FPIX Status

Bruno Gobbi

Northwestern University

U.S. CMS Project Status Meeting
Fermilab
November 20, 2003

US-CMS Pixel Project

FPix baseline:

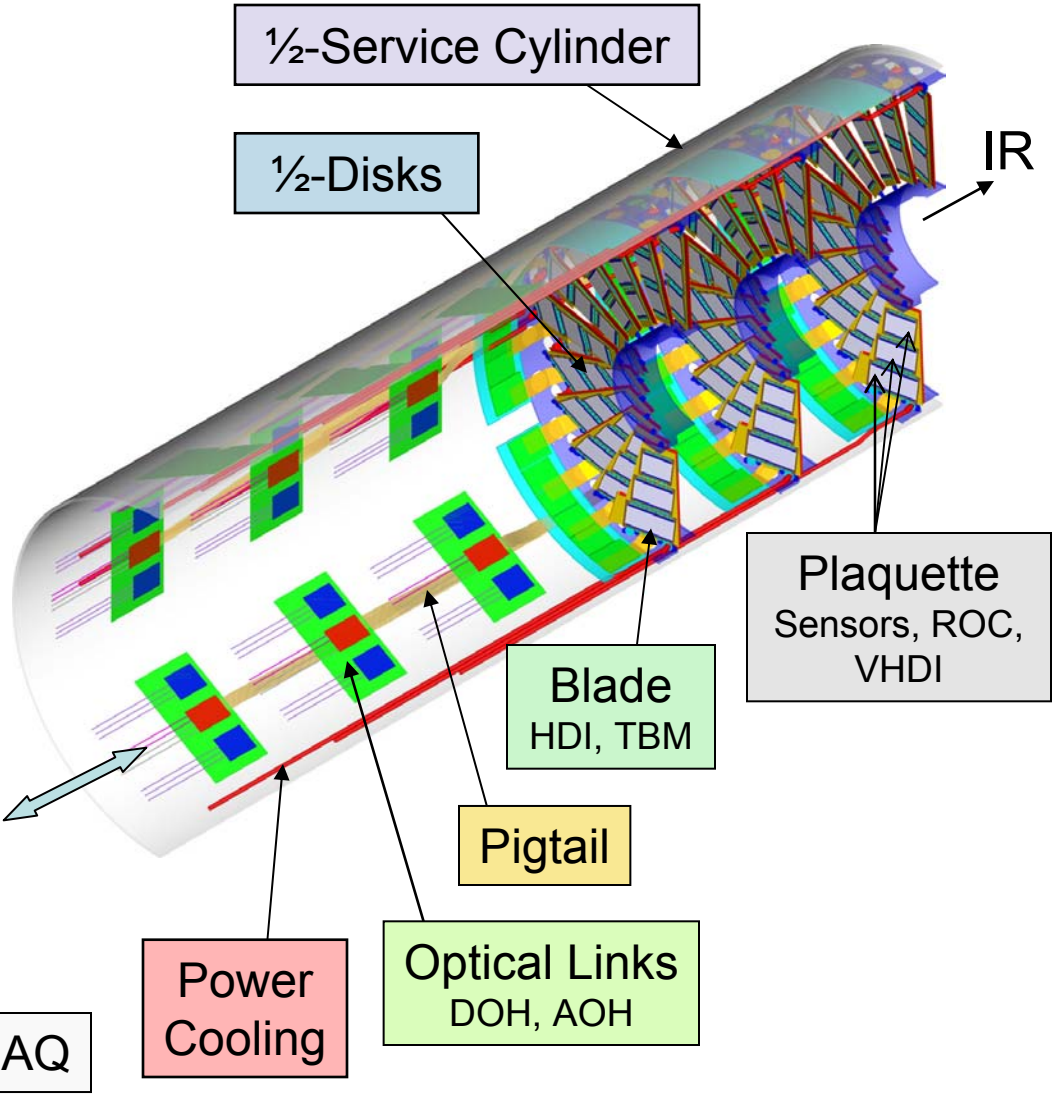
US delivers in '07

- 4 Disks (fully instrumented)
- TBM (for CMS Pixels)
- FEC (for CMS Pixels)

- Mechanical support
- Pixel sensors
- All the required electronics

Except:

- ROC, FED, and OL (designed by our collaborators)



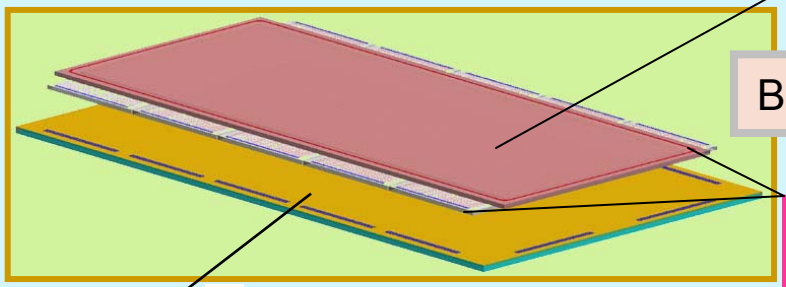
Pixel detector modules

Plaquette (700, 5 types)

Sensors

Bump bonded

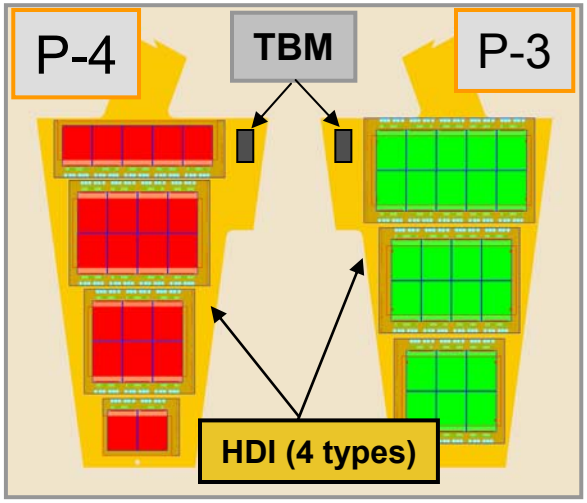
ROC (4,500)



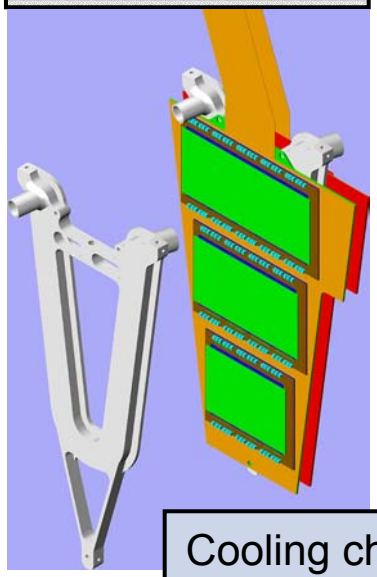
VHDI (700, 7)

Detector Unit (700)

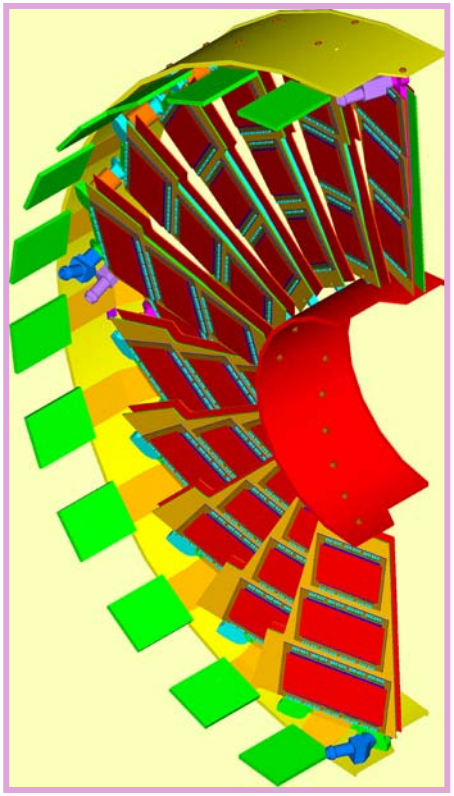
Panels, (200)



Blade, (100)



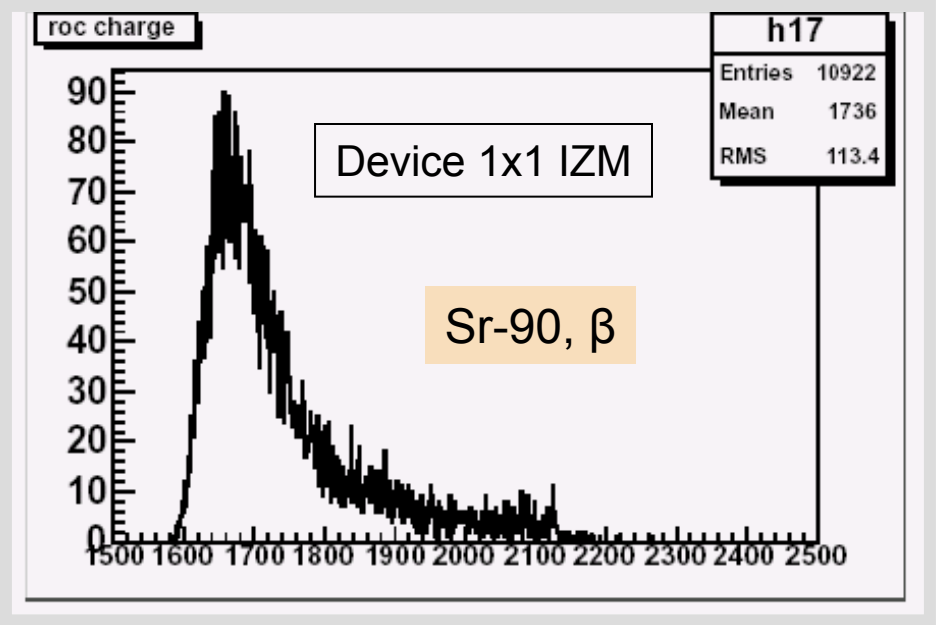
Cooling channels, (100, 4)



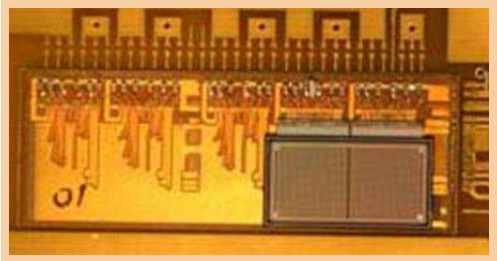
½ -Disk (8, 2 types)

Status FPix

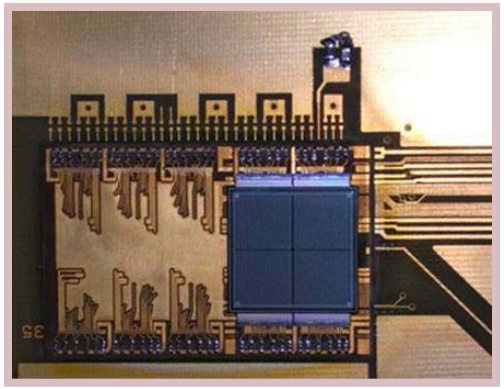
Sensors: Completed 2 pixel sensor submissions, Pre-production in progress
ROC: tested 2½-wafers of PSI43 (DMill), preparing to test 2½-wafers of PSI46
TBM: completed 2 R&D sub. for PSI43. Sub. for PSI46 version in progress
VHDI: 2 R&D sub. Completed, 3rd in progress (PSI43)
Bump Bond. : 3 R&D sub., 2 completed. 28 bump bonded devices on hand
Plaquettes: assembled 10, 5 show Landau with β, preparing for test beam run



1x2 Sensor



2x2 Sensor



Status ROC: IBM PSI46. Paul Scherrer Institute

IBM-PSI46 (¼-μm, pixel size 150 x 100μm^2) delivered August '03.
Test results show a significant improvement over the PSI43 in DMill.
The chip was tested in the beam at PSI. Works up to 70MHz.
The power consumption is 1/3 of the DMill version.

Reported at CMS ESR*) 11-05-03: 14 modifications foreseen.
9 implemented, 4 under discussion/study, 1 'column blocking' not yet understood

Blocks of modified sections are included in a
- MPW submission with CERN on Nov 11, 2003.

Submission of PSI46 Pre-production
- is scheduled for end Feb '04.
- chips are expected by May '04

*) ESR CERN Nov 5th 2003
http://agenda.cern.ch/fullAgenda.php?ida=a036136 68 transparencies on ROC

FPix: Status Electronics and Risk

Task	Manpower (%)	Status	Risk
• ROC: Paul Scherrer Institute			medium
		US: 2 ½ wafers (155 chips) IBM-PSI46 are at Fnal.	med. / high
		Testing ROCs (W. Wester, B. Baldin et. al.)	
		How to test an analog chip with 26 DACs?	
		The hardware and software for testing expected by Jan. ’04	
• TBM (chip): Ed Bartz, Rutgers	(80%)		medium
		Slow & Fast Hubs. R&D MPW subm. June 2003.	
		Parts returned in Sept ’03. Fast Hub has been included	
		in the TBM-0.25μm. MPW pre-prod submitted (Nov-11-03)	
• FEC (VME): Boris Baldin et. al. Fnal	(50%)		med. / high
		Conceptual design by end ’03. Prototype by end ‘04	

FPix: Status Electronics, cont., Sensors

Task	Manpower (%)	Status	Risk
• VHDI & HDI (flex circuits) Mike Matulik: Fnal (30%)			low / med.
VHDI: two R&D submission (PSI43, Rutg.) are used now order for third subm. (PSI43) has been placed			
VHDI: for 0.25μm to be designed next (Fnal)			low / med.
HDI: for 0.25μm not yet designed			high
• Electr. from Disks to Counting Room: Sergey Los, Fnal (25%):			med. / high
OLs, Monitoring, Power supplies, Power distribution on detectors, bias V distribution and filtering, grounding, …			
• Sensors (D. Bortoletto, Purdue, back ups JHU, Fnal):			medium
• Two R&D submis. (PSI43 and 46) have been completed			
• Pre-production Submission (PSI46): is next			
• files with design sensors' wafer are ready			
• order is being processed at Fnal			

FPix: Status Bump B., Mechanics

Task	Manpower (%)	Status	Risk
• Bump Bonding (R. Lander UCD, back up Fnal):			med. / high
• Two R&D submis. (IZM, MCNC) completed. 28 modules			
• Blank subm. of PSI46 (VTT) late by ~ 2 months			
• We plan an R&D Submission for 0.25μm with one of the 3 vendors used previously			
• Mechanics (Fnal): (I. Churin, V. Polubotko. 100%)			low
• Cooling Channel for Disks			
Pressure tested a cooling loop unit of 6 cooling channels. Results exceed requirements.			
• Service Cylinder			
We tested a prototype section. Results exceed requirements.			

FPix: Status Final Assembly

Task	Risk
• Assembly VHDI (Plaquettes)	med. / high
• At Purdue: Kirk Arndt (et al.): Extensive experience with Cleo, and blank Pixel modules (PSI43) Assembly with PSI46 is being developed	
• At Fnal: M. Kubantsev (et al.) Assembled blanks and 10 Plaquettes with real components (PSI43)	
• Assembly HDI (Panels)	high
• At Fnal: M. Kubantsev (et al.) Assembled numerous blank (R&D assembly & cooling) Jigs for PSI46 are to be developed	

FPix: Testing Final Components

Task	Risk
• ROC-0.25μm	very high
To be done at Fnal. Analog chip. Large number of DACs	
• TBM-0.25μm	medium
To be done at Fnal (all CMS pixels), Rutgers involved	
• FEC (VME):	medium
20 boards (Barrel and Disks) tested at Fnal	
• VHDI & HDI	medium
testing technique still to be developed testing at Fnal (?)	
• Controls & Monitors	med./high
R&D to be done, Fnal	
• Sensors.	low
Testing done at Purdue	
• Bump Bonding	low / med.
Test alignment sensors-ROCs, at Fnal	
• Mechanics	low
½-Disks, ½Service Cyl. Assembly and survey at Fnal	

FPix: Final Assembly

Task	Risk
• Assembly VHDI (Plaquettes), (at Purdue) Mounting ROC-Sensor on VHDI, wire bonding / test, 'Burn in' Plaquettes (need to design and build station), Fnal Storage devices, Bookkeeping (Data Base)	high
• Assembly HDI (Panels) Testing HDIs, Mounting Plaquettes on HDI, Wire bonding Testing Panels	high
• Installing Panels on ½-Disk structures Develop technique, build installation jigs Test read-out of ½- Disk, (RT, -20^{0}C)	high
• Install ½-Disks in Service Cylinder Test read-out (RT, -20^{0}C)	high
• Shipment to CERN Which components (½-Disks, ½-Serv. Cyl.) How to ship detectors	high

FPix: Remaining Issues

- technical decisions,
  - Testing of the ROC (analog design) could be very lengthy
  - Details of the assembly of the final detector still need to be fully understood and formulated
  - Details of the final check out of the detector must be studied
- engineering, we have adequate resources
  - mechanical: we now have a critical mass
    - Fnal: I. Churin (100%), V. Polubotko (100%), (G. Derylo, D. Olis)
    - Purdue: Kirk Arndt (60%)
  - electrical : we now have a critical mass
    - Fnal: B. Baldin (60%), M. Matulik (30%), S. Los (25%)
    - Rutgers: E. Bartz (60%)

FPix: Remaining Issues

- resources,
  - **need more physicists** for almost every task of the project
    to complete the R&D
    to proceed with the prototyping
    to assemble the detector
    to commission the detector
    to upkeep a construction data base
    to post relevant information on the WWW
    to work on every aspect of the software relevant to the Pixel detector and to the CMS Physics
  - will need additional assembly space at SiDet

FPix: Remaining Issues

- communications with CMS, have improved considerably
- The Pixel meetings at the CMS TK-Week and CMS-Weeks are now on VRVS and presentations on the WWW
  - US made presentations at CMS Reviews
    - CMS Tracker Annual Review in Sept. '03
    - ESR Review of CMS Pixels, Nov 5th '03
- completion of r&d
  - R&D still must to completed for
    - all the components depending on the 0.25μm chips
    - the assembly/commissioning of the detector
- cost/schedule
  - Cost increase is possible due to currency fluctuations
  - Considerable uncertainties will persist until the final assembly is better defined. This will affect the cost/schedule.

FPix: Remaining Issues

- risks in the system
  - From the list shown before the high risk tasks are:
    - the testing of the ROC (analog chip, many variables)
    - The final assembly, because of the uncertainty of when the R&D will be completed
- Is there any potential impact on CD-4A?
  - It is quite certainly that the CD-4A deadline can not be met

The US CMS FPix Project

UC Davis: R. Lander, D. Pellett, G. Grim

Fnal: M. Atac, U. Joshi, B. Baldin, I. Churin, S. Kwan, M. Matulik, A. Nomerotski S. Los, V. Polubutko, C. Selcuk, C. Gingu, W. Wester

JHU: B. Barnett, C.Y. Chien, K. Dongwook, M. Swartz, H.S. Cho, A. Peysner, X. Xiaobo

Mississippi: L. Cremaldi, B. Quinn, D. Sanders

NU: B. Gobbi, M. Kubantsev, E. Spencer, R.N. Tilden

Purdue: D. Bortoletto, G. Bolla, A. Garfinkel, K. Giolo, D. Miller, J. Myamoto, A. Roy, I. Shipsey, S. Son, K. Arndt

Rutgers: J. Conway, S. Schnetzer, R. Stone, S. Worm, E. Bartz, E. Doroshenko, L. Perera, S. Sherman, Y. Streltsov

D:\cms\fpix-authors.ppt