Overview and Status of ATLAS Pixel Detector

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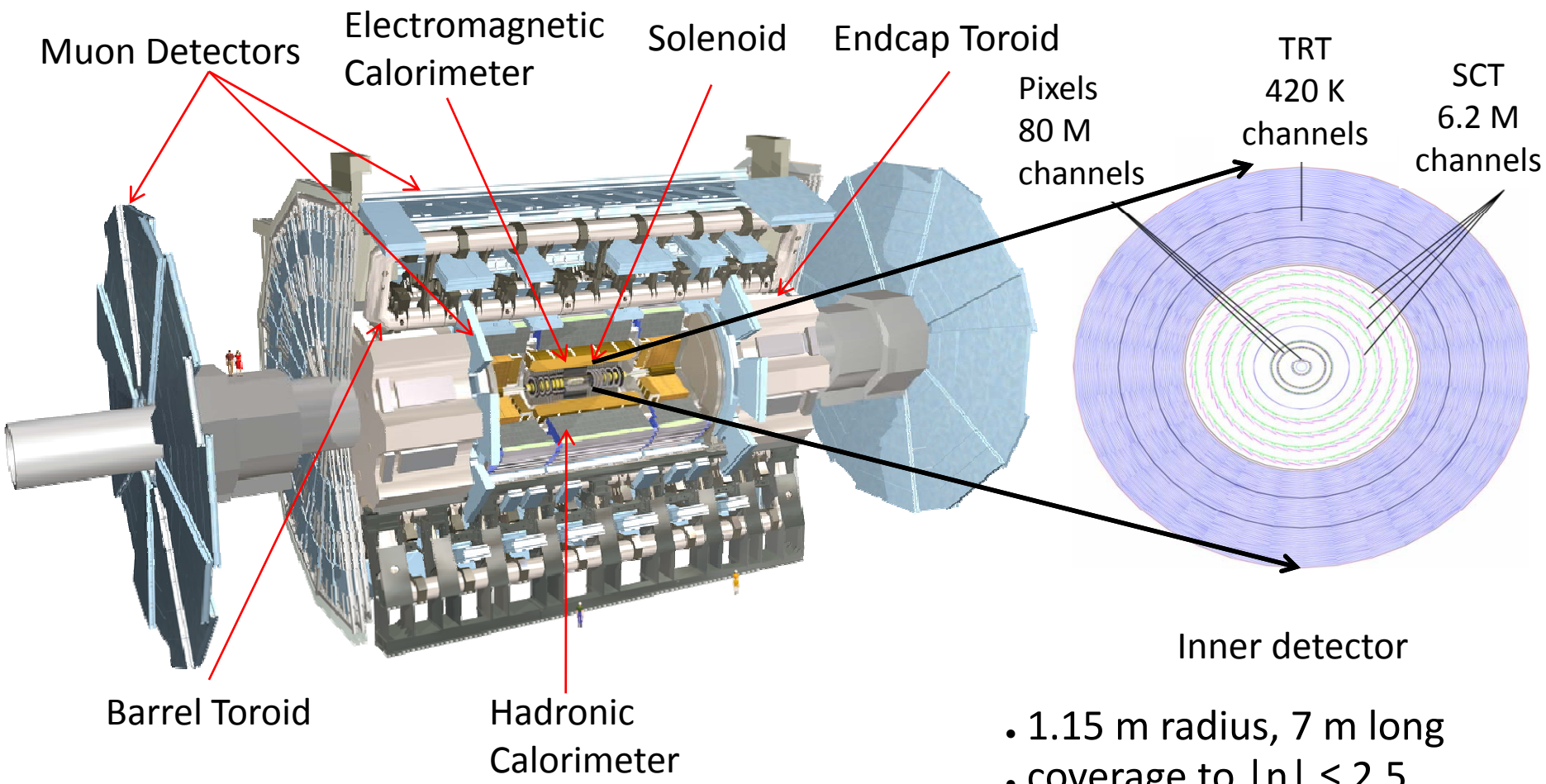
on behalf of the
ATLAS Pixel Collaboration

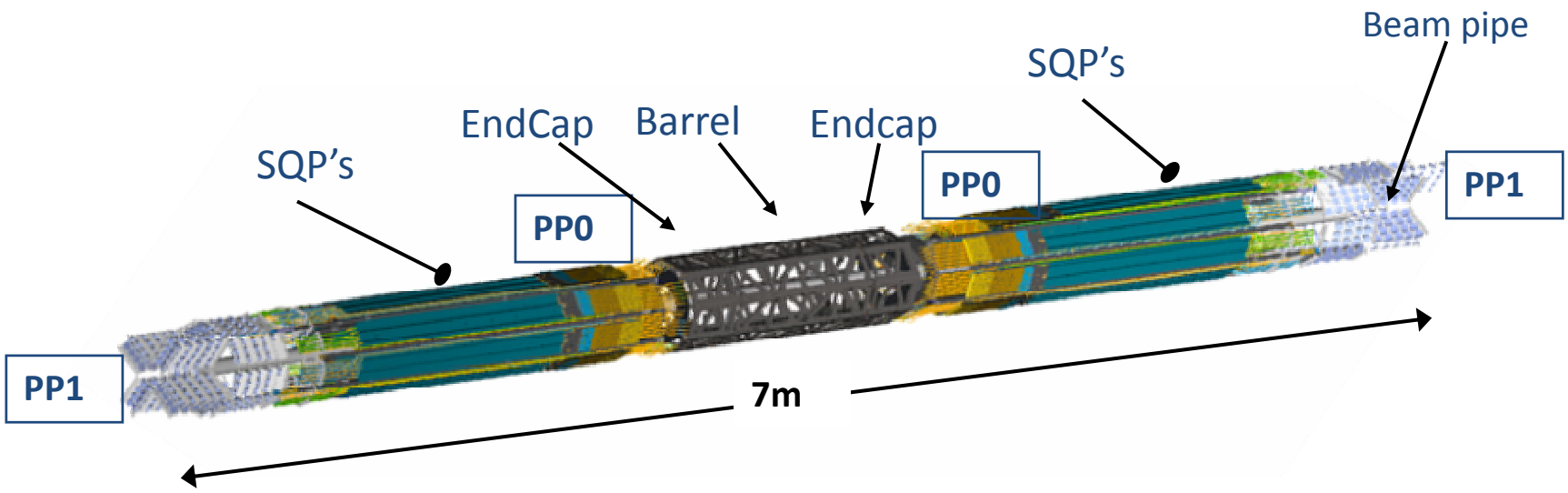
ATLAS Inner Detector



- 1.15 m radius, 7 m long
- coverage to $|\eta| \leq 2.5$
- inside 2 T magnetic field

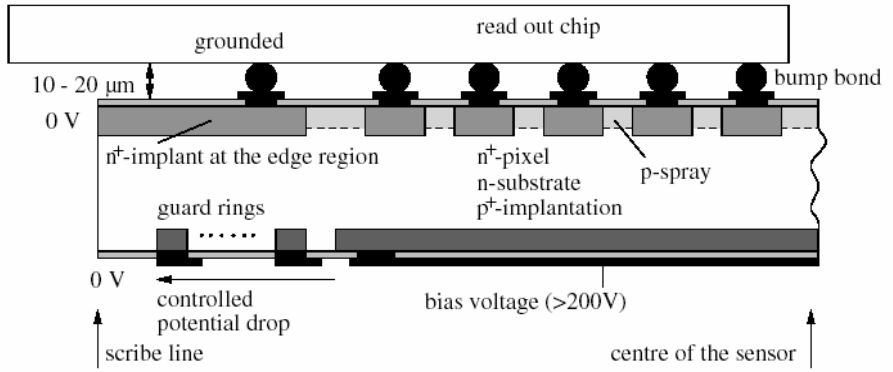
Pixel Package Overview

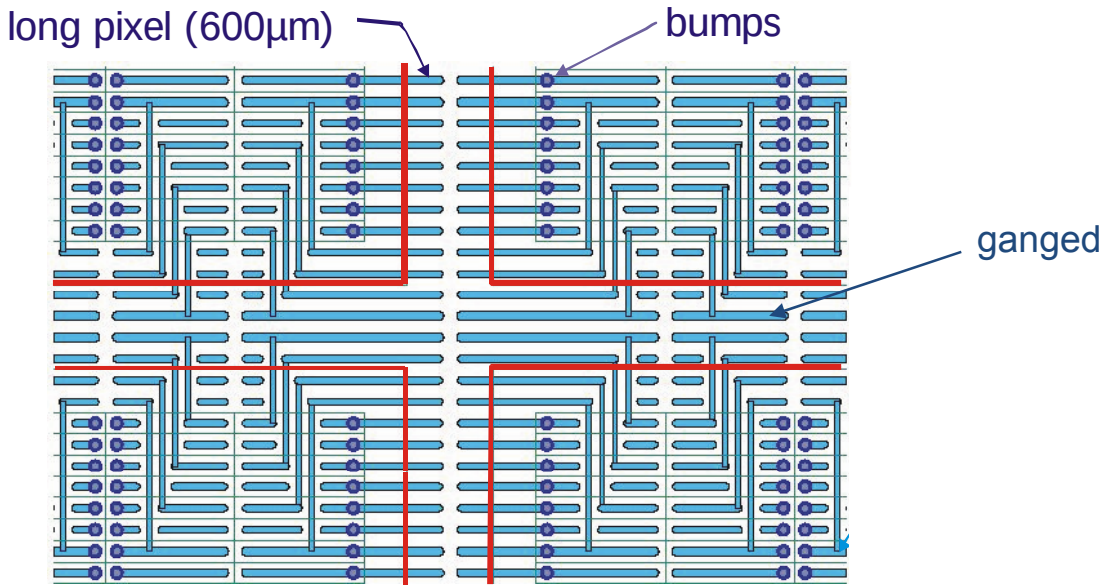
- Detector (barrel+ 2 Endcaps)
- SQPs (8 Services Quarter Panels)
- Beam Pipe and Services Supports



Pixel Sensor

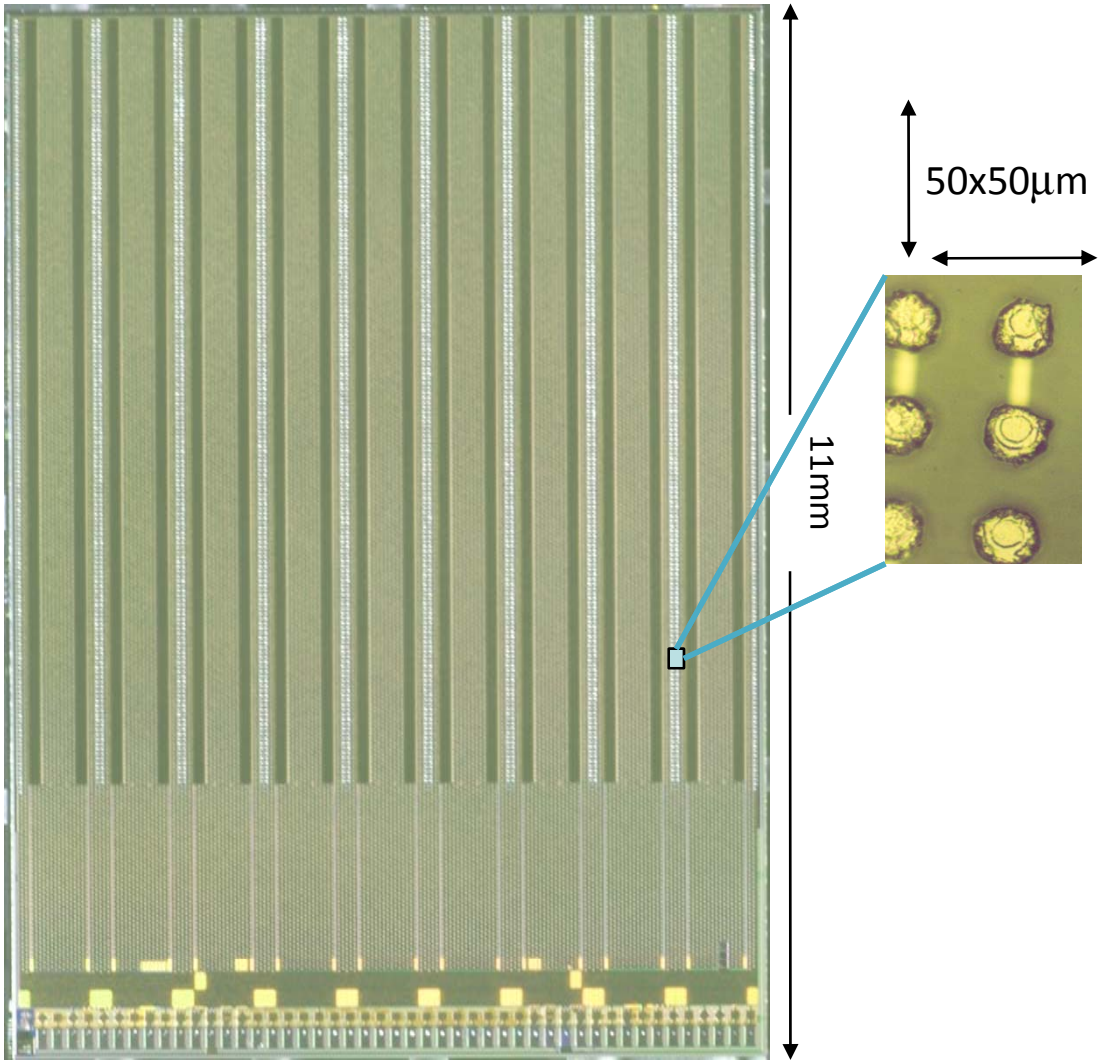
- p^+ pixels on n substrate
- Sensor bump bonded to 16 FE chips
- 41,984 50 µm x 400 µm Pixels
- Special pixels for chip overlap regions:
  - 5,248 “long” 50 µm x 600 µm
  - Ganged pixels





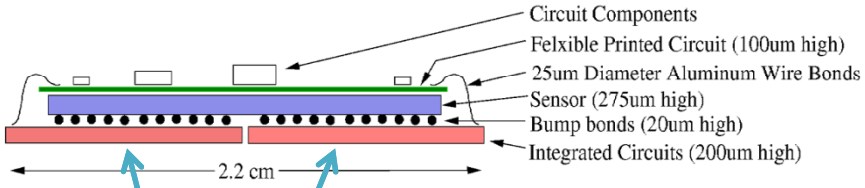
Pixel Front-End (FE) Chips

- Converts charge into Time over Threshold (ToT)
- Buffering + time stamp logic
- Charge injection
- Detailed monitoring
- 2,880 channels organized in 18 columns and 160 rows



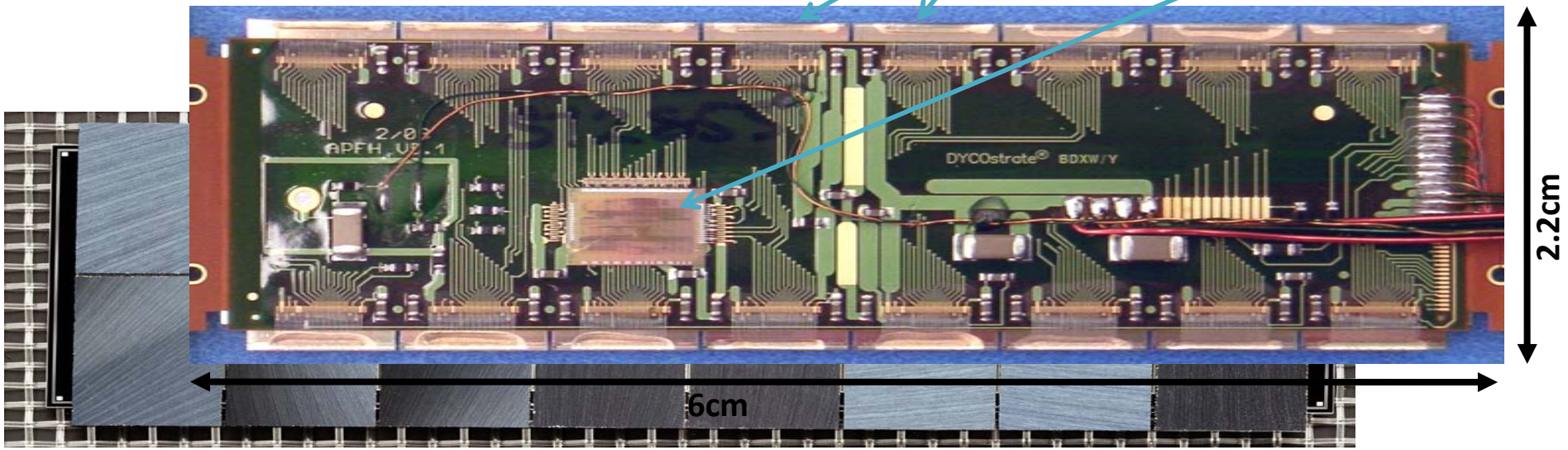
Pixel Module

- 0.25 µm CMOS FE chips
  connect to MCC
- Zero suppression and first event building
- Fast readout
  (25 ns beam crossing, 3.2 µs latency)
- Radiation hard to 50 MRad
  (NIEL > 10^{15} 1 MeV n_{eq}/cm^2)

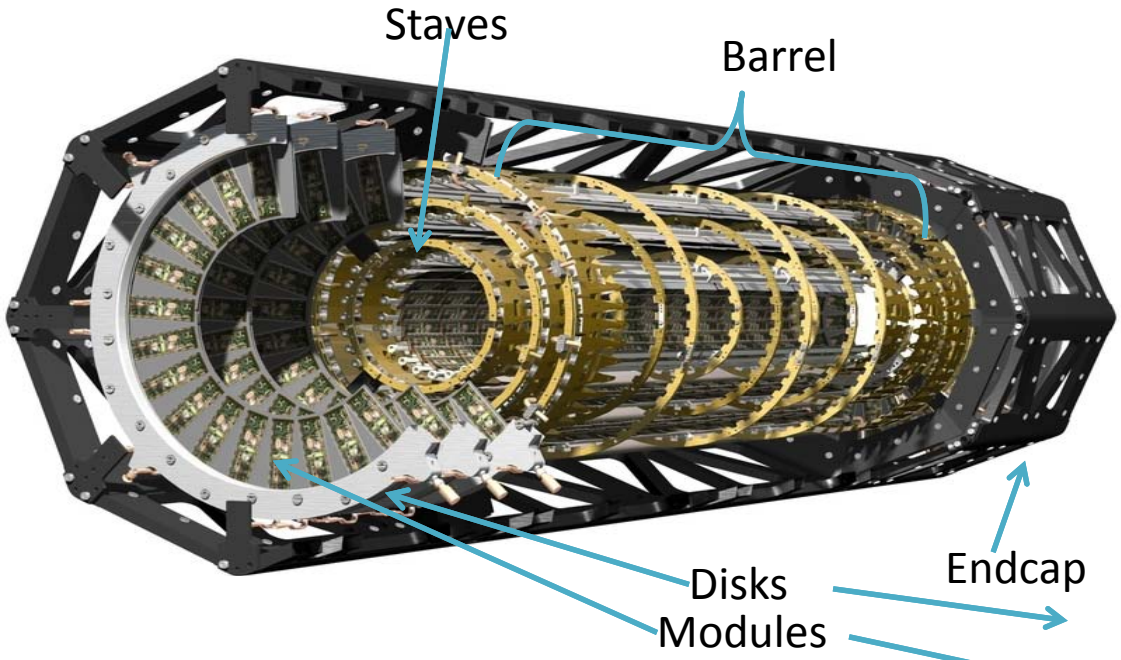


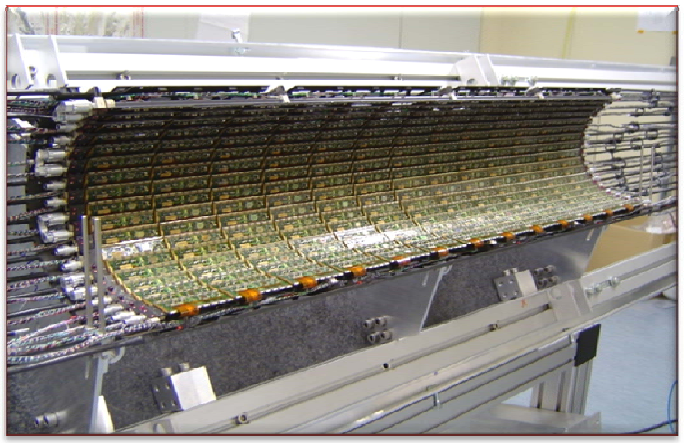
FE Chip

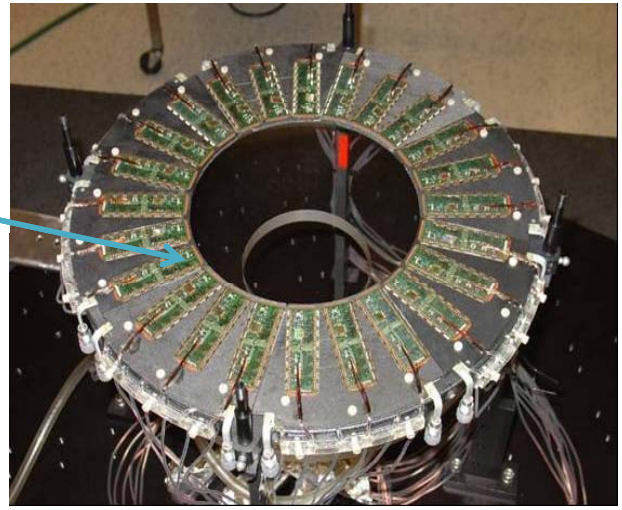
Module Controller Chip (MCC)



Pixel Detector

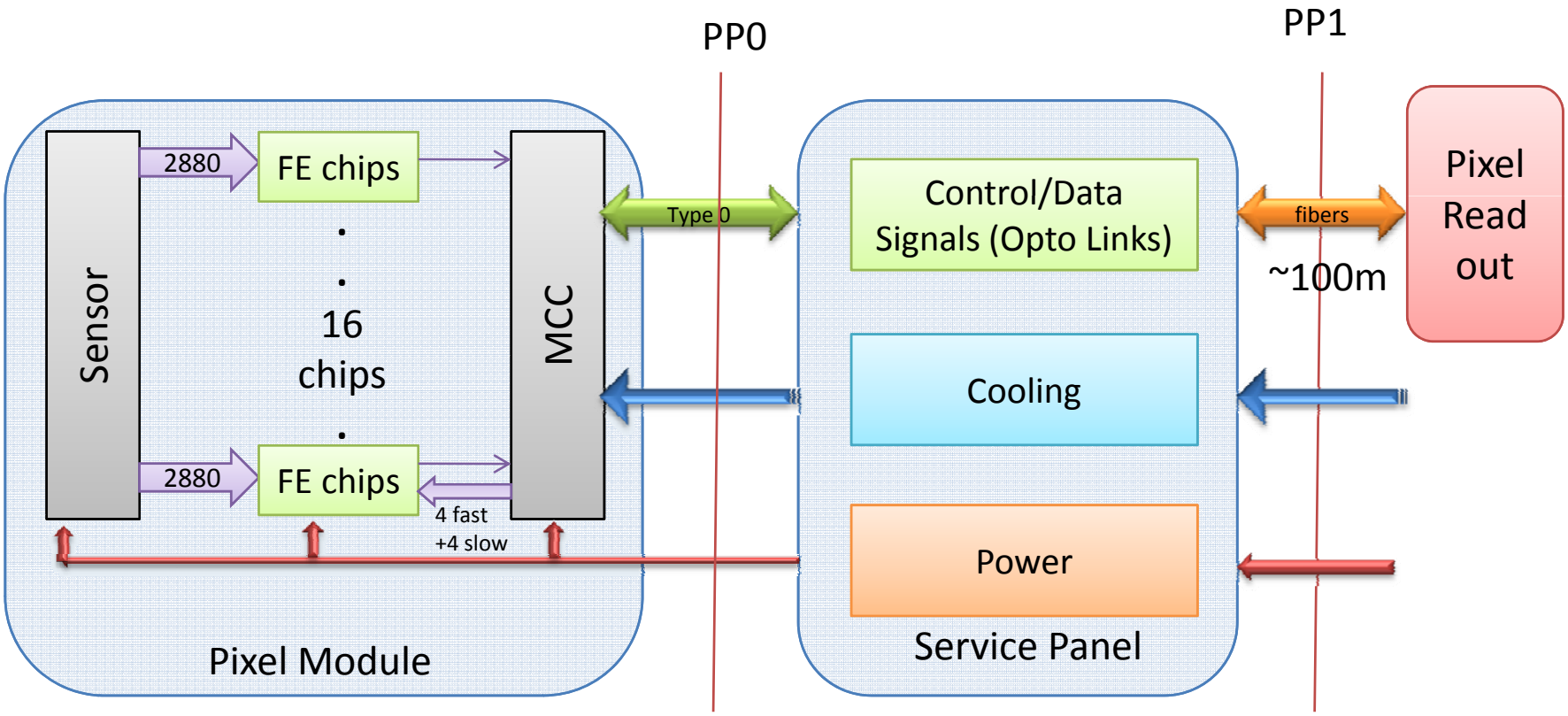




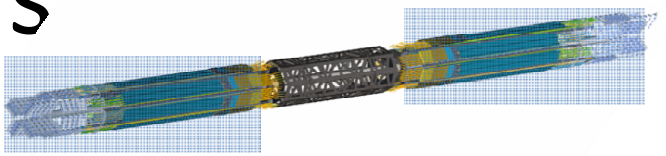


- 3 barrel layers, 2x3 disks
- Total of 1,744 Modules
- Good impact parameter resolution due to B-Layer at 5 cm

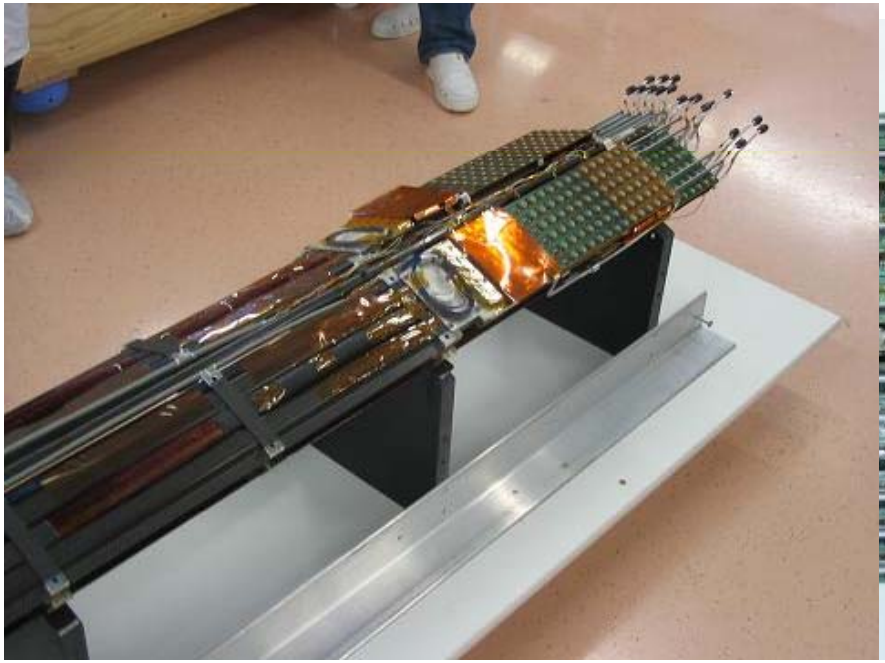
Pixel Services

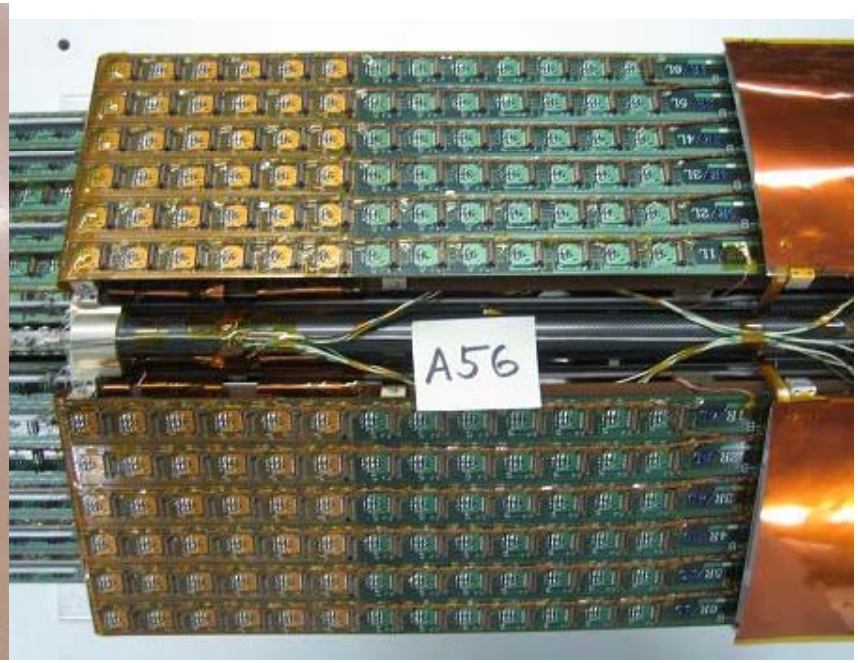


Service Panels



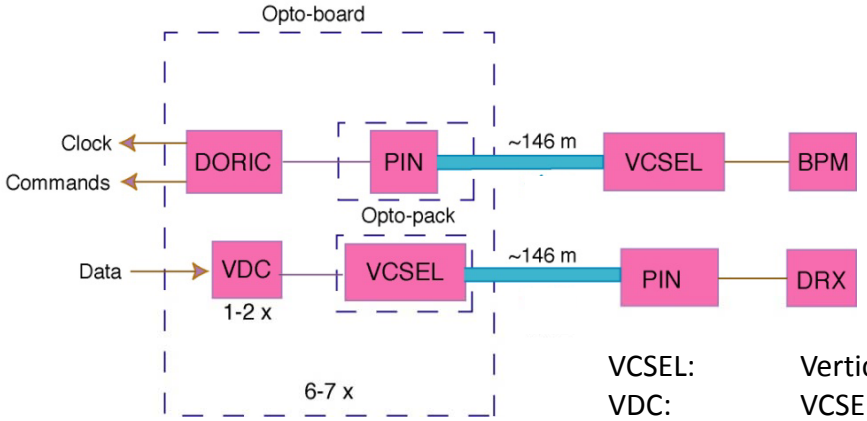
- 4 Service Quarter Panels (SQP) in each side
- SQP to route services to the outside of the Inner Detector Volume
- Module can send data with 40(L2), 80(L1, Disk) or 160(B) Mbit/s
- Opto-board services 6/7 modules
- 36 opto-boards per SQP

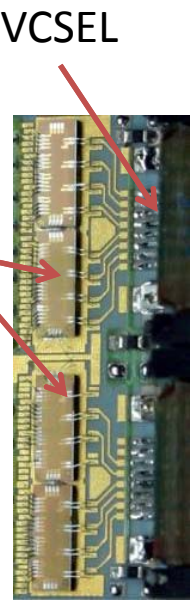


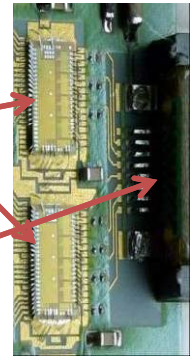


Opto-Boards

- Converts optical to electrical signal and vice versa
- Contains optical links, each serving a pixel module
  - B-layer : two data links per module due to high hit occupancy
  - L1, L2 and disks: one data link per module
  - Fabricated with BeO for heat management



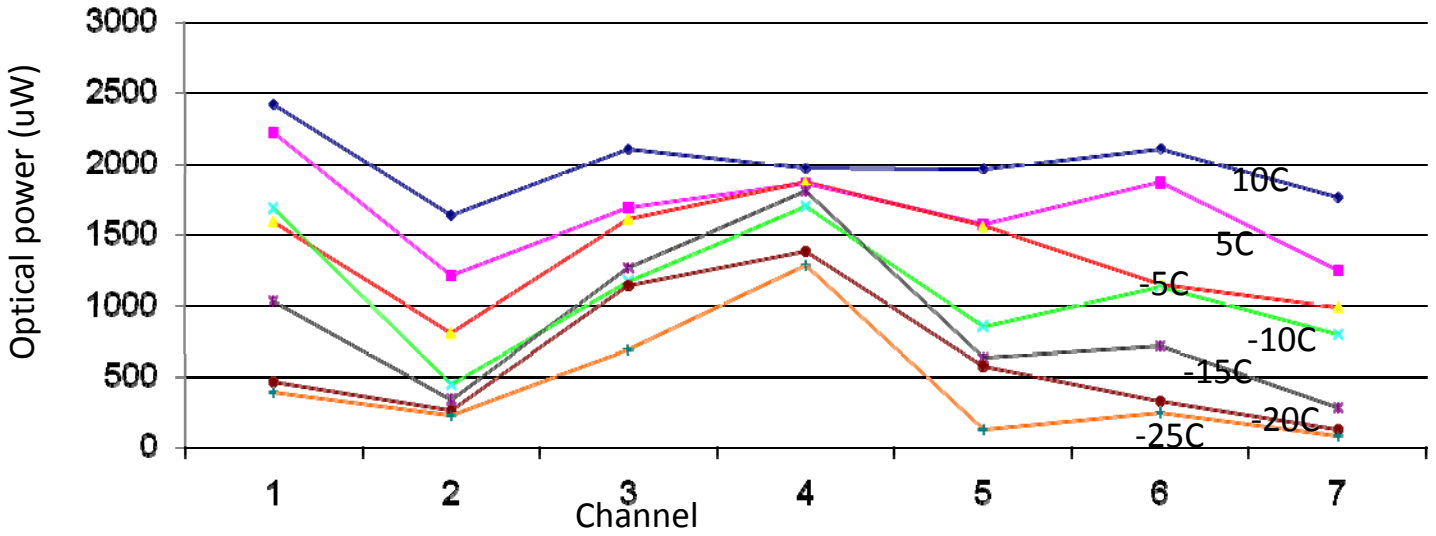




VCSEL:	Vertical Cavity Surface Emitting Laser diode
VDC:	VCSEL Driver Circuit
PIN:	Pin diode
DORIC:	Digital Optical Receiver Integrated Circuit

Temperature Dependent

- Optical power of some VCSEL channels decreases rapidly@ low T

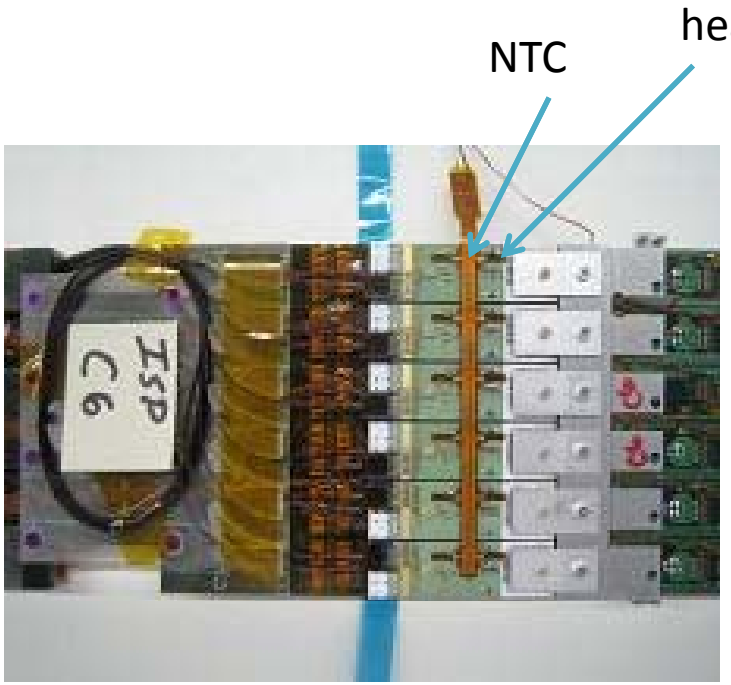


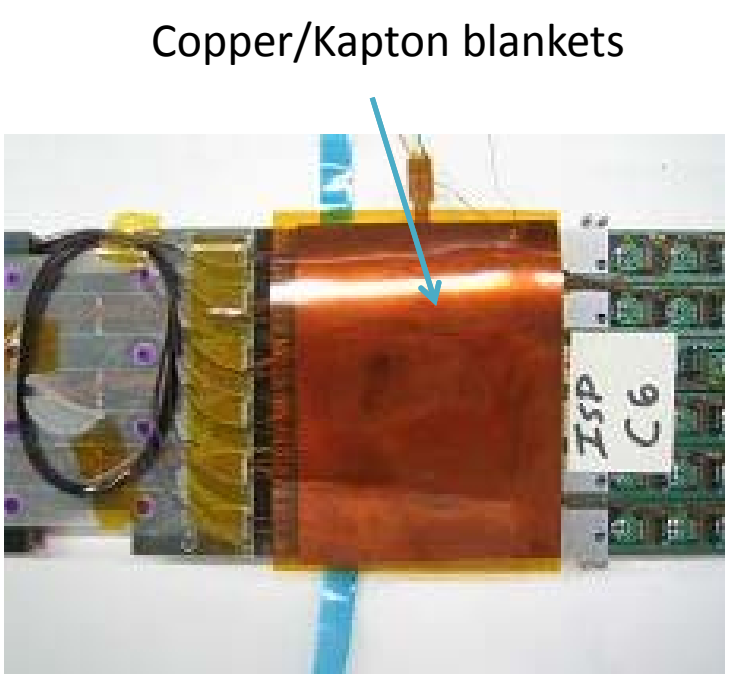
Cham. Tem.	Max/Min Ratios
10C	1.5
0C	1.8
-5C	2.3
-10C	3.8
-15C	6.5
-20C	10.7
-25C	16.2

- Characteristic of the VCSEL array
- There is only one parameter to change optical power (VISET) and it is common to the entire array (in the B layer common to both arrays)
- Known problem for long time
  - planned to run at 10 C
  - some locations were much cooler than anticipated

Temperature Dependent (cont.)

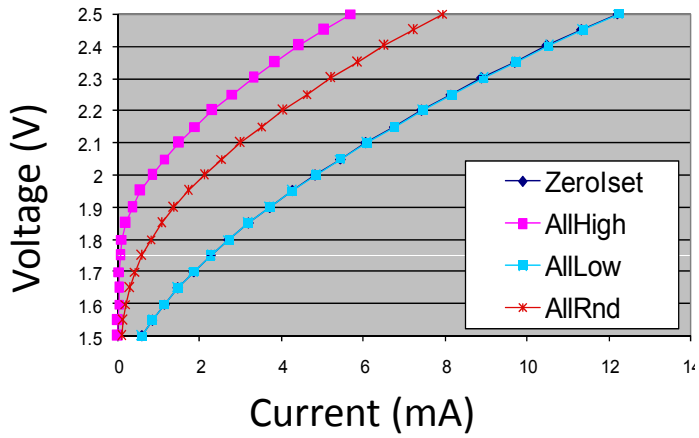
- Solution: install heaters

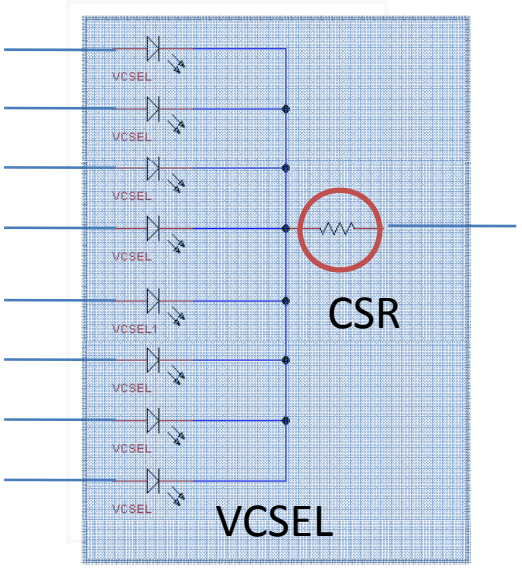




CSR (Common Serial Resistance)

- Symptom: like a dead VCSEL
- Some “failed” boards recovered
  - How to identify those recovered?
- A procedure is developed to measure the resistance of the inaccessible CSR and rejected the worst.(~7%)
- Still not understood the reason
  - conductive epoxy (5 µm) under the VCSEL array is thinner than manufacturer's recommendation (15 µm)

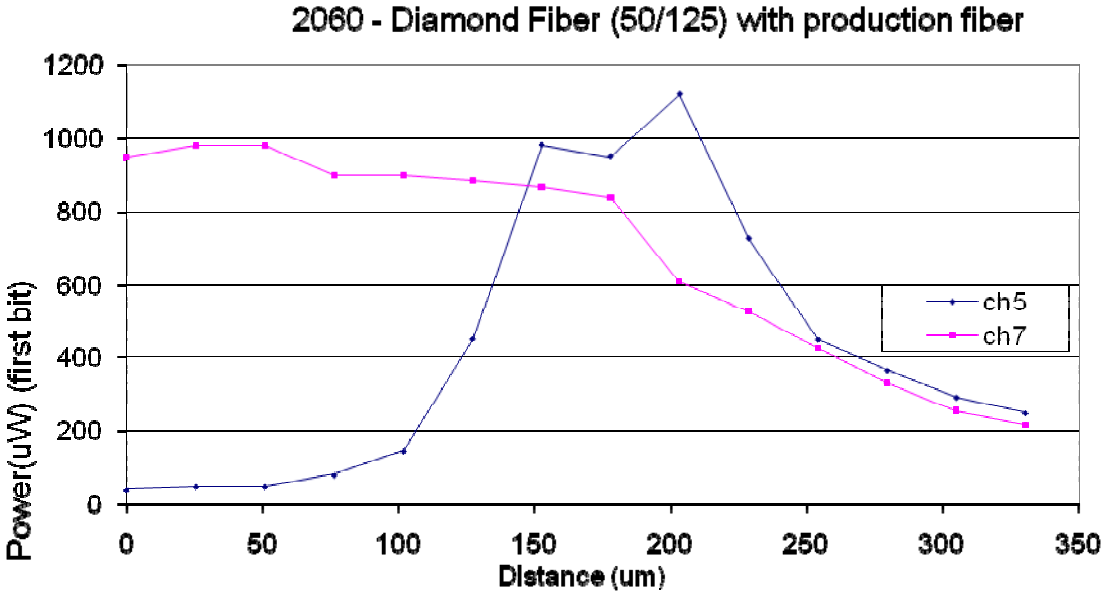


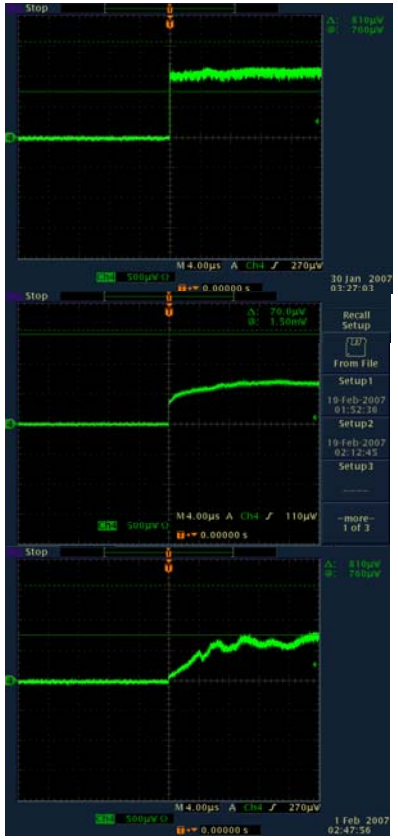


- After installation started in Oct 06, not a single board failed due to this.

Slow Turn On (STO)

- Was first discovered in SCT, but we failed to find any in our test system
- System test with prototype SQP found some STO
- A new testing procedure added to identify the arrays with STO and rejected ~7%.
- Depends on the distance from the VCSEL to fiber
  - Beveled finish on MT connector in system test allows fiber to be closer to VCSEL
  - Different modes of operation change with time ?
- No board is found to have severe STO after installation





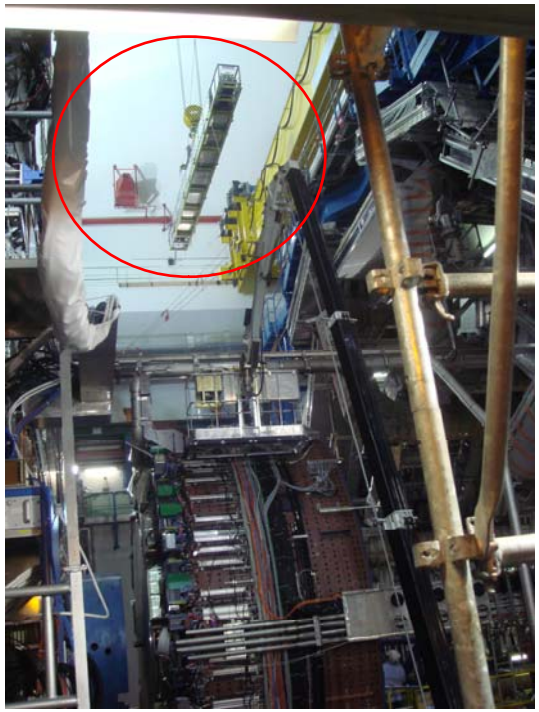
Current Status

- Connectivity test
  - Check the modules can be setup and read out through opto-boards
- Summary of problems not resolved in the Connectivity test
  - One dead link due to a failed PIN channel (cold solder?) rerouted but practically hard to operate.
  - A short between power and clock in a module
  - HV wire broken in a cable that is not accessible
  - Short on one FE chip: module is working with 15 FE chips.

- Only 4/1744 Modules defective (May be 2 are recoverable)

Current Status (cont.)

- Inserted the pixel package into the Dummy Support Tube (DST) and Installation at pit started.



- Summer: installation of services in the pit.
- Fall: Connectivity test in the pit followed by cosmic and collision data!!