Status of CMS
Progress Summary Report for October 2006 RRB23

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.

CMS has made much progress over the summer. The detector has been closed for the first time, the solenoid has been tested up to the design field of 4T, and cosmics data have been taken simultaneously from a slice of all the sub-detectors using predominantly the final components.

The items staged for design luminosity running include the fourth endcap muon station ME4/2, RPC chambers at low angles ($|\eta|>1.6$), 6 out of 8 DAQ online farm slices and third forward pixel disks.

The Magnet Test and Cosmic Challenge (MTCC)

A full-scale test and field-mapping of the state-of-the-art CMS 4 Tesla solenoid magnet system has always been envisaged prior to lowering the major elements of the experiment into the underground experiment cavern. The eventual evolution of the schedule forced CMS to complete more of the detector on the surface. Thus arose the concept of combining cosmic ray testing of several subdetectors with the magnet test, which, developed into the "cosmic challenge", a simultaneous system test of all parts of CMS.

The original objectives of the Magnet Test and Cosmic Challenge (MTCC) were stated as:

a) Test and commission the Magnet, including cooling, power supply and control system. Map the magnetic field;
b) Check yoke closure system and tolerances, movement under field and functionality of the muon alignment system (endcap + barrel + link to Tracker);
c) Check magnetic field tolerance of yoke mounted components;
d) Check installation & cabling of HCAL, ECAL and Tracker inside coil;
e) Test combined subdetectors in a 20 degree slice of CMS with magnet, using as near possible final readout, DAQ, trigger, control, safety and auxiliary systems. Check noise and inter-operability. Trigger and record cosmics, constructing intelligible events in many subdetectors simultaneously. Try out commissioning, synchronisation and operation procedures for CMS.

The benchmark of success in this last objective was considered to be the recording, offline reconstruction and display of a cosmic ray in the 4 subsystems of CMS (Tracker, ECAL, HCAL and Muon Detector) with the magnet operating at 4T.

Additional constraints were to:

- make no significant impact on critical path assembly progress;
- perform "cosmic challenge" in the shadow of commissioning & field-mapping;
- complement the trigger system (high rate) tests in B 904 electronics integration centre;
- use final systems as far as possible…no (or few) MTCC specific developments.

The original scope was expanded to include substantial offline as well as online systems objectives. Data transfer to some Tier-1 centers, online event display, quasi-online analysis on Meyrin site, and fast offline data-checking at Fermilab were some highlighted targets of MTCC Phase I designed to offer a first hand taste of a 'CMS-like' running experience.

After the cabling of the detector elements the final closing of the yoke proceeded. It was completed on 25 July allowing the start of the magnet test. The power circuit was completed and the testing of the coil progressed in steps: 5, 7.5, 10, 12.5, 15, 17.5 and then 19.12 kA to reach the nominal 4T field on 22 August. At each value, fast discharges were provoked to learn how to tame the dumping of energy inside the cold mass during such a discharge. At 12.5 kA a rupture disk was broken due to bad functioning of a safety valve. However, after adjustment of the cold box process to limit the quantity of helium in the phase separator circuits, the last fast discharges from the nominal current behaved as expected. All other parameters registered nominal values; the electrical insulation of the coil is good and all cooling circuits are vacuum tight. After running at 3.8T for 48 hours for the cosmic challenge, the coil was run at 4T for 2 hours on the 28 August, and the functional tests of the magnet have been declared completed with success.

In summary, after 15 years starting from early design, R&D, pre-industrialization, 6 years of construction and about one year of installation, CMS coil has been tested successfully. From cryogenic, electrical and mechanical tests the coil fulfills all specifications and seems easy to operate. Installation of CMS detectors inside the experimental area can proceed.

Twenty five million cosmic triggered events were recorded with the principal subdetectors active, of which 15 million events have stable field ≥ 3.8T. Data-taking efficiency reached over 90% for extended periods. Several thousand of these events correspond to the "4-detector" benchmark, and the whole data sample will provide useful understanding and calibration of the combined detector and software performance.

The main conclusions are:
i) CMS can be opened and closed on the timescales intended;
ii) The magnet worked stably and safely at ~ 4T;
iii) The subdetectors work with the magnet and each other (both systems and people!!);
iv) The subdetectors can be integrated with the central DAQ, trigger, DCS, DQM etc.;
v) The commissioning strategy broadly worked;
vi) CMS can work as a world-wide, unified team.

As a result of diligent work by hundreds of people over many years and by a dedicated, enthusiastic, mainly young, team in August 2006, MTCC phase I concluded on time with all objectives met.

With the first phase of the MTCC successfully completed, ECAL and tracker elements have now been removed to make way for the field-mapper. Corrections have also been made for field intolerant features found during MTCC phase I. CMS will be closed again for MTCC phase 2, to run during October, where the principle objectives are to map the magnetic field with an accuracy of 10^{-4}, to study the detailed response of HCAL and muon detectors to the magnetic field and to commission newly available elements of the global trigger.

Almost all the MTCC 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.

Civil Engineering

Status

Civil engineering (CE) works at Point 5 (located at Cessy, France) have been completed. Installation of the infrastructure in the USC55 cavern (for the counting rooms and services) is nearly completed. The infrastructure of the PM54 shaft has also been completed. The installation of infrastructure in the underground cavern UXC55 (for the experiment proper) has been completed. The two rotating shieldings have been installed, and the cabling of the cable chains is in full swing. The experiment cavern will thus be ready to receive the first detector elements, the two HFs, in October 2006. The construction of the SDX5 building has also been completed as well as that of the surface control room building, SCX. The latter is ready to receive the first elements of the computer farm.

The shielding plug, which will also be used as a lifting platform for the transfer of the experiment underground, has been tested under a load of 2400 tons. The static test of the gantry with the same load has followed, and the system is ready to perform its first dynamic test.

Changes
None.

Plans for 2006/2007
Complete infrastructure in all buildings and caverns and commission it. The UXC cavern will receive the first elements of CMS. Complete equipping of SCX as a full-fledged control room.

Concerns
None.

Installation and Infrastructure

Status

Gas and cooling pipes for DTs, CSCs and RPCs have been installed on the six yoke-disks and on the five barrel-wheels. Deliveries of the cooling plants (water and fluoro-carbon) have been completed. The rack system is in position, and has received crates before the start of the main cabling campaign. The plan for electrical distribution, including the Low Voltage system, has been completed, and this has allowed the finalization of the cabling plan.

The HF shielding for both ends and the forward cylindrical shielding surrounding it, manufactured in Iran, have been fully completed at CERN and transported to Point 5. The manufacture of the rotating shielding for both the ends has been completed. After filling with borated concrete these 'shieldings' have been installed and hinged from the forward shielding.

The contract for the heavy lifting tasks is operational, and the structure of the main gantry has been erected around the SX5 hall. The gantry has been tested before the first lowering operation, that for the HF detectors.

The cabling and final commissioning of chambers installed in YB0 will fall on the critical path after the field mapping campaign of the magnet.

Changes
None.

Plans for 2007
Lower the detector, complete cabling of cable chains, cable up the detector.

Concerns
Lowering of the CMS detector into the underground cavern and the subsequent cabling, especially of YB0 and the Tracker, fall on the critical path.

Magnet

Status

The magnet, including the coil, has been completed in SX5.

Pumping of the cryostat started before Christmas 2005, and cooling of the coil commenced in the beginning of February 2006. The coil reached its operating temperature (liquid helium – 4K) after 23 days of cool-down. The electrical test of the magnet in the surface building has been completed with success in August 2006. The nominal field of 4 Teslas was reached without problem. A period of stable operation for detector tests and detailed mapping of the magnetic field will follow in October 2006.

Changes
The coil has been fully tested with success.

Plans and milestones for 2007
After field mapping the magnet will be lowered in UXC5.

Concerns
None.

Tracker

Status

The CMS Tracker continues to make good progress. Hybrid production was completed at the end of 2005, module production was completed in the spring of 2006, and in August 2006 the production of all TIB shells, TOB rods and TEC Petals were completed. In October 2006 the forward (+) end of TOB will be completed, TIB + will be ready for integration into TOB+, and TEC+ will be delivered to CERN from Aachen, where it was completed in September.

In November 2006 the backward (-) end of TOB will be completed, TIB- will be ready for integration into TOB- and TEC- will be complete ready for integration into the Tracker support tube (TST).

The performance of the Tracker sub-detectors is very good. The number of dead or noisy channels is < ~2/1000 and the signal to noise ratio is > 25:1.

The Pixel Detector continues to make good progress. All components are now available and ~15% of the modules (Barrel Pixels) and Plaquettes (Forward Pixels) have been successfully produced. A pixel sector will be delivered to CERN in December 2006 for integration in the TIF before installation into CMS in September 2007. The full Pixel Detector will be ready to be installed into CMS in November 2007.

The readout electronics systems, power systems have been delivered to CERN and commissioned with the DAQ and DCS systems in the CMS Electronics Integration Facility.

The Tracker Integration Facility (TIF) is fully operational, and provides the environment and the infrastructure to integrate all of the Tracker sub-detectors into the TST. Following the completion of this integration, the Tracker will be commissioned in the TIF using the final data acquisition, slow control, safety, and off-line software systems. The facilities at the TIF allow for the commissioning of the Tracker at the working temperature of -10^0 centigrade.

A Tracker Analysis Centre has been established close to the TIF, with links to remote sites, so the whole Tracker community can be involved in understanding of the commissioning, operation and performance of the Tracker before it is transported to P5 and installed into CMS.

The Magnet Test and Cosmic Challenge (MTCC) was a successful test of the performance of all the Tracker systems working together with parts of all of CMS. Many lessons have been learned, which will be implemented in the commissioning of 25% of the Tracker at the TIF.

Prototypes of the new design of the Tracker Patch Panel 1 (PP1) have been received and are being tested before the start of production in November 2006. The new 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. It is very important that this is completed before CMS is closed.

Changes
With the new PP1 design the Tracker is installed into CMS after the pre-cabling is complete.

Plans and Milestones for 2006/2007
Complete the integration of the CMS Tracker in the TIF in 2006, and continue testing and commissioning until the pre-cabling at P5 is complete.

Install the Tracker into CMS in June 2007; connect to PP1 and commission in CMS.

Concerns
The schedule for the installation and cabling of the Tracker is very tight.

Electromagnetic Calorimeter

Status

About 56500 out of 61200 of the barrel crystals have been delivered and are being used to construct modules (400 or 500 crystals) in CERN and Rome. One-hundred-and-twenty-two modules, out of 144, have been assembled. Thirty bare supermodules (SM, each comprising 1700 crystals) have been assembled. The crystal production is now proceeding at the rate of about 1250 crystals per month. The last Barrel crystal will be delivered by 1 March 2007, allowing insertion of the last supermodule in UX in May 2007, as planned in the CMS assembly schedule v35. For both suppliers, the production of Endcap crystals will start immediately after the end of the Barrel crystals production and is expected to finish by February 2008.

For the Barrel electromagnetic calorimeter, the integration status is the following: all 140,000 APDs, all ASICs in Deep Submicron (DSM) Technology, the 13,000 Very-Front-End boards, 2600 Front-End boards, 2500 regulator boards and 5000 Gigabit Optical Hybrids have been received and tested. During last spring, an integration rate of 4 SMs per month was achieved. Currently 24 SMs are completed, which is consistent with the general construction schedule of CMS. The performance of the integrated supermodules satisfies fully the design performance stipulated in the TDR. After integration, each SM is subjected to a pre-calibration and commissioning run of 10 days with cosmic muons. In addition, eight SMs have already been pre-calibrated in an electron beam. Preliminary comparisons between the cosmic and test beam data indicate that the cosmic data could yield an initial inter-calibration with a precision better than 2%. Finally, two SMs have been successfully tested in the magnet of CMS during the MTCC, showing that the performance is maintained inside CMS and in the 4 Tesla magnetic field.

Large pre-series of all off-detector readout modules are in hand. Their production and testing will be completed by mid-November 2006. The final low voltage power supplies have been tested and the complete set has been ordered. All high voltage power supplies are in hand.

The construction of the Endcap mechanics is progressing according to schedule. All the mechanical pieces needed for the four Dees have been delivered to CERN. Over ninety percent of the 15000 VPTs have been delivered and tested to 1.8T. The production of the ~3300 endcap Very-Front-End boards and of the ~650 Front-End boards is going on. The other electronics boards are identical to the Barrel ones and are also being produced. To gain experience before the large assembly in 2008, an integration test with 500 endcap crystals mounted on the final mechanics, using pre-series of the endcap electronics, has been launched.

Preshower: All of the required silicon sensors have been produced. The gluing of the sensors on their mechanical supports has started in the various regional centres. All the specific Preshower DSM ASICs have been produced, packaged and tested. Difficulties were encountered with the production series of the front-end hybrid PCB's, forcing us to have a change of PCB producer. The new production should be qualified by the end of November. Half of the readout motherboards have been produced and are being tested. Excellent progress has also been done for the large mechanical pieces (windows, cooling screens).

Changes
None.

Plans and Milestones for 2006/2007
Continue integration of electronics into the SMs, integrate all EB+ modules by November 2006. Install EB SMs in HB.

Concerns
Crystal production remains on the critical path. The schedule for the completion of the ECAL is very tight.

Hadron Calorimeter

Status

All HCAL (HB, HE, HO and HF) absorber, optics, and front end electronics are completed, tested, installed and "burned in".

Modules of all geographic parts of HCAL were tested extensively in beam in 2004 and 2006 using final electronics. This established the relationship between the calibrating radioactive source and the pion and electron beams. Data were also taken with low energy pions and electrons with energy ranging from 2 to 9 GeV, thus extending the available data from 3 to 350 GeV. The 2006 test used a production EB supermodule and had extensive new beam line particle identification hardware. That allowed for a clean separation of electrons, muons, pions, kaons and protons over a sizable fraction of the full momentum range. The results will be used to tune the GEANT4-based simulation.

The calibration data establish an initial calibration prior to first collisions with an accuracy estimated at 5%. The calibration was reconfirmed in the 2006 test beam data taking.

The front-end electronics has been produced and tested for linearity and other quality factors at Fermilab. After "burn-in" the electronics was delivered to CERN and installed. The HCAL slow controls and data quality monitoring tasks are being inserted into the overall CMS framework during MTCC. HCAL triggers will be used globally in the second MTCC. The DAQ electronics for HCAL (HTR and DCC) are tested and delivered to CERN for "burn in" in Bldg. 904 and joint tests with global trigger and DAQ.

Changes
HF moved to SX5 and ready to be installed in SX. All calibrations established.

Plans and milestones for 2007
Install all HCAL sectors in UX, test with local DAQ and then establish global DAQ readout with final trunk cables and UX services. Install DAQ electronics in USC when schedule permits. Prepare software tools for initial calibration data sets to be taken in the initial 2007 run at 0.9 TeV.

Concerns
None.

Muon Detector

Status

Endcap Cathode Strip Chambers: All of the chambers (a total of 496 including 6% spares) have been assembled and tested at sites in China (IHEP-Beijing), Russia (JINR-Dubna, PNPI-St Petersburg) and US (FNAL, UCLA, UF). All chambers have been shipped to CERN, and over 90% have been installed on endcap yoke disks and commissioned. All of the peripheral crate electronics on the positive endcap have been installed and passed initial testing. On the negative side endcap, 36 chambers remain to be installed. The installation and testing of the peripheral electronics is underway. During MTCC one-sixteenth of all the muon chambers operated successfully in concert with the rest of the CMS detector. Trigger and DAQ electronics, LV and HV systems, gas systems, monitoring, and software were globally commissioned.

Barrel Drift Tubes: Chamber construction, including spares, was finished in June 2006. All the chambers are at CERN. The dressing and certification of chambers at ISR has also been completed. 136 chambers have been installed in the CMS yoke. Installation on yoke elements YB+1 and YB+2 has been completed. 40 chambers were installed in June in YB0. 93 chambers have been commissioned using cosmic rays with data taken through the on-chamber electronics housed in the Minicrates. Commissioning was suspended in July for the start of the Magnet test. The production of the Minicrates was completed in August and all of them are at CERN. The next installation campaign is planned in November when installation of 63 chambers in the negative wheels YB-2 and -1 will be carried out. This will complete the installation planned in the surface hall.

Fourteen chambers of three sectors, S10, S11 in YB+2 and S10 in YB+1 were successfully operated during the Magnet Test and the Cosmic Challenge in July and August. About 25 Million events were collected with Magnet on, and off, and triggered by the DT chambers.

The complete line of electronics from detectors to the concentrators of Trigger and readout in the yoke balconies and reception of signals in the counting room (DDU) was validated. Transmission of data to the slice of CMS DAQ was also a success.

Barrel RPCs (RB): The gap production has been finished and the remaining 20 chambers are under test. These 20 chambers will complete the full lot of 480 at CERN by the end of November 2006. Fifty-two RPCs are already coupled to 26 DT and ready to be moved to the surface hall for installation.

RPC 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 to have 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 gap production in Korea is proceeding well and is almost finished. Priority has been given to RE1 chambers. To date 108 out of the 144 RE1s have been installed on the yoke. RE2s and RE3s are being assembled in Pakistan (288 in total); all of the chambers for plus end have been assembled and installed on the yoke, while production for the minus end is still going on. So far about 15% of RE2s and RE3s for minus end have been assembled and certified in Pakistan.

Alignment: The first full-scale test of the CMS Alignment system was performed during July and August when the Magnet passed the test at full field.. This combined test of Technical Alignment and particle trackers (mainly Muons) will continue during the field mapping. About 30% of the Alignment system (Link, Barrel and Endcap) was working in July/August.

The system managed to measure with precision the movement of the iron yokes and the deformation of the first endcap disk. The presence, in July and August, of a tracker slice in the magnet equipped with its Alignment Ring, allowed to detect the relative movements of the "tracker" with respect to the Muon system. The results are encouraging. After the end of the field mapping a large fraction of the alignment parts will be dismounted for reasons of safety and for recalibration in the ISR stand. The equipment and calibration of the remaining 36 MABs will restart immediately at ISR.

Reconstruction of tracks in the Barrel MU allowed to crosscheck the position of the chambers versus the results of photogrammetry: the agreement is excellent, better than half a millimeter. This combined test of the Technical Alignment and particle tracks (cosmics) will continue during the field mapping.

Changes
None.

Plans and milestones for 2006/2007
Barrel Drift Tubes and RPC's: Install and commission chambers in all five YB wheels before lowering. Commission the 40 chambers to be installed underground by May 2007.

Endcap CSCs: Finish installation and commissioning of the remaining CSC chambers before disks are lowered into UX.

Endcap RPCs: Continue production and installation of chambers.

Alignment: Complete equipment and calibration of the rest of the system. Complete software and calibration DBs. Install and operate the system after lowering of CMS in the cavern.

Concerns
None.

Trigger and Data Acquisition

Status

Trigger: Production is either well underway or complete for most major trigger subsystems. The trigger subsystems have passed a series of integration tests composed of mostly production electronics in the Electronics Integration Center (EIC) in Prevessin. These involved multiple trigger subsystems with central clocking and control and data sent from detector electronics through to the Global Trigger.

All muon trigger subsystems (Drift Tube, CSC, RPC and a dedicated independent RPC cosmic trigger) were successfully operated using the Trigger Timing and Control (TTC) infrastructure in the MTCC during August. The trigger operated stably with an uptime fraction above 90% for long stretches writing data to tape at 200 Hz, producing single continuous runs with more than 500k events. The calorimeter and global triggers have been integrated and readied for operation in MTCC Phase 2.

The trigger software framework deployment is continuing across trigger subsystems. Installation has started in USC55 with all of the Regional Calorimeter Trigger Crates installed and a substantial portion of the TTC system in place.

The new Global Calorimeter Trigger (GCT) project is making good progress. Prototypes of the majority of cards in the system have been delivered and are either tested or under test. The cards that interface to the RCT have been successfully tested. It is still possible to maintain the original overall schedule for GCT delivery in June 2007 but without any contingency.

DAQ: The production and procurement of the Data to Surface (D2S) equipment (110 water cooled racks, 750 FRL/FMM systems, 200 PCs, 12 Myrinet switches and 1024 links plus cables and fibers) were completed in February 2006 and the installation of all read-out systems (FED-FRL links and controller PCs) in USC was completed in September 2006. The commissioning of the FED-FRL-D2S readout chain with the underground miniDAQ system will start in October 2006.

The administrative procedures for the acquisition of 600 PCs and three GigaBit Ethernet switches to be installed in the surface control room (SCX) for the first run global DAQ system have been completed and a tender will be prepared in October 2006. Final order is expected to be placed in January 2007, with the installation and commissioning taking place from March to August 2007.

The pre-series system installed during 2005 in the green barrack at Point 5 used to develop and validate the central DAQ software packages, has been successfully deployed in the Cosmic Challenge during last Magnet Test in the summer 2006.

Changes
The trigger system passed a major milestone with successful operation at the MTCC.
The GCT has produced prototype hardware, used up schedule contingency, but remains on its original delivery schedule.

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

CPT

Computing and Core Software, Physics Reconstruction and Selection, Tridas

Status
The CMS Software and Computing Project is organised as a single Project called CPT: comprising Computing and Core Software, Physics Reconstruction and Selection (PRS).

Computing: The CMS system consists of application services and CMS specific components on top of, and interfacing with, the WLCG middleware. It is making full use of the WLCG Grid of computing centers, the CMS-Tier0 center and CMS-CAF (CERN Analysis Facility) at CERN and the world-wide distributed system of regional Tier1 and Tier2 centers.

In 2006, essential computing components were delivered and integrated into a fully

functional CMS computing environment. With the new software framework much of the computing systems consisting of Data Management, Workload Management and database components were re-engineered, too. All essential components were delivered and integrated into a functional system in time for the WLCG Service Challenge 4 (SC4) that started in June 2006.

During SC4, the scaling behavior of the system was tested. In a period of three months ending in mid-August a total of 3 PetaByte of CMS datasets were transferred between storages systems through the worldwide Grid. CERN to the Tier-1 centers eventually achieved on a regular basis rates of 150MB/sec, corresponding to about 25% of the nominal rates. Work on improving throughput and robustness of data transfers is continuing as part of the joint CMS/WLCG Integration Taskforce. Many CMS regional computing centers came into operation and demonstrated good performance, well on track with a ramp that will reach the 2008 performance targets. All seven CMS Tier-1 centers participated in SC4 and some 20 Tier-2 center were part of the Service Challenge.

The basic parameters of the existing computing model remain the same, with the exception that the new LHC schedule presents the opportunity to improve the high-level trigger accept rate whilst simultaneously reducing the required computing resources. This change has the potential to accelerate the understanding of the detector performance, extend the physics reach of the experiment and the margin of safety in the computing model. The revised resource requests comprise a 20% reduction of the requests put forward in the October 2005 RRB meeting.

Software: A comprehensive Software Validation Suite for the simulation packages is now in place, while Reconstruction Validation packages are under development. The latest release of CMSSW has been used for the generation and simulation of more than 70 Million events. The latest releases contain complete local reconstruction for most sub-detectors, with complete interfacing to calibration Database and using the final data formats consistent with the hardware. All data-taking during the cosmic challenge (MTCC) was carried out with CMSSW which demonstrated its ability to read the various sub-detectors, apply calibrations, perform local reconstruction and assist in monitoring and debugging of the hardware. CMSSW was also deployed in the different integration tests (Tracker) and test-beam areas (ECAL and HCAL + ECAL).

The software related to the online selection of events in the Filter Farm (HLT) underwent a major revision in 2005, following the adoption by CMS of a new Software Framework. This revision is now complete and the new framework is fully integrated with the DAQ system. Finally, a first version of the RAW, RECO and AOD data formats for the main physics objects has been deployed.

Strong emphasis was placed on training activities. These activities included tutorials, documentation (Workbook, Reference Manual) and the introduction of a formal user support group.

Physics: Volume 2 of the Physics TDR, was submitted to the LHCC in June. This volume demonstrates the physics capabilities of CMS. To gauge the performance of CMS detailed analyses are being performed of a few challenging benchmark processes. These processes cover several Higgs boson decay channels, the production and decay of new particles such as Z' and supersymmetric particles, di-jet resonances, B_S production and a study of quarkonia in heavy ion collisions. The second part of Volume 2 document the physics reach with 1 to 30 fb^{-1}.

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 in the summer 2007. The work would document the actual startup of the experiment in 2007, along with the very early physics reach with 0.1 fb^{-1} and 1fb^{-1}.

MTCC: During the MTCC 25M events were taken using cosmic ray triggers. The complete readout chains were tested and data were successfully analyzed both online, using the Data Quality Monitoring infrastructure, and offline using the new Software Framework. Shortly after the end of the MTCC the first muons were reconstructed with preliminary calibrations, and p_T and angular muon spectra have been shown at the open meeting of the LHCC in September. First results of alignment with muon tracks are very encouraging. During the MTCC data taking offline quality check shifts were organized at CERN and at the ROC (FNAL), thus covering 24h/day, and on-line event display shifts were organized in the MTCC control room. Both shifts helped in providing fast checks of the recorded data. In October the MTCC will start a phase 2, with main emphasis the field mapping at several field values, and data taking for alignment and specialized tests with the muon system and the HCAL.

CSA06: The focus of all CPT activities in 2006 has been the preparation for the combined Computing Software and Analysis challenge. The CSA06 pre-challenge preparations began in July with the production of more than 50M Monte Carlo events. Nine data streams were prepared, one of which is tagged with HLT information. The simulation step has completed and more than 90% of the data has been transferred to CERN.

During the CSA challenge, the Tier-0 capacity will reach 1.4M SI2K and should demonstrate processing at 40 Hz or greater. Seven Tier-1 centres will receive the prompt reconstruction data. Several calibration and alignment exercises will demonstrate the capability to derive new constants and to reinsert those constants into the database for re-reconstruction at a Tier-1 centre. Centrally managed skim jobs will run on the primary datasets at the Tier-1 centres in order to derive secondary datasets for distribution to Tier-2 centres. A variety of analysis demonstrations are planned by the PRS groups to access these datasets via the CRAB job submission tool. The challenge should complete in November 2006.

Changes
The Physics TDR Vol. 2 was submitted to the LHCC in June 2006. Short reports on startup will be submitted to the LHCC in the summer 2007 instead of a third volume of the TDR.

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

Concerns
Availability of sufficient computing resources at the CMS T1s.

Overall Milestone Completion

In Figure 1, the planned and achieved integrated numbers of milestones completed are compared, month-by-month, with the CMS schedule v34.2. The "planned" milestones have not been updated for the change of the LHC schedule announced in June. The previous schedule foresaw collisions in the summer of 2007. The new CMS assembly planning allows the beam-pipe to be closed by the end of August 2007 and the initial CMS detector to be ready for the pilot run in the last quarter of 2007.

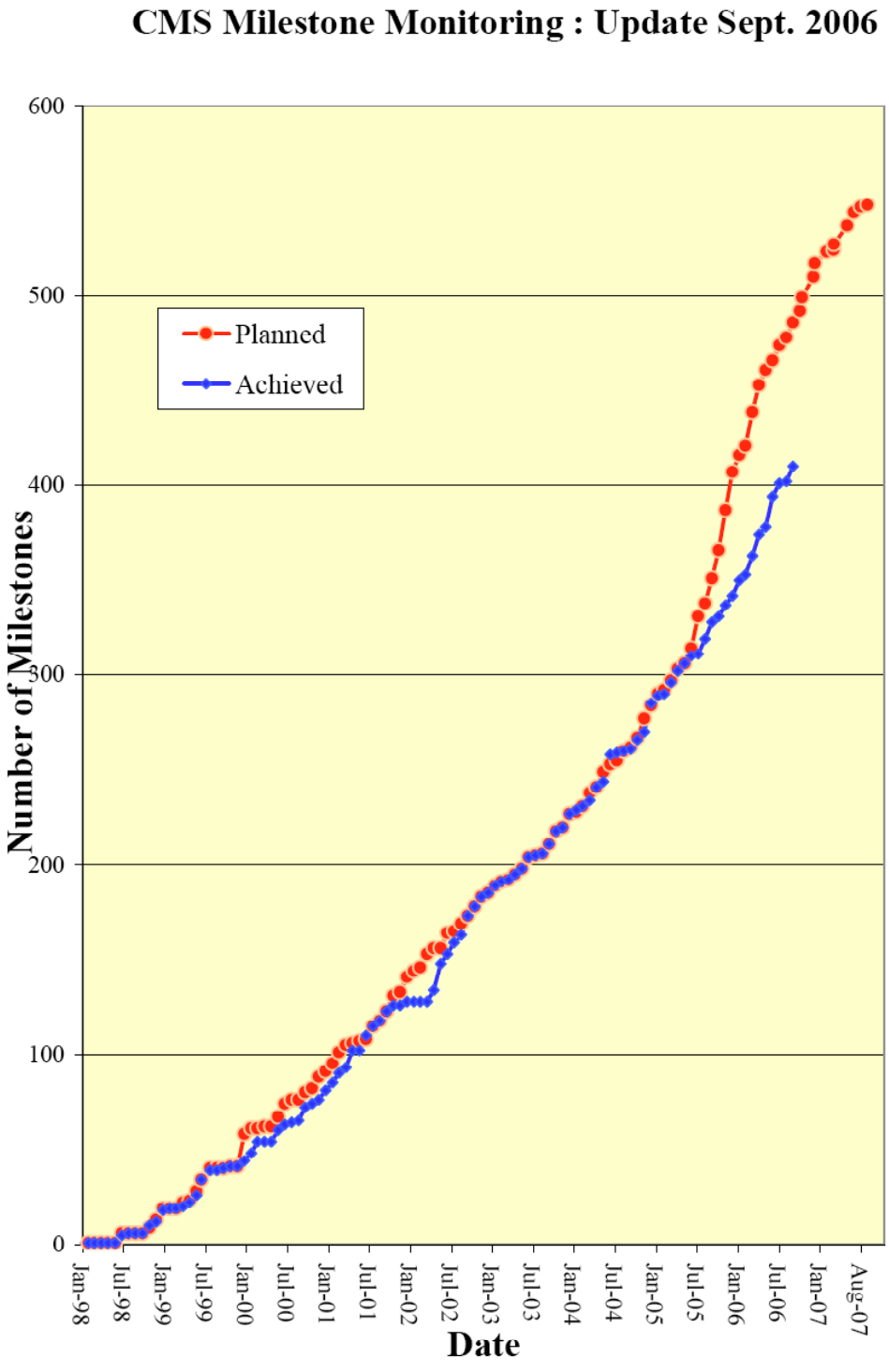

Figure 1: The intended and achieved integrated numbers of milestones.

Conclusions

The CMS assembly planning allows the beam-pipe to be closed by the end of August 2007 and the initial CMS detector to be ready for the pilot run in the last quarter of 2007.

The initial detector will be without the previously staged items, the pixel detector and the ECAL endcaps. 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 schedules for the completion of the Tracker and ECAL are tight. Lowering of the CMS detector into the underground cavern and the subsequent cabling, especially of YB0 and the Tracker, fall on the critical path.

Over the summer CMS has successfully closed the experiment for the first time, tested the magnet to the design field of 4T, and recorded data from cosmic rays traversing a slice of all the subdetectors. This has demonstrated that CMS can operate as a unitary detector.