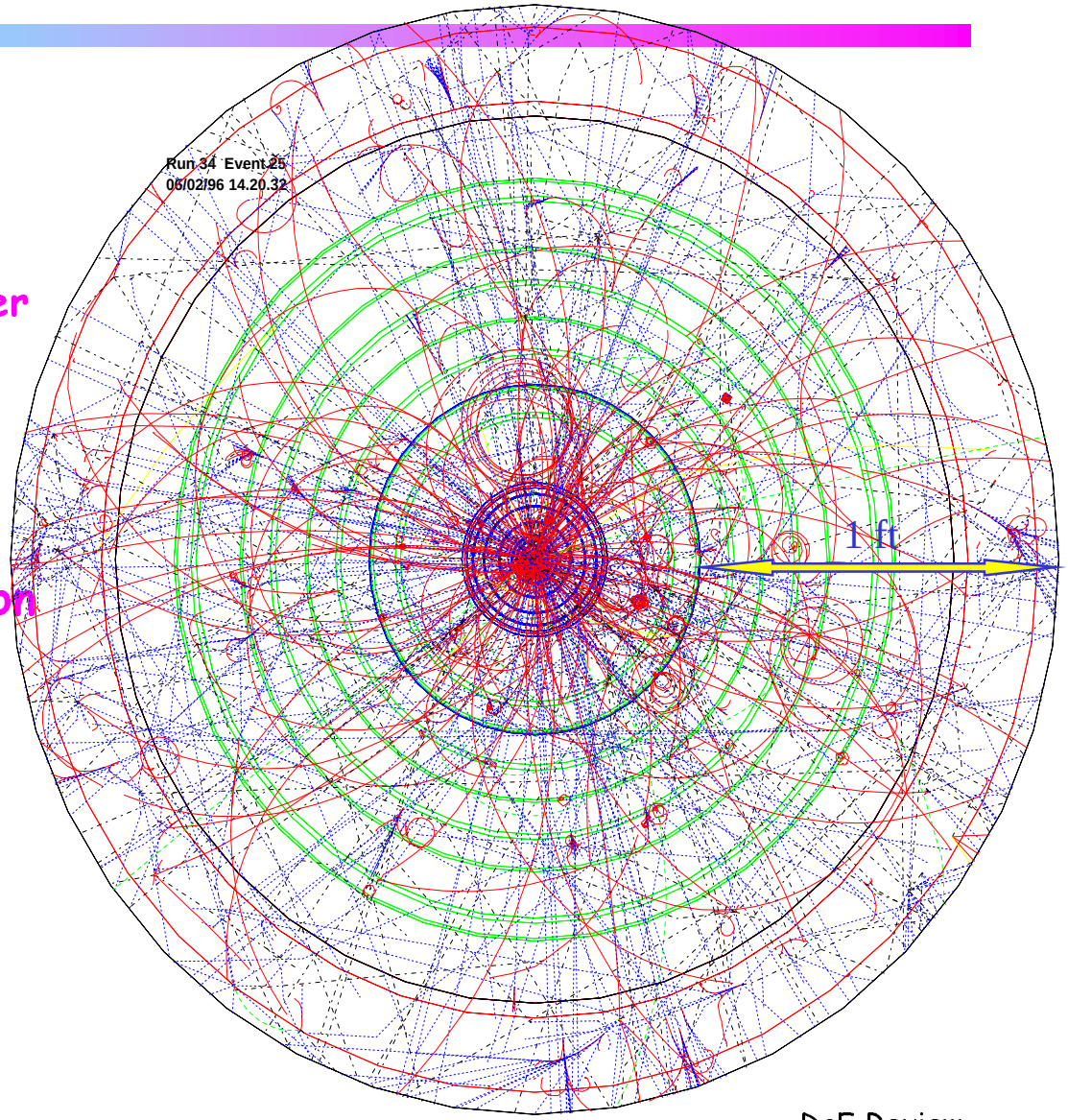
Scintillatingiac

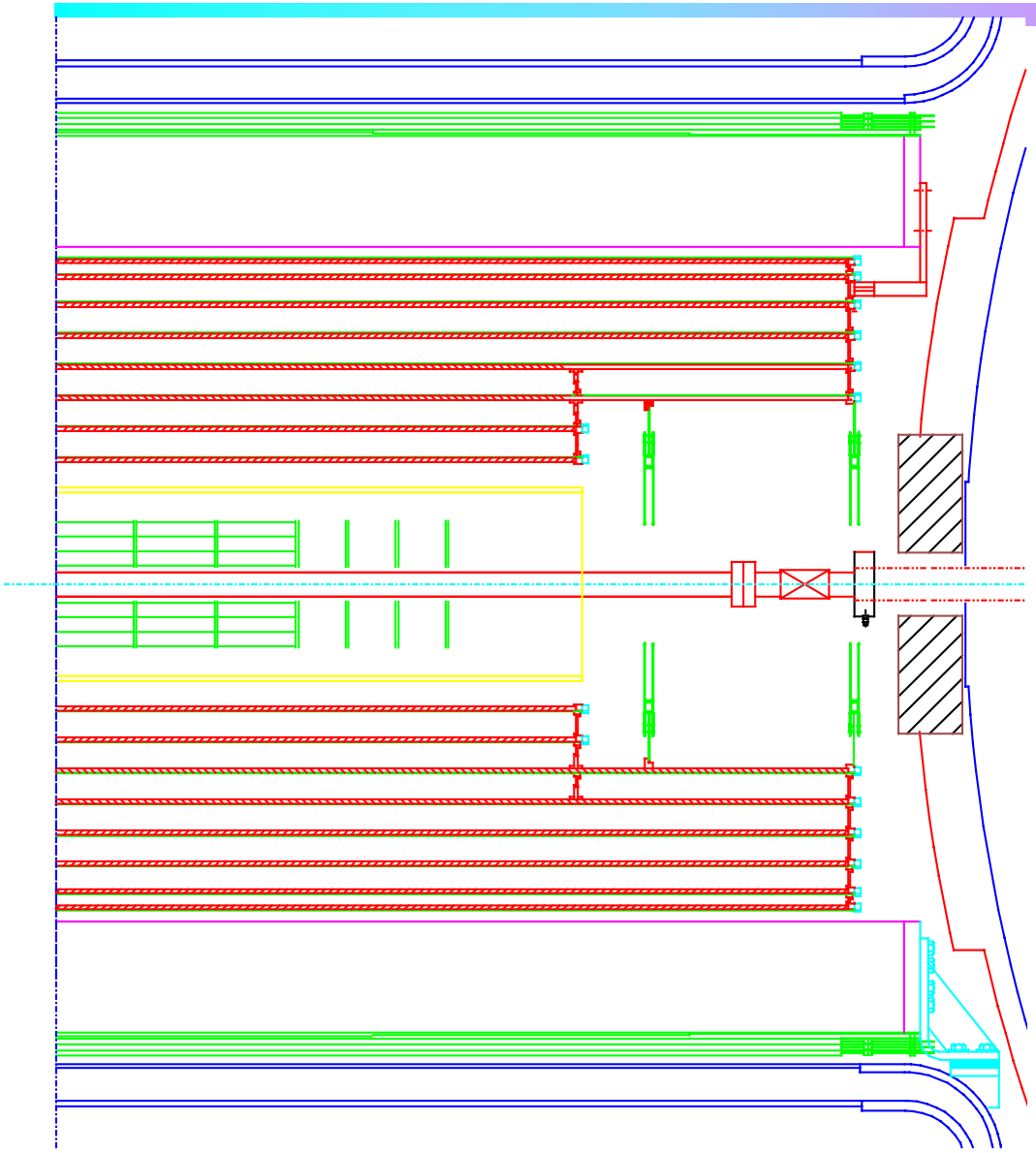
Provides:

1. With Silicon system
   - Track Reconstruction
   - Momentum measurement over $\eta = \pm 1.7$
   - Charge determination
   - Tagging of b-quarks
2. Fast Level 1 Triggering
   - Combining info. from muon and preshower systems
     - ▲ Single e, μ Triggers



$Z \rightarrow \mu^+\mu^-$ + 1 min bias

Stat

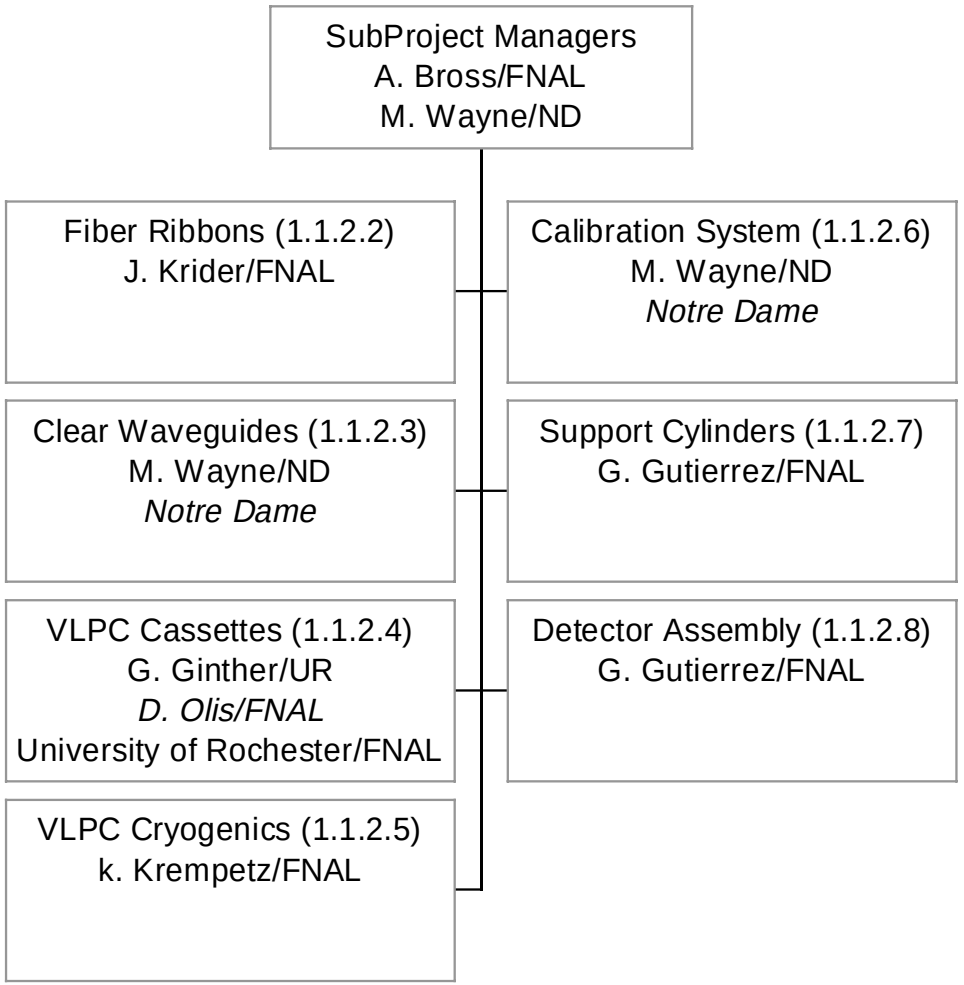


- 8 nested cylinders
  - r = 20 → 51 cm
- Each layer
  - 1 axial doublet
  - 1 stereo (u or v)

  xu - xv - xu - xv - ….

  Constant pitch ≈ 3°
- Layers
  - 1,2 - 1.8 m long
  - 2,8 - 2.6 m long
- Total channel count ≈77K
- Clear fiber brings signal to VLPCs - 7 - 11m

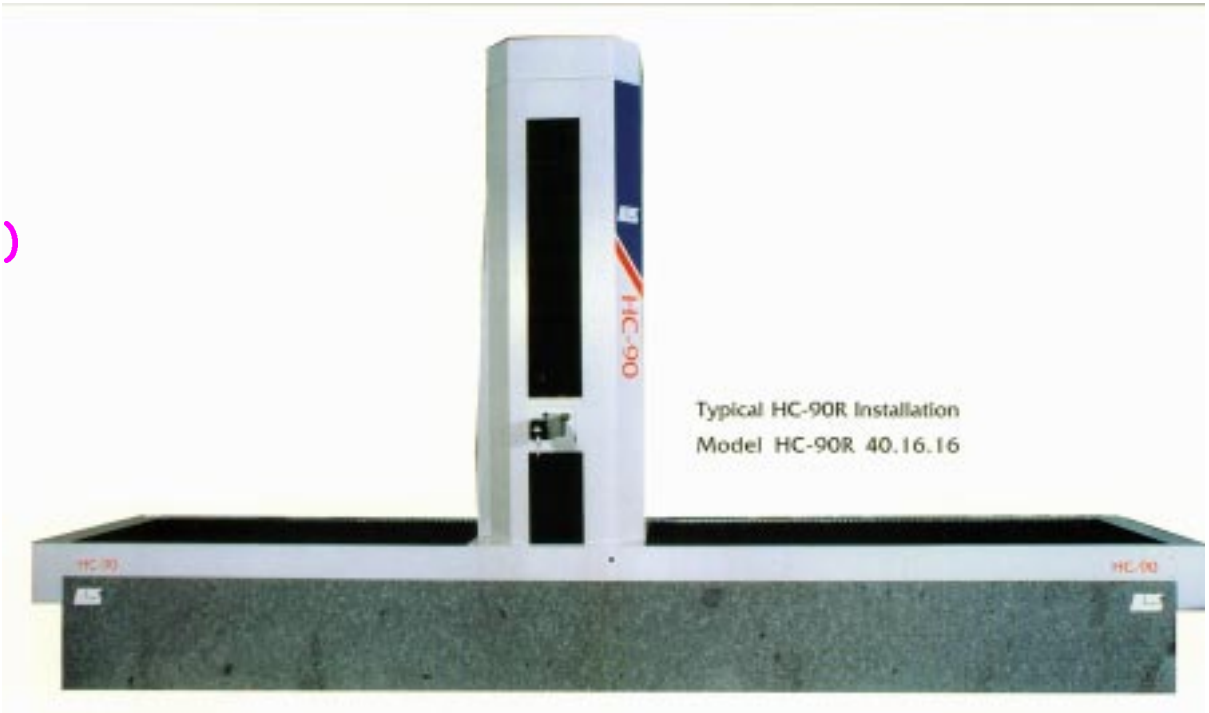
Fiber Tracker
WBS 1.1.2



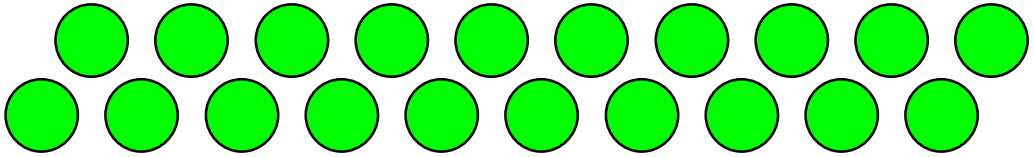
accanicall

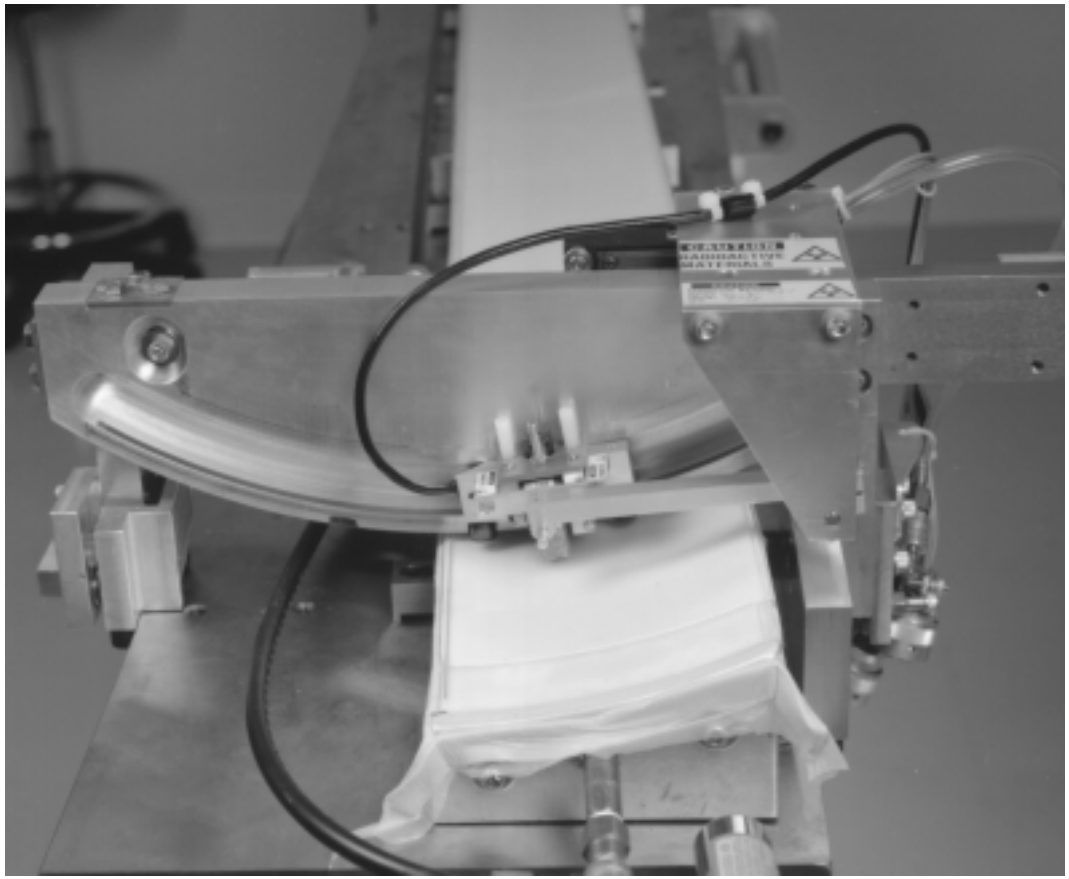
How do we glue precisely?

- LAB 3 FACILITY
  - 3200 ft^2 of clean room space + 1800 ft^2 general purpose area
    - Ribbon fabrication
    - Ribbon Mounting
    - Tracker Assembly (Nesting)
- Facility houses CMM
  - 4m X 1.5m X 1.5m
  - 20 μm → Volumetric precision (B89)
- CMM is used for
  - Component QC
    - Cylinders (mandrels)
    - Molds, connectors, etc
  - Ribbon Mounting QC
  - Cylinder nesting



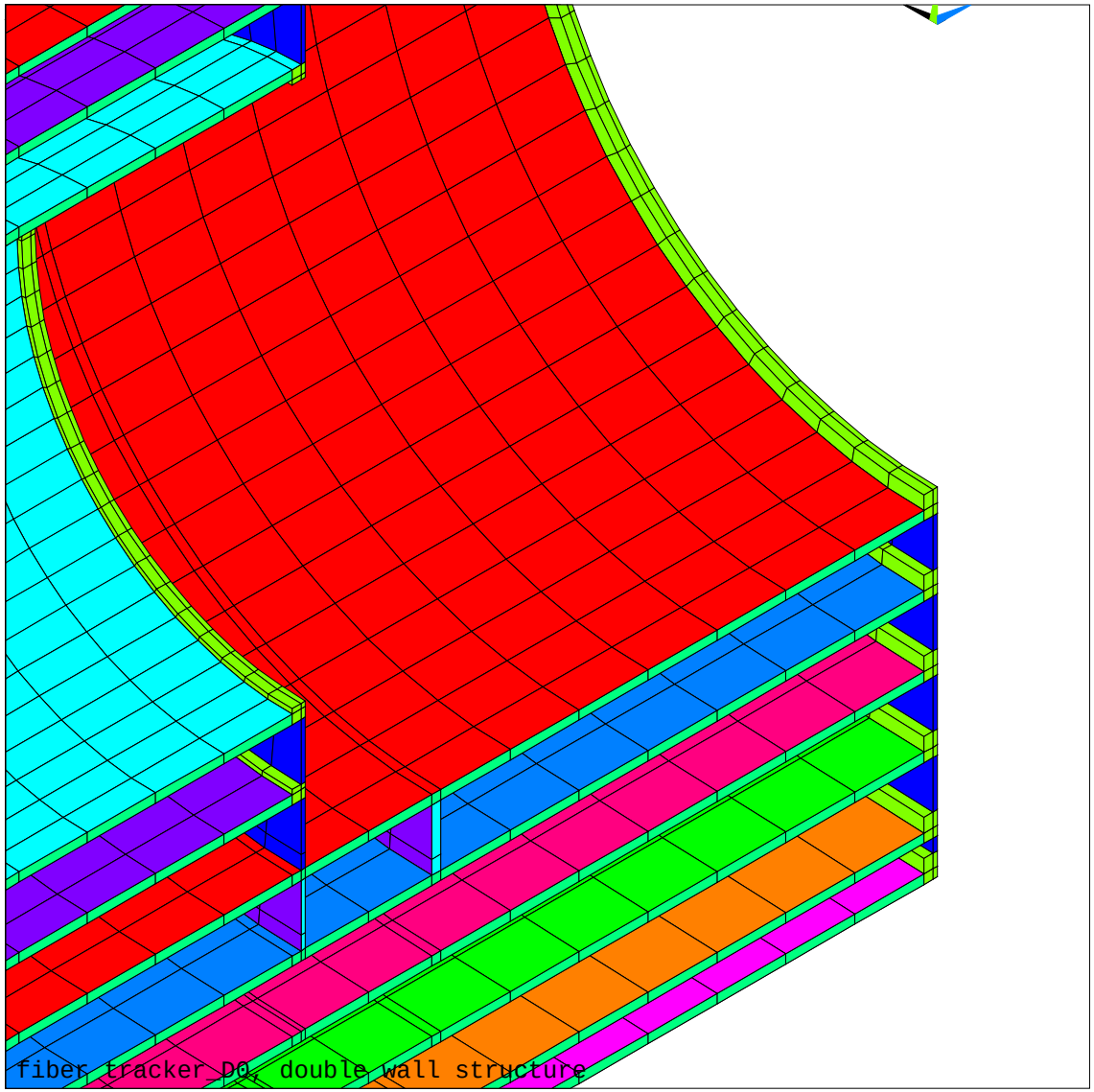
Scintillating Fiber Ribbons
WBS 1.1.2.2





- Interlocking doublet
- Pitch between 915 and 990 μm
- Grooved substrate - machined Delrin
- Substrate put into curved backbone
  - Fibers glued together with polyurethane adhesive
- Edge control good to 5 mil inter-ribbon gap specification
- Curved Torlon connectors then attached
- Ribbons is then QC'ed using scanning X-ray source

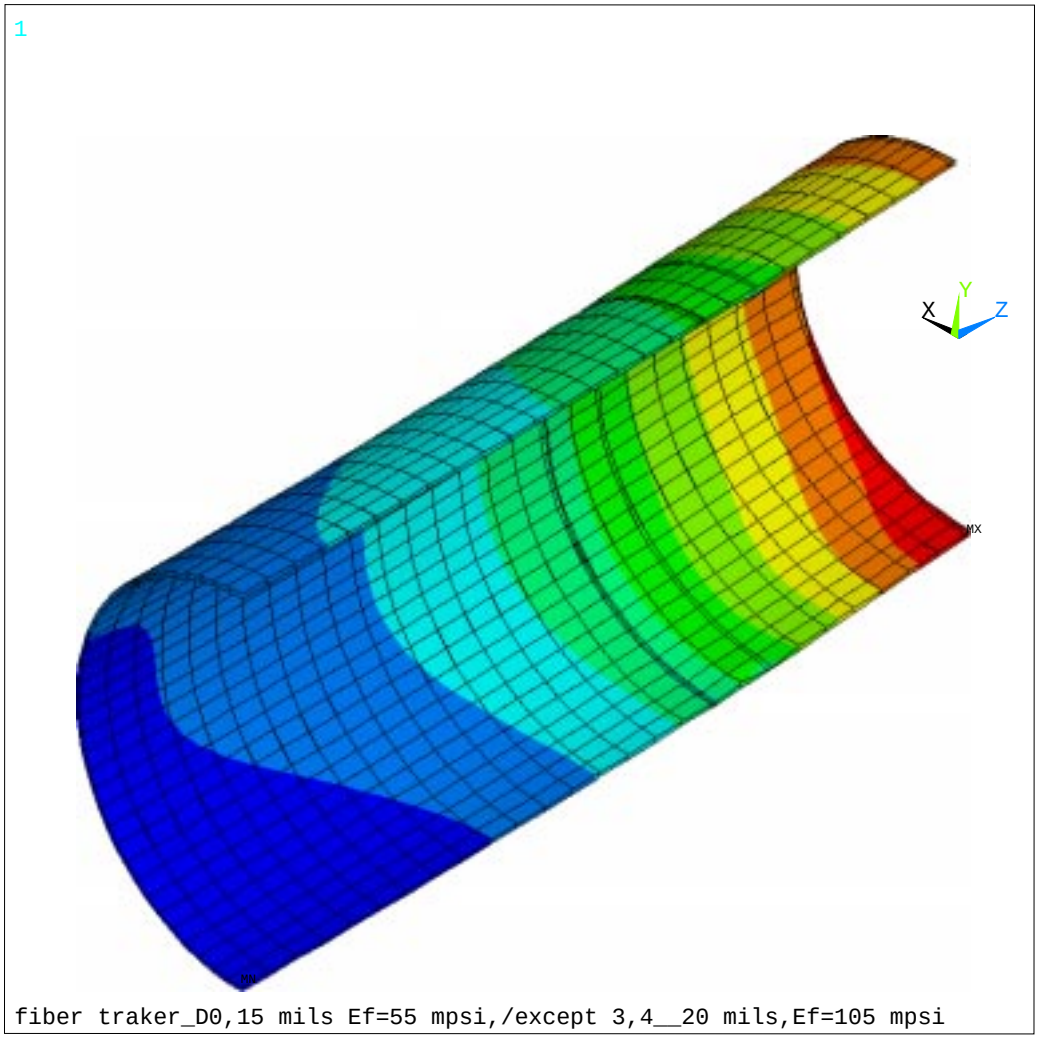
ANSYS Model - Detail



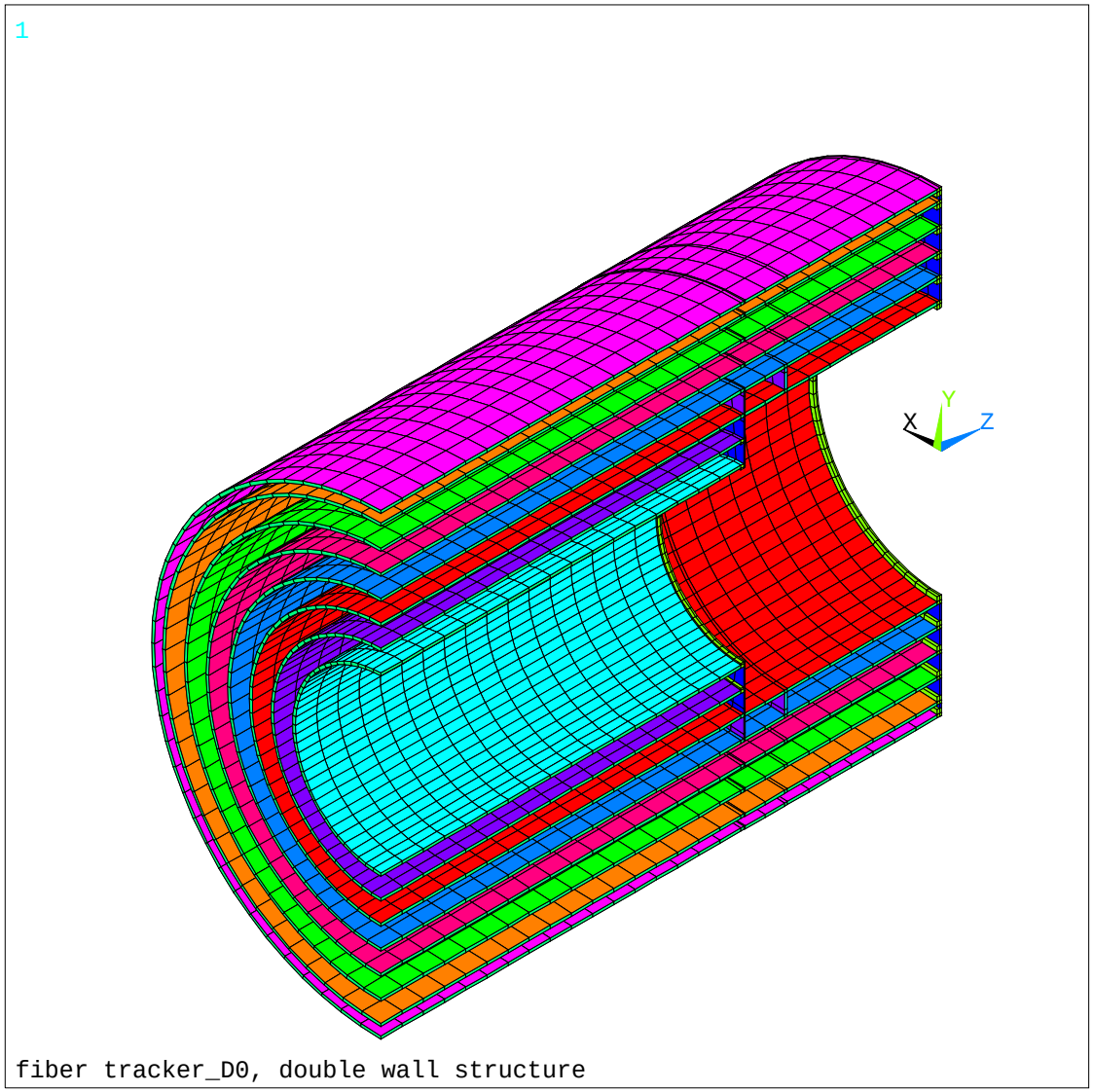

```
 ANSYS 5.3
 JAN  5 1998
 15:01:14
 PLOT NO.   2
 ELEMENTS
 TYPE NUM

 XV  =-1
 YV  =1
 ZV  =-1
*DIST=10.608
*XF  =-3.703
*YF  =-3.427
*ZF  =-14.506
 CENTROID HIDDEN
```

lide deletio



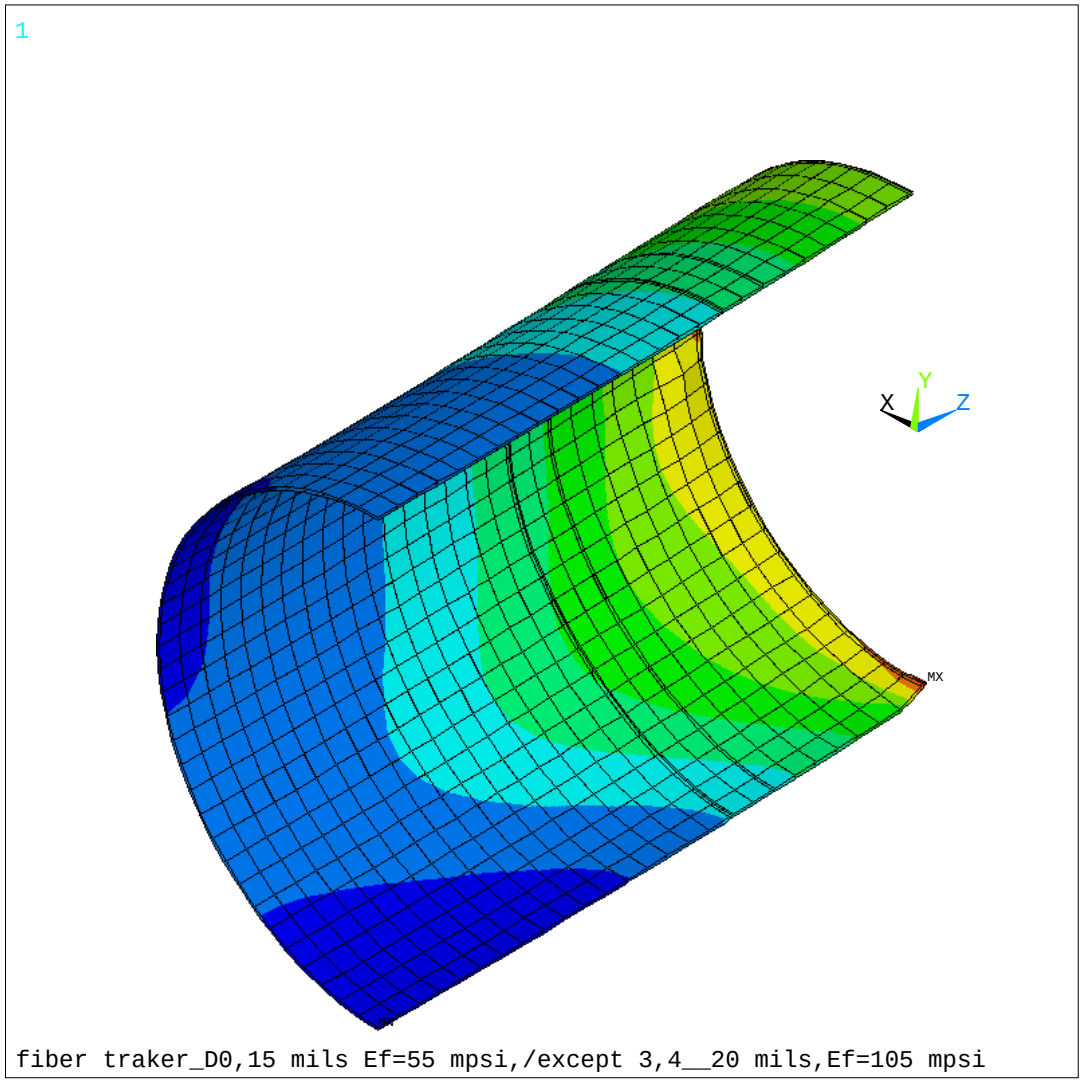
ANSYS Model



ANSYS 5.3
JAN 5 1998
14:59:32
PLOT NO. 1
ELEMENTS
TYPE NUM

XV =-1
YV =1
ZV =-1
DIST=34.171
XF =10.219
ZF =-25
CENTROID HIDDEN

lide Deletio



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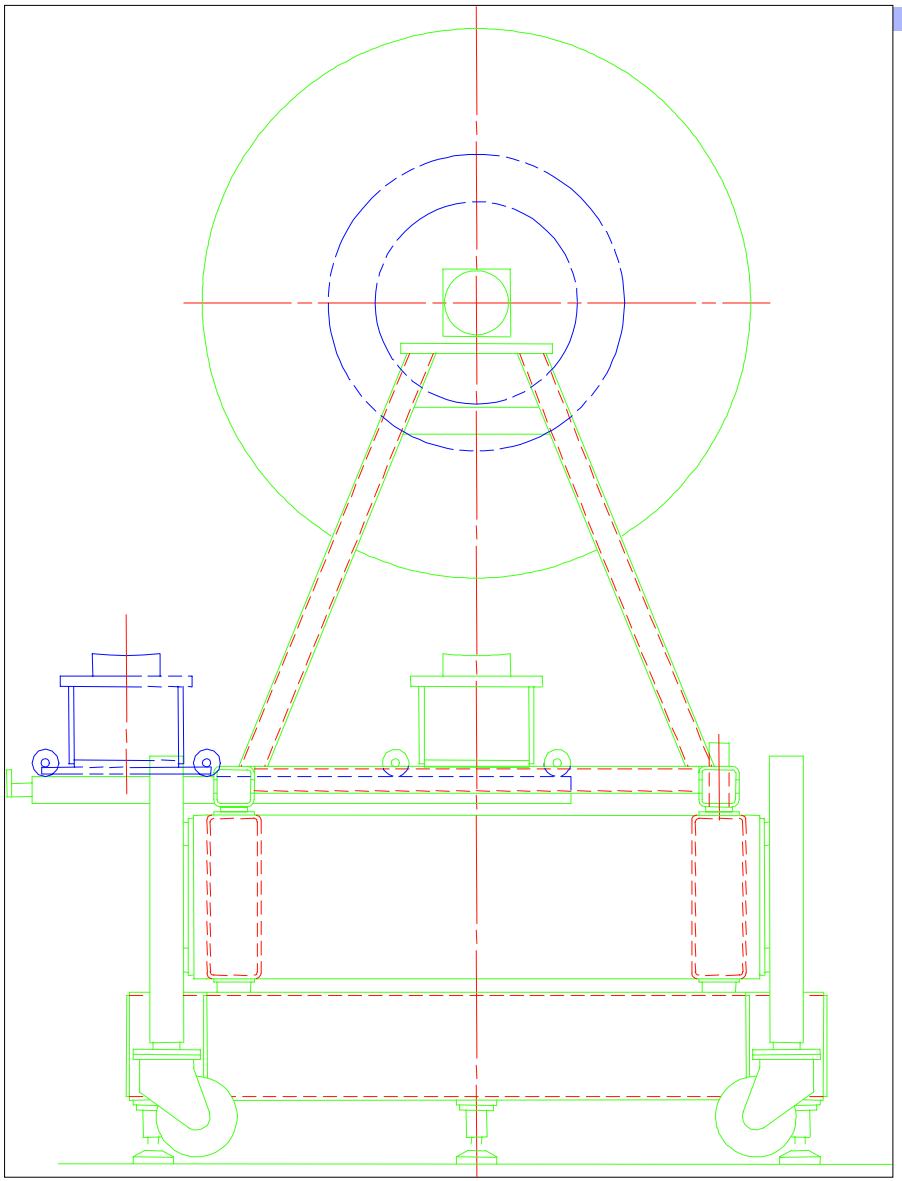
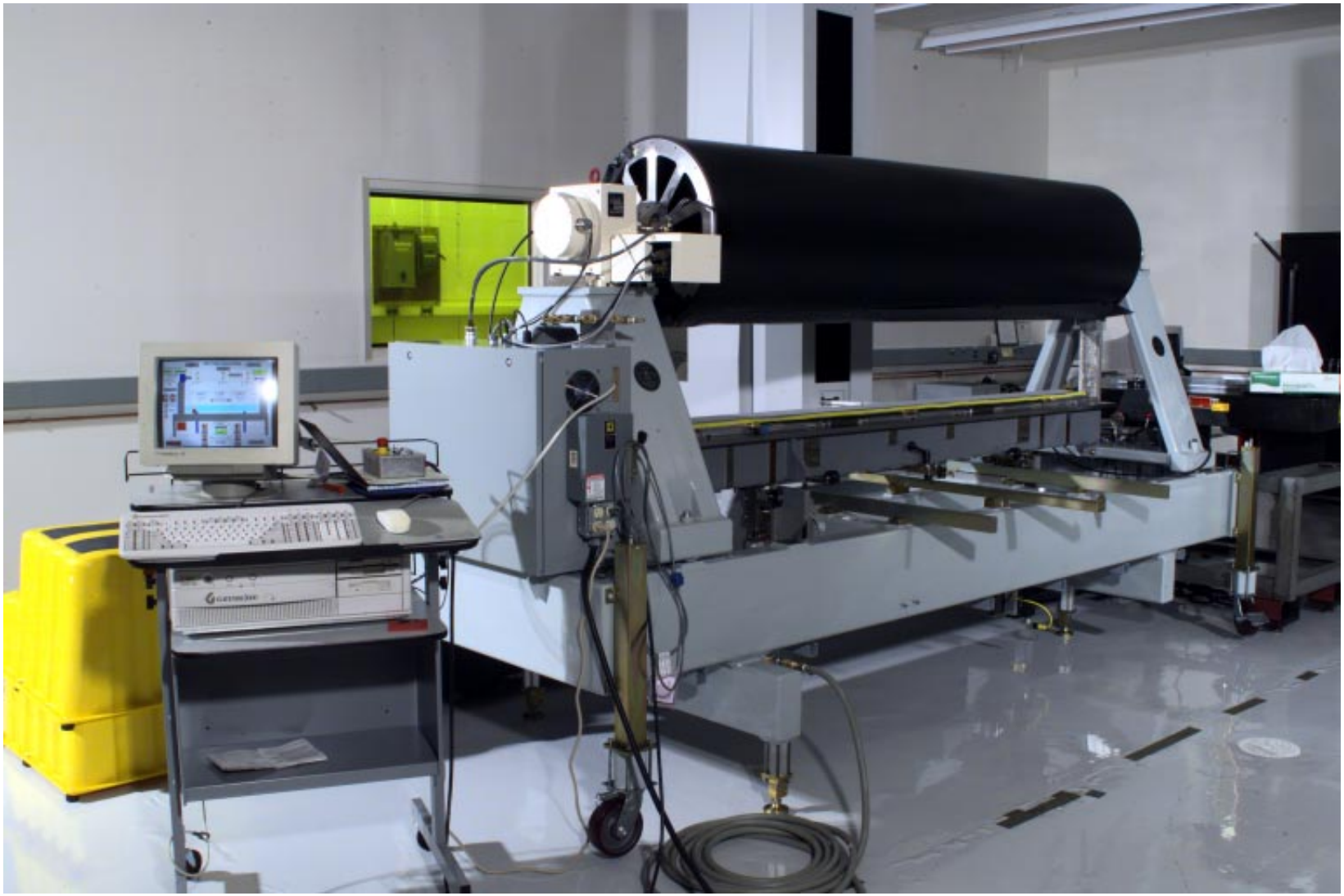
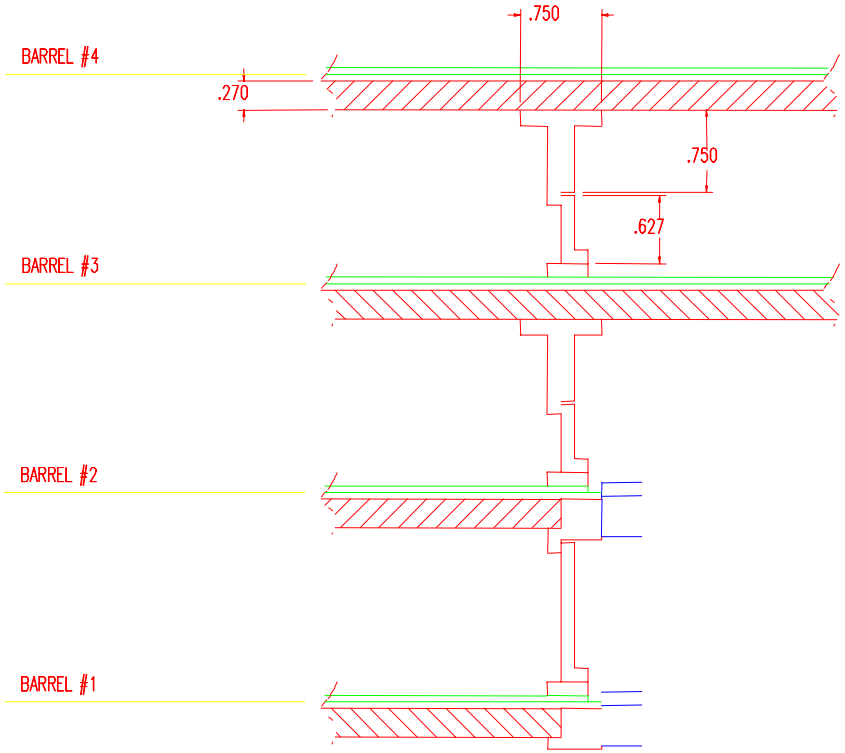


- Ribbons are laid into same mold fixture as they were produced in
- Machine incorporates
  - Precision rotary table
  - Precision vertical lifts
- Ribbon is placed at "Fixed Radius" with respect to cylinder axis
- Entire machine is calibrated/certified in large Horizontal CMM - Lab 3 Facility (more later)

io Moti

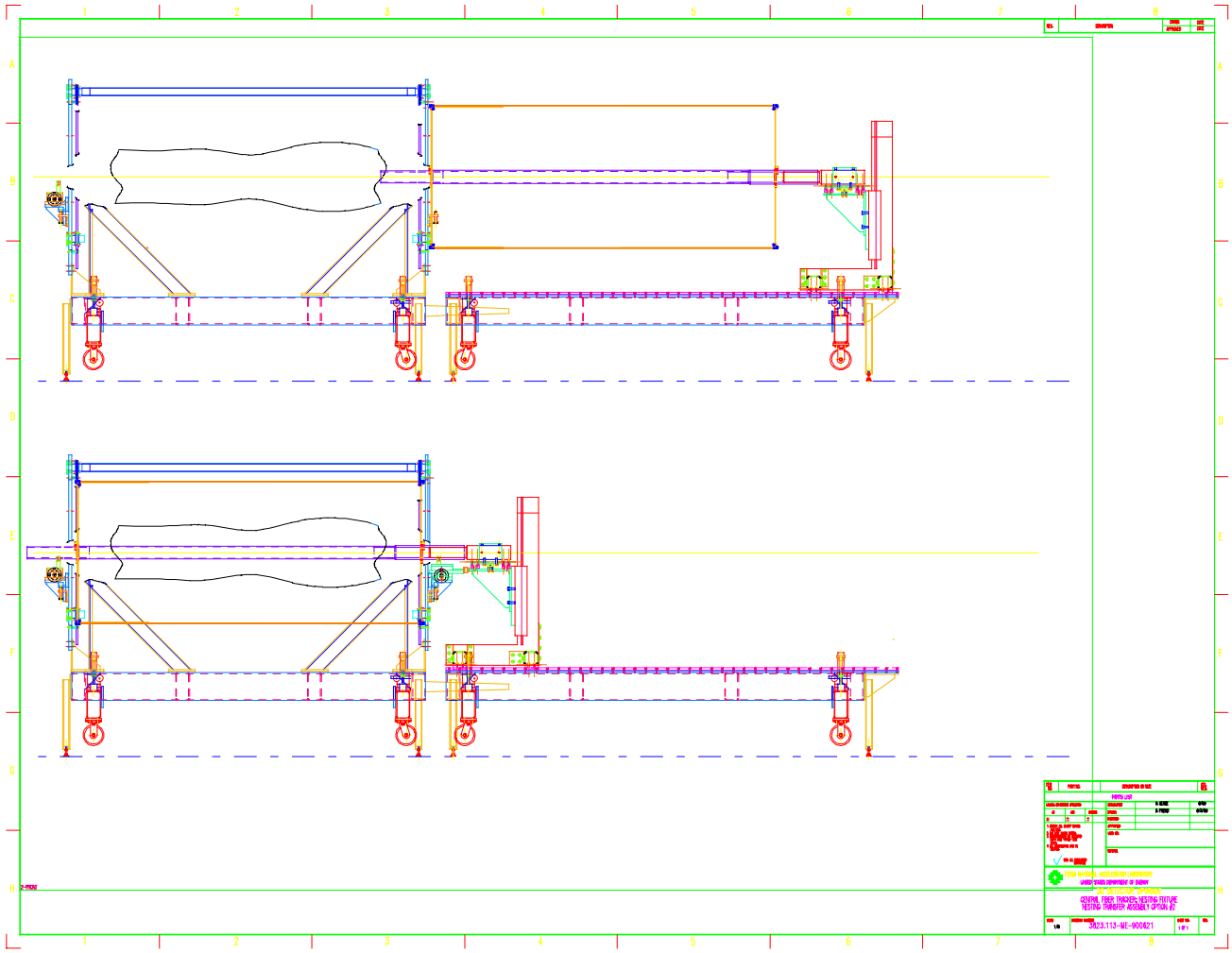


ae Ael
WBS 1.1.2.



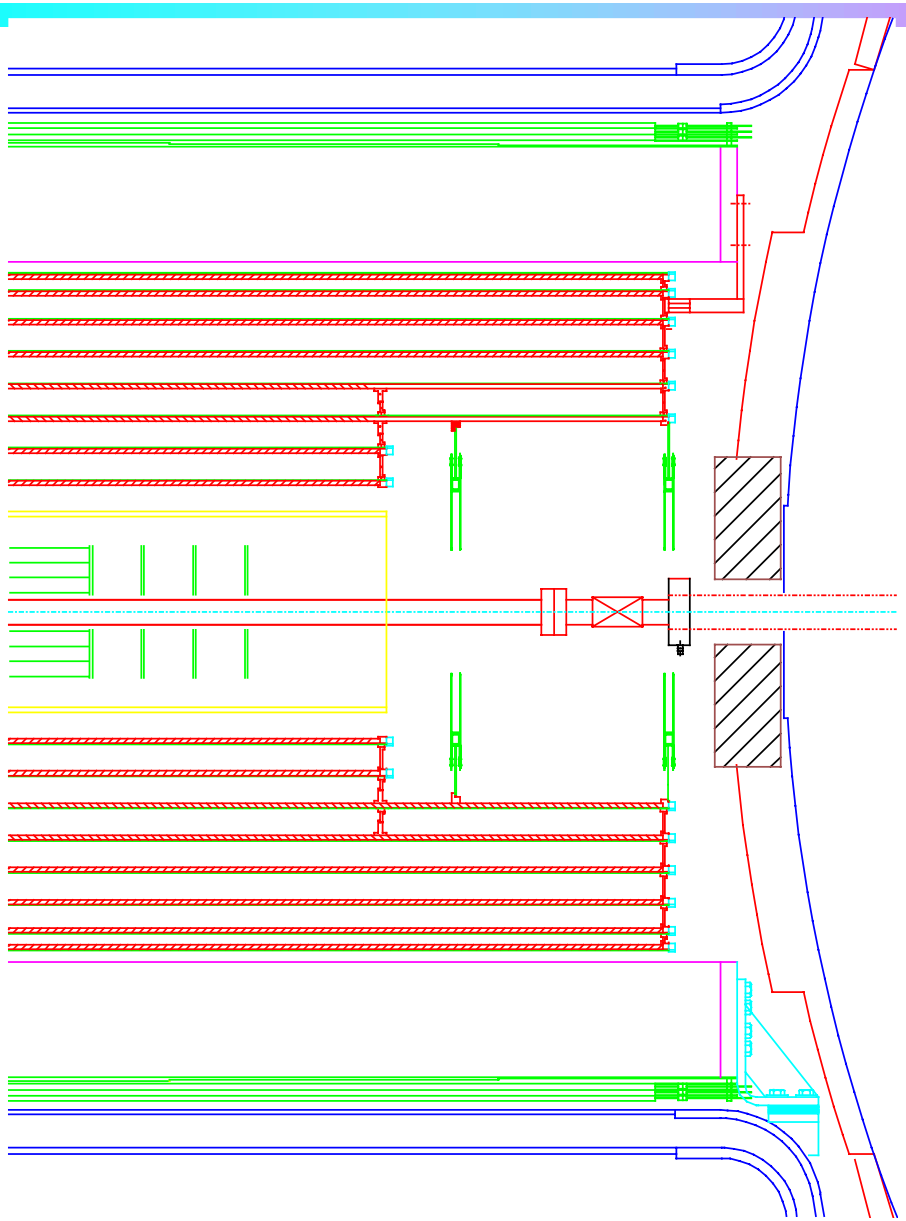
- The eight individual cylinders will be assembled "nested" using carbon-fiber rings and disks
- Low mass
- Very Stiff
- Glued to cylinders (ID) and fibers (s=20psi)
  - 50 mm bend r → 4000psi
- Entire operation performed with aid of CMM (lab 3 Facility)
  - End to end precision of better than 20μm

Tracker Assembly II



- Nesting Carts
  - Fixed Outer holds 8
  - 7-1 installed sequentially
- CMM used to determine relative position of cylinders
- 3 axis verniers (micrometers) allow for adjustment

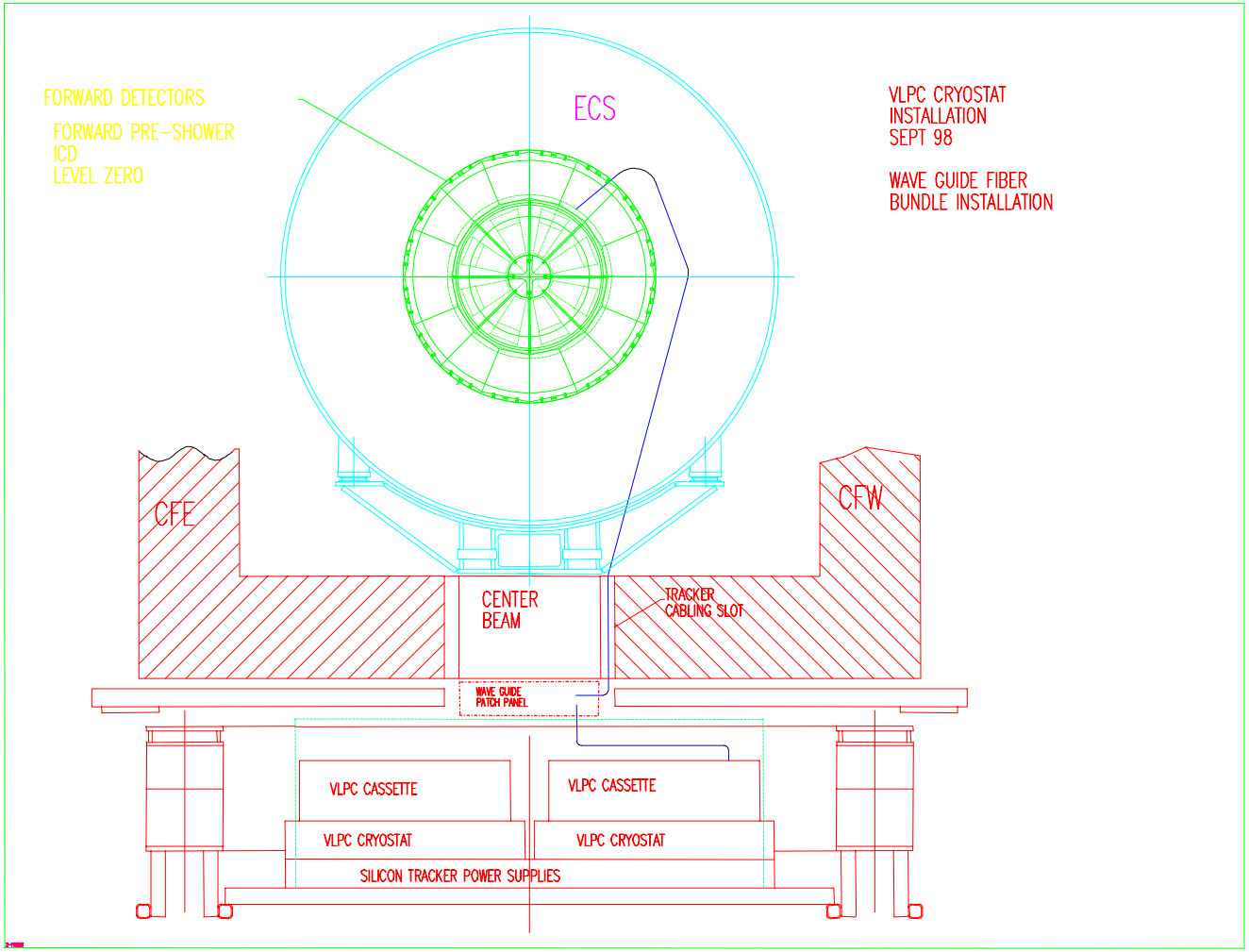
Tracker Assembly III



Overall Support Scheme

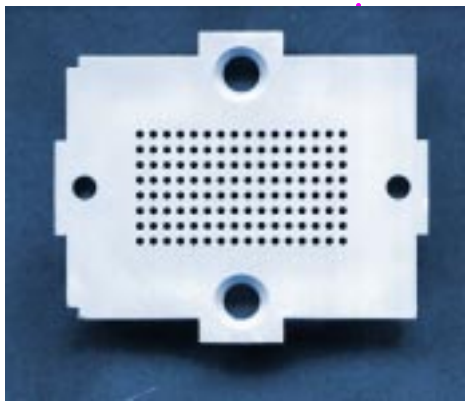
- Entire Tracker supported off coil
  - Via connection to end-disk
    - 3 and 9 o'clock
  - Coil supported via connection to central cryostat
- Silicon system sits in carbon-fiber trough inside cylinder 1
  - H Disks attached to cylinder 3 via kinematic mounts

Waveguide Bundle Fabrication and outing



Waveguide bundles consist of 256 fibers in light-tight nylon sheath

- Curved connector (256 ch.) at detector
- 2 128 ch. Connector

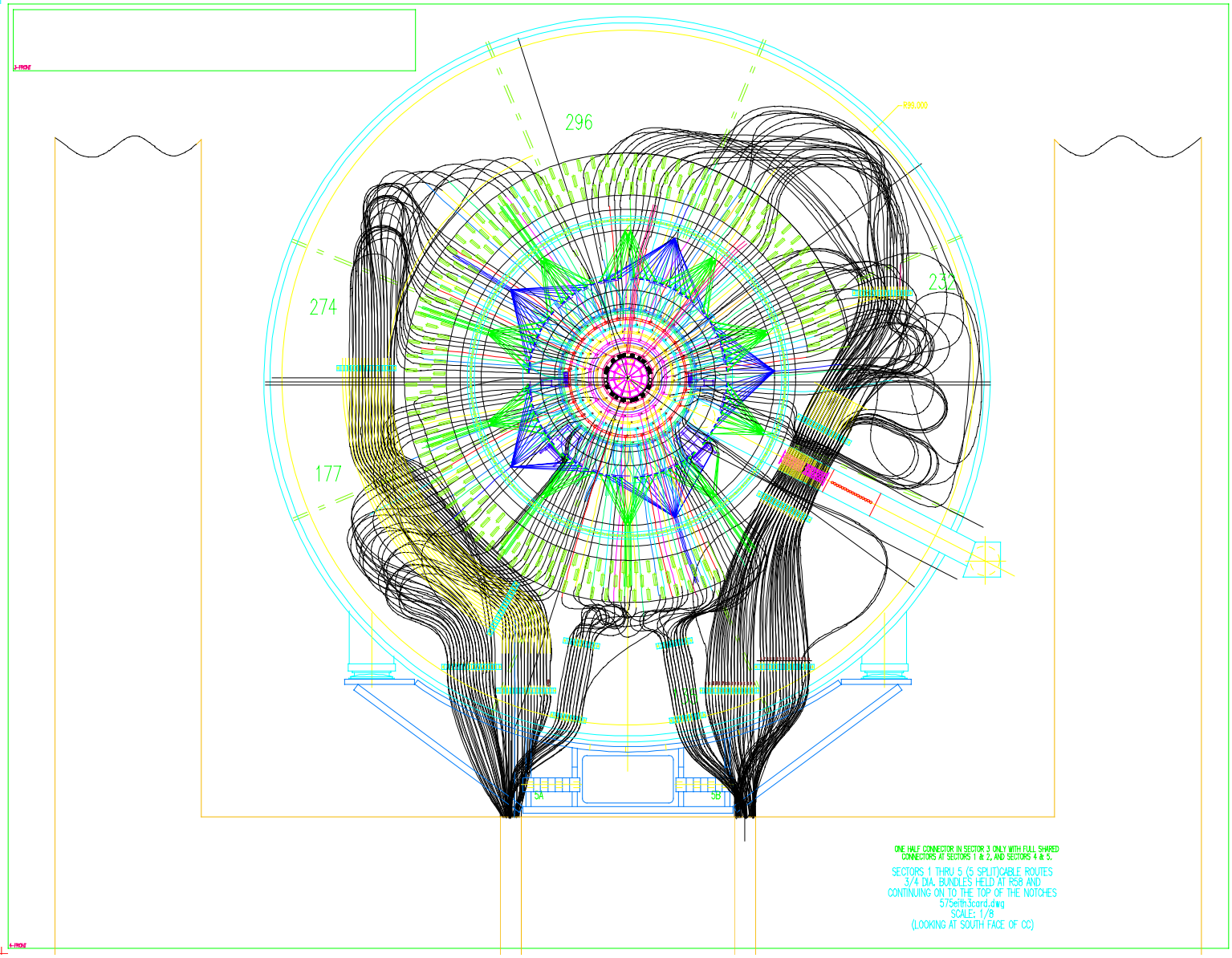


No optical mixer

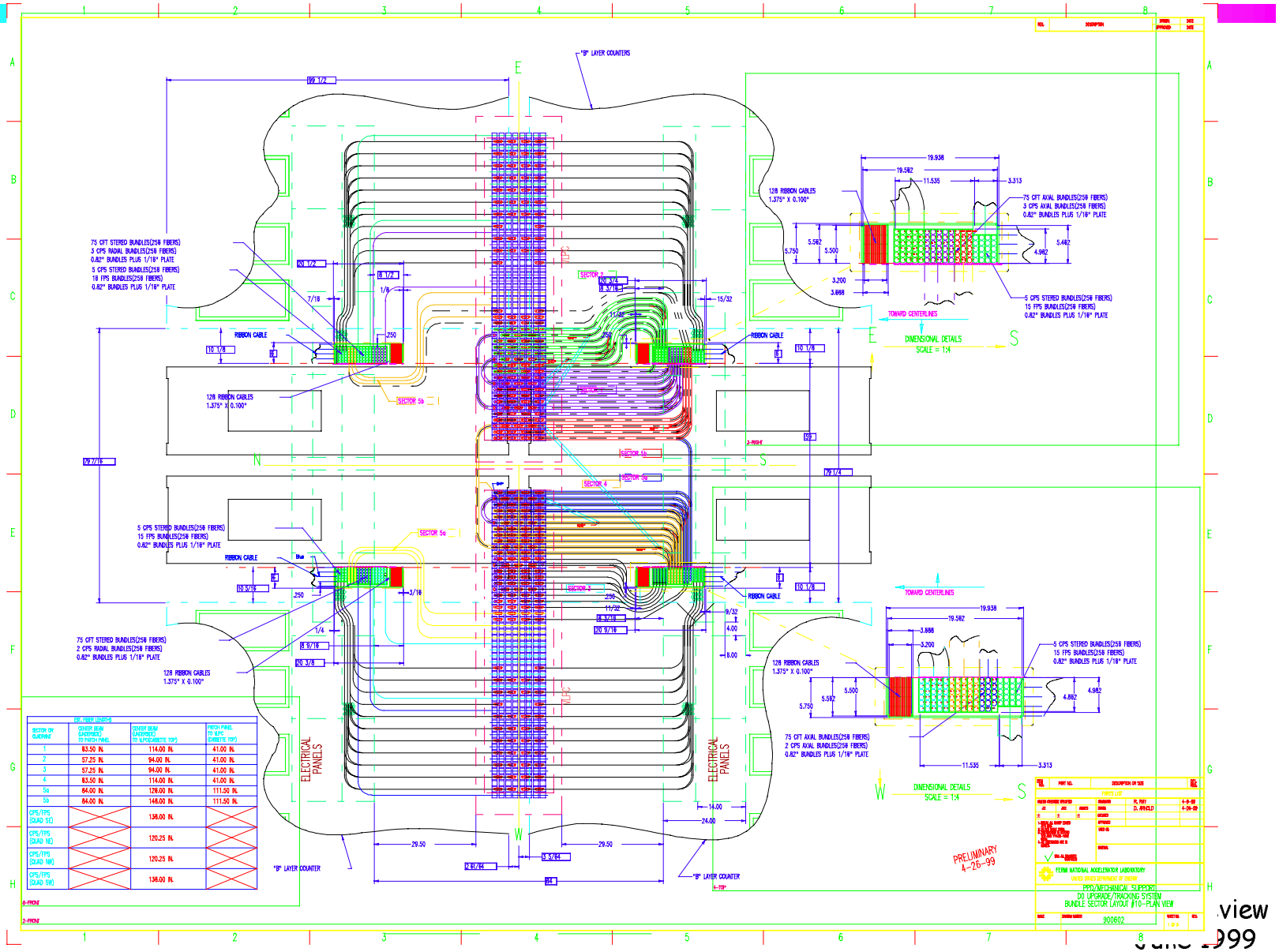
- Electronic mixer
- All Waveguide bundles go directly from detector to VLPC cassettes

Waveguide Bundle outing

- We now have routing for CFT and CPS complete.



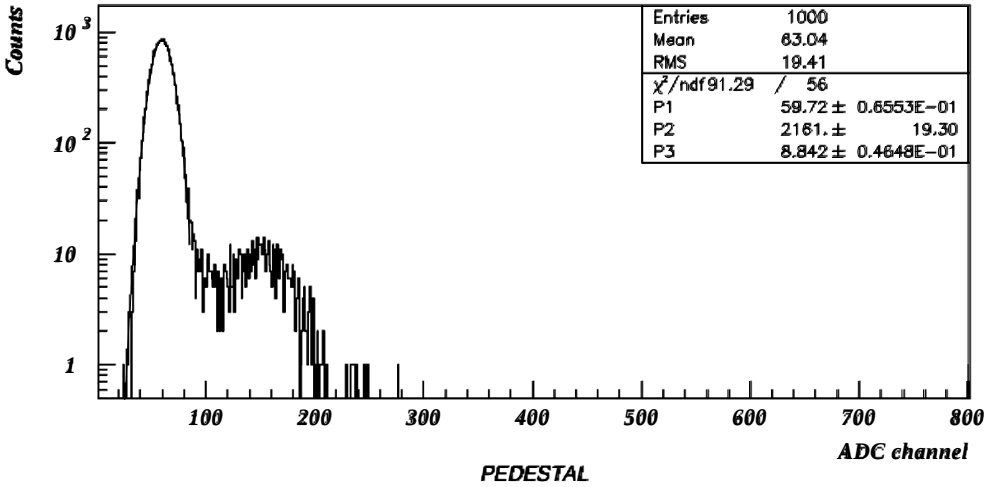
Waveguide Bundle outing

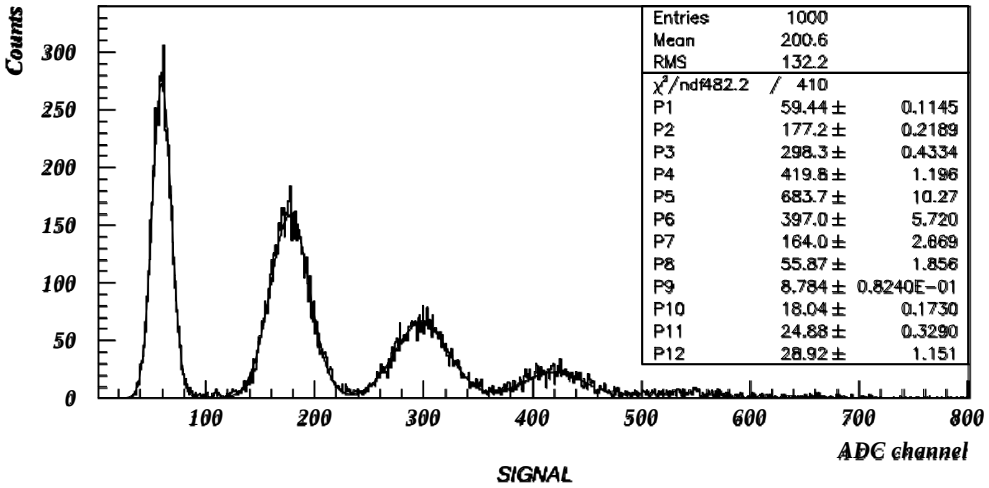


SECTOR OR QUADRANT	CENTER BEAM (LAMPSHADE) TO PATCH PANEL	CENTER BEAM (LAMPSHADE) TO SVX CASSETTE TOP)	PATCH PANEL TO SVX CASSETTE TOP)
1	83.50 IN.	114.00 IN.	41.00 IN.
2	57.25 IN.	94.00 IN.	41.00 IN.
3	57.25 IN.	94.00 IN.	41.00 IN.
4	83.50 IN.	114.00 IN.	41.00 IN.
5a	84.00 IN.	126.00 IN.	111.50 IN.
5b	84.00 IN.	148.00 IN.	111.50 IN.
CPS/FPS (QUAD SE)		138.00 IN.	
CPS/FPS (QUAD NE)		120.25 IN.	
CPS/FPS (QUAD NW)		120.25 IN.	
CPS/FPS (QUAD SW)		138.00 IN.	

view

June 1999

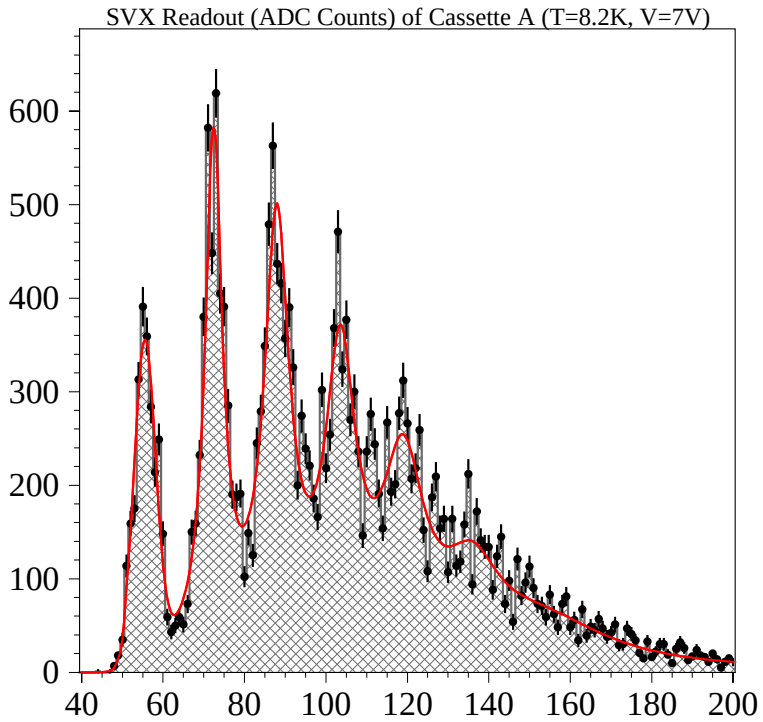




- VLPC → HISTE VI
  - High QE ≈ 80%
  - Low noise $<10^4$ (@ ≈ 1 pe)
  - High Rate capability
    - >40 MHz
  - High production yield
    - ≈ 70%
      (vs. 27% projected)

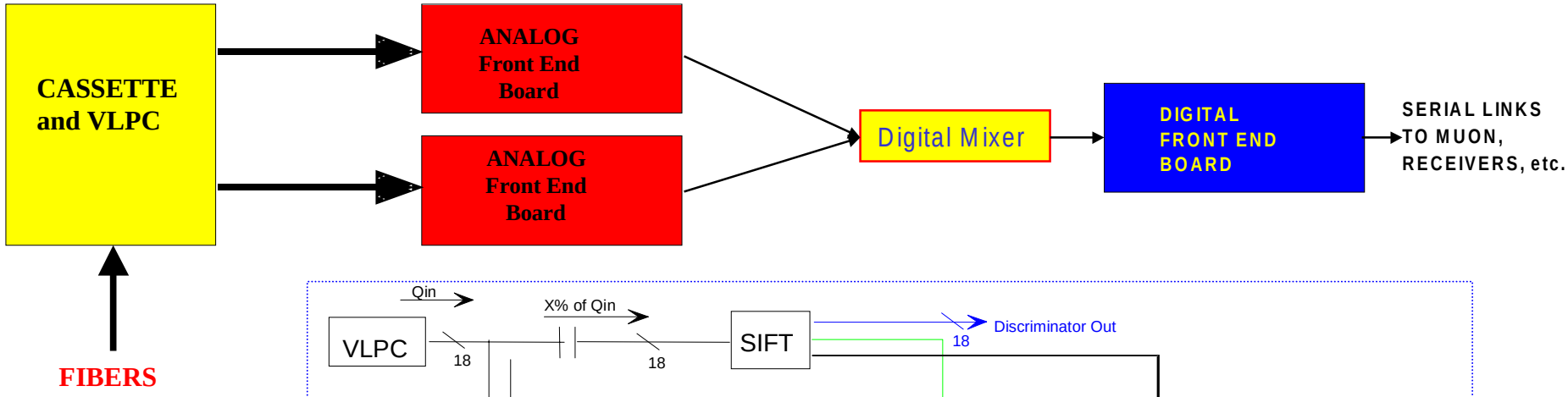
1024 Channel VLPC Cassettes

- Engineering Design Complete
  - All component parts on order
    - Approximately 50% in-house
- First Article(s) under test
  - In 4 cassette cryostat
  - Readout with SVX II readout chain successful

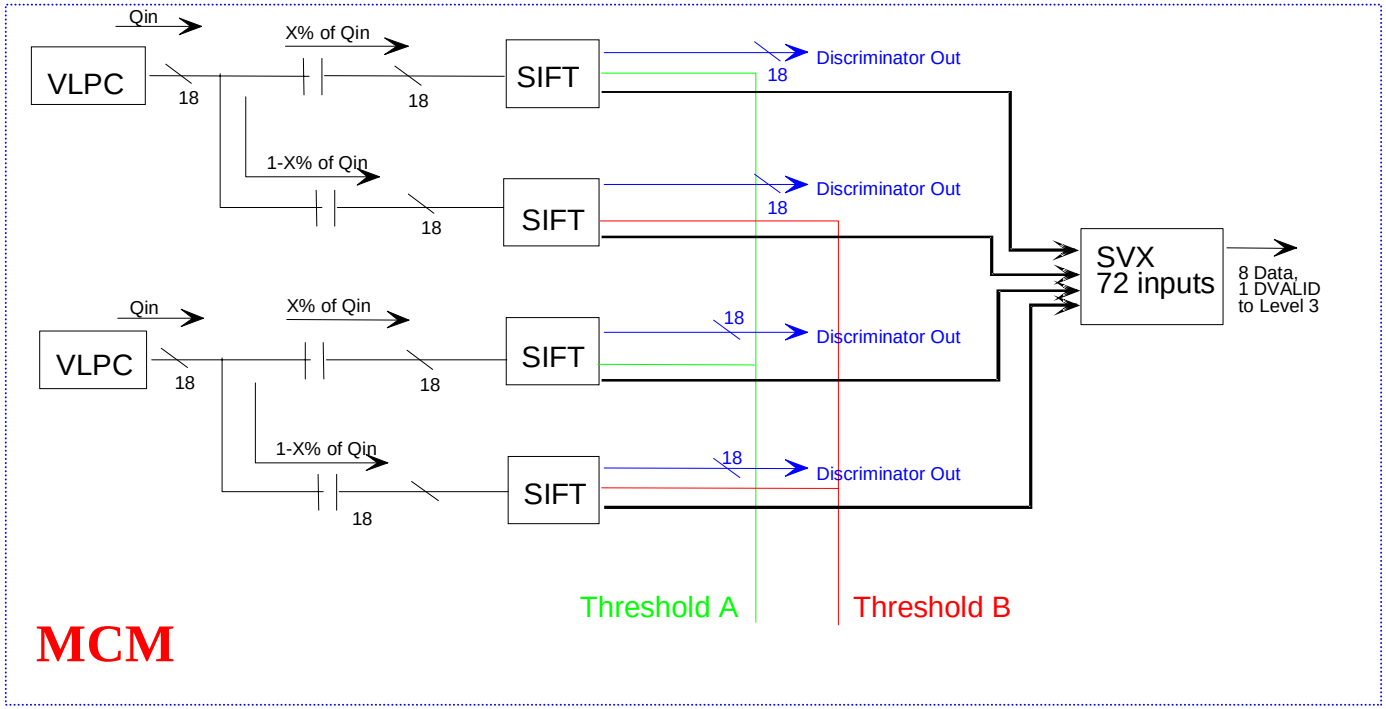


3'

CFT and PS Front-End



Each CFT/CPS Analog board has 8/12 MCM's



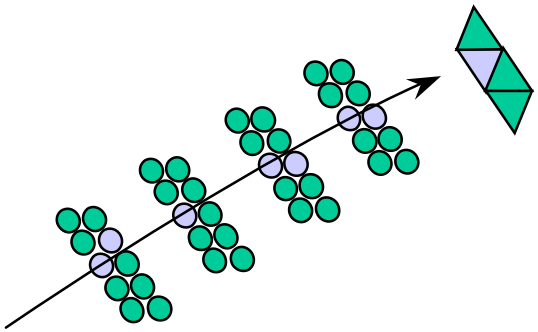
* Charge splitting only for PreShower

Tracking Trigger Overview

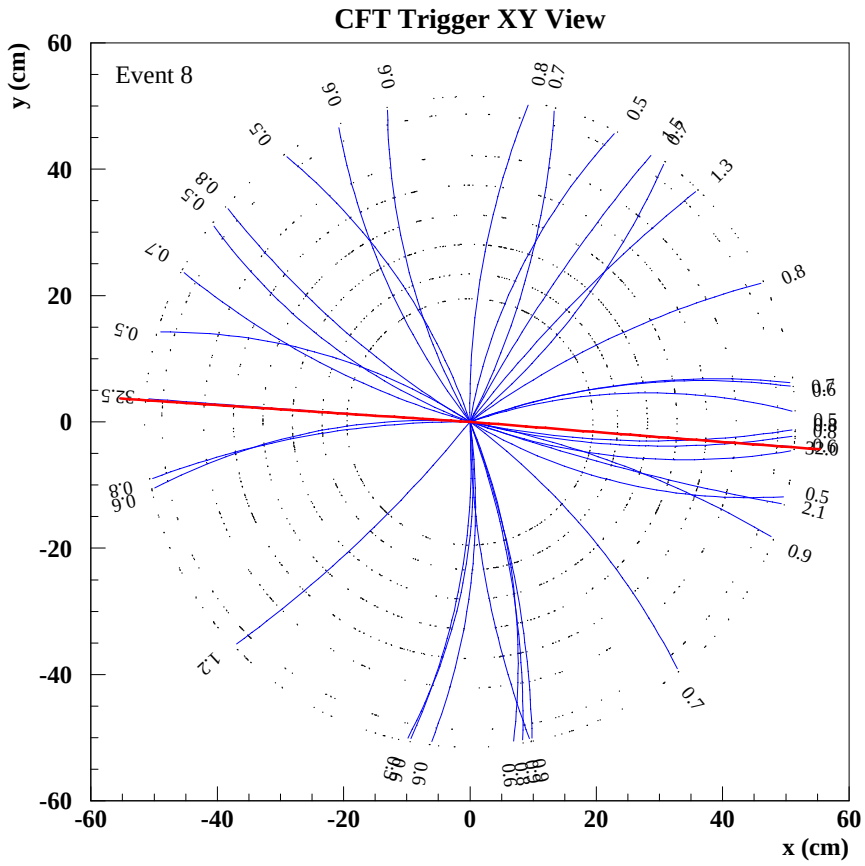
(1) Feed all axial fibers (+CPS) into logic gates/cells in Programmable Logical Devices

(2) Fiber hit pattern recognition **to look for tracks consistent with momentum P_T > 1.5 GeV/c**

(3) Send out the track information to outside L1 CFT



Trigger response for $Z \rightarrow ee$ with 4 min.bias

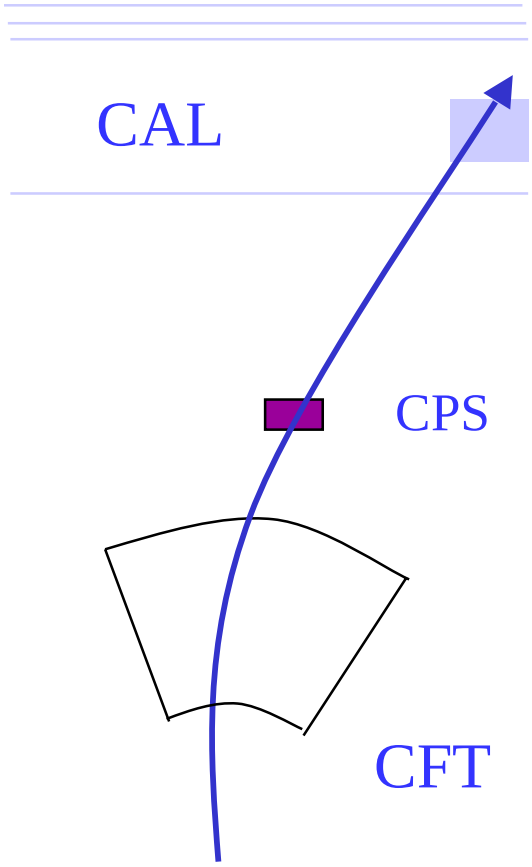


T ecrn Trigger

- Central : Match between CFT and CPS to form electron candidates.

- Forward: Match between upstream and downstream layers in FPS.

- Match between CFT/PS and CAL.



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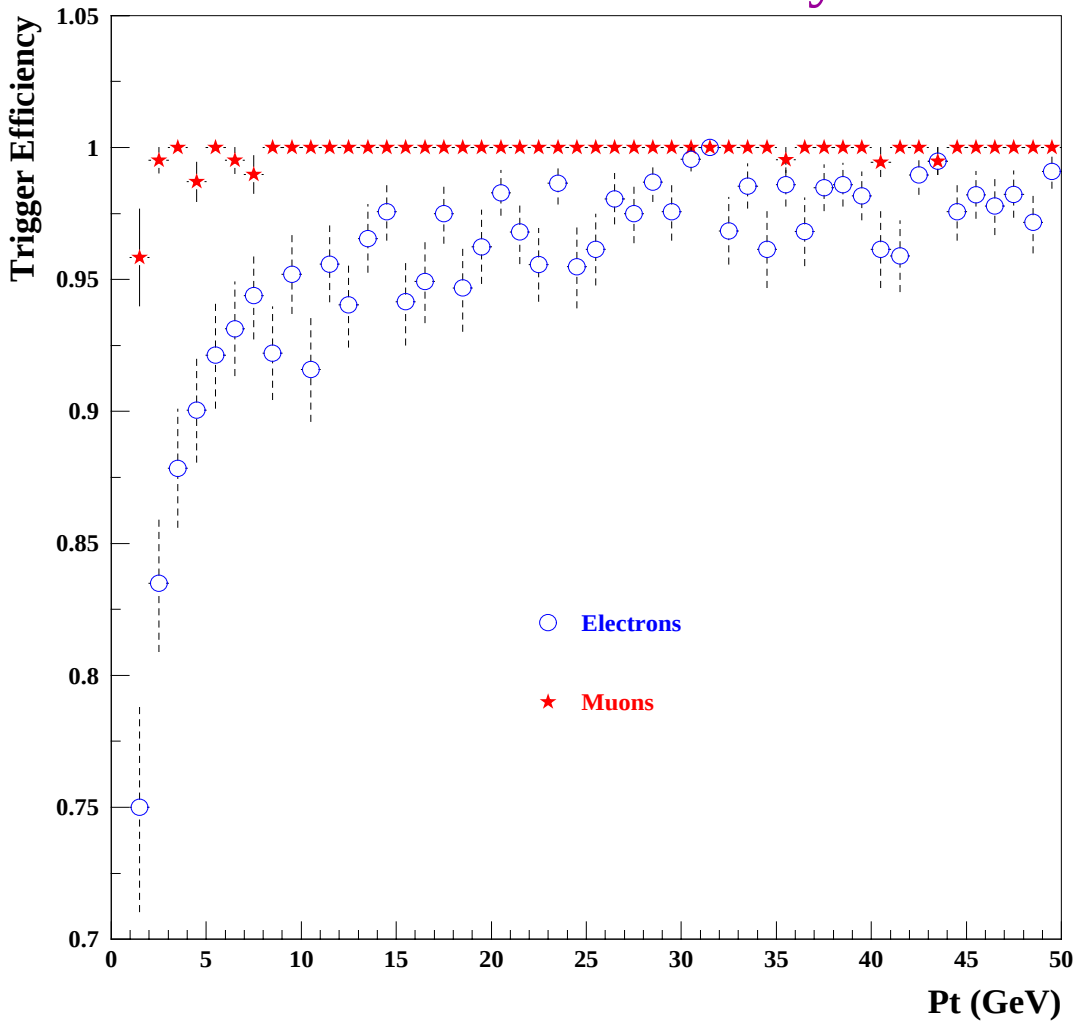
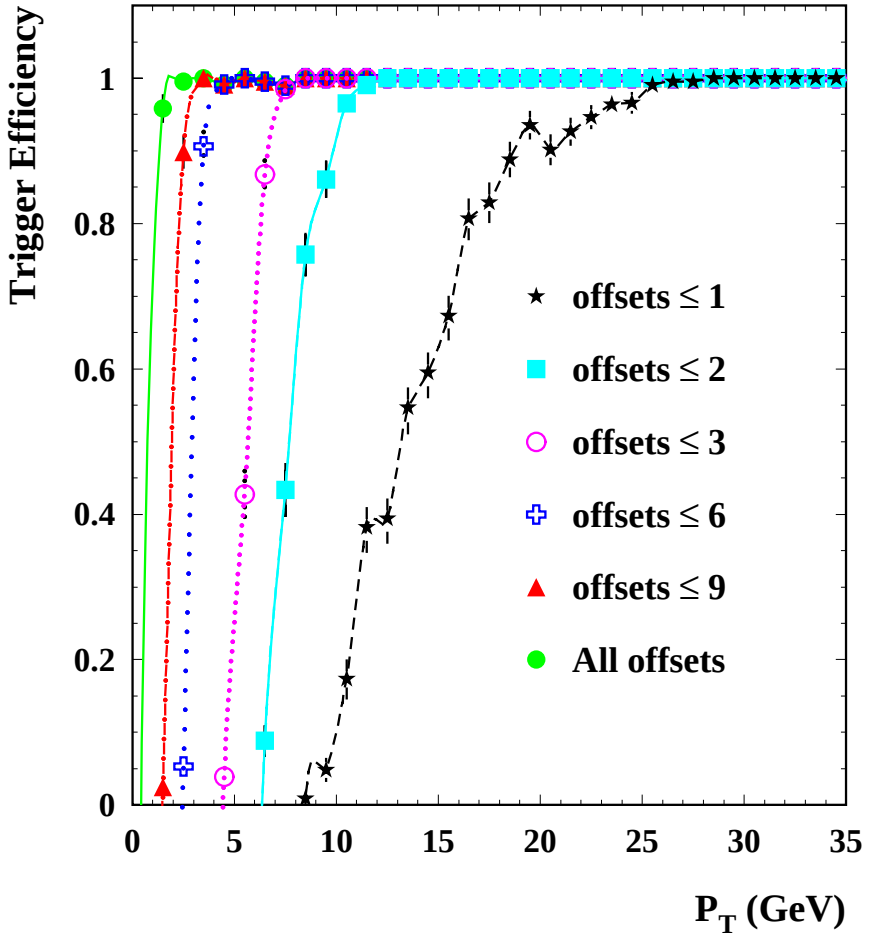
CFT Track efficiencies only for tracks from beam spot

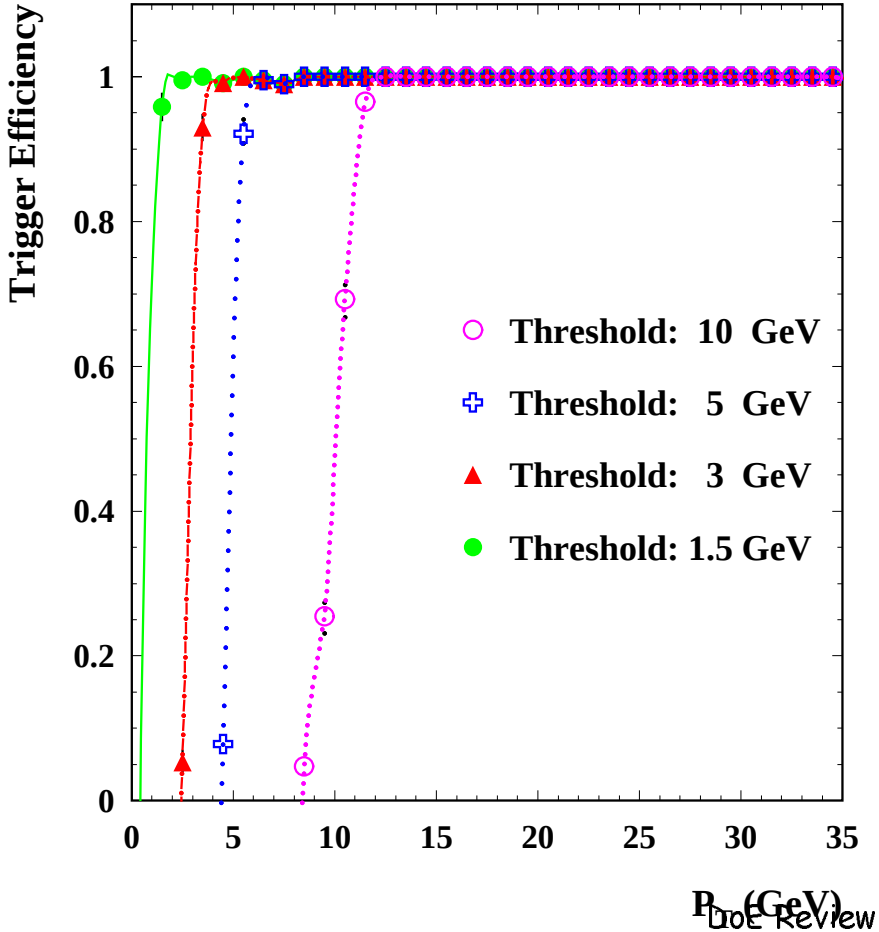


Track inning

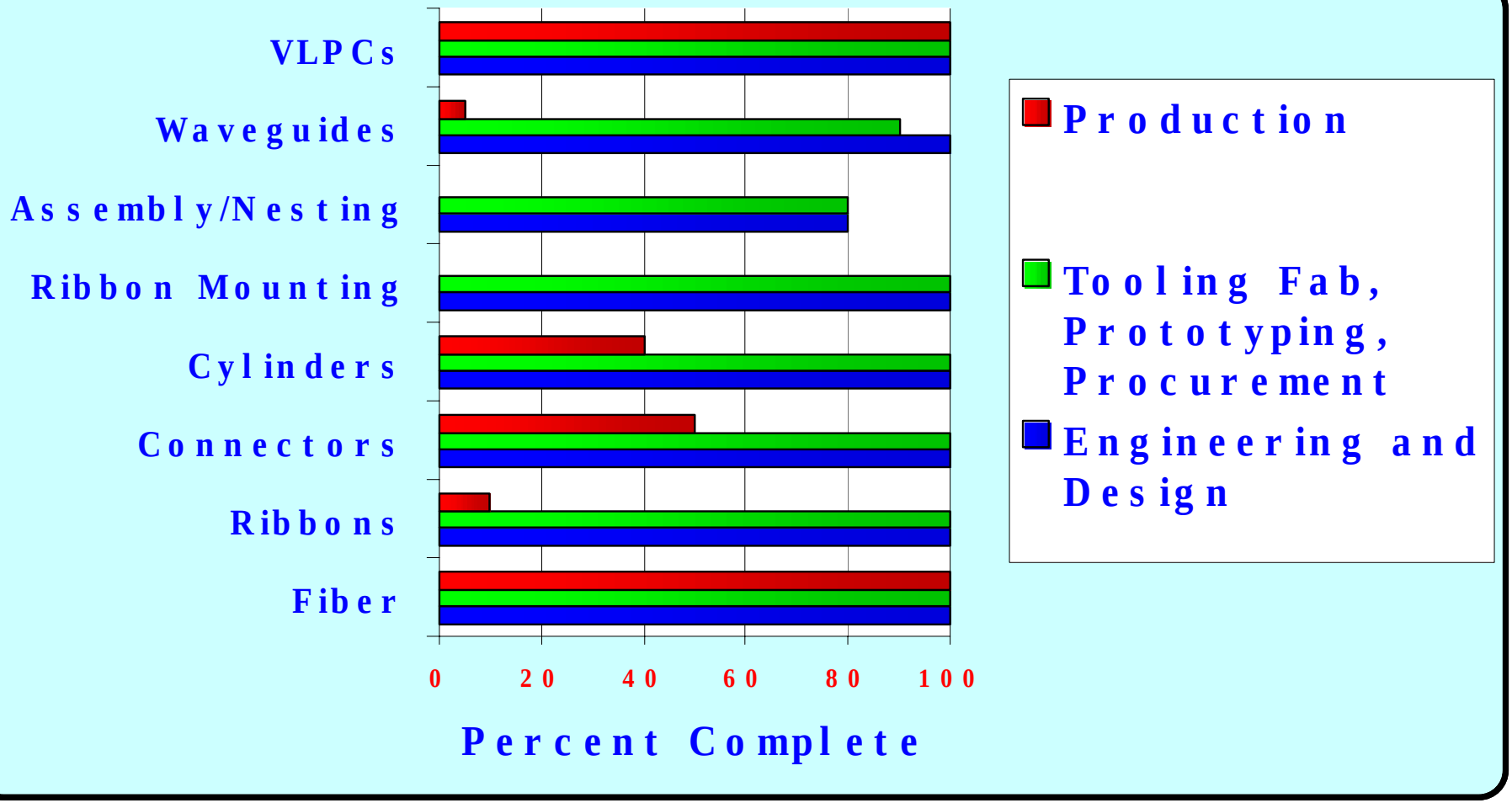
- P_T binning yields sharper turn-on than offset binning

offset = [(projection of H layer fiber hit on A layer) - A layer hit fiber] in units of fibers





Production Status



ier Tracker
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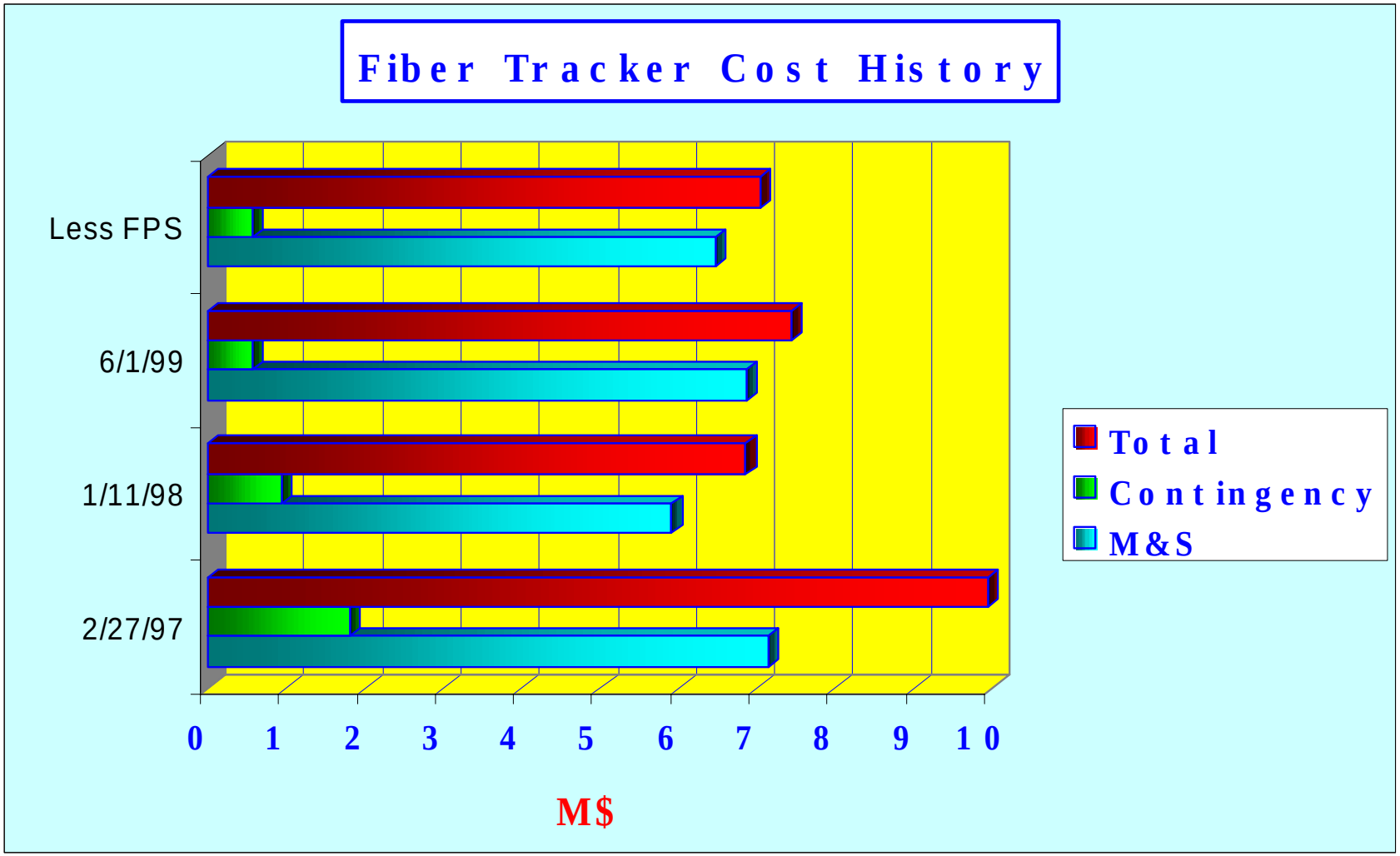
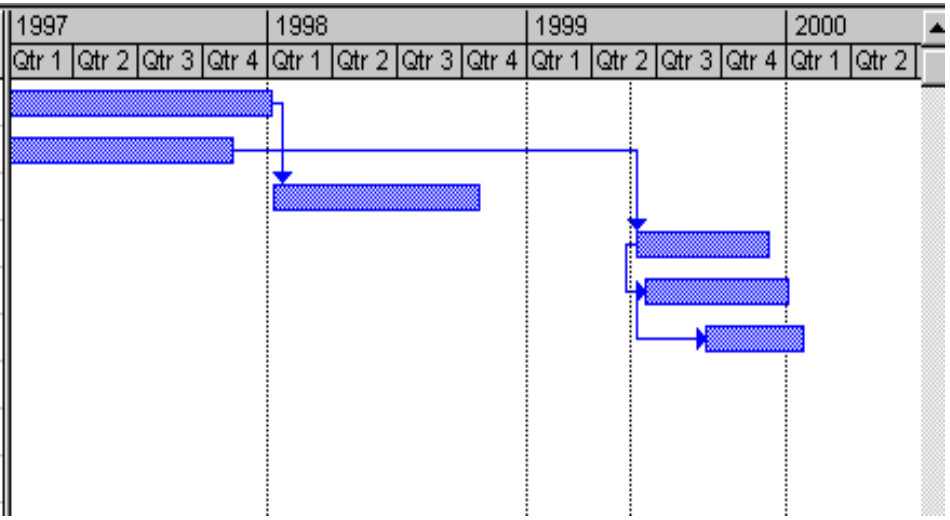


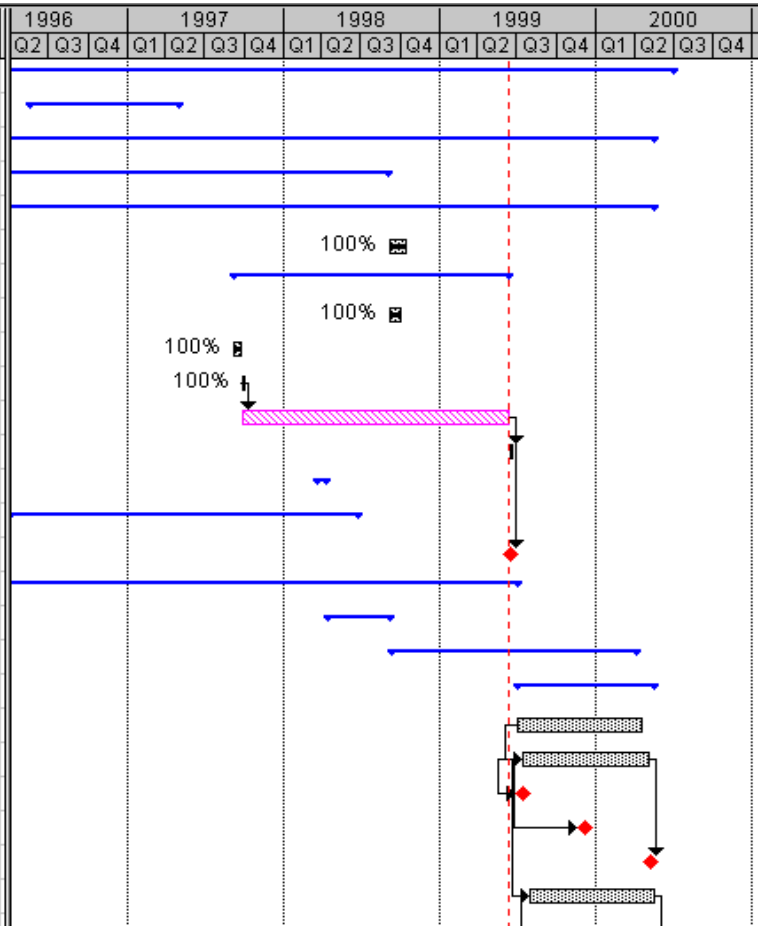
Scdu

	Task Name	Duration	Start	Finish
1	Tracker Engineering Design	105 wks	Tue 1/2/96	Mon 1/5/98
2	Fiber Procurement	100 wks	Fri 12/15/95	Thu 11/13/97
3	Cylinder Fabrication	42 wks	Tue 1/6/98	Mon 10/26/98
4	Ribbon Production	27 wks	Tue 6/1/99	Mon 12/6/99
5	Ribbon Mounting	29 wks	Tue 6/15/99	Mon 1/3/00
6	Tracker Assembly (Nesting)	20 wks	Tue 9/7/99	Mon 1/24/00

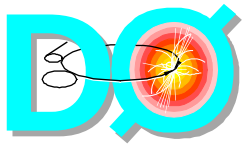


cee

	Task Name	Duration	Start	Finish
1	VLPC CASSETTE MANUFACTURE	238 w	Fri 9/15/95	Mon 7/3/00
2	VLPC DEVELOPMENT	48.4 w	Mon 5/13/96	Fri 5/2/97
11	CASSETTE MANUFACTURE	231.8 w	Fri 9/15/95	Thu 5/18/00
12	Task II	141.4 w	Wed 11/1/95	Tue 9/1/98
30	HISTE VI Cassette Procurement	231.8 w	Fri 9/15/95	Thu 5/18/00
31	Design Finalization	6 w	Wed 9/2/98	Wed 10/14/98
32	Cassette Parts Procurement	87.6 w	Tue 9/2/97	Mon 6/14/99
33	Finalize Engineering Drawings	4 w	Wed 9/2/98	Wed 9/30/98
34	Submit Parts for Bids	3.2 w	Tue 9/2/97	Tue 9/23/97
35	Award Contracts-FY97	0.2 w	Wed 9/24/97	Wed 9/24/97
36	Qualify Flex Circuit Vendor	84 w	Thu 9/25/97	Fri 6/11/99
37	Award Contracts-FY99	0.2 w	Mon 6/14/99	Mon 6/14/99
38	Assembly Tooling	4 w	Mon 3/16/98	Fri 4/10/98
41	Special Test Equipment	111.4 w	Mon 4/1/96	Fri 6/26/98
50	Cassette Production Readiness Review	0 w	Fri 6/11/99	Fri 6/11/99
51	HISTE VI Hybrid Production	188.8 w	Fri 9/15/95	Fri 7/2/99
59	Cassette factory setup	21 w	Mon 4/13/98	Wed 9/9/98
64	Module Assembly and Test	76.8 w	Thu 9/10/98	Thu 4/6/00
68	Cassette Assembly and Test	44 w	Mon 6/28/99	Thu 5/18/00
69	Module/Hybrid integration	40 w	Mon 6/28/99	Thu 4/20/00
70	Cassette assembly	40 w	Tue 7/13/99	Thu 5/4/00
71	M3-VLPC Cassette Assembly Begun	0 w	Tue 7/13/99	Tue 7/13/99
72	M3-VLPC Cassette Assembly 50% Complete	0 w	Thu 12/2/99	Thu 12/2/99
73	M3-VLPC Cassette Assembly Complete	0 w	Thu 5/4/00	Thu 5/4/00
74	Cassette Test	40 w	Tue 7/27/99	Thu 5/18/00



DoE Review
June 1999



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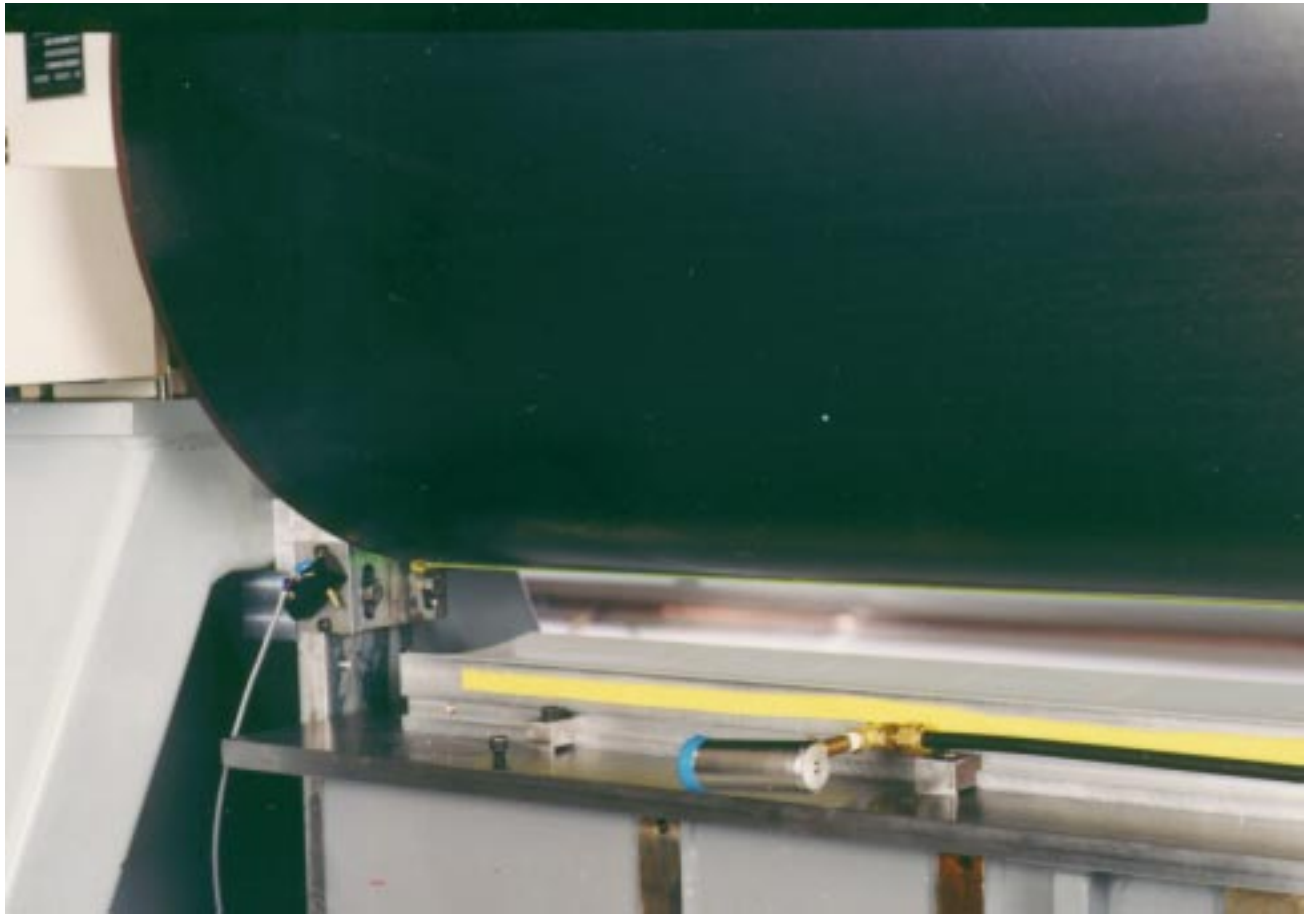
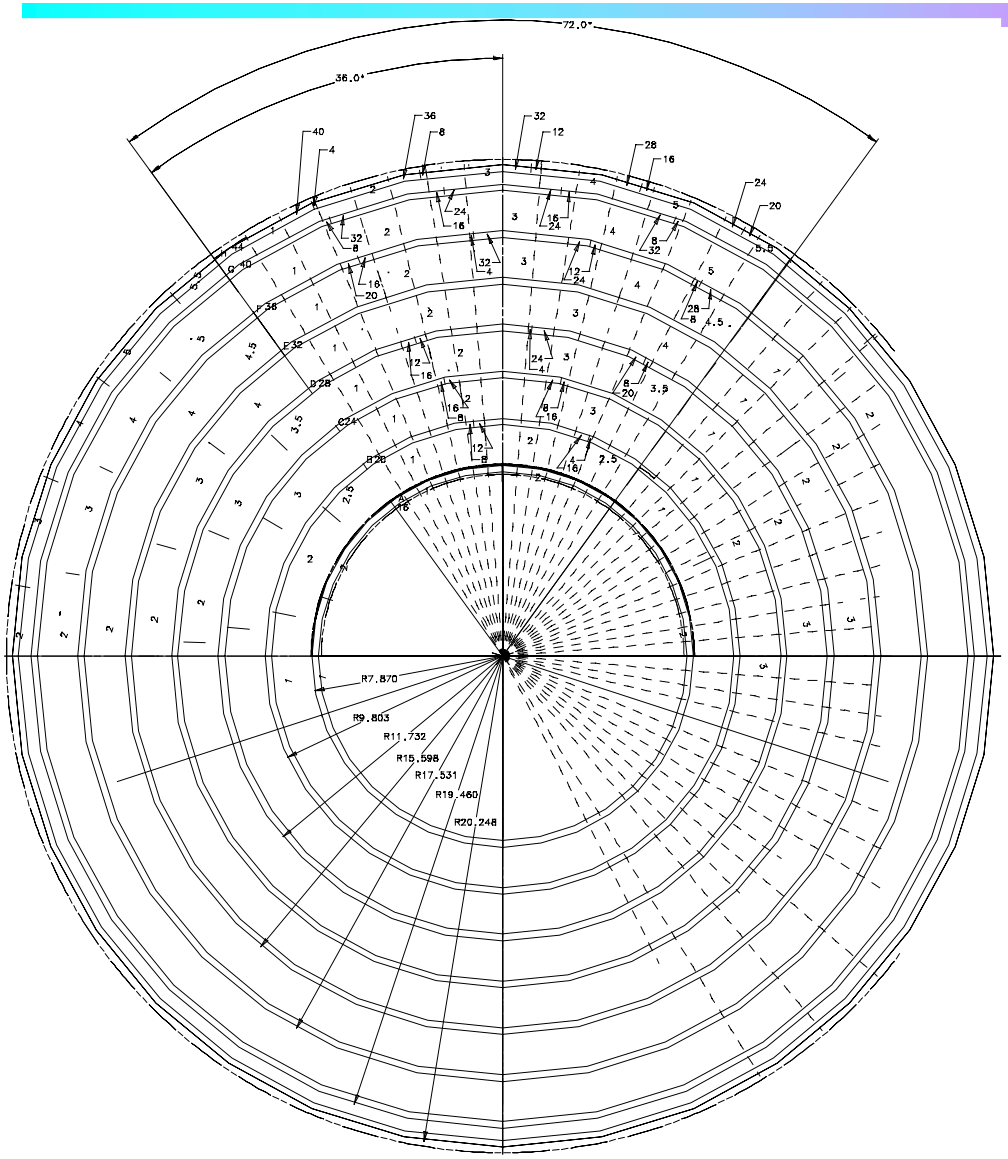


CFT Physical and Trigger sector ondaries tical ier

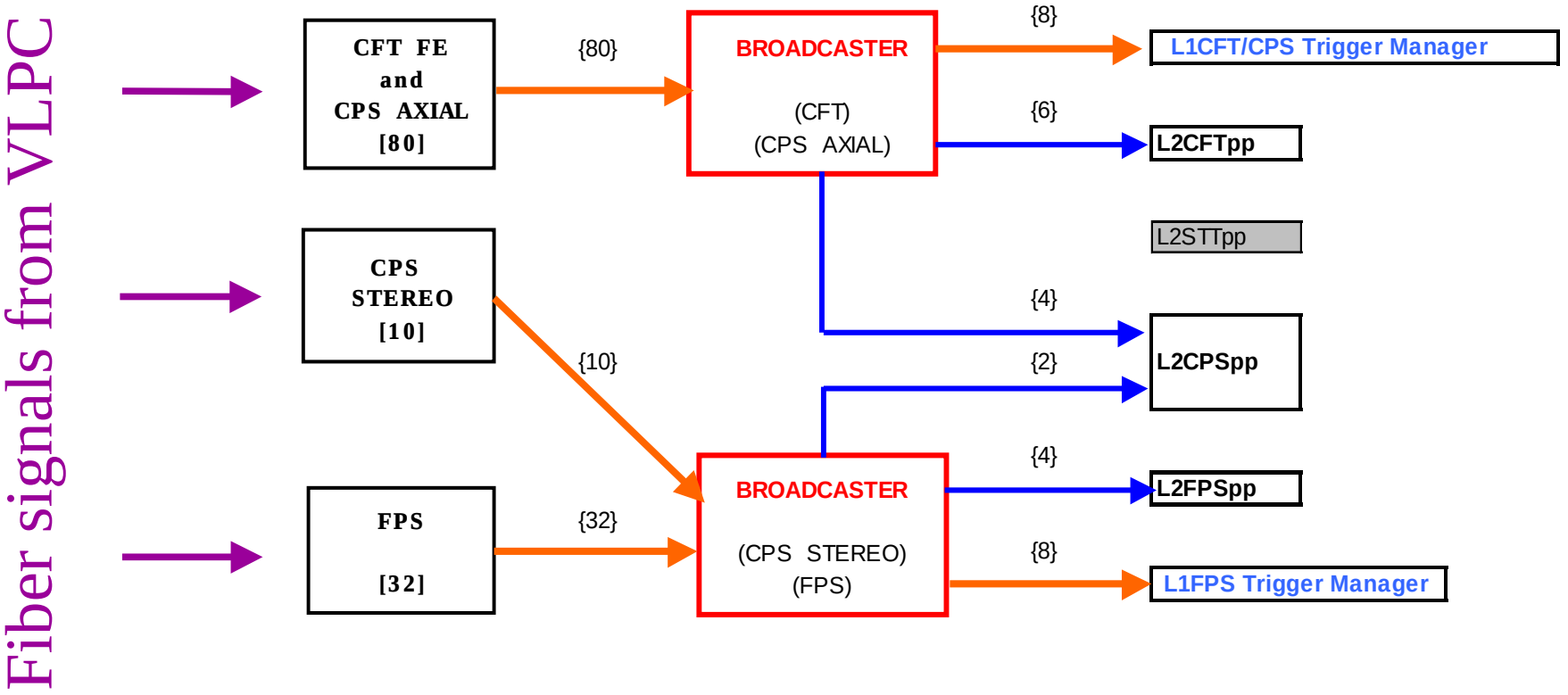


- 16 channel connector mapping to cassette (X,U,V)
  - require Y splices
- L1 trigger electronics requires mapping of signals from L1/8 2/7 ..
- Five fold symmetry within CFT and L1 Trig
- Optical Mixer (New)
  - Mixer
    - 128 in → 128 out
    - "Mapping" inside box
    - 5 Boxes for trig. Ch.
    - Two optical interfaces
  - Patch Panel
    - 32 X 8ch in → 128 out
    - One optical interface

Inter-relationship among CFT, CPS, and FPS

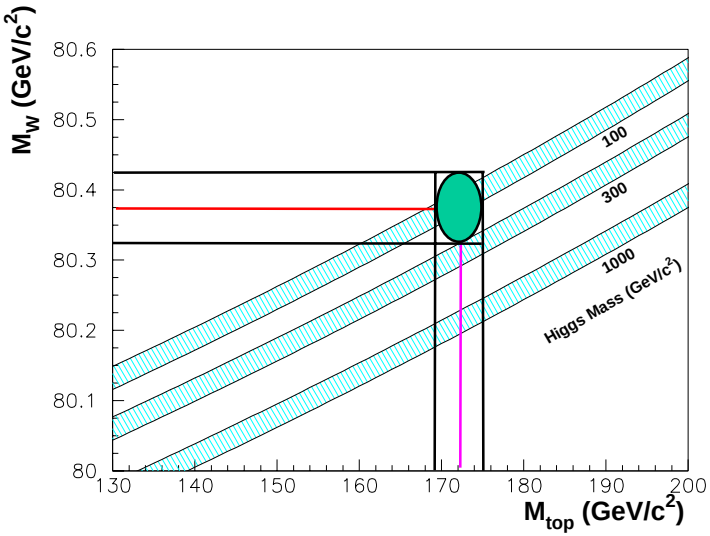
Fast Copper Serial Link

G Link



Physics Goals

- Precision Tests of the Standard Model
  - precision measurements (top mass, W mass, ...)
    - Constrain the Higgs Boson Mass
  - improvements to B physics capabilities
  - (B_s mixing, CP violation, ...)
  - QCD with W, Z, photon
- Extend the Discovery Reach
  - More data samples allow significant increases in the reach for SUSY, leptoquarks, W',Z',anomalous couplings,



• All these will benefit from the CFT tracking trigger to help trigger on electrons/muons etc.;

• STT and Muon Trigger rely on the CFT track seeds;

• PreShower uses CFT tracks to identify electrons/photons.