Status of CMS
Progress Summary Report for October 2007 RRB25

In the CMS Master Schedule, v36, the initial detector will be closed and the magnet turned on, with the pixel detector and one ECAL endcap installed, in April 2008. The other ECAL endcap should be ready for installation by the end of June. With the cancellation of the 900 GeV "engineering run" in 2007, CMS re-optimized its installation sequence both on the surface and underground.

The first phase of heavy lowering ended at the end of March. Since then the underground detector hall has seen massive installation of services and the complete installation of the barrel ECAL inside the HCAL. Meanwhile in the underground electronics rooms, there is continuous progress on installation and commissioning of the sub-detector electronics, trigger and data acquisition systems, with monthly exercises to read out pieces of the installed detectors through the global system. On the surface at Point 5, the muon systems on the remaining two barrel wheels and three endcap disks are completing preparations for lowering to restart at the beginning of October. On the Meyrin site, the integration of the silicon strip tracker was completed and about 25% of the system was read out simultaneously in a series of cosmic muon runs over several months during which some 5 million events were recorded; it is now being prepared for transport to CMS at Point 5. Meanwhile work in test beams also continues, including an important test of the combined endcap system of preshower and ECAL and HCAL systems.

Installation and Infrastructure

Status

The civil engineering having been completed, the focus in 2007 has been to complete the extensive infrastructure of services and safety systems in all buildings and caverns at Point 5 (Cessy, France).

During the spring and summer, several key milestones were completed, so that a number of tasks are now off the critical path: the installation of the barrel ECAL inside the barrel HCAL, tracker services up to Patch Panel 1, tracker pipe work and insulation with a sector test, and low voltage cabling. As with many of the service installations on YB0, HB/EB pilot sector cabling had some startup difficulties which have been overcome. The magnet yoke barrel wheels YB+1 and +2 have been moved "uphill" with cable chains attached, exercising a key CMS capability. The forward HCAL HF- was moved out of garage with chains attached, and the raising to beam level successfully tested.

The Installation of the Tracker cooling pipes and LV cables between Patch Panel 1 (PP1) on the inside the CMS magnet cryostat and the cooling plants and power system racks, respectively, on the balconies has been completed. The optical fibres from PP1 to the readout off-detector FEDs (first module in the event building chain of each subdetector) in USC will be installed in October, in parallel with the installation of the EB/HB services.

The USC rack system is functional, and the safety system has been fully tested. The underground control room is equipped and in continuous use, but work remains to be done to improve the availability and reliability of the central services.

Completion of heavy lowering in December will open the way for installation of the central parts of the beam pipe. Another required precursor for this activity is pre-installation of the forward pipes and pumps.

On the negative end, the installation and test of the forward beam pipe and 18m vacuum pump (a complex assembly) have been completed.

On the surface, YB-1 and YB-2 barrel wheel commissioning has been performed and these elements are ready for lowering. On the endcap disks, the last remaining RPC chambers are now installed on YE-3.

Plans for 2007 and beyond

The heavy lowering of the remaining elements will begin in October and is planned to be finished by the end of the year. The silicon strips tracker will be installed in November. Cabling and checkout of the lowered pieces will be performed as they become available.

The ultimate focus of the planning and Point 5 coordination is to be ready for a cosmic system test at 4 Tesla field with the full initial detector (though still awaiting one part of EE/ES) for the target of April 2008, but without compromising overall quality.

Concerns
The remaining cabling and commissioning determine the critical path.

Magnet

Status

The magnet system relocation and recommissioning underground is on schedule. Cryogenic and refrigeration test runs are complete and vacuum services are reconnected. Safety system commissioning is in progress, and reconnection of the electrical connections is ongoing.

Plans and milestones for 2007

End of October: start of magnet cool down.
End of November until mid-December: low current tests with the yoke in the open position.

Concerns
None.

Commissioning

Status

At Point 5 major progress has been made in the installation and operation of the off-detector electronics in the underground service cavern. The progress in commissioning has been paced by the deployment of the infrastructure.

To date more than 85% of off-detector readout electronics (including service cavern and the electronics on the cavern balconies and towers for the muon system) has been installed and tested. Most of the high voltage supplies have been installed and are not on the critical path for commissioning. The availability of low voltage supplies and power connections determines the amount of front-end electronics, which can be read out.

CMS has initiated a plan of regular global data taking exercises, which typically take place for 3 to 5 days during the last week of each month. The first one took place in May. During this test we have been able to read large numbers of the FEDs. These Global Runs have allowed commissioning of large fractions of the Level-1 Trigger functionalities (Global trigger, Global muon trigger, Global calorimeter trigger), both at the hardware and software level.

The basic functionalities of the High Level Trigger (data unpacking, data streaming) have also been tested successfully. These exercises have also helped in developing the final Data Quality Monitoring architecture and synchronizing software releases. Cosmic ray triggers have been used to record tracks going through the barrel Muon chambers and the Electromagnetic calorimeter at the end of August run.

Data are routinely transferred to the CERN Tier 0, to some Tier 1 centers, and from September onwards also to an increasing number of Tier 2 centers.

In summary, in a piecewise fashion we have tested functionalities of all the systems and subdetectors of CMS.

On the software side the Detector performance groups have also delivered major upgrades to the detector software, especially of the geometry of the as-built detector. They are also heavily involved in the CSA07 exercise (described below), particularly for the commissioning and deployment of the alignment and calibration code.

Plans and milestones for 2007 and 2008

By the end of 2007, the ability to power up most of the detectors mounted on the positive endcap, the two positive YB wheels, and YB0.

The next major milestone, in early 2008, is to commission the detectors on the negative wheels and endcaps after lowering and conduct a cosmic ray run with CMS closed and field on.

Concerns

To date we have tested functionality of all subsystems of CMS, but reading a small percentage (the noticeable exception is HF for which we read 50%) of front-ends. Some issues may show up only when scaling up to 100%.

Tracker

Status

The CMS Inner Tracking Detector continues to make good progress.

After completion of construction and integration of the Silicon Strip Tracker (SST), the successful readout and commissioning tests of ~25% of the SST were completed in the Tracker Integration Facility (TIF) at CERN in mid-July 2007. The Tracker has since been prepared for moving and installation into CMS at P5. The Tracker is essentially ready for installation.

The Tracker will be installed in CMS as soon as completion of the installation of the EB/HB services permits. The Tracker will then be connected to the pre-installed services on YB0 and commissioned with CMS in December.

The Forward and Barrel Pixel (FPix and BPix) detectors continue to make good progress. Module and plaquette production is complete and the quality is excellent.

75% of the FPix detector has been delivered to CERN from FNAL for commissioning and full system tests in the TIF, and the complete detector will be at CERN in November. The FPix commissioning detector was installed into the Silicon Strip Tracker in the TIF in July, and successfully readout with the Tracker.

The BPix commissioning detector has been completed at PSI and will be delivered to CERN in November for full system tests. The construction of the first half of the final BPix detector has been started at PSI and will be completed in November. The complete detector will be ready in January for installation into CMS in March.

The commissioning of the Tracker at the TIF was a very valuable and successful exercise in which ~100 people from the Tracker community were involved in taking Cosmic data at five operating temperatures. A total of ~5 million Cosmic triggers were recorded, at 15, 10, -1, -10 and -15^0 C. All aspects of the Tracker systems were thoroughly and successfully exercised. A sophisticated Data Quality Monitoring (DQM) system ensured that the recorded data was of good quality. This data were rapidly reconstructed using the CMS distributed computing facilities and analyzed throughout the Tracker community.

The analysis of the reconstructed data indicated that the Tracker fully meets the performance specifications detailed in the CMS Tracker Design Report (TDR), and that this performance was reliably maintained throughout the ~5 months of operation in the TIF.

Plans and Milestones for 2007

Install the Silicon Strip Tracker into CMS around the end of October. Connect the Tracker to the pre-installed services on YB0 and commissioned with CMS in December. Complete the construction of the pixels detector.

Concerns
None.

Electromagnetic Calorimeter

Status

Barrel:

The mechanical assembly of the last Barrel supermodule was completed in April. The electronics integration, using the new connection boards, was completed early July. The insertion of supermodules in CMS took place during two campaigns, the first half-barrel in May and the second one in July. Tests made after insertion have shown that the quality of the detector is excellent, with only 28 dead channels out of 61200 (0.05%).

All off-detector readout modules are in hand, and 90% are installed in the underground service cavern, USC. The cooling plant is ready and being commissioned. All of the high and low voltage power supplies have been delivered, and a large fraction of them already installed at Point 5, to be completed by the end of October 2007. The final cabling of the Barrel will take place in October.

Endcaps:

For both suppliers, the production of Endcap crystals started immediately after the end of the Barrel crystals production. More than 40% of the crystals have been delivered to CERN and tested. The in-kind production of 1500 endcap crystals in Russia is well advanced. The contract for the production of the last 5500 endcap crystals has been signed. The crystals production is expected to finish at the end of March 2008.

All on-detector electronics and off-detectors readout modules are in hand, with the exception of the off-detector endcap trigger module (TCC48), different from the barrel one due to the complex endcap geometry. The prototyping of the TCC48 has been delayed by PCB manufacturing problems but the installation is expected to be complete by June 2008.

The assembly of the endcaps is progressing according to schedule. A 500-channel prototype, using all final elements, is in the H4 test beam where it is currently taking data. This has been a vital learning experience for the integration of services and the development of test systems. The assembly of the first Dee is well advanced. The pace of the assembly of the final Dee will be driven by crystal delivery.

Preshower: Some difficulties were encountered with the production of the front-end hybrid boards. The production of the PCBs had to be transferred to a new firm, which has already successfully delivered 50% of the total needs (4500 pieces). A pre-series of 600 pieces was then assembled with components and delivered in August 2007; it is being qualified.

The production of the readout motherboard is complete: 50% have been tested and delivered to CERN. A Prototype of the specific off-detector readout module has been successfully used in a combined test beam with the electromagnetic and hadronic calorimeters and the production is being organized.

Plans and Milestones for 2007

Commission the barrel for data taking at the end of 2007.
Continue endcap crystals production and the assembly of endcap Dees.

Concerns

The schedule for the production of the Endcap TCC is tight.
The assembly of the Endcap Calorimeter and Preshower are on a tight schedule.

Hadron Calorimeter

Status

With all of HB installed, and with both HF and one end of HE underground, the focus has been on cabling and commissioning, as discussed in the Commissioning section above.

The full complement of 16 VME readout crates has been in operation in USC since the end of May, heavily used in Global Runs, trigger pattern tests, and front-end commissioning. Most of the optical patch panels, which route the fibers carrying the front-end signals to crates, are either fully connected (HE+, HF+) or awaiting installation of the trunk fibers from the detector. All ~600 installed fibers are fully commissioned and tested.

All 540 cables, which carry the HCAL trigger primitives to the Regional Calorimeter Trigger (RCT), have been installed and the majority tested.

Meanwhile the HCAL Detector Performance Group has made important progress. Realistic calibrations for all HCAL subsystems are now available and implemented in the simulation. The algorithms chosen for proposed HCAL calibration HLT triggers have been shown to be robust against changes in calibration constants.

Test beam data were taken this year with the endcap ECAL and HCAL. There is parallel progress on the simulation side: tools have been developed, and low-energy pion response has been tuned.

HPD studies have been enhanced by the establishment of an HPD test facility in Princeton using a 6 Tesla and a 1.5 Tesla magnet. HPD noise information will be gathered and analysed with an HPD signal/threshold trigger using the RCT path.

With test beam, in addition to the combined runs with the ECAL, HCAL also saw measurements of the response of the ZDC and CASTOR prototype detectors. The HF PMT response to muons and charged particle leakage was revisited and remeasured, confirming the results obtained in earlier HF test beams.

Luminosity Measurement using HF: An important function of the HF is real-time monitoring of the luminosity. A mezzanine board that taps into the digitized signals from the

HF photo-detectors accumulates histograms on a bunch-by-bunch basis. During August, all 18 HF+ lumi cards boards were installed and commissioned. This lumi system successfully participated in a global run, reading HF data and publishing it to its consumers.

Plans and milestones for 2007
The second HE detector, mounted on YE-1, is still to be lowered. Commissioning of the full HCAL continues.

Concerns
None.

Muon Detector

Status

Endcap Cathode Strip Chambers (CSC): All 468 chambers with on-detector electronics have been installed and commissioned on the surface at SX5, with cosmic ray muons detected in all chambers. Most of the off-detector electronics is installed and commissioned as well. The +z half of the endcap muon system is underground, and all service connections and cabling are complete. The services (gas, cooling water, and LV from the control room) are expected to become available within one month. About 8% of the +z CSCs have been hooked up to temporary services and their integration into Global CMS Trigger/DAQ systems has begun. The -z half of the CSC system will be lowered underground by the end of the year. Meanwhile, 8% of chambers on -z side have been operational on the surface for half a year and provided a very useful test bench for finalizing synchronization procedures, validating new firmware revisions, developing calibration procedures, and gaining general experience with system operations.

Barrel Drift Tubes (DT): The installation planned in the surface hall was completed, and three out of the five of the barrel wheels are underground. The barrel installation plan foresees the lowering of the remaining two wheels in October and the installation of the remaining 4 chambers per wheel underground.

The commissioning underground of the three wheels and of their final Trigger and readout electronics, operating from USC, started with YB0 in May and is now completed. Also the surface commissioning is done with final Trigger and readout electronics, and a final check will be made when the wheels will be connected to USC after lowering.

Integration in CMS of the DT DAQ and Muon DT Trigger is going well. In the last week of June, DT took part in a CMS global run with the new DAQ and final DDU connected to S-link. Data were taken under central run control and written out by CMS. The full Trigger chain (DT-DTTF-WS-BS-GMT-GT) was also tested at the same time in the Trigger DT Slice test. This provided a stable trigger to CMS. DAQ and Trigger tests were very positive.

RPCs (RB+ RE): All of the installed chambers have been pre-commissioned with high voltage and no major fault has been found. Commissioning of RPCs and the related Trigger in the cavern went in parallel with the DT using the specially designed "technical trigger". Integrated detector-trigger commissioning is concluded on wheel YB+2 and half way for YB+1. Commissioning of YB0 is expected by the end of October. Installation of RE RPC in the forward disks YE-2 and -3 is now completed

Special attention is being devoted to the closed loop gas re-circulation system, which is a key system for long-term operation. In July, the RPC test stand at ISR has been converted to study closed loop operation. This is a combined CMS/CERN/ ATLAS program.

Alignment: The plus endcap sector is now ready to start the commissioning in UX. The minus endcap is progressing well, with minor misalignment and interference of laser beams with CSC structures being fixed. On the Barrel part, all the remaining MAB cali-

bration tasks have been completed. The 12 MABs are already installed in YB+1 and YB+2 in UX and the hardware for the negative wheels is now ready for installation.

Plans for 2007/2008

Complete commissioning of all systems by March 2008.

Concerns

The time window for delivering the underground infrastructure services for the -z end-cap disks and -z system commissioning is very tight. The RPC gas recirculation system still needs to be demonstrated.

Trigger and Data Acquisition

Status

Level-1 Trigger: The trigger systems have completed production with the exception of the RPC trigger boards which is expected to finish at the end of October. The installation, cabling and testing of the trigger systems in USC is well underway. The first half of the Global Calorimetry Trigger (a concern in past years) is now installed and operating in USC and the remainder is in production. Trigger commissioning has started with detailed pattern tests of the Muon, ECAL and HCAL trigger chains. The ultimate goal of these pattern tests is to verify all links and algorithms in the L1-Trigger system. Muon, calorimeter trigger and global trigger systems are also being tested in the Global Runs. The Level-1 Trigger is being integrated with the subdetector electronics and with the central DAQ and is triggering on cosmic muons crossing the detectors installed and operating underground.

Trigger Coordination: After the successful completion of the "High Level Trigger Exercise" in June and the submission of the report to the LHCC, the Online Selection group has been re-organized into the newly formed Trigger Studies Group (TSG) as part of Trigger Coordination. A major activity of the TSG is porting the trigger paths used for the HLT Exercise for use in the CSA07 challenge (described below). The TSG is also developing tools for both online and offline data quality monitoring, studies of the effects of miscalibration and misalignment on the HLT algorithms, analysis of trigger performance, preparing trigger menus dealing with a variety of luminosity scenarios for the LHC startup, and collaborating with the Event Filter group for the online deployment and commissioning of the HLT algorithms.

DAQ: Underground, the installation and commissioning of all readout and control equipment was completed in April 2007. All components have been fully tested and sub-detector readout commissioning has started. Complete DAQ systems including Global Trigger, sub-detector FEDs, DCS, and mass storage are operated during monthly Global Runs since June 2007.

In the Surface Computing Room (SCX), data-to-surface optical cables are installed and all optical interconnections tested. 800 PCs (Dell 2950 dual core) have been delivered and installed in SCX. 640 PCs are equipped as Readout Unit (RU) with Myrinet and 4-GBE interfaces. During the first technical run part of these PCs will be configured as Filter Units to allow data taking up to 20 kHz. The commissioning of the central DAQ system has started in August 2007, and will continue during 2007 with the participation in the cosmic runs of November-December 2007.

During 2008, the Event Builder network will be completed with the installation and cabling of all final GBE switches. The tender for 50% of filter farm (1200 PCs) will be

issued in phase with the LHC Physics run schedules of 2008-09. On-line software development and optimization is continuing.

Concerns

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

Offline Software

Status

The work programme for the Offline Project is focused on preparing for the integration and commissioning tests of the detector readout systems (Global Runs), which started at the end of May, and a 50% scale test of the distributed computing infrastructure (CSA07). The code base has continued to grow rapidly during 2007 and now exceeds 1M source lines of code. More than 200 developers are committing new code each month. Attention is being given to improving the efficiency of the release process, as well as the performance and quality of the software. The work on systematically measuring and improving performance has continued, resulting in speed improvements by up to a factor 2 and reductions in memory usage in many areas.

The Full Simulation code has evolved to use new releases of Geant4 (8.2 and 8.3), allowing the most up-to date description of the physics processes, and providing tools to identify and fix overlaps in the description of the detector geometry. The robustness of the full simulation chain has been demonstrated by the more than 150 million events produced so far as preparation of the CSA07 exercise. In addition a first release of the Fast Simulation software, ported to the CMSSW framework, was made in June and is already used successfully for top quark analysis development, particle flow studies, and tracker alignment.

During CSA07, offline reconstruction will run after the MC data have passed through the (simulated) Level 1 trigger, and the HLT, and then primary dataset splitting and a full analysis will be performed in the way we intend it to be done during 2008. In addition a full end-to-end test will be made of the alignment and calibration infrastructure. This will be the first time the Conditions Database is used for storing and accessing constants during event reconstruction in a full-scale production environment. The calibration and alignment workflows will run on a prototype of the Central Analysis Facility (CAF) comprising 128 CPU's at CERN.

The Event Filter system is gearing up for routine data taking in the context of the CMS DAQ. The complete chain of applications, from the reception of events in the event builder to storage on the local disk buffer, has been operated without major problems in the context of the Global Runs in June, July, and August. So far, "HLT" processing in Global Runs has been limited to generic data consistency checks, unpacking of raw data, and basic data quality monitoring.

Plans and milestones for 2007

Preparation of the CMSSW_1_7 release for end 2007 Cosmic Run and HLT commissioning online.
Preparation of CMSSW_1_8 to include lessons learnt from CSA07.
Continue performance optimization and software quality improvements.

Concerns

Manpower is missing for several core offline tasks and we intend to address this using the internal CMS Memoranda of Agreement for maintenance and operation.

Computing

Status

The computing project has focused on site preparation, Monte Carlo production, and preparations for the upcoming Computing Software and Analysis Challenge CSA07. CSA07 is intended to test all elements of the CMS computing model at greater than 50% of the target rate expected from low luminosity data taking. Many organized workflows will be tested: Prompt Reconstruction, Re-Reconstruction, Calibration, Skimming, and event simulation. In addition we expect to have substantial user driven analysis activity including data subscription and data analysis. Scale tests of the Tier-0 began in mid-July and the challenge itself in late September and runs until end October.

The main visible achievements are the production of the close to 150 million Monte Carlo events (rates up to 65 million/month), which are the basis for the CSA07 exercise, the expedient production of Release Validation samples, and the swift distribution of the data to the various CMS computing sites. Six production teams were operational, using the Tier-1 and 25 Tier-2 sites and an average of more than 3000 job-slots. Improvements in transfer rates and site availability have been seen as computing sites across the globe contributed to Monte Carlo production and prepared for large-scale production and analysis as part of CSA07.

Site availability monitoring (SAM) has been instrumented with hourly CMS specific tests that probe sites for availability of important computing services at CMS computing sites. Success of the SAM tests is a good predictor of job success at the site. These tests help prepare the sites for production and for user analysis. Site availability has improved across the system as a result of this monitoring program.

Another important success has been the recent usage of the mass storage system CASTOR at CERN for running the Tier-0 type of applications, in which CASTOR holds up to the CSA07 requirements. Tests have shown an even higher performance.

Software documentation is being organized in terms of: a *workbook* providing initial instructions on accessing computing resources and using the software to perform analysis within the CMS collaboration; an *offline guide* to cover the usage and details of the software packages contained in CMSSW; and a *CMSSW reference manual*. The User Support team replies to the questions which are tracked in the system until the problem is solved. Additional sources for help are the Hypernews lists on most of the activities in CMS.

Plans and milestones for 2007

Test all elements of the CMS computing model at greater than 50% of the target rate expected from low luminosity data taking during the Computing and Analysis Challenge (CSA07). Analyze in detail the CSA07 performance and operational aspects together with participating centers.

Concerns

Manpower is missing for several computing tasks and we intend to address this using the internal CMS Memoranda of Agreement for maintenance and operation.

Physics

Status

In June 2007 the Online Selection physics group completed a comprehensive study of the expected CPU-performance of the High Level Trigger (HLT). The project involved porting of the Level-1 emulator and the HLT algorithms to the CMSSW framework followed by the tuning of trigger paths to obtain optimal physics performance. The latter was carried out with feedback from the Detector Performance, Physics Object, and Physics Analysis groups. The outcome was a 2008 candidate trigger menu for a luminosity of 10^{32} $cm^{-2}s^{-1}$. The trigger menu corresponds to a Level-1 trigger accept rate of about 17 kHz and a HLT accept rate of 150 Hz as measured with QCD backgrounds and a mixture of heavy-flavor and vector boson decays to leptons. The average time (Core 2 5160 Xeon processor running at 3.0 GHz) required to unpack the raw data and complete the HLT selection was determined to be 43 ms per event, in remarkable agreement with the 40ms estimate in the DAQ TDR of 2002, thus fulfilling an important goal and milestone in preparation for LHC startup.

Readiness for initial data-taking in 2008 is the highest priority of the CMS Physics program. The Physics Object and Physics Analysis groups have prepared detailed work plans focused on preparations for early LHC operation. Numerous workshops have been held and substantial improvements have been achieved in reconstruction and identification of all of the main physics objects and the methodology and preparation for data-driven physics analyses. The Physics groups have also identified the most important topics that may be accessible with integrated luminosities of 10, 100 and 1000 pb^{-1}. These topics are the focus of the "2007 Analyses" now underway. The 2007 Analyses will provide a comprehensive first assessment of how analyses can be performed under circumstances in which detector performance is not yet optimal due mainly to limited statistics of event samples used for calibration and alignment, or for background controls. The first results of these studies will be available in November.

Plans and milestones for 2007

During the CSA07 exercise, Physics will monitor the quality of the datasets. Datasets with residual miscalibrations and misalignments will be used to further study and prepare methods that can be employed for data analysis in early LHC operations. In addition to the large samples of Standard Model events processed at Tier-0 and distributed to Tier-1 centers, there will be ~50M Monte Carlo signal events (e.g. SUSY-BSM, Higgs, etc.) produced at Tier-2 centers during the CSA07 exercise.

An additional piece of the CSA07 challenge will be a first test of the Express Stream operation at the CERN Analysis Facility (CAF). The Express Stream is intended to provide reconstruction and analysis of roughly 10% of all data within a few hours of that data being taken.

Concerns

The ability of the CMS Computing infrastructure to process and distribute data from Tier-0 to Tier-1 centers and from Tier-1 to Tier-2 centers.

Conclusions

CMS continues to make significant progress in installation, commissioning, and preparations for data analysis. There are no significant technical issues. The main highlights during the last six months include the following:

i) Completion of the silicon strip tracker, with a substantial fraction operated at multiple temperatures with excellent performance. It is ready for installation at Point 5. Pixel construction is showing good progress toward timely completion.

ii) Completion of construction and installation of the Barrel ECAL, with excellent quality, and followed immediately by a smooth transition to Endcap ECAL work.

iii) The two barrel yoke wheels remaining on the surface are ready for lowering in October, with chambers having been commissioned with cosmics. The YE-2 and -3 disks were equipped with RPCs, thus completing installation of all surface-mountable muon chambers. The three remaining minus-end disks will be lowered before the end of the year.

iv) Underground, commissioning of detectors with cosmics is proceeding. Monthly CMS Global Runs were started in May; combined triggering and readout of multiple detectors is proceeding.

v) There was broad progress in commissioning the Level 1 Trigger. Much of the final data acquisition system was completed, including all links, and installation of the first 800 computers serving as readout or filter farm units.

vi) In the experimental cavern, the plus end was opened, with cable chains attached, for consolidation and preparation for cosmics data taking.

vii) With a significantly enlarged team, there was much progress on installation of services on YB0, following stringent QA/QC philosophy.

viii) HF raising and shielding closure test was introduced and completed, with lessons learned to reduce risks when closing for beam in 2008.

ix) Beam pipe installation on the minus-end was completed (off the critical path), with much learnt. This will help in installation of remaining sections.

x) All magnet ancillaries were lowered, re-installed, and nearly completely commissioned, so that low-current power tests may begin in November.

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.

xii) Preparation of Offline Software advanced across a broad front of framework, simulation, and reconstruction; releases are now synchronised with CMS needs for commissioning, online (HLT) and offline (reconstruction and physics).

xiii) The High Level Trigger Exercise was completed, demonstrating the foreseen capabilities. Preparation for physics analysis at startup advanced, with a focus on calibration, alignment, and analysis of early data.

The CMS assembly planning, re-optimized in light of the cancellation of the 900 GeV engineering run of 2007, foresees the completion of the initial detector (with pixels but missing one ECAL endcap) magnet closed and turned on for cosmic tests in April 2008.

CMS Global Financial Plan

Upon the recommendation of the CERN management CMS submitted to the October 2006 RRB 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 (see Table 1 taken from CERN-RRB-2006-105) in three steps was proposed.
The first priority is to complete the low luminosity detector requiring 17.5 MCHF.
The second priority is to complete the DAQ. For this 8.4 MCHF are needed.
The third priority is to upgrade to design-luminosity detector needing a sum of 16.6 MCHF.

The restoration of the forward RPC (RE) system was also proposed and is to be built via in-kind contributions. It was estimated to cost 5.9 MCHF.

CMS is very grateful to the many Funding Agencies that have already made commitments to these steps. The current situation is outlined in Table 2.

A recent CMS workshop on the restoration of the RPC system proposed splitting it into two phases, the first for the geometric region at lower eta ($|\eta| < 1.6$) and the second for the region at $1.6 < |\eta| < 2.4$). This scheme is presented in Table 3, along with the situation concerning funding.

As the completion of the low-luminosity CMS detector is imminent, the Funding Agencies that have not yet made commitments are urgently requested to do so as soon after this RRB as possible, at least for Steps 1 and 2 and to the restoration of the RE system. CERN has kindly indicated its willingness to help with issues of cash-flow up to and including 2010.

CMS is making all efforts to complete, as soon as possible, the construction, the installation and commissioning of the experiment, the latter culminating in a cosmic-rays run in April 2008 before data taking proper starts.

The October 2008 RRB, in one year's time and after the completion of the low-luminosity detector, will be an appropriate moment to present an update of the financial position of CMS (first presented in October 2006 RRB, CERN-RRB-2006-105) and to make any necessary adjustments.

Conclusion

CMS again urgently requests all the Funding Agencies that have not yet made commitments with respect to the October 2006 Global Financial Plan to do so as soon as possible after this RRB, at least for the Steps 1 and 2 and to the restoration of the Phase 1 of the RE system.

The construction, installation and commissioning of the low-luminosity 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.

Table 1: Completing the Design Luminosity CMS detector in three steps (kCHF).

From October 2006 RRB (CERN-RRB-2006-105)

	PhDs (1)	MoU Funding 2002 (2)	CTC1 RRB15 Oct02 (3)	CTC2 RRB20 Apr05 (4)	Constr. Funding 2006 (5)	STEP 1 Low Lumi (Constr.) (6)	STEP 2 DAQ (PhD) (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*	*Pledged*
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 Collab.*
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**						

Table 2: Status of Requests for Additional Funding

	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	
China	Endcap 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
Taipei	121	45		Request for Steps 1&2 in 2009/2010
Turkey				Awaiting response
United King-dom	575	202	762	
USA-DoE/NSF	5,252	1,722		
Sum	**15,100**	**6900**	**3000**	
Requested	**17,530**	**8,400**	**16,600**	
% covered	**86%**	**82%**	**18%**	

Bold: Input since the April 2007 RRB.

Table 3: The costs of the two phases for the restoration of the forward RPC system and the state of funding.

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

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

Provided all the requests mentioned above succeed the potential available funding would enable the start of the RE restoration project entailed in Phase 1. Some groups currently working on the barrel RPC system are also considering participating in the RE restoration project.