

FIBER OPTIC DATA ACQUISITION for the CDF SVXII

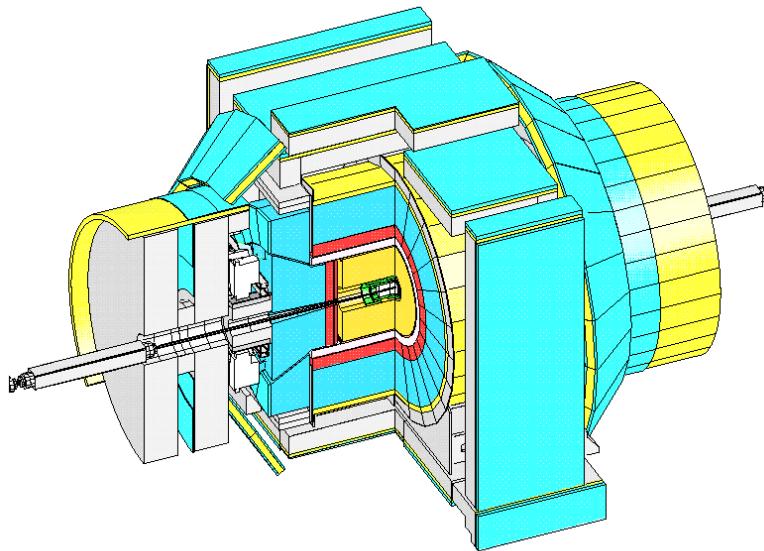
M. Chertok
Texas A&M University

APS Centennial
Atlanta, Georgia
Mar. 24, 1999

Outline of Talk

- CDF upgrade
- SVX upgrade
- DAQ overview
 - ◊ Parallel fiber optic data link
 - ◊ Serial fiber optic link for data and control
- Conclusion

The CDF II Detector



CDF is undergoing major upgrades to prepare for Tevatron Run II:

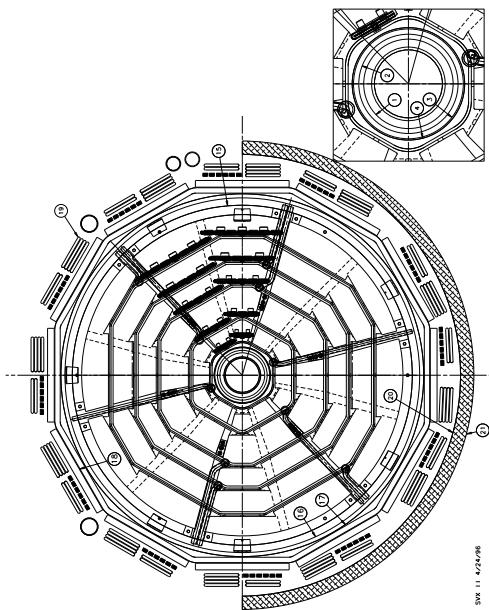
- ◊ Higher CMS energy
1.8 TeV → 2.0 TeV
- ◊ Higher inst. luminosity
→ $2 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$
- ◊ Run II total luminosity 2 fb⁻¹

→ New silicon, drift chamber,
calorimeter, muon chambers, triggers,
and DAQ

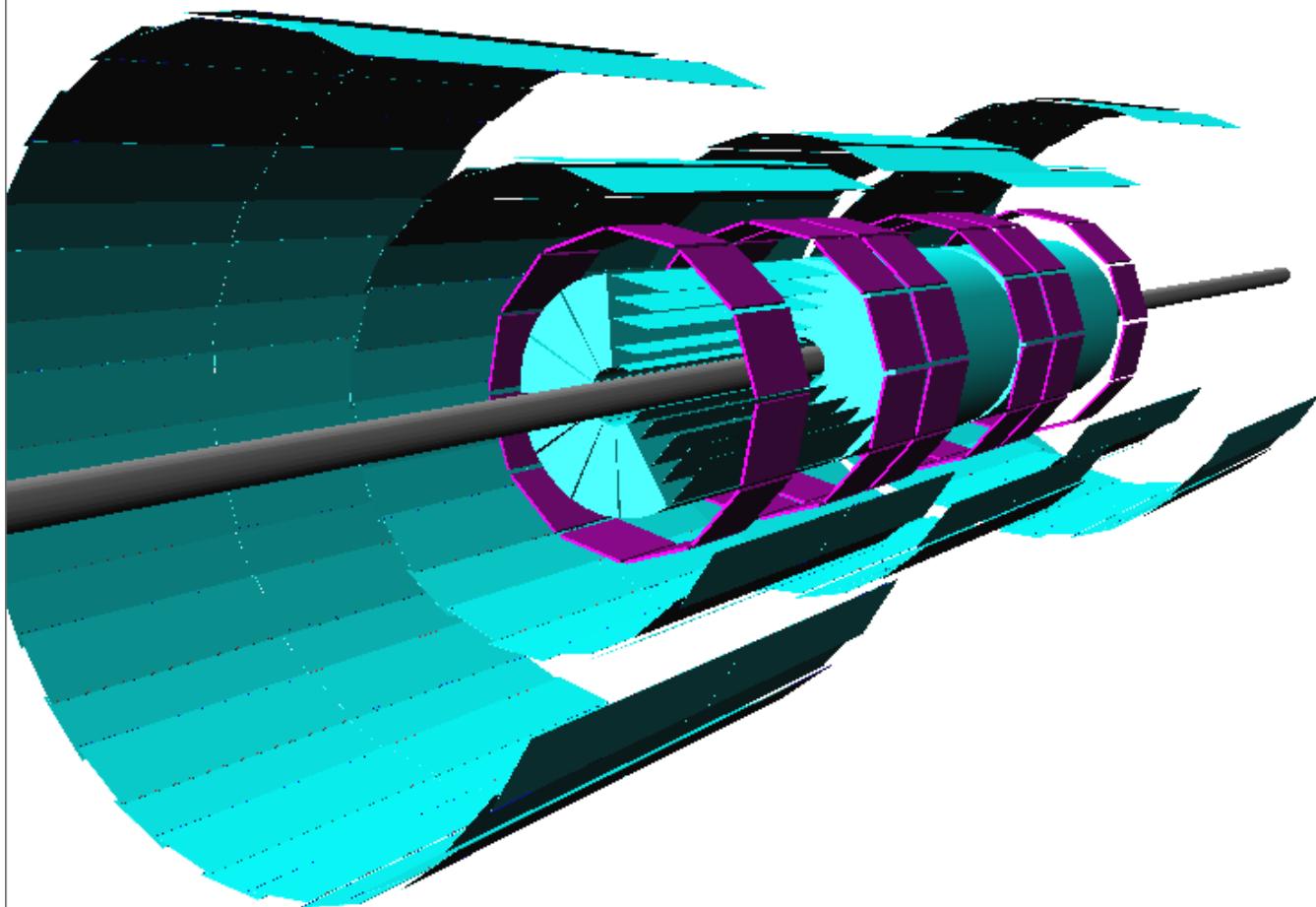
SVX Upgrade

Detector Parameters	SVX'	SVX II
Readout coordinates	$r - \phi$	$r - \phi; r - z$
Number of barrels	2	3
Number of layers per barrel	4	5
Number of wedges per barrel	12	12
Ladder length	25.5 cm	29.0 cm
Combined barrel length	51.0 cm	87.0 cm
Radius inner layer	3.0 cm	2.44 cm
Radius outer layer	7.8 cm	10.6 cm
Total number of channels	46,080	405,504*
Total number of readout chips	360	3168
Total number of detectors	288	720
Total number of ladders	96	180

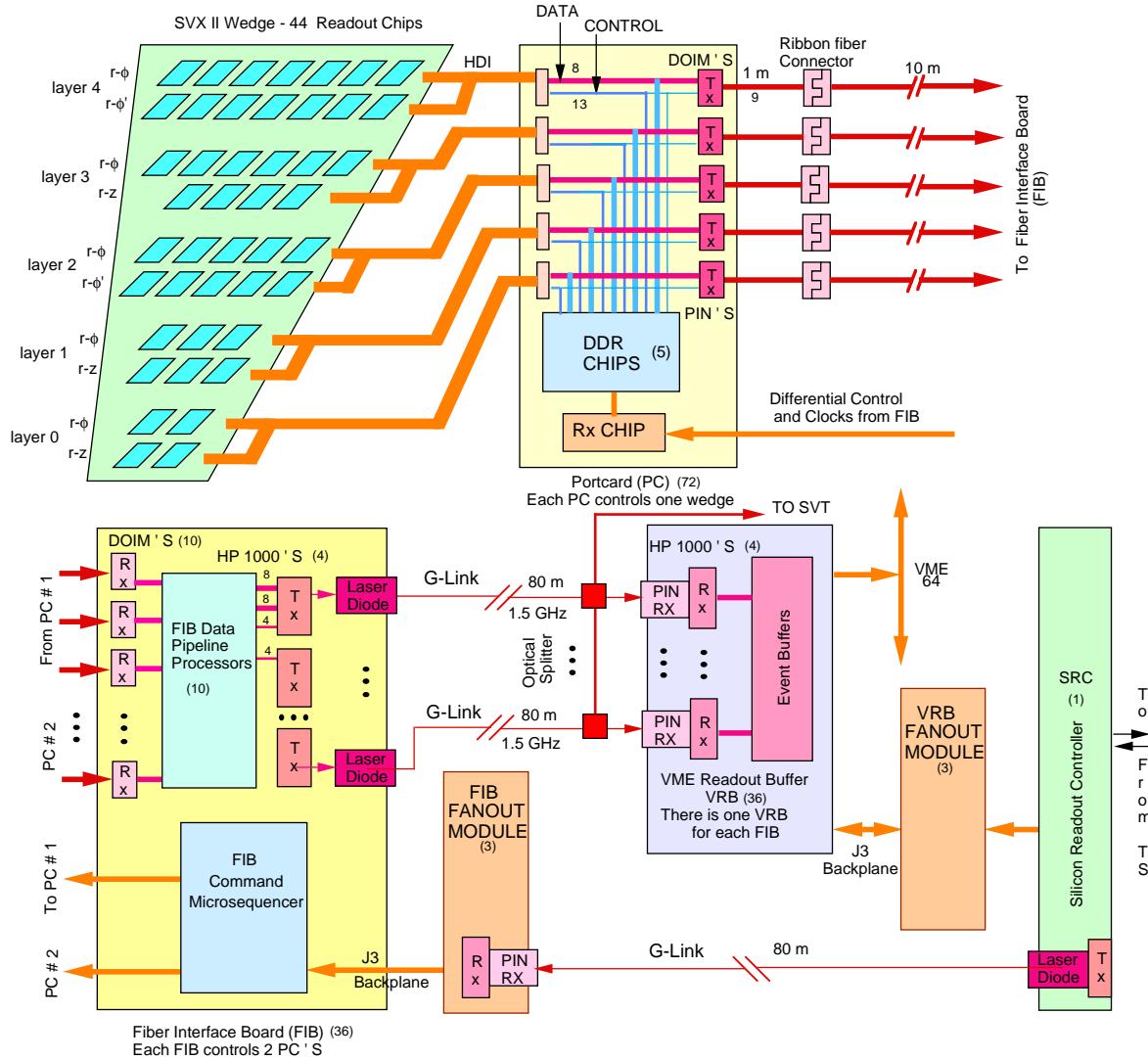
* +270K for ISL



SVXII + ISL



DAQ Overview



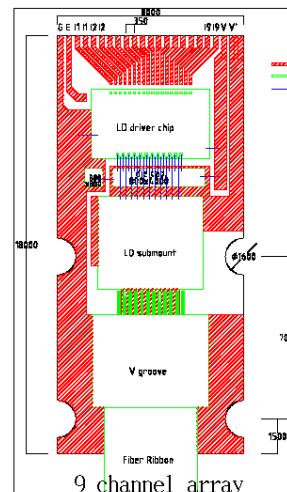
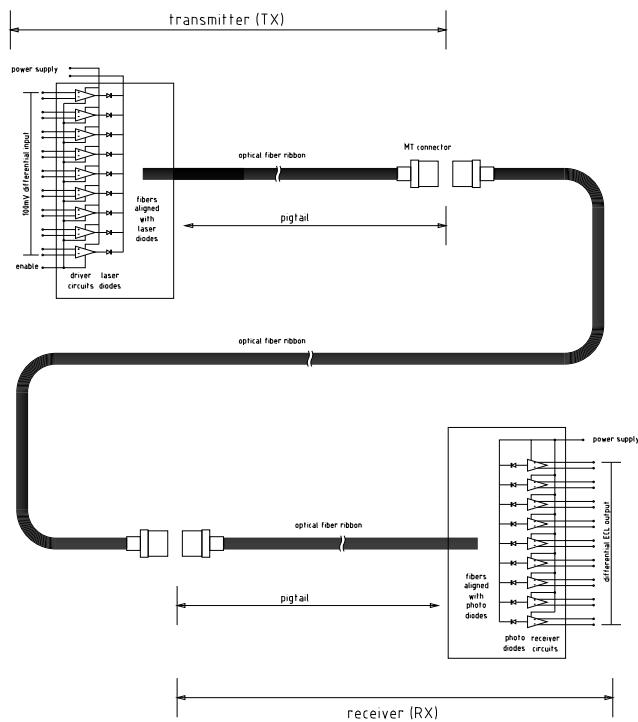
Parallel readout: 406K channels in $10\mu s$
Fiber readout: high BW, no EMI, compact, less material in tracking volume

Parallel Fiber Optic Link

Dense Optical Interface Module (DOIM)

- ◊ Transmitter (TX) converts digitized electronic data to optical at PC
- ◊ Receiver (RX) converts back to electrical at FIB $\simeq 20$ m away

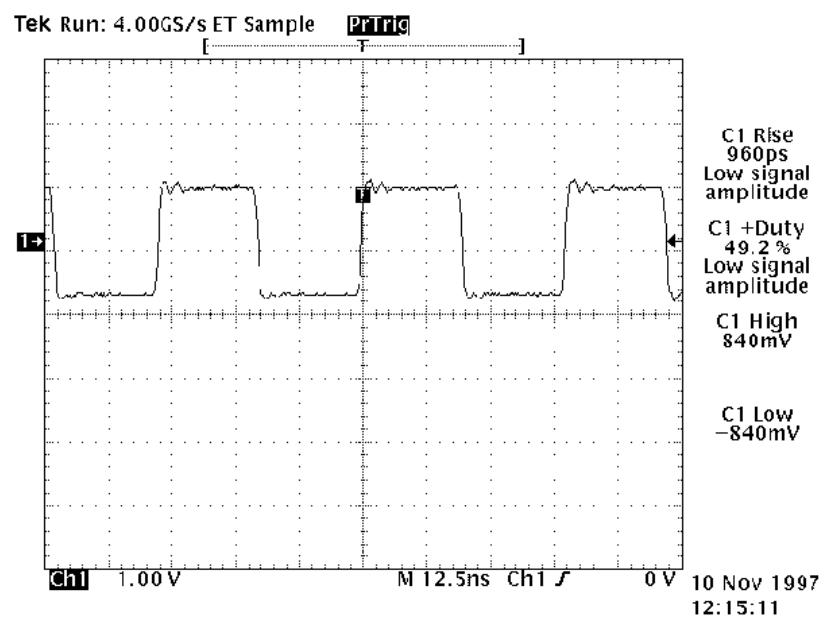
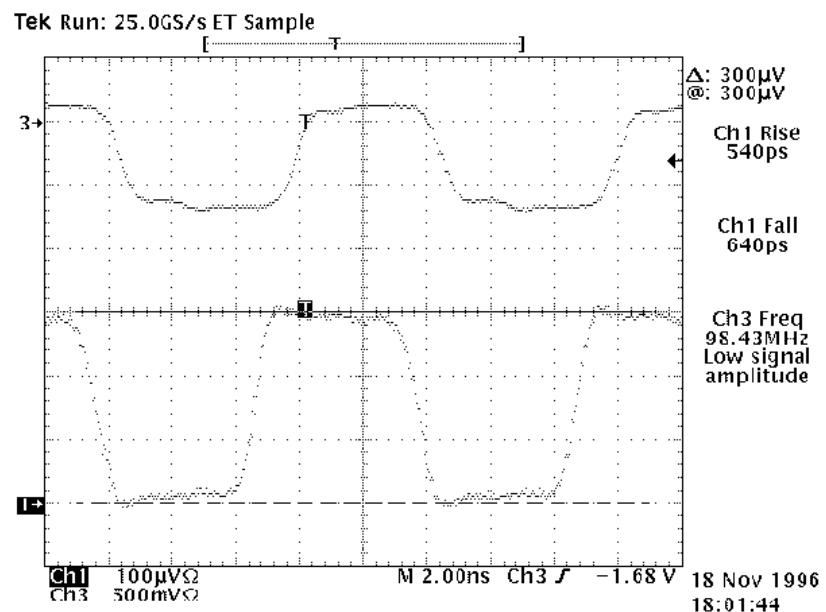
Parallel readout: One
 DOIM/wedge-layer
 → 3240 fibers full system



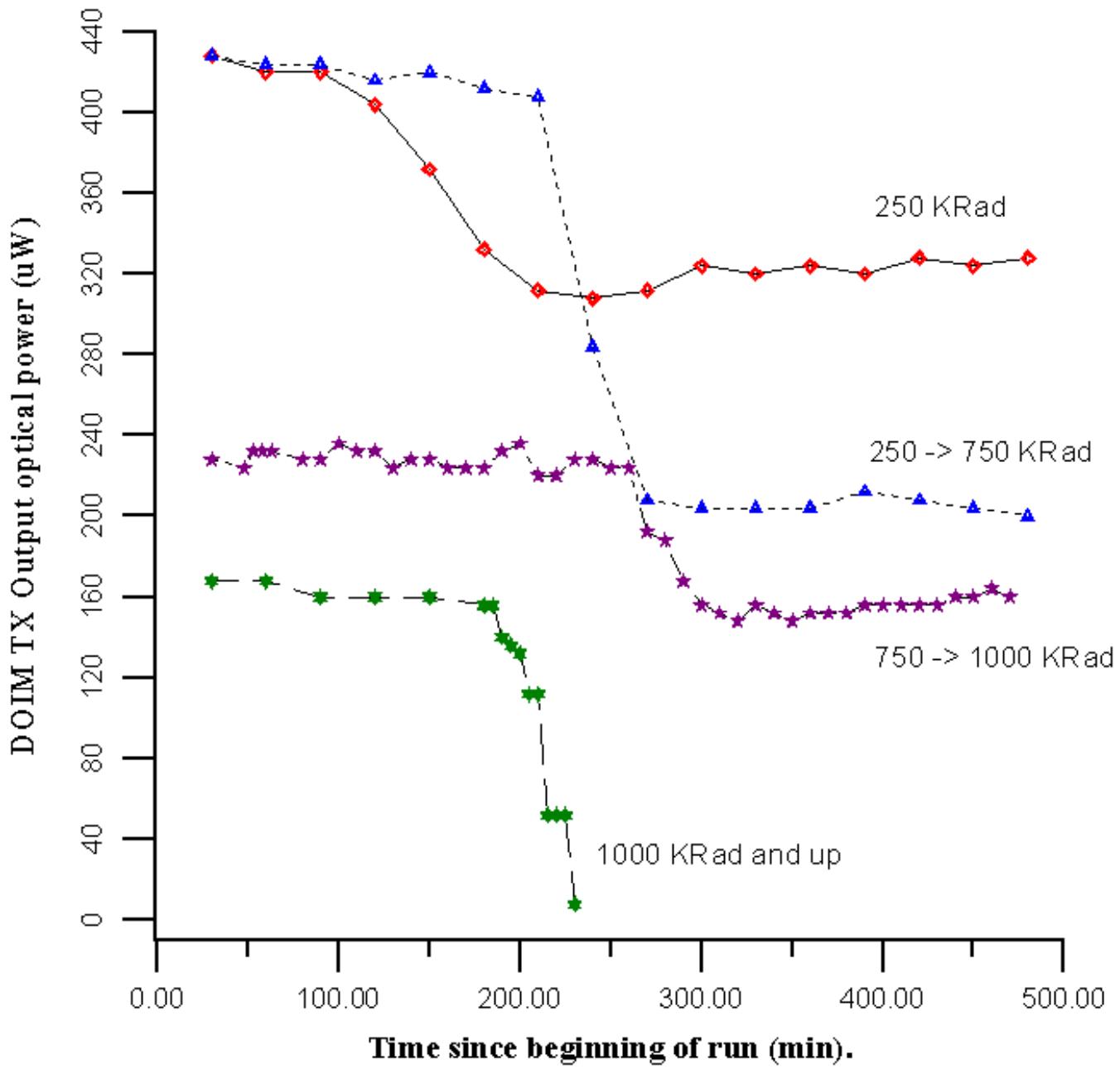
DOIM Parameters

Laser Diode DOIM TX	Type	InGaAsP/InP
	Wavelength	1550 nm
	Optical Power	$\geq 200 \mu\text{W}$
	Operating Temp	0-40 ($^{\circ}\text{C}$)
	Input	Differential, $\Delta V > 100 \text{ mV}$
	Switching Time	$t_r, t_f < 1.5 \text{ ns}$
Photo Diode DOIM RX	Optical Output	ON: $200\text{-}800 \mu\text{W}/\text{channel}$ OFF: $< 10 \mu\text{W}/\text{channel}$
	Power Dissipation	$< 2.3 \text{ mW}$
	Package Size	18 mm x 9 mm x 3.5 mm
	Bandwidth	1.9 GHz @ 3dB
	Operating Temp	0-40 ($^{\circ}\text{C}$)
Full System	Output	ECL
	Switching Time	$t_r, t_f < 2.0 \text{ ns}$
	Power Dissipation	$< 2.0 \text{ mW}$
	Package Size	15 mm x 9 mm x 3.5 mm
	Data Rate	53 MHz
	Bit Error Rate	$< 10^{-12}$
	Channel Skew	$< 0.5 \text{ ns}$
	Timing Jitter	$< 0.5 \text{ ns}$
	RX duty cycle	45-55%
	Total Number of DOIMs	360
	Fiber length	$\sim 20 \text{ m}$

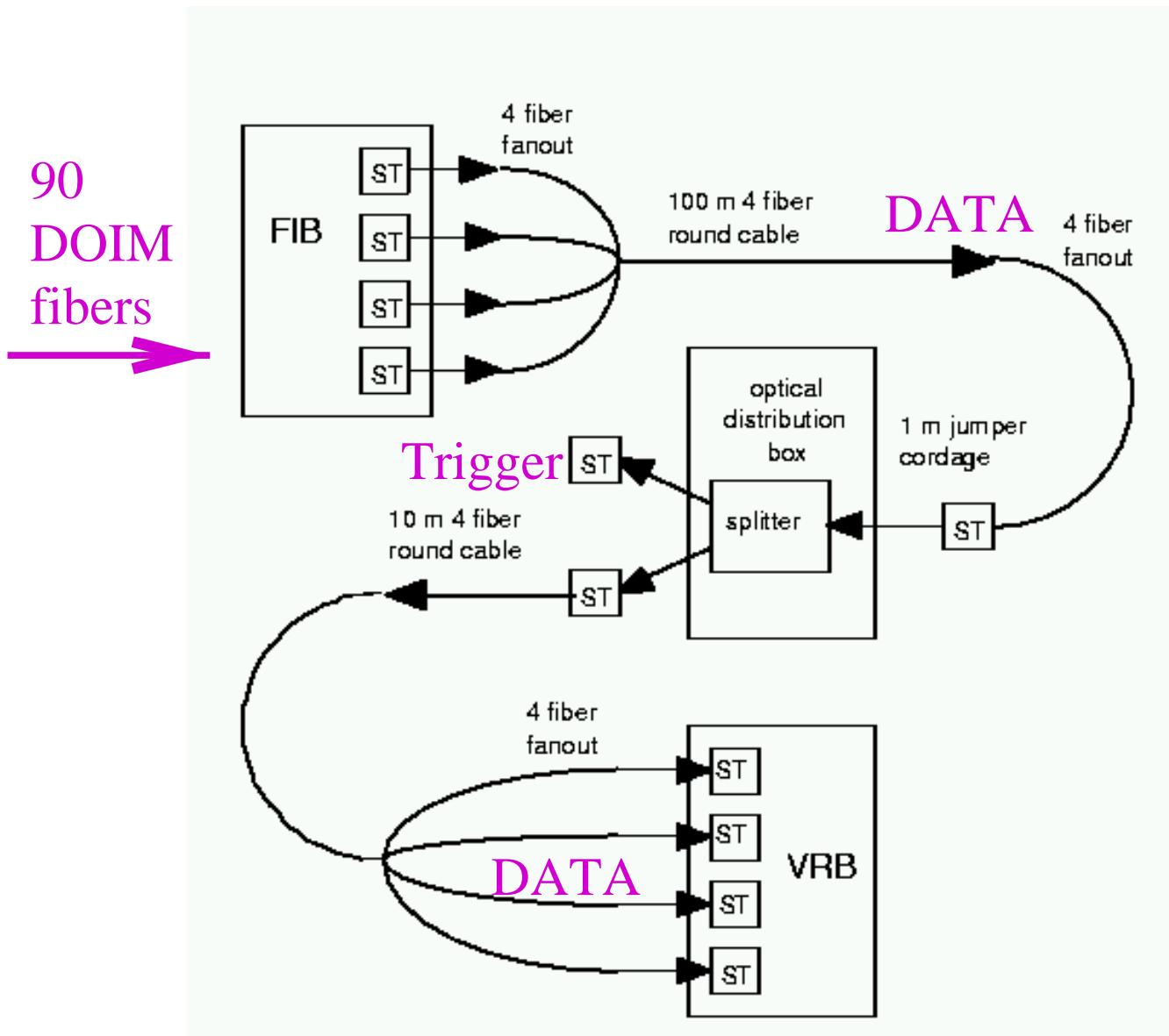
DOIM Performance



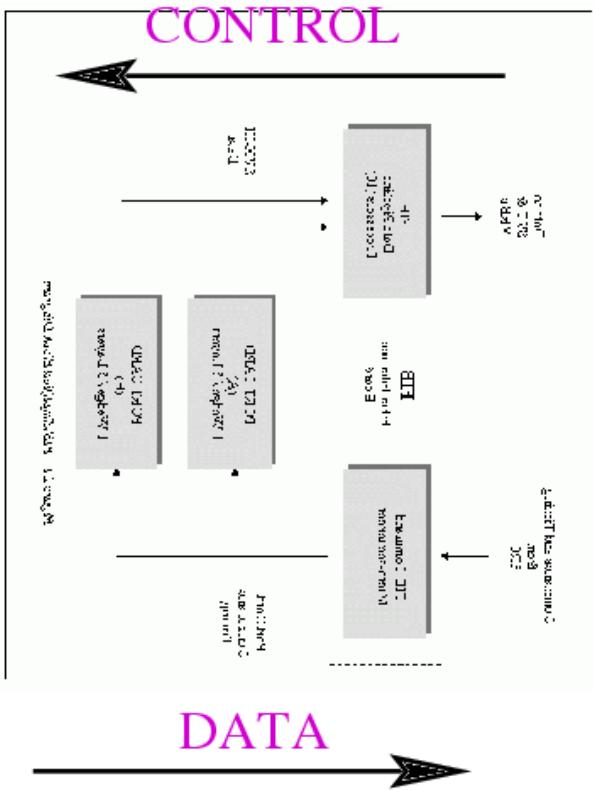
DOIM Radiation Testing



Serial Fiber Optic Link



FIB and VRB



FIB:
Control Readout
via Port Card

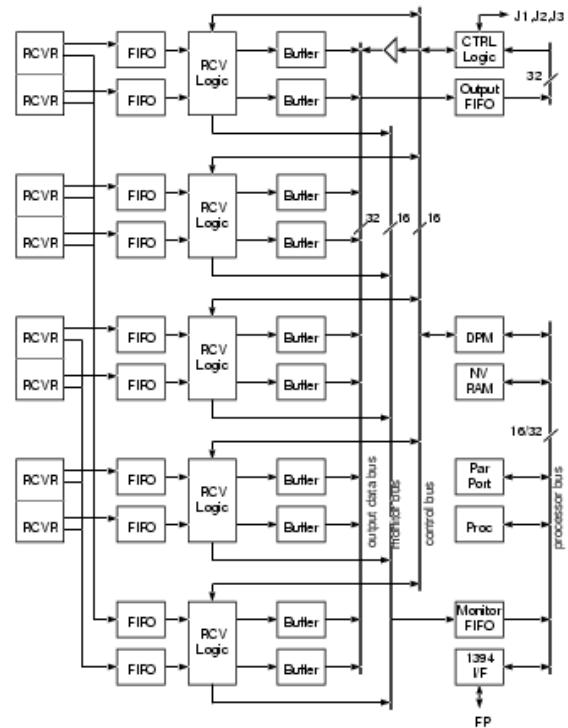
PED subtraction
Gain correction

Serialize DOIM
data

Synch. clocks

VRB:
Receive FIB data
after L1 accept

Hold during L2
decision



G-Link System

Serial fiber link uses
Finisar FTM-8510 and FTR-8510



- 1.5 Gb/s
- Serial link: 3240 DOIM fibers → 144 G-Links
- 850 nm
- 50 μ m / 125 μ m with ST connector
- Power req's. \simeq 3 W each

Spec for Bit Error Rate (BER) is 10^{-12}
Testing limit is 7×10^{-14}

Conclusion

SVX2 DAQ will be ready for Run II turn on in 2000. Fiber optics being used for first time at CDF for data and control signals.

Key successes:

- ◊ Radiation hardness
- ◊ BER testing
- ◊ Bandwidth capability

This DAQ will also be used for ISL and L00 silicon systems.