CERN-RRB-2007-086



Stat. Rep. Doc: CERN-RRB-2007-085





CMS Management Board







LHC Schedule: May 2007 Memo from the DG "Engineering run at injection energy, originally foreseen at end this year, shall not take place. The most efficient path .. is now to commission all the LHC hardware to full energy.."

CMS re-optimized its installation sequence both on the surface and underground.

However for CMS, the Main Target remains the same April 2008: CMS* Closed & Field ON (and Cosmics Run) On track for this.

*including one EE, and pixels



CMS Progress since Apr 07 RRB



CMS Progress since Apr07 RRB: 1

CMS has made significant progress over the last 6 months.

Main highlights are:

- i) Surface: Completion of the silicon strip tracker, with a substantial fraction operated at multiple temperatures, including operating temperature (-15°C), with excellent performance. Now ready for installation at Point 5. Pixel construction is showing good progress towards timely completion.
- ii) Surface: All surface-mountable muon chambers have been installed. YE-2, YE-3 disks equipped with RPCs.
- iii) UXC: Barrel ECAL construction and installation completed, excellent quality, and followed immediately by a smooth transition to Endcap ECAL work.
- iv) UXC: YB-1, YB-2 Barrel yoke wheels lowered. Muon chambers had been commissioned with cosmics in SX.
- v) UXC: commissioning with cosmics of detectors underground proceeding. Monthly CMS Global cosmics runs were started in May; combined triggering and readout of multiple detectors is proceeding.
 TSV



CMS Progress since Apr07 RRB: 2

- vi) **UXC: the plus end has been opened** for consolidation and preparation for cosmics data taking end-Nov., moved with cable chains attached.
- vii) UXC: With a significantly enlarged team, much progress on installation of services on YB0, following stringent QA/QC philosophy. <u>Some delay</u> called up contingency: lower YB- wheels.
- viii) UXC: HF raising and shielding closure test was introduced and completed. Lessons learnt →reduce risks when closing for beam in '08.
- ix) **UXC: Beam pipe installation** on minus-end completed (off the critical path), with much learnt. Will help in installation of remaining sections.
- **x) USC: All magnet ancillaries lowered & re-installed**. Low-current power tests begin in November.
- xi) USC/SCX: Broad progress in commissioning the Level 1 Trigger. and final data acquisition system, including all links, and installation of the first 800 computers serving as readout or filter farm units.



CMS Progress since Apr07 RRB: 3

- xi) Preparation and use of **Computing Infrastructure** continued (including production of over 150 million simulated events), and is now being tested in CSA07, a 50% (of 2008 requirement) round-the-clock month-long data challenge to exercise the CMS Computing Model. Reliability of data transfers and site availability being improved.
- xii) Preparation of **Offline Software:** software releases are now synchronised with CMS needs for commissioning, online (HLT) and offline (reconstruction and physics). Improving release procedures and code performance
- xiii) The **High Level Trigger Exercise** was completed, demonstrating the foreseen capabilities (40ms/Lvl-1 triggered event) using close-to-final code. **Preparation for physics analysis** at startup advanced, with a focus on calibration, alignment, and analysis of early data.



CMS Progress since Apr 07 RRB In Pictures



YB0 in April



Situation in Cavern (Oct'07)







Details of YB0 Services

Tracker services completed; HCAL services connection and check-out (3/4 done); ECAL services connection (1/3 done);





Installation of HB and EB services and testing thereafter





Lowering of YB-1, YB-2







Tracker Ready for Transport to Pt5



The Si tracker (200m², 10 Mch)
All systems operated reliably for 5 mo. Performance meets requirements set out in TDR

• ~ 5 M cosmics recorded and analysed.

CMS Status KKD20 ISV



Pixels

Barrel Assembly Barrel pixel assembled by Layer January08 FWD pixels full detector at CERN in Nov 07 Install in CMS in Mar 08 FWD pixels Layer 1 & 2 BPIX (3 Layers) FPIX (2 Disk) 672 Modules 96 Blades 96 Halfmodules 672 Plaquettes 18 11520 ROC 4320 ROC



2nd Half Barrel 18 SMs installed and tested in 12 working days!

1st Half Barrel Installed in May

Barrel ECAL installed. Excellent quality (28 ch dead/noisy out of 61200).

CMS Status RRB25 TSV



ECAL Endcap Assembly



Endcap crystals production is proceeding well: over 7000 crystals now delivered (out of 14750 needed). Last EE crystal will be delivered end-Mar'08.

EE assembly started. Install one endcap in Mar 08. 2nd ready end June'08.



YE-1 and Installation of Preshower Window



Endcap RPCs



Installation of all Endcap RPC chambers (432) has been completed

Station RE-3 is connected to services (gas & cooling) Pre-commissioning done.

Final check out of plus-end RPC stations during the ongoing access window

Full commissioning of RPC stations in the underground cavern

Expect to have the minus-end cap down before Xmas to start full commissioning.



Sub-detector Commissioning



Si Tracker Performance: Efficiency



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Layer Efficiency Real DATA



Commissioning of DTs in UX: YB0, YB+1





Participating Subsystems in Global Runs





Aug Global Cosmics Run: UX-US



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Off-Detector Electronics

More than 80% installed and tested (installation started January 07!)

	FEDs	Other	TP G	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 find e r	Dependent on component between 30% and 80% of tower electronics

Generally 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)



Trigger in USC55

- ECAL_EB & HCAL Trigger is installed and connected
 RCT & GCT (electron trigger) installed
- All 3 Muon systems (DT, CSC, RPC) installed
- Muon trigger tests running successfully being used regularly In Global Runs







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Commissioning of Software, Computing and Physics Analysis

Need to synchronize commissioning of the hardware, computing, offline and physics analysis systems

a) Software Releasesb) Computing Infrastructure: CSA07c) Preparation for Physics Analysis



CSA07 Workflows

Ongoing: Mimic in detail @ 50% of the distributed analysis during 2008





CSA07 and Physics

- Tier-0 output to Tier-1s: ~150 Mevt
 - ~ 100pb⁻¹ of "data".
 - Reconstruct with calibration/alignment constants corresponding to "detector knowledge with 10pb⁻¹ of data"
- AOD created and distributed to (all/multiple) Tier-1s
 - Run skim jobs on AOD at Tier-1's
- Test re-reconstruction at Tier-1
 - Same data, this time run with 100pb⁻¹ constants
- At Tier-2's: monitor incoming skim data; check/validate
 - In parallel: run on older samples (for 2007 analyses).
 - All analyses migrate to Tier-2s mimicking real-life.
 - Generate 50 Mevt Monte Carlo events
- CAF: first tests (data, code, organization) of "Express Line"
 - Three analyses: W/Z, Higgs and Z'.



CSA07: Progress



Castor Performance has been very good

Hitting metric for organized processing (simulation, reconstruction and skimming 25k per day)

Analysis metric of 75k jobs per day has still to be achieved

Use of Tier-2 sites for analysis increasing

Still to ramp up Tier-1 to Tier-2 transfers





- Prior to beam: early detector commissioning
 - Readout & trigger tests, runs with all detectors (cosmics, test beams)
- Early beam, up to 10pb⁻¹:
 - Detector synchronization, alignment with beam-halo events, minimum-bias events. Earliest in-situ alignment and calibration
 - Commission trigger, start "physics commissioning":
 - Physics objects; measure jet and lepton rates; observe W, Z, top
 - And, of course, 1st look at possible extraordinary signatures...
- Physics collisions, 100pb⁻¹: measure Standard Model, start search
 - 10⁶ W \rightarrow I v (I = e,µ); 2x10⁵ Z \rightarrow II (I =e, µ); 10⁴ ttbar \rightarrow µ+X
 - Improved understanding of physics objects; jet energy scale from W → j j'; extensive use (and understanding) of b-tagging
 - Measure/understand backgrounds to SUSY and Higgs searches
 - Initial MSSM (and some SM) Higgs sensitivity
 - Early look for excesses from SUSY& Z'/jj resonances. SUSY hints (?)
- Physics collisions, 1000pb⁻¹: entering Higgs discovery era
 - Also: explore large part of SUSY and resonances at ~ few TeV

Object id/eff : Data Driven Methods

- Tag and Probe (T&P): identify a physics object in an unbiased way in order to study efficiencies.
 - One object (tag) has strict ID criteria imposed on it. Second object (probe) has looser ID criteria. Additional property that links it to the Tag object to ensure a pure sample.
 - Z→ee events: one tight electron (tag); the other can be a probe, provided the invariant mass of the pair is ≈M_z











SUSY Early Hints

100pb⁻¹→ ~600 GeV sparticles, but: Need control over backgrounds Example from E_T^{miss} +3jet events

bkg*3 ~ signal @ 10pb⁻¹





Normalizing $Z \rightarrow vv E_T^{miss}$ to $Z \rightarrow \mu\mu$ using data



Physics Plans

• What CMS is currently doing:

• Computing-Software-Analysis (2007) challenge to mimic one month of operation at 50% of real capacity

"Analysis" includes miscalibration and misalignment for 100 pb⁻¹ of data, recovery of constants, usage in physics analysis. All analyses concentrating on how they will be carried out with real data

• Analysis: Concentrate on physics we can do with < 1 fb⁻¹.

Chart out the "how" of this work, and to prepare methods, tools and people.

• From Jan 08 to May 08

Have all the analyses (geared for 10 pb⁻¹ & 100 pb⁻¹) & organization (code + people) in place ready to absorb the data



Memorandum of Agreement

for the Maintenance and Operation of the CMS Detector

between the CMS Collaboration (CMS)

and the (Consortium of) Funding Agency(ies) (Provider) (Consortium of) Institute(s) (Provider) collectively named the Signatories Effort to be found within the Collaboration

FAs to take Note

A formal internal document has been prepared to cover the needs for the Maintenance and Operation of the CMS Detector. Discussed within the collaboration- in final draft. Aim for approval in CMS Collaboration Board in Dec'07.

A large effort, estimated at about 550 FTE per year, will be needed across the full Collaboration for the first two years of running, 2008 and 2009. A fair share of the service work is envisaged for all CMS members averaged per Institution at the level of 6 months of 100% effort every 2 calendar years. Physics analysis tasks, and other similar tasks, are not considered service work.

This mandatory level of service work will be reviewed at the end of the period. Web tools to manage the planning and accounting are being evaluated. CMS Status RRB25 TSV



Schedule Overview



v36 Schedule: Overview

LHCC: CMS has chosen to move to a more conservative (less parallel) installation schedule & undo some of the complexity of v35 schedule.

Main Target

Apr'08: CMS* Closed & Field ON - Cosmics Run: On track for this.

* including one EE, and pixels.

Secondary Targets

All heavy lowering completed by end-07 Tracker installed and parts being readout by end-07 Dec'07-Mar'08: Use opportunities to take cosmics data in open configuration (+ end, barrel, - end)

Observations

QA/QC: still following stringent QA/QC policy - install and test/measure at each step (complex & nested operations,)

Reduce risk: always seeking ways to reduce risks, e.g. shuffle tasks, introduce new tests, alter sequences to reduce dependencies CMS Status RRB25 TSV

1) Detector Installation, Commissioning & Operation	Aug	2) Preparation of Software, Computing & Physics Analysis	
V36 Schedule	Sep	S/w Release 1_6 (CSA07)	
	Oct	CSA07 S/w Release 1_7 (CCR_0T, HLT Validation	
Tracker Insertion Test Magnet at low current	Nov	2007 Physics Analyses Completed	
Last Heavy Element Lowered	Dec	S/w Release 1.8 (Lessons of (07)	
Several short periods Dec-Mar)	Jan		
	Feb	Functional Tests CSA08 (CCRC)	
Beam-pipe Closed and Baked-out	Mar	S/w Release 2_0 (CCR_4T, Production of startup MC samples)	
Cosmic Run CCR_4T	Apr	MC Production for Startup	
Master Contingency	Мау	CSA08 (CCRC) Combined Computing Readiness Challenge	

CMS Status RRB25 TSV 2nd ECAL Endcap Ready for Installation end Jun'08



Conclusions

CMS made significant progress during the summer. There are no significant technical issues.

Current critical path goes through Installation of services on YB0 To watch: ECAL Endcaps EE & ES assembly, readiness of infrastructure

CMS is on track to be closed and taking cosmics at 4T in Apr'08 in anticipation of collisions.

CMS will be ready for, and is eager to lay hands on, collision data at design energy.

With 100pb⁻¹ measure the Standard Model and establish CMS as a physics-producing engine

Also look for hints of new physics

With 1fb⁻¹ enter the Higgs discovery era. With a few fb⁻¹: firm discovery "SUSY" explorable over very large area with 1fb⁻¹; possible new resonances CMS Status RRB25 TSV 44



There are no serious technical impediments to CMS completing the initial detector in time for the first LHC run in 2008.

CMS weekly news appears in "CMS Times" - accessible from http://cms.cern.ch/



Reminder from October 2006 (RRB23)

Upon the recommendation of the CERN management CMS prepared a **global financial plan** up to 2010 evaluating not only the shortfall for the low luminosity detector, but also the funds needed to introduce the staged items for the design luminosity (10³⁴ cm⁻²s⁻¹).

The items were presented in a **prioritized way in 3 steps**.

Step 1: complete the low luminosity detector (17.5 MCHF).

Step 2: complete the DAQ (8.4 MCHF).

Step 3: upgrade to design-luminosity detector (16.6 MCHF).

The rescoping of the forward RPC (RE) system was also proposed and is to be built via in-kind contributions.

The October 2008 RRB, in one year's time and upon completion of the low luminosity detector, will be an appropriate moment to "close the books" on construction expenditure for the Low Luminosity detector.

Table 2		MoU Funding	CTC1 RRB15	CTC2 RRB20	Constr. Funding	STEP 1 Low Lumi	STEP 2 DAQ	STEP 3 Rest	Total Design	
CERN-RRB-2006-105	PhDs	2002	Oct02	Apr05	2006	(Constr.)	(PhD)	(PhD)	Lumi	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Austria	11	3,900	600	275	4,775	211	45	171	427	
Belgium	27	5,000	870	300	6,170	272	111	420	803	
Brazil	9				0	0	37	140	177	
Bulgaria	5	600	0	0	600	26	21	78	125	
CERN	72	85,200	13,500	4,800	103,500	4,569	297	1,119	5,984	
China	13	4,315	500	300	5,115			in	kind RPC	
Croatia	7	280	49	20	349	15	29	109	153	
Cyprus	3	600	106	0	706	31	12	47	90	
Estonia	2	90	16	6	112	5	8	31	44	
Finland	12	5,000	870	300	6,170	272	49	187	508	
France CEA	14	5,600	1,687	445	7,732	341	58	218	617	
France IN2P3	38	19,700	2,000	2,000	23,700		2,000	0	2,000	Pled
Germany BMBF	41	17,000	2,709	1,100	20,809	919	169	637	1,725	
Germany DESY	5				0	0	2,000	0	2,000	New
Greece	17	5,000		0	5,000	221	70	264	555	
Hungary	6	1,000	58	0	1,058	47	25	93	165	
India	26	4,400	300	500	5,200			in	kind RPC	
Iran	3	510	700	0	1,210			in	kind RPC	
Ireland	1				0	0	4	16	20	
Italy	181	55,000	8,927	4,000	67,927	2,998	746	2,813	6,557	
Korea	12	1,315	500	147	1,962			in	kind RPC	
Mexico	5				0	0	21	78	98	
New Zealand	3				0	0	12	47	59	
Pakistan	3	2,445	230	149	2,824			in	kind RPC	
Poland	12	3,000		0	3,000	132	49	187	368	
Portugal	5	2,000	300	140	2,440	108	21	78	206	
RDMS	72	18,862	2,211	1,657	22,730	1,003	297	1,119	2,419	
Serbia	3		450	0	450	20	12	47	79	
Spain	34	6,000	1,350	450	7,800	344	140	528	1,013	
Switzerland	30	86,500		200	86,700	0	124	466	590	
Taipei	11	2,330	410	0	2,740	121	45	171	337	
Turkey	18	1,000	58	0	1,058	47	74	280	401	
UK	49	9,100	918	3,000	13,018	575	202	762	1,538	
USA	418	104,320	12,800	1,868	118,988	5,252	1,722	6,497	13,471	
₍ Sum	1,168	450,067	52,119	21,657	523,843	17,530	8,400	16,600	42,530	
Requested			63,000	32,000						



CMS Status RRB25 TSV

The rescoping of the RPC system is now proposed to be done in two phases, the first for the geometric region at lower eta ($|\eta| < 1.6$) and the second for the region at 1.6 < $|\eta| < 2.4$.

COST Estimate	Phase 1 kCHF)	Phase 2 (kCHF)	
	4210	2740	

FUNDING	Contributions	Comments
Countries	kCHF	
Belgium	420	Likely to use its Step 3 funds for RPC
		system
China		Discussing a contribution of 580 kCHF
India	800	Request made
Iran		Discussing. Request made in Oct06 RRB
		was for 800 kCHF
Korea		Initial request to produce all gaps (esti-
		mated at ~580 kCHF)
Pakistan	1250	Granted

Some groups currently working on the barrel RPC system are also considering participating in the RE rescoping project. 48



Status of Additional Funding for Steps 1, 2 & 3

In bold input since Apr07 RRB

	Step 1	Step 2	Step 3	Comment
Austria				Discussing
Belgium-FNRS	136	56		
Belgium-FWO	136	56		
Brazil	n.a.			Request made for Step 2
Bulgaria				Awaiting response
CERN	4,569	297	1,119	
	Endcap			
China	RPC	Endcap RPC	Endcap RPC	Discussing request
Croatia	15			
Cyprus				Awaiting response
Estonia	5	8		
Finland	272	49		Funding in 2010 and 2011
France-CEA				Discussing
France-IN2P3	n.a.	2,000	n.a.	
Germany BMBF	919	118	637	Step 1&2 almost paid, Rest - Commitment
Germany DESY	n.a.	2,000	n.a.	New Agency
Greece				News in Oct RRB
Hungary				Discussing
India	Endcap RPC	Endcap RPC	Endcap RPC	Request Submitted, News in Oct RRB
Iran	Endcap RPC	Endcap RPC	Endcap RPC	Discussing
Ireland	n.a.	4	16	
Italy	2,500			Step 1 likely to partially covered
Korea	Endcap RPC	Endcap RPC	Endcap RPC	Discussing
Mexico	n.a.			Awaiting Response
New Zealand	n.a.	12		Step 2 OK, Step 3 discussing
Pakistan	Endcap RPC	Endcap RPC	Endcap RPC	Commitment made
Poland	132	49		+ve response, request in 2008
Portugal	108	21		Likely OK for Steps 1&2
RDMS-DMS				Discussing
RDMS-Russia				Discussing
Serbia	20			
Spain	344	140		Likely OK for Steps 1 & 2
Switzerland	n.a.	124	466	Apply in 2008
Таіреі	121	45		Request for Steps 1&2 in 2009/2010
Turkey				Awaiting response
United	575	202	760	
	575	202	102	
USA-DOE/NSF	5,252	1,/22		
Sum	15 100	6000	3000	
Domucated	17,100	0,400	3000	
Requested	17,530	8,400	10,600	
% covered	86%	82%	18%	



Conclusions on Funding

- CMS is grateful to the many agencies that have already made commitments to the various Steps.
- CMS now urgently requests the others to make commitments to at least Steps 1 & 2 and to the rescoping of the RE system asap after this RRB.

The construction, installation and commissioning of the lowluminosity CMS detector is now close to being completed. CMS is very grateful to all the Funding Agencies for the support provided over the long construction period.