Status of CMS

Sarah Eno

For the CMS Collaboration

Charge

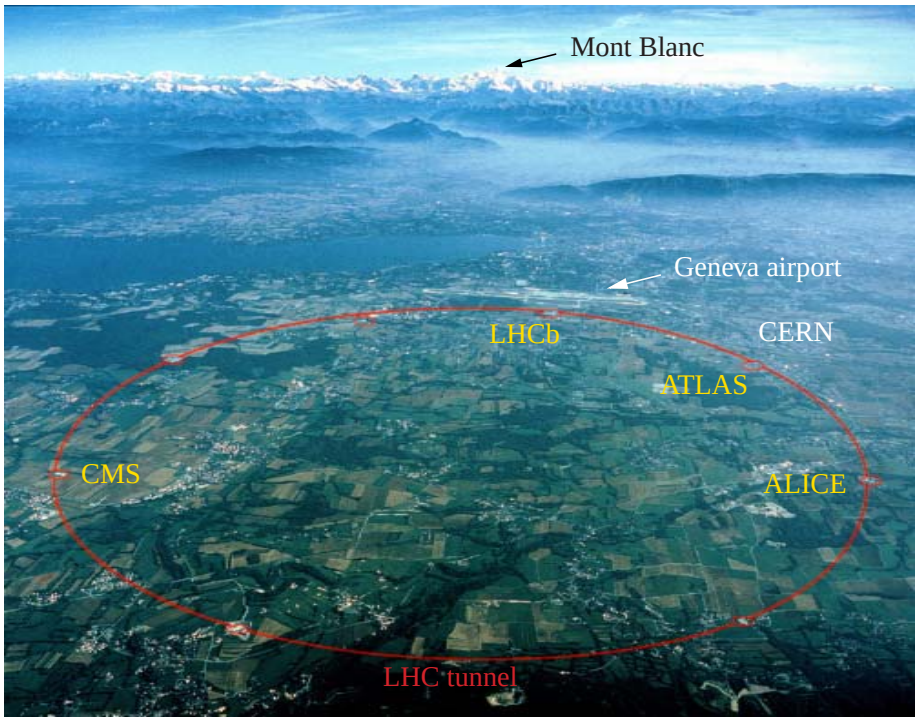
The CMS experiment is completing construction of their detector and computing components and approaching the advent of data at a new, higher energy frontier. Preparations are being made to assure rapid availability of physics results. We have asked that the full range of current efforts be reviewed, and would welcome your observations on these efforts.

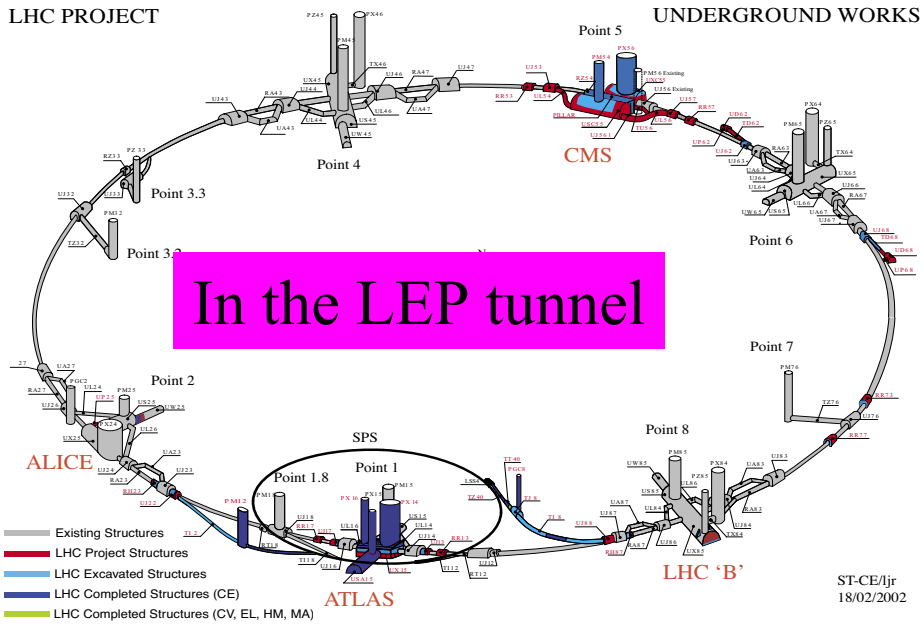
Outline

- Status/Schedule for the Machine
- Status/Schedule of the Detector
  - installation
  - cosmic slice test/test beams
- US CMS
- CMS at FNAL
  - SiDet
  - Tier 1 Center
  - the LPC

Apologies! Most of CMS is in Geneva this week at a "CMS week".

The LHC





- pp $\sqrt{s}$ =14 TeV L=10^{34} cm^{-2} s^{-1}=10 mb^{-1}MHz
- Pb-Pb collisions about 1 month/year
- crossing rate 40 MHz (25 ns)

Status/Schedule: Machine

It's real!

Schedule

Della Negra, Sept CMS week

LHC ~ on schedule for:

- October 2006 possible injection test through sector 8
- June 2007 end of commissioning and alignment all sectors, ready for beam
- CMS “Ready to close” June 30, 2007 or earlier
- Full detector running in early 2008

Machine

Bailey, Sept CMS week

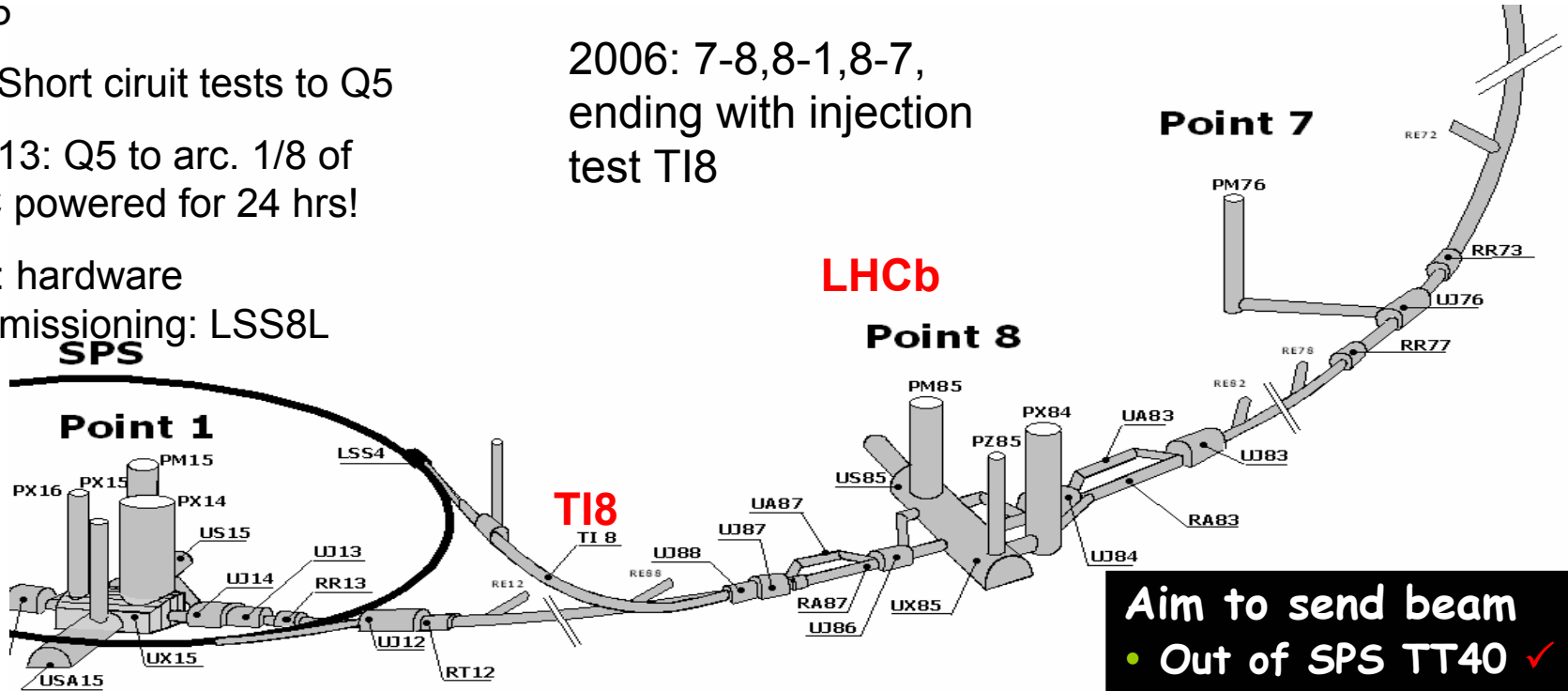
2005

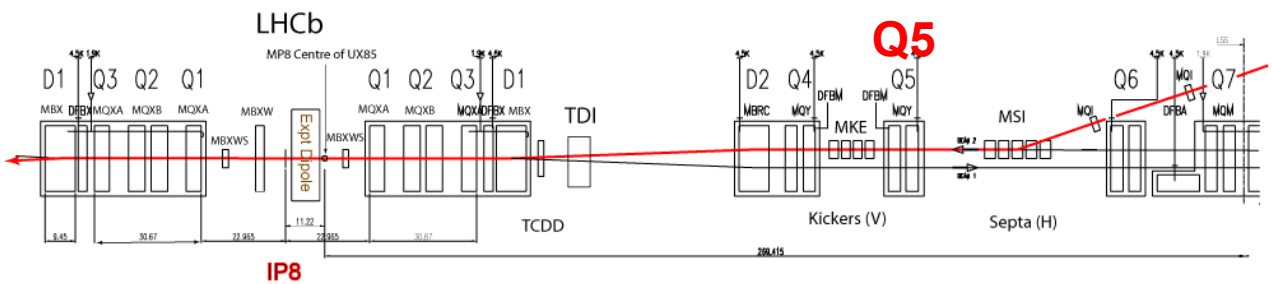
Jul: Short ciruit tests to Q5

Oct 13: Q5 to arc. 1/8 of LHC powered for 24 hrs!

Dec: hardware commissioning: LSS8L

2006: 7-8,8-1,8-7, ending with injection test TI8





Aim to send beam

- Out of SPS TT40 ✓
- Down TI8 ✓
- Inject into LHC R8
- Through insertion R8
- Through LHCb
- Through IP8
- Through insertion L8
- Through arc 8-7
- To dump at Q6 R7

Machine

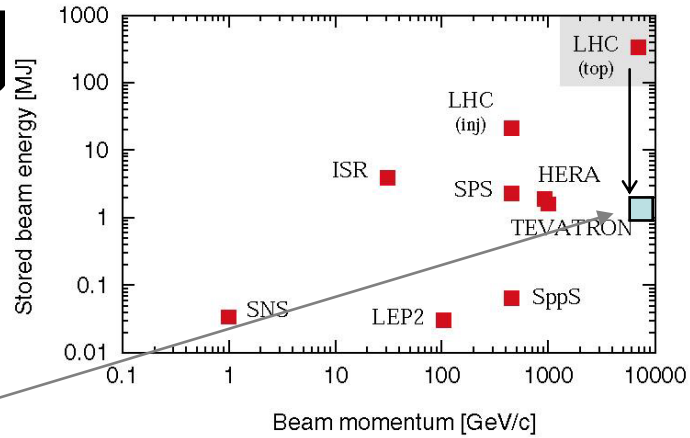
Bailey, Sept CMS week

Nominal settings	
Beam energy (TeV)	7.0
Number of particles per bunch	$1.15\ 10^{11}$
Number of bunches per beam	**2808**
Crossing angle (μrad)	285
Nomalised transverse emittance (μm rad)	3.75
Bunch length (cm)	7.55
Beta function at IP 1, 2, 5, 8 (m)	0.55,10,0.55,10

Related parameters	
Luminosity in IP 1 & 5 ($cm^{-2}\ s^{-1}$)	10^{34}
Transverse beam size at IP 1 & 5 (μm)	16.7
Stored energy per beam (MJ)	**362**

$10^{34}\ cm^{-2}s^{-1}$= 10 $nb^{-1}s^{-1}$= 40 $fb^{-1}y^{-1}$ (1y=$4x10^6$s)

Proposal for early proton running



Phase I collimators and partial beam dump

1. Pilot physics run with few bunches
   - No parasitic bunch crossings
   - Machine de-bugging no crossing angle
   - 43 bunches, unsqueezed, low intensity
   - Push performance (156 bunches, partial squeeze in 1 and 5, push intensity)
2. 75ns operation
   - Establish multi-bunch operation
   - Relaxed machine parameters (squeeze and crossing angle)
   - Push squeeze and crossing angle
3. 25ns operation with Phase I collimators + partial beam dump
   - Needs scrubbing for higher intensities ($i_b > 3 - 4\ 10^{10}$)

Phase II collimators and full beam dump

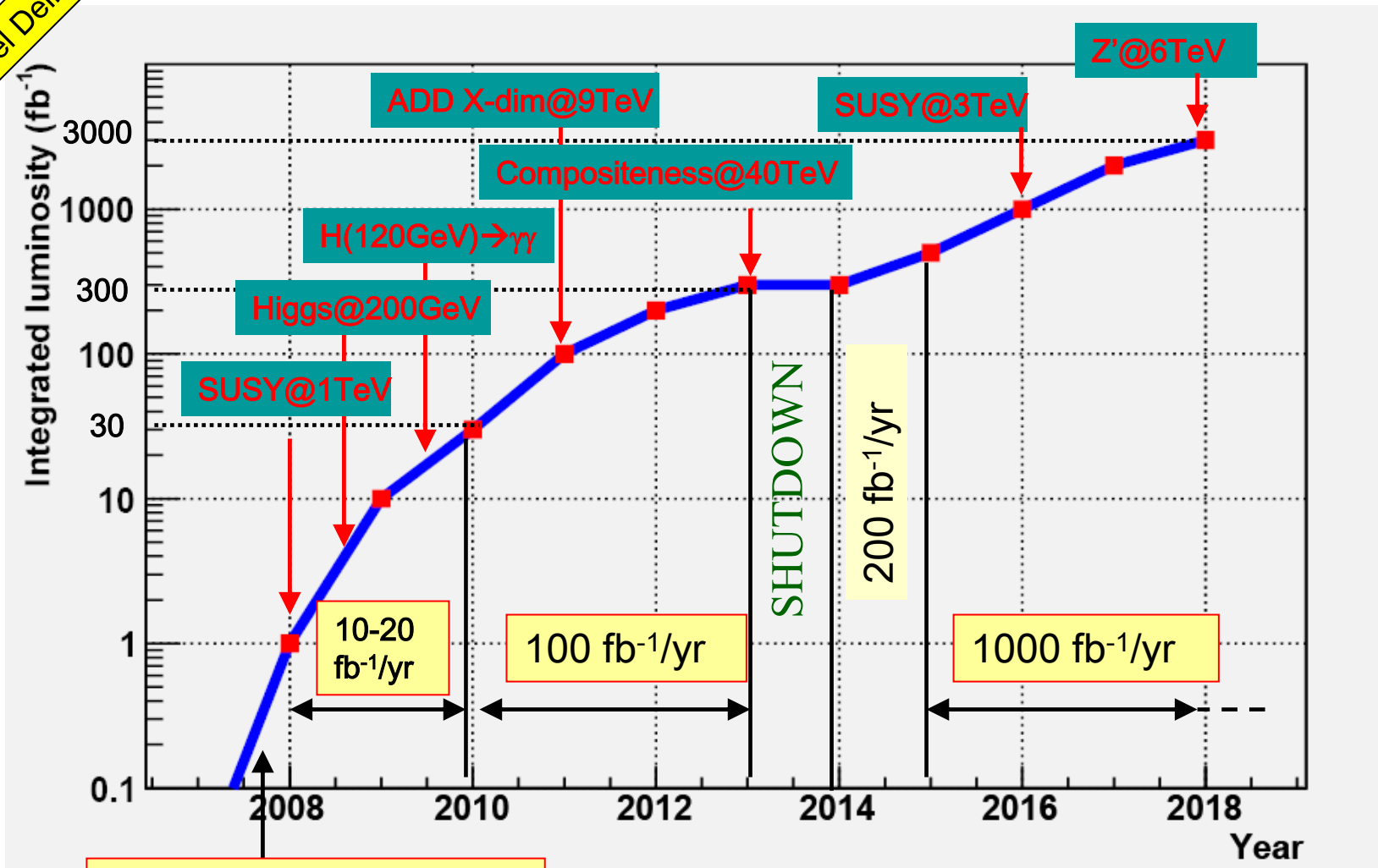
4. 25ns operation
   - Push towards nominal performance

Bailey, Sept CMS week

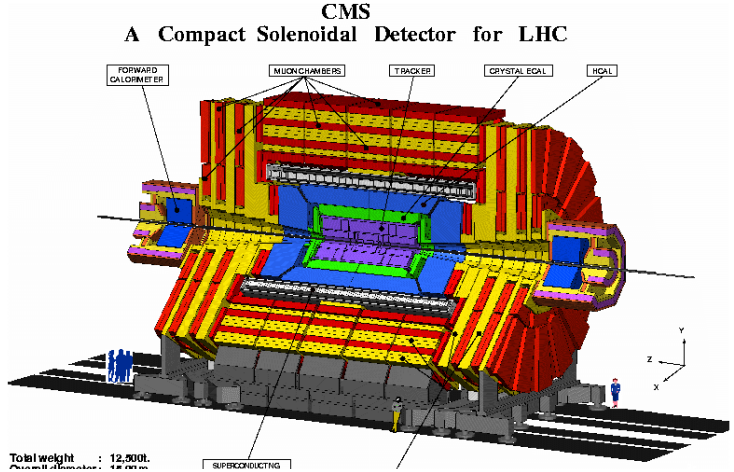
Luminosity

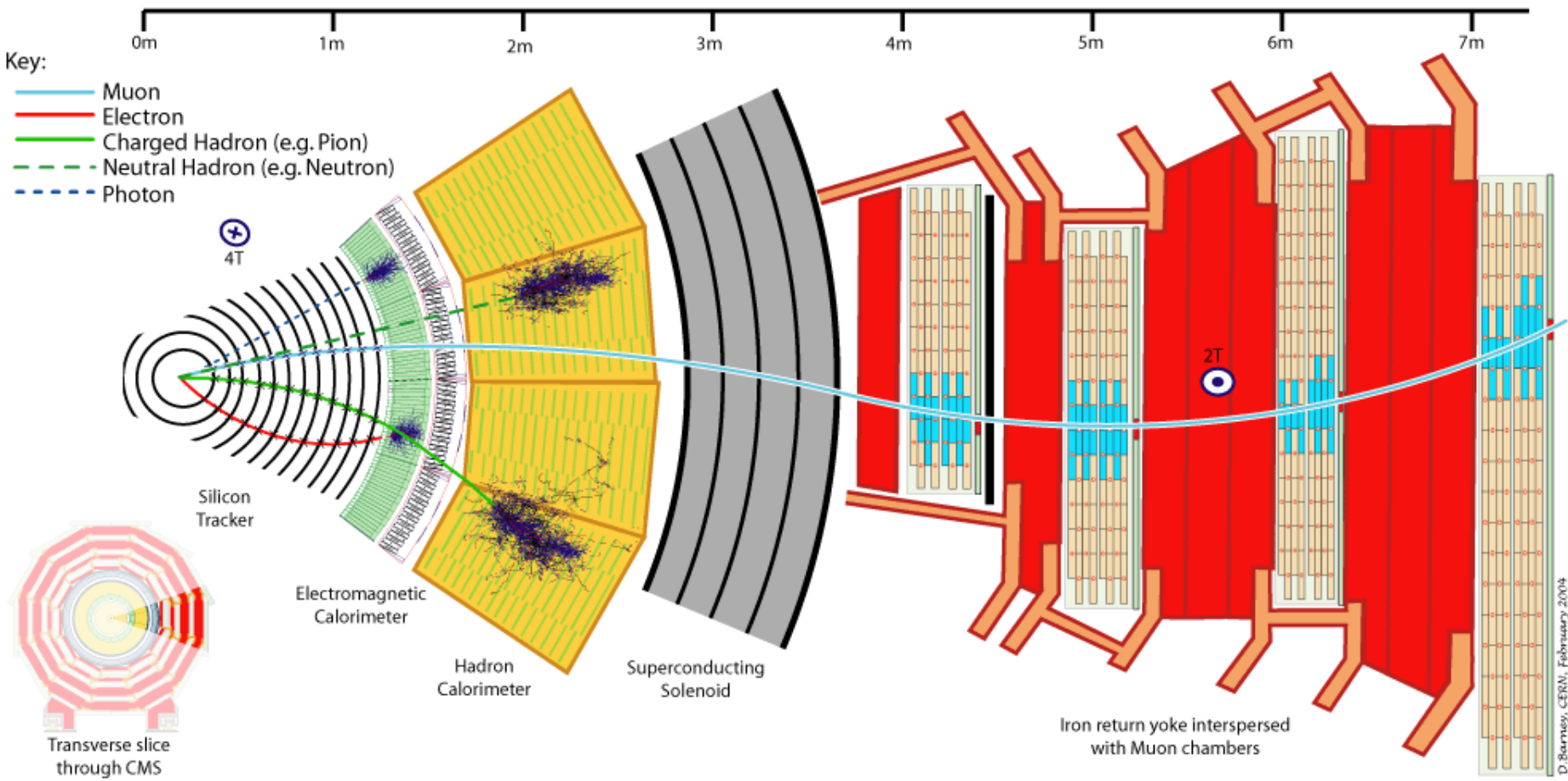
Della Negra, Sept CMS week

Michel Dell



CMS


CMS
A Compact Solenoidal Detector for LHC
FORWARD CALORIMETER
MUON CHAMBERS
TRACKER
CRYSTAL ECAL
HCAL
SUPERCONDUCTING
Total weight : 12,500t.


0m
1m
2m
3m
4m
5m
6m
7m
Key:
Muon
Electron
Charged Hadron (e.g. Pion)
Neutral Hadron (e.g. Neutron)
Photon
4T
2T
Silicon Tracker
Electromagnetic Calorimeter
Hadron Calorimeter
Superconducting Solenoid
Iron return yoke interspersed with Muon chambers
Transverse slice through CMS
D.Barney, CERN, February 2004

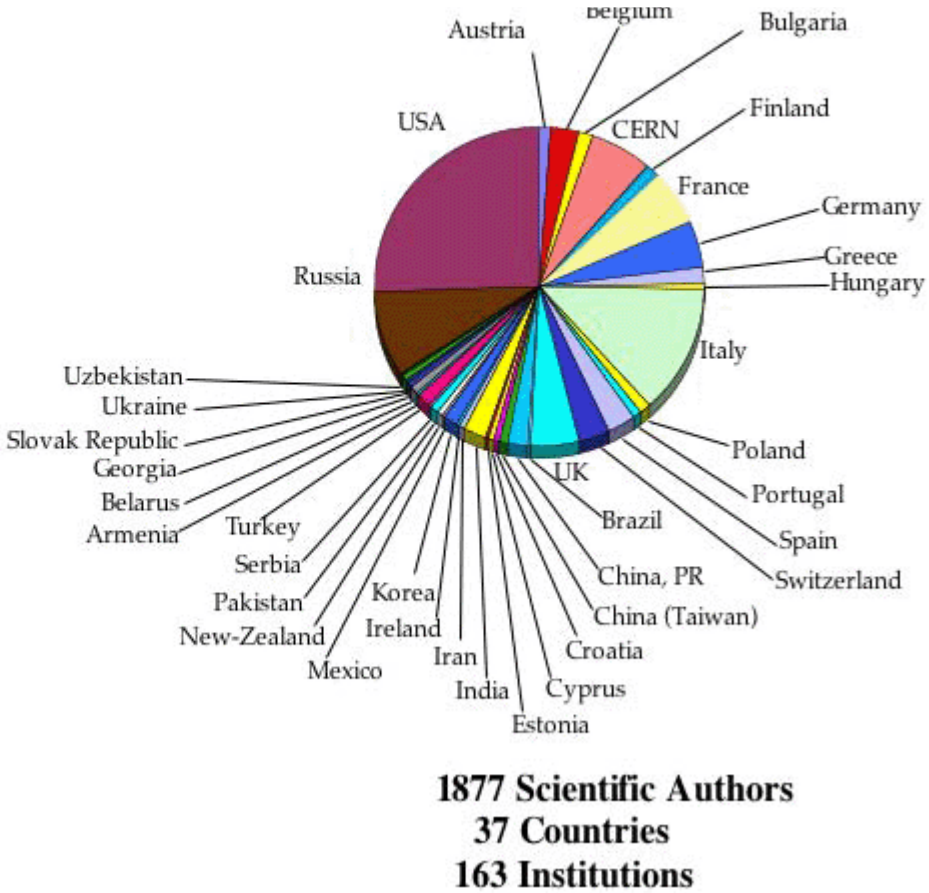
CMS

	Number of Laboratories
Member States	59
Non-Member States	60
USA	44
Total	163

	Nr of Scientific Authors
Member States	968
Non-Member States	403
USA	506
Total	1877

Associated Institutes	
Number of Scientists	46
Number of Laboratories	8

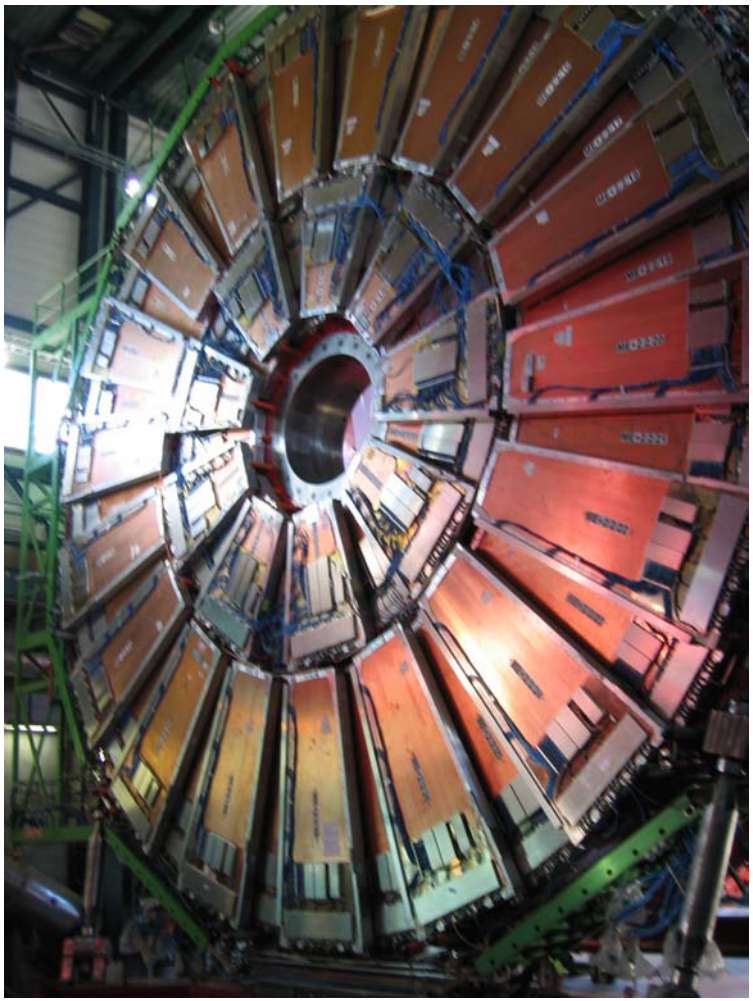
Sept, 28 2005/gm
http://cmsdoc.cern.ch/pictures/cmsorg/overview.html

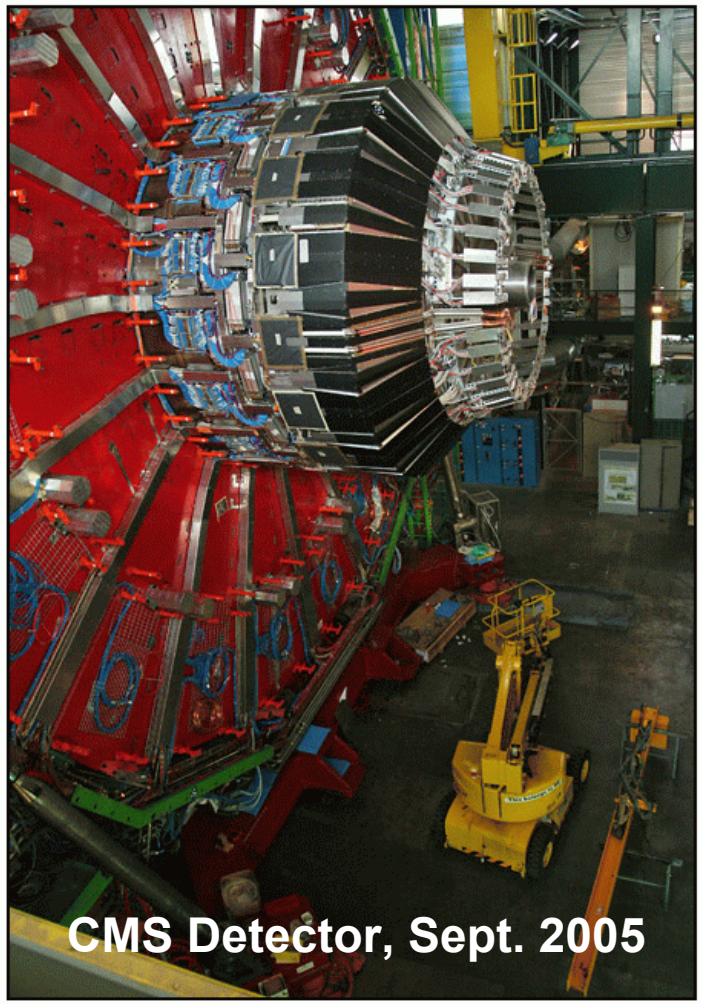


Ordered by size: USA (339 physicists), Italy (163), Russia (75), CERN (61), France (52), UK (44), Germany (45)

CMS

It's real!





Schedule

Magnet closed:	: Apr 06
Magnet test/cosmic challenge:	: Apr-Jul 06
EB+ installation	: Jul 06
USC ready for crates:	: Feb-Mar 06
UXC floor shielding & cable chains installed	: April 06-Jun 06
HF lowering:	: May 06
YE+/YB+ cable chains cabled	: June 06
YE3+ lowering start	: July 06
UXC ready for crates	: Jul 06
First connection to USC	: Jul 06
EB- installation	: Nov 06
Tracker installation	: Dec 06
ECAL/Tracker cabling complete	: Feb 07
Heavy lowering complete	: Feb 07
BPix and FPix:	: Nov 07

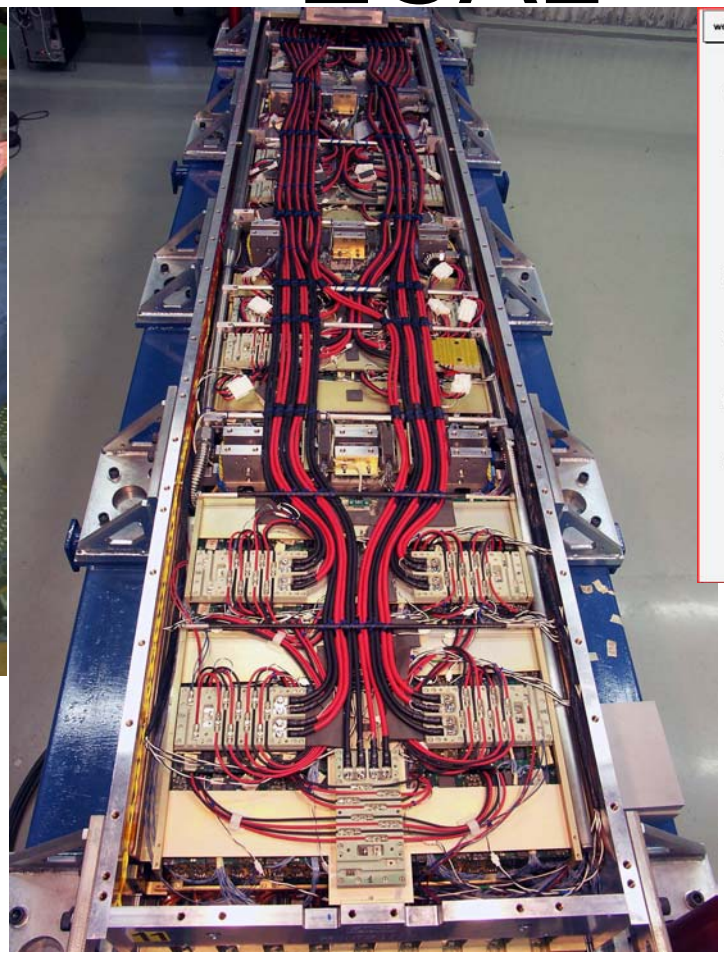
CMS ready to close 15 June 07

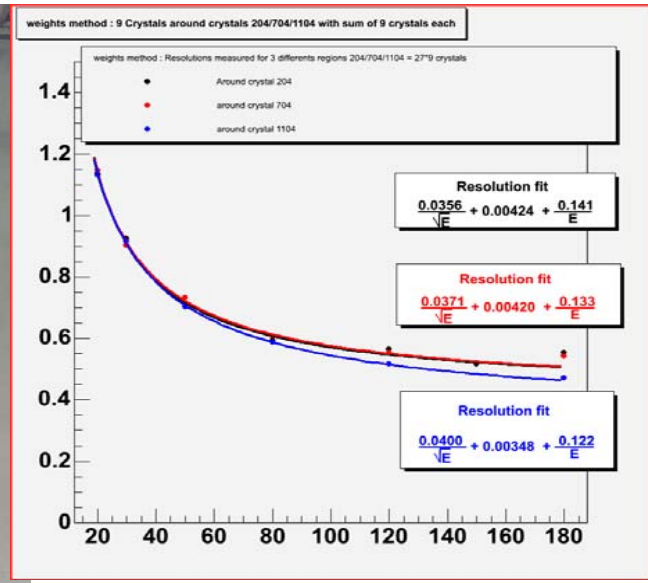
CR

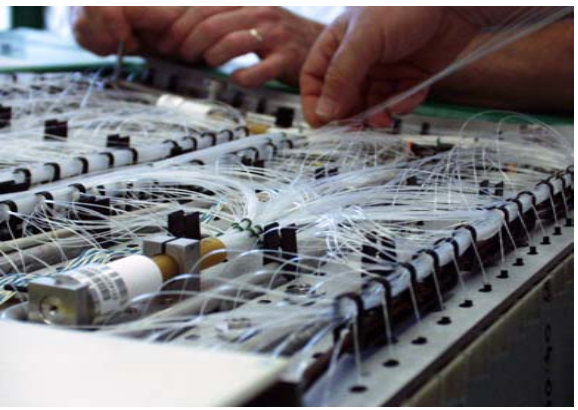
Della Negra, Sept CMS week

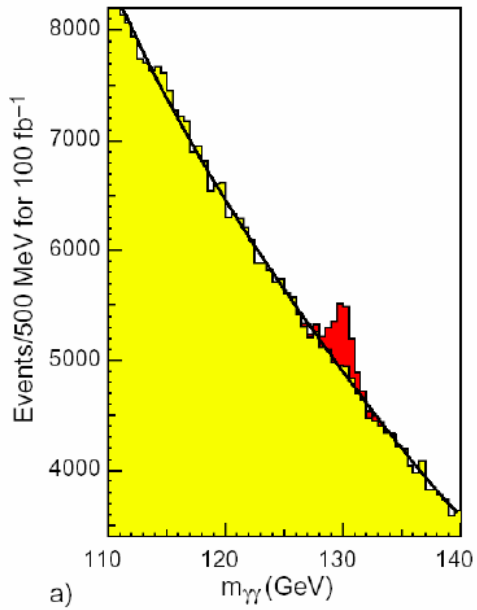
CR05: The sixth annual LHCC comprehensive review of CMS took place on 27-28 June. "It is realistic to expect CMS to install an initial working detector suitable for LHC operation starting in Summer 2007, although the completion of the detector installation can be foreseen beyond this date. The LHCC considers that the CMS schedule to achieve this is challenging…"

ECAL

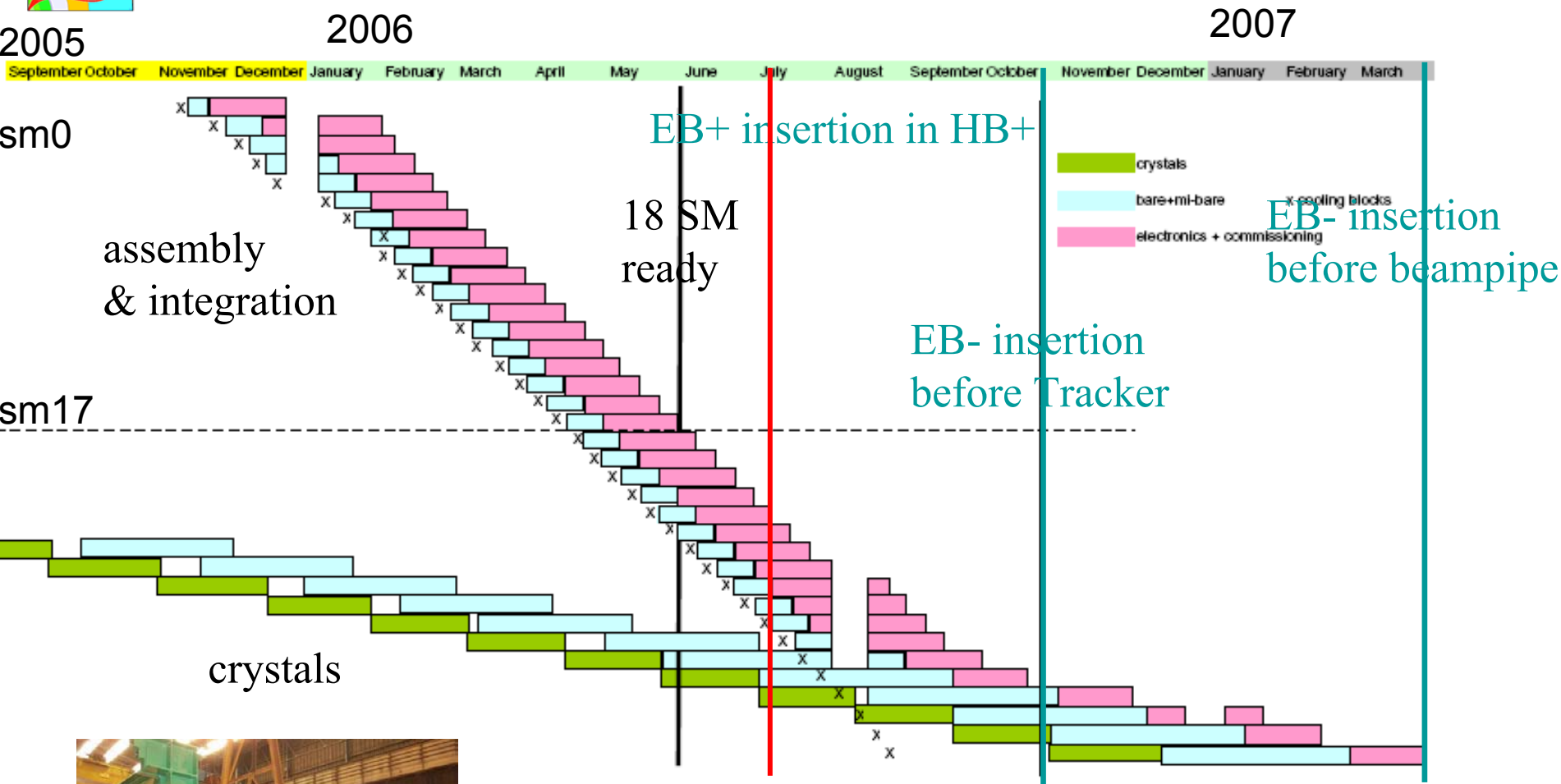



weights method : 9 Crystals around crystals 204/704/1104 with sum of 9 crystals each
weights method : Resolutions measured for 3 differents regions 204/704/1104 = 27*9 crystals
Around crystal 204
around crystal 704
around crystal 1104
Resolution fit
$\frac{0.0356}{\sqrt{E}} + 0.00424 + \frac{0.141}{E}$
Resolution fit
$\frac{0.0371}{\sqrt{E}} + 0.00420 + \frac{0.133}{E}$
Resolution fit
$\frac{0.0400}{\sqrt{E}} + 0.00348 + \frac{0.122}{E}$
1.4
1.2
1
0.8
0.6
0.4
0.2
0
20
40
60
80
100
120
140
160
180

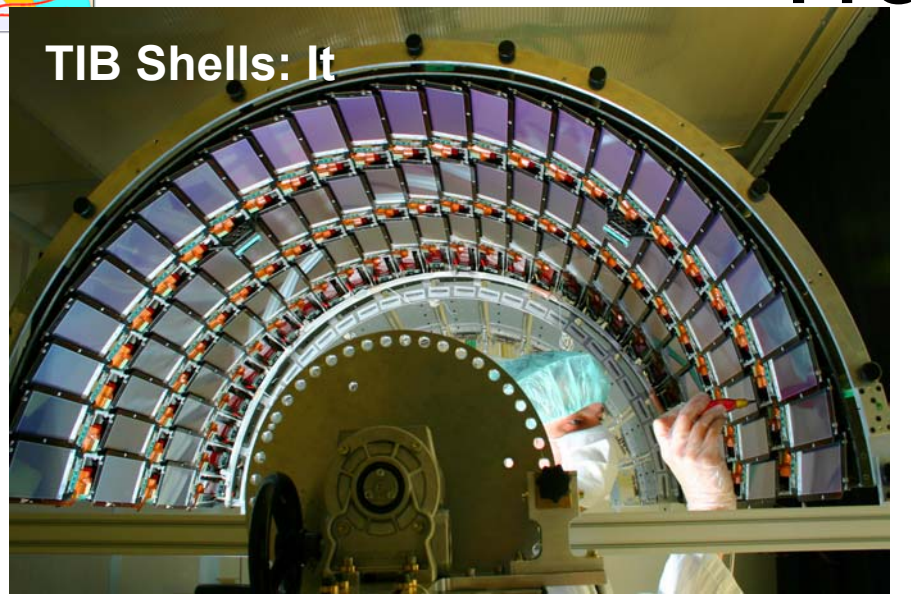


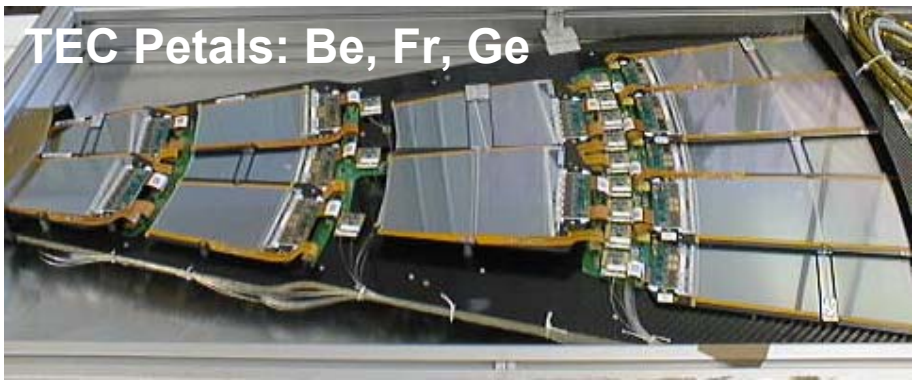

Events/500 MeV for 100 fb^{-1}
8000
7000
6000
5000
4000
110
120
130
140
$m_{\gamma\gamma}$ (GeV)
a)

ECAL Schedule



Tracker





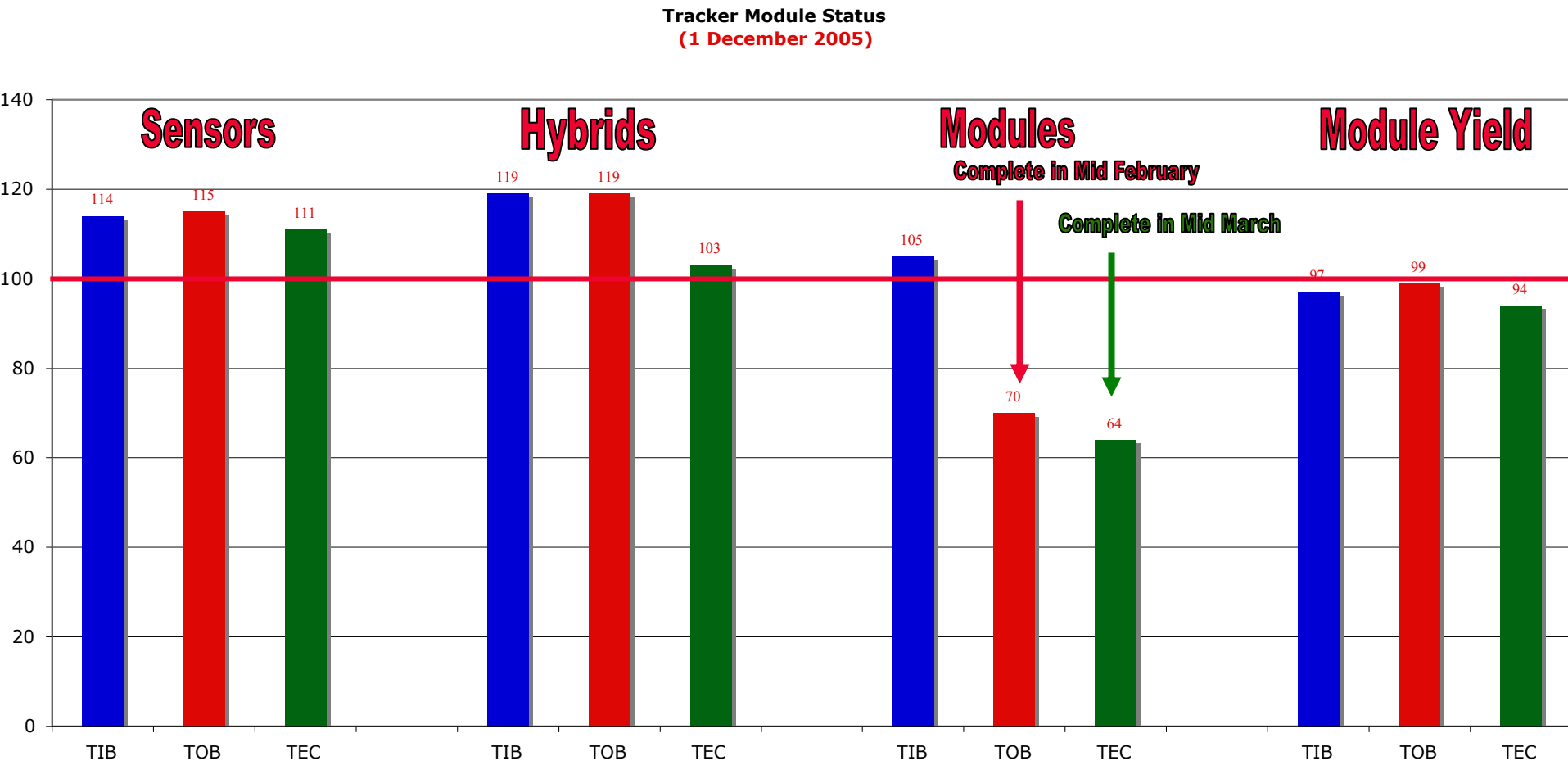
- **Tracker Integration at CERN (TIF, bat 186)**

TIB+	Nov 05
TIB-	Feb 06
TOB	Mar 06
TEC	May 06

- **Full commissioning in TIF: May-Oct 06**
- **Tracker Installation at Point 5: 1 Dec 06** (pixels later)

Silicon

Sharp, Dec CMS week



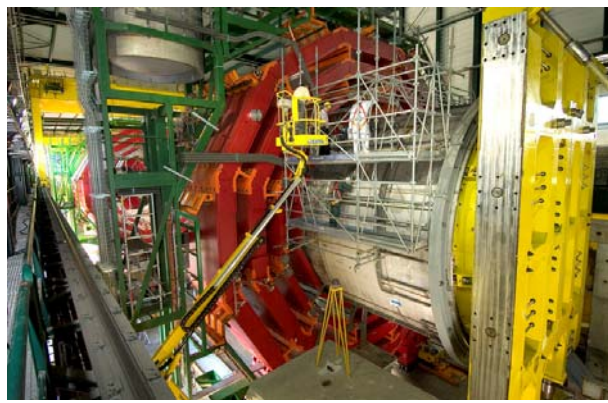
Tracker

Sharp, Dec CMS week

Tracker Component Production

- This Enormous Job is almost Complete
- It has involved ~ 150 People
- It has involved ~ 120,000 Parts
- It has involve 26 Types of Components
- Many Congratulations to all those involved in this Extraordinary Long and Very Meticulously Detailed Work
- The Focus of the Tracker now moves from Component Production to Integration and Commissioning

Magnet



Rotated 8/25/05, inserted 9/14/05, inner cryostat rotated 9/20/05, inserted 11/02/05

HB will enter Feb?

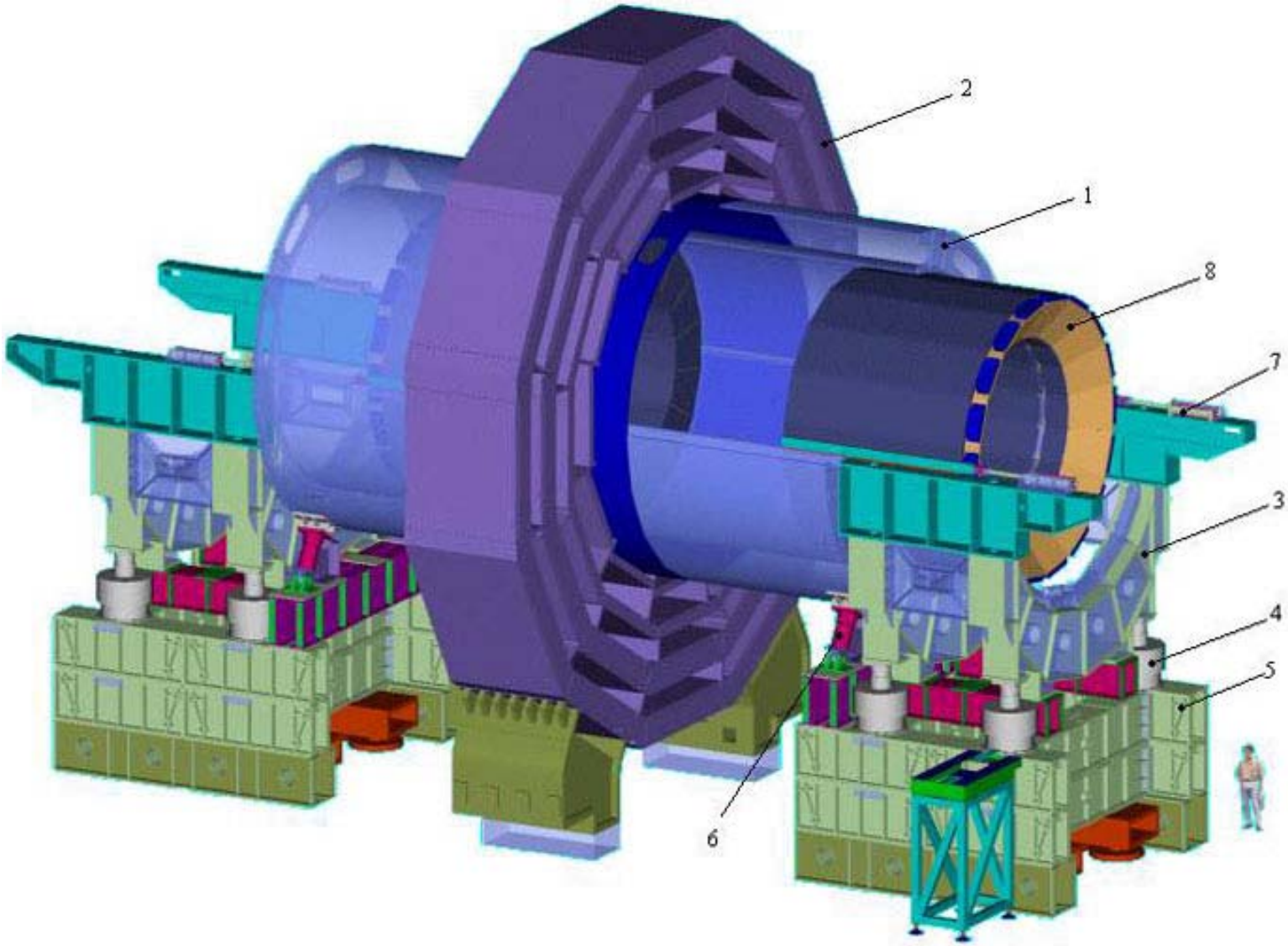
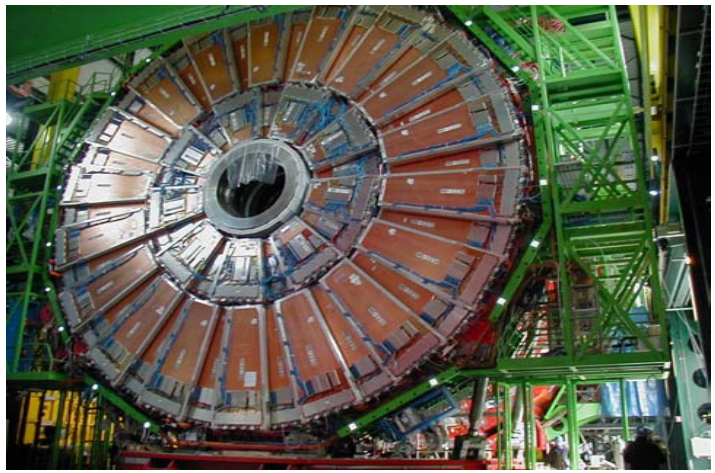
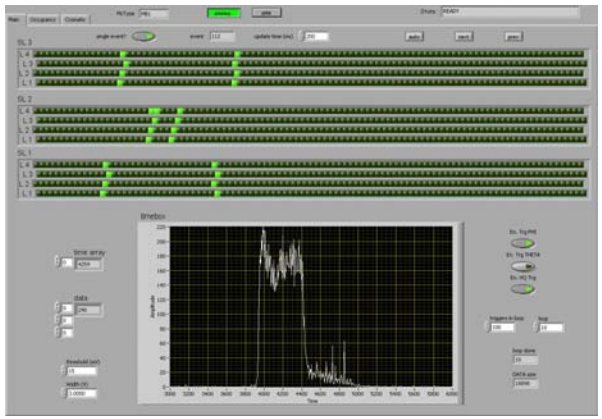
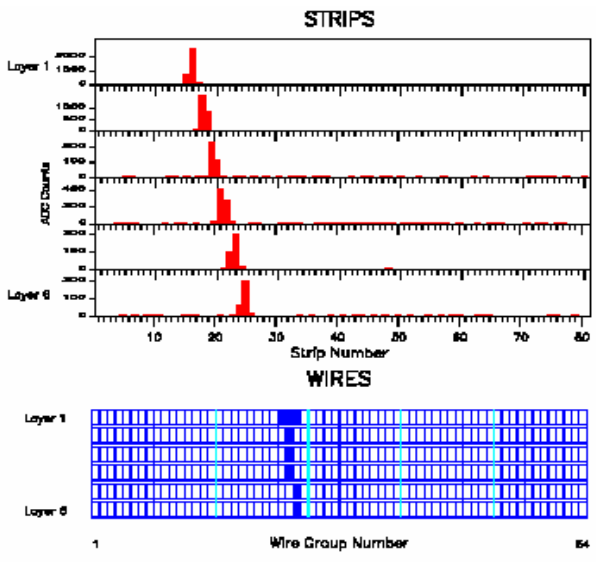


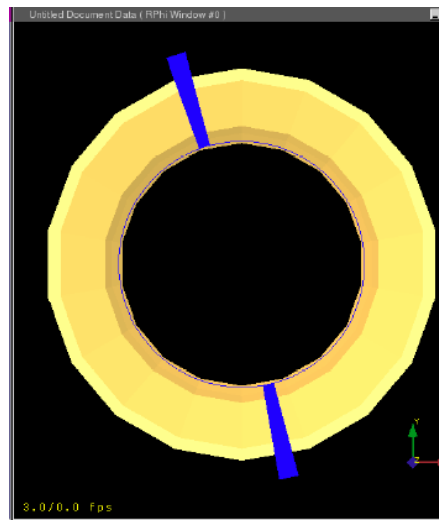
Fig. 47 HB installation into vactank.

Detector Shake Down Started



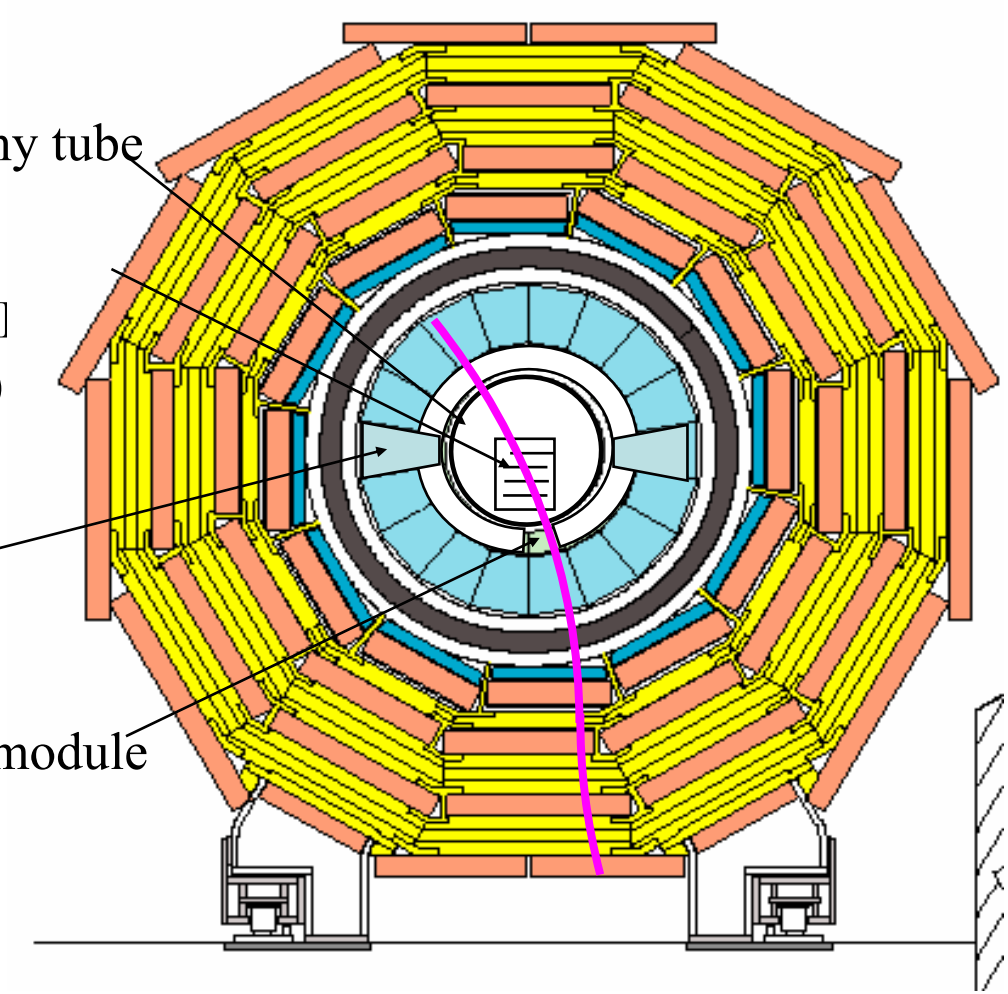






Magnet/Cosmic Slice Test

April '06 (then, heavy lowering!)



***ambitious* integration test:**

issues:

-compatibility with basic programme of tests
-special installations
-muon, rpc, hcal, ecal, trk detectors
-cabling & services (esp LV)
-controls and safety
-trigger
-off-det electronics
-DAQ & Run Control
-DAQ integration requires:
-local DAQ (over VME)
-FED Slink
Common trigger (ad-hoc with LTC?
-databases
-data-structure/storage
-analysis software etc etc etc

Summer Test Beams

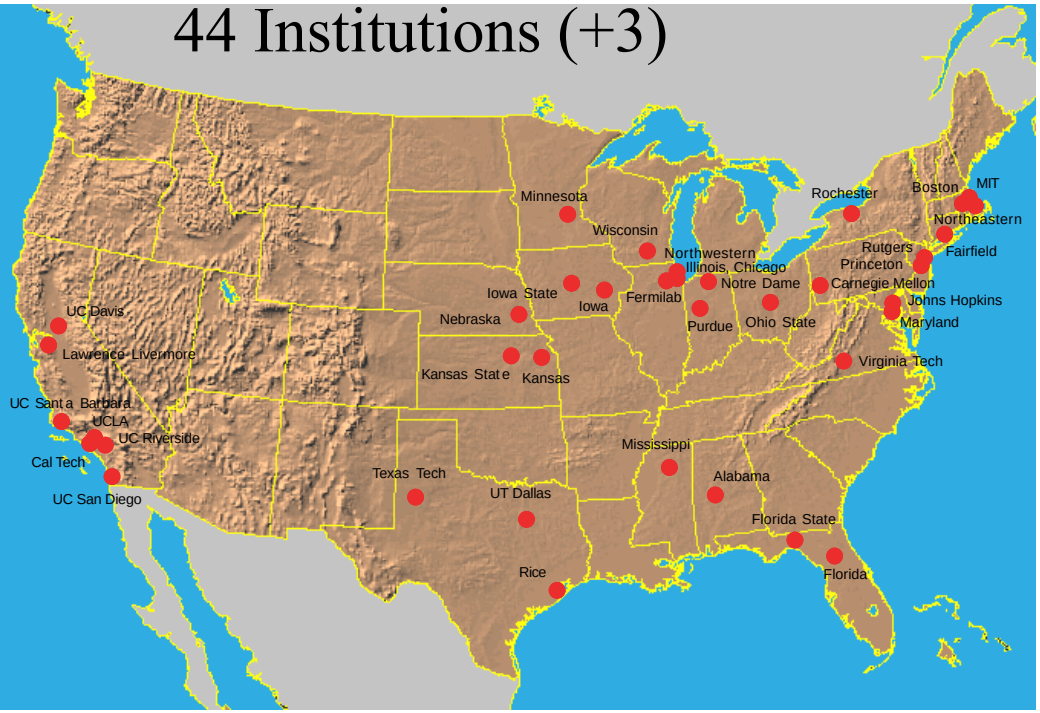
The CMS HCAL and ECAL groups will perform a Combined Test starting in mid-July and run for 9 weeks according to the following plan:

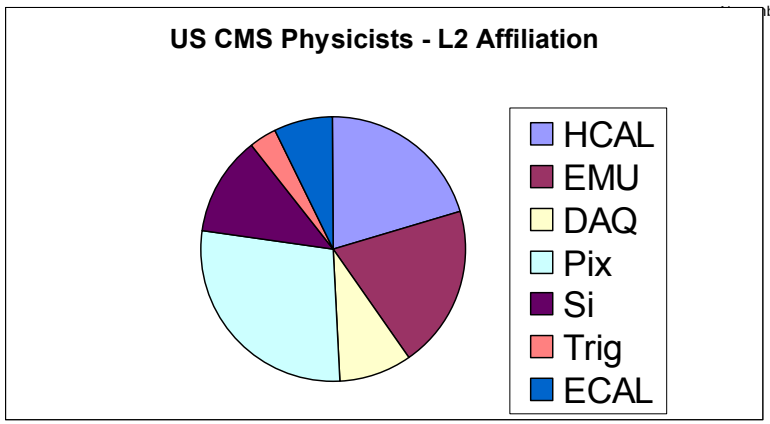
- 1 week: Set-up time
- 3 weeks: High-energy beam (10-300 GeV pions/electrons/muons; negative beam if possible).
- 1 week: Switchover from High Energy to Very Low Energy beam
- 4 weeks: Very Low Energy beam (2-9 GeV pions/electrons)

Typical intensities of 10 kparticles/spill.

The programme will be dedicated to measuring the response of the combined ECAL +HCAL to pions in the momentum range 2 - 300 GeV. The groups will also use electron (muon) beams to establish the calibration of ECAL (HCAL). Preferred time is July 19th (week 29th) to September 20th in week 38th , i.e. just before structured beam period.

USCMS





Information from Dan Green

By size (physicists)

FNAL: 58

Florida: 21

UCLA: 15

Davis: 13

MIT: 13

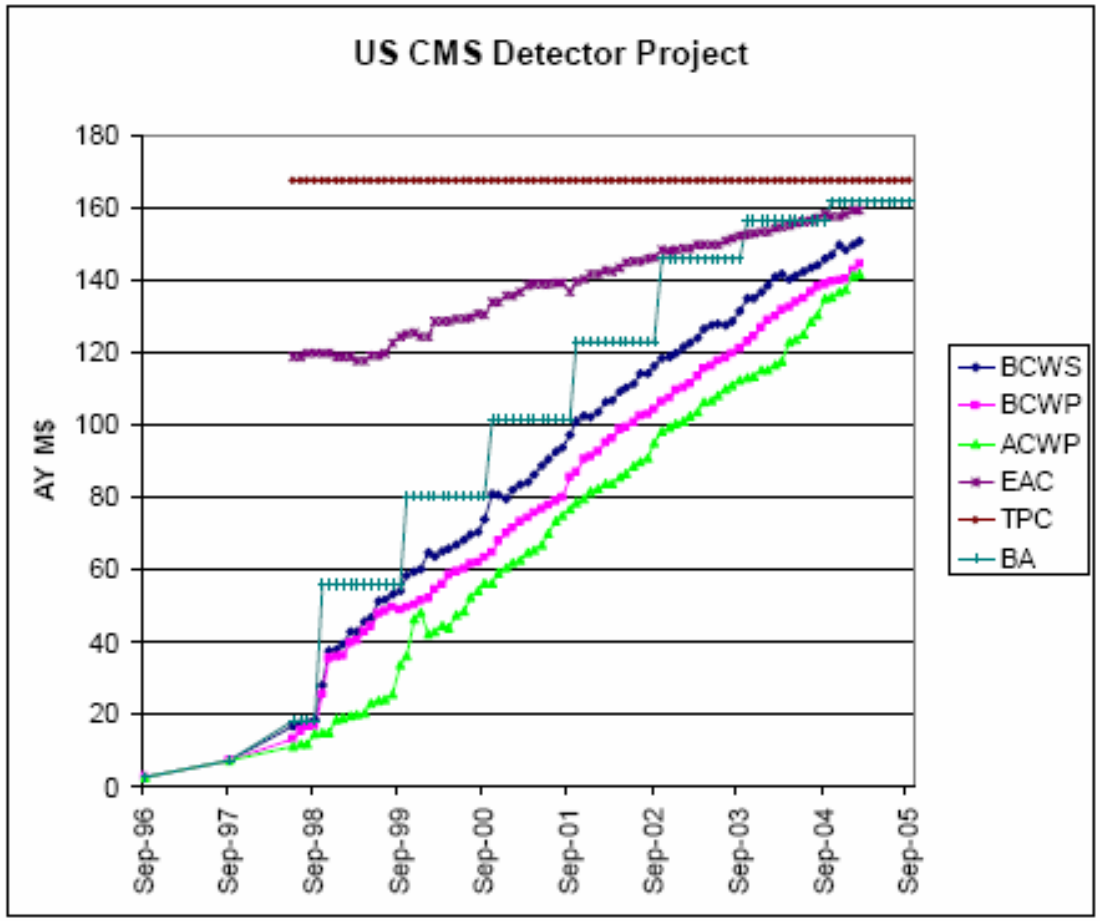
Rochester: 13

Rutgers: 11

Growing quickly!

CD4-A

USCMS is a well-managed project -> kudos to the FNAL leadership

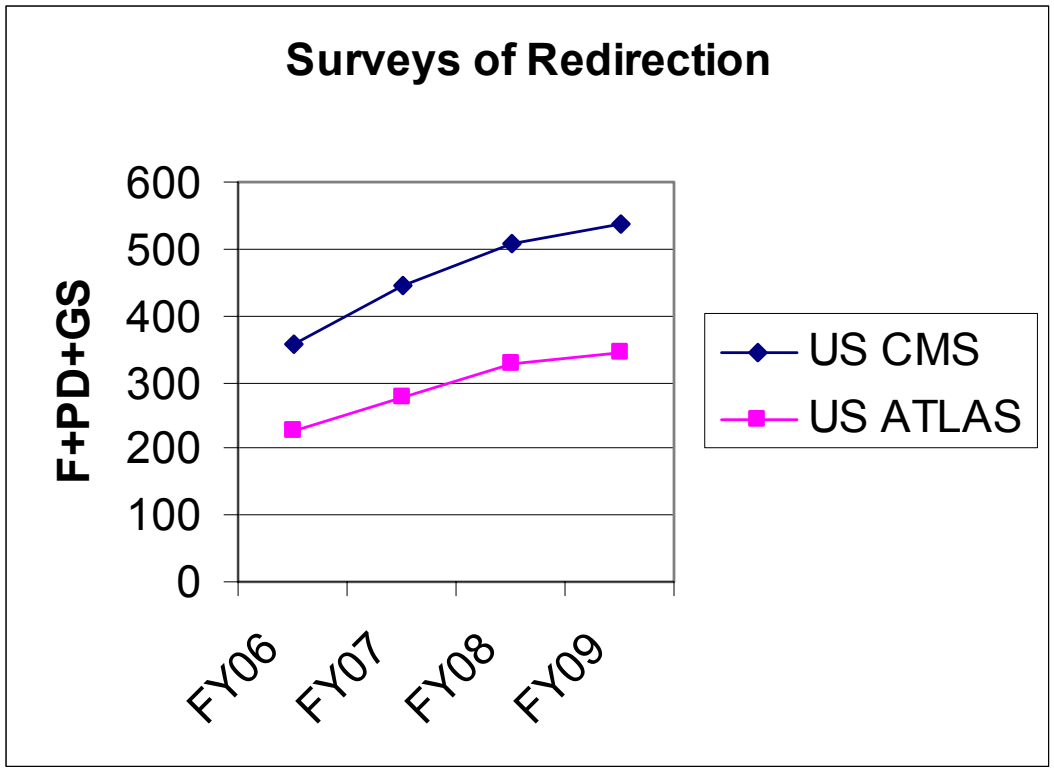


DOE-speak for finishing a project “Critical Decision - 4A/CD-4A”

Achieved Sept 30.

Presented to Orbach by Carolan on Oct 25.

Redirection Surveys



Dan Green

US CMS cannot supply COLA funds for the physicists within the current RP guidance. A survey was launched after the JOG (requested by P K Williams) to sharpen the redirection numbers by asking where physicists would locate. Does a 50:50 split make sense in DOE/NSF support to US ATLAS and US CMS?

Computing in the US

T0 at CERN, T1 at Fermilab as US CMS national center,

T2 at UCSD, Caltech, UFlorida, Wisconsin, MIT, Nebraska and Purdue as regional US CMS centers. (+ Brazil + China)

Good interactions with FNAL Tier 1 team

FNAL

- Provides most of the project management for USCMS
- Host for Tier 1
- created an “LHC Physics Center”
- creating a “Remote Operations Center”
- major roles in Silicon tracker (SiDet, FPIX)
- major roles in HCAL
- major roles in EMU

About 50 people in total, 3 postdocs. Hope eventually to have 10 postdocs.

Plus various other people in other divisions

CMS
Head - **Lothar Bauerdick**

Tim Doody
Ian Fisk
Oliver Gutsche-*pd*
Robert Harris
Dane Skow
John Weigand*

Distributed Applications
Lee Lueking-L
Anzar Afaq
Dave Evans
Yuyi Guo
Vijay Sekhri
Eric Wicklund

Software and Support
Liz Sexton-Kennedy-L
Patrick Gartung
Natalia Ratnikova
Maria Stavrianakou
Bill Tanenbaum

U.S. CMS Tier-1 Facilities
Jon Bakken-L
David Fagan
(Lisa Giacchetti-CSS)
Burt Holzman
(Joe Kaiser-CSS)
(Tim Messer-CSS)
(Gary Stiehr-CSS)
Hans Wenzel
Yujun Wu

CMS DEPARTMENT
D. Green, Dept. Head

Research Program
(D. Green, US CMS Program Mgr)
J. Freeman (M&O PM)
J. Hanlon, Project Office
(S. Landrud, Budget)
(T. Grozis, Financial Supt.)
(T. Read, Admin. Supt.)
T. Kramer (t) CERN Project Office

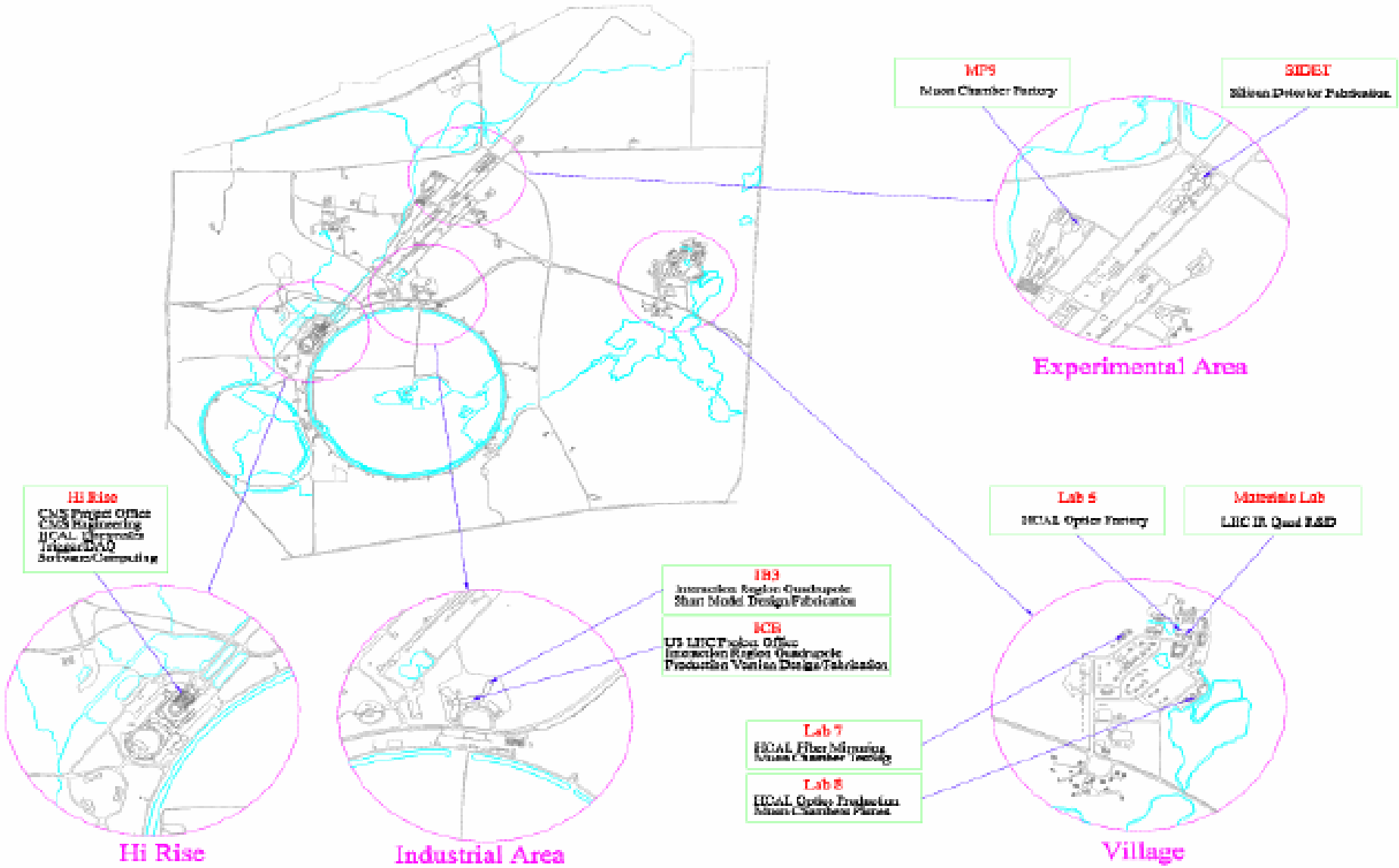
FNAL Detector Group
M. Atac
F. Borcherding
D. Eartly
J. Elias
U. Joshi
S. Los (t)
S. Lusin (t)
A. Ronzhin (t)
J. Spalding
L. Spiegel
I. Suzuki
J. C. Yun

FNAL Analysis Group
(A. Yagil)

M. Albrow
J. Damgov (G)
S. Esen (G)
A. Khanov
G. Lukkanin (t)
K. Maeshima
S. Piperov (G)
J. Whitmore
W. Wu
T. Yetkin (G)

FNAL

Fermilab Activity on the LHC



Project Management

CMS Project Manger: Dan Green

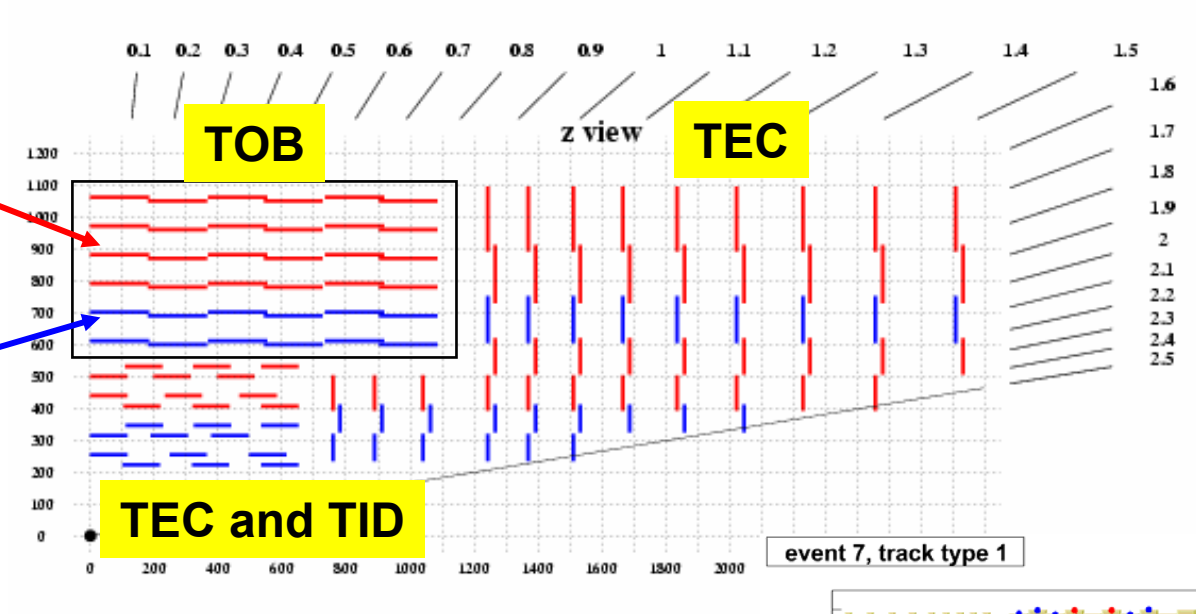
Computing: Lothar Bauerdick

M&O: Jim Freeman

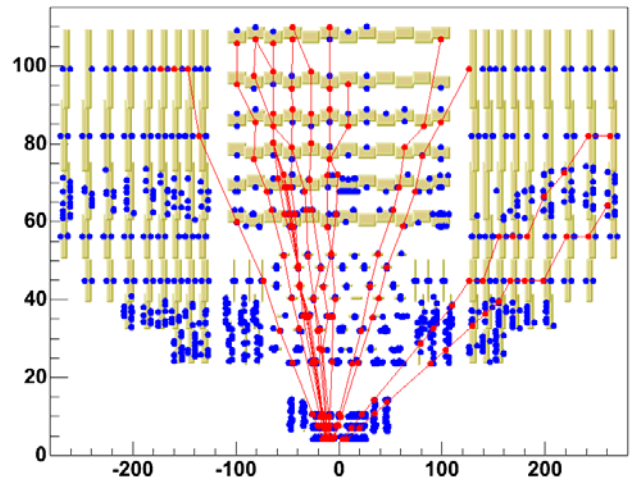
NSF: Bob Cousins

All but Cousins FNAL employees

SiDet



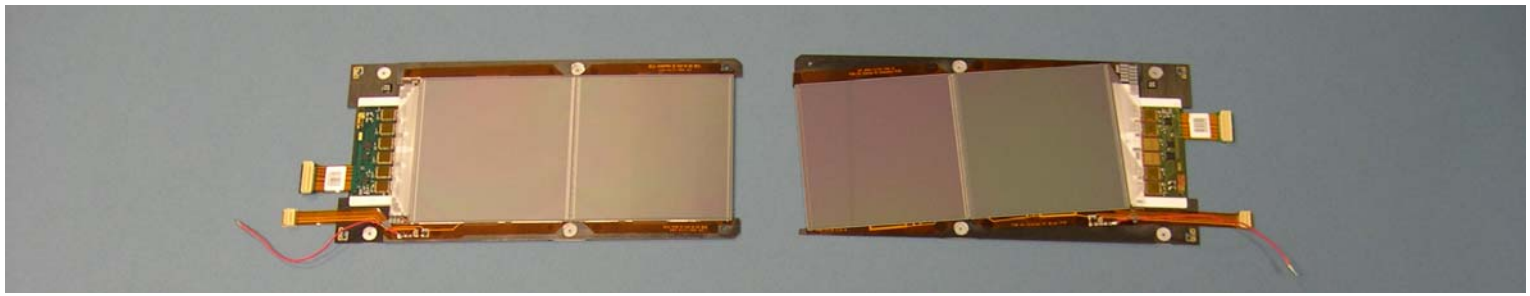
Tracking relies on a limited number of precision points. There is a premium on keeping noise and inefficiencies as low as possible.



SiDet

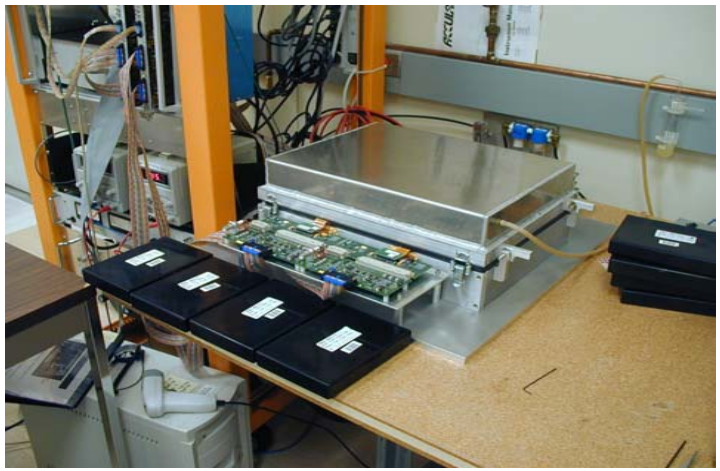
- SiTracker
  - Build all of the Tracker Outer Barrel modules, test them, and ship them to CERN in the form of rods.
    - Production split 50/50 between FNAL and UCSB.
      - UCSB currently building some TEC modules and will be joined next year by FNAL.
    - Components and test equipment provided by Tracker groups.
    - Mechanics and integration handled by TOB group at CERN.
  - Modules production will be completed in early 2006.
    - “25%” system test in spring 2006 and installation in experiment starting in November 2006.
  - Joe Incandela (UCSB) is the project leader.
- FPix
  - More extensive project to build all of the Forward Pixel disks. Includes component procurement, test equipment, mechanics, and integration.
  - Production will take place in 2006.
    - Installation in experiment deferred for safety reasons until after initial beam circulation in 2007.
  - Bruno Gobbi (NU) is the project leader.

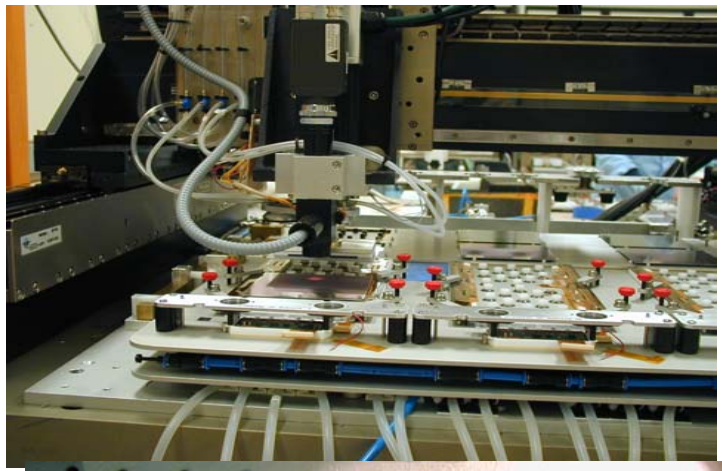
TOB Modules

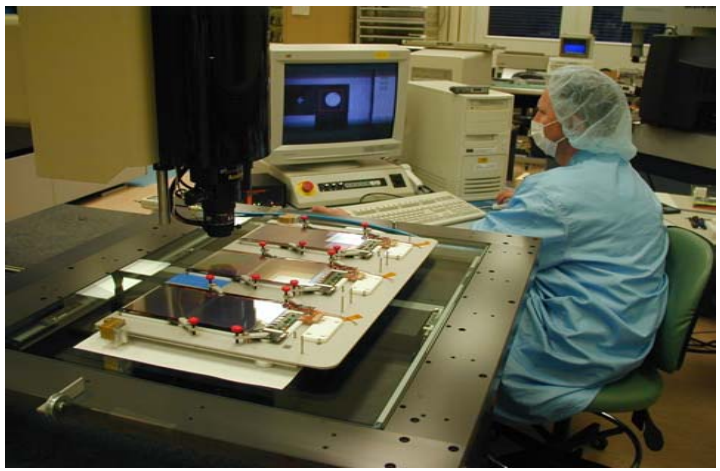


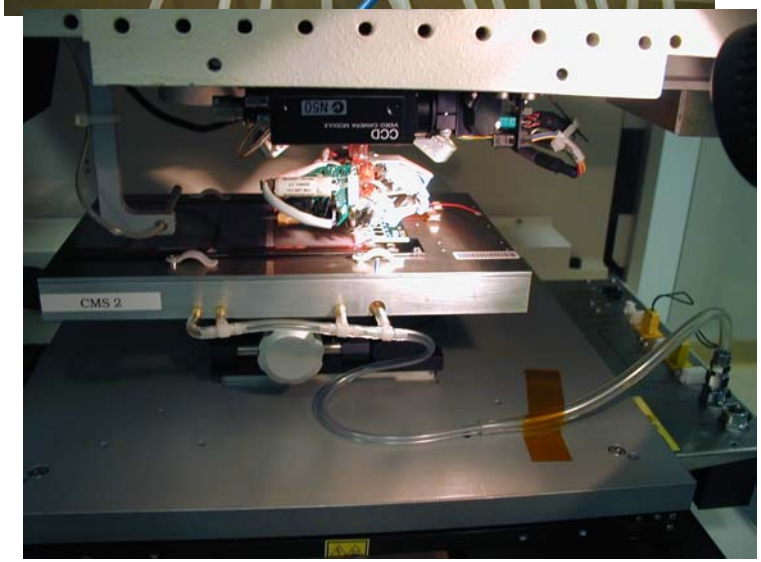
- Tracker Outer Barrel consists of 5,208 modules assembled in two ‘wheels’ each consisting of 6 layers of (688) rods.
  - Sensors are approximately 10 cm x 10 cm.
  - Modules always contain two sensors
    - Axial = RPhi
    - Stereo = 0.1 radian tilt angle
  - Layers 1 and 2 are double-sided in the sense that they contain back-to-back axial and stereo modules
    - 12 modules per double-sided rod
    - 6 modules for all other rods (L3, L4, L5, and L6)

SiTracker Production

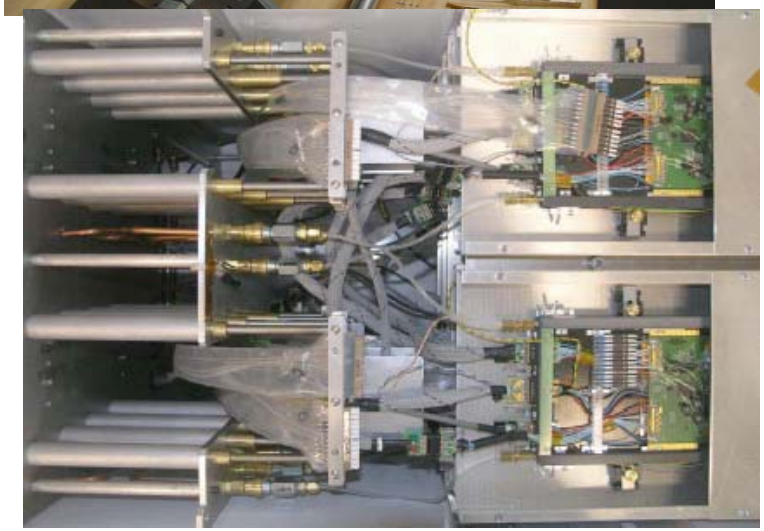




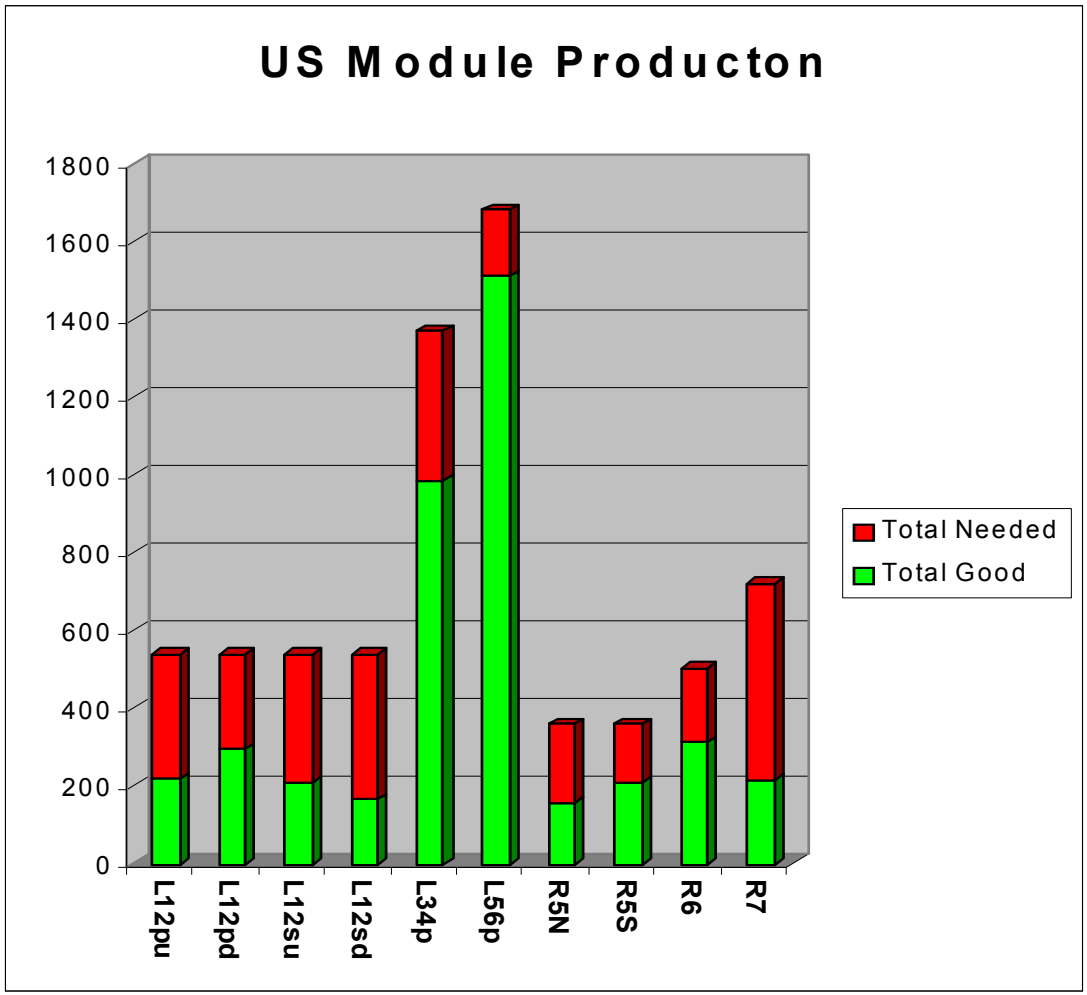




SiTracker Production



TOB Production



FNAL+UCSB

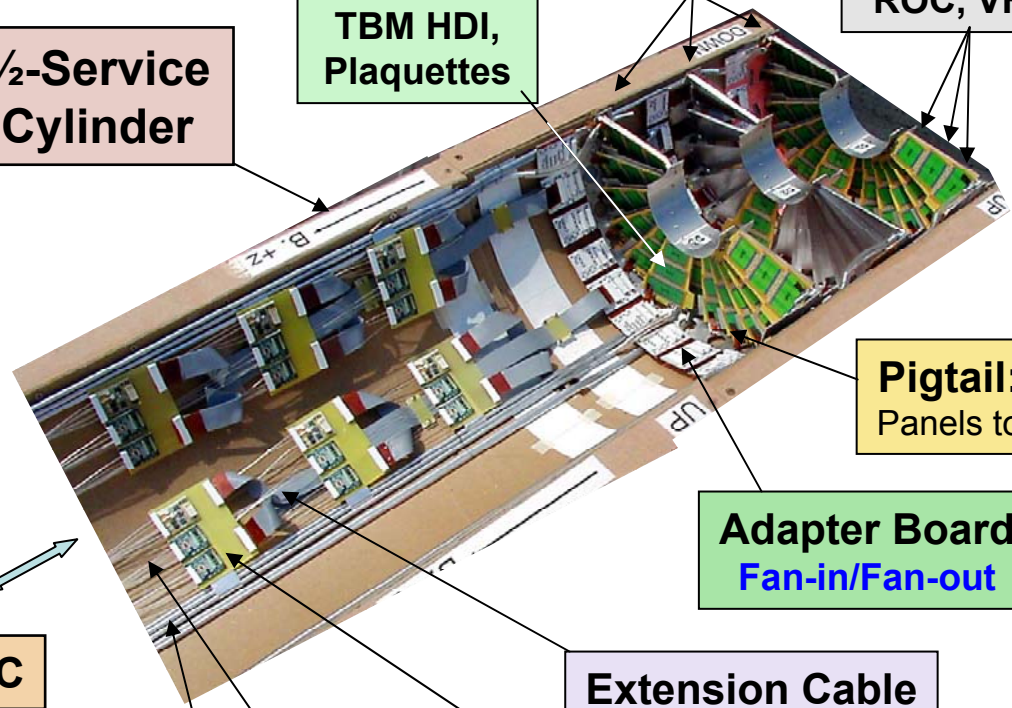
FPIX

FPix (baseline):

US delivers:

- **4 'disks'**
- **TBM** (for CMS Pixels)

- Mechanical support and cooling
- Pixel Sensors
- Assembled pixel detectors
- The required electronics (adapter board, port card) except the: ROC, FEC, FED and OL



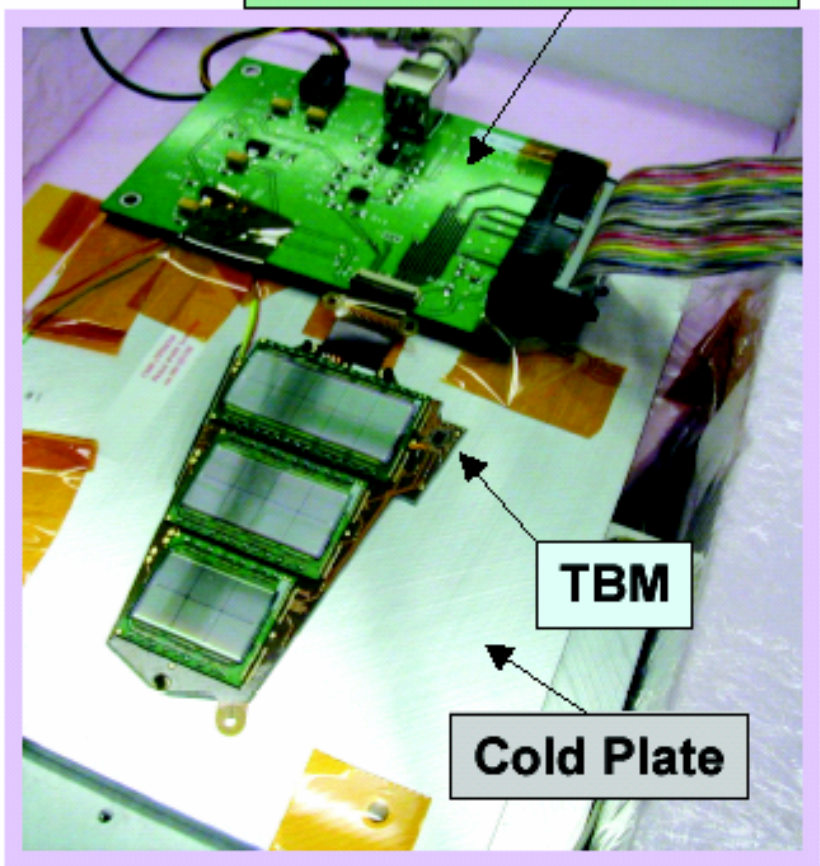
FPIX at SiDet

- Scheduled to start assembly in 2006.
- Purdue will build plaquettes
  - 6 per day
- Activities at SiDet
  - Extensive test of plaquettes
  - Burn-in of plaquettes
  - Assembly of plaquettes on panels
  - Burn-in of panels
  - Assembly of panels into blades; blades into half-disks.
- Production will run through 2006
  - Paced by bump bonding
    - 2 firms engaged
- Expect to have 5% of the detector in the ’07 run!

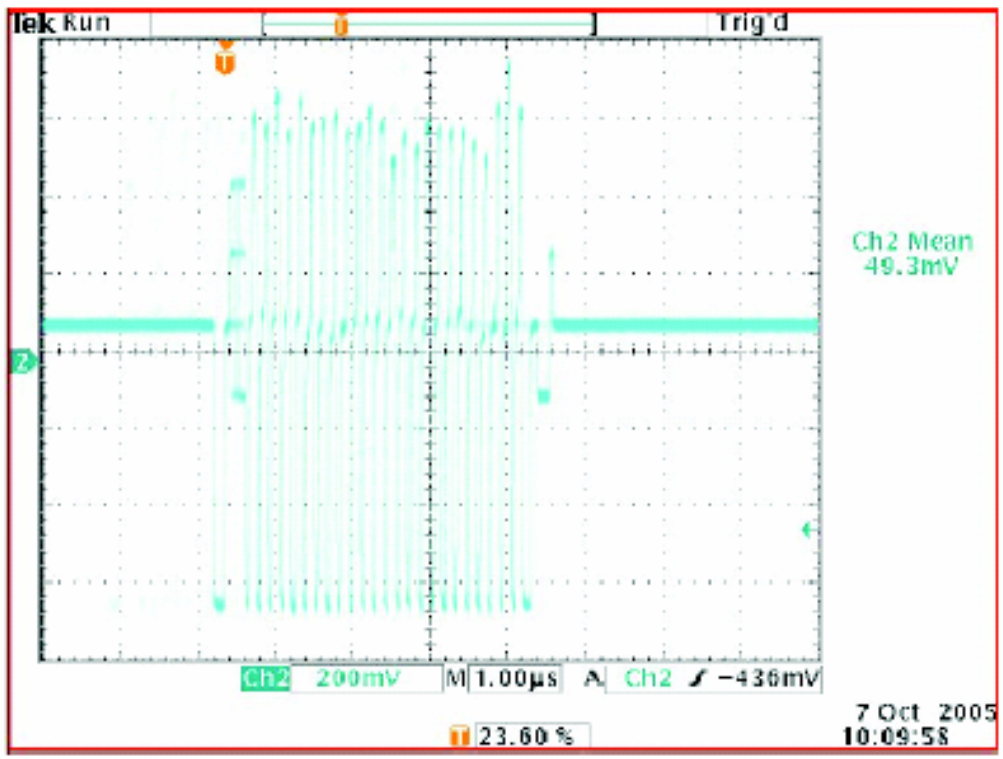
Milestone: 1st Panel Works!

This panel contains >100,000 pixels

3 Plaquettes' Panel (Be)



24 Token Returned



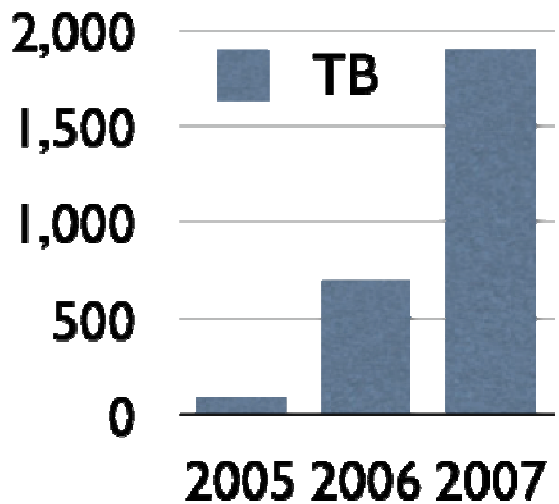
The Tier-1 Center at FNAL

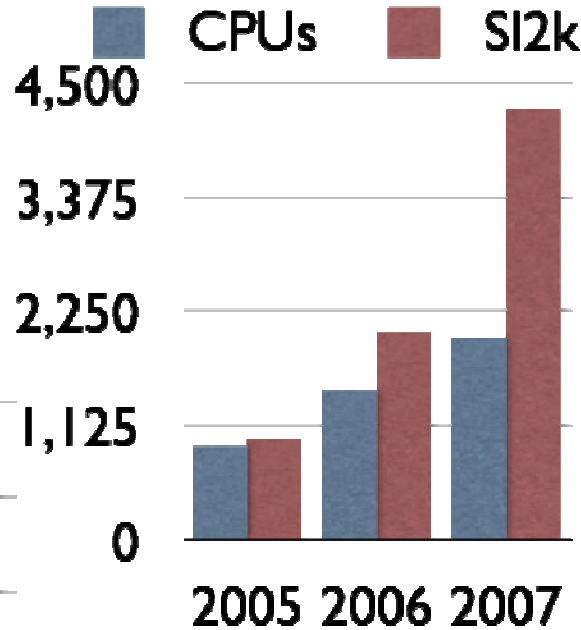
- FNAL is a the only LHC Tier-1 Facility dedicated to CMS
  - FNAL is the single largest Tier-1 center
    - By head count, US-CMS is about 30% of the CMS collaboration
      - FNAL is approximately two nominal Tier-1 centers by computing model requirements
- There are 7 Tier-2 centers supported by the FNAL Tier-1

- FNAL is completing the first year of a three year procurement ramp in preparation for the start of the experiment
  - FNAL is at approximately 25% of the complexity expected at the start of the experiment
    - 1000 batch slots in the processor farm
    - 100TB of disk in the mass storage
    - 250TB of tape
    - Access to a 10GB/s research network link
-

Tier-1 Facility Growth

- The Tier-1 Facility has ~25FTE of effort
  - Working on Facility operations
  - Grid, Facility, Software and Distributed Computing Development
  - Facility effort remains roughly constant though some transition to deployment and operations from development
- Facility grows with a steep ramp before the start
- of the experiment
  - Processing grows linearly
  - Disk grows by a factor of 20
- CPU number is similar to
- the Run2 experiments
  - Capacity increase
- Big increase in storage
- capacity

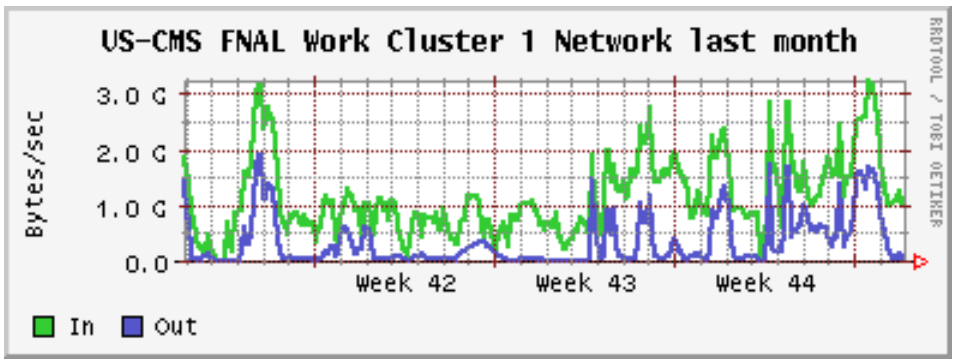




Preparations

•To prepare the center for the start of running, CMS is participating in a series of Service and Data Challenges

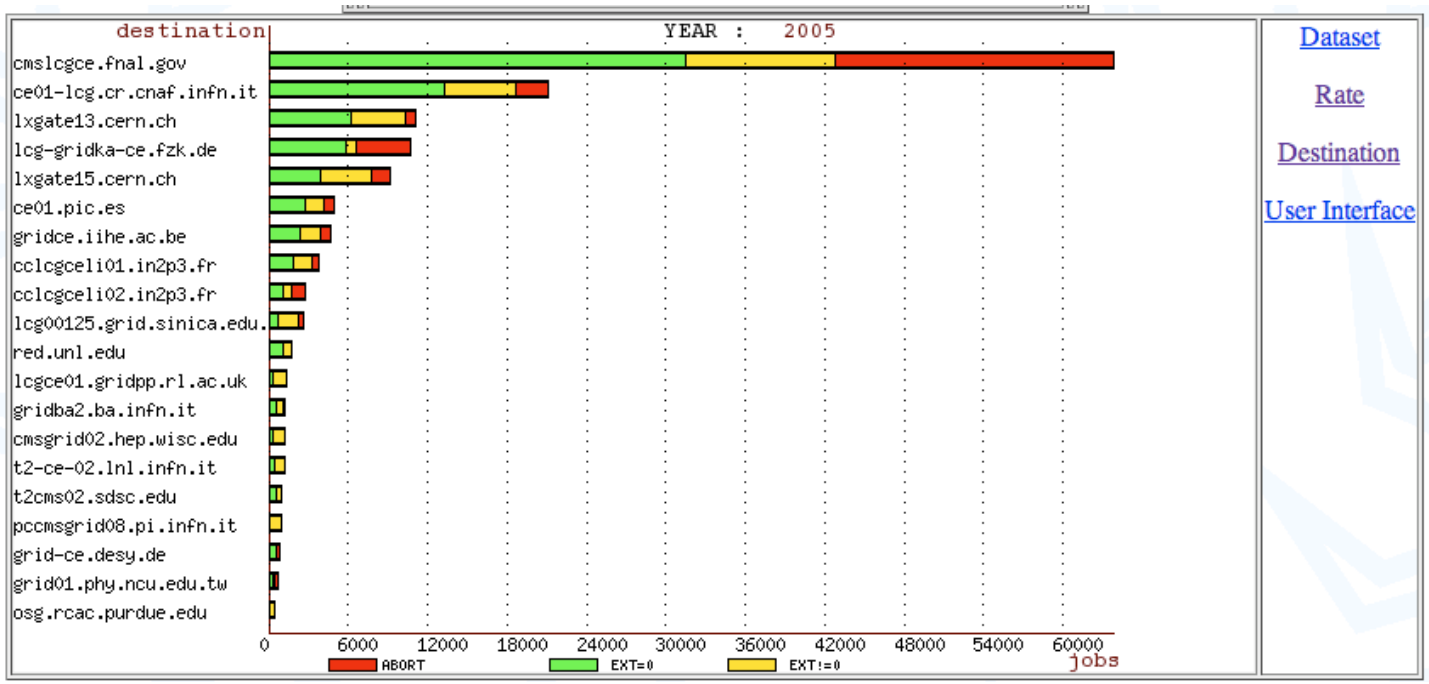
- Sustained network rates from CERN to Tier-1 and on to Tier-2 centers are important in a distributed experiment
  - FNAL has achieved rates of 7Gb/s to CERN on the research link
  - Working on improving the rates out to Tier-2 centers
- Once data has been stored at the Tier-1 it has to be served to analysis applications
  - dCache (disk caching system developed by FNAL and DESY) is deployed



  - Sustained rates of more than 1gigabyte per second.

Preparations (Cont.)

- Analysis Applications access the available Tier-1 data through the grid interface
  - the FNAL Tier-1 has grid gatekeepers for both the OSG and the LCG
    - Accessing the same physical resources
- CMS has developed infrastructure to submit grid jobs by users to access remote data at Tier-1 centers (CMS Remote Analysis Builder CRAB)
  - FNAL is the largest recipient of analysis grid jobs
-



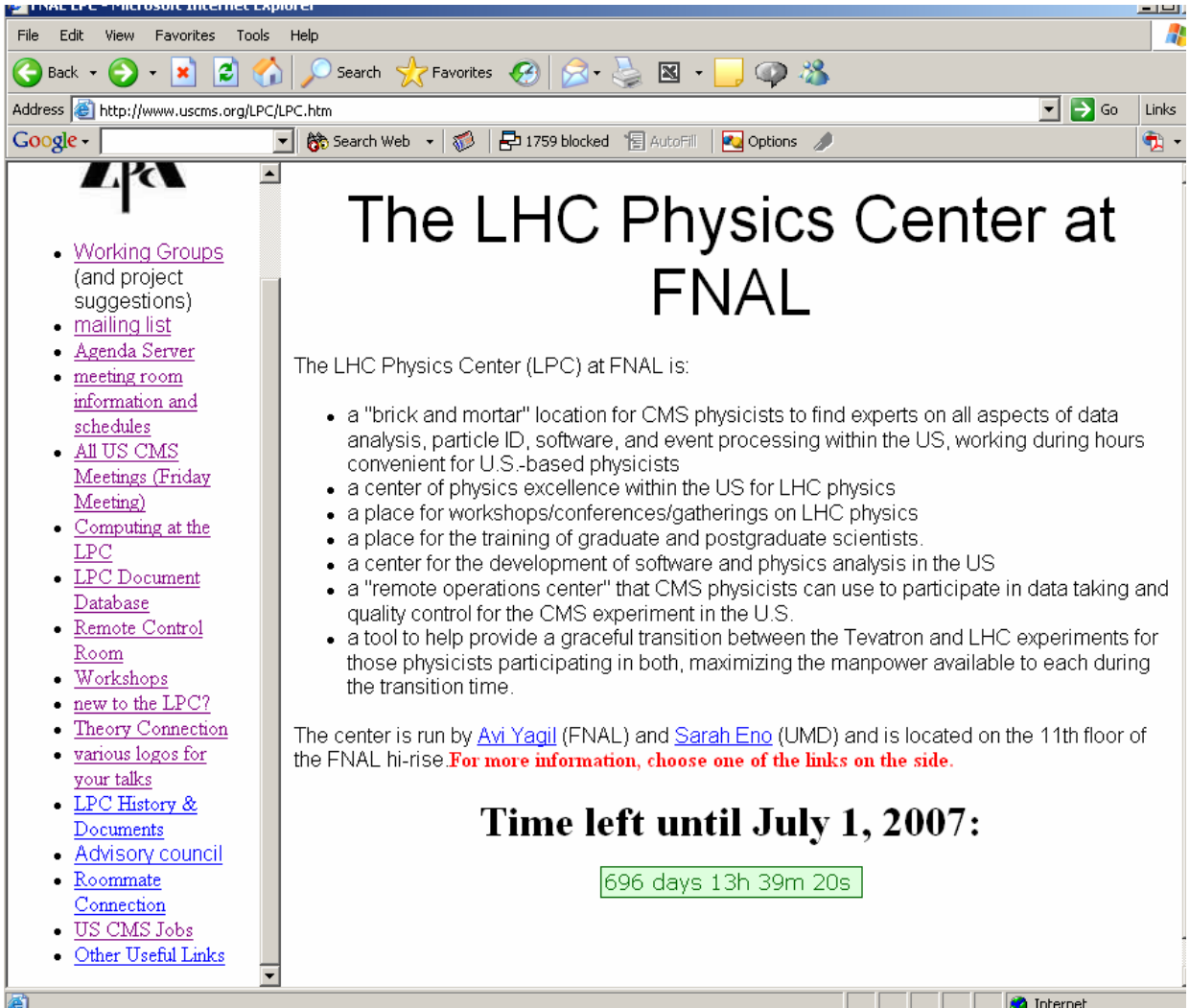
LPC

Located on the 11th floor of the FNAL high rise, the purpose of the LPC is to ensure the US gives the strongest possible assistance to international CMS in software preparations for Day 1 and to enable physics analysis from within the U.S.

- a critical mass (clustering) of young people who are actively working on software (reconstruction, particle identification, physics analysis) in a single location (11th floor of the high rise),
- a resource for University-based US CMS collaborators; a place to find expertise in their time zone, a place to visit with their software and analysis questions,
- a brick-and-mortar location for US-based physics analysis, with such physical infrastructure as large meeting rooms, video conferencing, large scale computing, and a "water cooler" for informal discussions of physics.

Web Information

http://www.uscms.org/LPC/LPC.htm



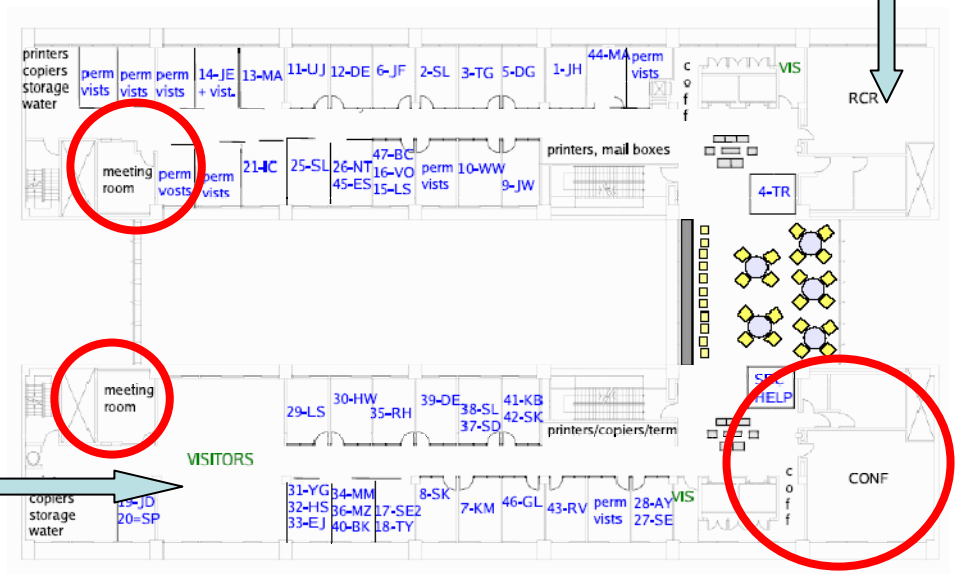
Resources: 11th Floor

- **Meeting Rooms/Video Conferencing/Internet**
- **terminals/printers/office supplies**
- **secretarial and computer support**
- **Coffee machines/Water cooler**

Remote operations center

Meeting rooms

Transient space



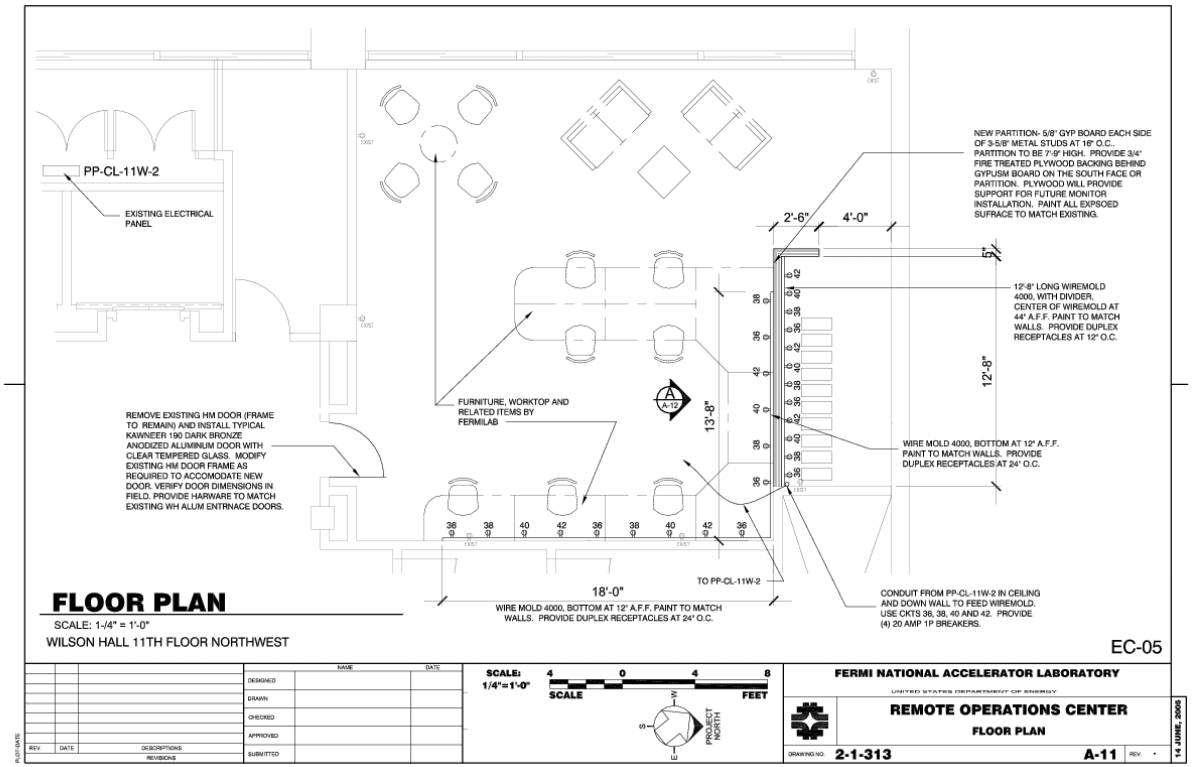
Room for 60 transients from Universities plus 60 permanent residents

Of the 60 permanent slots, 25% are University physicists. I expect 20 University-employed postdocs on the 11th floor full time by S06.

ROC

15th Sept. '05.

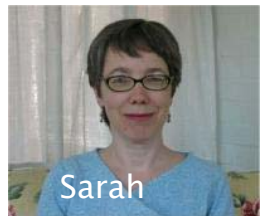
Contributors: FNAL, MD, Kansas State



- Will be used for cosmic slice test and 2006 test beams

More than just furniture…

- **offline/edm:** Liz Sexton-Kennedy (FNAL), Hans Wenzel (FNAL)
- **tracking:** Kevin Burkett (FNAL), Steve Wagner (CO)
- **e/gamma:** Yuri Gershtein (FSU), Heidi Schellman (NW)
- **muon:** Eric James (FNAL) , Michael Schmitt (Northwestern)
- **jet/met:** Rob Harris (FNAL), Marek Zielinski (Roch)
- **simulation:** Daniel Elvira (FNAL), Harry Cheung (FNAL)
- **trigger:** Greg Landsberg (Brown) , Kaori Maeshima (FNAL)
- **Physics:** Boaz Klima (FNAL)



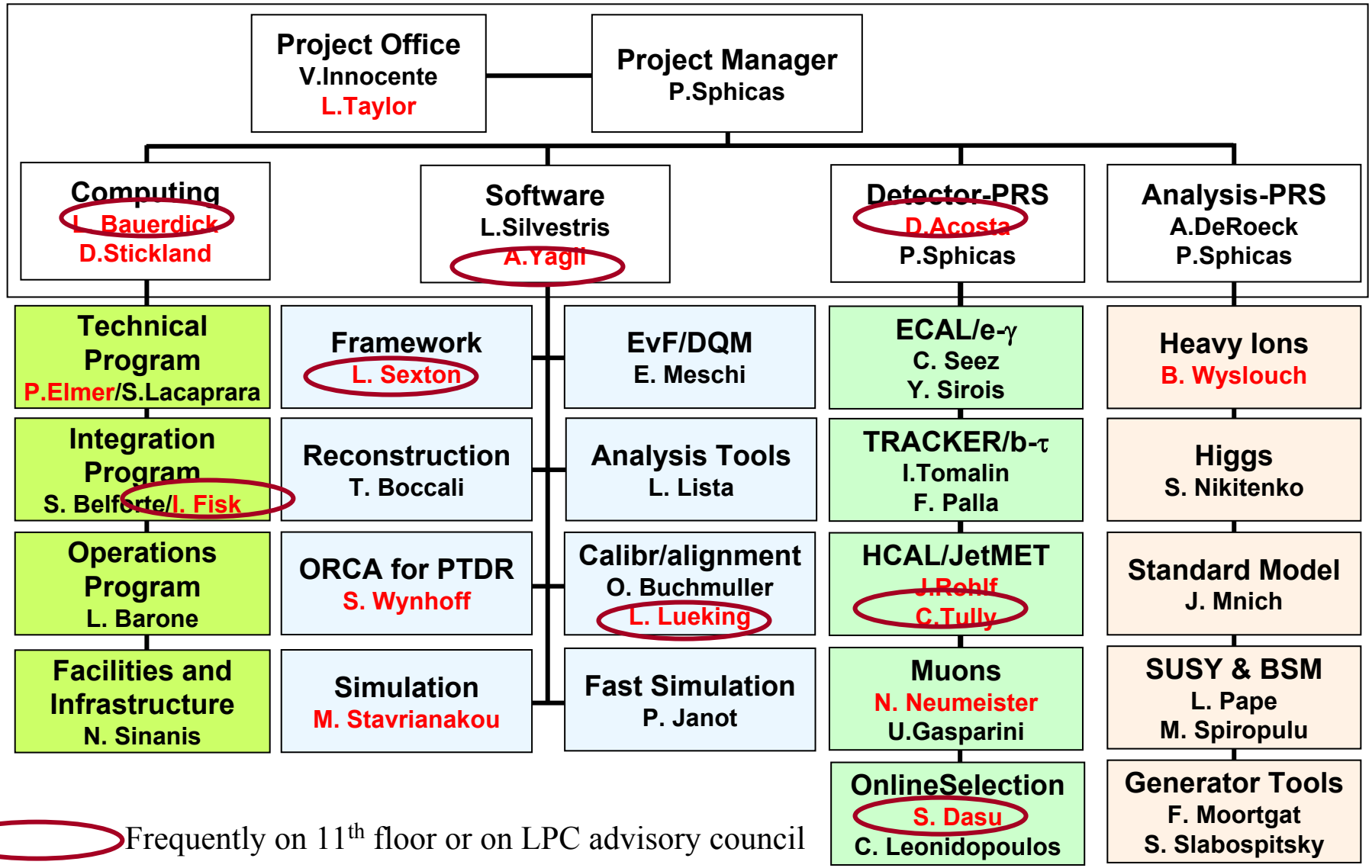
Past Year Highlights

Created Feb. 2004

Seven strong working groups!

- 11th floor layout planned and constructed, Web presence, Remote Operations Center work started
- weekly All USCMS meeting Fridays
- 4 well-attended sessions of CMS 101, 4 successful Tevatron/LHC workshops, 4 well-attended sessions of "software tutorials", tutorials on software tools
- a mini-workshop on LHC turn-on physics, a workshop to initiate LPC cosmic slice effort, hosted for international CMS "physics" week, a US CMS Meeting, a 2-week mini summer school
- French lessons
- Well-liked by funding agencies

Integration with International CMS



Frequently on 11th floor or on LPC advisory council

US University Involvement

Simulation: FNAL, FSU, Kansas State, Kansas, Louisiana Tech/Calumet, Maryland, Northwestern, Notre Dame, Rutgers, UIC, SUN… Ciemat, Tata

Jet/Met: FNAL, Rochester, MD, Rutgers, Boston, Cal Tec… r, Princeton, Texas Tech, Iowa, Mississippi, Minnesota, Santa… ern

Muon: FNAL, Carnegie Mellon, Florida, Florida Tech, Pu… Northwestern

e/gamma: FNAL, Northwestern, FSU, Minnesota, MD, B… an Diego, Cal Tech

Tracking: FNAL, Colorado, Cornell, Nebraska, UC Riverside, Wisconsin, Kansas State, Calumet

Trigger: Wisconsin, Florida, Northwestern, FNAL, Vanderbilt, Texas A&M, Brown, Maryland

Offline/edm: FNAL, Cornell

Physics: all

About 1/4 of the non-transient physicists on the 11th floor are University employees. All the (many) transients from Universities.

Plans for Coming Year

Commissioning of ROC

Planning for replacement for ROC (lhc@fnal)

“J-Term”

Physics group

Cosmic slice test

Full summer school

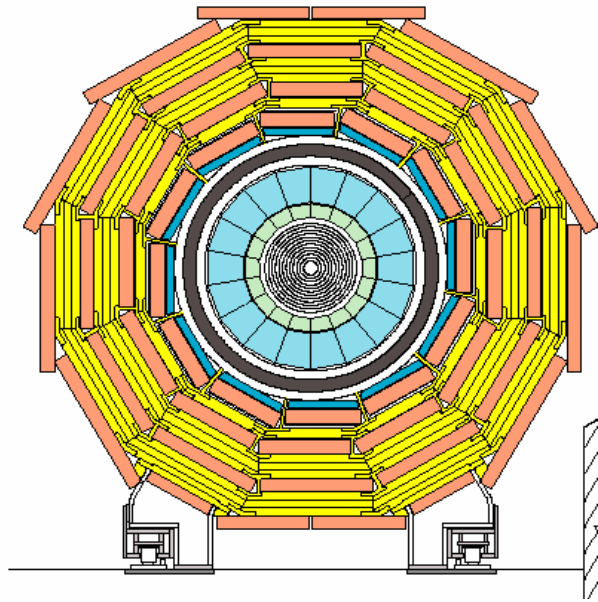
Increased interaction with FNAL theory division

ROC and Cosmic Test

- Data access
  - Being able to analyze the data efficiently is of a paramount importance: bring the data to LPC!
- Remote Operation Center: infra-structure for
  - Data taking monitoring (feedback to CERN)
  - Data transfer monitoring
- Data analysis
  - Setup the infrastructure for the data analysis at LPC
  - Reconstruction software, development and optimization of algorithms, calibration etc

Extremely Important for CMS and LPC

Cosmic Muon Challenge

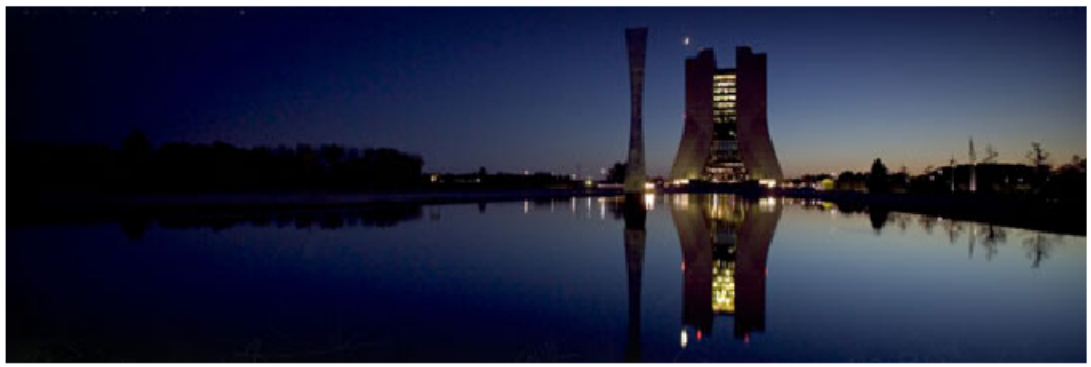


Summer School

http://projects.fnal.gov/hcpss/

News / Application / Program

Announcement:



CERN and Fermilab jointly present:

The Hadron Collider Physics Summer Schools

Introduction

For the past few years, experiments at the Fermilab Tevatron Collider have once again been exploring uncharted territory

August 9-19, 2006

LHC@FNAL

Erik Gottschalk – Chair (FNAL-PPD)
(slides from Erik)

1) A Place

- **That provides access to information in a manner that is similar to what is available in control rooms at CERN**
- **Where members of the LHC community can participate remotely in CMS and LHC activities**

2) A Communications Conduit

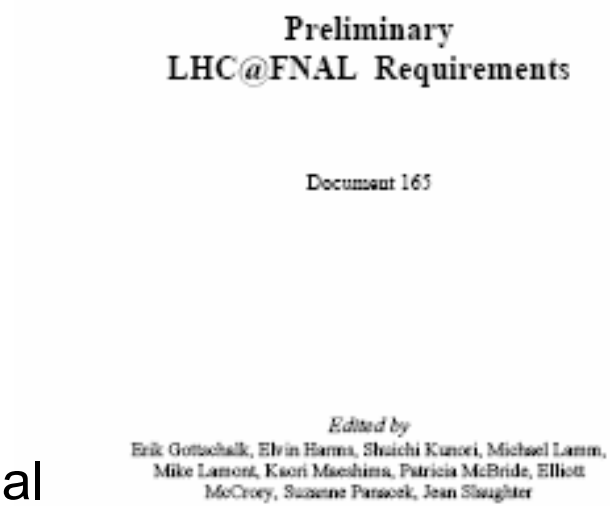
- **Between CERN and members of the LHC community located in North America**

3) An Outreach tool

- **Visitors will be able to see current LHC activities**
- **Visitors will be able to see how future international projects in particle physics can benefit from active participation in projects at remote locations.**

LHC@FNAL

- Requirements Document
  - Reviewed on July 21, 2005
  - Revisions made in response to recommendations from reviewers (see next slide)
- Document submitted to FNAL Director
  - July 29, 2005
- Meeting with Pier Oddone August 1st
  - Enthusiastic response
  - …"comprehensive document"
  - Discussed location for LHC@FNAL
- International CMS management in favor
- Funding to start in FY07. Perhaps operational by end of calendar '06


Preliminary
LHC@FNAL Requirements

Document 165

Edited by
Erik Gottschalk, Elvin Harms, Shuichi Kunori, Michael Lamm, Mike Lamont, Kaori Maeshima, Patricia McBride, Elliott McCrory, Suzanne Panacek, Jean Slaughter

LHC@FNAL

Slides from Erik Gottschalk

- **Status:**
- **We have started to work on the physical layout for LHC@FNAL, and are researching the tools needed for remote operations. This is needed for cost and schedule estimates.**
- **We are researching CERN computer and networking security issues.**
- **We have initiated a three-month trial of a commercial web collaboration tool (WebEx) that is being evaluated by several groups at Fermilab and may be used for the CMS Cosmic Challenge.**
- **In January of 2006 we will present our findings (requirements and resource loaded schedule) to the Fermilab Director.**

- **Our primary focus is on defining how an operations centre can be used to help members of the LHC community (in North America) contribute their expertise to LHC activities at CERN.**

Conclusions

- LHC is on schedule
- CMS is on schedule
- FNAL is playing a leading role in CMS

Backup Slides

Stage 1 – pilot run luminosities

Bailey, Sept CMS week

- No squeeze to start
- 43 bunches per beam (some displaced in one beam for LHCb)
- Around 10^{10} per bunch

Beam energy (TeV)	6.0, 6.5 or 7.0	6.0, 6.5 or 7.0	6.0, 6.5 or 7.0
Number of bunches per beam	43	43	156
β^* in IP 1, 2, 5, 8 (m)	18,10,18,10	2,10,2,10	2,10,2,10
Crossing Angle (μrad)	0	0	0
Transverse emittance (μm rad)	3.75	3.75	3.75
Bunch spacing (μs)	2.025	2.025	0.525
Bunch Intensity	$1\ 10^{10}$	$4\ 10^{10}$	$9\ 10^{10}$
Luminosity IP 1 & 5 ($cm^{-2}\ s^{-1}$)	$\sim 3\ 10^{28}$	$\sim 5\ 10^{30}$	$\sim 1\ 10^{32}$
Event rate / crossing IP 1 & 5	low	0.76	3.9

- Push one or all of
  - Partial optics squeeze in 1 and 5 (2m ???)
  - Increase bunch intensity

  - 156 bunches per beam (some displaced in one beam for LHCb)

Stage 2 – 75ns luminosities

- Partial squeeze and smaller crossing angle to start
- Luminosity tuning with many bunches
- Establish routine operation

Bailey, Sept CMS week

Beam energy (TeV)	6.0, 6.5 or 7.0	6.0, 6.5 or 7.0	6.0, 6.5 or 7.0
Number of bunches per beam	936	936	936
β^* in IP 1, 2, 5, 8 (m)	2,10,2,10	1,10,1,10	1,10,1,10
Crossing Angle (μrad)	250	285	285
Transverse emittance (μm rad)	3.75	3.75	3.75
Bunch Intensity	$4\ 10^{10}$	$4\ 10^{10}$	$9\ 10^{10}$
Luminosity IP 1 & 5 ($cm^{-2}\ s^{-1}$)	$\sim 1\ 10^{32}$	$\sim 2\ 10^{32}$	$\sim 1\ 10^{33}$
Event rate / crossing IP 1 & 5	0.73	1.37	6.9

- Push squeeze (1m ???) and crossing angle
- Increase bunch intensity if the experiments can stand it ?
- Tune IP2 and IP8 to meet experimental needs
  - Down in IP8 (1m ???)
  - Up in IP2 (50m ??? Then transverse beam displacement probably needed)

Stage 3 & 4 – 25ns luminosities

Bailey, Sept CMS week

- Production physics running
- Below e cloud threshold

Beam energy (TeV)	6.0, 6.5 or 7.0	6.0, 6.5 or 7.0	7.0
Number of bunches per beam	2808	2808	2808
β* in IP 1, 2, 5, 8 (m)	1,10,1,10	1,10,1,10	0.55,10,0.55,10
Crossing Angle (μrad)	285	285	285
Transverse emittance (μm rad)	3.75	3.75	3.75
Bunch Intensity	$3\ 10^{10}$	$5\ 10^{10}$	$1.15\ 10^{11}$
Luminosity IP 1 & 5 ($cm^{-2}\ s^{-1}$)	$\sim 4\ 10^{32}$	$\sim 1\ 10^{33}$	10^{34}
Event rate / crossing IP 1 & 5	0.77	2.1	19.2

- Scrubbing run (1-2 weeks)
- Increase bunch intensities to dump limit
  - Install beam dump kickers
  - Install phase II collimators

Long shutdown (6months)

- Increase bunch intensities towards nominal
- Tune IP2 and IP8 to meet experimental needs
  - Transverse beam displacement certainly needed in IP2

Detector Status

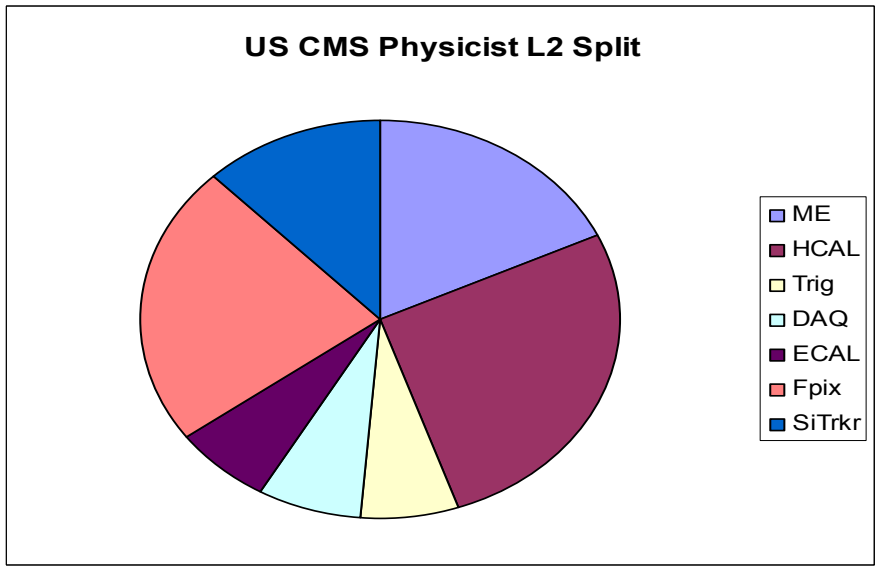
Della Negra, Sept CMS week

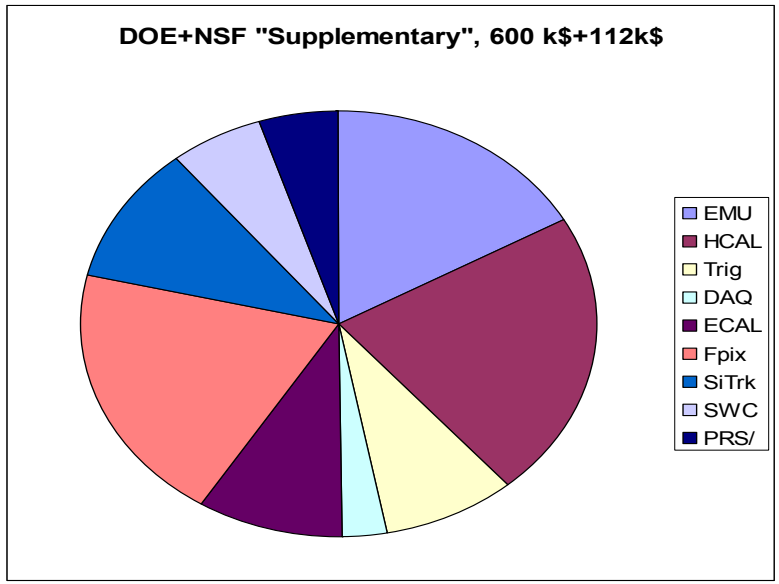
Crystals: CERN, on behalf of CMS, has placed the new contracts for all of the remaining crystals. Old Scionix and ISTC contracts are terminating with a one-month delay.
ACTION on CMS Management: Funds need to be found by October to pay remaining bills for ECAL data links and to order the LV power supplies for first half of EB.

Tracker Integration Facility (TIF) in Bat 186: (test complete Tracker in 25% sections)
During the last CMS Week it was decided to stage one DAQ slice in order to finance the TIF. The Clean room has been ordered through UK RAL with funding backed by the US. The Facility should start being used towards the end of October (see next report by P. Sharp).

Pixel scenario
Desirable configuration at start up: 3 barrel layers + 2 forward disks (3+2). Barrel funding ~ OK. Forward funding: Management in US has been strengthened, new collaborators have joined. More funds are needed. Scrubbing of FPIX project is ongoing, aim to baseline in October.

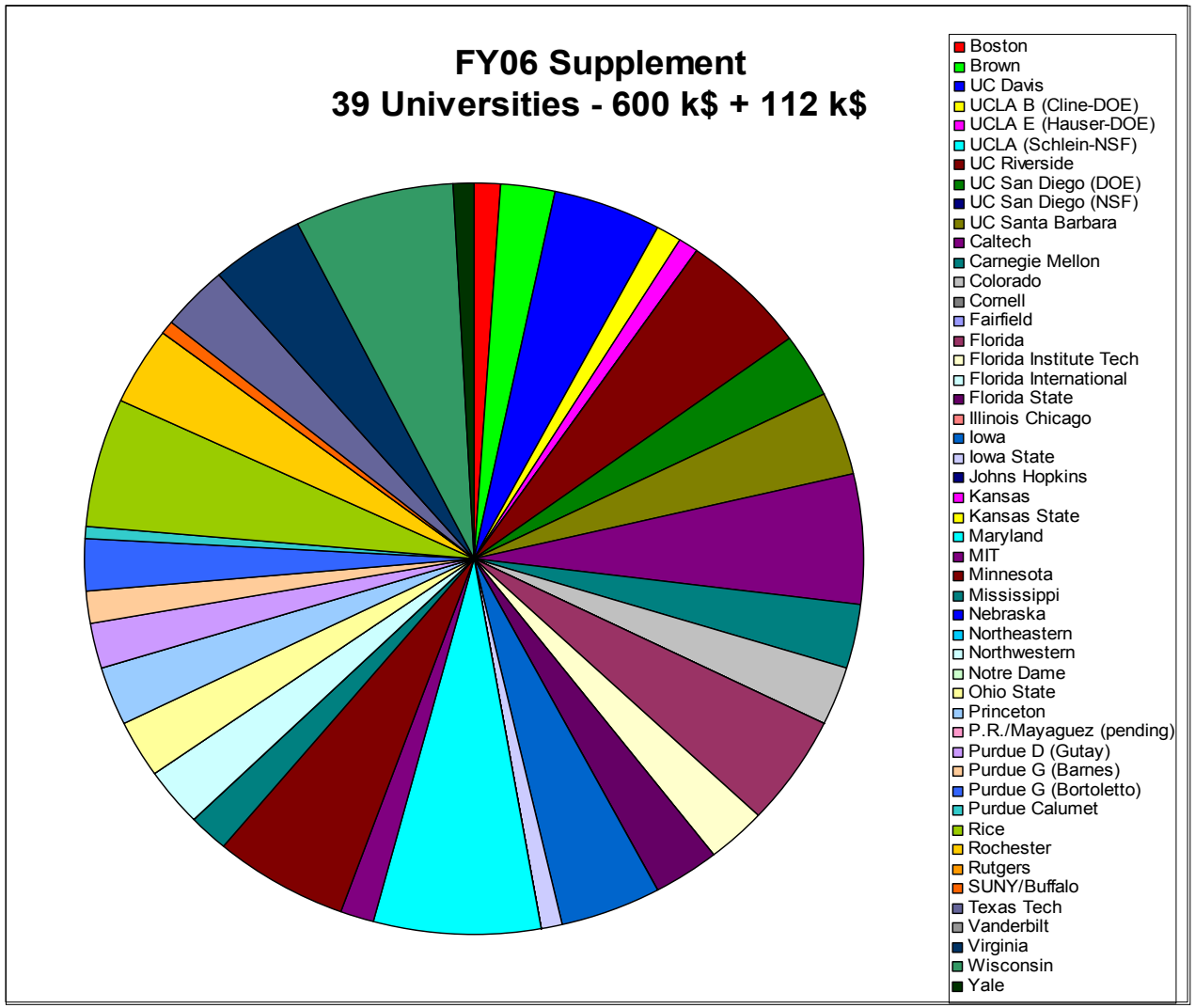
The FY06 “Core” Request





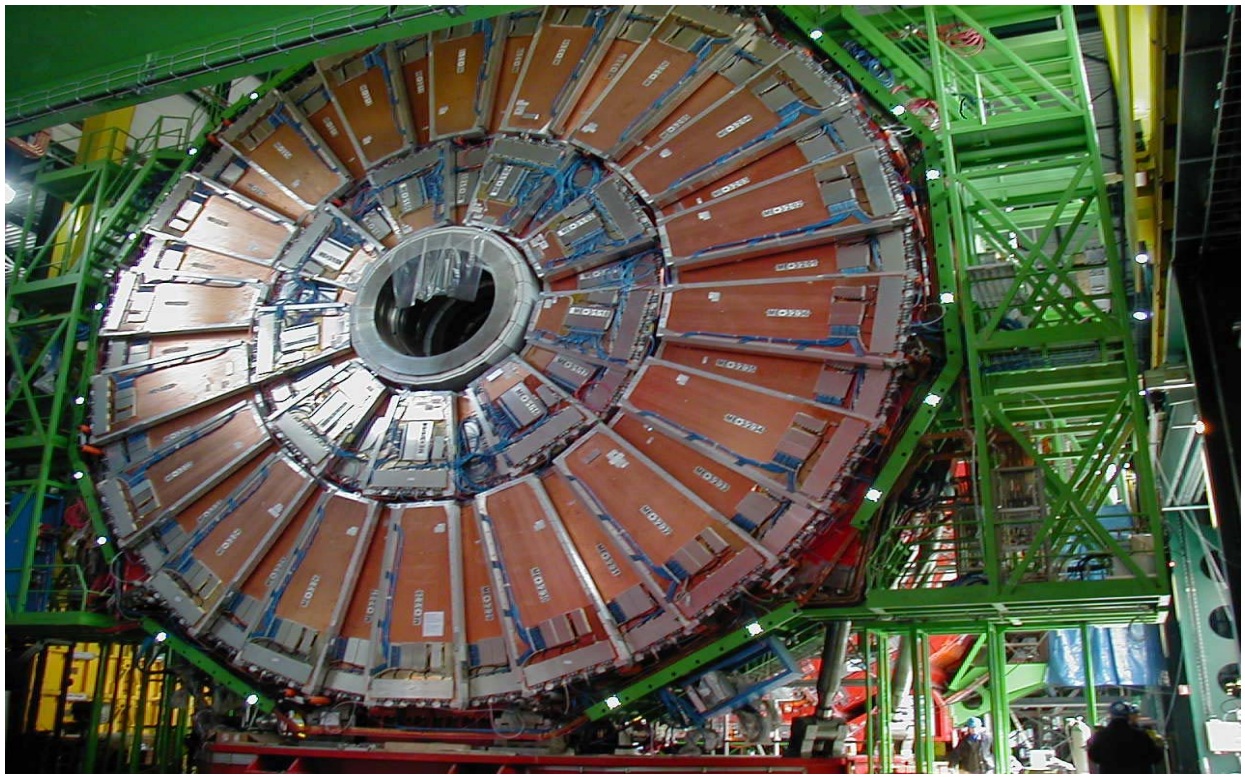
Tracking – Si + FPIX has been an area of strong growth in US CMS and that is reflected in the “bottoms up” process of defining the requests and the priorities. Special thanks to PK and DOE for increasing the support to US CMS.

DOE+NSF Request for FY06



The "bottoms up" process leads to a broad set of travel requests.

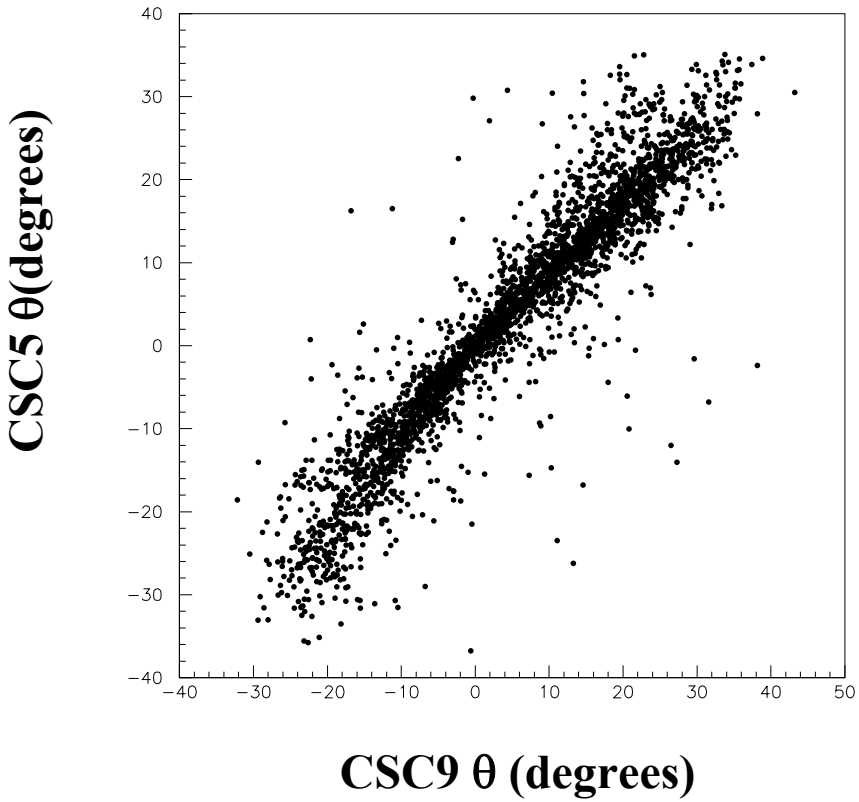
ME - CSC



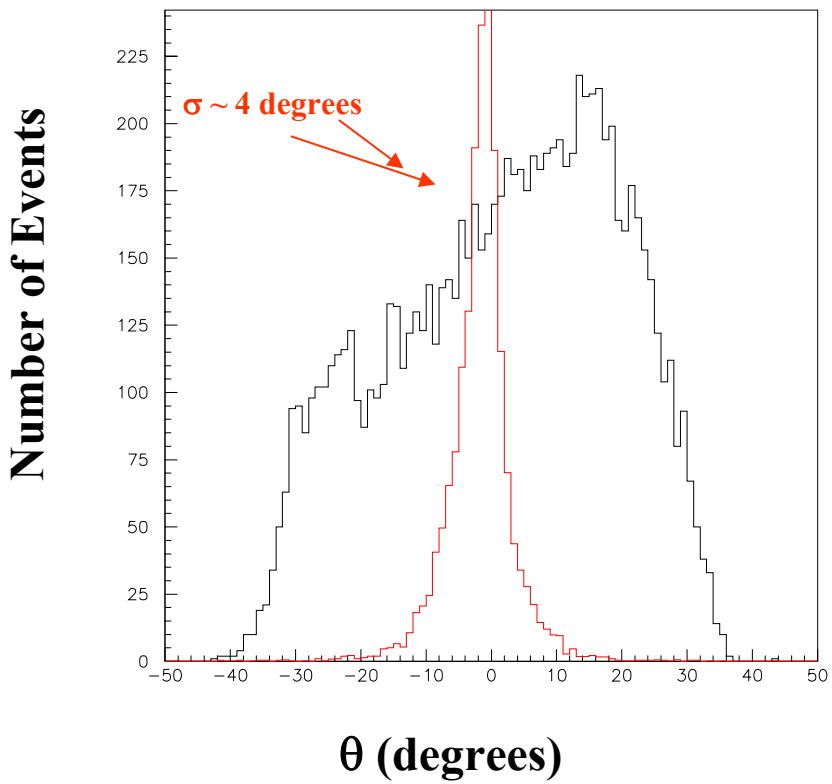
- 70 % installed
- Services hooked up
- Single CSC commissioning
- Multiple chamber layer triggers begun

Self-Trigger on ME2*ME3

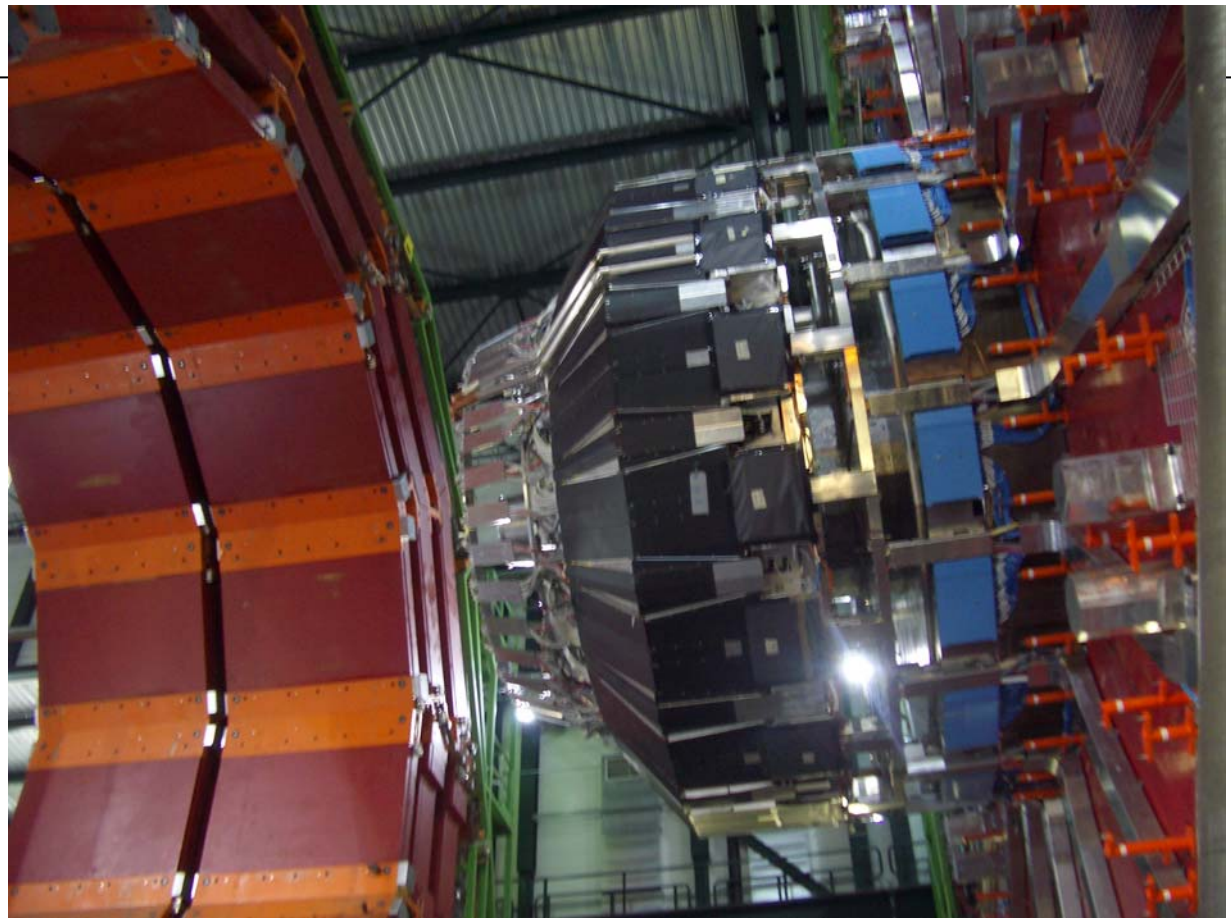
Cathode Strip Angle Matching



Black Curve – CSC5 θ
Red Curve – (CSC5 θ minus CSC9 θ)



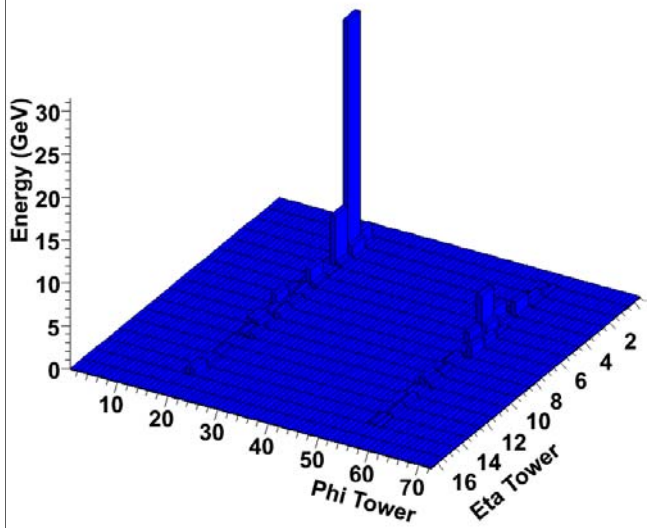
HCAL Status - HE

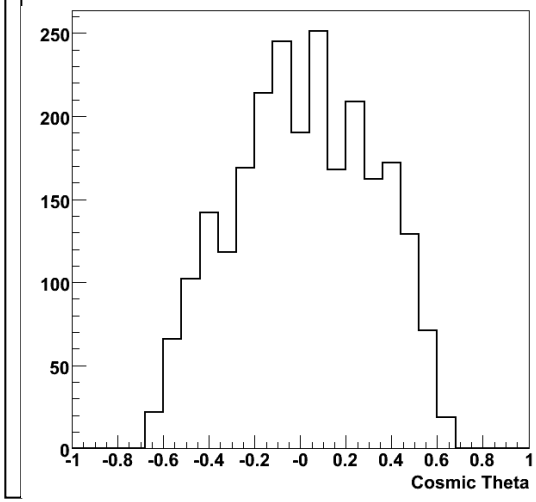


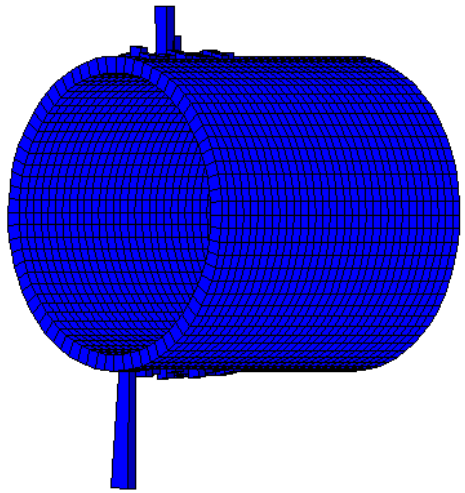
HE- nose, all RBXes installed, July 5, 2005.

Cables and services installed. LEDs and PEDs taken. Start source calibration.

HB – Self-Trigger

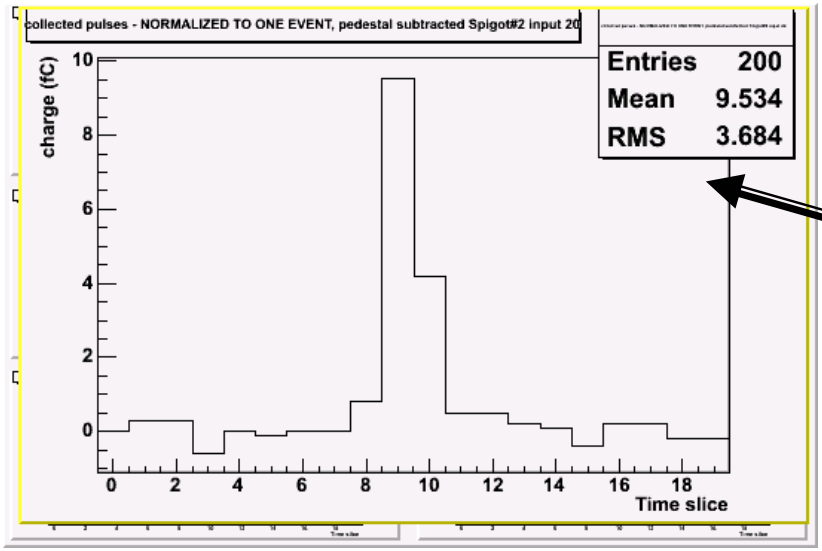






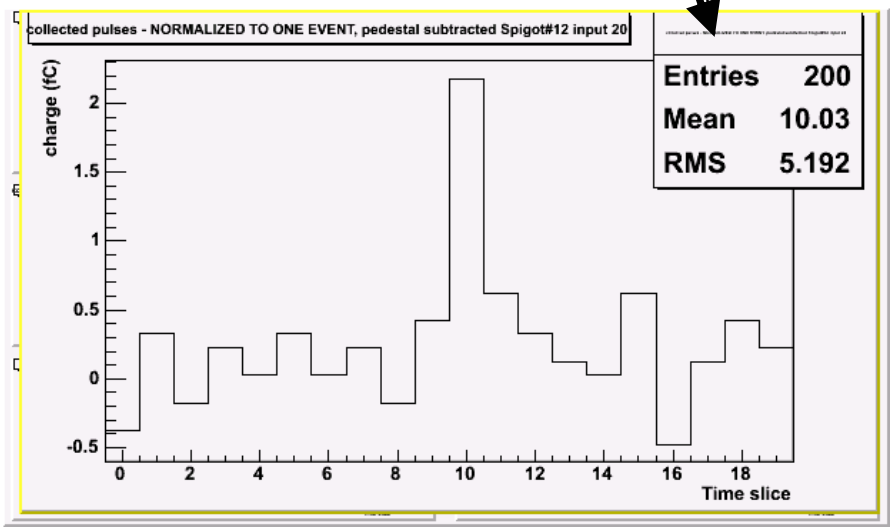
Use HCAL trigger primitives and "kludge" up the portable trigger.

Cosmic Rays in SX5 – Up/Down



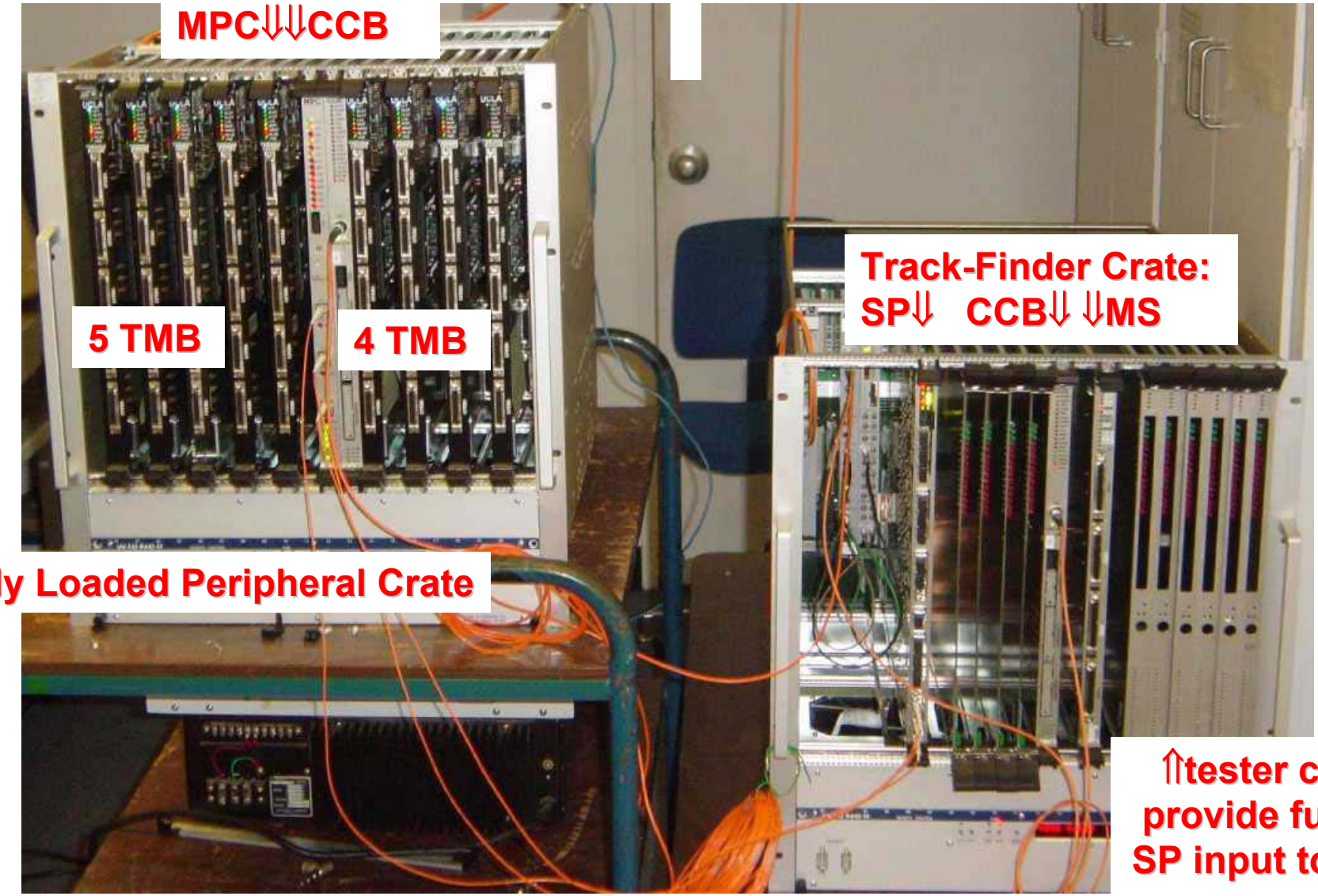
Timing of signals from upper wedges:
<t>= 9.5 time slices

Timing of signals from lower wedges:
<t>= 10.0 time slices = 12.5 nsec



Use LHC 40 MHz clock and synch up all cal towers – laser timing.

CSC Trigger Full Chain Test



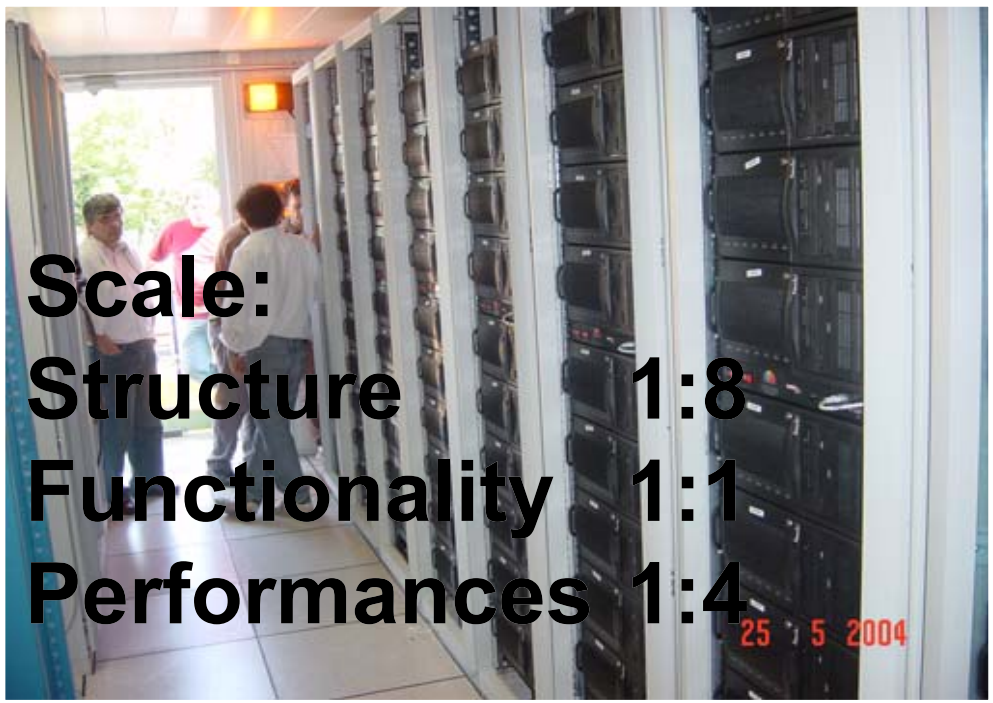
HCAL-SLB-RCT Integration in EIC

•Sent synchronous jet data from HCAL HTR Cards thru 6 SLB over 10m copper 4Gb/s Vitesse Links to 6 Regional Calorimeter Trigger Receiver Mezzanine cards, thru Receiver Cards, Backplane and Jet Summary Card to Jet Capture Card recording output of 256 crossings.

DAQ 2005-06:SX5 Pre-series

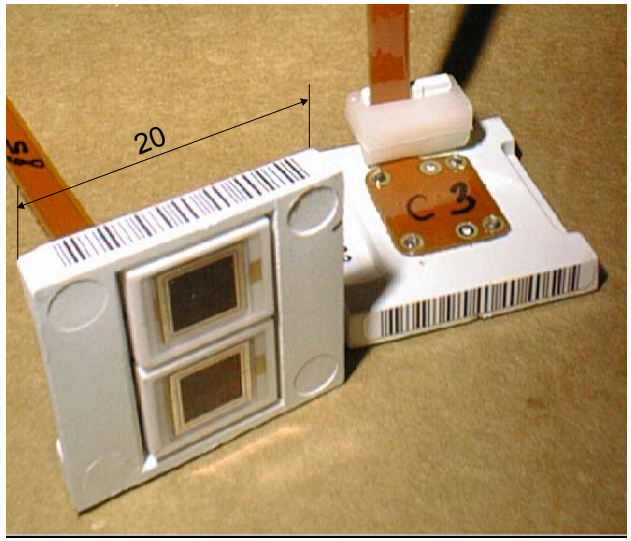
1:16

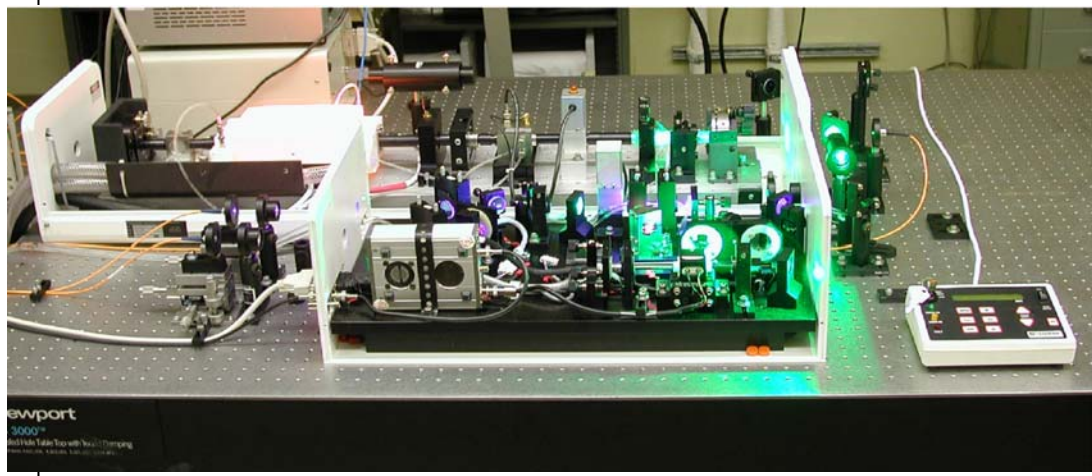
CMS DAQ factorizes – 1/8 of final DAQ installed in SX5. Logging data now from cosmic rays into various systems – called the "slice tests". Will evolve into full system tests with magnet being powered in 2006 and ~ all CMS subsystems being read out – called the "cosmic challenge".



ECAL - Status of US Responsibilities.

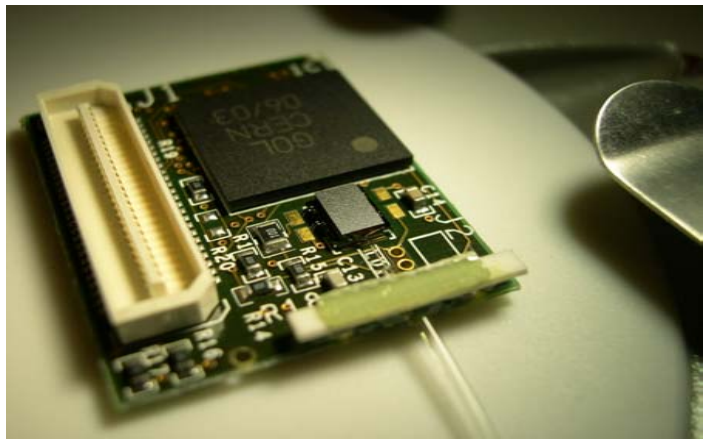
- Avalanche photodiodes
  - Delivery is complete.
  - All testing complete.
  - Sorted and mounted into capsules.
  - Will return ^{252}Cf source to ORNL by end 2005.
- Lasers for the monitor system:
  - Three lasers have been installed and are operational at CERN.
  - Personnel for system maintenance have been trained.
  - Engineering staff are available on an as-needed basis.

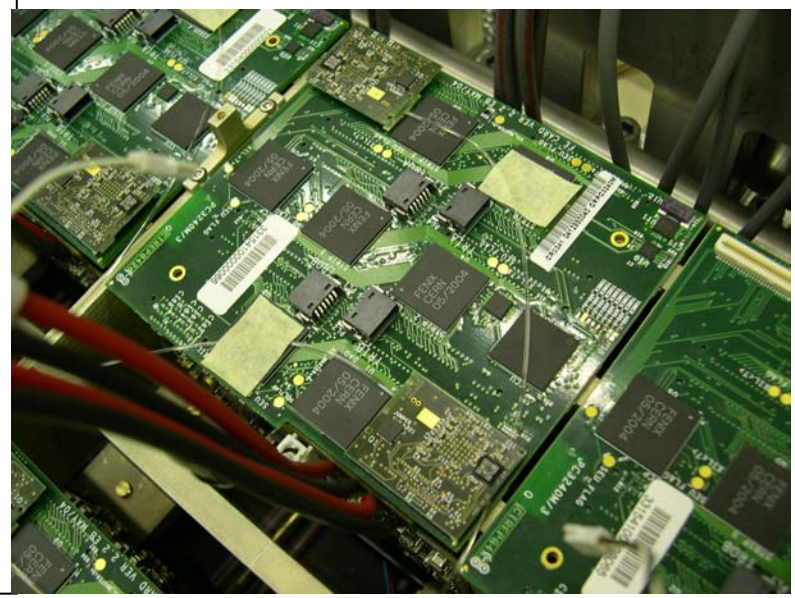




Status of US Responsibilities.

- Trigger - Data links:
  - Production of GOH board is now 2000 per month. Final delivery expected ~Feb 2006.
  - Special multi-ribbon cables for the end-cap calorimeter under tender.
  - All other components delivered -except trunk cables.
- Clock and Control:
  - Production of boards started.
  - Expect completion ~ Nov 2005.

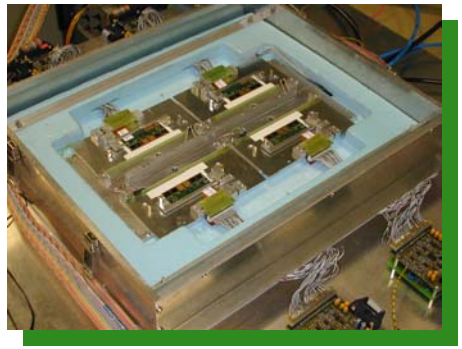




SiTrkr - US Production Cycle

Quick test hybrids on ARC

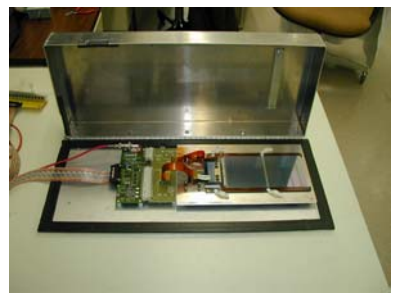
Wire bond



Thermal cycle hybrids

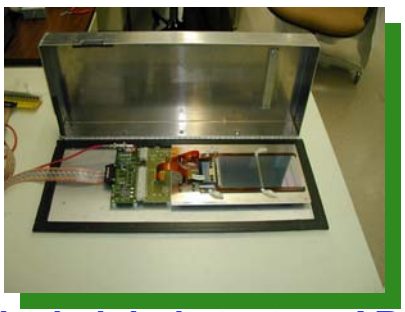
Gantry makes modules.

Wire bond



Modules test on ARC

Thermal cycled module



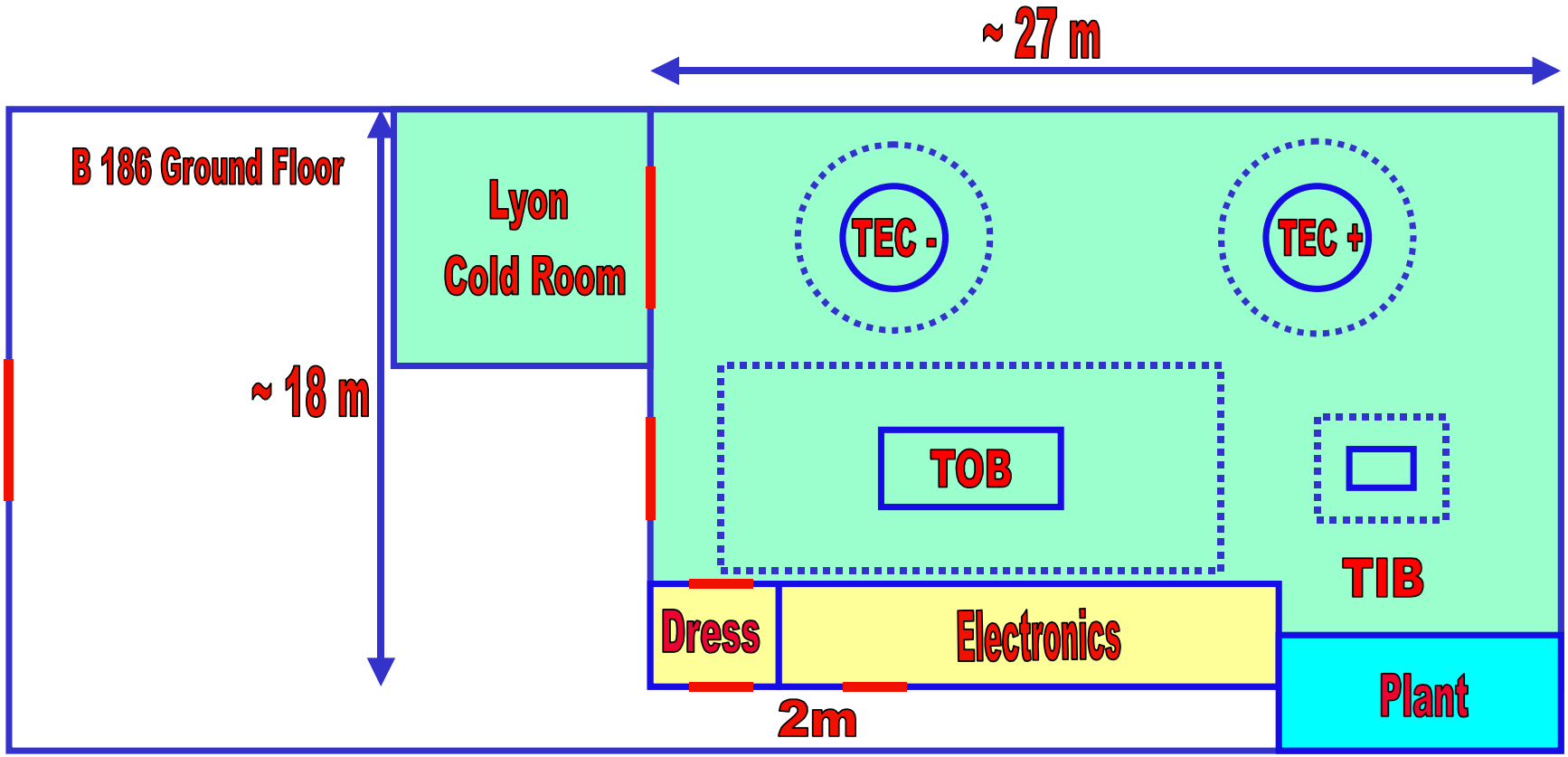
Final pinhole test on ARC

Assemble rods from modules

Rod burn-in

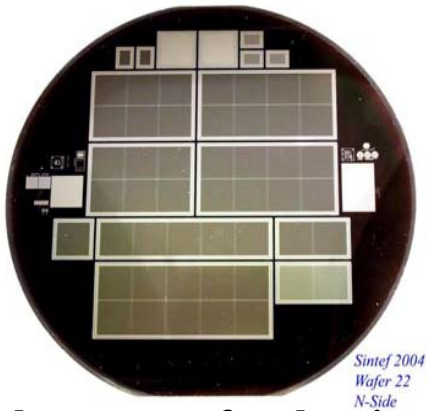
Rods shipped to CERN

Tracker Integration Center

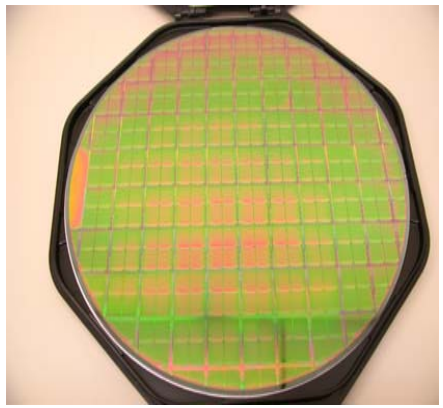


A new clean room will allow all subsystems to be integrated in acommon clean and secure area. DAQ equipment for operating up to 25% of the entire tracker will be installed. Teams from all communities will begin working together and sharing experience. US CMS will send elements of the CDF Run II team to co-lead the effort.

FPIX - Detection Elements

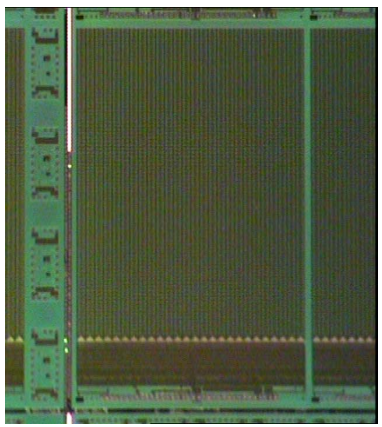


Pixel sensor wafer showing various sizes needed to form "panels"



Wafer of pixel readout chips

FPIX to be re-baselined in Oct. in CMS EDR and in FNAL PMG. Team augmented by new groups from BTeV – now lead by B. Gobbi and J. Butler

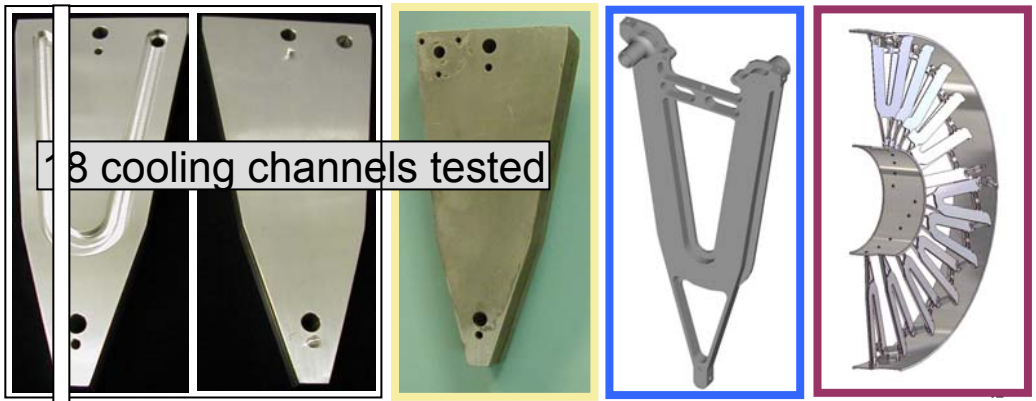


Pixel readout chip: 4160 pixels 100 x 150 μ^2

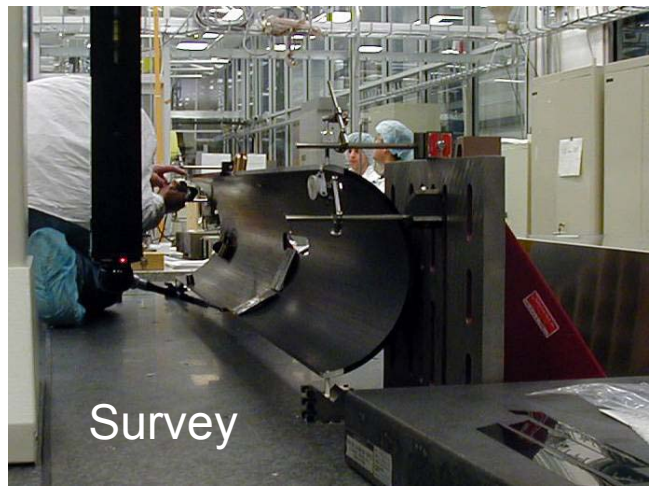
Bump bonded detectors received from vendors

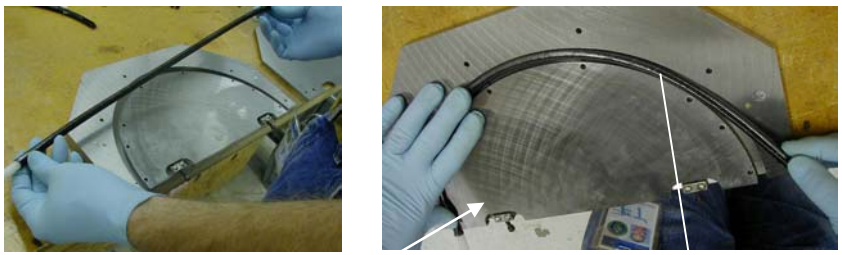
FPIX Mechanics

Mechanical Support Structures



"Cooling channel" Assembly:
Brazed Al Parts





Service Cylinder

Prototype meets specifications