Status of CMS
Progress Summary Report for April 2007 RRB24

In the current CMS Master Schedule the initial detector will be ready for first collisions in the last quarter of 2007. Installation of the pixel tracker and the ECAL endcaps is foreseen during the 2007/2008 winter shutdown, in time for the first physics run in spring 2008.

Since the successful recording of cosmic rays while the solenoid was ramped up to the design field of 4T last summer and autumn, the large sections of the detector have been pulled apart and ten out of the fifteen heavy elements have been lowered into the underground cavern. The lowering of the large central piece containing the solenoid on 28 February marked a major milestone, with the main focus subsequent activity shifting underground.

Phase 2 of the Magnet Test and Cosmic Challenge (MTCC)

At the time of the last RRB, Phase 2 of the Magnet Test and Cosmic Challenge (MTCC) was beginning, with the magnet energized again in order to map the field with an accuracy of 10^{-4} and record additional cosmic rays for further commissioning of the detector, trigger, and readout. Several maps were obtained at the desired precision. More triggers than originally planned were made operational and run stably for long periods with good acceptance and correct rates. All muon triggers, the calorimeter trigger and the global trigger participated in the MTCC using the final central infrastructure. Various system tests validated the trigger timing control, trigger software, and rate throttling.

Almost all the MTCC readout and data acquisition infrastructure in surface building SX5 will remain in place until the middle of 2007, to act as a commissioning platform for the –z end detectors and as a further test-bed for integration with trigger and DAQ. In March the first such cosmic ray data-taking began with events recording in the muon system.

Civil Engineering

Status

Civil engineering works at Point 5 (Cessy, France) have been completed. The experiment cavern was ready to receive the first detector elements, the two forward hadron calorimeters, in October 2006. Complete equipping of SCX as a full-fledged control room is underway.

Changes

None.

Plans for 2007

Complete infrastructure in all buildings and caverns and commission it.

Concerns

None.

Installation and Infrastructure

Status

The cooling plants (water and fluorocarbon) have been completed. The rack system is completed, and crates are being installed in parallel with the main cabling campaign. The electrical distribution has been completed. It is planned to complete the low-voltage distribution system by June.

The forward calorimeter, including the forward cylindrical shielding surrounding it, have been fully assembled at CERN and have been installed in their respective underground alcoves at both ends of the underground cavern. The rotating shielding at both ends has been installed and tested.

Heavy lowering began and pieces in the cavern now include both Forward Hadron Calorimeters (HF); the three +z end disks including one end of the Endcap Hadron Calorimeter (HE) and muon detectors; three of the five barrel wheels including muon detectors and the central wheel (YB0) and solenoid; and the two halves of the barrel hadron calorimeter (HB). Subsequently both HB haves were inserted back into the solenoid. The movable sections are being connected to their respective cable chains.

Changes

None.

Plans for 2007

Lower the remainder of the detector, complete cabling of cable chains on the minus side, and cable up the detector.

Concerns

The remaining cabling, especially of YB0 and the Tracker, fall on the critical path.

Magnet

Status

As noted above, the magnet was mapped during MTCC Phase 2 and is now in place in the underground cavern. Ancillaries are being transferred to the underground service cavern.

Changes

None.

Plans and milestones for 2007

All ancillaries must be reinstalled, connected and tested to allow cooling down of the coil in September.

Concerns

None.

Tracker

Status

The CMS Tracker continues to make good progress. All of the tracker subdetectors were completed and delivered to the Tracker Integration Facility (TIF) at CERN by the end of November for insertion into the Tracker Support Tube (TST) and further commissioning. The TIF has been equipped with 25% of the readout electronics, 25% of the power supply system and fully operational data acquisition, detector control and safety systems. Each of the sub-detectors has been thoroughly tested and subjected to rigorous Quality Assurance at each stage of construction, and before integration into the TST. The quality of the sub-detectors is excellent with < 0.3% of dead or noisy channels and a signal to noise ration of > 25:1 in the peak readout mode. By mid-March all elements of the tracker had been inserted into the TST, and the first cosmic ray muons were recorded in view of performing alignment tests amongst many other tests.

A Tracker Analysis Centre has been established at the TIF, which is used to control both the commissioning process and data taking with a cosmic ray trigger. All aspects of Tracker operations are exercised and data are analyzed using the full on-line and off-line software suites both at CERN and throughout the collaboration using the CMS distributed computing system.

The Pixel Detector continues to make very good progress. All components have been qualified, and module and plaquette production is > 60% complete. An engineering sector of the Pixel Detector will be inserted into CMS for the planned Pilot run of LHC at the end of 2007. The first two half shells of the Forward Pixels (FPix) engineering sector have arrived at CERN from Fermilab and the integration of this sector has started at the TIF. The engineering sector of the Barrel Pixels (Bpix) will arrive at CERN in July. The complete Pixel Detector will be ready to insert into CMS in the first quarter of 2008 for the first physics data taking at LHC in 2008.

The readout electronics systems and final power systems have been delivered to CERN and commissioned with the DAQ and DCS systems in the CMS Electronics Integration Facility. The installation of these systems at P5 continues to make good progress

The new design of the Tracker Patch Panel 1 (PP1) is in full production. The design allows the pre-cabling of the Tracker to be completed on YB0 before the Tracker is installed into CMS. After the pre-cabling is completed, the Tracker can be installed, aligned and connected to PP1. There is a plan to install all the services onto YB0 before installing the Tracker in August 2007.

Changes

None

Plans and Milestones for 2007

Continue to commission all aspects of the CMS Tracking systems at the TIF until the pre-cabling at P5 is complete.

Complete the construction of the pixels detector

Install the Tracker into CMS; connect to PP1 and commission in situ.

Concerns

The schedule for the installation of services onto YB0 is very tight.

Electromagnetic Calorimeter

Status

All 61200 of the barrel crystals have been delivered. All modules (400 or 500 crystals) have been assembled in CERN and Rome. Thirty-five (out of thirty-six) bare supermodules (SM, each comprising 1700 crystals) have been assembled. The last supermodule will be ready by April 20th. For both suppliers, the production of Endcap crystals started immediately after the end of the Barrel crystals production and is expected to finish by February 2008. Around 1200 crystals have been delivered.

The production of all 140,000 APDs (for the barrel) and of the 16000 VPTs (for the endcaps) is complete. The production and test of the on-detector electronics has been completed for both the barrel and the endcaps.

In 2006, twenty-five supermodules were integrated with electronics. However, a potential long-term weakness was identified with one of the passive connection boards, and it was decided to remedy this situation by exchanging this board. The present integration rate of 9 supermodules per month is consistent with the general assembly schedule of CMS. At the time of writing 13 SMs had been modified. The performance of the integrated supermodules satisfies fully the design performance stipulated in the TDR.

All off-detectors readout modules are in hand, with the exception of the endcap trigger module (different from the barrel one due to the complex endcap geometry), whose prototype is under testing. Eighty percent of these modules are installed in the CMS service cavern and the installation will be complete by May 2007.

The construction of the endcaps is progressing according to schedule. All mechanical elements needed for the four Dees (D-shaped mounting structures) have been delivered to CERN. A 500-channel prototype, using all final elements, is under assembly and will be moved to the H4 test beam area at the end of May. The construction of the first Dee has already started. The pace of the endcap assembly is driven by the crystal delivery.

Preshower: All of the required silicon sensors have been produced. Forty percent of the bare micromodules (the sensor glued on its ceramics and its mechanical support) have been assembled. The specific Preshower DSM ASICs are available. Some difficulties were encountered with the production of the front-end hybrid printed circuit boards: a new pre-series was delivered in February 2007 and has been recently qualified. The production of the readout motherboard is 60% complete. Prototypes of the specific off-detector readout module have been successfully tested and the production will be launched in the next months.

Changes

A potential long-term weakness in a passive connection board has been rectified.

Agreement has been reached for the in-kind production of 1500 endcap crystals.

Agreement has been reached for the production of the last 5500 endcap crystals.

Plans and Milestones for 2007

Complete the exchange of the weak connection board, install all barrel supermodules in CMS and commission the barrel for data taking at the end of 2007.

Continue endcap crystals production and proceed with the assembly of endcap Dees.

Concerns

Crystal production remains on the critical path for endcaps. The schedule for the completion of the Endcaps and Preshower is very tight.

Hadron Calorimeter

Status

By the end of 2006 the initial assembly and installation of all HCAL (HB, HE, HO and HF) subdetectors was complete. All cabling from the front ends to patch panels is complete for all subdetectors. Both HF detectors, both halves of HB, and the +z HE are now in the underground cavern.

In the CMS Electronics Integration Facility on the Prevessin site, HCAL has set up a complete readout chain, from the front-end Hybrid Photodiodes (HPDs), the QIE digitizers, 1.6 GHz optical data fibers, HTR and DCC trigger/data processor cards, through the SLB mezzanines which transmit the Level 1 Trigger Primitives to the Regional Calorimeter Trigger. This facility provides the essential functions of verifying the integrity and proper operation of each crate of HCAL VME electronics before installation in the USC55 cavern, as well as discovering any conflicts. Of particular importance was the verification of transmission of HCAL and ECAL Trigger Primitives to the RCT, an intersection where the contributions of four separate subdetector groups must work together flawlessly. In all, during the crucial build-up year 2006, 16 VME crates, over 200 HTR, 40 DCC, and 30 TTCf Fanouts have been integrated and verified.

A primary integration goal was achieved for HCAL with its participation in the Magnet Test and Cosmic Challenge. A number of HCAL barrel wedges and HCAL endcap sectors participated in the integration exercise and were used in the latter phase of the MTCC as trigger generators. The cosmic muon data serve as a crosscheck of the calibration using sources because it is compared to the test beam data taken for muons. The HCAL front end electronics, the data acquisition electronics (DCC) and the trigger system (HTR) were all tested in the MTCC along with the detector slow controls system (DCS) for HCAL. In the course of the MTCC it was found that the HO modules had to be relocated to optimise the response of the HO photodetector (HPD) readout in the magnetic field. It was also found that the HCAL photodetector noise output was a function of the magnetic field strength. At zero Tesla and four Tesla fields the noise output is minimum and about equal at both settings.

By end of March of 2007 both HB detectors were installed inside the CMS magnet cryostat underground in UX5. Layer 16 of HB was installed before lowering into UX, so that HB is complete except for layer zero. Initial readout tests of HF underground were also successful, with HF signals being readout by the entire electronics chain from the front ends in the UX5 experimental hall to the HTRs and DCCs in the USC55 electronics area.

Changes

No major changes.

Plans and milestones for 2007

The second HE detector, mounted on YE-1, is still to be lowered into UX. Verify the Trigger/DAQ path for the rest of the HCAL detector. Participate in the global cosmic ray tests during 2007.

Concerns

None.

Muon Detector

Status

Endcap Cathode Strip Chambers: All but the last 36 recently-installed chambers have been commissioned with cosmic rays on the surface, and testing has now begun on those 36 chambers as well. The +z half of the endcap disks with installed chambers and on-chamber and peripheral electronics have been lowered into the experiment cavern. Preparations for commissioning underground have begun. The chambers on the "minus" side will continue to be tested on the surface for the next few months before lowering.

Barrel Drift Tubes: The installation planned in the surface hall was completed, and as noted above, 3/5 of the barrel wheels are underground. The barrel Installation plan foresees that 8 chambers per wheel are installed underground, because their pockets are taken by the lowering device: the 24 chambers of the two positive and of the central wheel were installed without problems just after lowering.

The next step is the commissioning underground of complete wheels that are quite independent units, operated from USC. The first one will be YB0, planned in April. At the same time, the test of fully equipped negative-end wheels is starting in the surface hall. The scheme for the test on the surface is the same as for the Cosmic Challenge (MTCC), with control of few sectors at a time.

Fourteen chambers in three sectors of wheels +1 and +2 (S10, and S10 and S11 respectively) were successfully operated in the MTCC. More the 100 Million events from cosmic muons were collected with different Trigger settings and different values of the Magnetic Field. The behaviour of chambers and Trigger in Magnetic Field is fully compatible with the expectations. The Magnet Test was important to validate the full Trigger and DAQ chains and allowed starting the mass production of the Trigger Collectors sitting in the towers of the wheels and of the DDU in the CR. The test was a large-scale proof of the behaviour of about 12000 channels of Trigger and (6% of the full system). The system proved to be robust under operating conditions for about five months.

Barrel RPCs (RB): RBs are coupled together with the DTs before installation and the same considerations as above are valid for RPC. All of the installed chambers have been pre-commissioned with high voltage and no major fault has been found. An integrated detector-trigger commissioning is now on the way for wheel +2 and it will then continue in sequence on wheels +1 and 0. RPCs coupled to the DT of the three sectors in wheel YB+1 and +2 were operated during the magnet test. The performance was very good: currents and noise are very low and the behaviour very stable. A special electronics designed for trigger on cosmics was tested: this allowed a combined trigger with DTs. A very useful cross-check could be performed of the spatial position and timing of the crossing tracks.

Endcap RPCs (RE): the RPC gap factory in Korea is active and mass production of gaps is almost finished. Priority has been given to RE1 chambers under the responsibility of Peking University. All of the RE1 RPCs (144 chambers in total) have been installed on the yoke, both at the plus and minus ends and have been successfully pre-commissioned. RE2 and RE3 RPCs are being assembled in Pakistan (288 in total); their installation is finished for the plus endcap and full pre-commissioning has been done; hence, the positive end cap is complete. For the minus end, the Pakistani chambers for station 2 have been installed and pre-commissioned. The minus end cap is expected to be completed by the summer this year, prior to lowering the minus end cap yokes.

Alignment: In the Magnet Test about 30% of the complete system to cover two radial sections of CMS in the Barrel and Endcap yokes was successfully commissioned and tested at all magnetic field values. Studies on system dynamic range, geometry reconstruction, motion and deformation of the yoke structures with field, and detector opening and closing tolerances and reproducibility are on going. First studies of alignment with tracks have also been performed using data taken with the magnet off and on. They allow refining and validating alignment algorithms and establishing strategies for the alignment of the muon detectors using survey measurements, as well as optical- and track- based information.

Installation and functionality tests of the final system have been completed in underground for the +z side detector structures. Assembly and installation of the rest of the system is progressing accordingly with the general CMS schedule. Final commissioning of the system is pending on the availability of the LV power supply.

Changes

None.

Plans and milestones for 2007

Barrel Drift Tubes and RPC's: Complete commissioning of the chambers in the five wheels. Continue commissioning in UX.

Endcap CSCs: Finish commissioning of the remaining CSC chambers before the –z disks are lowered into UX. Continue commissioning in UX.

Endcap RPCs: Install RE3 and commission the full RE system.

Alignment: commission the system

Concerns

Delivery of LV supplies will define the pace of commissioning of DTs and RPCs.

Trigger and Data Acquisition

Status

Trigger: The trigger and data acquisition consists of four parts: the detector electronics; the calorimeter, muon and global first level trigger processors; the readout network; and an online event filter system.

The Level-1 Trigger System is initially expected (at low luminosity) to reduce the bunch-crossing rate of 40 MHz to an event rate of 50 kHz. Each physics event (1 Mbyte data size) is contained in about 600 front-end buffers. The data acquisition (DAQ) System assembles event fragments from these buffers into complete events, which are then delivered to the HLT for processing. The High Level Trigger (HLT) System is expected to reduce the Level-1 event rate by a factor 1000, leading to a maximum rate of sustainable physics events of ~ 10^2 Hz for a nominal Level-1 event rate of 100 kHz. The physics algorithms of the HLT are implemented in software that is executed in a conventional computer. A large number of such computers, organised in a so-called "Filter Farm", are required to process events at the rate delivered by the Level-1 trigger.

A key characteristic of the DAQ design is its modularity that allows a staged deployment. The design provides the maximum of flexibility in the on-line physics selection process.

Level-1 Trigger: Most trigger systems have completed production. Detailed extensive inter-system integration testing is also mostly completed in the Electronics Integration Centre (EIC) in Prevessin. The Magnet Test and Cosmic Challenge (MTCC) was a major success for the trigger system with more triggers than originally planned operational and stably running for long periods with good acceptance and correct rates. All muon triggers, the calorimeter trigger and the global trigger participated in the MTCC using the final central infrastructure. Various system tests validated the trigger timing control, trigger software, and rate throttling. The installation, cabling and testing of the trigger systems in USC55 is now underway and integration tests are taking place in preparation for commissioning in the summer. Other tests will involve complete slices of individual detectors being triggered and their data captured, as well as operation in global test runs.

DAQ: The pre-series system installed in temporary quarters at Point 5 in 2005 has been exploited as a full DAQ system to take data during the Cosmic Challenge. The system included a LCT trigger, 33 FRLs, 6 FED Builders, a 6x6 EVB, 16 FUs, 2 Terabyte storage and 20 DAQ/DCS servers; more than 50 million events have been collected from June to November 2006 allowing a realistic evaluation of the readiness for the final system of all hardware and software components.

In the underground area (USC) the installation of all readout and control equipment was completed in December. This included 512 FRLs, 660 FMMs, 60 PCI crates, 800 LVDS cables and optical fibres, 250 DAQ controller PCs, an 18-PC cluster for mini-DAQ, 1024 port Myrinet switches, and CERN network interconnection. The component test and the readout systems commissioning started in January 2007.

On the surface, 110 water-cooled racks have been installed into the DAQ computing room (SCX) and the Data-to-Surface and event builder cabling has started. The procurements for Myrinet switches, GBE switches and optical cables have been completed. The order for 700 PCs to be used for the first collision DAQ system has been issued and the PC installation in SCX will be completed in August 07. The optical cables for the data transfer from USC to SCX will be installed in March 07.

Changes

Installation in USC55 of the first parts of the GCT has begun, with the rest of the system moving into production.

In USC the miniDAQ is operational. The readout commissioning of all sub-detectors has started. At the surface the SCX computing room is ready with 100 racks, Myrinet and GBE Force-10 switches installed. Equip SCX, install PCs and get DAQ ready for data taking at the end of 2007

Concerns

The time available for installation and commissioning in the underground area is short.

Computing, Offline Software, and Physics

Status

In 2006, CMS Computing, Software, and Physics were organised as part of a single project called CPT, while beginning in 2007 they are separate projects reporting to the spokesperson. Major milestones reached included the completion of the new framework and application software suite (CMSSW) to the point where it could be used in the Magnet Test and Cosmic Challenge (MTCC); successful participation in the WLCG Service Challenge 4; the combined Computing, Software and Analysis challenge (CSA06); and

the development of new computing systems to enable the running of CMSSW jobs on the grid.

The software of the CMS experiment is well advanced and has been used to perform detailed simulation of the detector response and to implement sophisticated reconstruction algorithms. A comprehensive set of changes has been made in the underlying software framework and in the services it provides, and in the model for data storage to prepare the experiment for data taking. These changes address additional requirements on the software to implement calibration and alignment strategies, ensure tracking and reproducibility of the reconstruction results, simplify and standardise the way physicists develop reconstruction algorithms, and facilitate interactive analysis.

The computing project handled the data acquired in the CMS Magnet Test and Cosmic Challenge (MTCC) and transferred it to the CERN storage systems and from there to a number of regional Tier1 and Tier2 centres for analysis. Data handling during the MTCC included transfers in quasi-real-time to the Fermilab Remote Operations Centre ROC for data quality assurance and monitoring during the MTCC data taking.

A major effort was made to prepare the new CMSSW software for data taking during the MTCC. The software supported the readout, calibration, local reconstruction, and visualisation of data from various sub-detectors, and was used for monitoring and in debugging of hardware. The components of the Event Filter were integrated with the DAQ/Run Control system and the storage system saved them to disk and performed elementary bookkeeping. More than 30M events were collected at a maximum rate of 200 Hz and transferred to CASTOR at an average steady rate of 20 MB/s. A parasitic stream was implemented to serve event display and Data Quality Monitoring consumers. The event display proved to be an extremely useful tool for inspecting data online.

The combined Computing, Software and Analysis challenge of 2006 (CSA06) was a six-week exercise to test the workflow and dataflow associated with the data-handling model of CMS. It successfully demonstrated the workflow of the CMS data handling model at 25% of the capacity needed for operations in 2008. Much of the Data and Workload Management software and database components were re-engineered along with CMSSW. All essential components were delivered and exercised during the challenge, including a fully functional prototype of the system used to manage data-flows at Tier 0, and a first version of the new MC production system (ProdAgent). The CMS Remote Analysis Builder (CRAB), which is used for submission of analysis jobs to the grid, has also been adapted to work with CMSSW. Data management services are provided by the Database Bookkeeping System (DBS), the Data Location System (DLS), the PhEDEx data transfer system that is used for orchestrating the transfer of CMS datasets to regional centres, the distributed database access system (FronTier) and the CMS monitoring and job tracking system (Dashboard). The successful integration of these components into a functional system represents a big success for the project.

The CSA06 challenge was conducted using ~0.5 million lines of software developed in the context of the new framework and involved the production of over 60M simulated events. The simulation chain (geometry, simulation and digitisation) was extensively validated in terms of description correctness, detector response, physics quality and software robustness and performance using a set of specially written tests (SVSuite). The rapid deployment of reconstruction packages with sufficient stability to sustain the CSA challenge was another major achievement. Modules were developed for local reconstruction (e.g. clustering, segment building in muon chambers), global reconstruction (e.g. full tracking using Kalman Filter, vertex finding, jets, missing ET) and reconstruction of high-level objects (e.g. electrons, photons, muons, B- and tau-tagging). After tuning, the software ran with a negligible crash rate and without memory leaks. Calibration and alignment tools have also been developed and used to produce specialised reduced datasets (ALCARECO streams) for the calibration exercises.

By the end of CSA06 challenge in the middle of November, some 200M events were processed and reconstructed at the Tier-0 centre, and all seven participating CMS Tier-1 centres received fully reconstructed events. The CSA06 computing tests included skimming of datasets at Tier-1 centres and moving analysis datasets to Tier-2 sites, large-scale running of analysis jobs at Tier-2 and Tier-1 centres reaching more than 50000 jobs/day, calibration exercises to demonstrate the use and scalability of the distributed calibration/alignment databases, demonstration of targeted physics analysis based on specific samples and prepared primary datasets, etc. A set of performance metrics had been defined to allow CMS to establish the readiness of CMS computing, software and analysis preparations for this "25% scale" test. Almost all these computing metrics have been achieved. An analysis of detailed results and lessens learned was performed. It is valuable input to further developments and major tests to be performed in 2007 with an increased system.

Important milestones for the computing and software systems in 2007 will be the commencement of integration and commissioning tests of the detector's readout systems (Global Runs), which start at the end of May, and a 50% scale test of the distributed computing infrastructure and software stress test (CSA07). The work schedule foresees a series of ~monthly incremental software releases to prepare CMS for these exercises. Improvements are planned for the geometry and material descriptions of the detector, to the reconstruction and calibration algorithms and to the workflow and dataflow management tools. Migration to Geant4 8.2 has recently been completed and validated, and migration to the SLC4 operating system has been prepared. A Software Performance Task Force has been created and has started to instrument the software release process with an advanced set of tools for measuring CPU, memory and IO performance. A database project is being established to manage the overall strategy of the distributed database infrastructure and to establish an operational service. The next two software release cycles will be used to produce 100 million simulated and reconstructed events for the CSA07 challenge and for physics studies.

Physics: The addendum to Volume II of the Physics TDR documenting the CMS performance in heavy-ion physics was submitted in March 2007. A third volume of the Physics TDR was planned for completion by January 2007. With the startup now taking place at 0.9 TeV, and then at 14 TeV in 2008, the collaboration has decided to submit short reports on startup to the LHCC. The first report will be submitted in June 2007 and will be on the High-Level Trigger performance. The early physics reach with 0.1 fb^{-1} and 1fb^{-1} will be documented in a report which will be submitted later in the year.

Changes

The CPT project has been evolved and re-structured to one that is more adapted for the upcoming phase of operation and data taking

Plans and milestones for 2007

Intensive preparation for data-taking in 2007 pilot run and 2008 physics run.

Concerns

The schedule for producing the next two releases, for simulation and reconstruction, respectively, is tight.

Conclusions

CMS has made very significant progress over the last 6 months. The main highlights are:

- detector can be closed and opened quite fast (~ one week/side),
- the magnet can be run stably at the design field of 4T,
- all the detectors and systems, electronics, trigger, DAQ and software can function as a real experiment,
- data can be distributed out from CERN-T0 to all 7 T1s and 25 T2s at the rate of over 25% of what is expected in 2008,
- the Physics TDR vol II has demonstrated the great physics potential,
- the first phase of the heavy lowering of the elements of the experiment into the underground cavern, including that of the heaviest element, the YB0, has been successfully completed.
- all of the silicon strip tracker has been integrated into the Tracker Support Tube and cosmic ray muon tracks are being recorded.
- the barrel crystals production has been completed and the bare barrel supermodules assembly will terminate soon. Endcap crystals production has started and the last contract for the remaining endcap crystals is being finalized.

The CMS assembly planning projects the initial CMS detector to be ready for data taking in the last quarter of 2007.

The pixel detector and ECAL endcaps will be installed during the winter shutdown of 2007/2008 and be ready for the first physics run in 2008.

The CMS Collaboration is making all necessary preparations to rapidly analyse data from the LHC.

CMS Global Financial Plan

Upon the recommendation of the CERN management CMS submitted to the October 2006 RRB (CERN-RRB-2006-105) 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 (10^{34} $cm^{-2}s^{-1}$). The items under consideration in this global plan were presented in a prioritized way.

A plan in three steps was proposed (Table 2 CERN-RRB-2006-105, reproduced below).

The first priority is to complete the low luminosity detector (Step 1, column 6). For this 17.5 MCHF are to be committed in 2007.

The second priority is to complete the DAQ (Step 2, column 7). For this 8.4 MCHF are needed.

The third priority is to upgrade to design-luminosity detector (Step 3, column 8) needing a sum of 16.6 MCHF.

All the Funding Agencies were kindly invited to reach a rapid agreement on the first two steps. Many bi-lateral contacts have taken place since the last RRB and below we outline the current status per Funding Agency.

Table 2 from CERN-RRB-2006-105
Completing the Design Luminosity CMS detector in three steps (kCHF)

	PhDs (1)	MoU Funding 2002 (2)	CTC1 RRB15 Oct02 (3)	CTC2 RRB20 Apr05 (4)	Constr. Funding 2006 (5)	STEP1 Low Lumi Constr (6)	STEP2 DAQ (Ph D) (7)	STEP 3 Rest (PhD) (8)	Total Design Lumi (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*
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*
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
Extra									
Sum	**1168**	**450,067**	**52,119**	**21,657**	**523,843**	**17,530**	**8,400**	**16,600**	**42,530**
Requested			**63,000**	**35,000**					

Status of Requests for Additional Funding

	Step 1	Step 2	Step 3	Comment
Austria				Discussing
Belgium-FNRS	**136**	**56**		Request made (likely OK)
Belgium-FWO				Awaiting Response
Brazil	Not Applicable			
Bulgaria				Awaiting response
CERN	**4,569**	**297**	**1,119**	
China	Endcap RPC	Endcap RPC	Endcap RPC	Forward RPC
Croatia	**15**			Awaiting response (likely OK for Step 1)
Cyprus				Awaiting response
Estonia	**5**	**8**		Include in next year's budget
Finland	**272**	**49**		Funding in 2010 and 2011
France-CEA				Discussing
France-IN2P3	Not Applicable	**2,000**	Not Applicable	
Germany BMBF	**919**	**51**		Step 1 & partial Step 2 OK, Rest - Await
Germany DESY	Not Applicable	**2,000**	Not Applicable	New Agency
Greece				Awaiting response
Hungary				Discussing
India	Endcap RPC	Endcap RPC	Endcap RPC	Forward RPC
Iran	Endcap RPC	Endcap RPC	Endcap RPC	Forward RPC
Ireland	Not Applicable			Awaiting response
Italy	**2,500**			Step 1 likely to be partially covered
Korea	Endcap RPC	Endcap RPC	Endcap RPC	Forward RPC
Mexico	Not Applicable			
New Zealand	Not Applicable			Discussing
Pakistan	Endcap RPC	Endcap RPC	Endcap RPC	Forward RPC
Poland				Awaiting response
Portugal				Awaiting response,likely OK for Steps 1&2
RDMS-DMS				Discussing
RDMS-Russia				Discussing
Serbia				Discussing
Spain	**344**	**140**		Responded-likely OK for Steps 1 & 2
Switzerland	Not Applicable	**124**	**486**	Apply in Sept 2007 for 2008
Taipei	**121**	**45**		Awaiting response, likely OK for Steps 1&2
Turkey				Awaiting response
United Kingdom	**575**	**202**	**762**	
USA-DoE/NSF	**5,252**	**1,722**		
Sum	**14,708**	**6,694**	**2,367**	
Requested	**17,530**	**8,400**	**16,600**	
% covered	**84%**	**80%**	**14%**	

Conclusion

The Chairman of the RRB has sent letters to many of the Funding Agencies. The letters request the RRB delegates to be prepared to make commitments as requested at the forthcoming RRB meeting and preferably beforehand, if at all possible.

CMS is very grateful to the several agencies that have already made commitments to Steps 1 and 2.

The completion of the CMS detector is imminent. Commitments have to be taken before the next RRB on the remaining elements and any shortfall will cause highly undesirable delays. These delays must therefore be avoided. In addition, the order for 5,500 endcap crystals has to be placed and all the funds needed for C&I have to be secured. CMS therefore urgently requests all the Agencies that have not yet made commitments to do so at this April RRB, at least for the Steps 1 and 2. CERN has kindly indicated its willingness to help with issues of cash-flow up to and including 2010.