CMS Commissioning

Darin Acosta

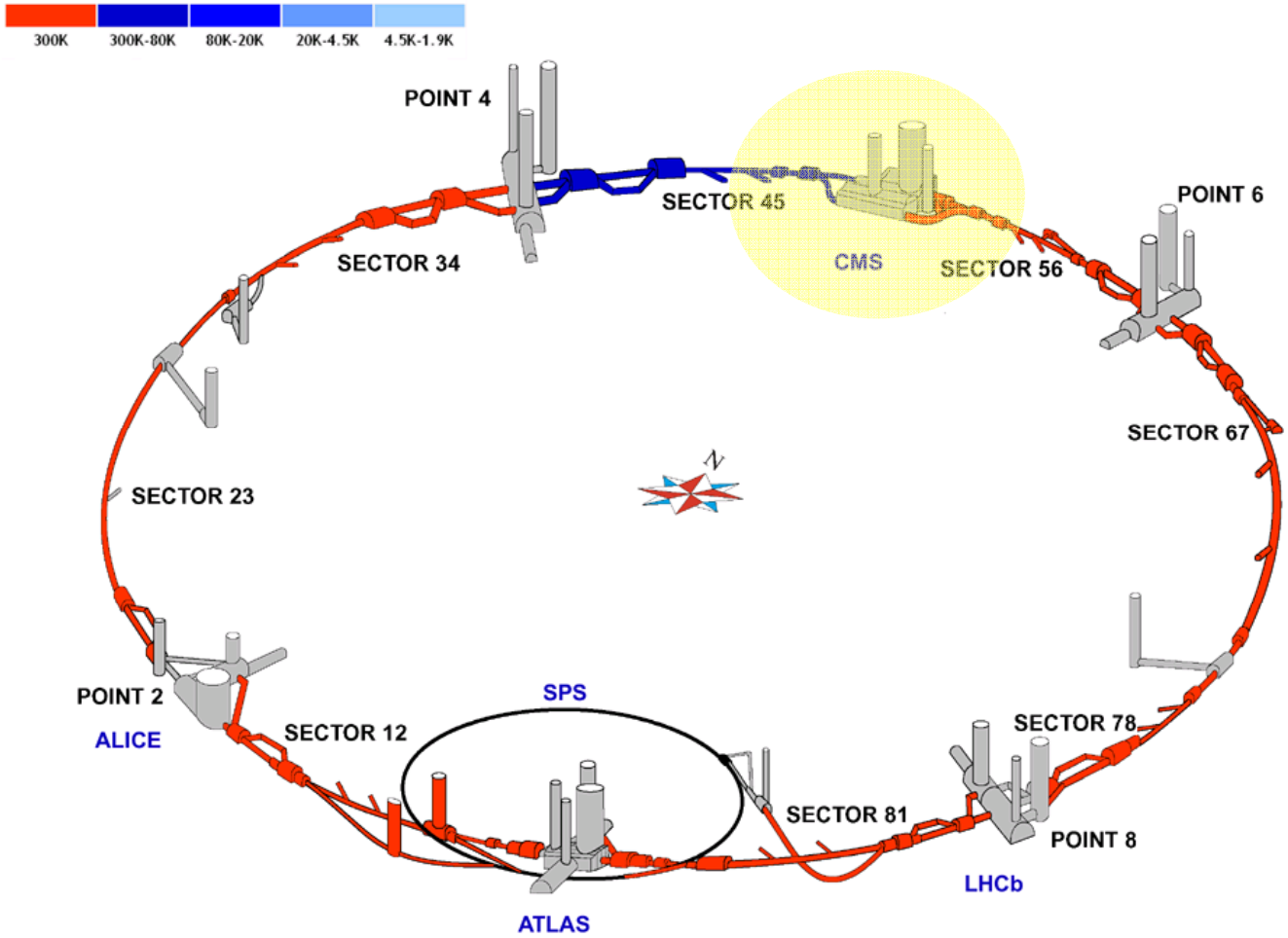
University of Florida

Outline

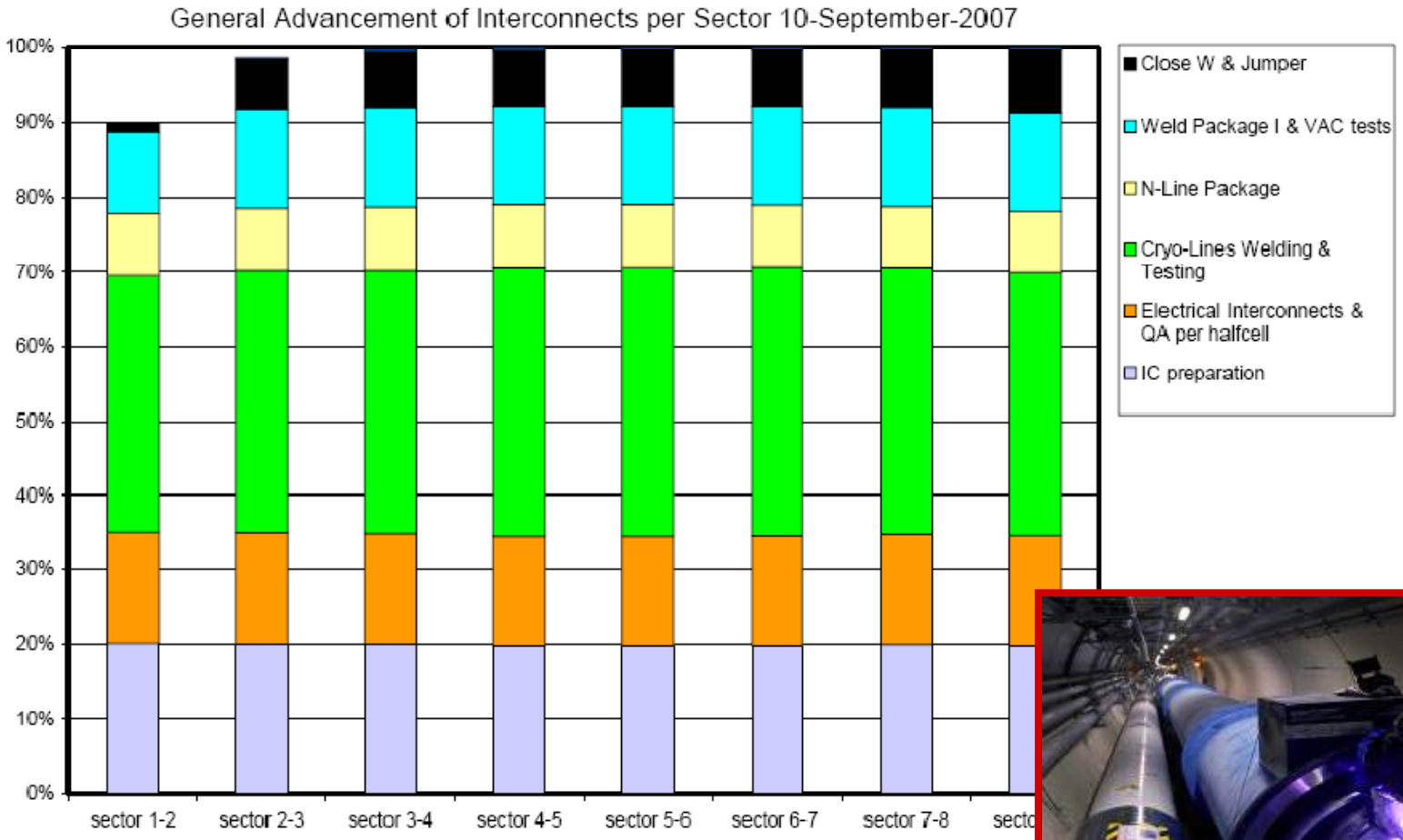
- Status of the LHC
- Brief Overview of CMS
- Status of CMS Installation
- Commissioning Exercises
- Commissioning Plans

The Large Hadron Collider

- 7 TeV on 7 TeV proton-proton collider, 27km ring
- 1232 superconducting 8.4T dipole magnets @ T=1.9ºK
  - ~8K total magnets & components

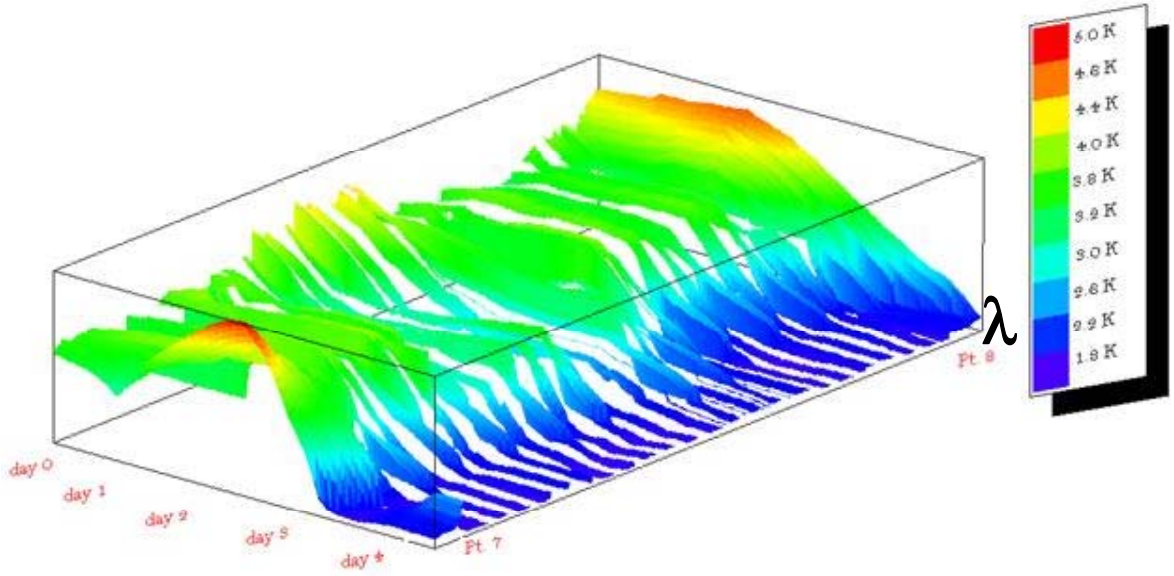


LHC Magnet Interconnections



First LHC Cooldown: Sector 7-8

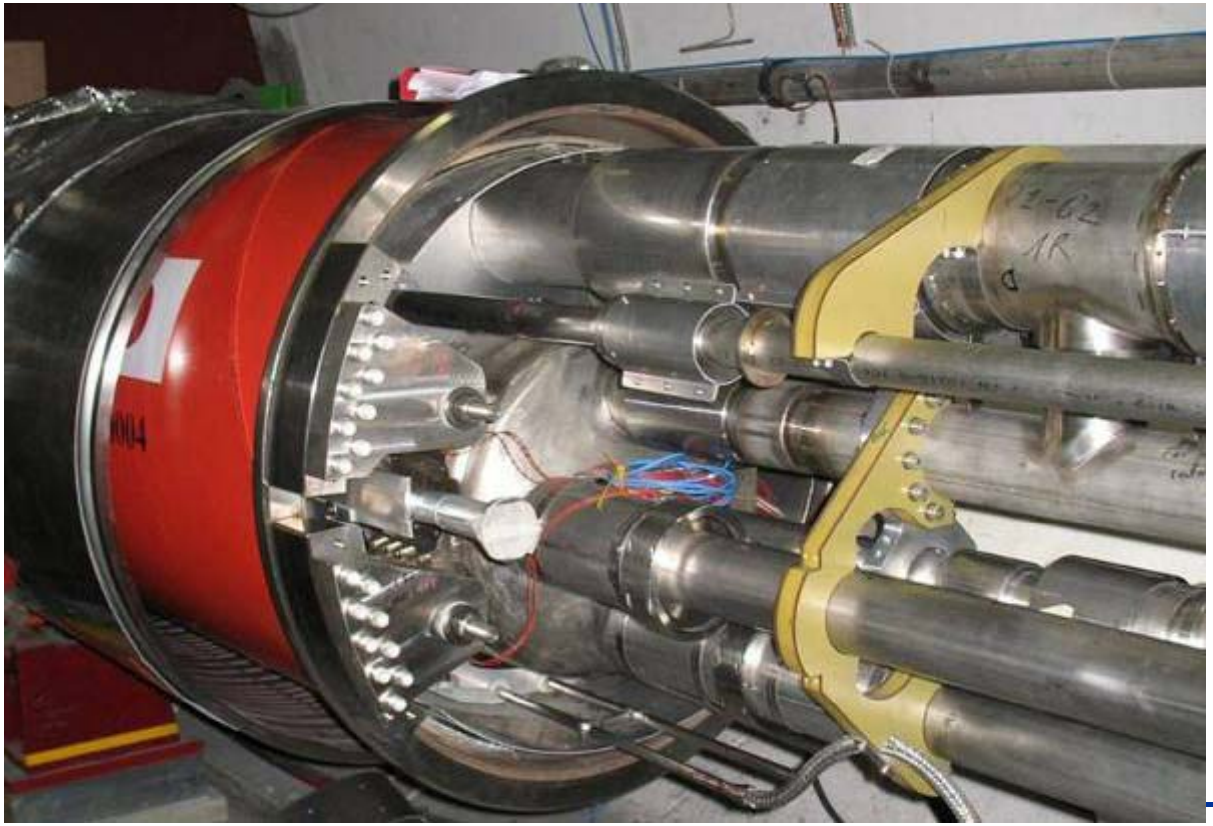
Magnet temperature profile along Sector 7-8 during final cool down to He II



- From RT to 80K pre-cooling with LN2. 1200 tons of LN2 (64 trucks of 20 tons). **Three weeks** for the first sector.
- From 80K to 4.2K. Cool-down with refrigerator. **Three weeks** for the first sector. 4700 tons of material to be cooled.
- From 4.2K to 1.9K. Cold compressors at 15 mbar. **Four days** for the first sector.
- First sector cooled down to nominal temperature and operated with superfluid helium; teething problems with cold compressor operation have now been fixed.

Repair of the Triplets (focusing quadrupoles)

- All inner triplet assembly repairs are complete!
- Three of eight triplets have been installed and successfully pressure tested in the tunnel



A Q1 magnet assembly with cartridges held in place by the four earlike brackets bolted to the outer flange

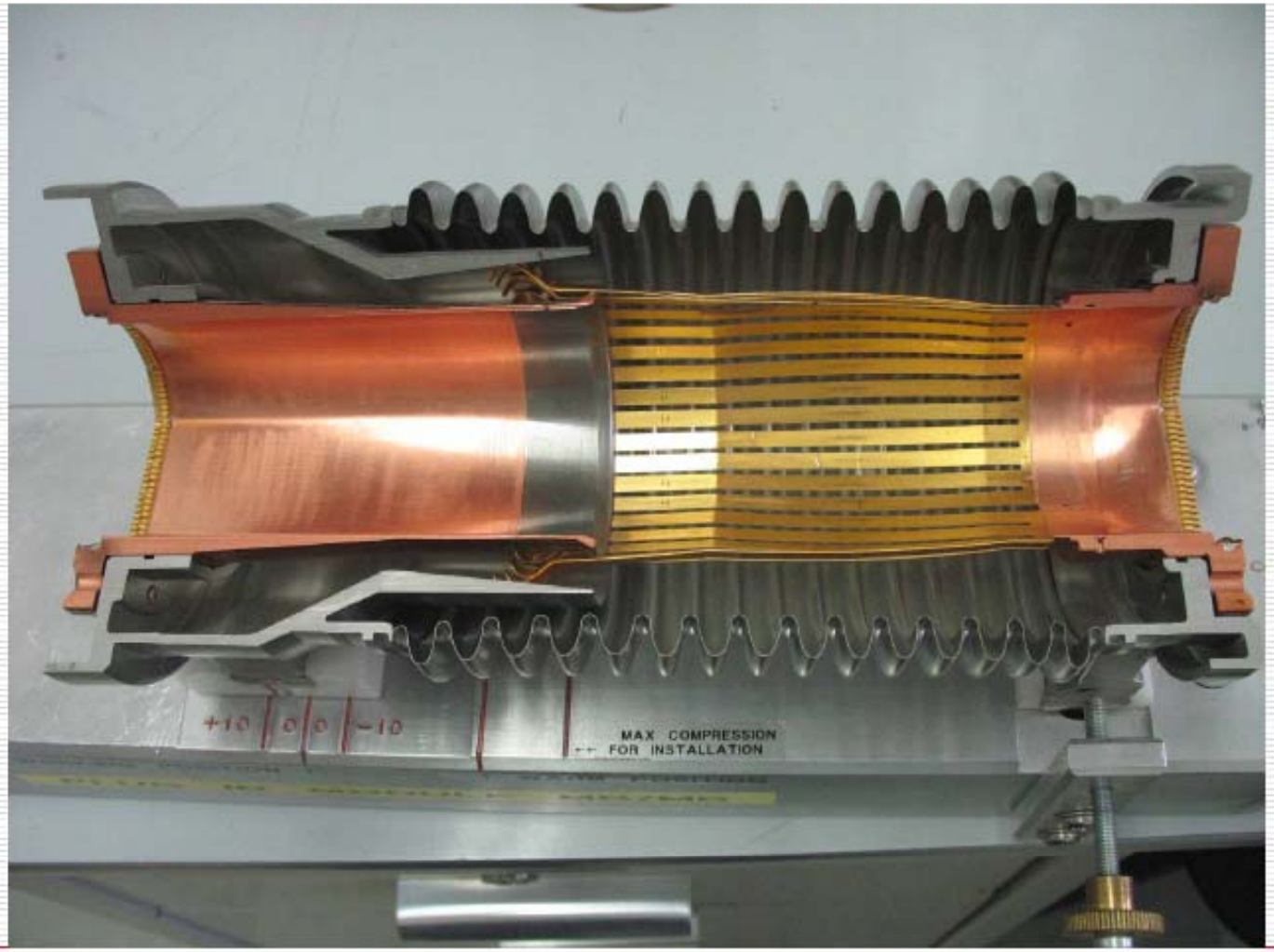
Situation in Sectors

As of Sept.27: **http://hcc.web.cern.ch/hcc/**

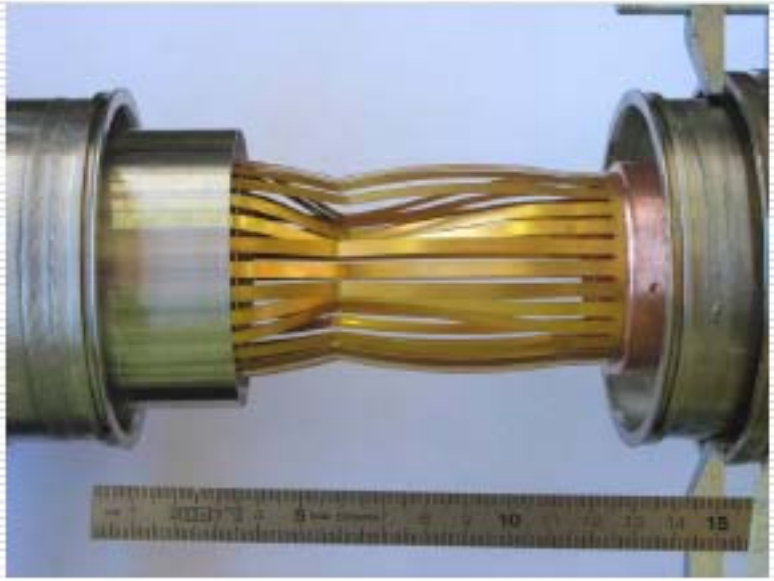
- Arc 1-2 and 2-3: interconnection on-going, closure in Sept.
- Arc 3-4: closed, leak tests of individual sub-sectors in progress
- Arc 4-5: cooled at 80K
  - The ElQA team completed the electrical qualification of the circuits of the Sector45 at 80K: no defects encountered.
  - Leaks appeared at 4R and 5L, now fixed ➔ 3 weeks delay
  - Cool-down started for part that was at room temp. (Oct. update)
- Arc 5-6 and 6-7: closed, leak tests of individual sub-sectors on-going
- Arc 7-8: cooled down, partial power tests (no low-β), now warmed-up
  - The closure of the sector has started this week and will last five weeks. Leak tests before flushing will start on Oct.1
  - In total 7 plug-in modules (out of 450) in the arc are damaged and they are now being replaced →
- Arc 8-1: closed and pressure tested, flushing starts next week
  - One leak localised in cold mass of Q17.R8. The replacement of the leaking short straight section will start on Oct.1

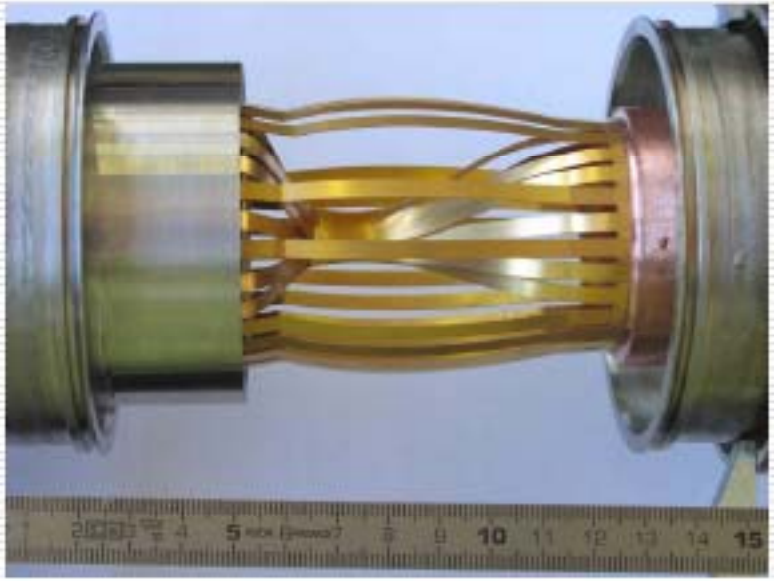
Plug-In Modules

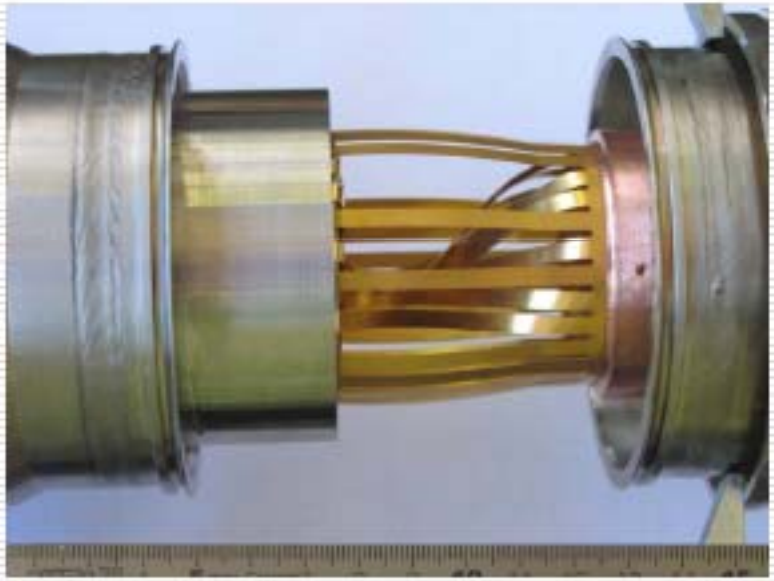
An MM plug-in in equivalent cold position



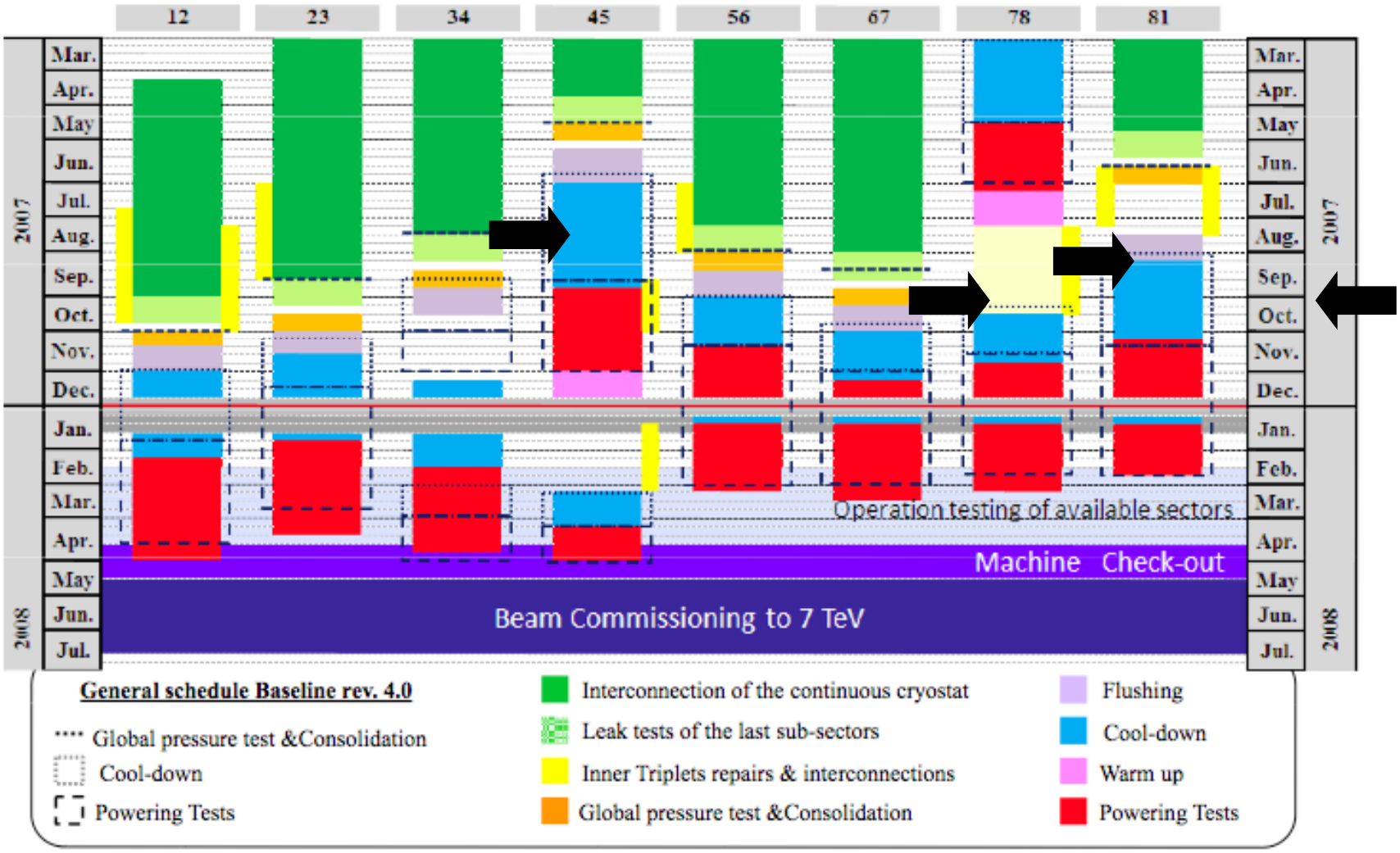
Damaged Plug-In Modules







General Schedule up to date – 03 August 2007



Expectations of Luminosity Buildup

Parameter	Phase A	Phase B	Phase C	Nominal
k / no. bunches	43-156	936	2808	2808
Bunch spacing (ns)	2021-566	75	25	25
N (10^{11} protons)	0.4-0.9	0.4-0.9	0.5	1.15
Crossing angle (μrad)	0	250	280	280
$\sqrt{(\beta^*/\beta^*_{nom})}$	2	$\sqrt{2}$	1	1
σ^* (μm, IR1&5)	32	22	16	16
L ($cm^{-2}s^{-1}$)	6×10^{30}-10^{32}	10^{32}-10^{33}	$(1-2)\times10^{33}$	10^{34}

J. Wenninger

Stage A physics run

$$L = \frac{N^2 k_b f \gamma}{4\pi\varepsilon_n \beta^*} F$$

$$Eventrate / Cross = \frac{L\sigma_{TOT}}{k_b f}$$

- Start as simple as possible
- Change 1 parameter (k_b N $\beta^*_{1,5}$) at a time
- All values for
  - nominal emittance
  - 7TeV
  - 10m β^* in point 2 (luminosity looks fine)

Protons/beam ≲ 10^{13}
(LEP beam currents)

Stored energy/beam ≲ 10MJ
(SPS fixed target beam)

Parameters			Beam levels		Rates in 1 and 5		Rates in 2	
k_b	N	β^* 1,5 (m)	I_{beam} proton	E_{beam} (MJ)	Luminosity ($cm^{-2}s^{-1}$)	Events/ crossing	Luminosity ($cm^{-2}s^{-1}$)	Events/ crossing
1	1010	11	$1\ 10^{10}$	10^{-2}	$1.6\ 10^{27}$	<< 1	$1.8\ 10^{27}$	<< 1
43	1010	11	$4.3\ 10^{11}$	0.5	$7.0\ 10^{28}$	<< 1	$7.7\ 10^{28}$	<< 1
43	$4\ 10^{10}$	11	$1.7\ 10^{12}$	2	$1.1\ 10^{30}$	<< 1	$1.2\ 10^{30}$	0.15
43	$4\ 10^{10}$	2	$1.7\ 10^{12}$	2	$6.1\ 10^{30}$	0.76	$1.2\ 10^{30}$	0.15
156	$4\ 10^{10}$	2	$6.2\ 10^{12}$	7	$2.2\ 10^{31}$	0.76	$4.4\ 10^{30}$	0.15
156	$9\ 10^{10}$	2	$1.4\ 10^{13}$	16	$1.1\ 10^{32}$	3.9	$2.2\ 10^{31}$	0.77

Stage B physics run

$$L = \frac{N^2 k_b f \gamma}{4\pi\varepsilon_n \beta^*} F$$

$$F = 1/\sqrt{1+\left(\frac{\theta_c \sigma_z}{2\sigma^*}\right)^2}$$

$$Eventrate/Cross = \frac{L\sigma_{TOT}}{k_b f}$$

- Relaxed crossing angle (250 μrad)
- Start un-squeezed
- Then go to where we were in stage A
- All values for
  - nominal emittance
  - 7TeV
  - 10m β* in points 2 and 8 (will not be like this)

Protons/beam ≈ few 10^{13}

Stored energy/beam ≤ 100MJ

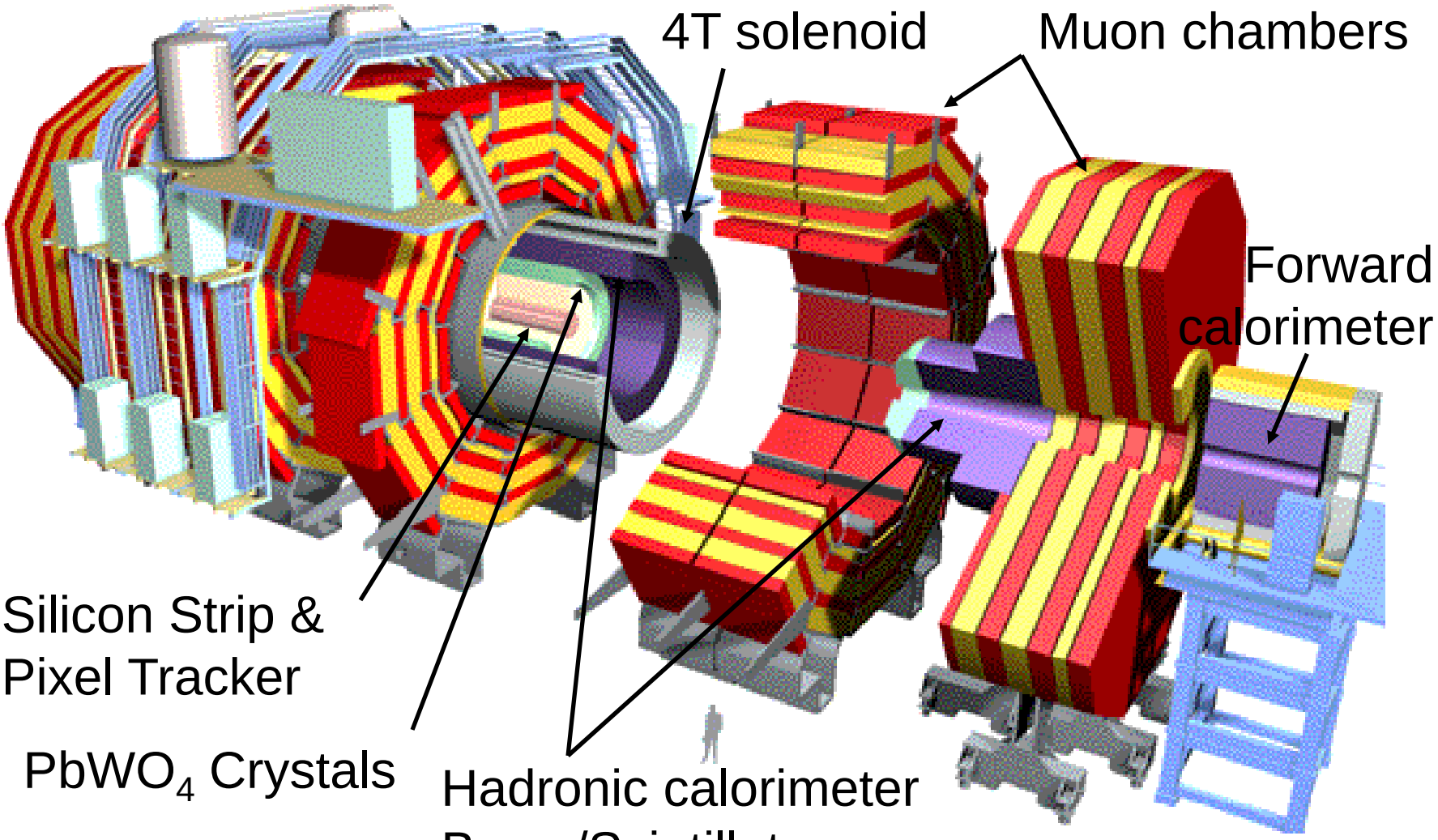
Parameters			Beam levels		Rates in 1 and 5		Rates in 2 and 8	
k_b	N	β* 1,5 (m)	I_{beam} proton	E_{beam} (MJ)	Luminosity ($cm^{-2}s^{-1}$)	Events/ crossing	Luminosity ($cm^{-2}s^{-1}$)	Events/ crossing
936	$4\ 10^{10}$	11	$3.7\ 10^{13}$	42	$2.4\ 10^{31}$	<< 1	$2.6\ 10^{31}$	0.15
936	$4\ 10^{10}$	2	$3.7\ 10^{13}$	42	$1.3\ 10^{32}$	0.73	$2.6\ 10^{31}$	0.15
936	$6\ 10^{10}$	2	$5.6\ 10^{13}$	63	$2.9\ 10^{32}$	1.6	$6.0\ 10^{31}$	0.34
936	$9\ 10^{10}$	1	$8.4\ 10^{13}$	94	$1.2\ 10^{33}$	7	$1.3\ 10^{32}$	0.76

Summary of LHC Status

- All magnets installed
- Interconnections nearly complete
- All LHC triplet repairs complete, pressure test passed
- A few damaged “plug-in modules” observed after warming up sector 7-8
  - No delays to LHC schedule anticipated by CERN mgmt. due to this
- Experiments to be ready for beam with beampipe baked out by April ’08
  - First beam injection scheduled for May 21, ’08
- LHC commissioning to collisions, ~30 days
- First collisions summer 2008

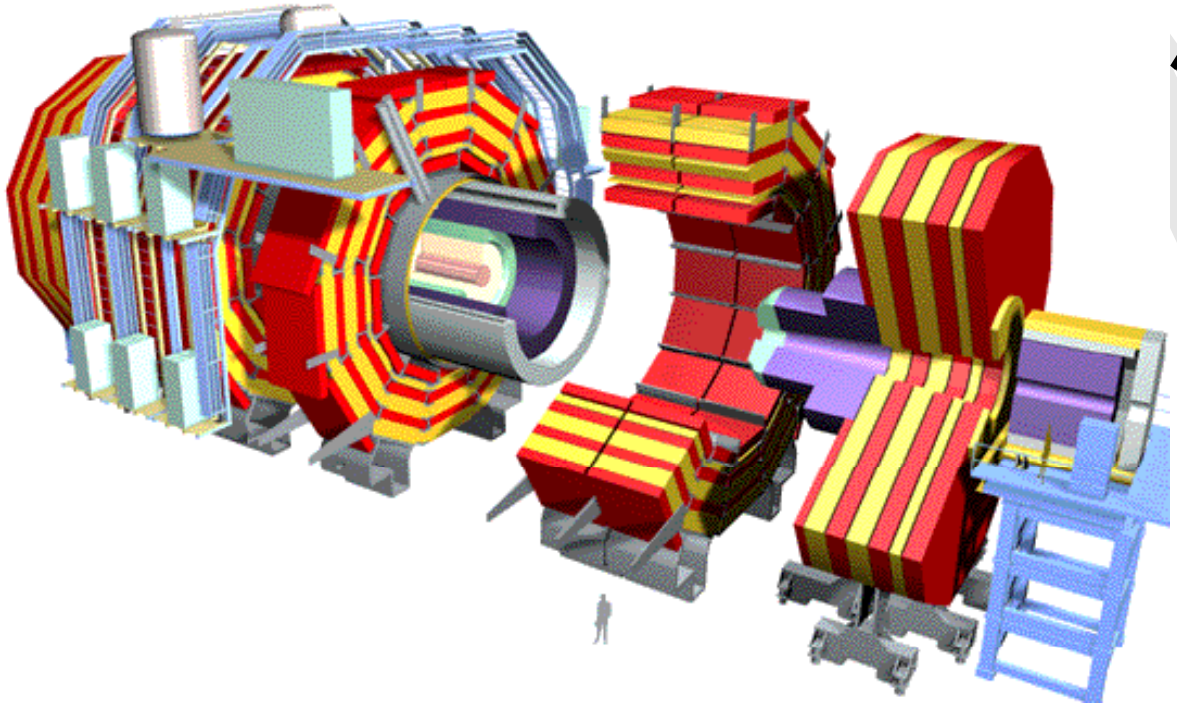
  - CERN D.G. has scheduled Oct.21, 2008 for the LHC Inauguration celebration

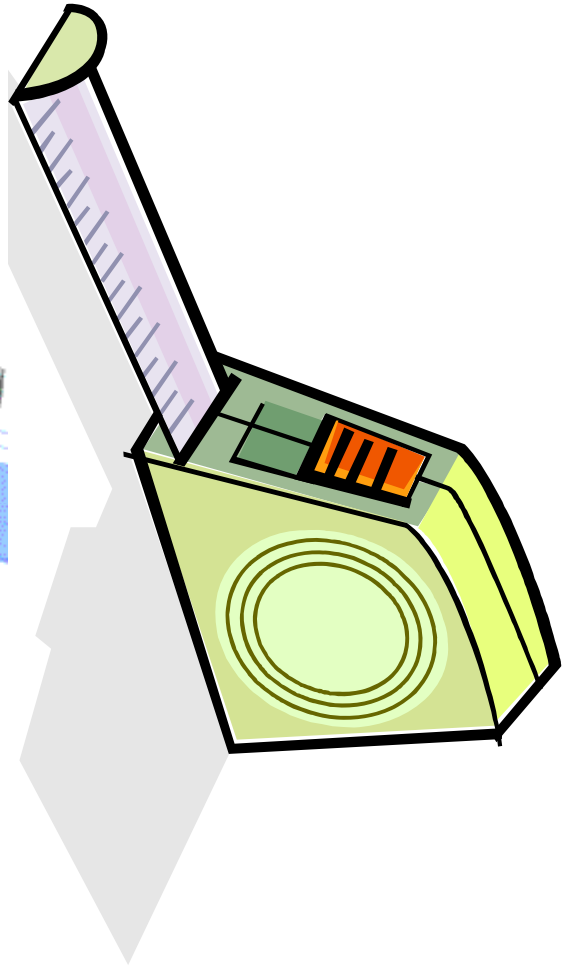
The Compact Muon Solenoid Experiment



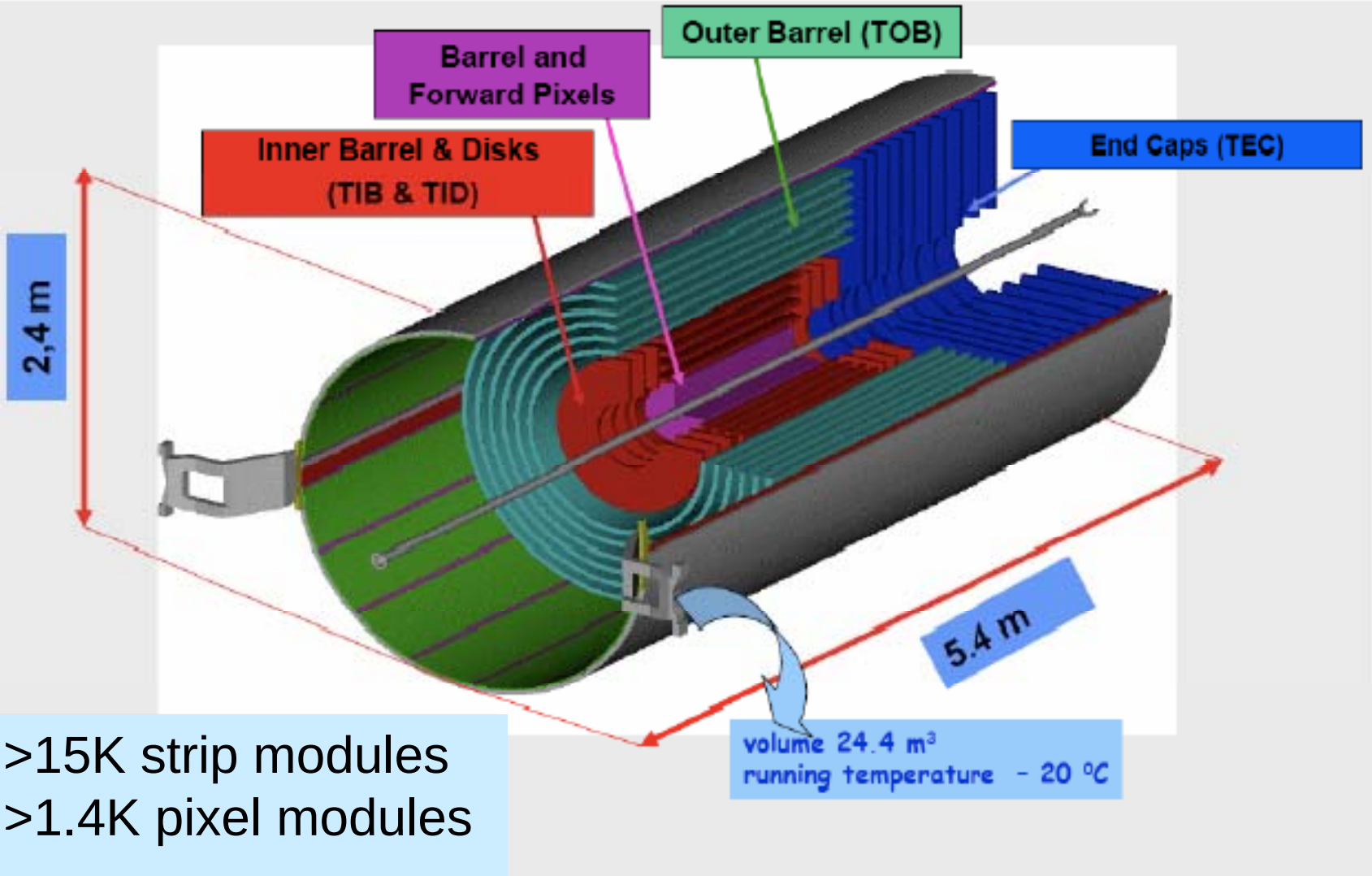
The Scale of CMS

(The height of the commissioning mountain to climb…)



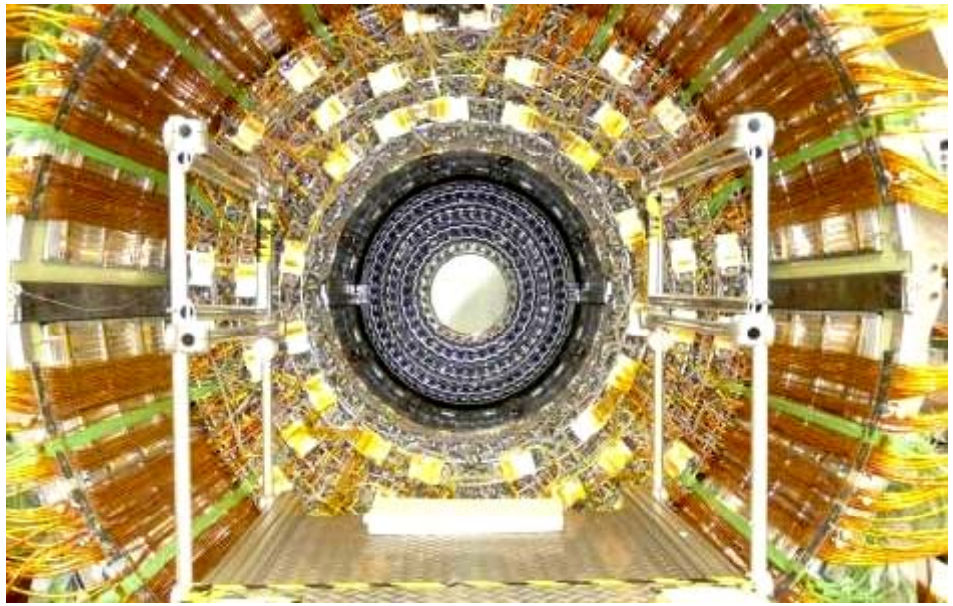


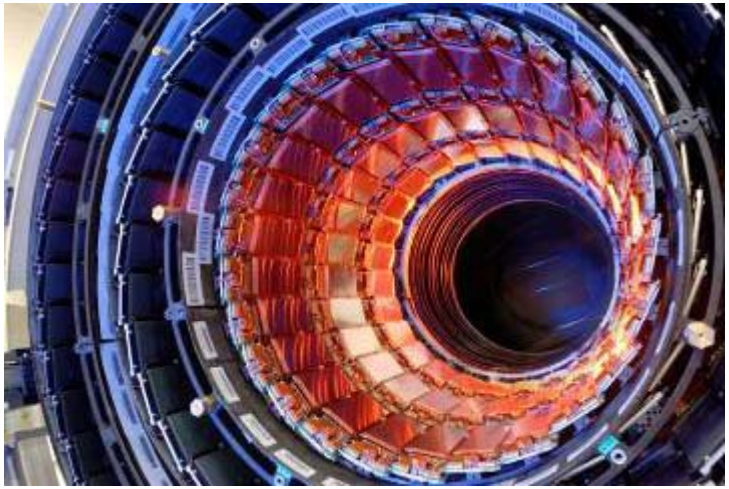
The CMS All-Silicon Tracker



>15K strip modules
>1.4K pixel modules

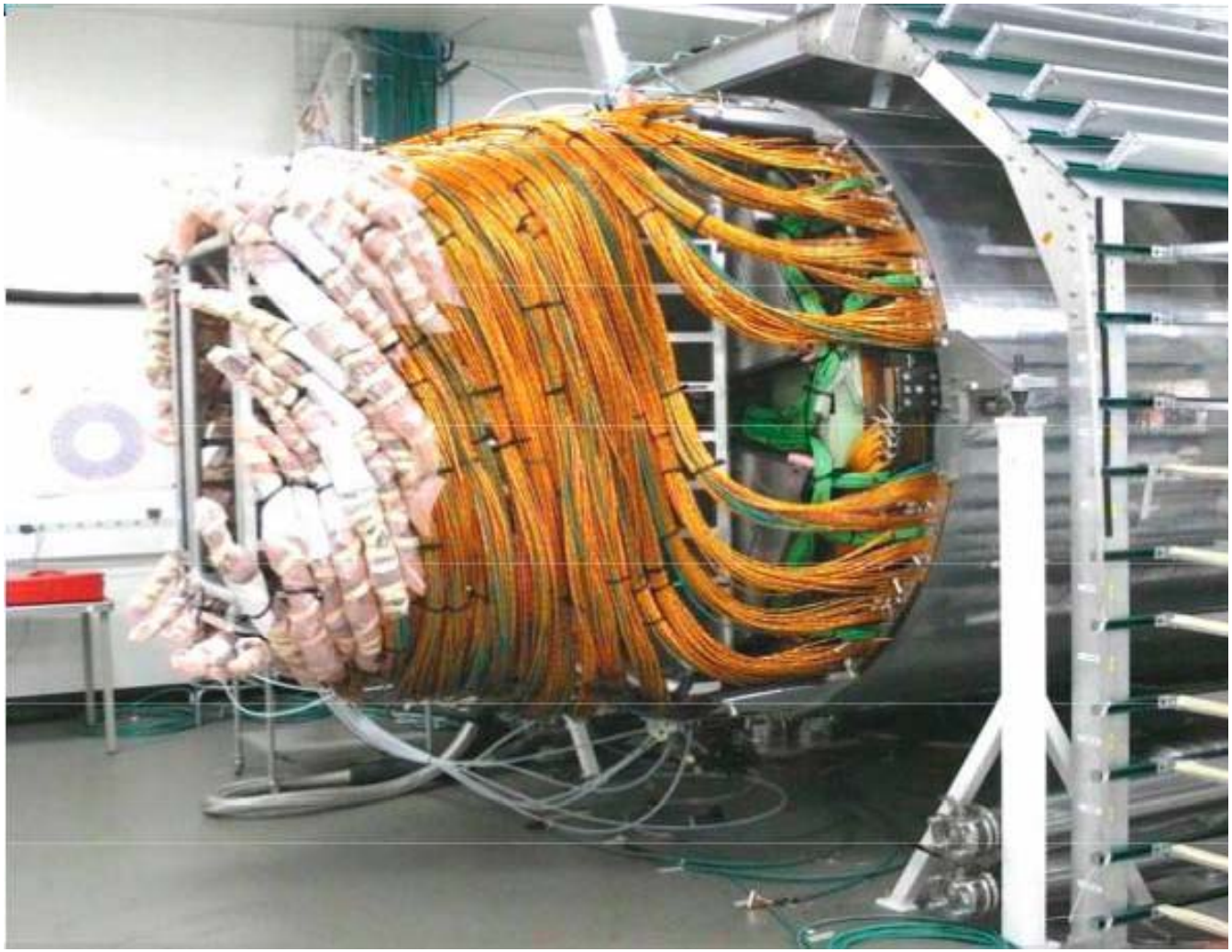
CMS Silicon Tracker





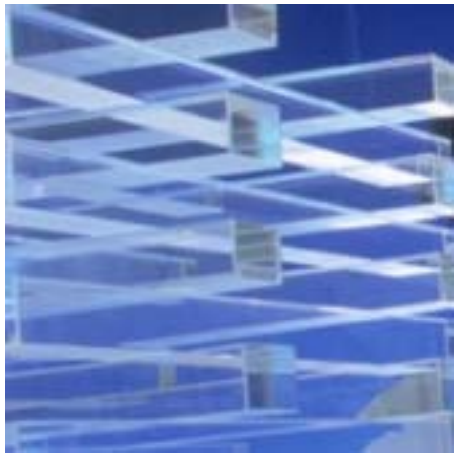
- Strip Tracker, complete
  - 200 m^2 coverage
  - 10μm precision measurements
  - 11M electronic channels
    - For comparison, CDF inner vertex detector < 1M
- Inner Pixel tracking system
  - FWD pixel complete, barrel: Jan.'08
  - 66M channels!

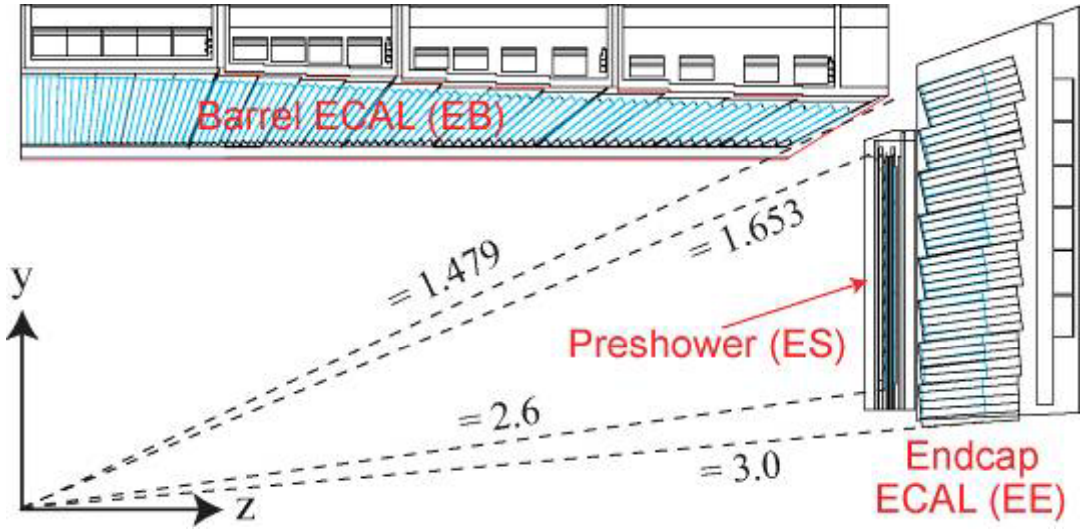
Strip Tracker is Ready for Installation



- After a very successful commissioning campaign (more later)

CMS Crystal Calorimeter



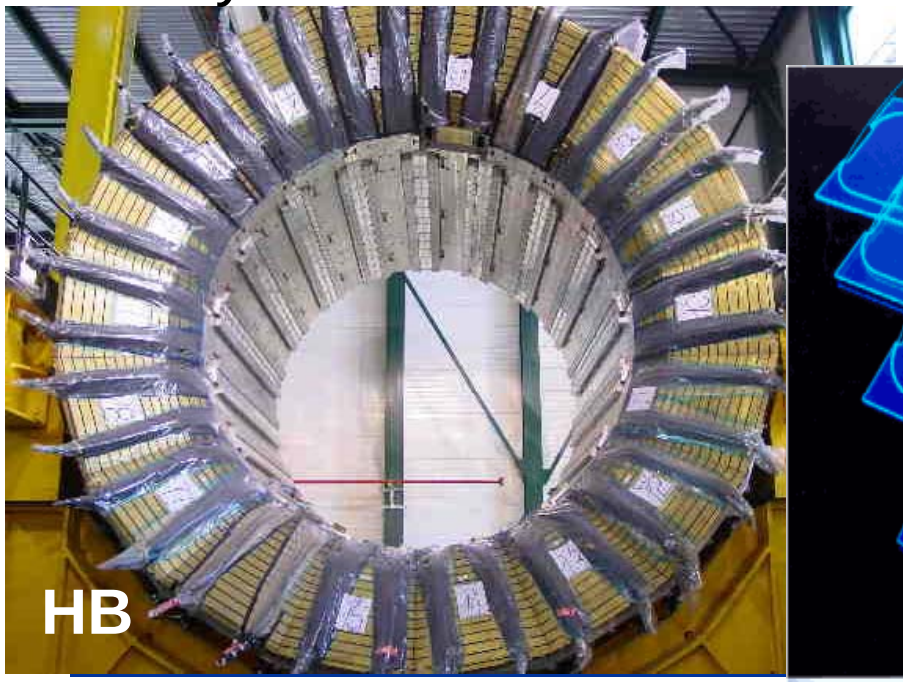


- $PbWO_4$ crystals
  - 61K in the barrel, 22 x 22 mm^2, avalanche photodiode readout
  - 15K in the endcaps, 28 x 28 mm^2, vacuum phototriode readout
    - Production of first endcap to be ready by end Feb'08 and second endcap by end Jun'08 (so unclear if ready for first beam)
- Ultimate precision of energy resolution: 0.5%
  - Requires measurements of crystal transparency using laser monitoring system due to irradiation dependence
- Preshower detector for endcaps
  - Silicon sensors, 4300 modules, 137K channels

Hadron Calorimeter

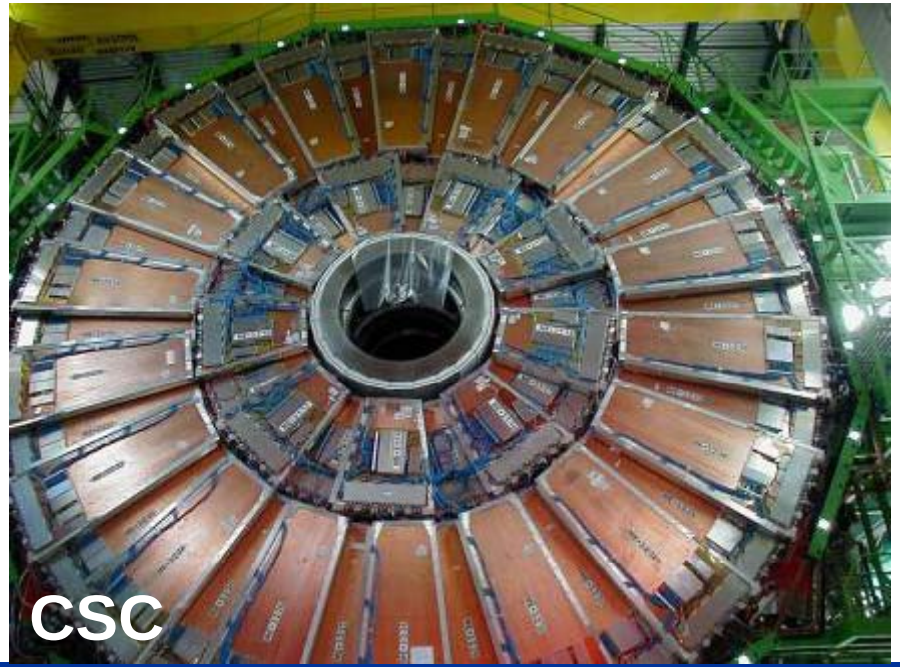
- HB and HE: brass & scintillator with WLS fiber readout
  - Coverage to $\eta < 3$, $\Delta\phi \times \Delta\eta = 0.087 \times 0.087$ (coarser for $\eta > 1.8$)
- Hadron Outer calorimeter (tail catcher) outside solenoid
- Hadron Forward: steel & quartz fiber: coverage $3 < \eta < 5$

Approx. 10K channels,
Hybrid PhotoDiode readout for all but HF (PMT)

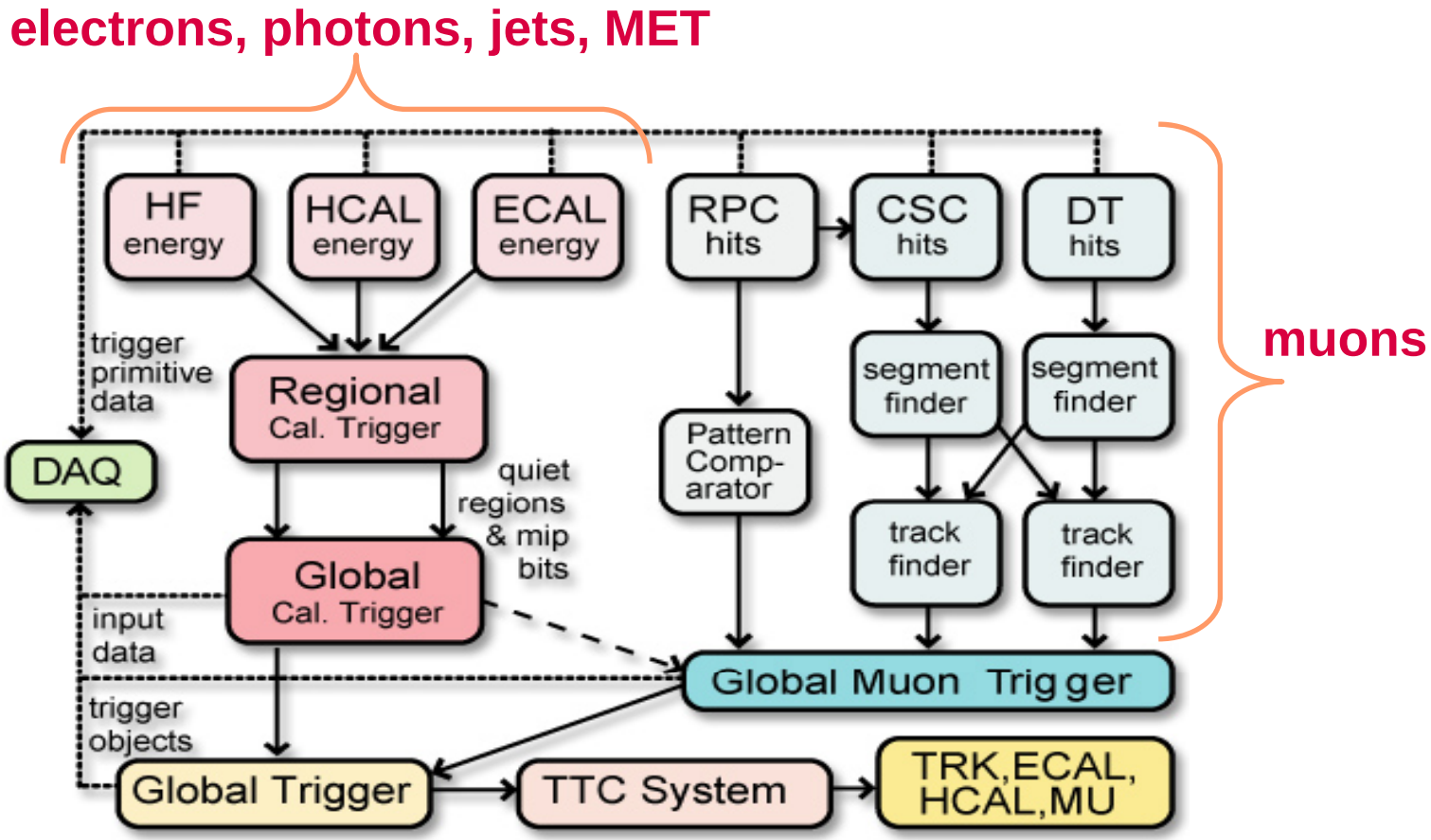


CMS Muon Systems

- 3 technologies, all self-triggering
  - drift-tubes, cathode strip chambers, resistive plate chambers
- 25000 m^2 of active detection planes
  - 100μm precision on position for DT and CSC
- About 1M electronic channels
- All surface-mountable muon chambers now installed.

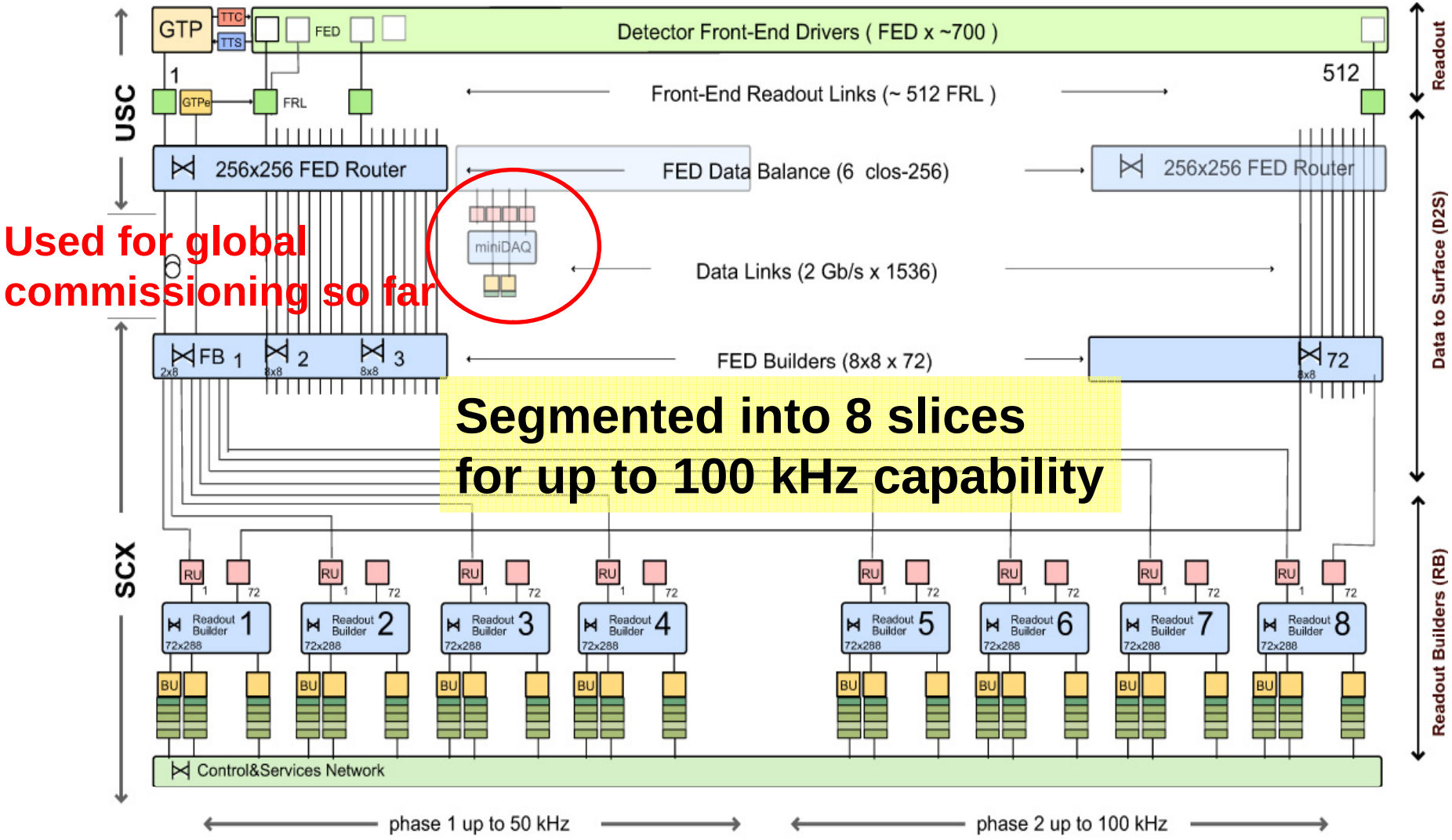


Level-1 Trigger Scheme



- Algorithms pipelined at 40 MHz for deadtime-free operation
- Extensive use of ASICs and FPGAs on custom electronic boards
- 100 kHz accept rate directly to High Level Trigger CPU farm

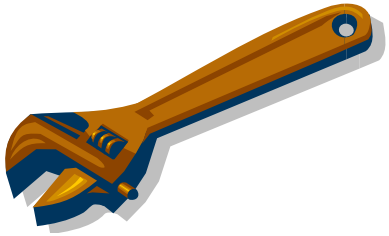
DAQ Structure



Used for global commissioning so far

Segmented into 8 slices for up to 100 kHz capability

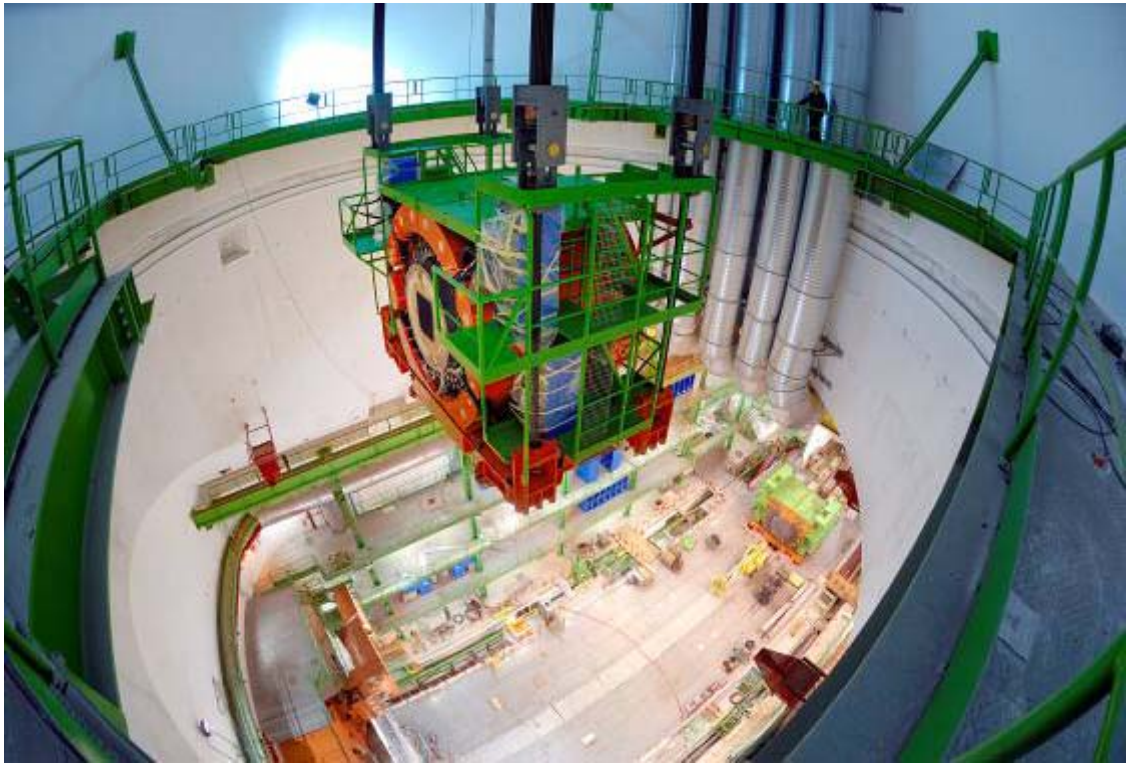
Some Assembly Required



Status of UX5 Hall, May 2006

Lowering of CMS Heavy Elements

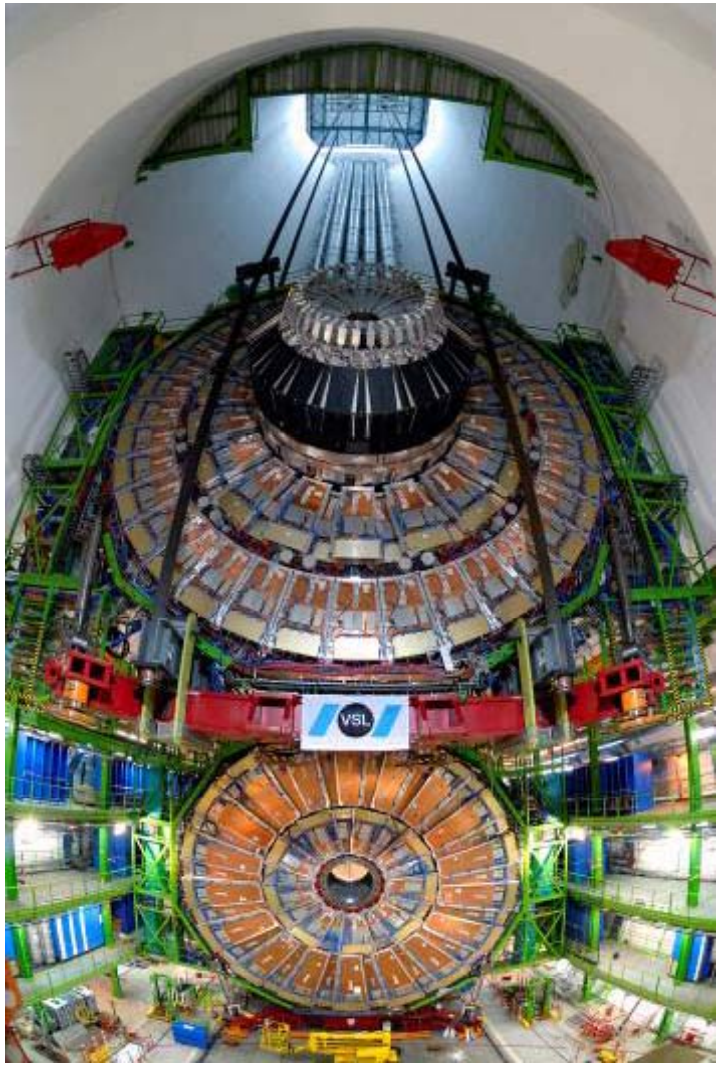
- Recall that detectors preassembled into complete structures
- The first phase of heavy lowering was completed in 4 months



Lowering of the Hadron Forward Calorimeter, Nov. 2, 2006

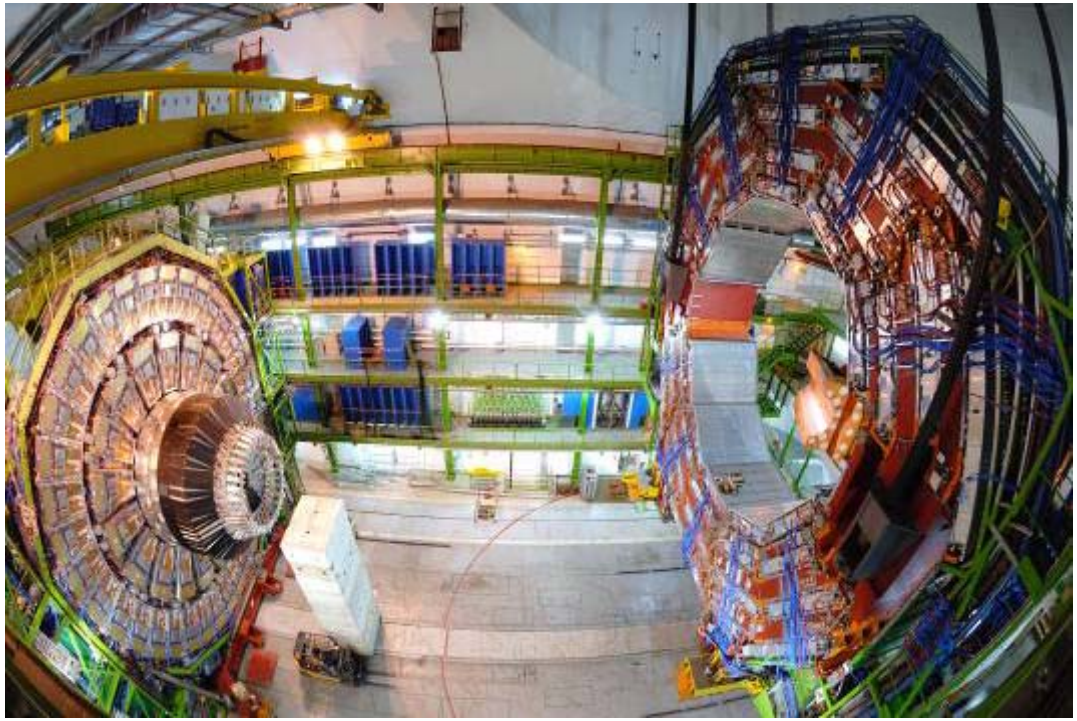
…and raised into position Sept. 2007 (for test)

Lowering of Positive Side Yoke and Detectors



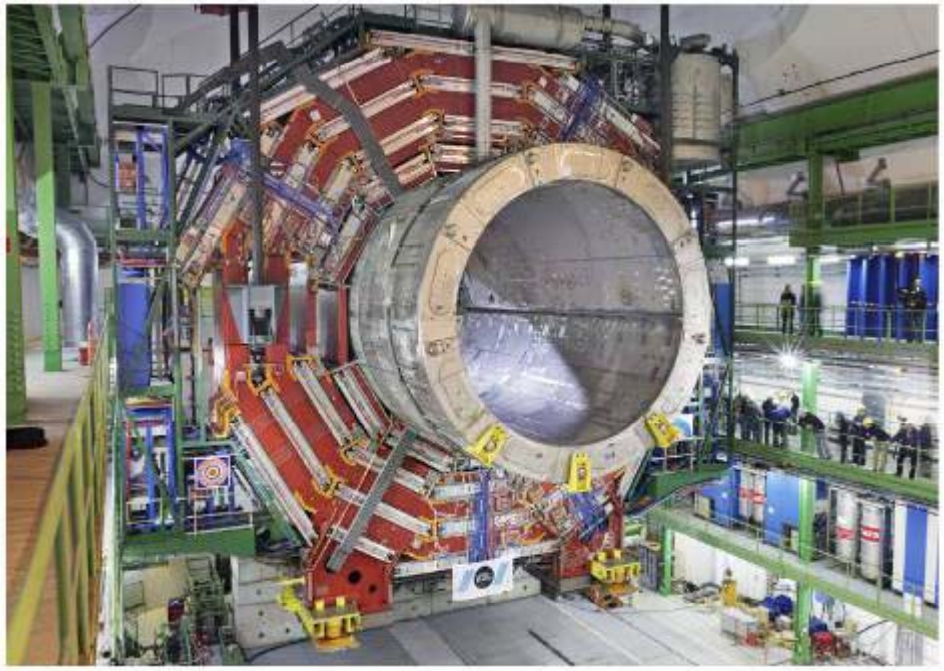
Endcap disks
YE+1: Jan. 9, 2007
(with 300 ton nose)

Barrel wheels
YB+2: Jan. 19, 2007



Milestone: Central Yoke and Solenoid

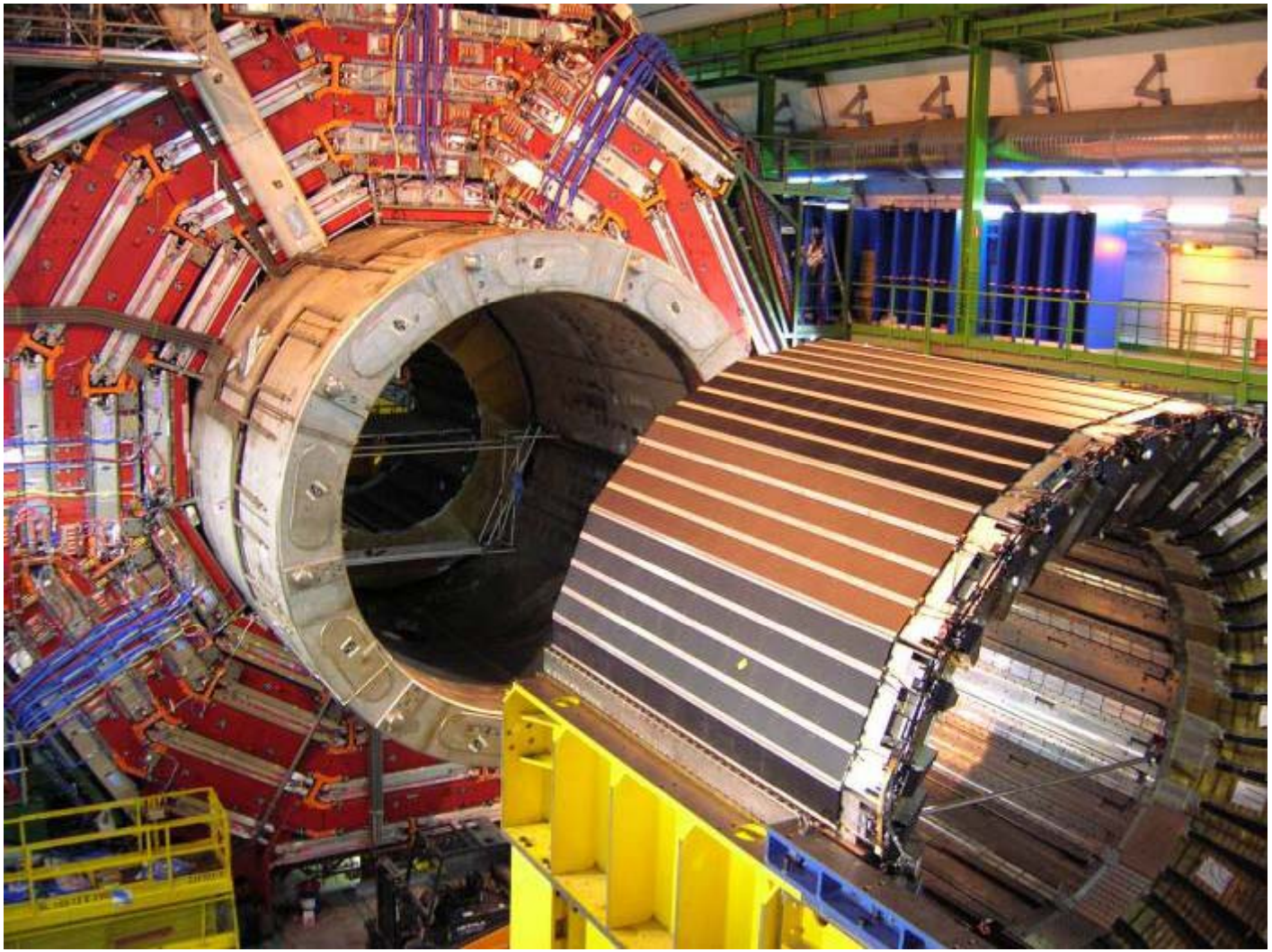
YB0: central wheel and magnet (2000 tons)
Feb. 28, 2007



YB0 landing in the CMS experiment hall

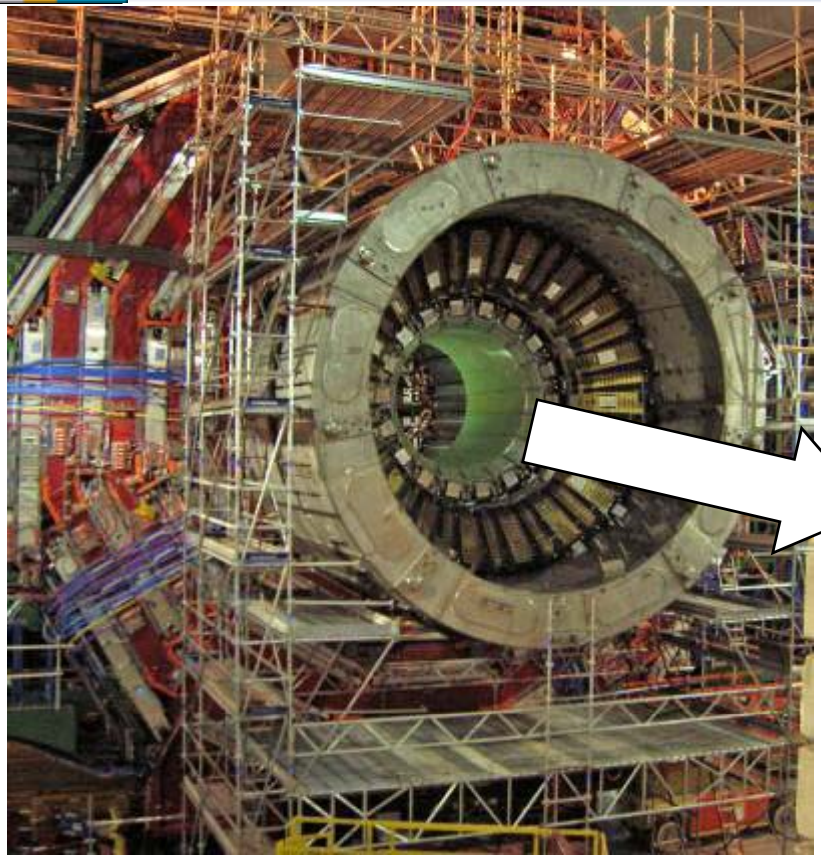
All magnet systems reconnected in cavern and commissioned.
Start cool-down end-Oct.
Powering tests at low current end-November.

Insertion of Barrel of Hadron Calorimeter



March 2007

Insertion of Barrel Electromagnetic Calorimeter

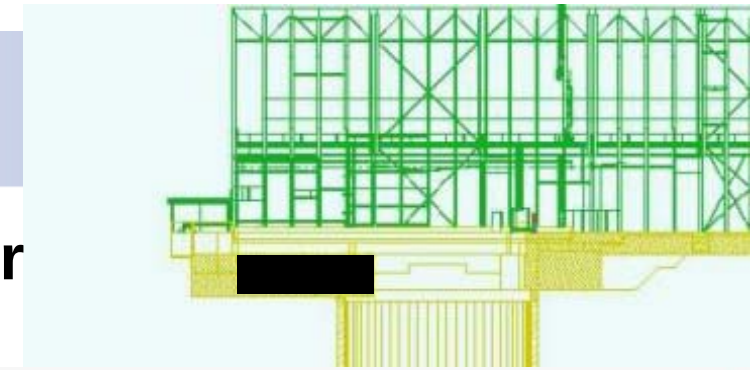


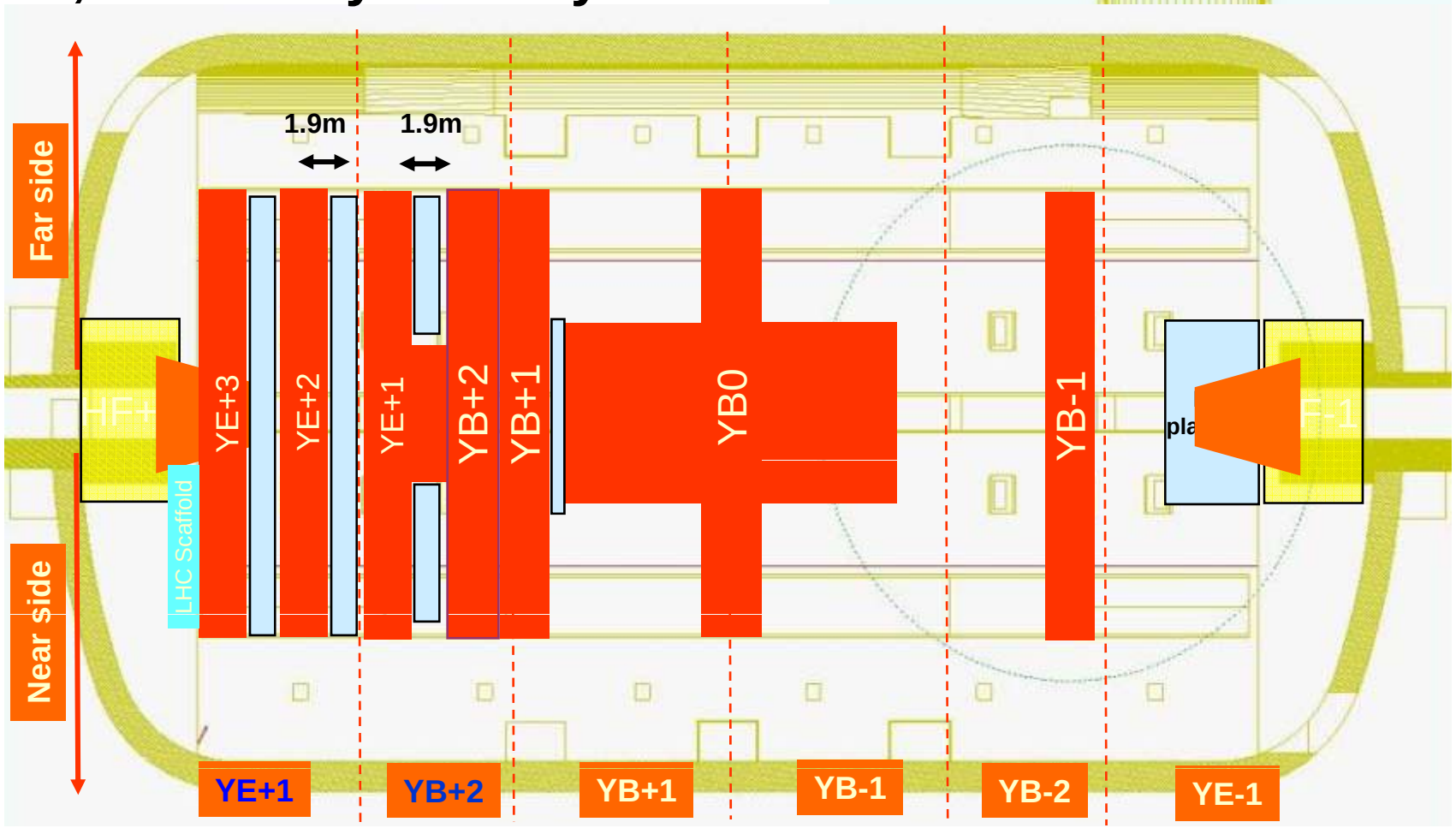
Insertion of the last barrel SuperModule, 61K $PbWO_4$ crystals, July 27, 2007

(Only 28 dead/noisy channels)

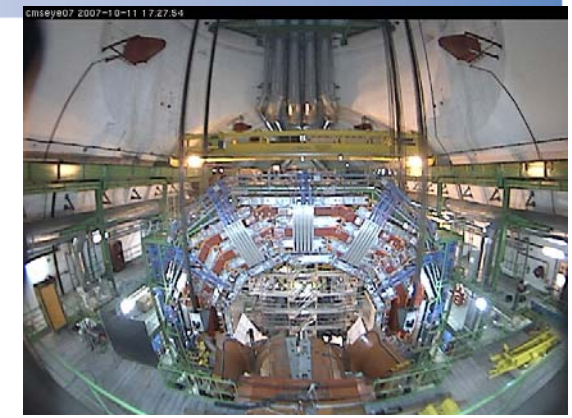
Occupancy of the Cavern, as of yesterday

Heavy lifting >2/3 complete, and after a hiatus, resumed yesterday





Installation and Global Test Schedule



yesterday

- Lowering of remaining heavy pieces
  - YB-1 and YB-2 on Oct.11 and 17
  - YE-3, YE-2, and YE-1 by the end of the year
- November '07
  - Delivery of remaining 25% of forward pixel system from FNAL
  - Transport of Tracker to P5, insertion, start of installation
  - Start of magnet commissioning underground at 500 Amps
- Dec.'07
  - CMS Cosmic Run, B=0T, Dec '07
    - 1-2 week data-taking run with CMS open and field off
- April '08
  - CMS Cosmic Run, B=4T, April '08
    - 1 month run with CMS closed, field on, all subsystems participating

The Campaign to Cable

- LV power to 3 disks (YE+3,+2,+1) and wheels (YB+2,+1,0) to complete by end of October
- YB0 Tracker cooling pipes and LV cables between the patch panel inside the CMS magnet and power system racks on the balconies has been completed
  - One pipe tested to -30ºC
- Barrel ECAL and HCAL cabling on YB0 in progress
  - HCAL Barrel about >50% complete and commissioned
  - ECAL Barrel has cabling of 4 / 36 Supermodules well underway, <u>but is critical path</u>

Off-Detector Electronics Installation

- More than 80% in st

Data buffers to DAQ

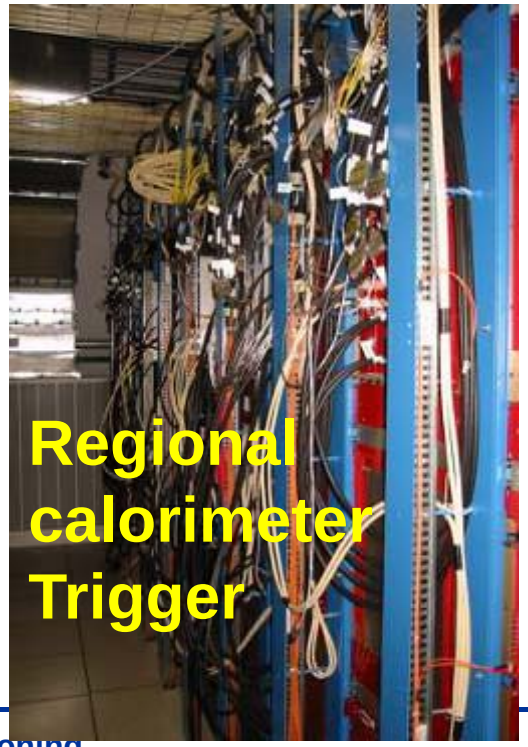
L1 Trigger primitives

	FEDs	Other	TPG	Tower electronics
Tracker	100%	100% FECs	n.a.	n.a.
ECAL (Barrel)	100%	100% CCS	80%	n.a.
HCAL (HE,HB,HF)	100%	50% HLX (HF lumi boards)	100%	n.a.
DT	40%	60% of front-ends connected to USC and commissioned	50%	More than 80% of tower electronics
CSC	75%		100%	100%
RPC	100%	100%CCS	100% sorter, 10% Track finder	Dependent on component between 30% and 80% of tower electronics

- HV supplies are either installed or not on critical path.
- Availability of front ends for installed detectors depends on availability of Low Voltage supplies and/or service infrastructure availability (cables, Safety system, cooling)

Level-1 Trigger in USC

- ECAL EB & HCAL Trigger installed and connected
- RCT & GCT (electron trigger) installed
- Muon Trigger is installed (DT,RPC,CSC)
- Pattern tests ongoing



DAQ Installation

- "miniDAQ" set up in the service cavern to support detector commissioning activities and Global Runs
  - Can accept all detector DAQ inputs for full functionality tests, but limited bandwidth and processing for data-taking
- Data-to-surface optical cables (2048 links, 2 Tb/s bandwidth) are installed and all optical interconnections tested
- 800 PCs (Dell 2950 dual CPU dual core) have been delivered and installed in SCX.
  - During the first technical run part of these PCs will be configured as Filter Units to allow data taking up to 20 kHz.
  - Commissioning started August, to be used in Cosmic Run Dec.2007
- The tender for the 50 kHz HLT PCs (1200) will be issued in phase with the LHC Physics runs schedules of 2008-09.
- On-line software development and optimization is continuing.

Experiment Commissioning

- Overall Goal
  - Bring experiment into working order with expected performance and ability to record data with high efficiency
- Components
  - Systems integration
    - Power, cooling, detector electronics, Trigger, DAQ, run control, slow control, safety system
    - Bring everything into reliable and safe operation
    - Automated and reproducible procedures
  - Timing and synchronization
  - Data quality monitoring
  - Calibration and alignment

➔ Testing the consistency of procedures & design of systems when operated collectively and not just individually

Commissioning Strategy

- The experiment is not complete, but neither can we afford to wait until it is finished before starting commissioning
- Push in 2 directions:
  - Horizontally: Tests of functionality and scale of individual components
    - Detector FED-DAQ system tests
    - Trigger pattern tests
    - Single detector slice tests
  - Vertically: Tests of integration end-to-end
    - Global commissioning runs of slices of the experiment at ever increasing scale and complexity

Complicating Factors

- CMS is still a construction site, with major components still being installed and cabled.
- Very difficult to commission sensitive electronics and detectors while the basic services are still being installed and commissioned
  - Need final LV power, cooling, cabling
  - Must arrange that sensitive pieces of equipment are left undisturbed
  - Must deal with cavern noise due to arc welding, for example
- Temporary arrangements (wall power) have been needed in some places to achieve what we have so far
  - Limits to ~5% front-end electronics powered in-situ
- Central services like DAQ and Trigger are not quite in their final form, and are still being commissioned
  - Limits how much Tracker DAQ electronics can participate in global commissioning
- But nevertheless we have to commission in parallel with installation in order to be ready for beams in 2008

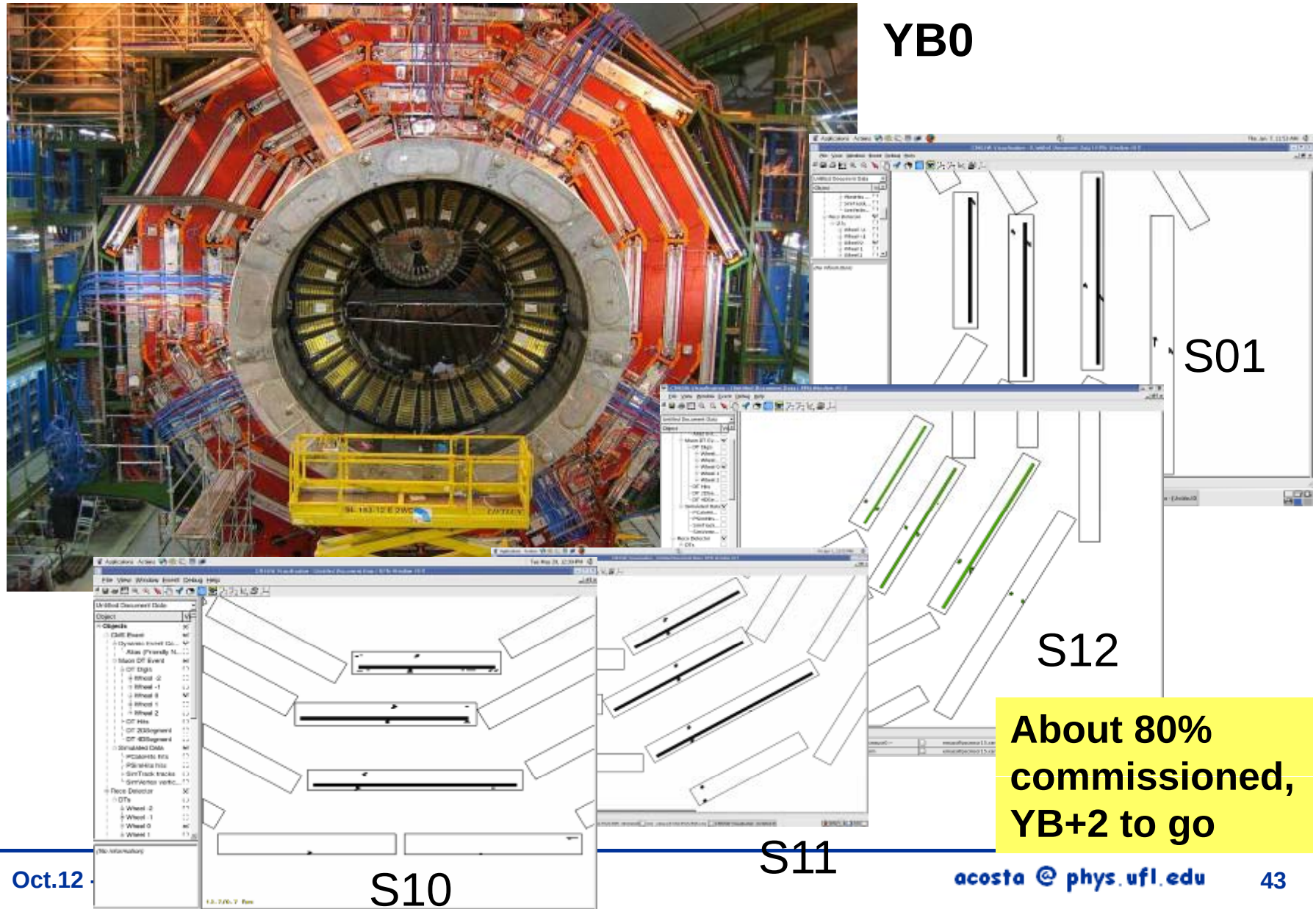
Detector Performance

- Commissioning success will be measured by achieving the design performance of the experiment
  - Efficiency, fake rate, resolution, etc. as measured in data
  - Studying issues of noise, synchronization, calibration, alignment,…
- The "Detector Performance Groups" of CMS are the forums in which the specialists of each detector community engage in the development of detector-specific software and procedures (reconstruction, calibration, etc.)
  - Each DPG is formally part of the corresponding Detector Project, with coordination and oversight by the Commissioning Coordinators
- Responsibility is to deliver calibrated and locally reconstructed 'segments' to the Physics Object groups

Commissioning Training Hikes

- Subsystem Local Commissioning
- Combined Test Beam programs
- 2006 Magnet Test and Cosmic Challenge
- 2007 Global Runs

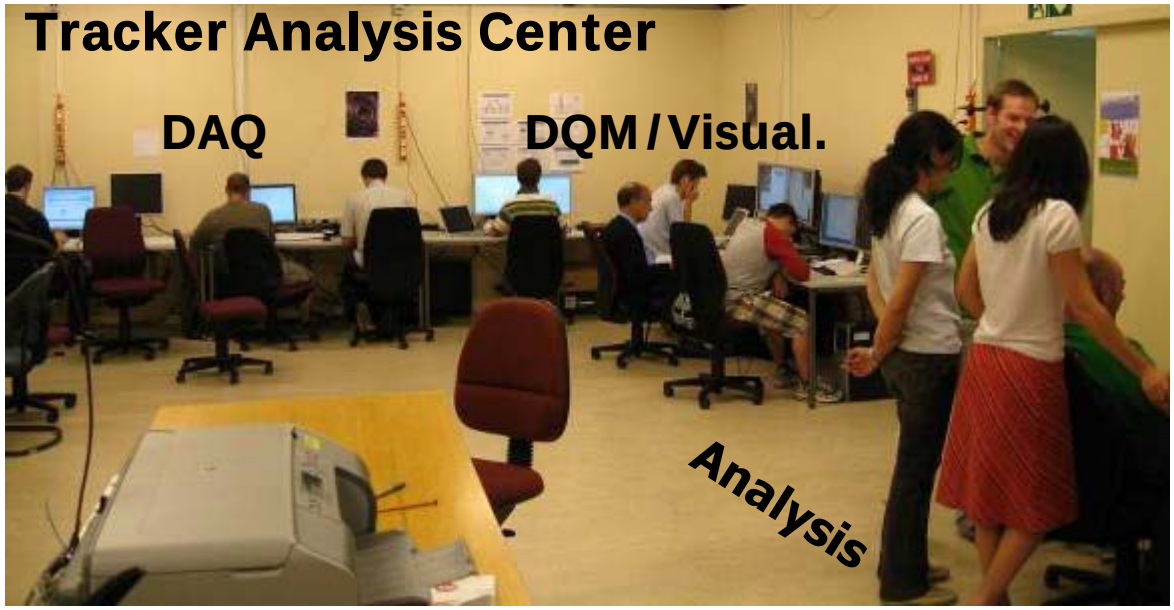
Drift Tube In-Situ Local Commissioning

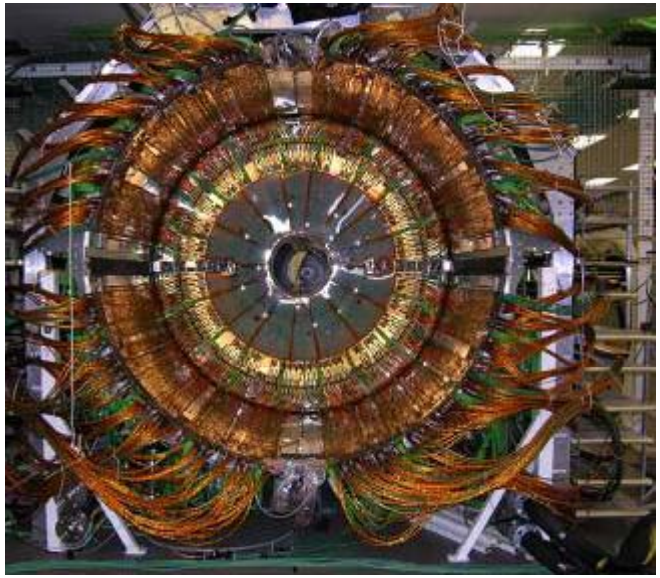


About 80% commissioned, YB+2 to go

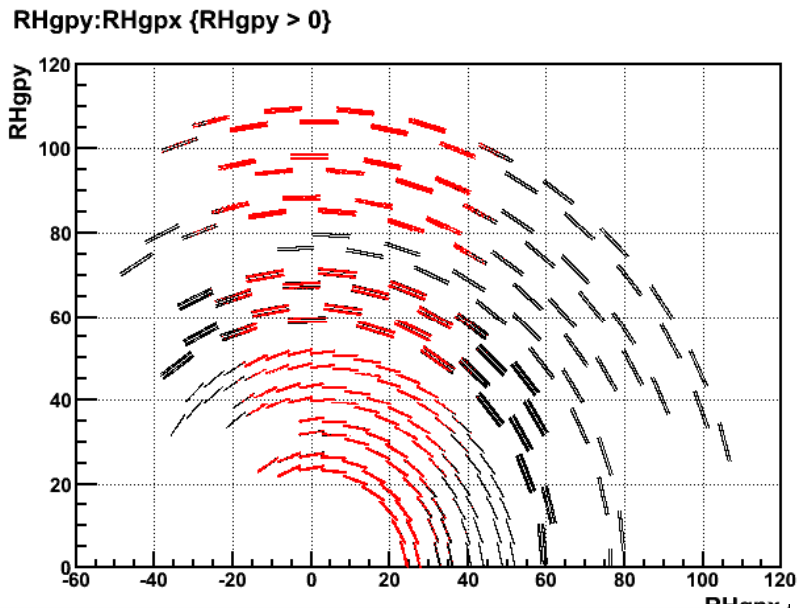
CMS Tracker Integration Facility

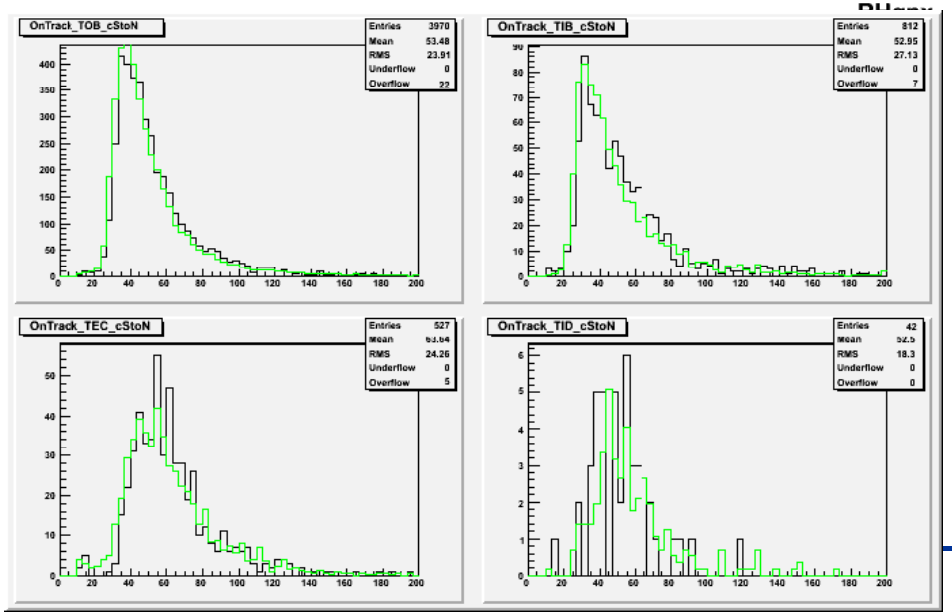
- 15% of the silicon strip tracker connected and readout from January – July 2007 in dedicated surface facility
  - Nearly 2M channels, more than CDF silicon vertex
- Gain operational experience, detector performance studies, alignment studies
  - 5M cosmic muon tracks collected @ T=15, 10,-1, -10, -15 ºC

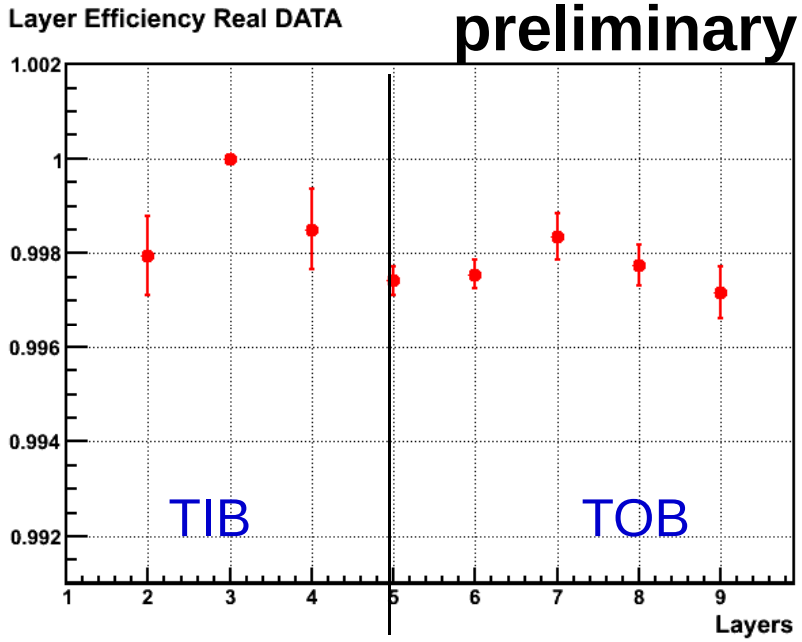




Tracker S/N and Efficiency



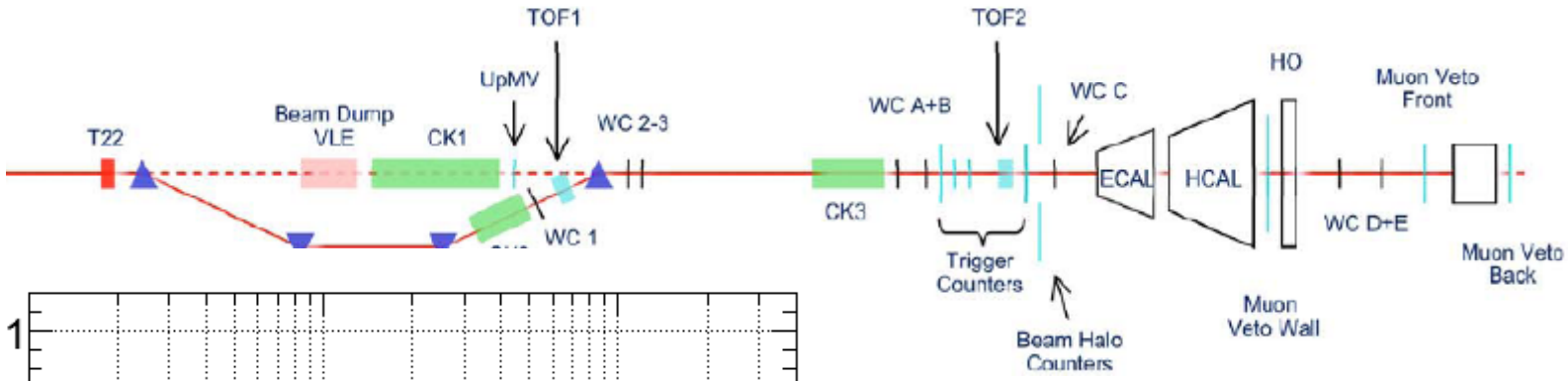


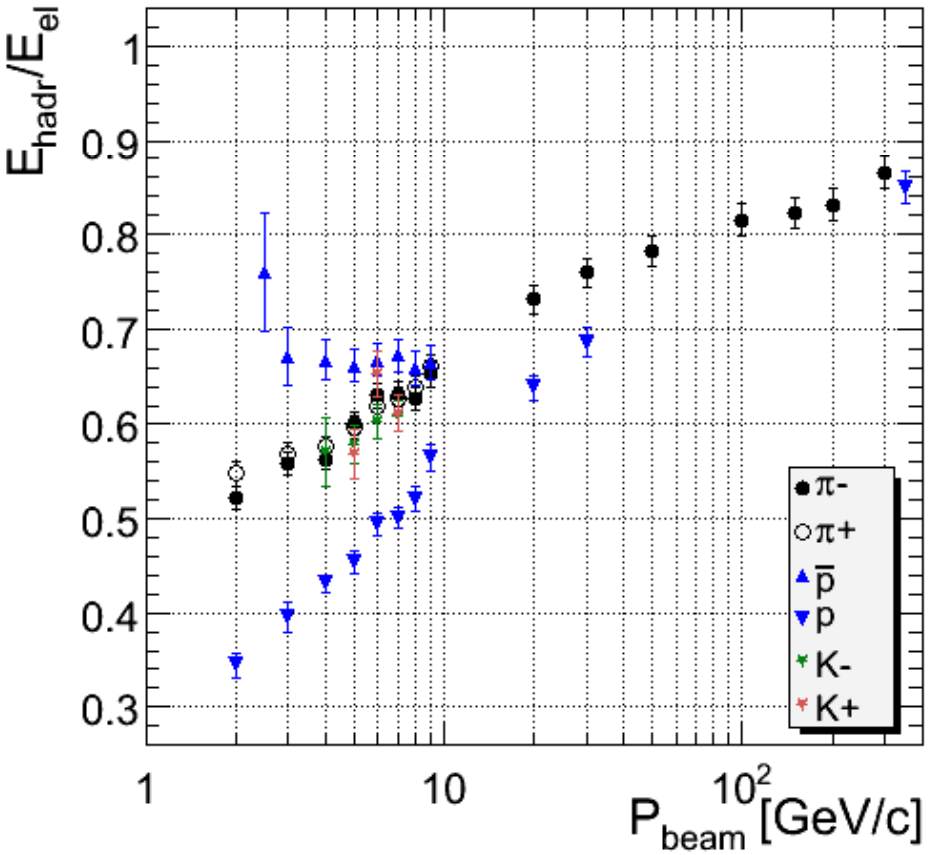


- S/N ~27 for TIB, ~31 for TOB/TEC
- Number of dead or noisy strips: < 0.2 %
- Efficiency for single cosmic muon tracks: > 99.7%

Performance studies ECAL+Preshower+HCAL

2006, 2007

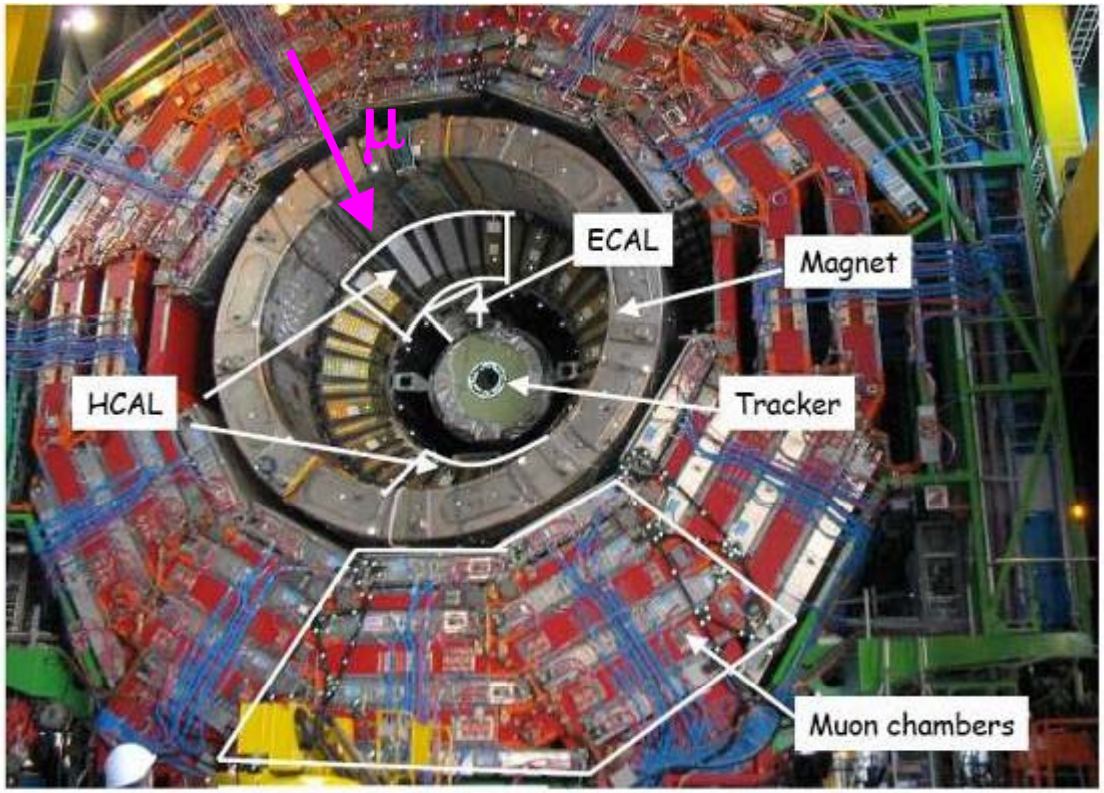




Simultaneous operation of 3 systems (2007)

Combined test beams with particle id and special optics to reach beam energies of 2 GeV
(very useful for tuning detector simulation)

CMS Magnet Test and Cosmic Challenge (MTCC)



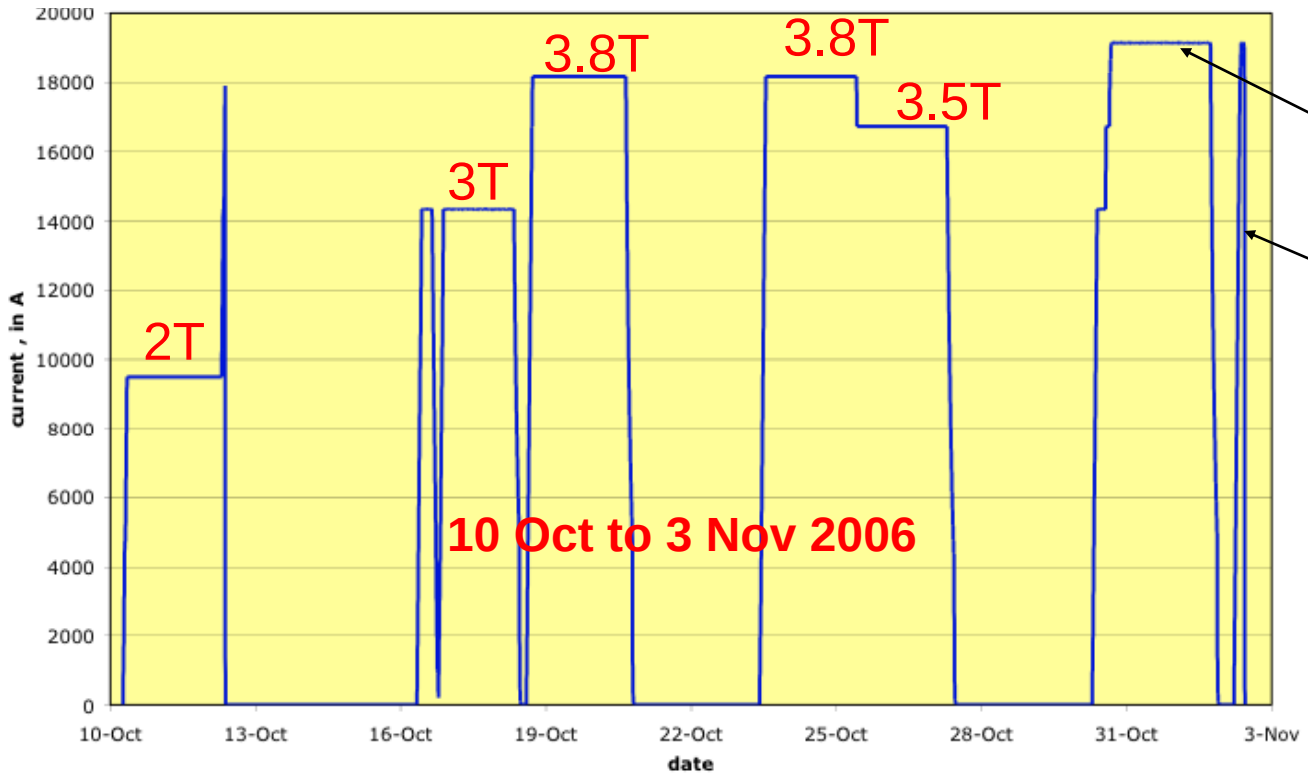
Aug. – Nov. 2006

- Tested the 2.7 GJ solenoid in surface assembly building
- Operated a vertical slice of CMS:
  - Muon Detectors (6–8%):
    - ➔ Drift-tubes
    - ➔ Cathode strip chambers
    - ➔ Resistive plate chambers
  - Barrel Hadron Calorimeter (22%)
  - Barrel electromagnetic calorimeter (5%)
  - Tracker (~1%)
  - DAQ and Trigger

Two Phases:

- Phase 1: all detector elements participate, B=0, 3.8T
- Phase 2: remove tracker+ECAL, insert B field mapper, B→4T

Magnet Worked! Magnetic Field Mapped



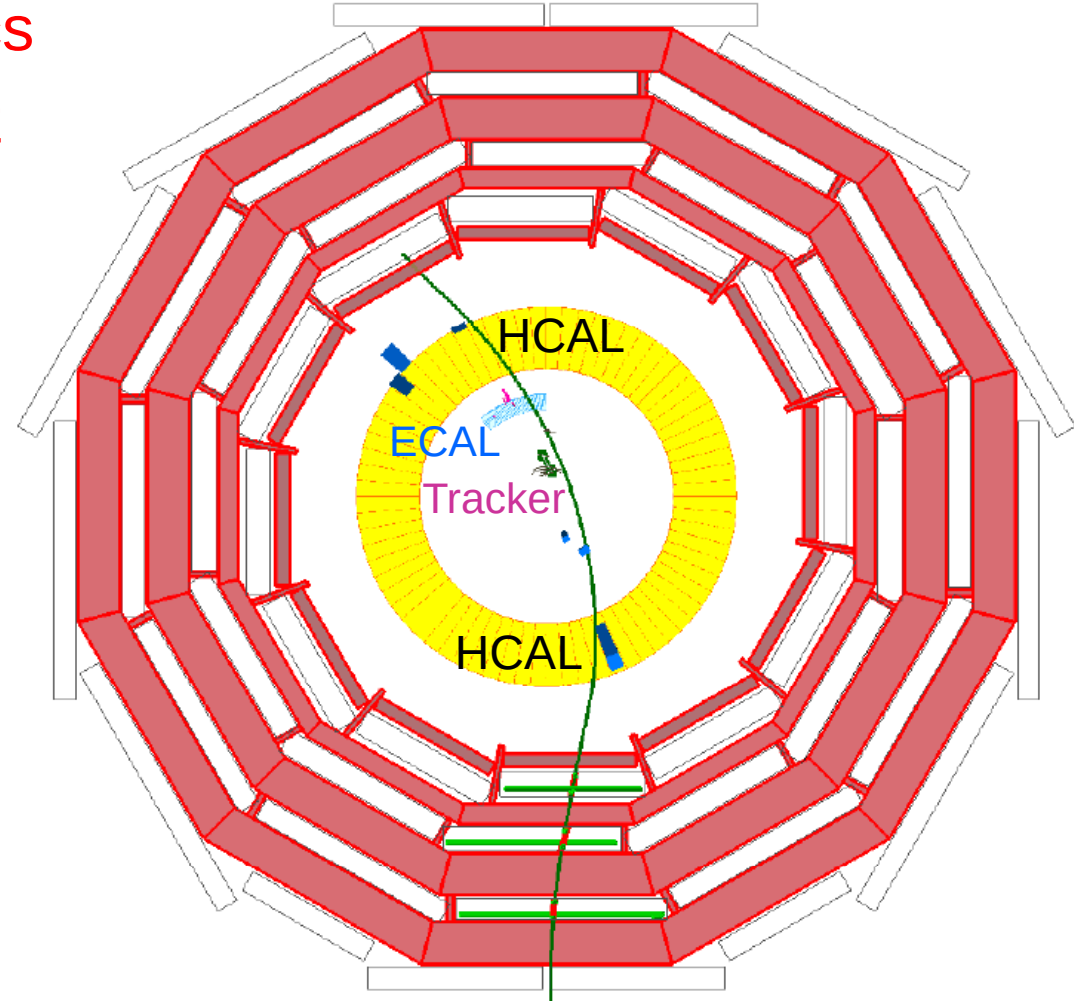
4T = **19.140kA: stable operation confirmed**

Temp stability margin 0.6 K

Field mapped at: 2.0, 3.0, 3.5, 3.8(twice) & 4.0 T with 0T references. statistical precision of 10^{-4} achieved

The Detectors, Trigger and DAQ worked!

- Recorded ~200M cosmics
- Trigger rate up to 200 Hz
- Data very useful to measure detector performance, validate detector simulation and reconstruction algos, study noise
  - In fact it is still a treasure trove

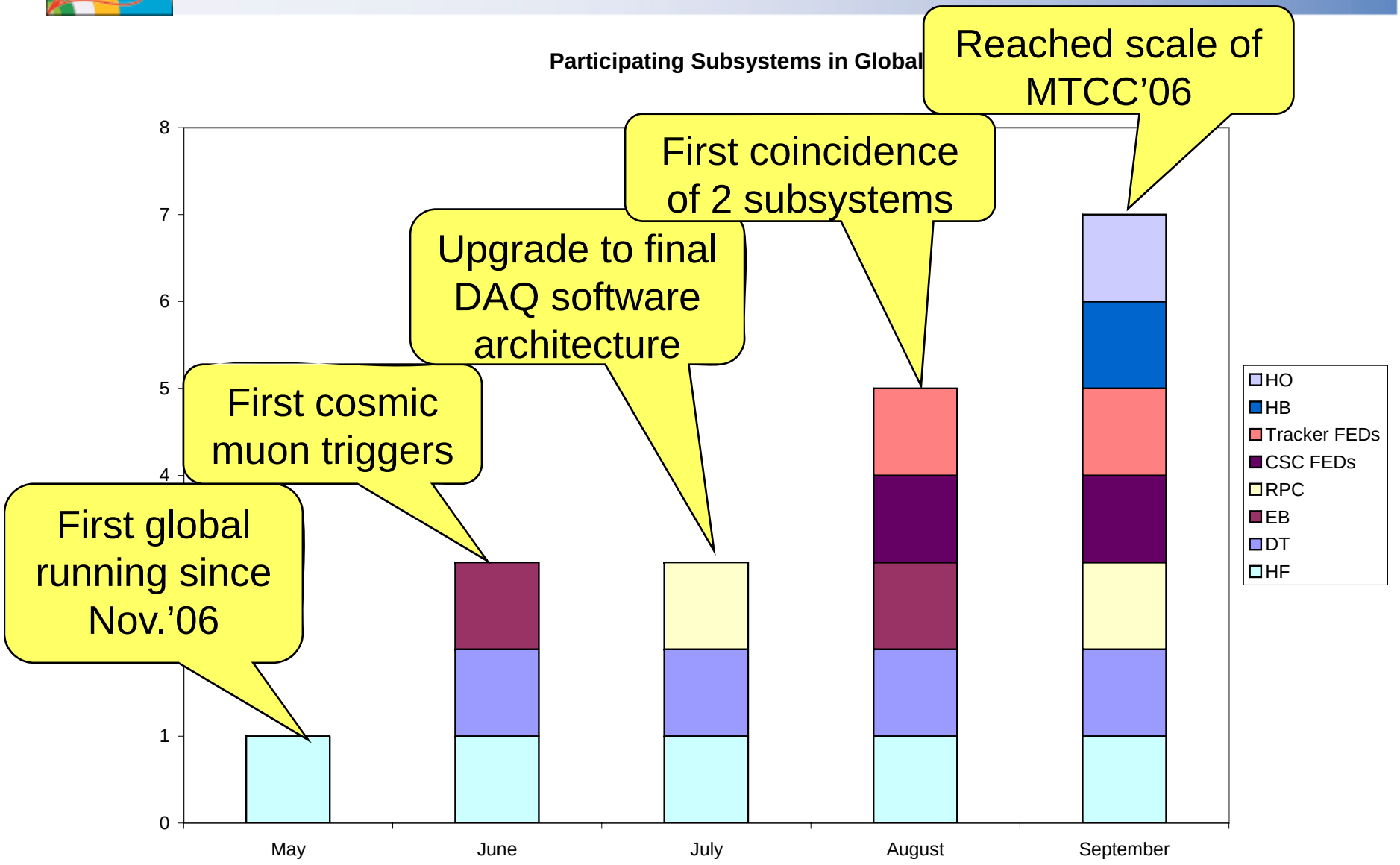


Run 2605 / Event 3981 / B=3.8 T / 27.08.06, 22h
Muon traversing DT, RPC, HCAL, ECAL, Tracker

2007 "Global Runs"

- Since May 2007, the last 3-5 days of each month have been devoted to global commissioning exercises with installed detectors and electronics underground
  - Balancing the need to continue installation and local commissioning activities with the need for global system tests
  - This campaign was preceded by subsystem to DAQ connectivity and functionality tests
- Prior to each global run a detailed list of goals is established which is in turn translated into a working plan which is discussed every morning of the days where the GR is scheduled
- The incremental goals from one GR to the next can be subdivided in two main categories: increased functionality, increased complexity.

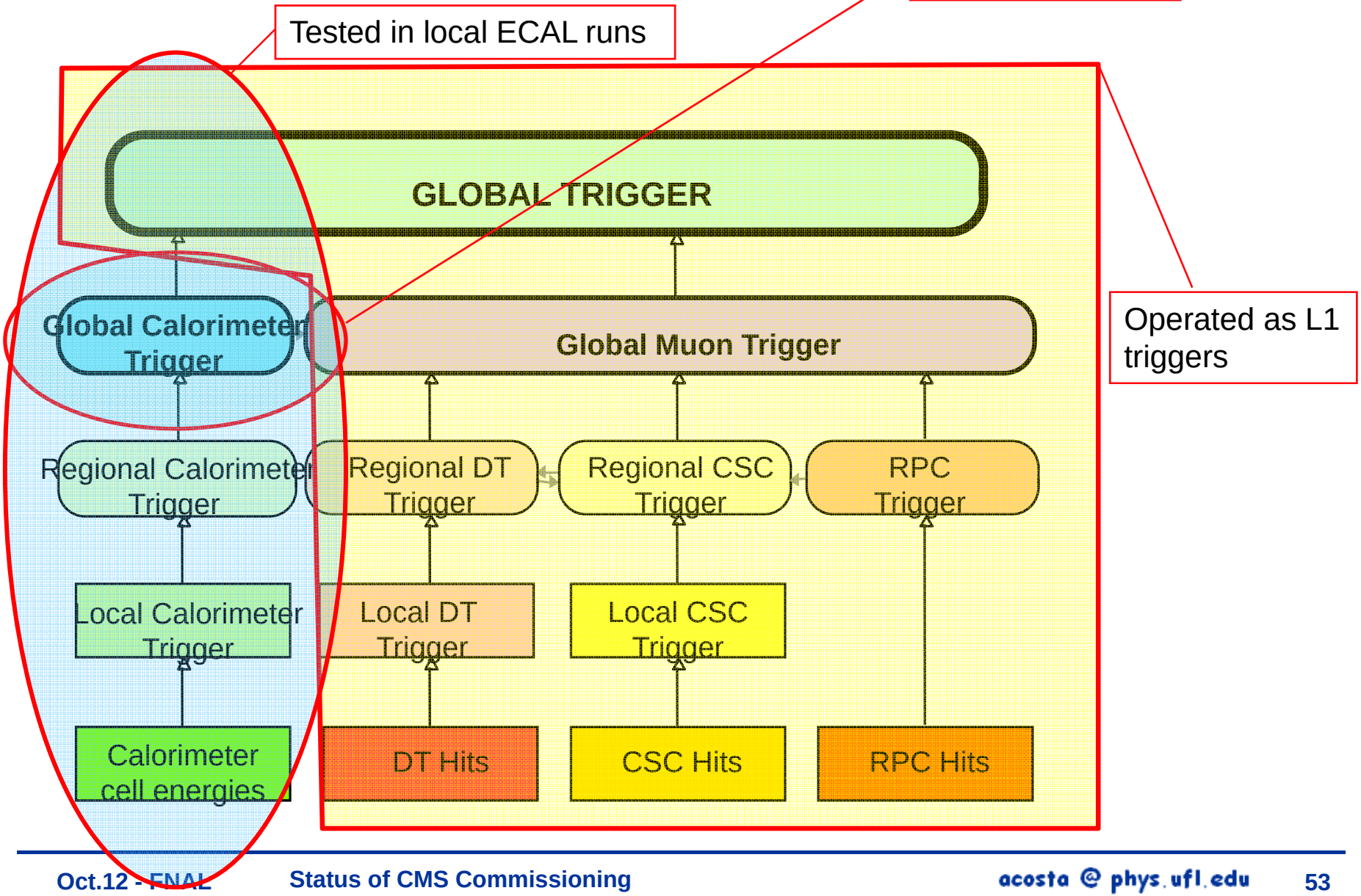
Increasing Complexity of the 2007 Global Runs



Highlights of GR achievements (May – Sept.)

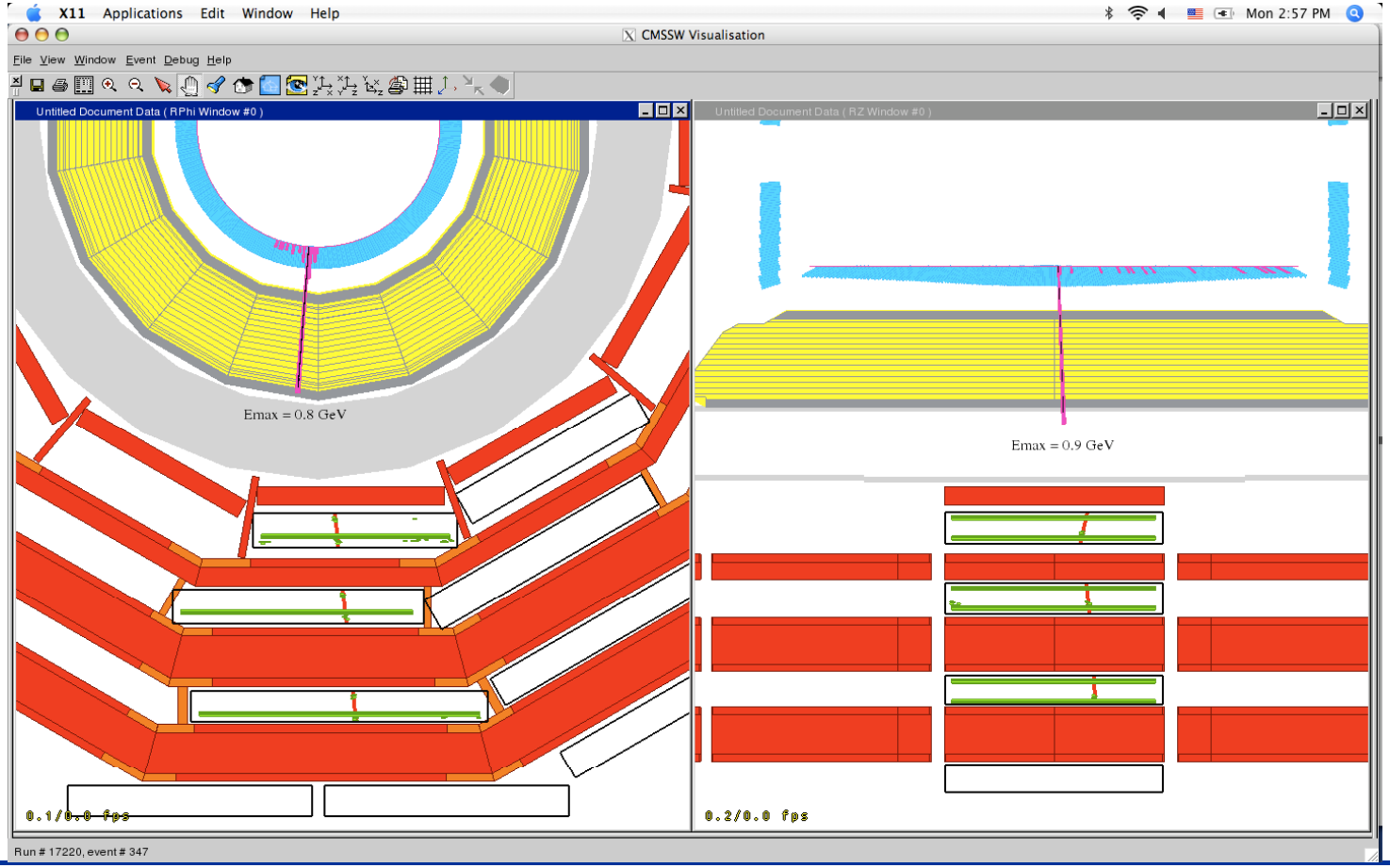
- Readout of EB, HB, HF, HO, DT, RPC, CSC and Lumi front ends
  - ~3 – 20% of powered subsystem front ends (50% for HF)
  - Scale similar to MTCC-2006 by the September 2007 GR
- Readout of almost 60 FEDs (data buffers connected to DAQ, out of ~700)
  - Three times MTCC scale
  - ~200 FEDs of Strip Tracker tested separately (~1/2 Tracker total)
- Commissioned Run Control and Level-1 trigger control software
- Initialized and configured detectors from database
- Integrated real time DQM framework
- Deployed High Level Trigger data unpacking and reconstruction with latest CMS offline software
- Data streaming from Storage Manager (data logger)
- Data flow demonstrated to Tier-0 (CERN), Tier-1(FNAL), Tier-2(Florida,MIT), and Tier-3(Minnesota) computing centers
  - Latency typically less than 1 hour. Reconstruction now applied
- Remote shifters at FNAL Remote Operations Center

Trigger in Global Runs



ECAL and Drift Tube Coincidence

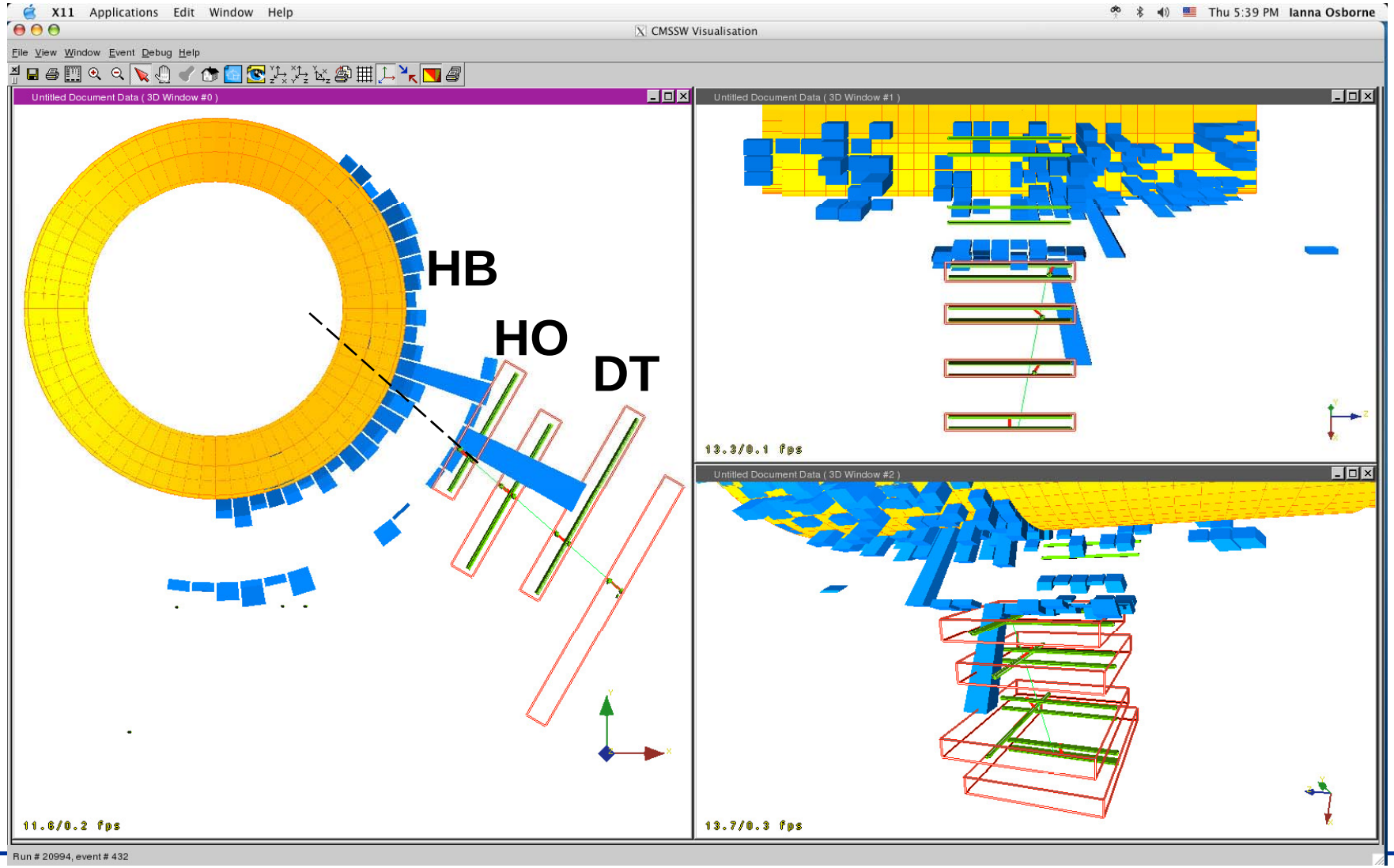
- August Global Run
  - ECAL and DT readout synchronized to Global Trigger (from DT)
  - An ECAL m.i.p. trigger was demonstrated after Global Run



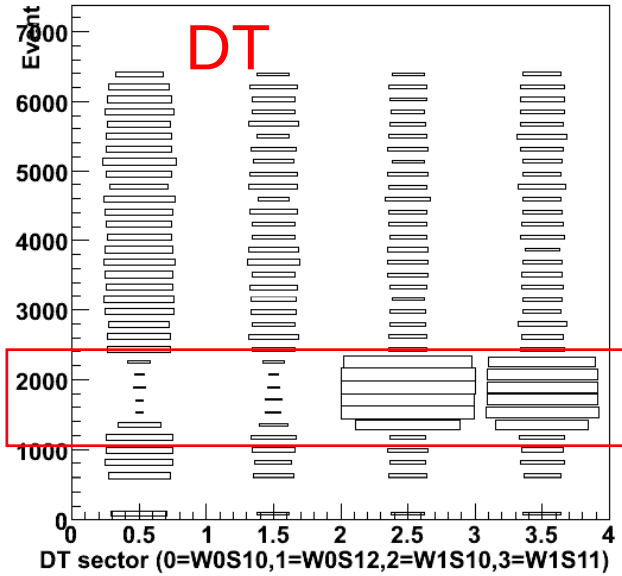
HCAL and Drift tube coincidence

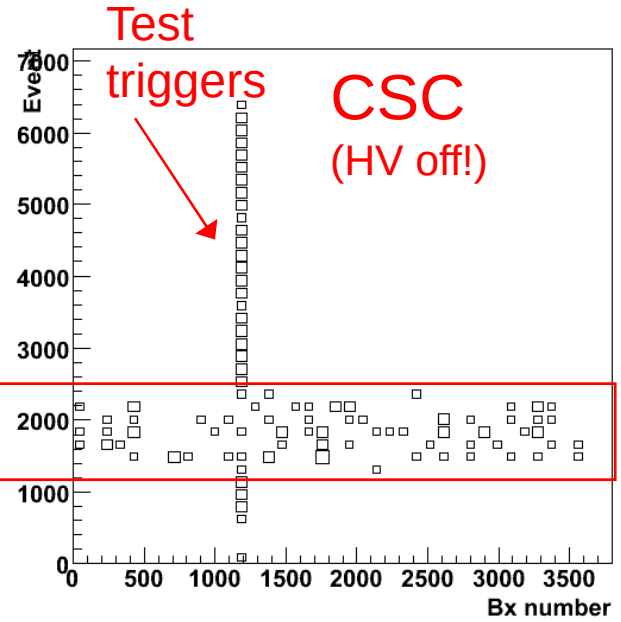
- September Global Run

HCAL zero-suppression is off



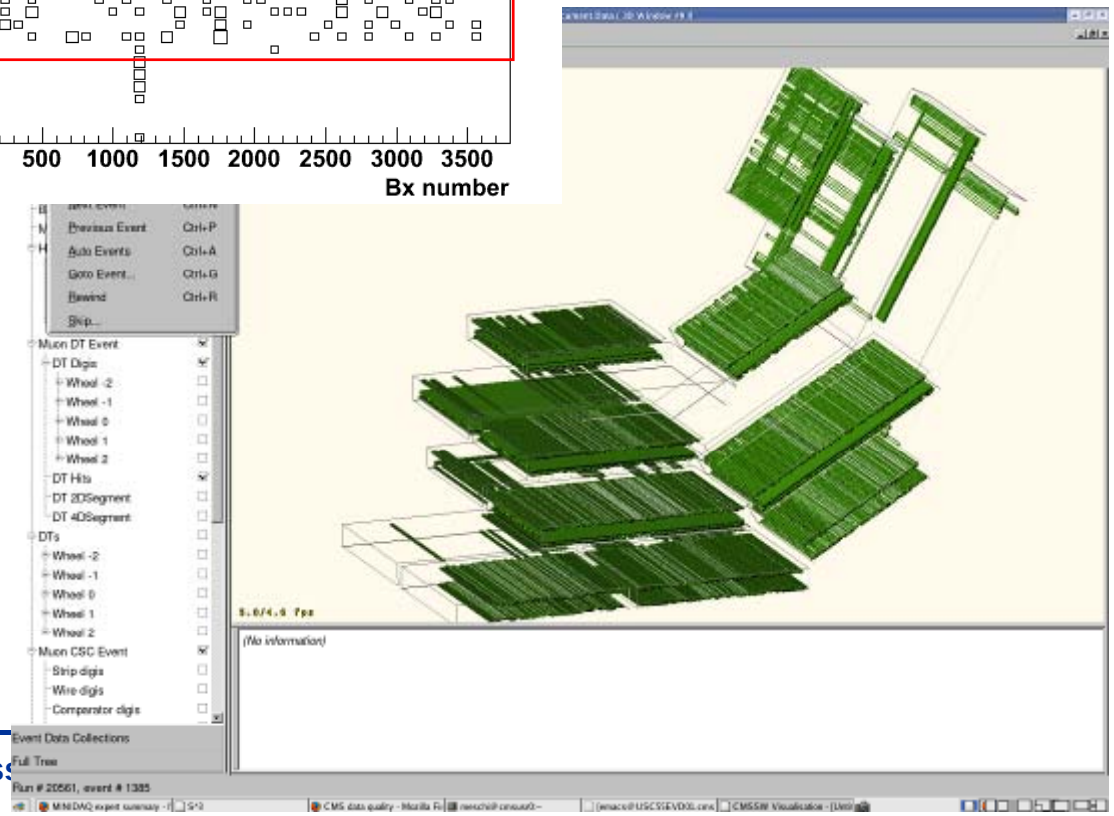
Correlated DT, CSC Noise



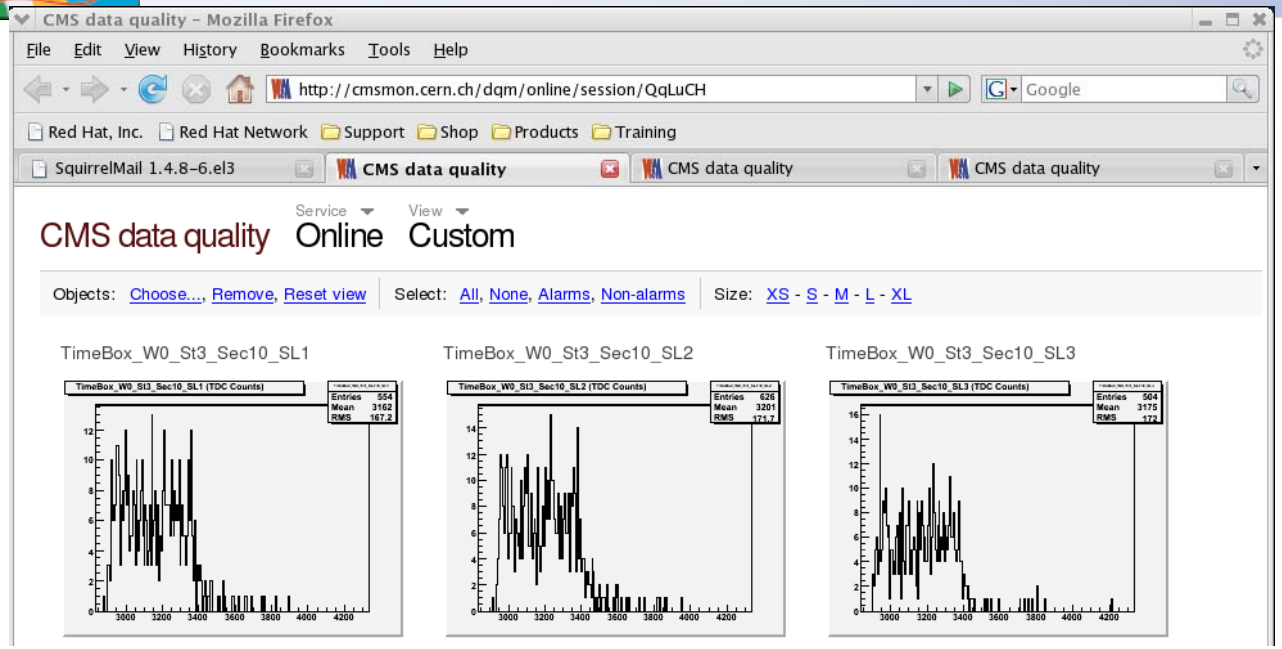


Later traced to arc welding equipment
(High freq component)

Drills and crane had minimal/no effect



Online DQM



- Software framework mostly in place: used for detector-expert DQM, and general shifter DQM in development
  - But still must define all needed histograms and summary plots, set up reference histograms, define automated checks, set up alarms, …
- Final web-based GUI in development, preliminary version available/tested
- Runs live from events served by the Storage Manager (data logger) or from events in the HLT filter farm, as well as from files
- DQM results archived and linked to Run Summary web page

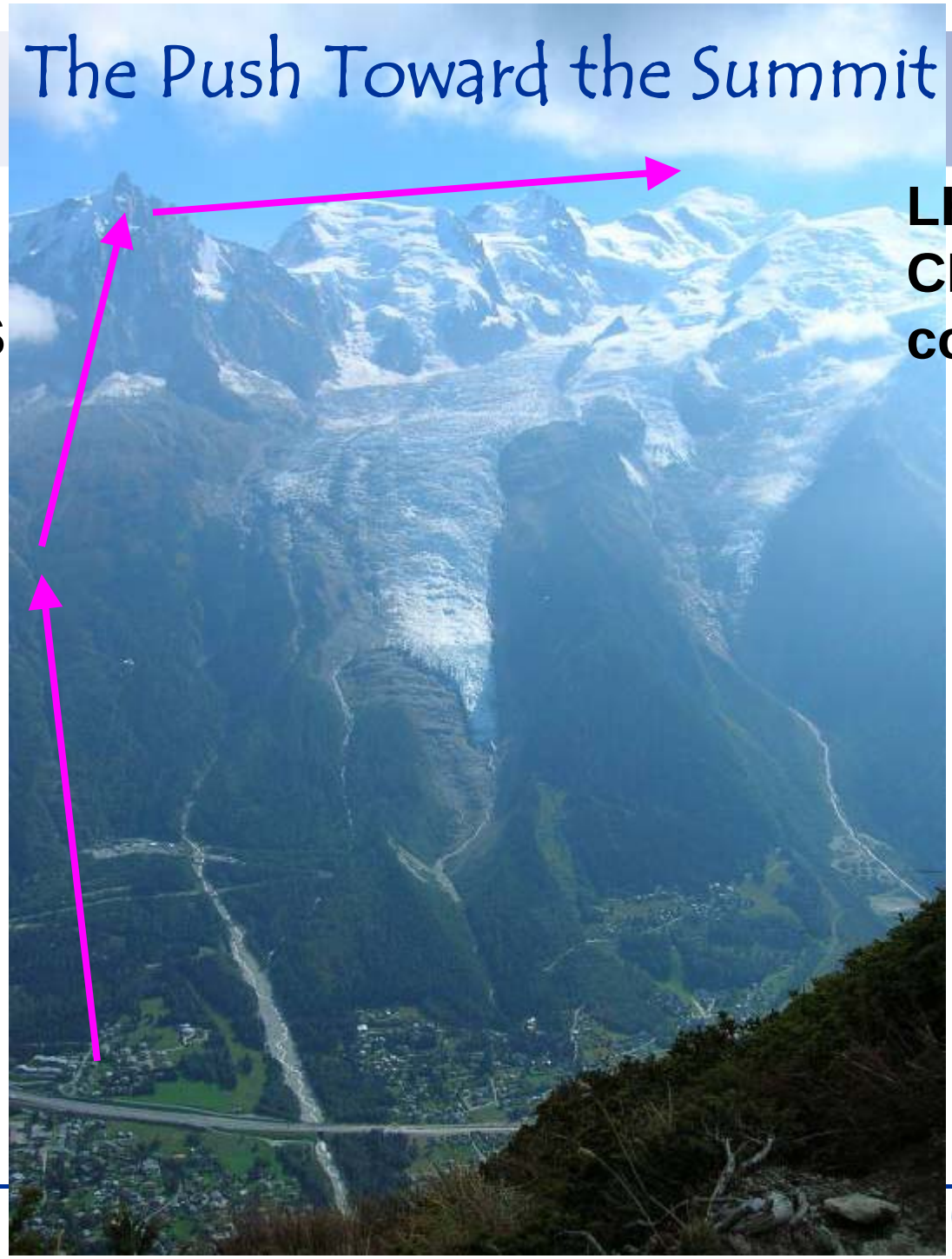
Snapshots from September's Global Run

A little crowded in the underground control room, since systems are still expert driven

(Surface control room ready Jan'08)

But good camaraderie as run operations begin to take shape

The Push Toward the Summit



Cosmic Run ’08: 100% CMS
April ’08

Cosmic Run ’07: ~50% CMS
Dec.’07
(may extend into ’08)

LHC collisions, CMS fully commissioned

Higher rates, occupancies, radiation

Main Goals for Future Runs

	DAQ	DCS	L1Tr	HLT	DQM	Offline	Computing	Det.
GRES 26-28 Sep 07	XDAQ 3.11 MiniDAQ RCMS 304 Filter farm unpacking and reco	Local Subdet control	GT,GMT,DTTF, CSCTF,RPCTF Rtae < 1KHz	Unpacking+digi reco	Automatic start, shifters Final gui Remote monitoring	CMSSW16 Digi reco at tier0	Digi reco at tier0 Data to 1 tier1 and 1 tier2	5 sectors DT, 7 wedges HB, 1 HF,4 sectors RPCB,CSC FEs
GREN 26-30 Nov 07 24h shifts	RCMS 3.1(global config map) XDAQ rel4 Run from 1 slice of final DAQ farm	Safe (24/7) operation for Ye+ and YB+,YB0	+RCT, GCT, EBMip HCAL trigger	Local reco mu LV1 confirmation. Frontier condDB	Geometrical navigation in GUI	CMSSW17	Several primary datasets	**3 wheels DT, all EB, all HB,some RPCs, all CSC +endcap** DAQ: XDAQ3.11 10 KHz trigger for empty events 0/suppression
CCR07 12-22 Dec 07 24h shifts	XDAQ 3.13? Config everything from DB				trigger DQM code	and data processing)	Tier0, all Tier1s, some Tier2s CAF phasing in	+some tracker
GREF 25-29 Feb 08	XDAQ 4 All DAQ task fault tolerant Run from surface control room '10KhZ' 8 slices DAQ setup	Central control			info			All YE+(if RPC LV ok) YB+,YB0,YB-, some YE- 50 KHX trigger empty events
CCR4T 21- ?? April 08 24h shifts	Phase in final Filter farm		All trigger HW and SW ready for LHC	Complete cosmic trigger menu	LHC DQM environment: GUI, history, trends, correlations with conditions	CMSSW20 Cal and alignment in CAF Run quali flags	Cal and alignment in CAF	All CMS (less EE/ES-)

For the first time >50% of detector readout

For the first time, the final DAQ

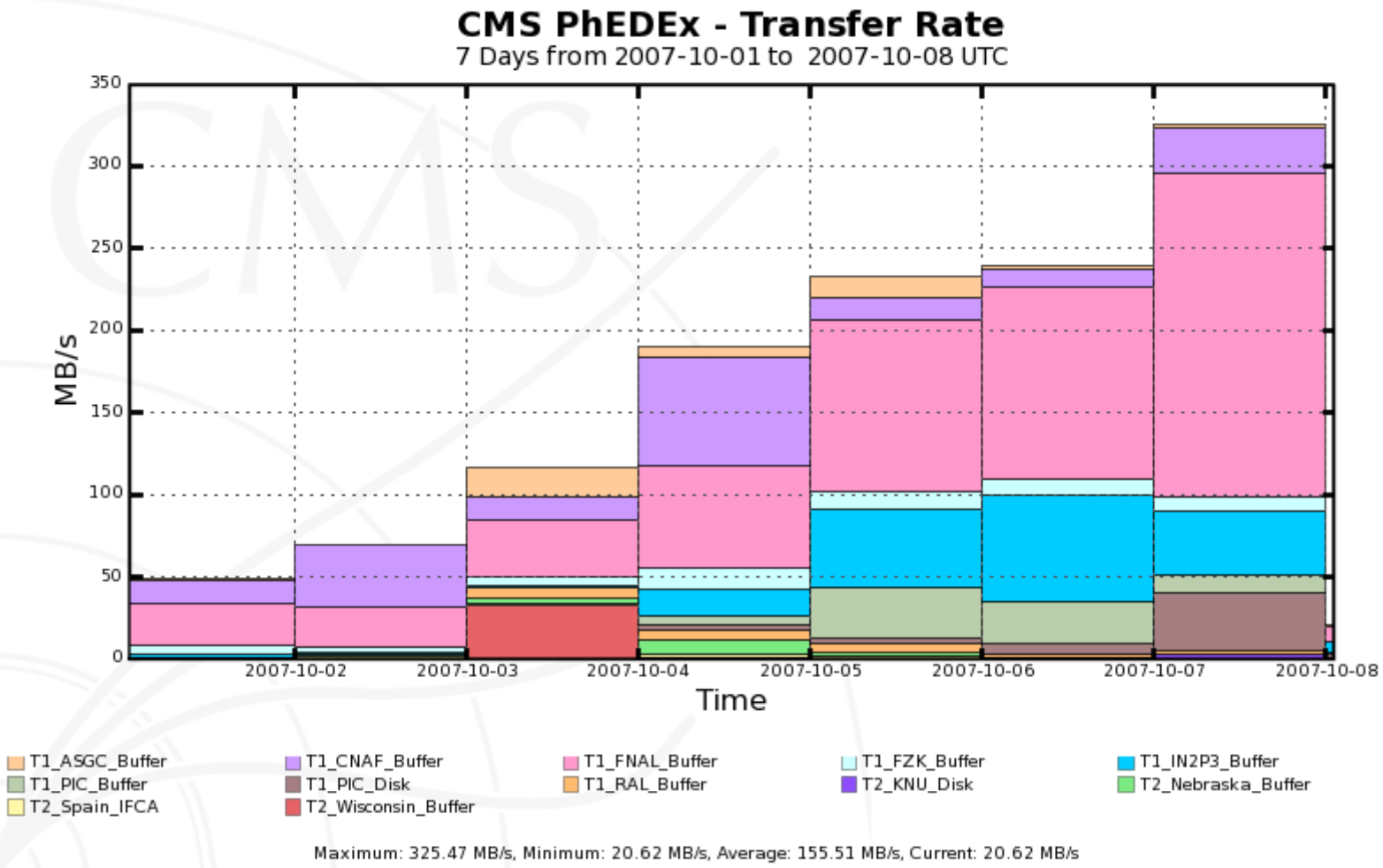
CSA07: 50% Computing Challenge

- Commissioning the data handling system (with MC, not cosmics)

Service	2008 Goal	CSA07 Goal	CSA06 Goal	Status 2006
Tier-0 Reco Rate	150Hz - 300Hz	100Hz	50Hz	Achieved
Network Transfers between T0-T1	600MB/s	300MB/s	150MB/s	Achieved (6/7 cont.)
Network Transfers between T1-T2	50-500 MB/s	20-200 MB/s	10-100 MB/s	Achieved (15 sites)
Network Transfers T1-T1	100MB/s	50MB/s	NA	Not Attempted
Job Submission to Tier-1s	50k jobs/d	25k jobs/d	12k jobs/d	3k jobs/d
Job Submissions to Tier-2s	150k jobs/d	75k jobs/d	48k jobs/d	Achieved
MC Simulation	1.5 10^9 events/year	50M per month	NA	Not Attempted

CSA07 Started Last week

- Moreover, pre-processing occurred over the last month, overlapping (but not interfering) with the last Global Run



FNAL Involvement in CMS Run Operations

- The FNAL ROC and LPC serves the large U.S. CMS constituency
  - Many facets, including ability to take remote shifts in local timezone, work with group leaders on software and analyses, etc.
  - Guidance in all remote centers design (e.g. Meyrin)

- Many deliverables from FNAL to CMS:
  - Web-based monitoring
    - Making info in databases available via the web
      - ➔ Run summary, trigger summary, slow control monitoring, DQM, Expt. status, file transfer status, data processing status, etc.
    - Screen snapshot service
  - DQM
    - Root browser and archival of files
    - Framework development
    - CERN and FNAL shifts
  - DAQ
    - Storage Manager development (includes DQM services)
  - Data Operations
    - In many areas: Tier-0, Tier-1, etc.

Summary

- CMS installation is very far along, but still major activities to complete
  - Completion of cabling, installation of Tracker
- CMS commissioning is well underway
  - Of course teething problems generally encountered with each step forward
- 50% scale tests coming soon, and on target to have nearly 100% of CMS ready for commissioning with cosmics by April '08
  - Last ECAL endcap ready end-June '08
- For further news and updates, see for example the "CMS Times", which has weekly updates on pit activities
  - http://cmsinfo.cern.ch/outreach/CMSTimes.html
- Or technical info for collaborators:
  - http://cmsdoc.cern.ch/cms/performance/crc.html
- On a personal note:
  - My door is always open (physically and virtually), and I very much welcome any advice or experiences you have had from commissioning past experiments (or CMS currently)
  - If you want to come contribute to commissioning CMS – even better! Even just as another pair of eyes examining data

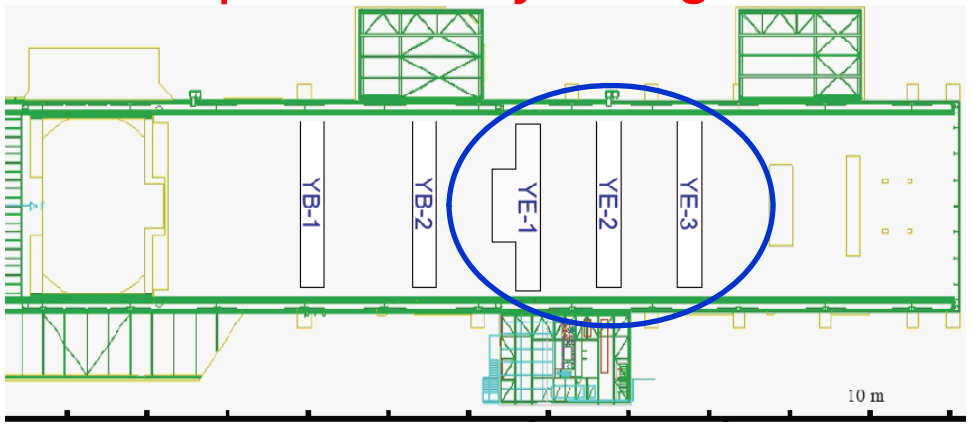
We all look forward to the view from the summit…
W, Z
Higgs
Z'
?
SUSY
Little Higgs
Hidden valley
top
Underlying event
Extra dimensions

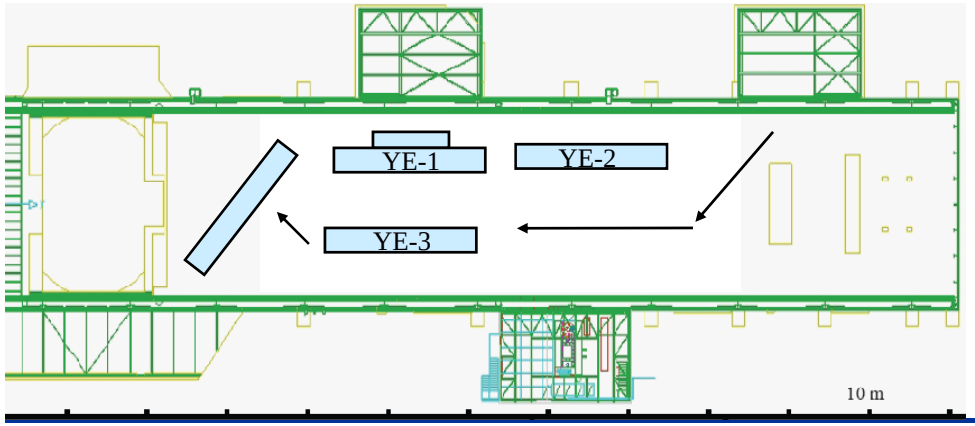
Backup

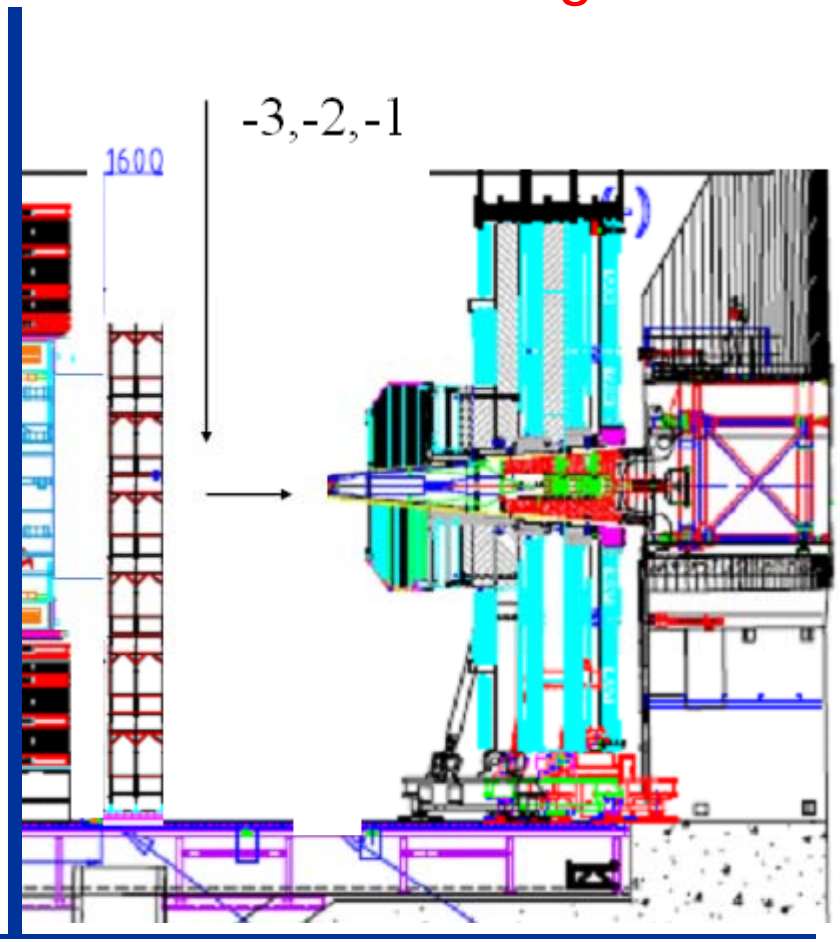
Status of UX5 Hall, September 2007

Pirouette of the 1000 ton disks

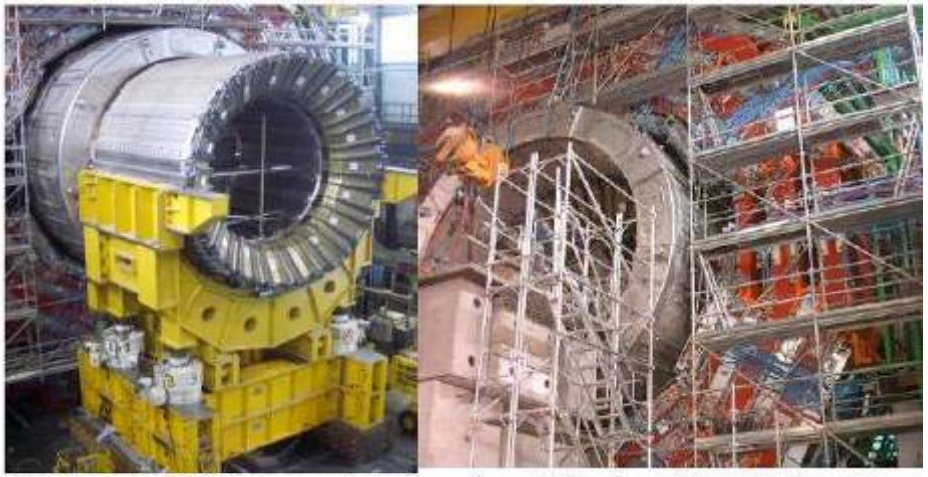
- To better accommodate the ongoing cabling and installation activities with the meeting of an end-of-year deadline to complete heavy lifting, reverse order of final lowering







MTCC: Valuable Experience Installing and Closing CMS on the Surface, before moving Underground



HB Insertion: First one took two weeks, while plus side took three days

EB Insertion

As well as integrating services (cabling, cooling, safety systems) and operations (calibration, alignment)

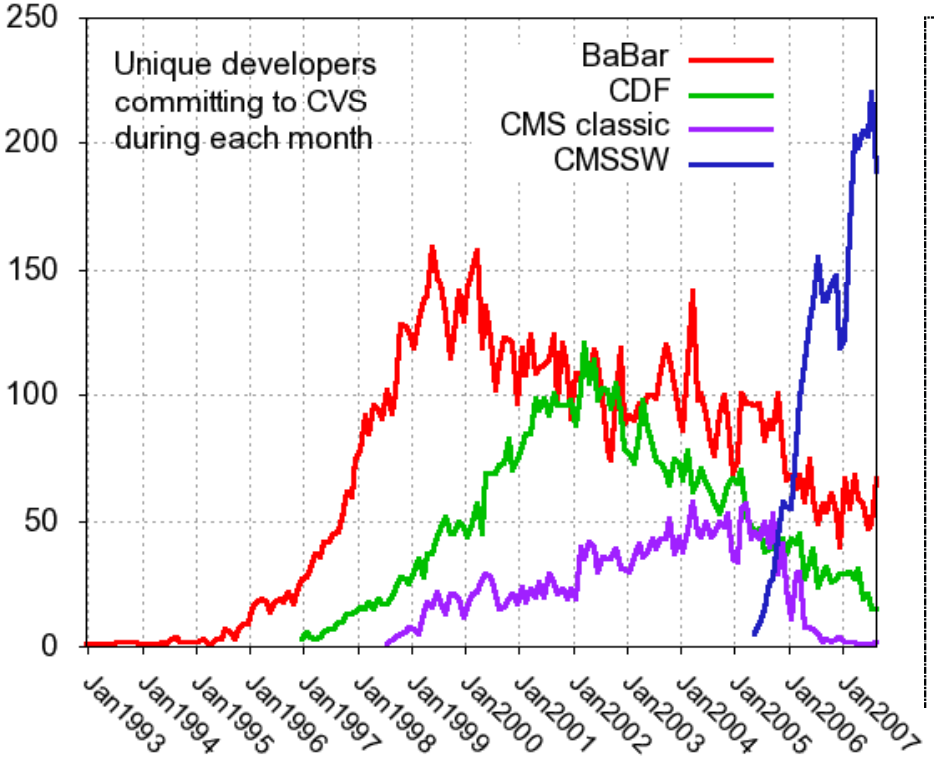
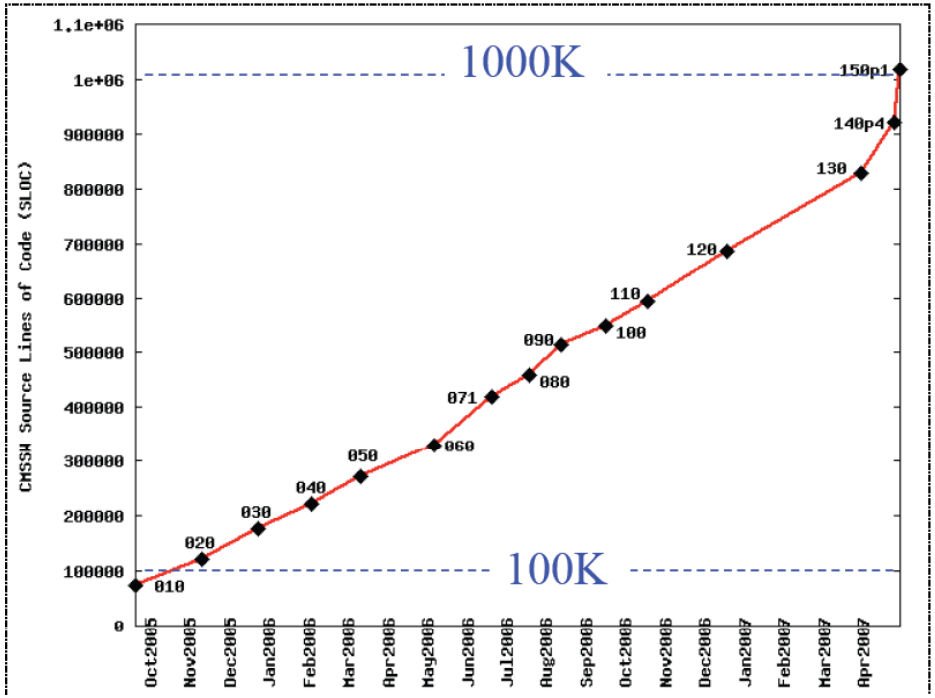
Drift Tube Local Commissioning

- Underground On surface

Sector	YB+2	YB+1 Summary	YB0 Summary Run summary	YB-1 Summary	YB-2
1	W2.S1	W1.S1	W0.S1	W-1.S1	W-2.S1
2	W2.S2	W1.S2	W0.S2	W-1.S2	W-2.S2
3	W2.S3	W1.S3	W0.S3	W-1.S3	W-2.S3
4	W2.S4	W1.S4	W0.S4	W-1.S4	W-2.S4
5	W2.S5	W1.S5	W0.S5	W-1.S5	W-2.S5
6	W2.S6	W1.S6	W0.S6	W-1.S6	W-2.S6
7	W2.S7	W1.S7	W0.S7	W-1.S7	W-2.S7
8	W2.S8	W1.S8	W0.S8	W-1.S8	W-2.S8
9	W2.S9	W1.S9	W0.S9	W-1.S9	W-2.S9
10	W2.S10	W1.S10	W0.S10	W-1.S10	W-2.S10
11	W2.S11	W1.S11	W0.S11	W-1.S11	W-2.S11
12	W2.S12	W1.S12	W0.S12	W-1.S12	W-2.S12

About 80% commissioned

For each sector Results from DQM analysis

Cosmic data yet to be taken & analyzed

Software Commissioning as Well…