

LARGE HADRON COLLIDER COMMITTEE

Minutes of the ninety-fourth meeting held on
Wednesday and Thursday, 2-3 July 2008

OPEN SESSION

1. LHC Hardware Commissioning Status Report: Roberto Saban
2. LHCb Status Report: Andrei Golutvin
3. Proposal for R&D on the Development of Micro-Pattern Gas Detector: Leszek Ropelewski

CLOSED SESSION:

Present: J.-J. Blaising, S. Dalla Torre, S. de Jong, J. Engelen, M. Ferro-Luzzi, F. Forti, M. Gonin, C. Hawkes, V. Kekelidze, J. Knobloch, W. Kuehn, M. Mangano, R. Mankel, M. Martinez-Perez, P. Mato, C. Niebuhr, A. Nomerotski, E. Perez, B. Peyaud, S. Smith, E. Tsesmelis (Secretary), T. Wyatt (Chairman), R. Yoshida

*part-time

Apologies: J. Haba

1. PROCEDURE

The Chairman welcomed the new members, Chris Hawkes, Wolfgang Kuehn and Andrei Nomerotski, to the Committee.

The minutes of the ninety-third LHCC meeting (LHCC 2008-008 / LHCC 93) were approved.

2. REPORT FROM THE CHIEF SCIENTIFIC OFFICER

The Chief Scientific Officer (CSO) reported on issues related to the LHC. He reported good progress in the cool-down and hardware commissioning of the LHC machine. All sectors have been cooled down and hardware commissioning is advancing in parallel in several sectors. In light of the current status, the exact date on which the LHC machine and experimental areas will be closed is presently under review. Commissioning of the LHC experiments is well underway, and includes extended global cosmic-ray runs. Discussions for the LHC luminosity upgrade, regarding both the accelerator and the experiments, have started with a view of approaching funding agencies for new investments in this area.

3. REPORT FROM THE ALICE REFEREES

The LHCC heard a report from the ALICE referees, concentrating on the status of the installation and commissioning of the experiment.



Very good progress was reported on the ALICE detector installation. All the detector elements delivered to Point 2 have been installed and the solenoid magnet doors have been closed. Installation of the final elements of the radiation shielding is well underway. The current planning has ALICE ready for beam on 28 July 2008 and will include the full hadron and muon capabilities of the experiment, while the full electron and photon detection will be finalized later.

The referees also reported on the status of the ALICE commissioning. Global commissioning of the ALICE experiment is in progress. Thousands of tracks in the Inner Tracking System (ITS) and Time Projection Chamber (TPC) have been recorded and the first results on the detector alignment have been obtained. In parallel, commissioning of the ALICE DAQ is well underway with the global cosmic-ray runs and also with dedicated runs of the ITS, TPC and V0 detectors. Commissioning of the ITS cooling systems has been finalized, but only after lengthy delays due to problems with the working points. Good progress was reported on the TPC, but difficulties were experienced with the stable operation of the cooling of the front-end electronics and a number of front-end cards are not functioning. The commissioning of the Muon Tracking Stations 3/4/5 has been delayed, due primarily to the noise problems in the Wiener power supplies. The power supplies are currently being repaired. The Time-of-Flight (TOF) detector is providing a very useful cosmic-ray trigger by using coincidences between several modules. The problem associated with the DC-DC converters that appear not to function in the magnetic field is under investigation.

4. REPORT FROM THE ATLAS REFEREES

The LHCC heard a report from the ATLAS referees, concentrating on the status of the experiment and the Full Dress Rehearsal.

The referees reported on the status of the experiment. The ATLAS detectors are in their final positions and the Inner Detector (ID), Calorimeters and Small Wheel muon chambers have been closed around the experimental beam pipe. Both the Solenoid and Barrel Toroid magnet systems have been tested and are operational. The leak in the helium line of the End-cap Toroid (ECT-A) has been repaired and is now undergoing final tests. A global test of all ATLAS magnets is scheduled to be completed by mid-August 2008. Repair of the ID evaporative cooling plant has made impressive progress. All problems have been resolved and the plant is expected to be fully operational in July 2008, in time for the bake-out of the experimental beam pipe by the end of July 2008. Commissioning of the Semiconductor Tracker (SCT) and Pixel Detector has been put on hold, awaiting the completion of the repair to the cooling plant. Having the ID operational for the LHC start-up requires the optimization of procedures and software tools in order to speed up the detector's commissioning. Commissioning of the Transition Radiation Tracker (TRT) is progressing well. The critical issue remains the timely availability of the TRT read-out drivers. The LHCC noted the reduction in performance of the LAr End-cap Calorimeter low voltage power supplies in the magnetic field. A dedicated ATLAS team is investigating the issue and the set up for the first LHC run.

The LHCC also heard a report on the ATLAS Full Dress Rehearsal. The exercise proved to be a very useful step in getting the ATLAS computing ready for LHC operation. The basic ATLAS computing is functioning and many problems were addressed successfully during the exercise. Additional effort on the calibration loop and express stream, together with an enhanced co-ordination of activities at the Tier-1 and Tier-2 centres, is still required.

5. ATLAS TECHNICAL DESIGN REPORT ON THE FORWARD DETECTORS FOR THE MEASUREMENT OF ELASTIC SCATTERING AND LUMINOSITY

The LHCC has completed its scientific and technical evaluation of the ATLAS Technical Design Report (TDR) on the Forward Detectors for the Measurement of Elastic Scattering and Luminosity (LHCC 2008-004 / ATLAS TDR 18) submitted in January 2008. The Committee was impressed by the quality of the work presented in the TDR and congratulates the Collaboration. The concept of the ATLAS Forward Detectors, built around the Roman Pot stations of the ALFA (Absolute Luminosity For ATLAS) detector, is well-suited to the challenge of providing a measurement of the elastic scattering and luminosity. The TDR demonstrates that the technological issues do not pose potentially prohibitive problems.

The Committee has no major concerns. An ancillary document (LHCC 2008-011) records the overall assessment by the LHCC of the project at this time, thereby emphasizing some points which should be monitored in the future as the project progresses. The LHCC review of the TDR was not a detailed review of the engineering or procurement readiness.

Recommendation:

The LHCC recommends general approval of the ATLAS Technical Design Report on the Forward Detectors for the Measurement of Elastic Scattering and Luminosity. The LHCC considers the schedule given in the TDR to be appropriate. The schedule will be used by the Committee to measure and regulate the future progress of the project.

6. REPORT ON THE CMS REFEREES

The LHCC heard a report from the CMS referees, concentrating on the installation and commissioning of the experiment, the computing and the preparations for sustained operation.

The referees reported on the installation of the CMS experiment. The experimental beampipe is leak-tight and baked-out and the trial insertion and closure of the Pixel Detector was successful. A one-month delay was reported in some parts of the Tracker commissioning due to a serious failure in the condenser/heat exchanger. The condenser, evaporator and all heat exchangers have been changed and the final check-out is in progress following the re-start of the cooling plant. Construction of the four Dee modules making up the End-cap Electromagnetic (EE) Calorimeter is advancing well. Dee-1 is complete, Dee-2 is undergoing final tests and commissioning, commissioning of Dee-3 has started and Dee-4 construction is approaching completion. Good progress was also reported on the Beam Radiation Monitors, with all systems expected to be ready for installation on schedule. Problems in the integration of the Preshower Detector have caused delays in the mounting of the ladders and the installation of the detector in CMS will only be possible during the first LHC shut-down. Failures of the magnetic field rack ventilation units are continuing at an average rate of about two per week. Repairs are in progress and negotiations have started with a new manufacturer for the supply of robust field-tolerant units for installation during the winter LHC shut-down.

The Committee also heard a report on the commissioning of the CMS experiment. Commissioning has progressed via stand-alone activities of sub-detectors alternating with global cosmic-ray runs. Successful cosmic-ray runs with no magnetic field were completed in May and June 2008.

The referees also reported on the status of the CMS computing. The Computing, Software and Analysis (CSA08) and Common Computing Readiness Challenge (CCRC08) exercises in May 2008 proved to be highly successful. CSA08 exercised three months of data-taking with two luminosity scenarios and provided the opportunity to analyse the calibration and alignment data. The CCRC08 provided extensive tests of the CMS Tier links, tested the re-processing of data at the Tier-1 centres and provided a test-bench for the Tier-2 analysis.

The LHCC took note of the CMS preparations for sustained operation. Amongst the concerns, the LHCC noted that the CMS sub-system field teams are mostly not large enough to cope with sustained operation, the long-term deployment of the experimental area management teams is precarious, and the costs for the consolidation of the infrastructure must be done using Maintenance and Operation funds.

7. REPORT FROM THE LHCb REFEREES

The LHCC heard a report from the LHCb referees, concentrating on the status of the installation and commissioning and the preparations for first physics.

The referees reported on the status of the LHCb installation and commissioning. Commissioning of the Vertex Locator (VELO) is approaching completion. The 3% of modules not yet commissioned is due to missing low voltage power supplies (late delivery) and TELL1 read-out boards (require better quality of vias). Good progress was reported on the commissioning of the Inner Tracker and Outer Tracker and the Ring Image Cherenkov detectors RICH-1 and RICH-2 are ready for the LHC start-up. Recovery of the Outer Tracker gain loss has made progress by implementing measures based on gas flushing and module heating. The vacuum quality remains a problem for some of the RICH-2 Hybrid Photon Detectors (HPDs). The issue needs to be resolved together with the manufacturing firm as the number of spares is now declining. The Calorimeter system is complete and ready for LHC start-up. The LHCC took note that the ventilation turbines for the crates that are tolerant to magnetic fields have mechanical defects. This is a common production across all experiments and repairs and a new production is being organized. Global commissioning of the LHCb experiment is progressing well. The Online System is also ready for LHC start-up. Preparations for the key physics measurements – CP Violation, rare decays and flavour physics – are also well advanced. Construction of the replacement modules for the VELO has started and full production is expected to be completed in April 2010.

8. REPORT ON THE LCG MINI-REVIEW

The LHCC heard a report on the first LHC Computing Grid (LCG) Project Mini-Review, concentrating on the general status of the project, the Application Area, the middleware, the Common Computing Readiness Challenge (CCRC08) and the LCG Fabric.

General Project Status

The LCG Project has made significant progress since the last Comprehensive Review in 2007. The basic middleware services are in place and have been improved in terms

of stability and reliability. The computing capacity required for the 2008 data taking has been installed, while the installed storage capacity is only about 52% of what is required.

The CCRC08, carried out in February and May 2008, has been a reasonable success and validated the overall functionality of the system. However, the data reprocessing at the Tier-1 centres and the widespread analysis was not tested simultaneously for all the experiments.

Co-ordination and communication between experiments, the Tier-1 sites and the LCG, although improved with respect to the past, needs continuous attention and remain of crucial importance.

The pledged resources do not fully match the experiment requirements, with the significant shortfall for ALICE being noteworthy. A preliminary enquiry for pledges for 2013 has started, but it seems that a 5-year planning cycle may be questionable.

The current infrastructure, based on Enabling Grids for E-Science (EGEE) and Open Source Grid (OSG), is funded till 2010. The question of the long-term sustainability of the infrastructure is still unresolved, although an initial blueprint for the European Grid Initiative (EGI) project has been prepared.

Application Area

Good progress was reported in the Application Area. Specifications for the extended schema evolution in the ROOT object-oriented data analysis framework have been agreed by the experiments. The removal of the SEAL core libraries and services project dependencies in the persistency framework has been completed. Two new R&D projects have started: WP8, Parallelization of Software Frameworks to exploit Multi-core Processors and WP9, Portable Analysis Environment using Virtualization Technology.

The manpower reduction in the Application Area planned for 2009 has been brought forward to 2008. The current manpower level appears to be sufficient to support the on-going activities, but further reductions would be detrimental for the project.

Middleware

The gLite 3.1 middleware baseline services are largely in place and perform well. Some scalability issues for the LCG Computing Element (LCG-CE) and for the information system remain, however. No major upgrades are foreseen, with the main focus now on the stability and reliability. The Computing Resource Execution And Management (CREAM) Computing Element is in the last steps of certification and should solve the scalability issues in LCG-CE.

The OSG 1.0 middleware has been released and deployed, with significant improvements in interoperability with the LCG.

The addendum to the SRM V2.2 storage resource manager has been agreed to, with the absolute minimum of additional required functionality. The short-term solution will be implementation-specific and will be realized before the end of 2008, while for the longer term, an implementation-independent full solution will be discussed only after the first experience with data.

Common Computing Readiness Challenge (CCRC08)

The results from the second phase of the CCRC08 challenge in May 2008 have shown that the experiments and the World-wide LCG (WLCG) would be in the position to handle the first LHC data in 2008. The WLCG middleware and basic services, such as the databases, are in place and functional. However, the large amount of software changes and the level of WLCG expert interventions, of the order of one per day, indicate a still rapidly-developing system.

The LHC experiments tested their computing and analysis models to various levels of complexity. The ATLAS experiment tested the data transfers between the Tier-0 and Tier-1 centres during three days with an equivalent rate of 200 Hz and with concurrent activities from the CMS experiment. Tier-1 to Tier-1 transfers, beyond the needs anticipated for 2008, were also tested during two days with transfer rates up to 90 MB/s. The CMS experiment carried out a stress test of all transfer links from Tier-0 to Tier-1 centres, which reach the required nominal rate of 600 MB/s, and from the Tier-1 to Tier-2 centres, with a total of 120 TB of data transfer per day. In addition, data were reprocessed in all Tier-1 centres, and user analyses at the Tier-2 centres were tried via both co-ordinated and chaotic submission of jobs by individual users. The LHCb experiment performed a test equivalent to one month of data taking assuming a 50% LHC efficiency. Both LHCb to Tier-0 input rates and Tier-0 to Tier-1 transfer rates were tested, reaching the required nominal rates. The ALICE experiment also tested Tier-0 to Tier-1 data transfers up to satisfactory rates, and performed well in handling 10 GB single files.

Despite the good performance of data transfers between Tier-0 and Tier-1 centres, some of the main milestones of the CCRC08 exercise, namely the study of the behaviour of the Tier infrastructure against chaotic usage of resources, and the possible interference between experiments during data reprocessing at Tier-1 centres, were not tested due, to some extent, to a lack of co-ordination among the experiments and the WLCG when planning the CCRC08 activities.

LCG Fabric

The ramp-up of Tier-0 and Calibration Analysis Facility (CAF) resources at CERN is proceeding well. Disk installations, are, however, somewhat delayed, as only 52% of the pledged disk space was installed in May 2008, and the rest is being deployed progressively. The CASTOR mass storage system has been generally running well during CCRC08; a number of smaller incidents, however, necessitated several upgrades mainly to the SRM interface to improve its resilience. An encouraging number of performance metrics have been integrated by now, which allows for better monitoring of the system performance. This system should be further developed and improved. Generally, CASTOR operation is now more strongly exposed to the actions of individual users, whose use patterns are in contrast to the controlled production operations of the experiments, and the system is not optimized for them. Managing this kind of access needs more attention in the future.

Due to cooling power considerations, the usable floor space in Building 513 will hit hard limits by the end of 2010. Even on this time scale, aggressive retiring of old servers by new and more cooling-efficient hardware is necessary to be able to accommodate the required computing power during the LHC computing ramp-up. Planning for a new computing centre has therefore started. Nevertheless, temporary

solutions are needed to bridge the time until the new center can be operational, which is not before 2012.

Most Tier-1 centres had procurement delays in 2008. While CCRC08 did not suffer noticeably, it is important to have the situation well under control for 2009, when long LHC runs are foreseen. Reliability of the sites has been improving steadily over the last half year. There are still outstanding high-level WLCG milestones: two (of 12) sites are yet to put their 24x7 support into operation, and five still need to implement a Service Level Agreement for VO boxes.

For the Tier-2 sites, the reporting scheme for installed resources needs to be improved, as it is still difficult and onerous to collect accurate information to assess the balance with respect to the pledges. Overall, the pledges are largely in the range of the requirements, only the ALICE experiment still has a significant shortfall of Tier-2 processing power. In terms of reliability, several of the Tier-2 sites have already reached an impressive average reliability of close to 95%, but the overall average is not yet acceptable. The experiments should use their leverage to control and improve their reliability, for example by hosting attractive datasets at well-performing centres, or by properly crediting the host institutions within the internal accounting system.

Overall Conclusion

The LHCC considers that the LCG Project has shown significant progress since the last Comprehensive Review in both the production and analysis phases and that the WLCG has become a reality. With the caveat of the outstanding concerns, the Committee considers that it is realistic to expect WLCG to have an initial working system ready for the start of LHC operation in 2008.

9. REPORT FROM THE LHCf REFEREES

The LHCC heard a report from the LHCf referees. Excellent progress was reported on the installation and commissioning of the LHCf experiment. Both arms of the LHCf experiment have been installed in the LHC TAN absorbers in January 2008. The LHCf DAQ is operational and the exchange of timing and other signals with ATLAS and with the LHC accelerator is ready. LHCf plans to take data in 2008 with stable LHC conditions at luminosities less than $10^{30} \text{ cm}^{-2} \text{ s}^{-1}$.

10. REPORT FROM THE LHC EXPERIMENT UPGRADE REVIEW

The LHCC heard a report on the LHC experiment upgrade review held by the Committee in view to a future increase in the LHC luminosity. The objective of the review was to bring together all interested constituencies from the machine and experiments in an effort to establish contacts, to agree on various scenarios defining the overall framework for such an upgrade and to define possible timescales for the upgrade of the experiments. The first stages of the LHC accelerator upgrades, which includes the realization of the full collimator system and the construction of a new linear accelerator, LINAC4, together with new interaction region final magnets, is already part of the approved programme. Plans for a further phase, based on the construction of a Superconducting Proton Linac (SPL) and a new proton synchrotron, PS2, are under development. These measures are expected to push the luminosity to a few times $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ and studies are also underway to reach $10^{35} \text{ cm}^{-2} \text{ s}^{-1}$. The referees provided an overview of the ATLAS and CMS activities and projects. An impressive number of R&D projects are underway in both ATLAS and CMS. In

addition, an organized effort is underway to prepare various R&D activities that are common or generic in nature. The LHCC noted the need to obtain experience with the current experimental set-ups before finalizing choices for the upgrades. However, given the existing timescales, the time available to implement the new designs is tight. The Committee will establish referee teams that will review the experiment upgrade activities in the future. Whilst the focus of the first meeting was on the challenges that the higher luminosity places on ATLAS and CMS, future meetings will also address special challenges for the ALICE and LHCb experiments.

11. REPORT FROM THE LHC PROGRAMME CO-ORDINATOR

The LHCC heard a report from the LHC Programme Co-ordinator. He reported excellent progress in the hardware commissioning of the LHC machine. Since the previous meeting of the LHCC in May 2008, a number of key LHC milestones have been passed successfully, including the commissioning with beam of the TI2 and TI8 transfer lines and the safety tests of the access system for the TI2 and TI8 transfer lines together with the first phase for the full LHC access system commissioning. Preparations for first LHC operation are well advanced and detailed parameter settings have been finalized. Weekly meetings chaired by the LHC Programme Co-ordinator have started and are well-attended.

12. REFEREES

The LHCC referee teams are as follows:

ALICE: M. Gonin, J. Haba (Co-ordinator)

ATLAS: F. Forti, V. Kekelidze (Co-ordinator), R. Mankel, P. Mato

CMS: S. de Jong, M. Martinez-Perez, S. Smith (Co-ordinator), R. Yoshida

LHCb: S. Dalla Torre, C. Niebuhr, B. Peyaud (Co-ordinator)

TOTEM: S. Dalla Torre

MOEDAL: B. Peyaud

LHCf: M. Mangano, C. Niebuhr

RD39: S. de Jong

RD42: V. Kekelidze

RD50: R. Yoshida

LCG: F. Forti (Co-ordinator), R. Mankel, M. Martinez-Perez

13. The LHCC received the following documents:

Minutes of the ninety-third meeting held on Wednesday and Thursday, 7-8 May 2008
LHCC-2008-008/LHCC-A-093

R&D Proposal Development of Micro-Pattern Gas Detector Technologies
LHCC-2008-011/LHCC-P-001

Review of the ATLAS Technical Design Report on the Forward Detectors for the Measurement of Elastic Scattering and Luminosity
LHCC-2008-013/G-140

14. DATES FOR LHCC MEETINGS

Dates for **2008**:

24-25 September

19-20 November

Dates for **2009**:

18-19 February

6-7 May

8-9 July

23-24 September

18-19 November

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