Drift Tube Tracker is installed, data were taken with Cosmic Ray Trigger





Fiber Tracker

- **Schedule**

- ◆ **48 week slip since Lehman 98**

- ◆ **Primary Causes**

- **Vendor Delivery delays**

- VLPC flex circuit
- Optical connectors

- **Tooling design and fabrication delays**

- Ribbon Molds

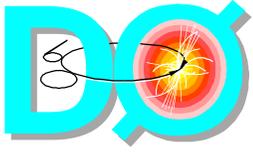
- problems with PPD Tech center
routing machine

- Ribbon and waveguide connectorization tooling
- Ribbon Mounting machine

- **Finalization of procedures**

- Ribbon gluing
- Optical connector gluing
- Cassette cold-end component gluing
- Ribbon Mounting

- Manpower limitations



Fiber Tracker

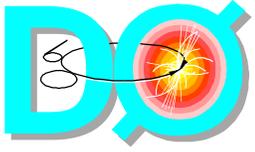
- **Schedule**

- ◆ **Current Status**

- ◆ **Optical connector delivery on schedule**
- ◆ **VLPC flex circuit procurement on track**
 - Vendor qualified
 - Capabilities (technical+production)
 - Excellent
- ◆ **Tooling ready and on schedule**
 - Ribbon Molds, Connectorization, ribbon mounting machine
- ◆ **Procedures Finalized**
 - Ribbon Fab
 - Connectorization
 - Cassette assembly
 - Ribbon Mounting

- ◆ **Production**

- ◆ **Ribbon Fab., Cylinder Fab, connectorization, ribbon Mounting**
 - Started and have good time estimates



Fiber Tracker

- **Schedule**

- ◆ **Time/effort in current schedule based on experience with actual production**

- ◆ **Mitigates some of delay**

- ◆ **Only Uncertainty**

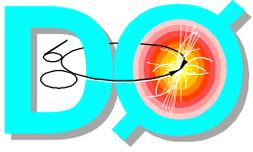
- ◆ **Tracker Assembly (nesting)**

- Tooling fabrication almost complete

- Actual procedures being developed

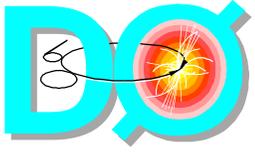
- Will conduct prototype tests this summer

- Procedures need to be finalized/debugged by 9/99 to prevent schedule slippage

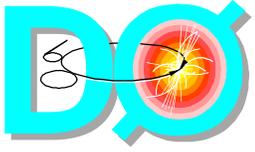


Summary

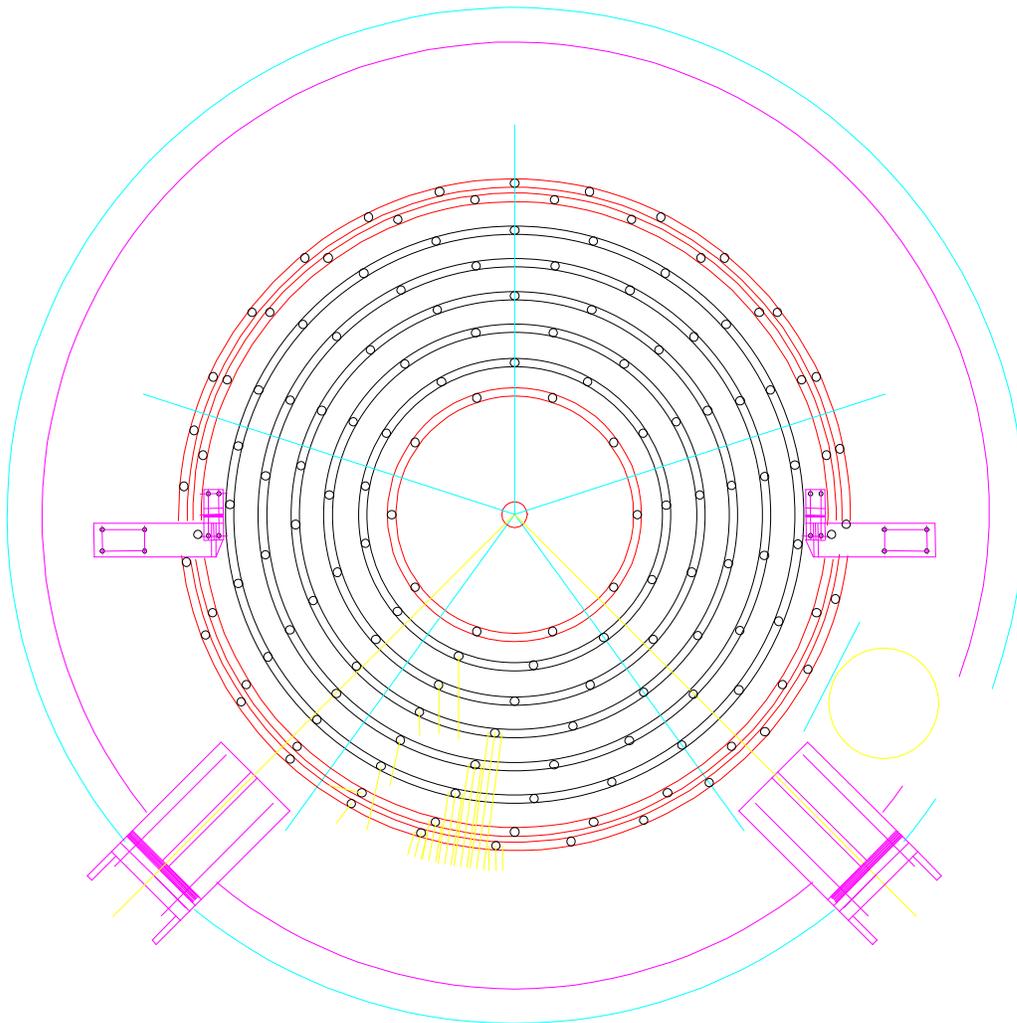
- All components of central fiber tracker are in production
 - ◆ Detector performance will meet Physics challenges of Run II
 - ◆ VLPC system performing extremely well
 - ◆ Active detector (Fiber Ribbons) well understood, production parts fully within specification
 - ◆ Mechanical support structure in production
 - Low Mass System
 - Excellent rigidity
 - ◆ Final Assembly Techniques developed, tooling fabricated
- Schedule consistent with May 2000 Roll in

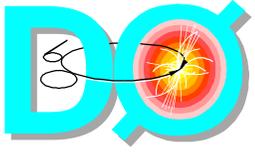


The End



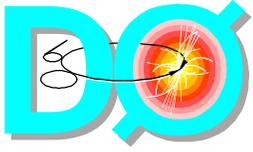
Tracker/Coil Supports





Cosmic Ray Test

- Test stand from Lab 6 has been moved to Lab 3
 - ◆ 2.5 GeV steel muon filter
 - ◆ Trigger Counters
 - ◆ Cryogen delivery system
- Cryostat
 - ◆ 4 slot prototype cryostat (4096 channels)
- New DAQ System
 - ◆ Utilizing Fermilab DART system
 - ◆ Code development then applicable to Run II environment (can utilize work done for Si)
 - ◆ Looking for new stand-alone external tracking system
- Plan test of cylinder 3 once complete



Fiber Electronics

