U.S. Pixel Mechanics Overview

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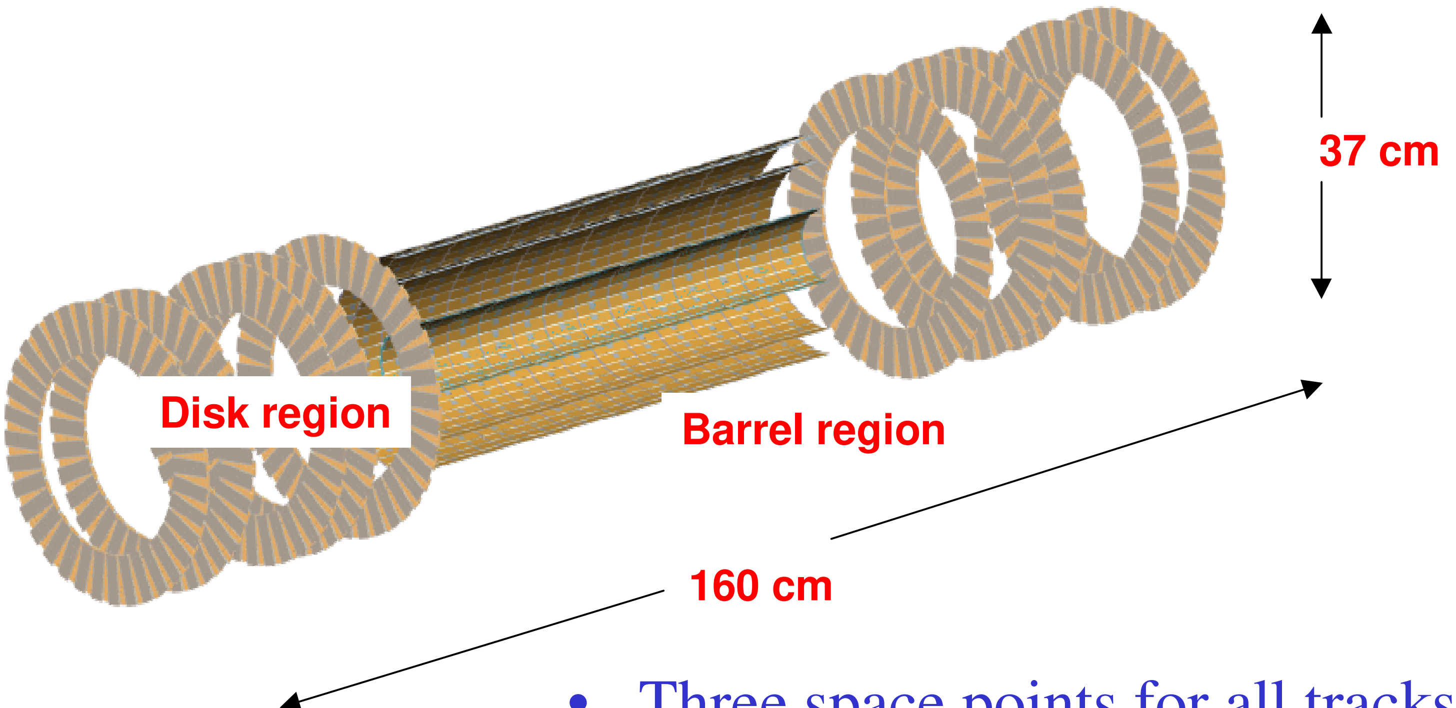
April 2000

Pixel System



- Three space points for all tracks
- Three barrel layers
  - Innermost is “B-layer” and is removable from outside the Inner Detector
- Five disks on each end

Pixel Layout Summary

Pixel Layout							
Version: March 2000							
Barrel						Active	Tilt
	Radius(mm)	Staves	Modules	Chips	Channels	Area(m^2)	Angle(^{o})
B-layer	41.5	18	234	3744	1.44E+07	0.23	-19.5
Layer 1	93.0	40	520	8320	2.40E+07	0.49	-17.5
Layer 2	127.0	56	728	11648	3.35E+07	0.68	-17.5
Subtotal		114	1482	23712	7.19E+07	1.39	
Disks							
	Inner	Outer				Active	
Z(m)	Radius(mm)	Radius(mm)	Modules	Chips	Channels	Area(m^2)	Sectors
495	121.4	182.2	66	1056	3.04E+06	0.06	11
575	121.4	182.2	66	1056	3.04E+06	0.06	11
640	121.4	182.2	66	1056	3.04E+06	0.06	11
705	99.2	160	54	864	2.49E+06	0.05	9
770	99.2	160	54	864	2.49E+06	0.05	9
Subtotal(Both Sides)			612	9792	2.82E+07	0.57	102
GRAND TOTALS			2094	33504	1.0E+08	1.96	

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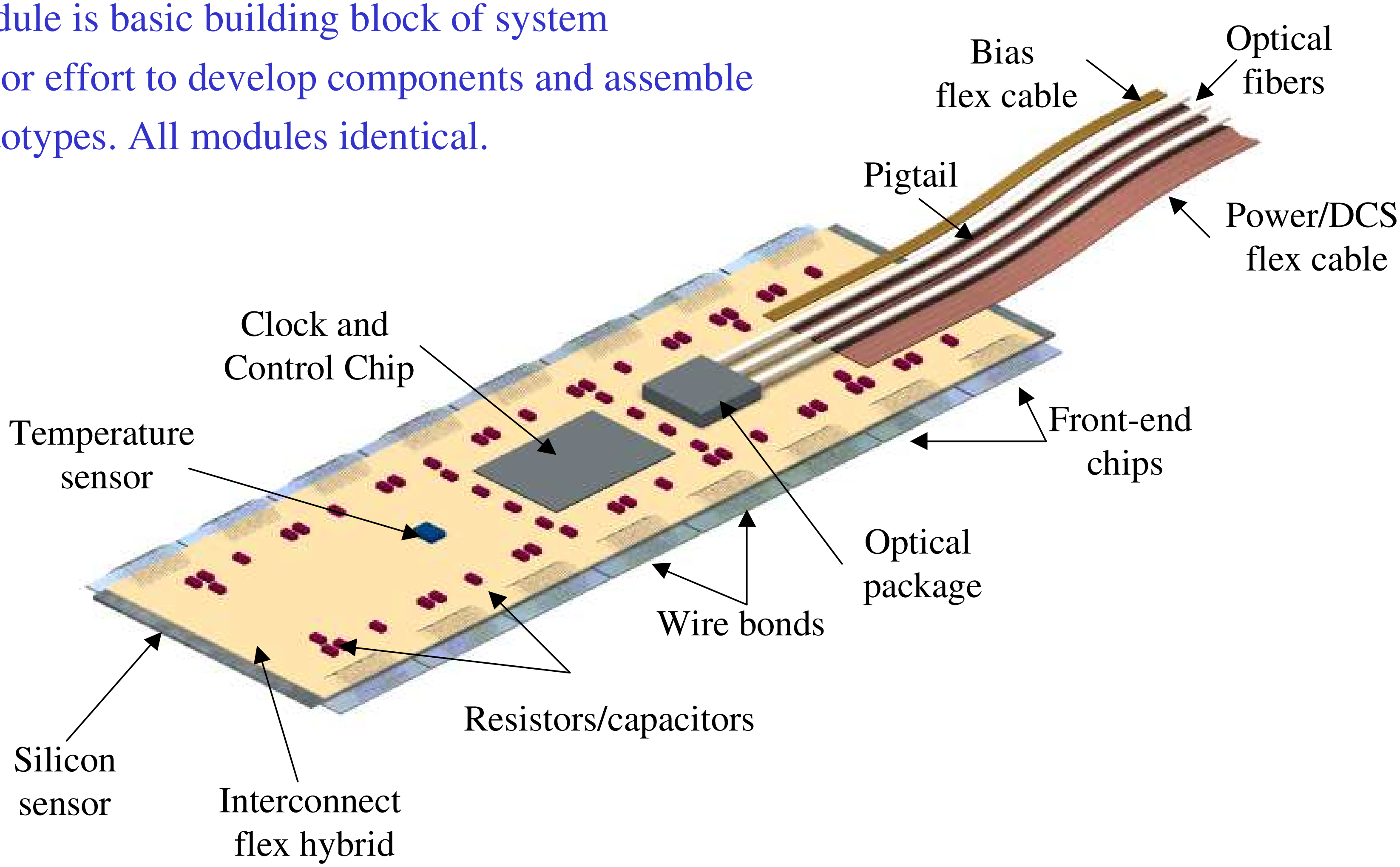
Pixel Module

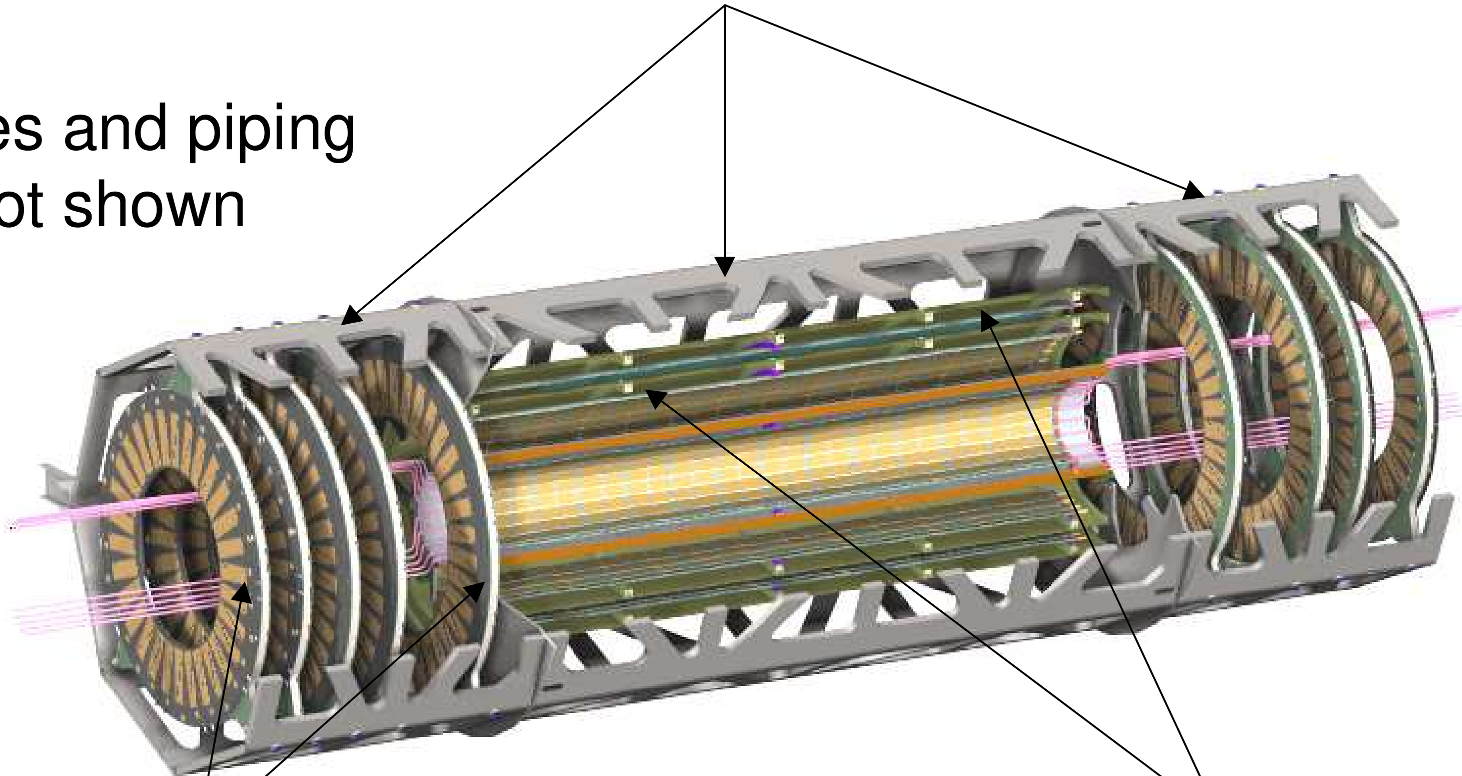
Module is basic building block of system
Major effort to develop components and assemble prototypes. All modules identical.



Pixel Mechanics

Support Frame

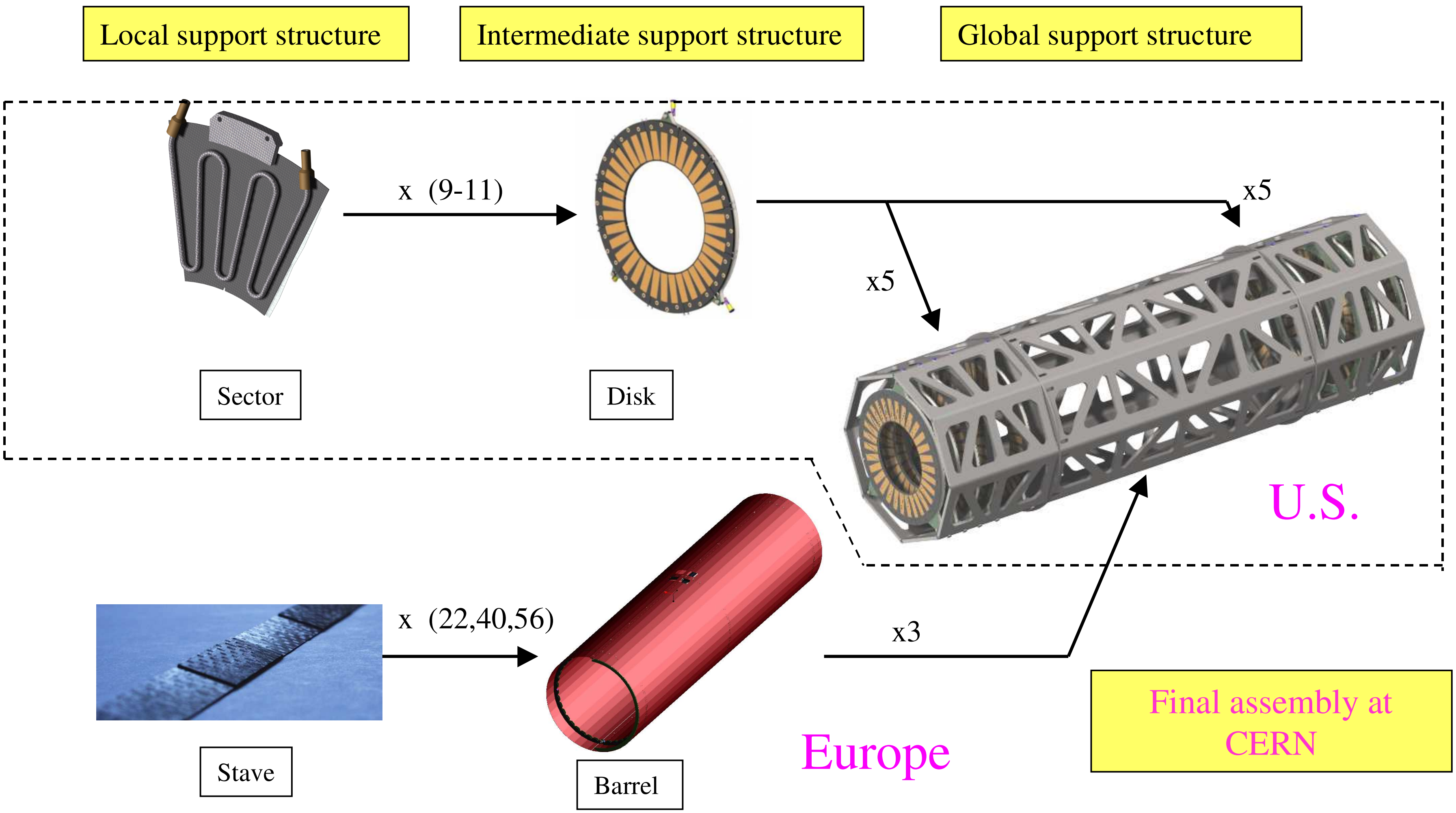
Cables and piping
not shown



Disk rings support sectors

Barrel shells support staves

Overview of Proposed Responsibilities



Pixel Power and Cooling

- Power
  - Power is generated by integrated circuits, connections to them(cables and connections) and in the silicon detectors.
  - Design(for mechanics) maximum power is about 50W per disk sector.
- Baseline cooling system is an evaporative system based on C_3F_8
  - Liquid C_3F_8 under pressure expands(via orifice or capillary) to form mixed phase that cools the mechanical structure.
  - The maximum normal operating pressure within the mechanical structure depends on detail on the cooling system design, which is not complete, but is currently 4 bar absolute.
  - In the very unlikely case of sudden blockage of the exhaust tube, the maximum pressure within the mechanical structure might reach 10 bar absolute for a brief period(duration not known) before relief.
  - Systems tests are underway now to fix the essential requirements for the mechanical system: effective hydraulic diameter(s), maximum normal operating pressure and fault pressure conditions. The requirements presented now may be modified as a result of these tests.

Definition of Terms and Proposed US Responsibilities

- Local supports
  - These precisely locate and cool the pixel electronics modules
  - Staves in the barrel region
  - Sectors in the disk region(US)
- Intermediate supports
  - These hold the local supports and connect to the support frame
  - Half-shells in the barrel region
  - Rings in the disk region(US)
- Support frame and related(US)
  - Central section with "cones" supporting barrel shells
  - Two identical end sections for disks
  - Inner thermal barrier/B-layer support
  - End thermal barrier, stiffener and cable support
- Services
  - Cables for power and slow signals. Multiple types.
    - "Low mass" within Inner Detector volume(US)
    - Outside volume
  - Cooling
    - Plant and piping to pixel detector
    - Disk region piping/connections(US)
    - Barrel region piping/connections

The US Team

- Hytec, Inc under contract to LBNL. Bill Miller et al
  - Support frame design
  - Disk ring design
  - Disk ring support/pixel-to-SCT support(in collaboration with LBNL)
  - Alternative disk sector design(SBIR supported)
- LBNL
  - Lead engineer/configuration management - E. Anderssen
  - Sector detailed design/assembly/testing - J. Wirth, F. Goozen, J. Taylor
  - Disk assembly/testing - J. Wirth, J. Taylor, T. Weber, F. Goozen
  - Disk ring supports/SCT attach - E. Anderssen
  - Thermal barriers and related - E. Anderssen
  - Services and related interfaces design - E. Anderssen, M. Alford, J. Taylor
  - Cable design and fab - E. Anderssen, T. Weber, R. Bartolo
  - Cooling connections design and fab - E. Anderssen
  - Module attachment interface - F. Goozen
  - Final assembly/survey - F. Goozen, E. Anderssen
  - QA coordination - J. Taylor
  - Expect additional engineer(part time) to be added by May. Also can call on additional design help and will add assembly personnel as we move into production. And additional shop personnel, of course.
- Ohio State
  - Fabrication of tooling for disk rings
  - Other tooling fabrication planned

Pixel Project Status in US

- The pixel work in the US is approved only for development through about this fiscal year - until about October 2000.
- Production is not yet approved and there will be a production baseline review later this year(early November).
- The detailed cost estimate for production is under preparation and will not be presented here.
- The associated schedule is also under development but is not ready yet and we will not show <u>US</u> production schedules at this review.
- There is a complete overall ATLAS schedule and key milestones from this will be presented. The key review milestones are
  - ATLAS Final Design Review(FDR) -> more like US Preliminary Design Review
  - ATLAS Production Readiness Review(PRR) - more like US Final Design Review
- However, the US scheduling process is typically more conservative and so the ATLAS milestones should be regarded as aggressive - best case.

Where Are We in US Mechanics Design?

- Much more detail later…but to summarize the situation
- Disk Sectors
  - Many prototypes made and tested but baseline design recently changed
  - In preliminary design
  - Fabrication of multiple baseline sectors in progress to obtain "statistics" on outstanding points.
  - Meeting ATLAS schedule for design reviews is tight but meeting production schedule is OK.
- Disk Rings and Disk Assembly
  - One prototype made. Full disk assembled and tested.
  - Second prototype under construction
  - In preliminary design, except for ring to frame support which is in conceptual design
  - Schedule is OK
- Support frame
  - Full prototype end section fabricated successfully
  - In preliminary design, except for thermal barriers, which are in conceptual design phase
  - Major issue is to define all interfaces, particularly services
  - Schedule is OK assuming interfaces can be defined.
- Services
  - Cable prototypes under fabrication.
  - Coolant prototypes under fabrication
  - In conceptual -> preliminary design
  - Schedule OK but major interface issue that affects many other items, including overall Inner Detector
- Final assembly/installation
  - In early conceptual design phase

ATLAS Mechanics Milestones

- The critical path item in the overall ATLAS pixel schedule is the integrated circuit electronics, and there is currently considerable uncertainty in the schedule for this.
- The mechanics is not(yet) on the critical path. ATLAS milestones shown below. US goal is to try to meet these milestones, but with float in schedule - so US milestones will be more conservative.

Milestone	**ATLAS Baseline**	
Local supports		
FDR	6/15/00	
PRR	9/28/00	
Start production	10/23/00	
Float of about 6 months in need date		September 2001
Complete production	1/21/02	
Global supports		
FDR	9/28/00	
PRR	1/26/01	
Start production	3/21/01	
Complete production	9/16/02	
Assembly/Installation		
Disk assembly complete(LBNL)	3/11/03	
Disk assembly complete(CERN)	9/30/03	
Pixels ready for assembly in SCT	1/21/04	
Current US projection of 1st production module		
ready to be mounted to local support		

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