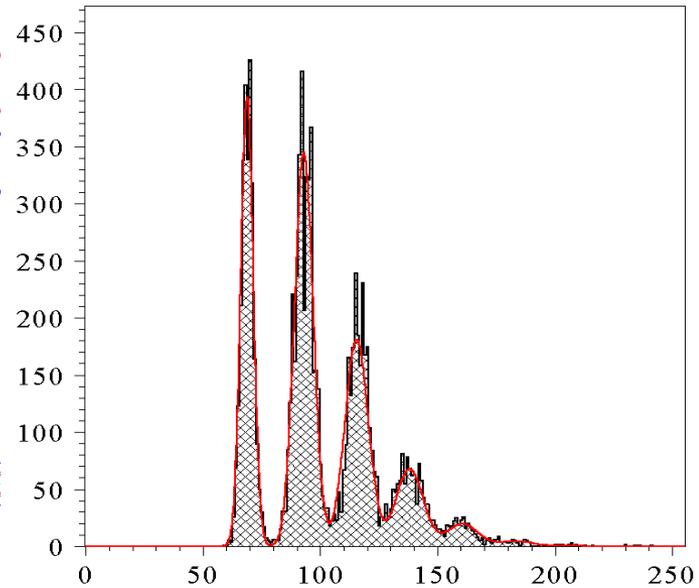
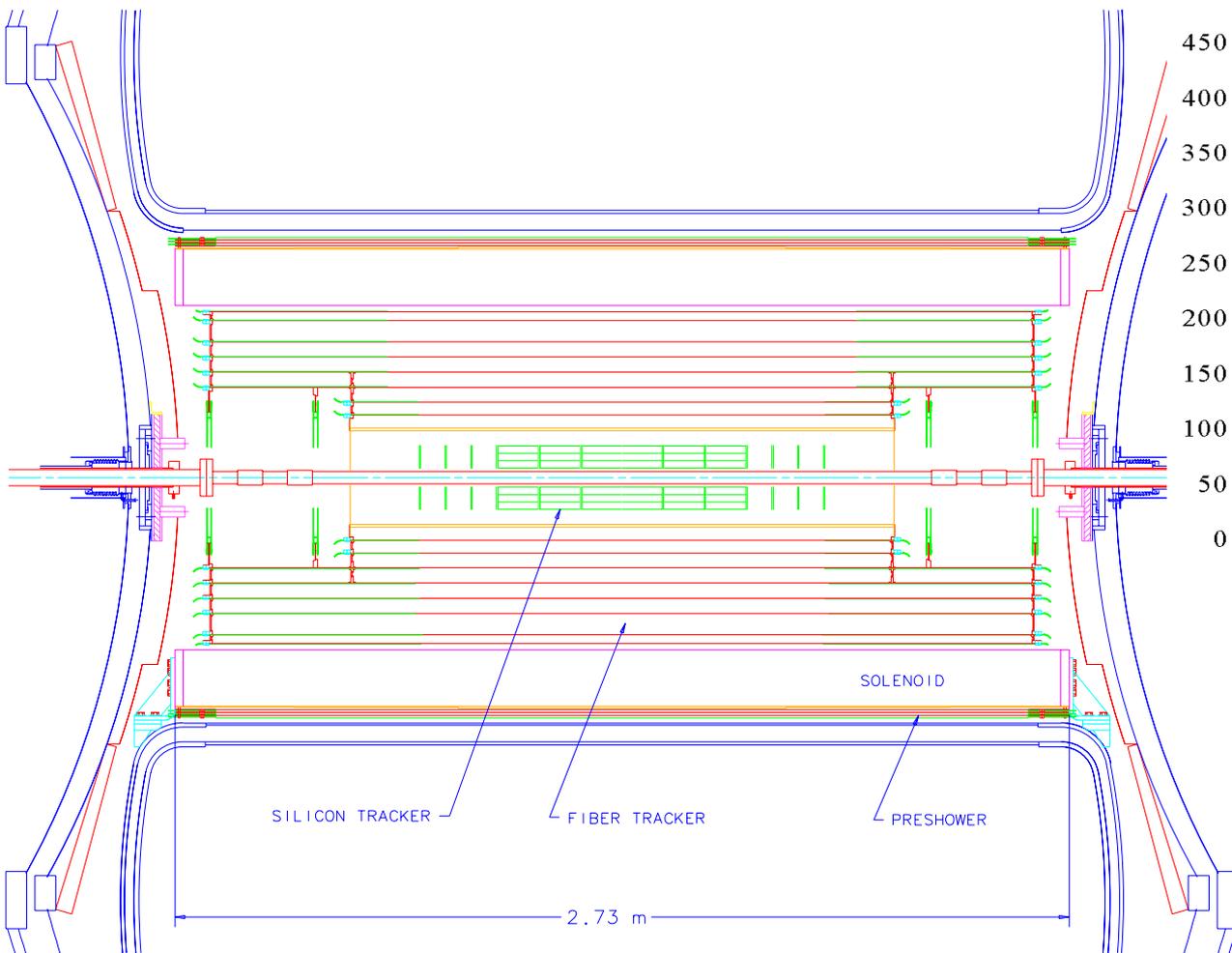
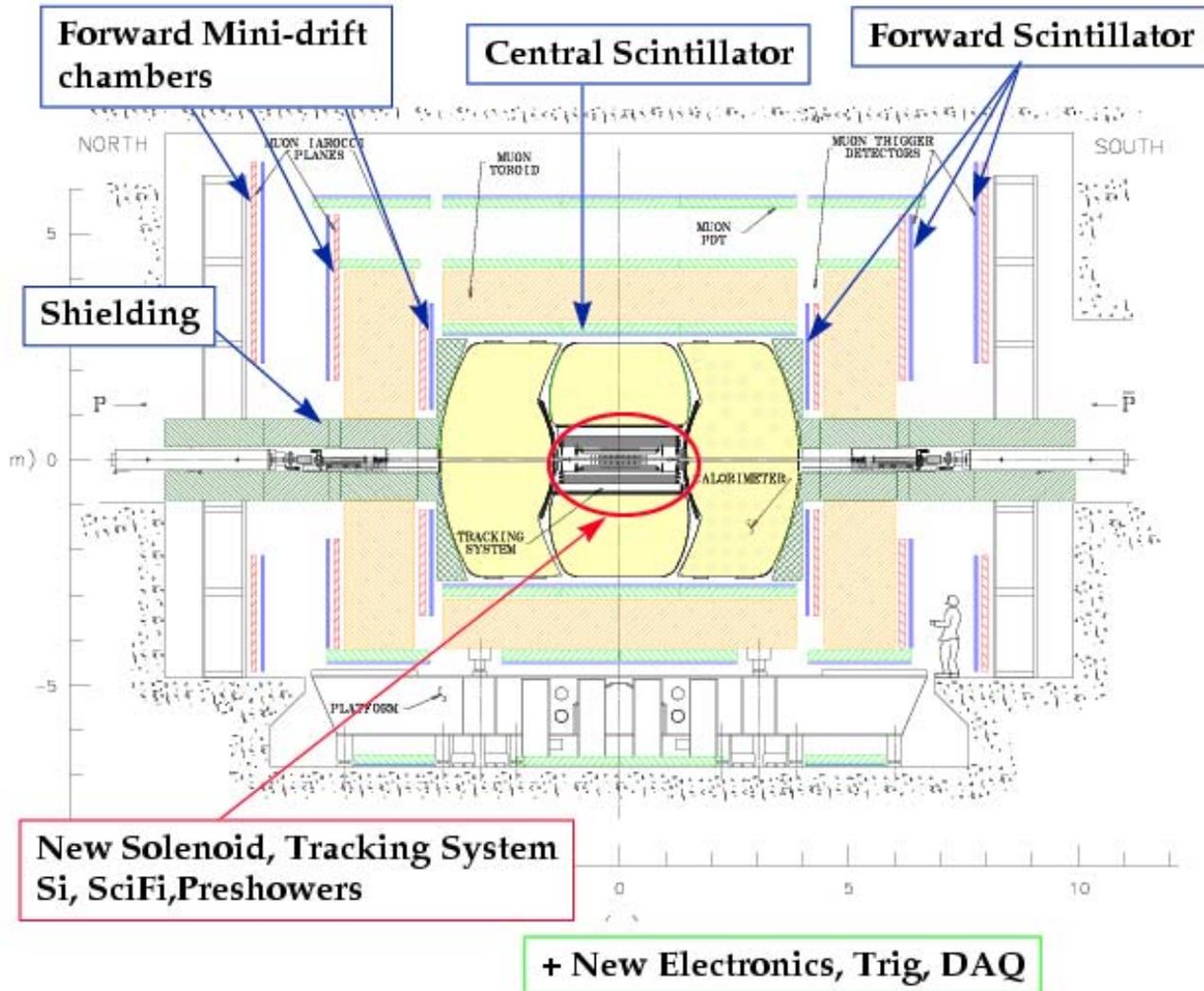


DØ's VLPC Detectors: The Fiber Tracker and Preshowers

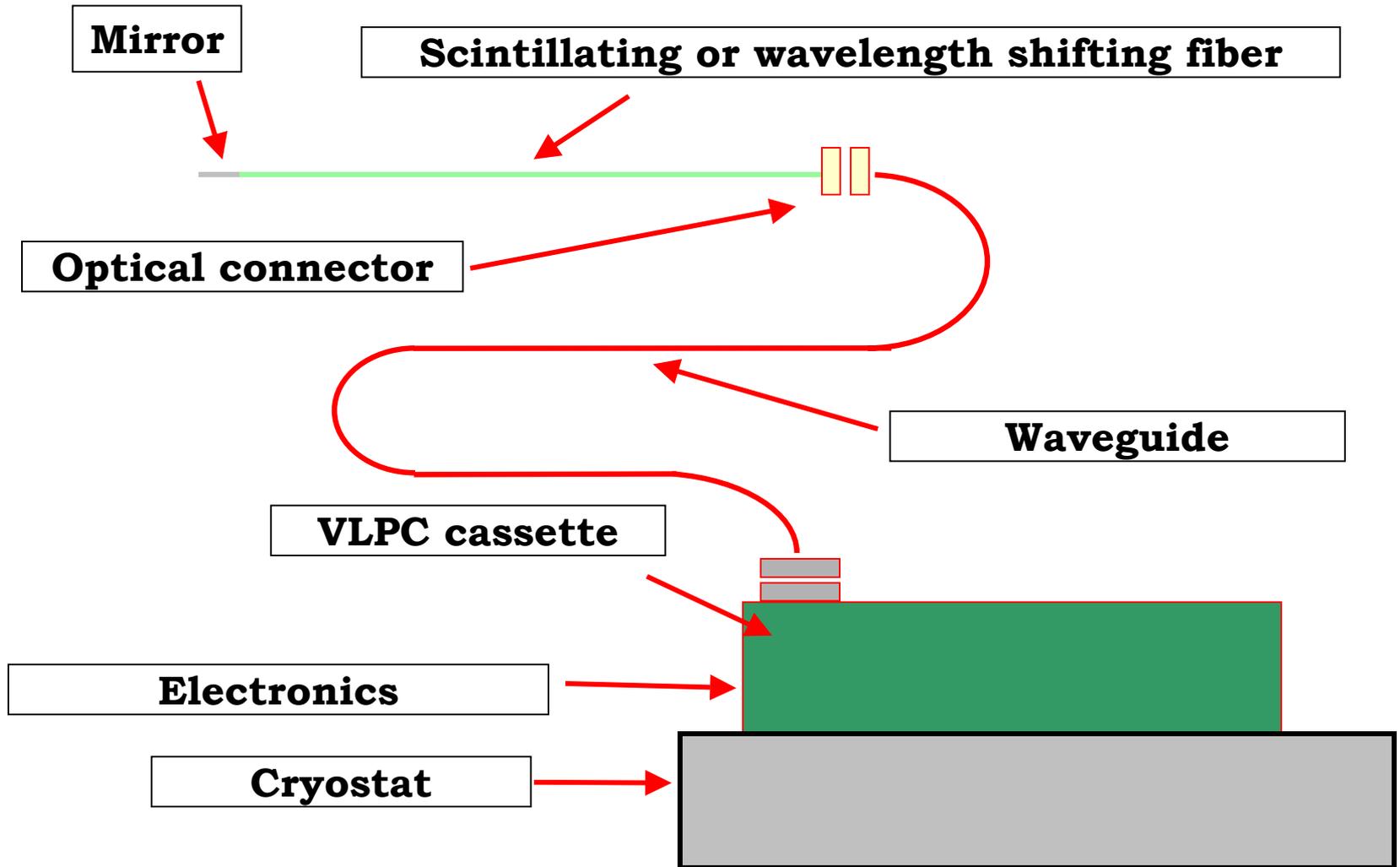


Greg Davis
University of
Rochester

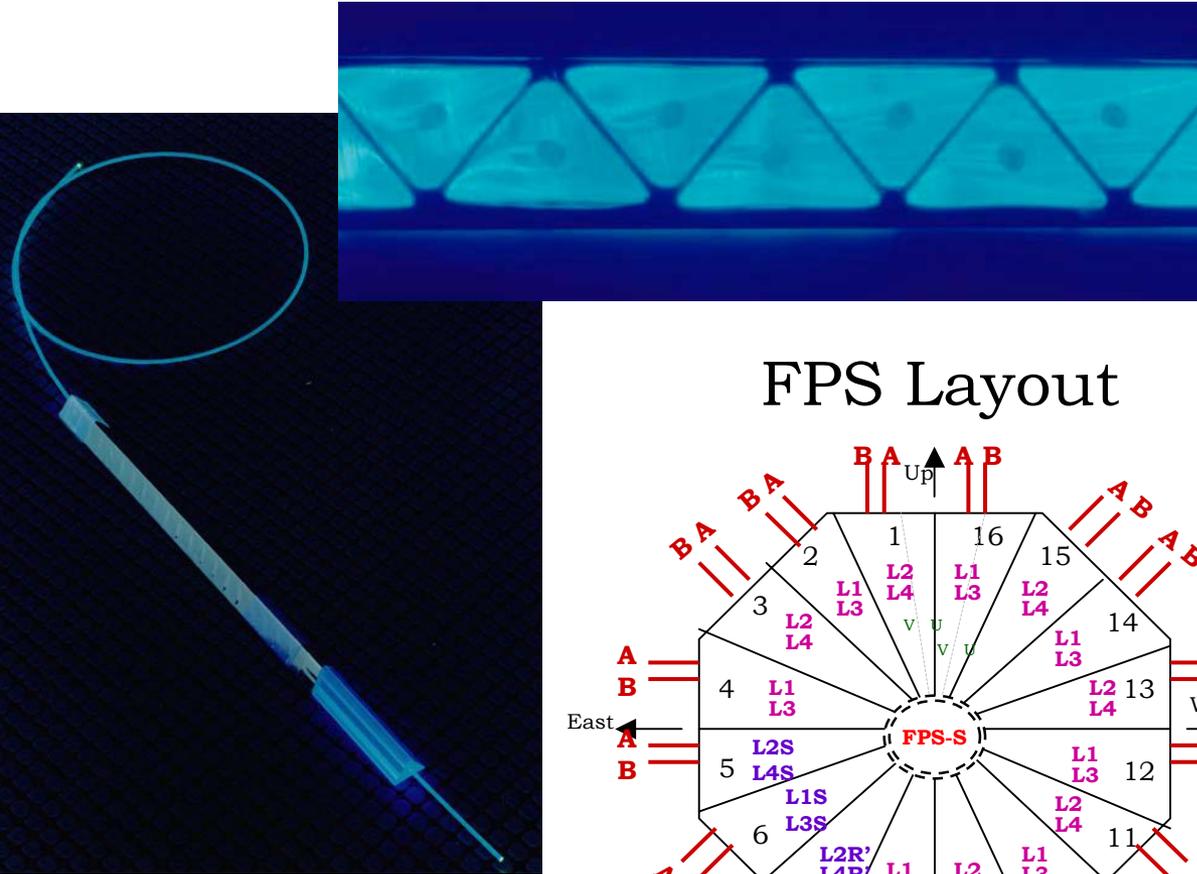
DØ Overview



A Single Channel

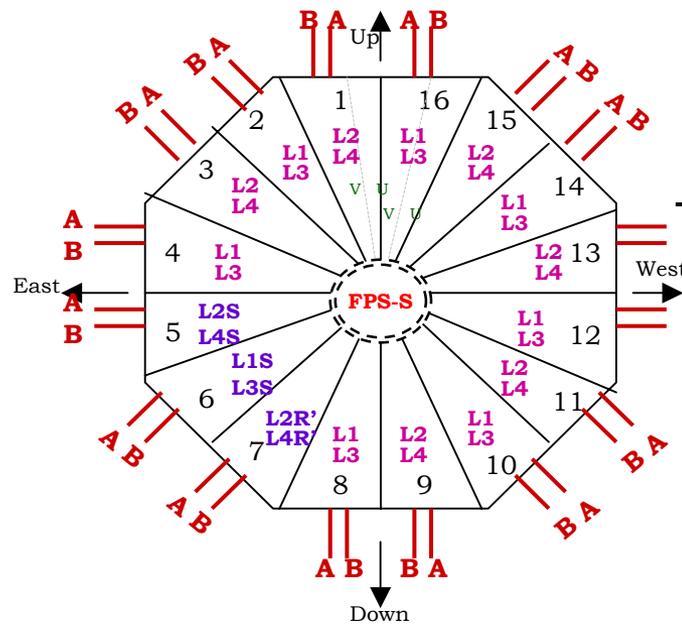


The Preshower (PS) Detectors



- The PS detectors are made of extruded scintillator with wavelength shifting fibers running through the center.
- The CPS is in three layers (one axial two stereo) surrounding the solenoid.
- The FPS is on the EC with a layer in front of (MIP) and behind (shower) a lead absorber.

FPS Layout

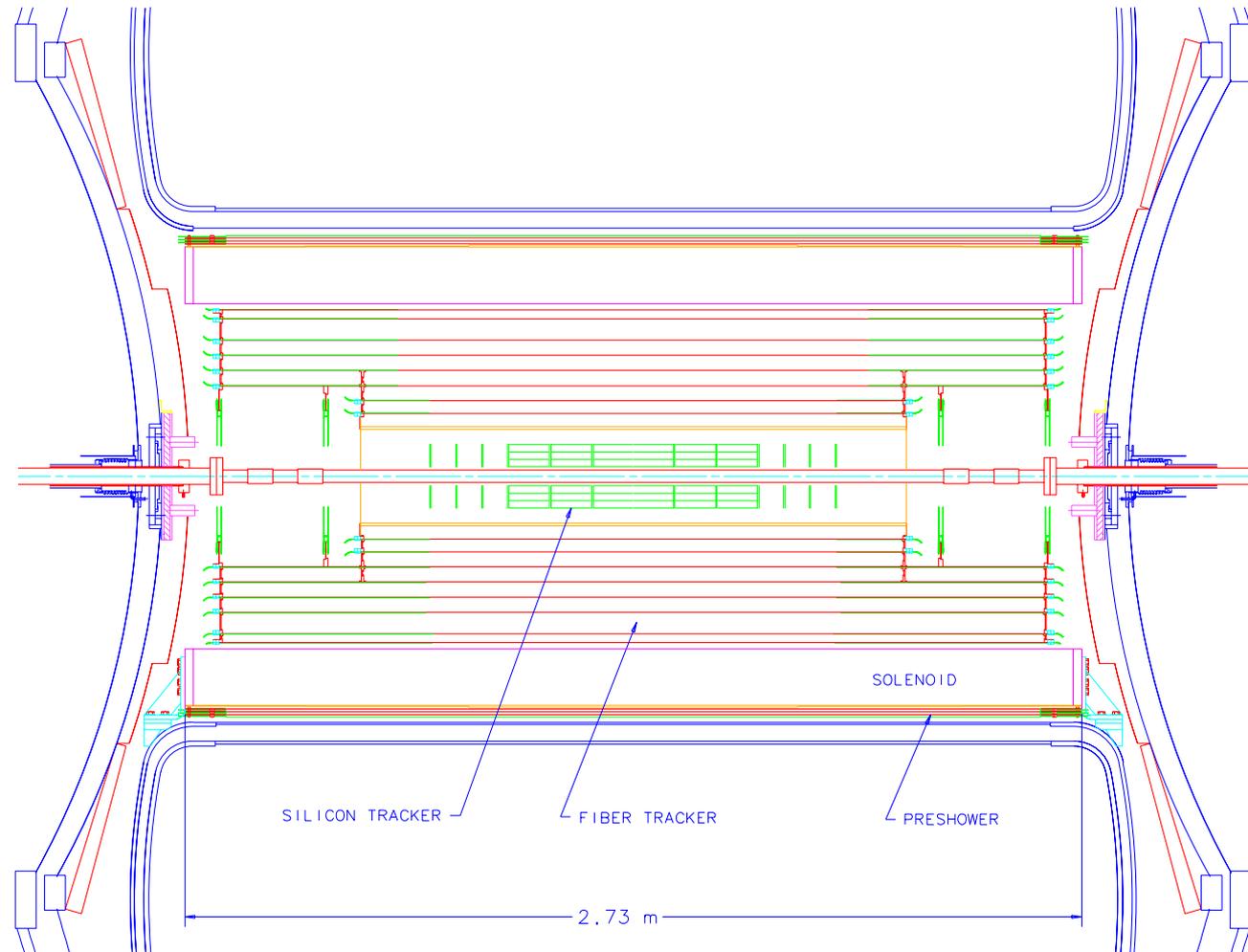


What the Preshowers Do

- The central preshower was originally added to DØ's design to get back the energy resolution lost by placing the solenoid magnet in front of the calorimeter.
- It also provides some other interesting benefits:
 - For example, with the improved position resolution, the CPS can often distinguish an electron from a pair of pions, one charged and one neutral. This can help with b tagging.

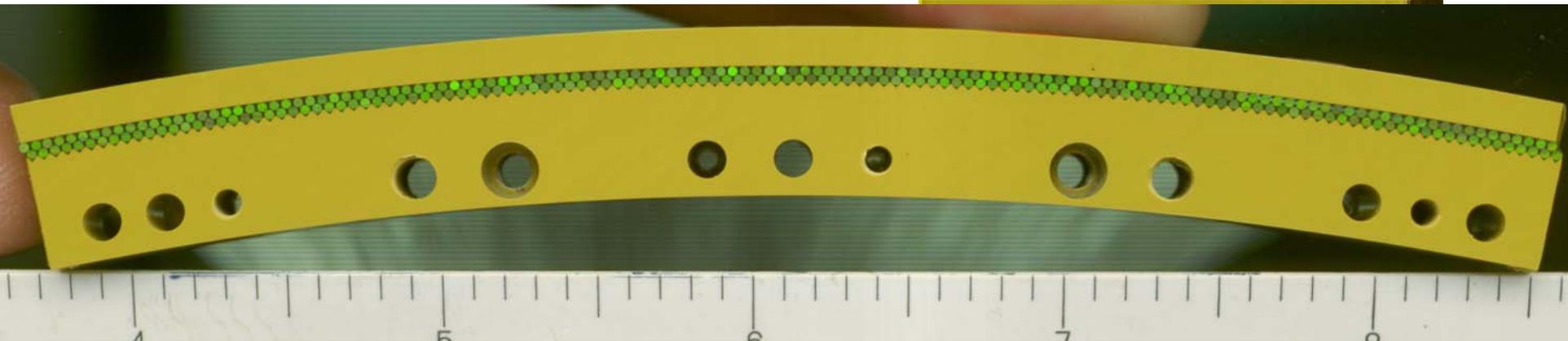
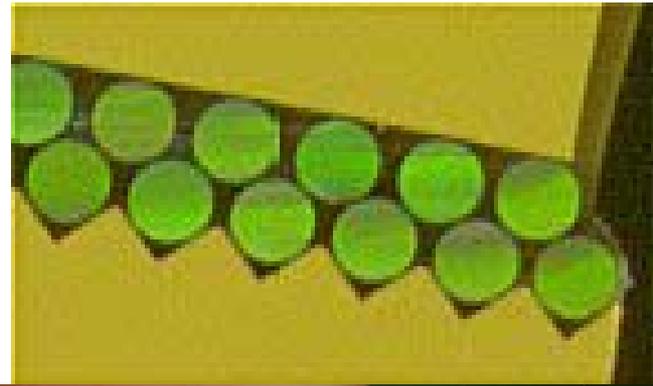
CFT Overview

- Scintillating fibers are 1.8 or 2.6 m long
- Waveguides are from 8.2 to 11.4 m long
- On the order of 10 photons will get to the VLPCs
- Fiber Diameter 835 μm
- CFT: 77k channels
- PS: 23k channels

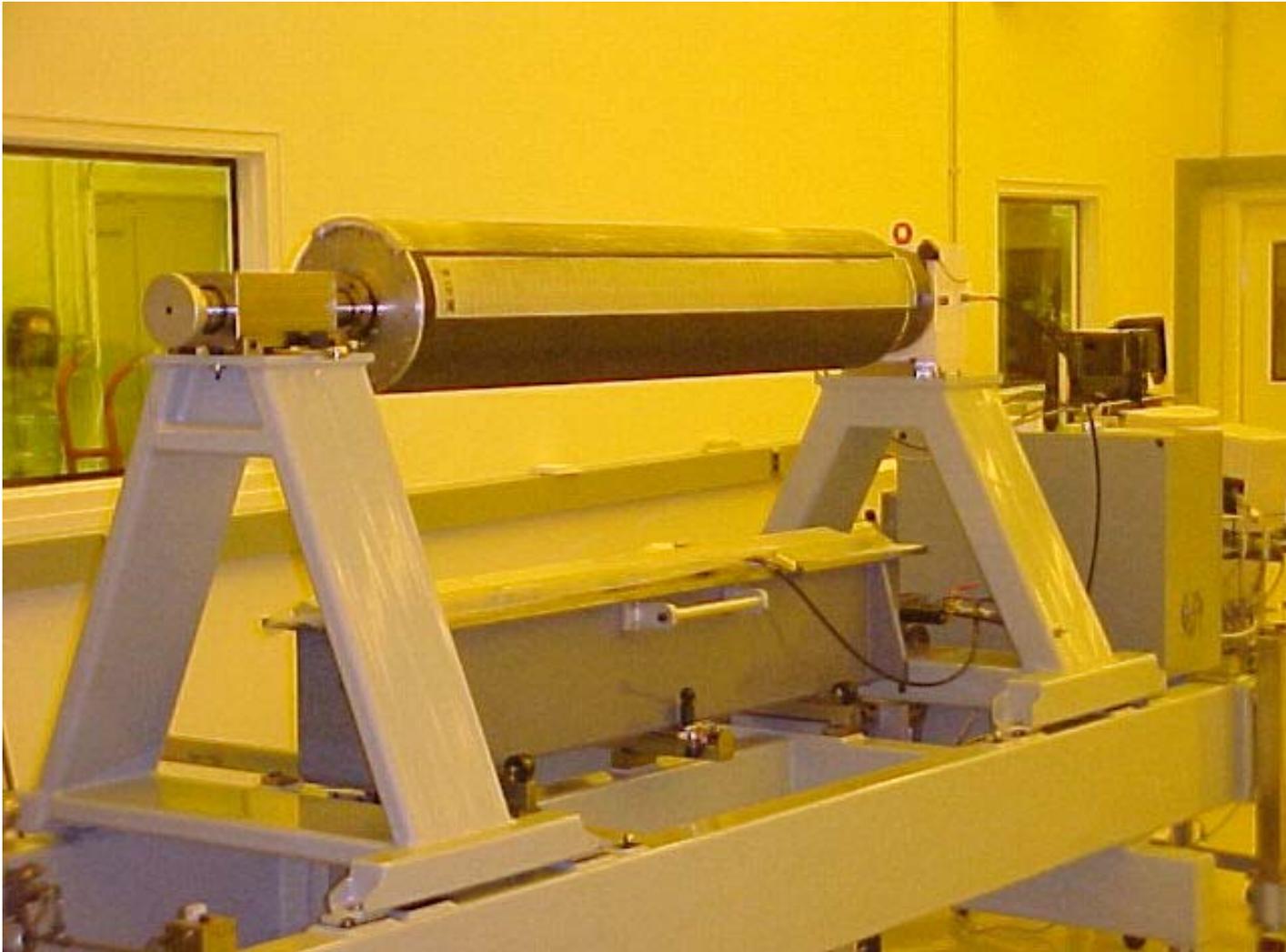


CFT Cylinders & Ribbons

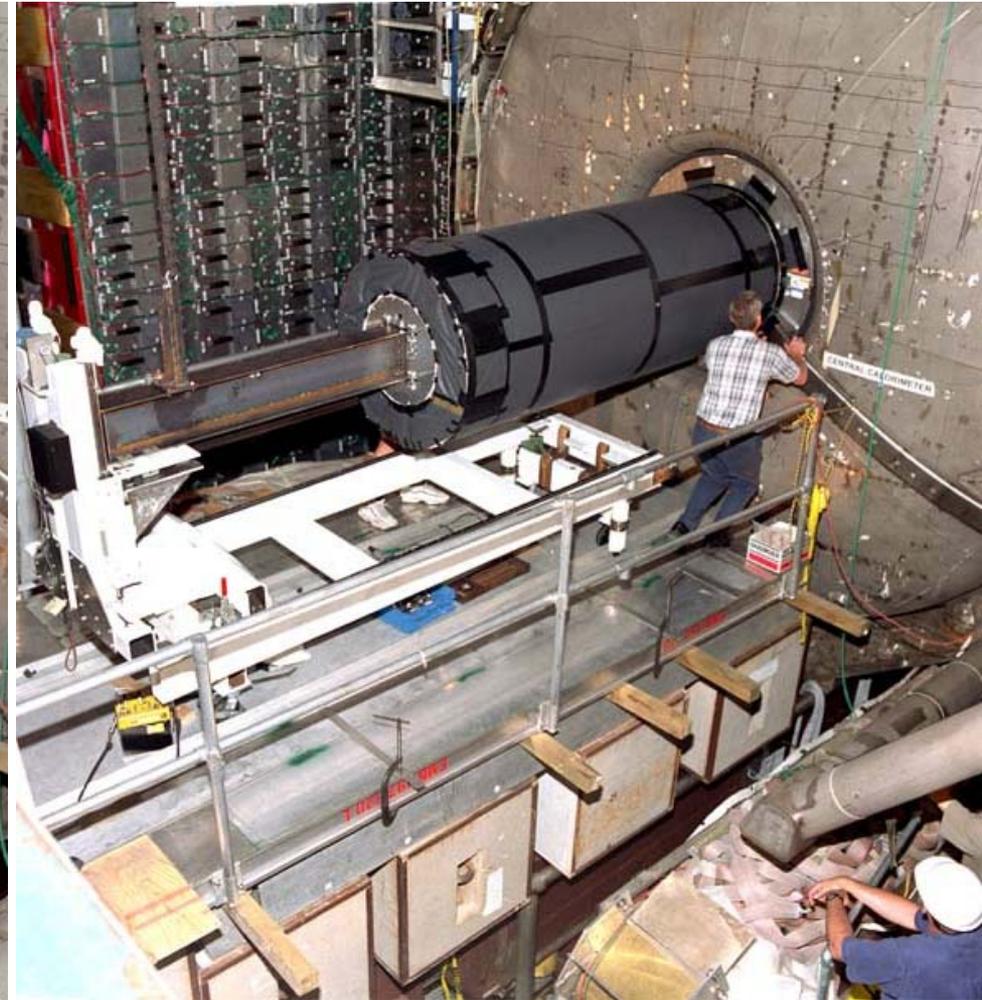
- The scintillating fibers are on 8 carbon fiber cylinders labeled A-H from inside to out.
- Axial fibers readout on the south, stereo on the north.
 - This leads to some confusion with A at S and S at N!
- Axial doublet layers are glued to the cylinder and the stereo doublets are on top of them.



Building the Cylinders



Installing the CFT

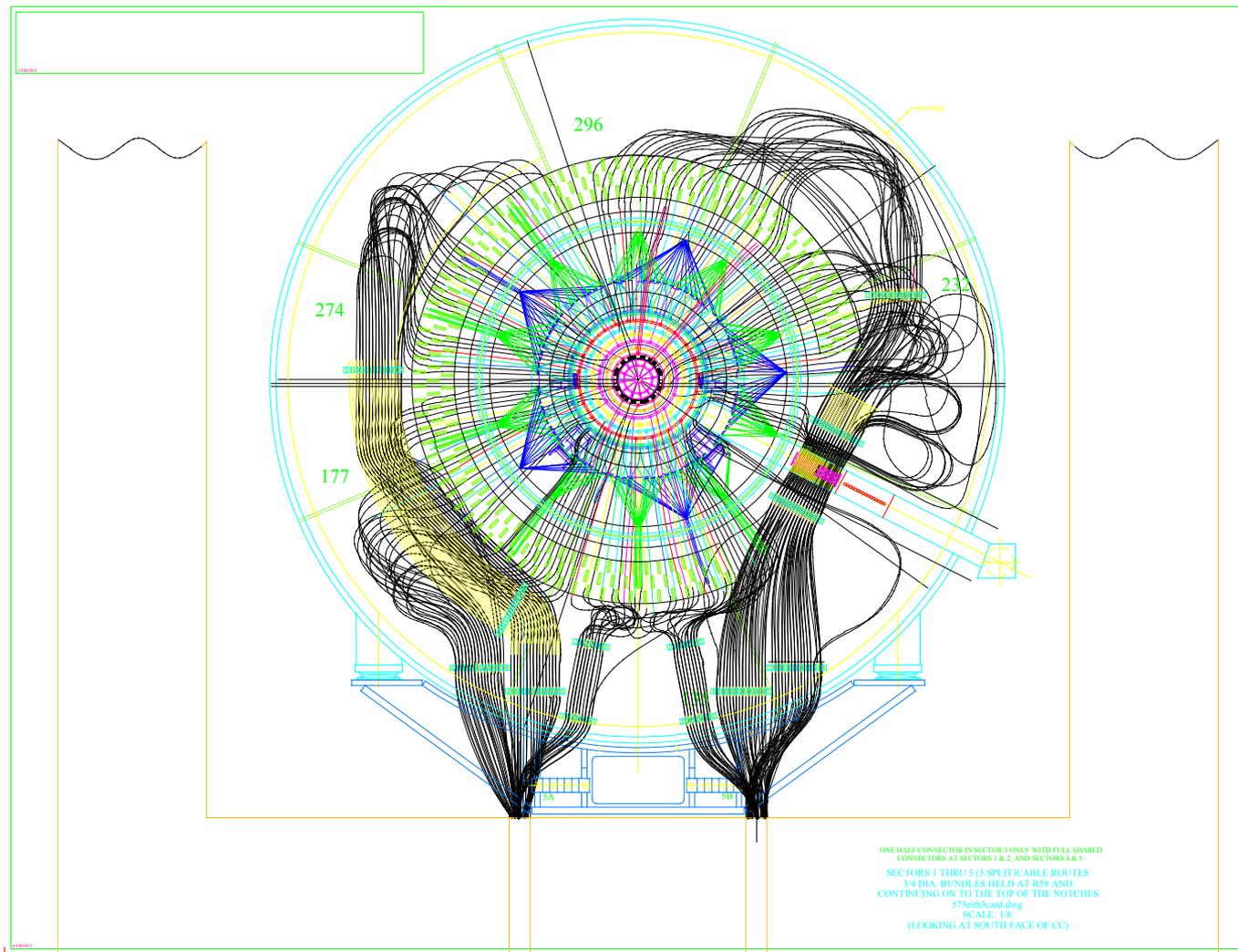


February 24, 2003

davisg@fnal.gov

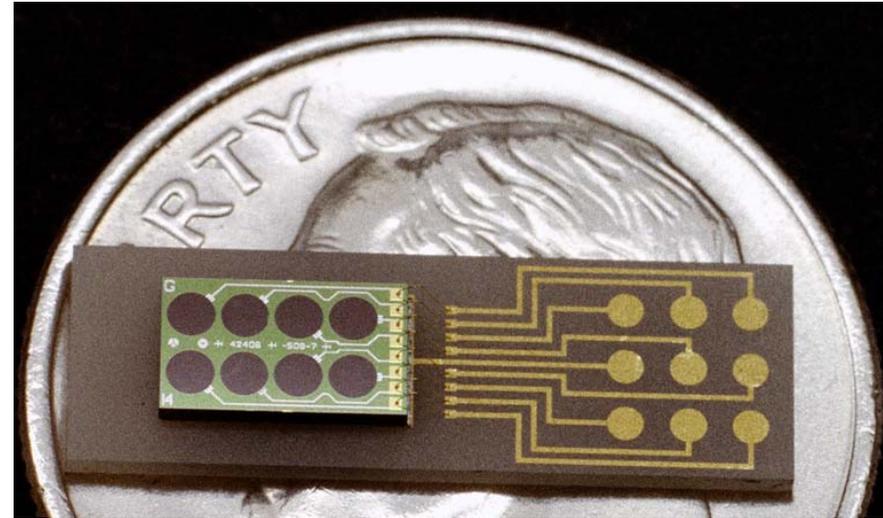
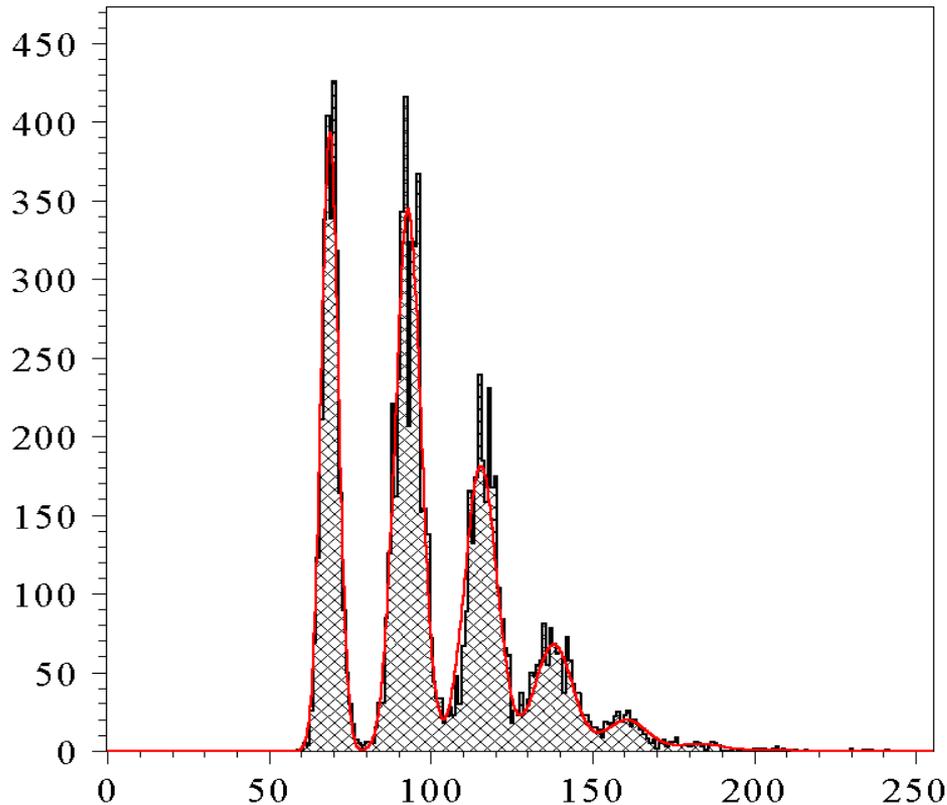
Waveguides

- Getting all waveguides to fit was something of a challenge.
- Each of the 5 supersectors of the CFT has a single length for all of its waveguides



VLPCs

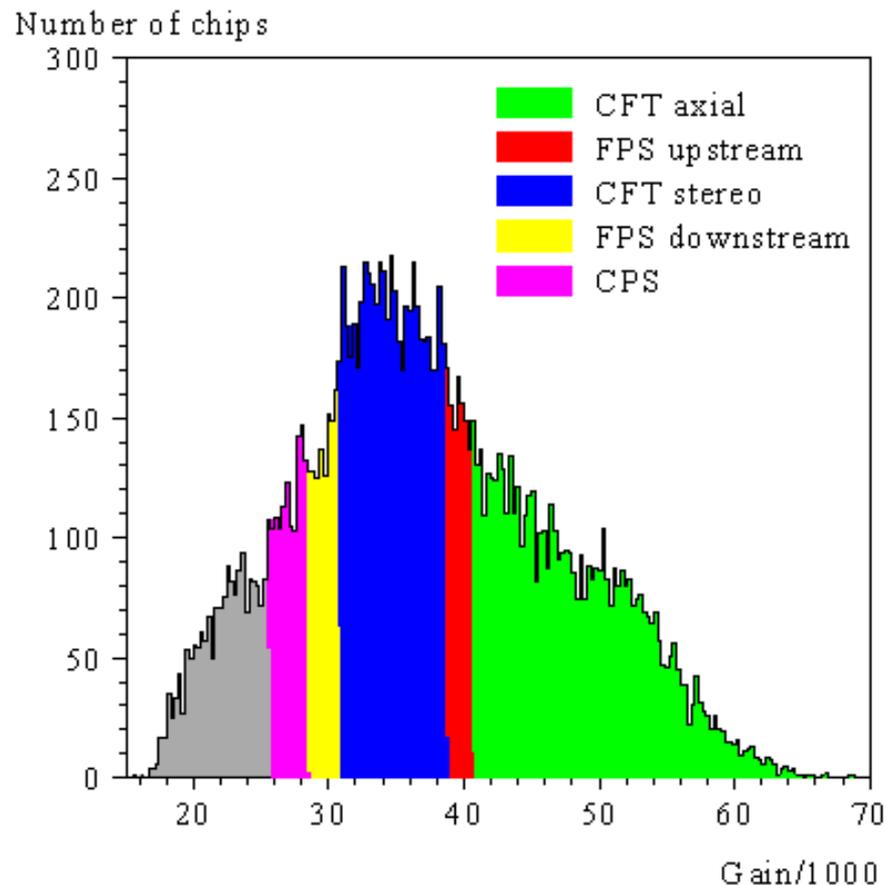
Visible Light Photon Counter (VLPC)



- Operate at 9 K
- Quantum Efficiency ~80%
- High gain: 17k to 65k electrons per detected photon

VLPC Non-uniformity

- VLPC characteristics vary among and across production wafers.
 - Variations observed in:
 - Gain
 - Optimum bias voltage
 - Relative quantum efficiency
 - Rate effects
- Similar chips are grouped together to optimize performance.

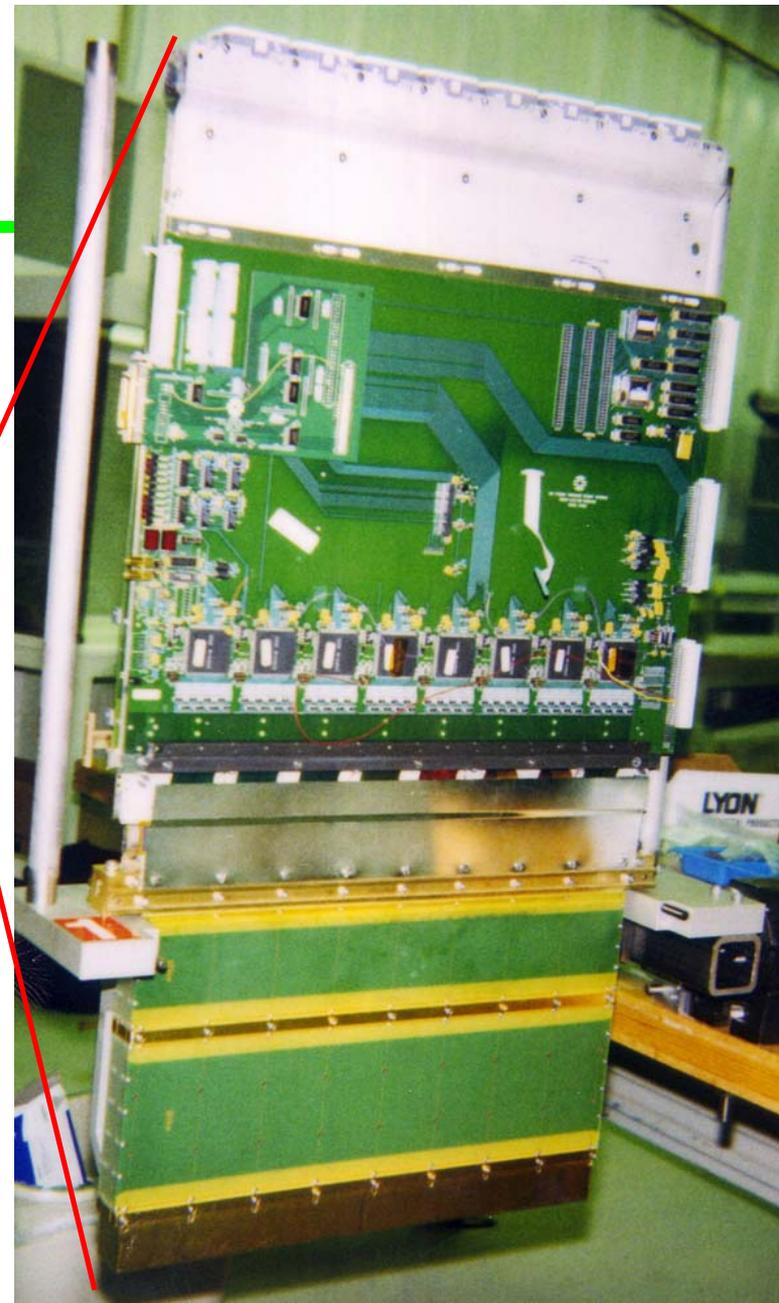


Graph made from Boeing test data

VLPC Cassettes

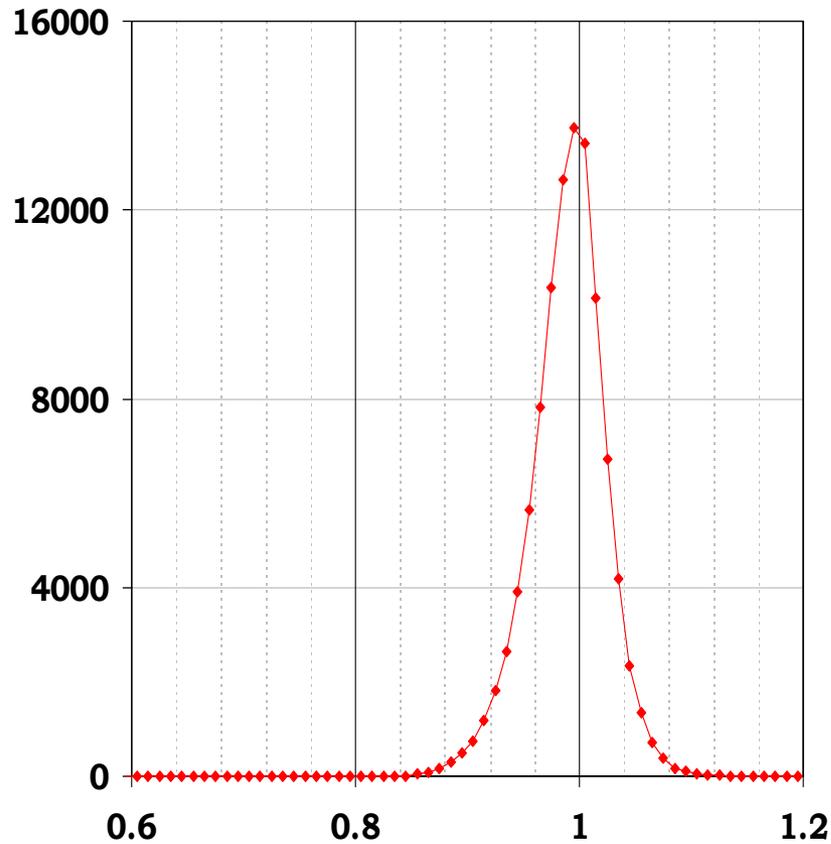
- The cassettes hold the VLPCs in their operating conditions.
- Each cassette has 1024 readout channels.
- 99 Cassettes are required to run our full system.

1 m

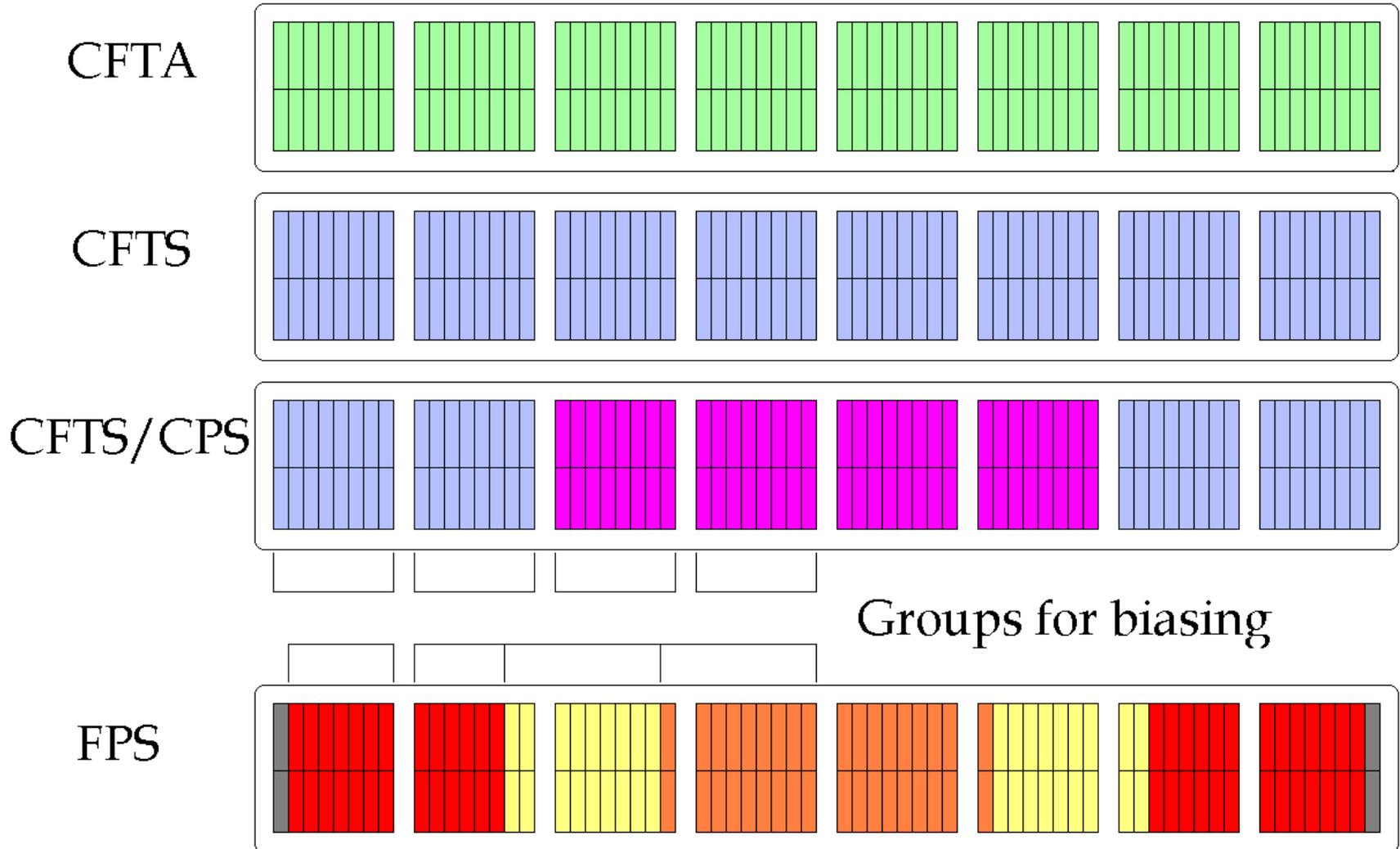


Cassette Module Construction

Light Transmission



Cassette Classes

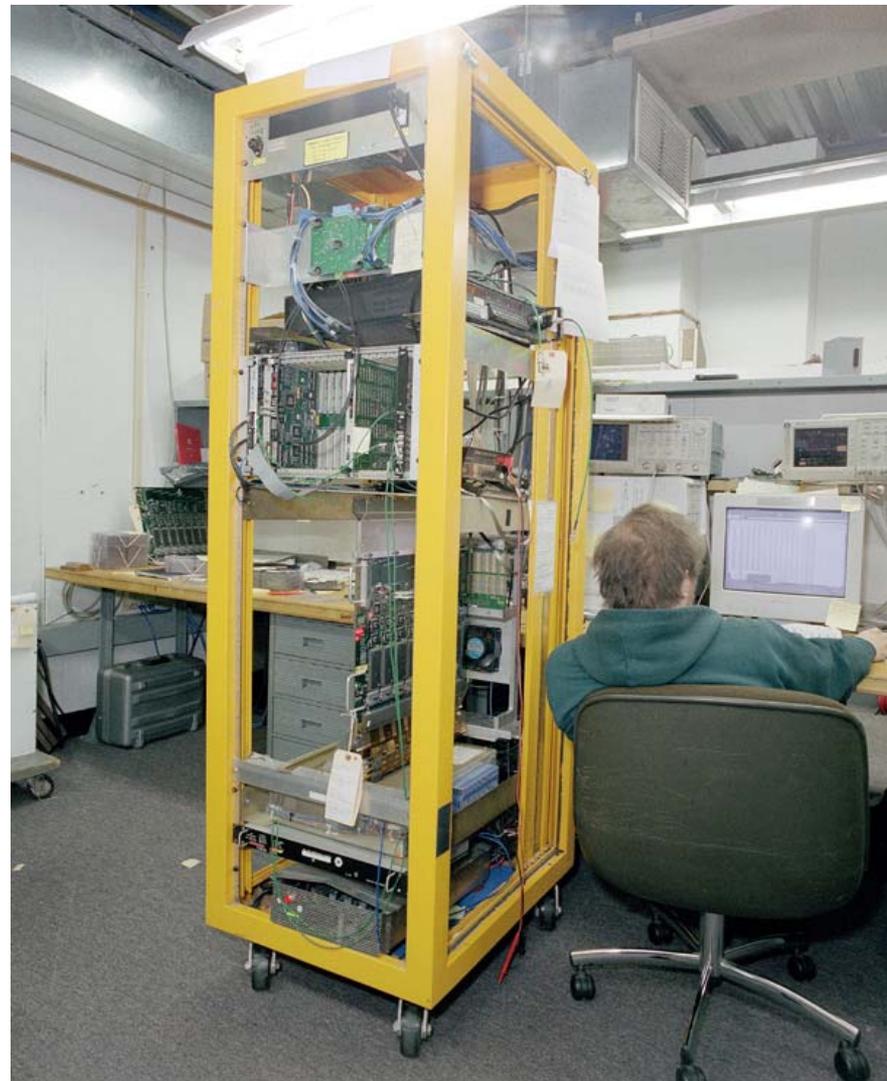
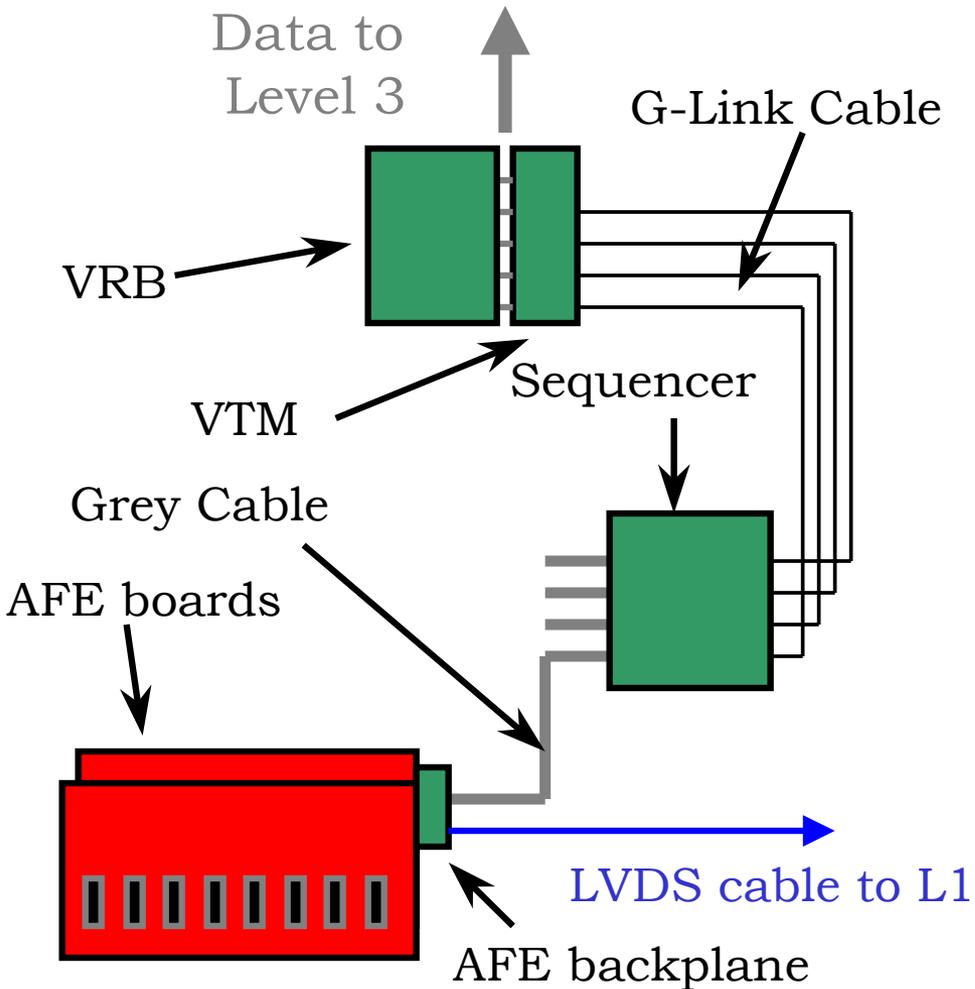


The Cryostat



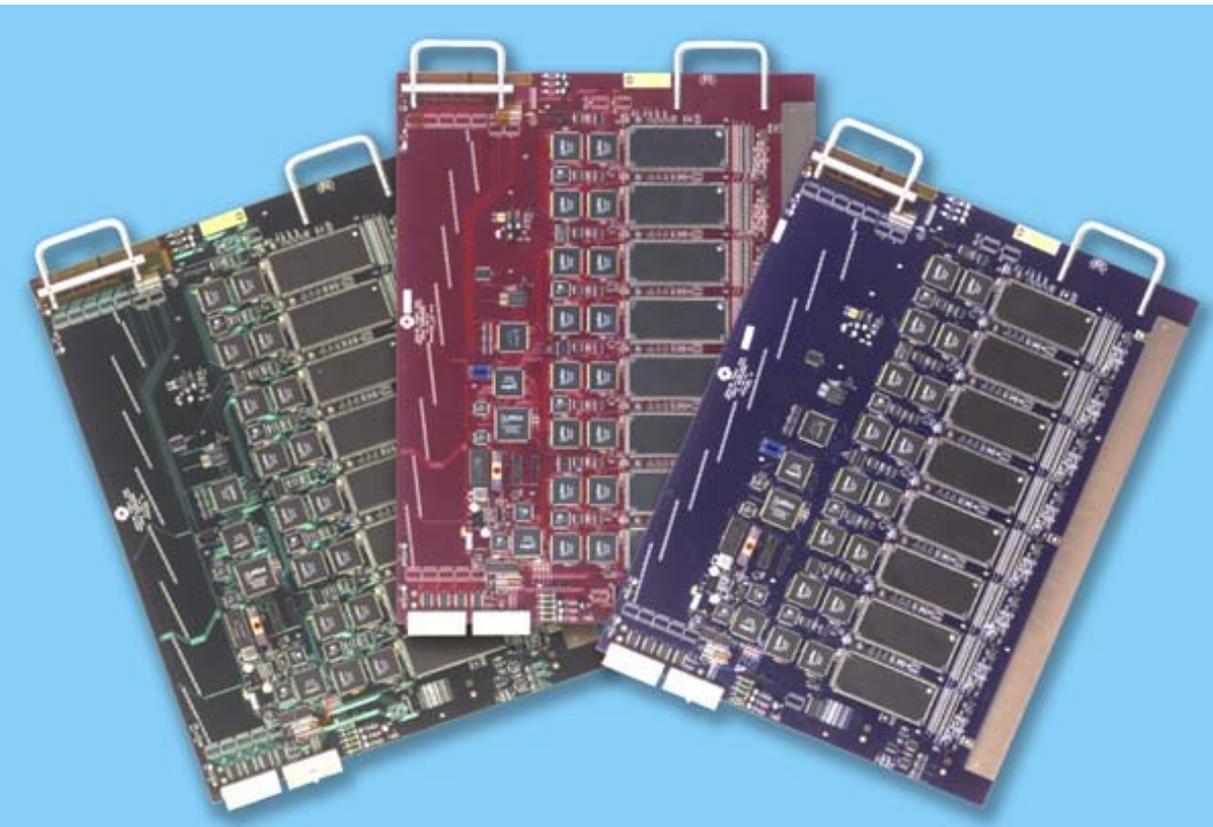
- The VLPC cassettes are sitting in two large liquid He cryostats under the calorimeter.
 - The cassettes have been described as slices of bread in a toaster.

Readout Overview



Analog Front End (AFE) Boards

Green CFT only Red FPS Blue CFT/CPS

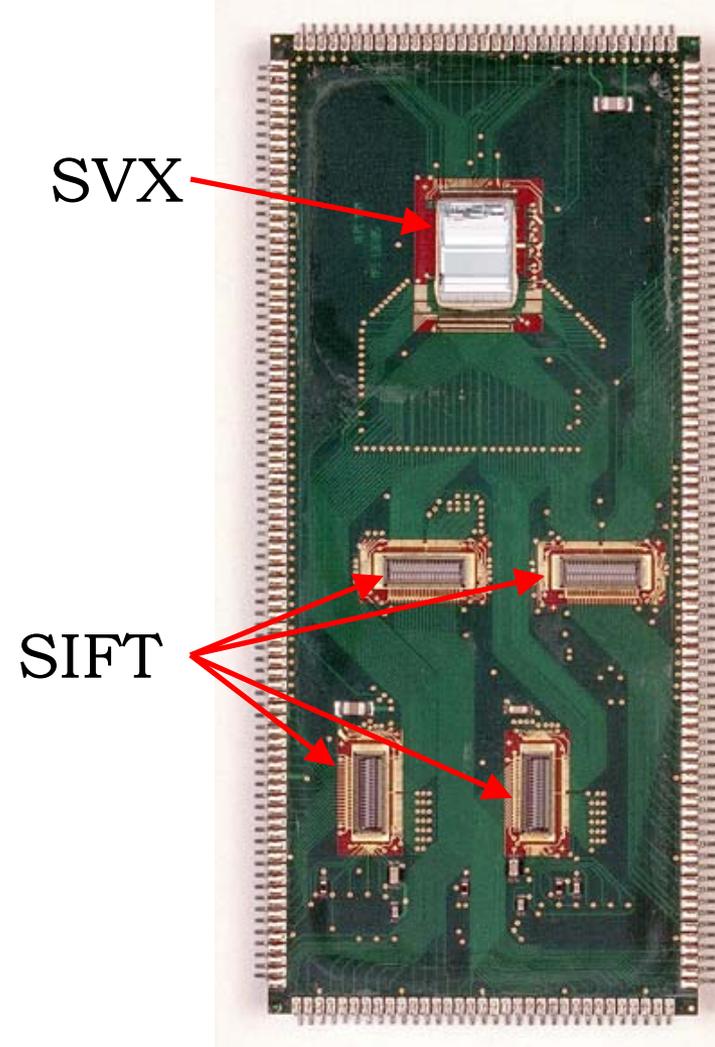


AFE specs:

- 512 channels
- ADC for VLPC
- discriminators for trigger readout
- bias to VLPCs
- Right hand boards control VLPC temperature

Multi Chip Modules (MCM)

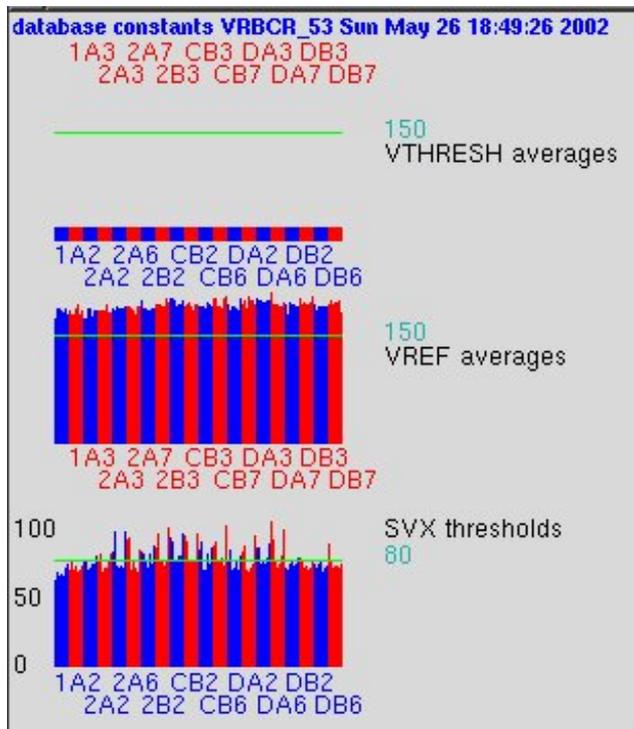
- Each AFE has eight MCMs that readout 64 channels each.
- The charge first comes to the SIFT chips which sends some of the charge to the SVX and uses the rest for its discriminator.
- The SVX2e chip is the ADC.
 - This is the same SVX chip used in our Silicon detector.
 - It has 128 channels, only half are “bonded” for read out.



MCM Parameters

Some typical values

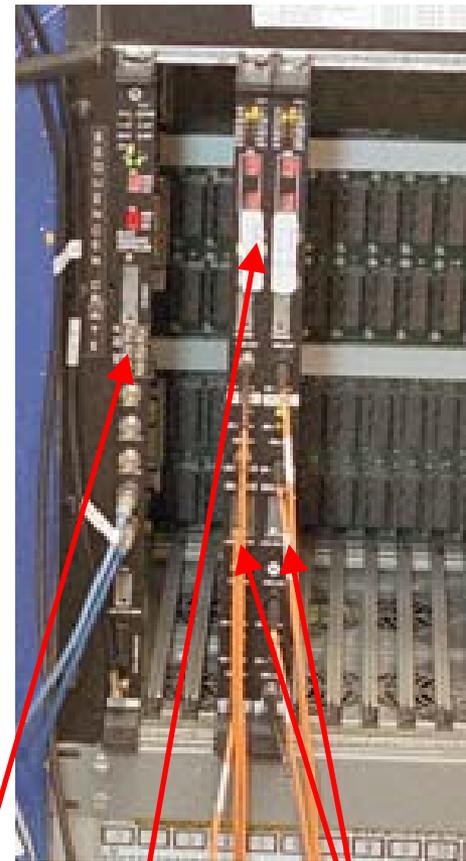
VTHRESH is empty because the discriminators are “off”



- There are three primary parameters that are fed into the MCMs when the boards are downloaded:
 - VTHRESH: This parameter sets the discriminator threshold, larger numbers make it fire more.
 - VREF: The voltage across the SIFT chip, it moves the SVX pedestal.
 - SVX threshold: The SVX readout threshold in ADC counts.

Sequencers

- The sequencers sit in two crates on the platform next to the cryostats.
- Each sequencer is connected to four pairs of AFE boards by 50 conductor cables.
 - AKA “grey cables”
- The sequencer takes that signal and converts it to a light pulse in a G-link cable that goes up to the mobile counting house.
- Each of the crates has a sequencer controller for timing.
- These crates, and everything beyond them, are nearly identical to the SMT’s electronics
 - There are real differences though.



SEQC

SEQ

G-link

VME Readout Buffer (VRB) Crates

- There are four VRB crates in MCH2 that handle all of our data.
- Each sequencer crate in the pit feeds two VRB crates upstairs.
- Each sequencer sends its signals to a VTM which converts the light pulse to an electronic signal on the crate's backplane which is picked up by the corresponding VRB.

The 4 Crates of the Hypothesis

(Pestilence, Famine, War & Death?)



<u>Number</u>	<u>Name</u>	<u>SEQ Crate</u>	<u>Description</u>
0x50*	CFTAX	3	The entire CFT axial
0x51	CFTST [†]	5	Mixed CFTS and CPS
0x52	CPS [†]	3	Mixed CFTS and CPS
0x53	FPS	5	The complete FPS

*Note 0x implies hexadecimal numbering

[†]These names can be misleading

Special Units in the VRB Crates

- Each VRB Crate contains three special units.
 - One VRB Controller (VRBC) that controls the crate.
 - One Single Board Computer (SBC) that is our interface with the L3 trigger.
 - One Power PC that does some controlling of the crate and is the secondary data acquisition path.

AFE Power Supplies – Vicors

- The AFE boards are powered by thirteen Vicor power supplies under the cryostat.
- Each Vicor powers one “AFE Crate” which contains up to sixteen AFE boards.
- The thirteen AFE crates are each divided into A and B halves that can be powered up and down.
 - These crates also give the AFEs their operational names like “4B0” – 4B is the half crate and there are 8 boards, 0-7. Even numbered boards are lefts.
- The Vicors provide +12, +5.5, +5, +3.3, and -12.
- They can be powered remotely from the control room or the platform itself.



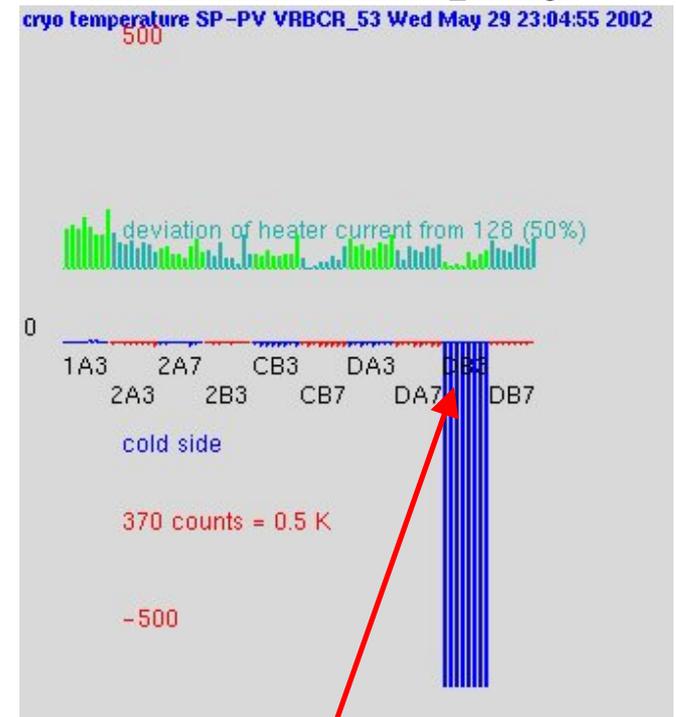
Temperatures

- There are (at least) three temperature systems that are important to CFT operation.
 - The CFT itself has about a dozen thermometers mounted on it. There have been questions about what environment the CFT can live in.
 - Nobody has been talking about these temperatures in months
 - The PIC chip on the AFE board has a temperature gauge. If the AFE gets too hot, it does not work well.
 - Our cooling on the platform controls this adequately.
 - The VLPC's cryogenic system.

VLPC Temperature Control

- At the bottom of the cryostat, the cold block is held at ~6K.
- Each group of 16 VLPC chips has three resistors underneath it: a calibrated thermometer and two heaters.
- This system allows the right hand AFE board to finely control the temperature of the VLPCs.

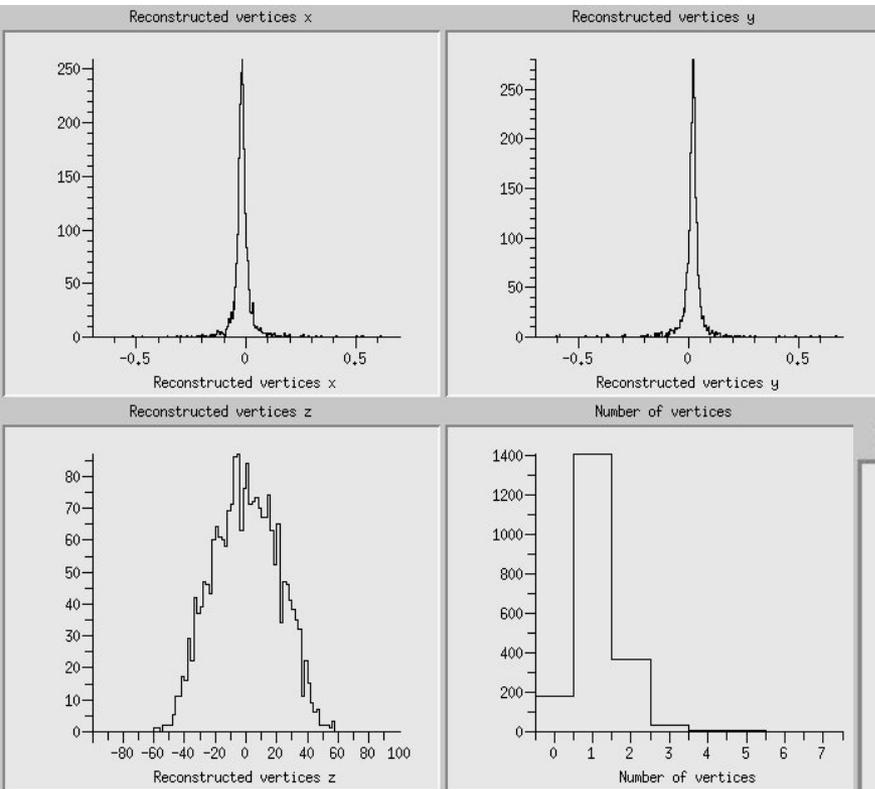
Standard Temperature Control Display



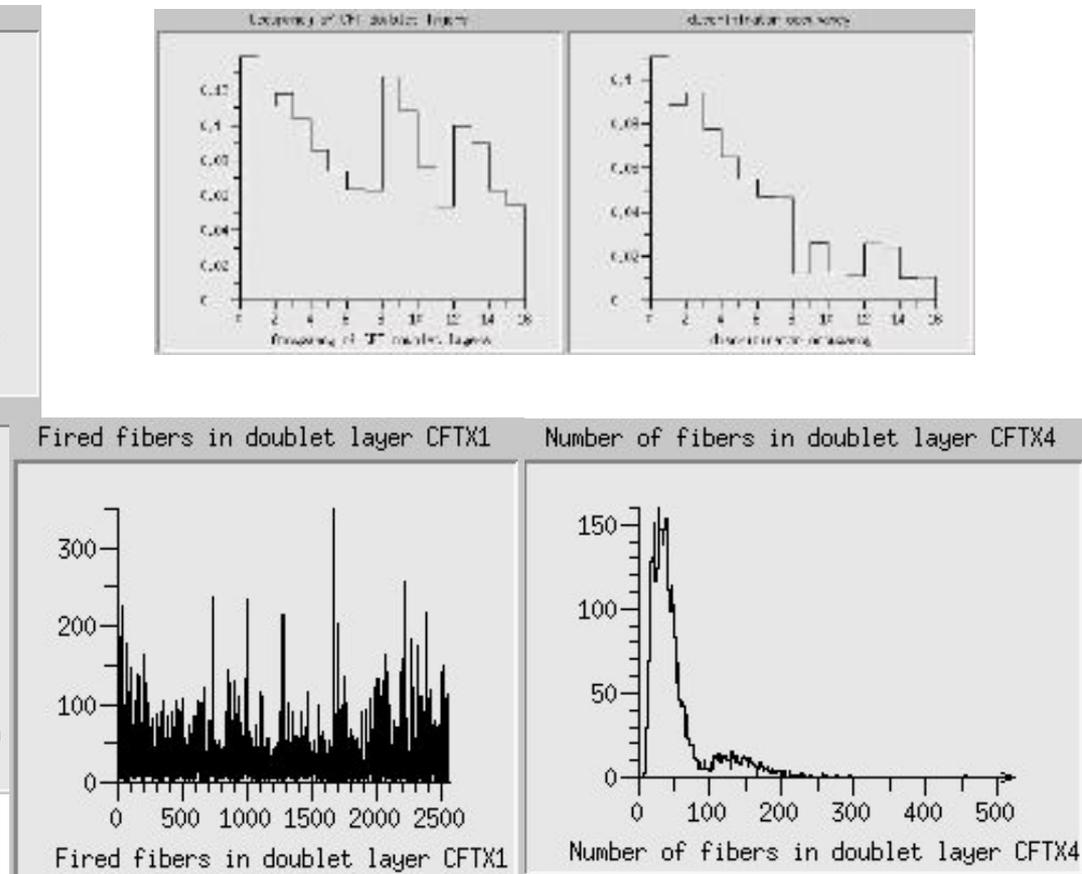
Troubled Board

Examines

Vertex Examine



CFT Examine



Front End Busy

- The CFT had horrible problems with FEBs.
- This has largely been resolved through the use of the front end busy utility
 - Rather than pushing buttons and running as fast as possible, we have documented out problems.

VRBs and Sequencers associated with crate CFTA

VRB	RO Bsy	Scan Bsy
5009	0	0
500A	0	0
500B	0	0
500C	0	1
500D	0	1
500F	0	1
5010	0	1
5011	0	0
5012	0	0
5013	0	0

Lights increment at updates:

Update Now

Exit

The LED System

- Each of the three detectors has an LED system for calibration and testing purposes.
- The system is currently run by a Windows PC sitting in MCH2.
- Eventually, this system should be run with 1553.
- With today's system, we can light specific groups of channels all over the detector.
 - This has proved very valuable for sorting out the map.
 - We also use this system to determine the gain of each channel.

Tracking: $\gamma \rightarrow e^+e^-$

2003/01/23 15.13

2003/01/23 15.14

