

LARGE HADRON COLLIDER COMMITTEE

Minutes of the ninety-fifth meeting held on
Wednesday and Thursday, 24-25 September 2008

OPEN SESSION

1. LHC Status Report: Lyn Evans
2. ALICE Status Report: Juergen Schukraft
3. ATLAS Status Report: Peter Jenni
4. CMS Status Report: Tejinder Virdee
5. LHCb Status Report: Andrey Golutvin
6. TOTEM Status Report: Ernst Radermacher
7. LHCf Status Report: Oscar Adriani
8. ALICE Electromagnetic Calorimeter Technical Design Report (LHCC-2008-014 / ALICE-TDR-014): Thomas Cormier

CLOSED SESSION:

Present: F. Bedeschi, J.-J. Blaising, G. Blazey, C. Cecchi, S. Dalla Torre, S. de Jong, J. Engelen, M. Ferro-Luzzi, F. Forti, M. Gonin, J.-F. Grivaz, C. Hawkes, W. Kuehn, M. Mangano, R. Mankel, M. Martinez-Perez, P. Mato, C. Niebuhr, A. Nomerotski, B. Panzer (replacing J. Knobloch), B. Peyaud, D. Pitzl, S. Smith*, E. Tsesmelis (Secretary), T. Wyatt (Chairman), R. Yoshida

*part-time

Apologies: J. Haba, V. Kekelidze, J. Knobloch, E. Perez

1. PROCEDURE

The Chairman welcomed the new members, Franco Bedeschi, Jerry Blazey, Claudia Cecchi, Jean-Francois Grivaz and Daniel Pitzl, to the Committee, and thanked the outgoing members, Silvia Dalla Torre, Francesco Forti, Junji Haba, Sijbrand de Jong, Vladimir Kekelidze, Rainer Mankel, Carsten Niebuhr and Bernard Peyaud, for their excellent contributions to the Committee over many years.

The minutes of the ninety-fourth LHCC meeting (LHCC 2008-010 / LHCC 94) were approved.

2. REPORT FROM THE CHIEF SCIENTIFIC OFFICER

The Chief Scientific Officer (CSO) reported on issues related to the LHC. First beams in the LHC were successfully steered around the full 27 kilometres of the accelerator on 10 September 2008. After ten days of operation, the LHC is now on stand-by following an incident in Sector 3-4 involving a large helium leak. Investigations have indicated that the most likely cause of the incident was a faulty electrical connection between two of the accelerator's magnets. Before a full understanding of the incident can be established, however, the sector has to be brought to room temperature and the magnets involved opened up for inspection. The time necessary for the investigation



and repairs precludes a restart before CERN's obligatory winter maintenance period, bringing the date for restart of the accelerator complex to early spring 2009. LHC beams will then follow. Optimization of the planned shut-down period is being worked out. The LHC experiments are adjusting to the new shut-down plan and are preparing to make full use of it. Following the successful circulation of first beam in the LHC on 10 September 2008, the LHC will be officially inaugurated at CERN on 21 October 2008. Representatives of the governments of CERN's Member and Observer States and other participating nations have been invited.

3. REPORT FROM THE ALICE REFEREES

The LHCC heard a report from the ALICE referees, concentrating on an update on the commissioning, preparations for the shut-down, the status of the computing funding and a report on the Technical Design Report for the Electromagnetic Calorimeter (EMCal).

The Committee heard a report on the commissioning of the ALICE experiment. The commissioning, together with the initial calibration and alignment of the detector, have progressed well. Since December 2007, three cosmic-ray commissioning runs have been undertaken, the last of which started in May 2008 and consists of a global commissioning, calibration and alignment production run. Particle fluxes through the ALICE experiment were observed during the TI2 dump tests in June 2008, the TI2 injection tests in August 2008 and from the first circulating beam in September 2008. The LHCC congratulated the ALICE Collaboration for successfully preparing the experiment for first LHC beams.

The referees also reported on preparations for the shut-down period. Cabling on the Miniframe, which carries the services to the ALICE central detector, will be modified during the shut-down in order to improve the access to the Time Projection Chamber (TPC). Repairs to TPC read-out electronics will be carried out during this period and the cooling fluid flow regulation to individual circuits of the Silicon Pixel Detector (SPD) will also be improved during the shut-down.

The LHCC heard an update on the ALICE computing resources. The global short-fall for the computing resources remains about 40% of the pledged funding for the 2009-2011 period. Proposals to address this short-fall are being evaluated and the LHCC will monitor progress in future sessions.

The referees reported on the ALICE EMCal Technical Design Report. The physics motivation for the EMCal is to enhance the experiment's capabilities for jet quenching measurements, as well as to enable triggering on high-energy jets, to improve jet energy resolutions and to augment existing ALICE capabilities to measure high-momentum photons and electrons. The calorimeter is based on the Shashlik technology – a layered lead-scintillator sampling calorimeter with longitudinal wavelength shifting fibre light collection – and will be installed in the ALICE central detector. Following further deliberations, the LHCC referees will make a full report at a future session of the Committee.

4. REPORT FROM THE CMS REFEREES

The LHCC heard a report from the CMS referees, concentrating on the status of the experiment and the plans for the shut-down period.

The Committee heard a report on the status of the CMS detector. The LHCC congratulated the CMS Collaboration for successfully completing the installation of the detector and for preparing the experiment and the entire data chain for first LHC beams. The CMS detector performed well for the first LHC beams. Good progress was reported on the Preshower (ES) detector. Assembly of the ES is well-underway and the first instrumented absorber is now inside the environment-controlled TIF area. Full tests with the final off-detector electronics and DAQ are commencing. It is expected to have the ES ready for installation by the end of 2008. Installation of the CASTOR calorimeter and parts of the TOTEM T2 Telescope were installed just prior to the LHC

start-up. All detectors of the Beam Radiation Monitoring (BRM) system were installed in time for the LHC start-up. Commissioning of the CMS magnet to the operating field of 3.8 T needs to be continued. At values just below 3 T, field-induced effects on the PM54 lift and relative movements of the Forward Hadronic Calorimeter HF, Collar Shielding and CASTOR table were observed. This must be understood and rectified. After reaching 3.8 T, CMS plans to commence a CRAFT commissioning run with cosmic-rays.

The referees reported on the CMS shut-down plan. The technical planning is adapting to the untimely long shut-down resulting from the LHC incident of 19 September. Much work was foreseen for January-March 2009, including installation and commissioning of the ES, as well as consolidation / repairs to the electrical distribution system, to the detector gas system, to the inertion / dry air system, and to the cooling system, but this cannot easily be brought forward due to a lack of material and personnel. CMS must improve procedures and reduce risks associated with opening and closing the detector and also complete the shimming configuration between the Rotating Shielding and the Collar Shielding in the forward region. The LHCC noted the issues and concerns regarding resources for the core technical team and for the procurement of spares and replacement equipment.

5. REPORT FROM THE TOTEM REFEREE

The LHCC heard a report from the TOTEM referee, concentrating on the status of the experiment, the plans for the shut-down and the outlook for early physics.

The LHCC heard a report on the status of the TOTEM detectors. Production of the T1 Telescope is advancing. Some of the Cathode Strip Chambers (CSCs) need to be produced again due to issues of planarity of the original chambers. Production of the full read-out electronics chain is well underway and the mechanical support needs to be modified due to the revised installation procedure. Fabrication of the Gas Electron Multiplier (GEM) chambers for the T2 Telescope is complete and production of the read-out electronics is well underway. The support of the T2 Telescope moved during the CMS magnet powering and a technical analysis of the event is in progress. All Roman Pot (RP) stations have been installed in the LHC tunnel at 147 m. and 220 m. from the interaction point. Two of the RP stations have been equipped with silicon detectors and need to be commissioned. The interlock and movement control of the RPs is in progress.

The Committee took note of the TOTEM plans for the shut-down period. The Collaboration plans to complete the installation of the T1 and T2 Telescopes. Moreover, all RP stations at 220 m. are expected to be equipped with detectors, while only some of the RP stations at 147 m. will be so equipped in order to learn more about background and radiation.

The referee reported on the possibilities for early physics measurements of TOTEM with a $\beta^* = 90$ m. Measurements of elastic and diffractive protons could be made with a few instrumented RP stations and the T1 Telescope.

6. REPORT FROM THE LHCf REFEREES

The LHCC heard a report from the LHCf referees, concentrating on the status of the experiment. Excellent progress has been made by the LHCf Collaboration in preparing the experiment for first data-taking with LHC beams and the LHCC congratulated the LHCf Collaboration. Installation of the LHCf calorimeters was completed in January 2008 and both Arm-1 and Arm-2 calorimeters are working well. In addition, two scintillator Front Counters were installed in front of both calorimeters and will be used to check the beam quality prior to moving in the calorimeters from their garage to beam positions. The interface of signals and timing information with the LHC machine is also complete. Synchronization of LHCf with ATLAS has been performed and it is now possible to correlate LHCf events with ATLAS events. First LHC beam events were observed. The measured beam-gas event rate was measured and was found to be consistent with the expectations based on the residual gas pressure. The referees also

reported on the beam tests at the SPS. The energy resolution was measured to be $< 3\%$ even for the smallest tower. The Committee noted that LHCf is ready for data-taking at the LHC.

7. REPORT FROM THE MOEDAL REFEREE

The LHCC heard a report on the MoEDAL experiment, concentrating on the status of the experiment design and the preparation of the Technical Design Report. The MoEDAL experiment aims to search for highly-ionising particles at the LHC using plastic track-etch detectors. MoEDAL plans to start data-taking in 2009 in proton-proton mode with 20% of the detector deployed in order to ascertain the backgrounds. The MoEDAL array will be installed in the VELO cavern at Point 8. Full deployment of the MoEDAL configuration will be in place as from the 2010 LHC run. MoEDAL also proposes heavy-ion running for three periods, if possible. Agreement in principle has been reached with all parties concerned for the MoEDAL final design and integration at Point 8. Improvements of the etching procedure are under study. The MoEDAL Technical Design Report is under preparation and will be sent to the LHCC by the end of November 2008. The LHCC encourages the MoEDAL Collaboration to continue with the design of the experiment configuration leading up to the submission of the Technical Design Report.

8. REPORT FROM THE LCG REFEREES

The LHCC heard a report from the LCG referees, concentrating on the general status and issues from the experiments. The World-wide LHC Computing Grid (WLCG) is ready to receive data from the LHC experiments and to provide services in production mode. The middleware is in place and functional, although not all the required functionality is available. In particular, the lack of a proper quota system in the storage is problematic for the experiments that have not developed specific solutions. At present, the deployed resources of computing power and storage are not fully used, which might be attributed in part to the development of the LHC schedule and in part to residual inefficiencies in the system. The list of milestones is well defined and the milestones are being passed as scheduled. Accounting of the stability and reliability for the Tier-1 centres is now available for each experiment and the referees urge that this is also done for the Tier-2 centres. The first report and recommendations to the Computing Resources Review Board by the Computing Resources Scrutiny Group will be made in November 2008. Deliberations are on-going on the sharing of WLCG resources at CERN amongst the experiments. The LHCC took note of the good progress made by the experiments in their use of the WLCG.

9. REPORT FROM THE RD51 REFEREES

The Committee heard a report on the R&D proposal on the development of advanced gas-avalanche Micro-Pattern Gas Detector (MPGD) technologies and associated read-out systems for applications in basic and applied research (LHCC 2008-011 / P-001). The proposal is to develop techniques for such detectors so they can be capable of coping with high-flux rates while also improving the needed space-point resolution and the radiation hardness of the detectors. The proposed research is organised in seven working groups, each being structured through a set of tasks.

The Committee considers that the proposed experimental programme is sound and that the results of the R&D would be important for future high luminosity colliders, including an upgraded LHC. The proposal also has the potential to improve the collaboration between several institutes towards a common goal. However, the Committee asks the Collaboration to present a clearer definition of the resources and responsibilities of each institute, which will lead to the eventual signing of the Memorandum of Understanding.

The LHCC, therefore, **recommends** that the Collaboration carries out its programme of work, and encourages the Collaboration to define the resources and responsibilities of each participating institute. A status report should be submitted to the LHCC in one year.

10. REPORT FROM THE LHC PROGRAMME CO-ORDINATOR

The LHCC heard a report from the LHC Programme Co-ordinator. The SPS-LHC injection and synchronization tests in August and September 2008 provided a very useful opportunity to test the kicker timings, the apertures, the magnet polarities and the optics. The tests also allowed ALICE and LHCb to perform synchronization tests and to observe horizontal tracks. The experiment interlocks were also activated. Following first beam on 10 September 2008, a series of successful studies and tests with the machine followed, including systematic optics tests, beam capture, aperture studies and the dumping of one beam while the counter-rotating beam was circulating. The studies were interrupted by electrical transformer problems at Point 8, which stopped the cryogenic plants for Sectors 7-8 and 8-1, and by a cold compressor stop for Sector 4-5 prior to the stop of operations caused by the incident in Sector 3-4 on 19 September 2008. A plan for the shut-down period, for the completion of the commissioning of the LHC accelerator in 2009 and for the physics runs in 2009 is being developed.

11. REPORT FROM THE ATLAS MINI-REVIEW

The LHCC heard a report from the ATLAS Mini-review, concentrating on the progress leading up to the first LHC beams, experience gained with LHC first beams and issues to be addressed prior to the LHC run in 2009.

The referees reported that the ATLAS Collaboration has made tremendous progress in preparation for first LHC beam on 10 September 2008 and the LHCC congratulated the ATLAS Collaboration. In particular, excellent progress was made since the previous LHCC session in July 2008 with the evaporative cooling system for the Inner Detector, with the performance of the power supplies for the Muon System and with the integrity in the magnetic field of the low voltage power supplies for the LAr End-cap Calorimeter. All ATLAS sub-detectors – Pixel Detector, Semiconductor Tracker (SCT), Transition Radiation Tracker (TRT), LAr and Tile Calorimeters, and the Muon System were installed, cabled and integrated into the DAQ. The Pixel Detector and LAr Forward Calorimeter (FCAL) had high voltage off, while the Muon System and SCT were operated at reduced high voltage during the period with first LHC beams. Most of the ATLAS systems had passed successfully through a series of combined data tests with cosmic rays. Commissioning of the Pixel Detector is on-going.

ATLAS commissioning with beam started with the first LHC beams and particularly so-called splash events on the LHC collimators around ATLAS were used for the further commissioning of the ATLAS experiment. The calibration and alignment procedures are in progress as they require more statistics, both with and without magnetic field, to reach the required accuracy in the alignment of the tracking devices. The ATLAS operational model works well.

The LHCC identified certain critical issues which remain outstanding, including the need to a) rectify the instability of the read-out modules for the Cathode Strip Chambers (CSCs), b) replace the failing TX timing transmitters common to the SCT and Pixel Detector and c) consolidate the cooling system in order to ensure efficient running of the SCT and Pixel Detector in 2009.

The ATLAS magnet system is operational. The long chain of necessary tests and trainings was completed to ensure a reliable operation of all the magnet parts, Solenoid, Barrel Toroid (BT), and End-Cap Toroids ECT-A and ECT-C, both in stand-alone and combined modes. The ECT-A required additional training steps to reach the full current, but since quenches were localized in different coils, this is not considered to be indicative of defects. Some remaining steps are required to complete the magnet

commissioning and to reach the required current of 20.5kA in a combined BT, ECT-A, ECT-C mode.

The Beam Interlock and Injection Permit systems are fully operational and are integrated into the Detector Control System (DCS). The primary machine parameters are available and information from the Beam Condition Monitor (BCM) is available. The LHCC urges ATLAS to develop further their beam dump protocols.

The Trigger and DAQ are fully installed and many checks have been done with cosmic-ray runs and with the first LHC beams. The Trigger still needs some further tuning and timing during final commissioning with the LHC beam in 2009. Further installation of computing power will continue for ATLAS operation at higher rates. The performance of the Event Builder is being evaluated.

The on-line and off-line calibration procedures are well organized and have passed through various checks in the FDR-1 and FDR-2 Full Dress Rehearsals phases. Very good inventory is prepared for what remains to be done. The 24h loop for calibration procedures will be initially relaxed and should be carefully followed-up during LHC data-taking, as should the status of the condition database. The ability for reprocessing should be indicated on a more realistic scale.

Excellent progress was reported on the software, computing and strategies for physics commissioning. The ATLAS software has been intensively checked during FDR-1 and FDR-2 and is considered to be in a good state. The software has been validated and stress tested, but still requires more effort to reach optimal conditions. The ATLAS computing operations are in a good state and are ready for data taking. The computing system is ready for implementation when LHC data are available, requiring just some better regulation in the usage of the data storage systems. ATLAS may need to develop an internal disk quota system. The strategies for physics commissioning have been studied in detail with simulated data, and further progress was achieved during FDR-1 and FDR-2.

12. REPORT FROM THE LHCb MINI-REVIEW

The LHCC heard a report from the LHCb Mini-review, concentrating on the progress leading up to the first LHC beams, experience gained with the first LHC beams and issues to be addressed prior to the LHC run in 2009.

The LHCC heard a report on the status of the LHCb detector, together with its installation at Point 8, and the preparations leading up to LHC data-taking. The construction and commissioning of the LHCb experiment have been realized with impressive success and the LHCb Collaboration is congratulated for their efforts over many years. The LHCb sub-systems were in a good state for the first LHC beams. The chamber installation for the M1 Muon Station is scheduled for the 2008-2009 LHC shutdown period. The major outstanding issue is related to the Hybrid Photo Diode (HPD) read-out for the RICH-1 and RICH-2 Ring Image Cherenkov detectors. Because of a high-ion feedback rate, 20 HPDs have been exchanged and a further 10 have started showing similar characteristics and are being monitored.

The referees reported on the experience gained with first LHC beams. Event samples were recorded in LHCb during the LHC injection tests and with first circulating beam. This has enabled LHCb to carry out a series of timing synchronisation studies and to make first attempts at measuring the detector spatial resolution.

The LHCC heard a report on the status of the Outer Tracker. The issue of gain loss of the Outer Tracker has been approached with great vigour and the understanding of the cause has made much progress. The cause of the problem has been traced to the use of Araldite AY103 in the chamber fabrication and the test modules built with Tra-Bond glue show no negative effects. Solutions based on high-voltage training at high currents, flushing the detector with gas and the heating of the modules have been introduced and a significant reduction of the gain loss has been obtained. *In situ* irradiations are made to measure the gain loss. The Committee will continue

monitoring the performance of the Outer Tracker, as the detector is an essential element of the LHCb trigger, particularly at higher luminosities.

The Committee took note of the initiative taken by LHCb for improving the detector, the trigger and the read-out systems in order to handle data taking at a luminosity of $2 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$. This effort will allow extending the physics reach of the experiment, in particular with the study of very rare B-meson decay channels and the search for new CP-violation signatures. As soon as the first results from LHC will become available, and if they uncover hints for new physics, a more detailed physics programme at high luminosity should be prepared. This upgrade scenario will require several years for the development and construction of new detector parts and the conceptual studies should receive immediate attention so as to complete in due time the necessary upgrade solutions.

13. REPORT FROM THE LHC EXPERIMENT UPGRADE REVIEW

The LHCC heard a report on the LHC luminosity upgrades. Work is in progress to study upgrades to the particle detectors which are needed to follow the increase in LHC luminosity. The plans for the upgrades to LHCb were presented and are described in Section 12 above. The primary upgrade items for ALICE include a smaller inner radius for the Tracker, an upgrade to the DAQ input/output bus and the improvement of the particle identification capabilities of the ALICE detectors. For ATLAS, the Phase I upgrade options include the replacement of the present beryllium beam pipe with a beam pipe of smaller radius and a B-layer inside the existing ATLAS detector. ATLAS is also investigating possible strategies to mitigate the effect of high occupancies in the Transition Radiation Tracker (TRT). For Phase I, CMS plans to replace the entire Pixel Detector, improve the granularity of the inputs to the Level-1 trigger, complete the de-scoped muon chamber array, and replace the existing Hadron Calorimeter read-out by Silicon Photo-Multipliers as well as introducing some segmentation in depth for the read-out. New appointments to the LHCC membership have been made also with a view of strengthening the expertise in areas relevant for upgrades. An LHCC referee team is being established to review the LHC experiment upgrades.

14. REFEREES

The LHCC referee teams are as follows:

ALICE: M. Gonin (Co-ordinator), W. Kuehn, J.-F. Grivaz

ATLAS: J. Blazey (Co-ordinator), C. Cecchi, P. Mato, D. Pitzl

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

LHCb: F. Bedeschi (Co-ordinator), C. Hawkes, A. Nomerotski

TOTEM, LHCf, MoEDAL: C. Cecchi, M. Mangano, P. Mato

LCG: J.-F. Grivaz, C. Hawkes, M. Martinez-Perez (Co-ordinator)

Experiment Upgrades:

Co-ordinator: D. Pitzl

RD39: D. Pitzl

RD42: A. Nomerotski

RD50: A. Nomerotski, R. Yoshida

RD51: W. Kuehn

15. The LHCC received the following documents:

Minutes of the ninety-fourth meeting held on Wednesday and Thursday,
2-3 July 2008
LHCC-2008-010/LHCC-A-094

ALICE Electromagnetic Calorimeter Technical Design Report
LHCC-2008-014/ALICE TDR-014

Report from RD51 Referees LHCC-2008-011/ LHCC P-001

16. DATES FOR LHCC MEETINGS

Dates for **2008**:

19-20 November

Dates for **2009**:

18-19 February

6-7 May

8-9 July

23-24 September

18-19 November

Emmanuel Tsismelis
E-mail: LHCC.Secretary@CERN.CH
Tel. 78949, 164057

LHCC Secretariat: Morna Robillard (Bldg. 3/R-012) Tel. 73224
morna.robillard@cern.ch