Status of CMS

Progress Summary Report for April 2008 RRB26

In the CMS Master Schedule, the initial detector will be closed and the magnet turned on, with the pixel detector and one ECAL endcap installed, in June 2008. The other ECAL endcap should be ready for installation in July.

The main highlights during the last six months are recalled:

i) All of the 15 heavy elements are underground. The last one (YE-1) was lowered on 22 January. Definitive closure of the experiment has started: the barrel wheels are locked into the final position.

ii) The massive installation of services on YB0 was completed in November following a stringent QA/QC philosophy. This included cooling pipes and their insulation (tested to -20°C), cables from the detector to the balconies, optical fibres from the detector to the underground control room, etc. Thermal screens have been fitted over the services lining the outside of the solenoid vacuum tank.

iii) The Silicon Strip Tracker was installed on 15 December 2007. It was aligned to ±1 mm, and connections (980 pipes, 3350 optofibres, 2330 cables) were completed before Easter. Initial tests indicate very good noise performance.

iv) Almost all of the off-detector electronics is installed in the underground service and experimental caverns.

v) CMS solenoid: all ancillaries are commissioned and leak and pressure tested and the solenoid has been cooled down. This should lead to a low-current test in April.

vi) ECAL: All 36 barrel supermodules are commissioned in CMS, reconfirming the excellent quality. The last endcap crystals were delivered on schedule in March. Crystals have been mounted on three of the four endcap Dees.

vii) Commissioning: Level-1 Trigger, ECAL, HCAL, Muon and DAQ systems are undergoing *in situ* commissioning (including cosmics data-taking).

viii) DAQ: The final data acquisition system is installed, including all links to bring data to the surface, and the first 800 computers for the online farm are operational (1/8 of final power). The High Level Trigger target timing of 40 ms/event has now been demonstrated at Point 5 in a 20 PC subfarm operating in the online environment. We are ordering 400 of the newest PCs to attain L1 to HLT rate of 36 kHz for first physics in 2008.

ix) Software & Computing Infrastructure: In CSA07, metrics were almost all met, but separately and intermittently. Further functional tests (preparations for CCRC - Combined Computing Readiness Challenge) were successfully performed in February 2008. Much work is ongoing for release CMSSW2.0 for CCRC, CRAFT (Cosmic Run at 4T), CSA08 (Computing, Software and Analysis), to demonstrate stable, sustained and simultaneous operational readiness for first data-taking.

x) Preparation for physics analysis continued with focus on startup integrated luminosities of 1, 10 and 100 pb^{-1}, and associated issues of calibration and alignment. Work going on for CSA08 and LHC startup.

Installation and Infrastructure

Status
Shortly after the New Year, the two remaining endcap disks, YE-2 and YE-1, were lowered, marking the completion of eight years of assembly in the surface building SX5. Immediately after the lowering of the last disk, the connection of the YE minus endcap to services started. The complex campaign of connecting the Tracker to its patch panels began right after the re-opening of the Lab and finished in March.

The CMS services have successfully passed their commissioning tests and we are gathering experience in the operation. A task force has been set up to analyze the services and to understand their status and what further steps are required to be ready for sustained operation in the near future. Six working groups (Cooling, Powering, Gas, Detector safety & monitoring, Inertion & Dry air, Networking) are going through the hazards and operability (HAZOP) process, to identify weak points and make proposals for enhancing the reliability and sustained availability of the different systems.

Plans for 2008
The next big task ahead is the installation of the beam pipe. With the wheels locked in position over the vactank, YE+ was moved away from the head wall to give space to install the forward pipe in the iron nose on the +z end. This task was postponed after problems encountered in early 2007, but the equivalent –z forward pipe has meanwhile been successfully installed. Following the installation of the central beam-pipe within the Tracker, the pipe will be baked out and then filled with inert gas. The installation of the pixels and ECAL Dees can then proceed. The detector is scheduled to be closed for the Cosmic Run At Four Tesla (CRAFT) in June.

Concerns
The schedule is tight for installation of the beam-pipe and defines the critical path to closure of the experiment in June.

Magnet

Status and Plans for 2008
The magnet ancillaries, which were brought down from the surface and reinstalled in USC, were commissioned. The solenoid has now been cooled down. A low-current test is planned for April. Tests at full field await the closure of CMS in June. The CMS Magnet Advisory Committee (MAG) recommended an operating field of 3.8 T. There are no known problems with running at 4 T. In recommending the slightly lower value of the operating field the MAG took into account reduced aging effects over the 10-20 year period of use of the magnet and an increased general safety margin.

Concerns
None.

Commissioning

Status
The end of 2007 has seen a series of global runs that have had many successes: the complexity of the systems tested exceeded that of the MTCC exercise done on the surface in 2006. While muon-subdetector triggers have been routinely part of global exercises since July 2007, we tested for the first time the trigger chains of both the ECAL and the HCAL

using successfully the full chain of Regional-Calorimeter-Trigger, Global-Calorimeter-Trigger, and Global Trigger. The High Level Trigger reconstruction and selections have also been successfully commissioned.

The beginning of 2008 was marked by several consolidation steps: a faulty component was replaced in 70% of the DAQ farm PCs and the whole online system was migrated to Scientific Linux 4 and a new core software framework (a complex operation with debugging lasting more than 2 months). During this time commissioning continued with dedicated short runs involving one or two detectors and the global trigger and global DAQ aiming to debug/fix features that had been uncovered in earlier global exercises. The first global run took place in mid-March and involved substantial fractions of all subdetectors with the exception of the tracker whose cabling was being finished.

The final framework for the Data Quality Monitoring has been implemented and routinely used during the global runs. The software teams are also deeply involved in the offline exercises (CSA07 last year and the upcoming CSA08 challenge), demonstrating the ability of our system to deal with the calibration and alignment workflows using simulated data. In parallel the software teams of the various subprojects have been preparing all the software needed to deal with the data reconstruction, calibration, and alignment.

Plans and milestones for 2008
A major milestone ahead is a two week long cosmic run towards the end of April that will involve all subdetectors including the tracker. The subsequent major milestone will be the CRAFT run in June that will leave CMS ready to take data at LHC.

In addition to sending the data to the Tier 0 computing centre, all Tier 1 centres, and some Tier 2s, these global exercises will test the workflow for the calibration and alignment processes. In particular, the CMS Analysis Facility based at CERN will be used.

Tracker

Status
The Silicon Strip Tracker (SST) was installed in CMS in December 2007. All of the power, cooling and readout electronics systems had been installed and thoroughly tested before the Tracker was installed.

The connection of the SST to the pre-installed services started in January and was successfully completed in March. The commissioning of the SST started in March and data will be taken with CMS towards the end of April.

The cooling plant, serving both the Tracker and the Preshower detectors, suffered a serious failure due to a manufacturing fault as it was being commissioned. This failure has resulted in substantial extra costs due to the contamination of the (C_6F_{14}) cooling fluid, and significant design changes will be required to avoid similar failures in the future.

The Forward and Barrel Pixel (FPix and BPix) detectors continue to make good progress.

The completed FPix detector was delivered to CERN from FNAL for commissioning and full system tests in the TIF in December 2007. The BPix detector will be delivered to CERN towards the end of April 2008.

Plans and Milestones for 2008
SST will participate in the late April global run with other CMS subdetectors.

Installation of the pixels detector is currently foreseen in May/June after the bake out of the LHC beam pipe.

Commission the full Inner Tracking Detector with CMS in June.

Concerns
None.

Electromagnetic Calorimeter

Status
Barrel: The final cabling of the Barrel was completed in November 2007. All supermodules were connected to their services (high and low voltage supplies, cooling plant, detector safety and control system) and to their readout/trigger electronics, and have been successfully commissioned. The ECAL Barrel is integrated in the general CMS DAQ system and contributes regularly to the CMS global runs.

The crystals for the 37th (spare) supermodule have been ordered and will be delivered by May 2008.

Endcaps: All the crystals for the endcaps have been delivered to CERN and tested.

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. Prototypes of the TTC48 have been received and successfully tested. The order has been placed and the installation is expected to be complete during summer 2008.

A 500-channel prototype, tested in the H4 test beam last October, has shown good performance.

The assembly of the Dees is advancing well. Crystals have been mechanically mounted on three Dees and should be completed by the end of May 2008. Electronics, internal cables for the services, and the internal cooling system are being integrated in the first Dee, which should be ready for installation by mid-May 2008. Taking advantage of the lessons learnt, the integration of the next three Dees will go much faster and the endcaps should be completed by late July 2008.

Preshower: The difficulties encountered with the production of the front-end hybrid boards, and their assembly, have been solved. 1100 hybrids (25% of the needs) have been qualified and mounted on modules. Another 1100 were delivered in mid-March. The production should be completed in May.

The production of the readout motherboards is complete. The pre-production of the specific off-detector readout module is going on.

The procurement of the large mechanical pieces (absorbers, cooling screens, windows, outer drums) will be completed by the end of March 2008. The large-scale assembly has started.

Plans and Milestones for 2008
Complete the assembly of the four endcap Dees by July 2008. Complete the assembly of the first Preshower by July 2008 and of the second Preshower soon after.

Concerns
The schedule for the production of the Endcap TCC is tight.

The schedule for the assembly of the Endcap Calorimeter and Preshower is tight.

Hadron Calorimeter

Status
All of the HCAL has been installed underground. Final cabling and commissioning of the endcaps HE-, lowered in January 2008, and the forward HF- is underway.

The November Global Run allowed the HCAL group to compare cosmic muon response in the barrel HB to that of radioactive source data. This comparison demonstrated that the relative calibration of wedges that were exposed to sufficient cosmic muons was identical to that of the wire source data, indicating that calibration had been successfully transferred from the test beam to the underground cavern of UX5.

Simulations suggest a minimal impact of discharges observed in the HPDs during MTCC in 2006. These are strongly damped at the operating field. Nevertheless, HPD studies of noise have been continuing and strengthened by the establishment of an HPD test facility in Princeton using a 6 Tesla and a 1.5 Tesla magnet. The acquisition of noise maps of 200 HPDs *in situ* has begun (all of HB and HE+).

The integration of CASTOR and ZDC into CMS continues.

Luminosity Measurement using HF: An important function of the HF is real-time monitoring of the luminosity. A mezzanine circuit board ("lumi card") 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 Global Runs.

Plans and milestones for 2008
The major task in the months before first beam is to measure the response of all HCAL sub-detectors in the magnetic field of CMS and establish a complete noise map for HCAL at the final magnet settings.

Concerns
None.

Muon Detector

Status
Endcap Cathode Strip Chambers (CSC): The mini-cable chains connecting the three +z endcap disks were bolted into place and the services (water and gas pipes, LV and HV cables, optical fibers, etc.) needed for disk YE+2 and YE+3 were installed in these chains. The LV supplies were installed around the disk peripheries. All LV cables and fanout boxes were installed and cabled. All optical fibers ducts were installed and the fibers were blown through the ducts and spliced into place. By January we began commissioning the +z endcap. By early March over 200 chambers could be run successfully for the local and global runs.

The –z endcap disks were lowered by the end of January (YE-3 in December 2007, YE-2 and YE-1 in January 2008) and work began to connect the mini-cable chains and the infrastructure services. The connections are nearly complete and involved LV and HV, gas and optical fibre connections. The commissioning of the gas system has begun. The optical fiber ducts are in place and the blowing of fibers also began in early March.

Barrel Drift Tubes (DT): The last two barrel wheels, YB-1 and YB-2 were lowered in the cavern at the beginning of October 2007. The two wheels were completely commissioned on the surface during the summer. A final *in situ* check of chambers on both these wheels has been done.

At the end of October, the DTs operated for the first time all 50 chambers of a wheel together. The test was done on the central wheel, YB0, and was very successful.

50,000 cosmic muon events, among them several spectacular extended muon showers, were triggered and read-out. This allowed also a first important test of the DT DCS that controls the Readout and Trigger electronics sitting in the minicrates installed on the chambers.

Four out of the five wheels were fully equipped with the LV supplies.

Synchronization of chambers in the same wheel is nearly completed. Synchronization between different wheels is being carried out. The first step was done at end of February on the positive CMS side: YB+1 was closed and locked to YB0 and YB+2 to YB+1.

The DAQ and DCS are now complete and show good performance.

YB0 is currently available for triggering the internal CMS detectors. A proper partitioning of DAQ and Trigger is being setting up to allow operation of YB0 independently of the activity of commissioning and testing of the chambers in the other wheels.

In summary: four wheels (-1,0,+1,+2) are completed and connected to the cavern services and CR, ready to take data in the coming Global Runs. Final checks are going on YB-2.

Resistive Plate Chambers (RB and RE): After completion of the installation of both RB and RE, the commissioning of the detector has continued systematically. All the chambers except for those on W-2 have been commissioned. The remainder will be commissioning by the beginning of April. The test is performed Tower by Tower (half a wheel) and allows checking the chamber functionality and the full trigger electronics up to the Link Boards. During this phase, some chambers with significant gas leakage were found and substituted. The cause was traced back to defective junctions in the chamber internal gas circuit. RE commissioning will start soon, using provisionally some RB equipment for HV and LV. The RE power system will be partially delivered during March.

A major effort was concentrated on the preparation of the final gas system and the closed loop gas system studies at the ISR. The final gas distribution system was commissioned and all necessary system infrastructures were made available for the start-up. Four barrel sectors are now under flow using the final system. Gas re-circulation in those sectors will be activated in a few weeks after a careful monitoring of the detector behaviour in the present condition. In parallel, ISR studies are continuing. It has already been demonstrated that a long term run at high percentage of re-circulation is possible. A new cycle after filter regeneration has just started.

Alignment: All 36 optical Alignment modules for the Muon Barrel (MABs) are now installed. Functionality tests were completed without problems. Eighty percent of the installed components have been tested after installation, including the light sources sitting on the drift chambers and the camera on the MABs. The failure rate is of the order of 1/1000 and is tolerable.

All alignment hardware of both endcap parts is installed. Electronics and sensors have been tested and commissioned readout software is running and under integration into DCS. The plus endcap is ready for system running with the final DAQ.

The LINK Disks are installed and cabled in YE+1 and YE-1. Fibers and cables are installed in the cable chains for the +z part and under installation for the negative side. The DAQ is ready and the plan is to start final commissioning with completed chain of connections.

Plans for 2008
Complete commissioning of all systems by the end of April 2008, so that the Alignment system is ready to take data as soon CMS closes.

Concerns
The time for the commissioning of the –z endcap is limited. The schedule for commissioning the forward RPC system is tight.

Trigger and Data Acquisition

Status
Level-1 Trigger: The installation, cabling and testing of the trigger systems in the underground service cavern USC55 is mostly concluded. All trigger systems have completed production and are installed, except ECAL endcap trigger hardware (TCC48). Detailed extensive inter-system integration testing is also mostly completed. Various system tests validated the trigger timing control, trigger software, and rate throttling. The Level-1 trigger system, integrated with the subdetectors and the run control, has been operated successfully in the Global Runs since May 2007. Currently, all muon triggers and the calorimeter trigger are providing stable cosmic triggers to the experiment at correct rates using the final infrastructure. The commissioning of the trigger systems in USC55 is now being extended to the remaining detector components as they come online.

Trigger Coordination: The Trigger Studies Group has produced a series of Level-1 and Higher Level Trigger (HLT) menus that cover running with the luminosities from the LHC startup through 10^{32} cm^{-2} s^{-1}. There is also a suite of calibration and alignment triggers that can output small fragments of the detector information at higher rates, as well as W/Z-enriched samples that can be used for detector and physics commissioning.

A candidate 10^{32} trigger menu has been deployed in a special testing Filter Farm to evaluate the CPU-performance of the HLT algorithms. The findings were in good agreement with last summer's HLT optimization studies.

DAQ: Underground, the installation and commissioning of all readout and control equipment was completed in April 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 installed in SCX.

The commissioning of the central DAQ system started in August 2007 and is continuing in parallel with the participation to the Global Runs. During spring-summer 2008, the Event Builder network will be completed with the installation and cabling of 8 GBE switches (for the final 8 DAQ slices). A tender for the purchase of 400 dual CPU Quad-core PCs allowing up to 36 kHz level-1 rate HLT selection, is out. The order will be issued in April 2008 and the installation is scheduled in summer 2008. The completion of the HLT farms (allowing up to 100 kHz level-1 rate) will follow in phase with the LHC Physics run schedules of 2009-2010.

The on-line software developments and optimizations are continuing. The Quattor tool is used to deploy and configure all on-line system software.

Concerns
End of contract effects on continuity of experienced man-power and essential developers during the critical phases of final integration and first operations.

Offline Software

Status

In the last quarter of 2007, the project's activities were focused on the Computing Software and Analysis Challenge (CSA07), which provided an extensive stress test of the performance, stability and operability of all CMS software. For the first time production workflows included data unpacking to reproduce the RAW data format, HLT processing, and the organisation of event samples into primary datasets using information produced by the HLT ('file-splitting'). In addition, the Conditions Database was used during reconstruction for accessing calibration, alignment and configuration data. Tests of calibration and alignment and of express stream analysis were also performed at the CAF.

The Challenge proved to be extremely useful in identifying the components of the software that work well and those that were in need of further development work. The simulation and reconstruction applications ran very stably with essentially no crashes reported and CPU performance was found to be within the nominal budget. However, the memory footprint of the CMSSW application was found to far exceed the goal of 1 GB specified in the CTDR and the size of the reconstruction and analysis components of the event (RECO and AOD respectively) have continued to grow with consequences for storage requirements.

Significant progress has been made since CSA07 to address issues raised by the challenge. Performance monitoring tools now run automatically as part of the software release process and generate reports that are used to rapidly identify those areas that need attention. Using this information, campaigns have been started in all projects in order to optimise memory usage and cpu performance. Many improvements have already been implemented, including a major revision of the HLT data model and improvements to the I/O subsystem. These changes are now being included in the CMSSW_2_0 release cycle, which will be used for the next major challenge (CCRC/CSA08) scheduled to take place in May 2008. In addition, two task forces were set up to analyse RECO and AOD contents. Considerable scope for reducing storage requirements has been identified by eliminating duplications, optimising the format in which data are stored, and more generally by reviewing the content of the datasets.

The functionality of all application codes is essentially complete but continues to evolve with incremental improvements. In the Full Simulation application, the geometry has been refined to better reflect the real detector and attention is being given to the validation of the simulation in view of comparing with real data. The Fast Simulation is now functionally complete, and has been benchmarked to be ~1000 times faster than the Full Simulation while maintaining a very good description of the detector response and reconstruction performance. It will now be used to provide very high statistics samples (~500M events) for Trigger and Physics studies.

A common particle model and toolkit for physics analysis, with a starter-kit, is being prepared in order simplify the take-up of the new tools by newcomers.

The Online Data Quality Monitoring infrastructure is being commissioned at Point 5 and is in routine use during Global Runs to display live data. Shift crews have been organized to look at the data regularly, and their feedback is used to refine the priorities for future developments. The same DQM infrastructure is being adapted and enhanced for monitoring of jobs running offline, i.e., at the CAF, Tier-0, Tier-1 and for release validation purposes. The former PS main control room has been refurbished and is now being commissioned for use as the "CMS Centre" for offline operations. The centre comprises 22 operator consoles including the associated PCs and monitoring screens. The Centre will be used in forthcoming Global Runs for offline DQM.

Plans and milestones for 2008
CMSSW_2_0 to be released beginning of April and used for CCRC/CSA08 exercises during May 2008.

CMSSW_2_1 to be released beginning of June in time for start of data-taking.

Concerns
The time for the releases is limited.

Computing

Status
The Computing Software and Analysis Challenge (CSA07) was the main focus of the Computing Project in the second part of 2007. It tested all aspects of the CMS computing model at greater than 50% of the target rate expected from low luminosity data taking.

A task force started in July to commission and improve the quality of data transfers. By December it was able to commission over 200 links between the sites and to keep them in production. The work on automating the testing and monitoring the performance of data transfers is continuing; the number of commissioned link had reached more then 300 by February 2008. It remains a large challenge for the computing project to maintain the required links between the production sites.

Close to 150 million Monte Carlo events (rates up to 65 million/month) were produced as the basis for the CSA07 exercise. The MC production teams continued with physics signal production and processing while the Tier-0 and Tier-1 teams worked on splitting the data into Primary Data Sets (PDS), reconstruction and skimming. The storage systems at CERN and FNAL were stressed particularly heavily by the challenge workflows.

During the challenge period, the data operation teams supported global run activities and delivered requested run data to the Tier-1s and Tier-2s. Datasets from earlier MC production periods were available at the Tier-2 centres, and physicists accessed and analyzed these datasets. In addition, tests were done of calibration and alignment at the CERN Analysis Facility (CAF) and an express stream analysis exercise was completed.

Information from the Challenge has been used to develop plans for further improvements of the computing infrastructure and software components. After CSA07 the computing project visited the CMS Tier-1 centres to review the exercise. These visits strengthened the collaboration between the project and the sites. A new task force on Process and Data Access (PADA) was created to help coordinate integration of the computing and offline systems in preparation for the work ahead in 2008.

During phase 1 of the Combined Computing Readiness Challenge (CCRC08) in February 2008, a set of functional tests on data archiving, processing, and data transfers was run together with tests from other LHC experiments.

The link between Point 5 and CERN main site was tested by gradually increasing the number of streams in parallel. CMS was able to test extensively the processing of a massive number of files, with a writing speed on tapes of up to 1.3 GB/sec. During CCRC in February the majority of the load created at the T0 was due to CMS, shifting interference tests between CMS and other virtual organizations/experiments (VO's) to the next period of CCRC08 in May.

Another part of the CCRC08 tests consisted in assessing the functionalities and the quality of data transfers between the different tiers of the infrastructure: between T0 and each of the seven T1s, between the T1s, and between T1s and T2s bi-directionally. No specific problems were encountered during this test, also in the presence of the other VO's. Tests are continuing approaching realistic bandwidth values and usage patterns.

Tests of data pre-staging and reprocessing capacity of the T1s measured latency, throughput and success rate for Tape to Buffer staging. Results were site-dependent; no general operational issues were found. ATLAS was also able to reconstruct at two T1s together with CMS; during these limited tests no serious interference was observed.

The CERN Analysis Facility (CAF) resources have doubled compared to CSA07 and the integration of major components, such as CASTOR or CRAB, is well under way, as is the deployment of key user services.

The CMS Software documentation policy describing the CMS Software documentation suite (WorkBook, Offline Guide and CMSSW Reference Manual) has been written, and user support and documentation responsibilities are shared in offline, computing and physics subgroups.

Plans and milestones for 2008
During CCRC08 in May 2008 a full end-to-end test is planned to demonstrate the readiness of the Computing, Software and Analysis systems for data taking.

Finalize the scope and the tests planned for the CCRC08 tests in May and produce the data samples needed.

Commission the 2008 computing resources at the T0, T1 and T2 centers and at the CAF.

Perform the CCRC08 tests in May together with the other LHC experiments.

Processing data from Global Runs and and first LHC data.

Concerns
Manpower is missing for several computing tasks and we are addressing this using the internal CMS Memoranda of Agreement for maintenance and operation.

Physics

Status
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.

Since autumn 2007, physics exercises concentrated on two areas: the completion of the "2007 analyses" (a list of physics topics indicative of the early physics reach of the experiment) and participation in the combined Computing Software Analysis (CSA07) challenge.

The Physics groups have identified the most important topics that may be accessible with integrated luminosities of 10, 100 and 1000 pb^{-1}. These topics were the focus of the "2007 Analyses". The 2007 Analyses provided a 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 became available in December.

During the CSA07 exercise, Physics groups monitored the quality of the datasets. In addition to the large samples of Standard Model events processed at Tier-0 and distributed to Tier-1 centers, there were ~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 was 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.

At the end of 2007, a specific effort was launched to prepare a series of common physics-analysis tools in association with the Offline organization. Also being reviewed is the content of the basic datasets for reconstruction (RECO) and analysis (AOD) to increase efficiency in the use of disk space, by avoiding duplications and by means of a better treatment of information. A Physics Analysis Toolkit (PAT) is being created for physics analysis.

Datasets with residual miscalibrations and misalignments from the CSA07 productions are currently being used for further study and preparation of methods that can be employed for data analysis in early LHC operations.

Plans and milestones for 2008

During the CSA08 exercise, Physics will monitor, again, the quality of the datasets. In addition, four to five physics analyses will be run in quasi-real time at the CAF with data sent out directly by the Tier-0.

The physics groups are also planning a massive simulation of the early trigger table using a very large sample of events simulated with the fast simulation. These samples will also be used to define the early primary datasets of the experiment.

Finally, in association with the Offline organization, a first version of the Physics Analysis Toolkit will be distributed in March. The PAT task force is also developing a "Starter Kit" to assist newcomers and non-expert users to get acquainted quickly with CMS Physics Analysis.

Concerns

The availability of software releases in time for the various activities needed to prepare for the startup of the experiment, the training of people in the latest analysis software.

Conclusions

CMS continues to make significant progress in installation, commissioning, and preparations for data analysis. There are no significant technical issues. All CMS detectors are installed except for pixels and endcap ECAL. CMS is aiming to close the experiment in June and to take cosmics data at operating field. In June all detectors will be installed except for one ECAL endcap.

Commissioning, including using cosmics, with evermore complete setups (complexity and functionality) is proceeding apace. Work already carried out so far gives confidence that CMS will operate with the expected (TDR) performance.

CMS has requested 2 months advance warning of arrival of beam.

CMS is eager to take collision data at nominal or close to nominal energy.

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 (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 upscope to design-luminosity detector needing a sum of 16.6 MCHF.

The restoration of the forward RPC (RE) system was also proposed. The RPC system will be restored in two phases, the first for the geometric region at lower eta ($|\eta| < 1.6$) and the second for the region at $1.6 < |\eta| < 2.4$). The estimated cost for Phase 1 and Phase 2 is 4.21 MCHF and 2.74 MCHF respectively. The Phase 1 of the RPC upscope project is being set up and the 2009 Draft Budget for CMS Construction, to be submitted to the October 2008 RRB, shall contain a more detailed cost estimate for Phase 1 along with the "Money Matrix".

CMS is very grateful to the many Funding Agencies that have already made commitments to above-mentioned steps. The current situation is outlined in Tables 2 and 3.

As mentioned in the ECAL section of this report, barrel crystals have been purchased for a spare supermodule. This cost was included in the Step 1 request mentioned above. However, when account was taken of the exact costs incurred for the purchase of the crystals needed to complete CMS it turned out that there was a shortfall of some 500 kCHF. The CMS Collaboration decided to proceed with the purchase, after obtaining support from the LHCC. We propose to cover this shortfall through the ECAL M&O Cat B funds spread over 3 years (CERN-RRB-2008-030), however, keeping within the current and projected requests. So no additional request, over and above that projected, is being made. It should be noted that all other components for this spare supermodule have already been purchased through the spares category in ECAL M&O Cat B.

At the last RRB it was stated that the October 2008 RRB, after the completion of the low-luminosity detector, would be an appropriate meeting to present an update of the financial position of CMS, with respect to that presented in October 2006, and to propose any necessary adjustments. This update will take account of the shift of the LHC startup with respect to what was expected in October 2006.

Conclusions

As the completion of the low-luminosity detector is imminent, 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, 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 very 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 (kCHF)

	Step 1	Step 2	Step 3	Comment
Austria	**211**	**45**	**171**	
Belgium-FNRS	136	77		
Belgium-FWO	136	34		
Brazil	n.a.			Request made for Step 2
Bulgaria				Awaiting response
CERN	4,569	297	1,119	
China	Endcap RPC	Endcap RPC	Endcap RPC	
Croatia	15			
Cyprus				Awaiting response
Estonia	5	8		
Finland	272	49		Funding in 2010 and 2011
France-CEA	**341**	**58**	**218**	Step 3 likely in 2009
France-IN2P3	n.a.	2,000	n.a.	
Germany BMBF	919	169	637	
Germany DESY	n.a.	2,000	n.a.	
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 be partially covered
Korea	Endcap RPC	Endcap RPC	Endcap RPC	
Mexico	n.a.			Awaiting Response
New Zealand	n.a.	12		Discussing Step 3
Pakistan	Endcap RPC	Endcap RPC	Endcap RPC	
Poland	132	49		
Portugal	108	21		
RDMS-DMS				Discussing
RDMS-Russia				Discussing
Serbia	20			
Spain	344	140		
Switzerland	n.a.	124	466	
Taipei	121	45		Request for Steps 1&2 in 2009/2010
Turkey	**47**	**74**		
U.K.	575	202	762	
USA-DoE/NSF	5,252	1,722		
Sum	**15720**	**7130**	**3390**	
Requested	**17,530**	**8,400**	**16,600**	
% covered	**90%**	**85%**	**20%**	

Bold: Input since the October 2007 RRB.

Table 3: The state of funding of the restoration of the forward RPC system.

FUNDING Countries	**Contributions kCHF**	**Comments**
Belgium	420	Likely to use its Step 3 funds for RPC system
China	**500**	
India	800	Request made. News in Oct.
Iran		Discussing. Request made in Oct06 RRB was for 800 kCHF
Korea	522	
Pakistan	1250	

Bold: Input since the October 2007 RRB.