CERN/LHCC 2010-008
LHCC 101
6 May 2010

LARGE HADRON COLLIDER COMMITTEE

Minutes of the one-hundredth-and-first meeting held on
Wednesday and Thursday, 5-6 May 2010

OPEN SESSION I - Status Reports

1. CMS Status Report: Albert De Roeck
2. ATLAS Status Report: Kevin Einsweiler
3. LHCb Status Report: Patrick Koppenburg
4. ALICE Status Report: Karel Safarik
5. TOTEM Status Report: Valentina Avati
6. LHCf Status Report: Yoshitaka Itow
7. LHC Machine Status Report: Steve Myers

OPEN SESSION II - Physics Reach with 0.1 fb^{-1} and 1 fb^{-1} at 7 TeV

8. Electroweak, High-P_T QCD and Top Physics: Thomas Le Compte
9. Searches for New Physics (including Standard Model Higgs): Oliver Buchmueller
10. Heavy-quark Physics (b- and c- quarks): Guy Wilkinson
11. Minimum Bias & Soft QCD in Proton-Proton & Heavy-ion Collisions: Andreas Morsch
12. Plans for the LHC Physics Centre: Michelangelo Mangano

CLOSED SESSION:

Present: F. Bedeschi, S. Bertolucci*, J. Blazey, P. Bloch, A. Boehnlein, H. Breuker, C. Cecchi, D. D'Enterria, E. Elsen, M. Ferro-Luzzi, J.-F. Grivaz, C. Hawkes, W. Kuehn*, D. Macina, M. Mangano, P. Mato, T. Mori, A. Nomerotski, B. Panzer-Steindel, R. Roser, E. Tsesmelis (Scientific Secretary), T. Wyatt (Chairman)

*part-time

Apologies: R. Heuer, D. Pitzl

1. PROCEDURE

The minutes of the one-hundredth LHCC meeting (LHCC 2010-005 / LHCC 100) were approved.

This being their first meeting, the Chairman welcomed T. Mori and B. Panzer-Steindel to the LHCC.

The LHCC expressed its appreciation of the Collaborations for their well-received Open Session presentations on the physics reach with 0.1 fb^{-1} and 1 fb^{-1} at 7 TeV centre-of mass energy and of the report on the plans for the LHC Physics Centre by Michelangelo Mangano.

2. REPORT FROM THE DIRECTOR FOR RESEARCH AND SCIENTIFIC COMPUTING

The Director for Research and Scientific Computing reported on issues related to the LHC. He underlined that the 2010 LHC physics run at up to 7 TeV centre-of-mass energy has had an outstanding start and the LHC machine, experiments and computing are in an excellent state. The LHC will be operated at 7 TeV centre-of-mass energy during 2010 and 2011, with a target integrated luminosity of 1 fb^{-1} and with a heavy-ion run at the end of both years. This extended operations period would be followed by a long shutdown (of the order of twelve months) in 2012 to repair and consolidate the inter-magnet copper stabilizers to allow for safe operation at 14 TeV centre-of-mass energy. He also underlined the good communication between the LHC machine and experiments and noted the importance of presenting physics results based on a reasonable integrated luminosity at the 35th International Conference in High Energy Physics, to be held in Paris in July 2010.

3. REPORT FROM THE LHC PROGRAMME CO-ORDINATOR

The LHCC heard a report from the LHC Programme Co-ordinator. He focused on progress in beam commissioning and the physics runs since the previous LHCC sessions and on the plans for the near future. First LHC beams for 2010 were available on 27 February for commissioning the LHC with beam. This was followed by first physics collisions at 7 TeV centre-of-mass energy on 30 March and by the first run with a stronger focusing in the interaction points (β^*=2 m) on 23 April. During the 2009 and 2010 LHC physics runs, data has been collected at 900 GeV, 2.38 TeV and 7 TeV centre-of-mass energies with an increasing instantaneous luminosity. Prospects for the future running of the LHC are driven by machine protection issues and the safe operation of the machine. The LHCC supports early efforts to commission running with non-zero crossing angle, if this could be achieved without disrupting the LHC operations to steadily increase luminosity. This would give a greater choice of filling patterns, and consequently a more efficient production of luminosity across all four interaction points. The experiments need to prepare for the increased number of interactions per bunch crossing as the luminosity is maximized by packing the limited allowed beam current into the minimum number of bunches. The plan is to operate the LHC at 7 TeV centre-of-mass energy during 2010 and 2011, accumulating an integrated luminosity of 1 fb^{-1} and with a heavy-ion run at the end of both years.

4. TEST BEAMS

The PS and SPS Physics Co-ordinator reported on the LHC test beam plans for 2010. The 2010 Injector Accelerator Schedule (Version 1.6) has been published. Physics at the PS East Hall is scheduled to start with a three week delay (due to the need to replace two faulty magnets), North Area physics will start on 10 May and CNGS started on 29 April. The end of fixed-target physics is scheduled for 22 November. The PS and SPS Fixed Target User Programmes have also been published, and include beam time periods to LHC experiment-related test beam projects and to the detector R&D projects (RD39, RD42, RD50 and RD51). The LHCC took note of the increased requests for beam time at the PS and SPS. The Committee asked that the R&D Collaborations state their requests for future beam time at their annual reviews and that the requests should abide by the agreed rules for beam time.

5. REPORT FROM THE LHC EXPERIMENT UPGRADE REFEREES

This LHCC session did not include an in-depth review of the LHC experiment upgrades. This will be scheduled for the July 2010 session once the conclusions from the various task forces considering the options for upgrading the LHC machine and its injectors are available and presented to CERN Council. The LHCC took note of the proposal for future proton and mixed-field irradiation facilities with slow extraction. The Committee recognizes the importance for the LHC operation phase and for the LHC upgrade programmes of the availability of adequate irradiation facilities. The

LHCC will review the proposal and accompanying request for improved radiation facilities at CERN at its future sessions.

6. DISCUSSION WITH CMS

General Status

CMS is in outstanding shape and almost fully commissioned by any measure. The active channel counts are high and there are no significant fiducial gaps in any system. The operating efficiency is remarkable. The analysis is amazingly complete and rapid for an experiment that has seen little data. The LHCC **congratulates** the Collaboration on these achievements.

Physics analysis organization with a few priority task forces is a good way of focusing the Collaboration. The Management is aware of the risks that are created by establishing the ensuing non-standard procedures and measures have been taken to realign the task force effort with the global analysis efforts of the Collaboration.

Detailed Observations

There are some timing studies still to be completed in the muon drift chambers that are less exposed, but CMS has the issue well in hand.

The uptime of the experiment is high in this early phase of data-taking. CMS has all the tools in hand to meticulously monitor the causes of downtime and quality cut inefficiencies and to improve beyond even the current level. The LHCC would like to pursue the evolution of these quantities as the luminosity increases.

The trigger system has been operating well and is simulated to within 10-20% of measurements. This level of agreement is a remarkable achievement. The efforts to understand pile-up events are especially acknowledged, in particular if the machine were to move quickly to a 50 ns high intensity scheme. However, since rates are expected to increase by orders of magnitude, it would be good to anticipate the detector and readout behavior beforehand. The LHCC realizes that this is a demanding task and all avenues should be explored to safeguard from unpleasant surprises. Many tools are at hand, including the "Event Mixer".

The Collaboration has taken an aggressive and appropriate response to the appearance of the Electromagnetic Calorimeter (ECAL) spikes. However, care should be taken to ensure that their treatment or removal does not impact physics signals at higher luminosity. Simulations of the impact on tau and jet efficiency and resolution would be reassuring. In addition, any data information removed by the suppression algorithms should be retained for later study and use, if necessary. In general, vetoes should be avoided.

An attempt should be made to understand better the role of slow neutrons which have been associated with some of the out-of-time detector response.

The LHCC congratulates CMS for gaining an understanding of the beam gas events (PKAM) so soon after start of data-taking. The events are easily tolerated at a rate of 0.3 Hz. To counter an increase with the foreseen beam current increase options for improving the vacuum and further beam scraping should be explored.

The progress in physics analysis is exceptional. The LHCC thanks the Collaboration for sharing early and preliminary results with the Committee.

CMS has supplied the incident report regarding the beam pipe movement during the Christmas technical stop. This report is relevant for future operations at the detector and directly affects the installation of TOTEM, for example. The observations are in fact relevant for operations on any of the LHC detectors and should be distributed accordingly.

7. DISCUSSION WITH ATLAS

The ATLAS experiment is functioning very well and the LHCC **congratulates** the Collaboration on its achievements. ATLAS is collecting data very reliably at 7 TeV centre-of-mass energy. The LHCC was shown a number of detector performance plots which indicate that the ATLAS experiment is already at a very advanced stage with respect to alignment, calibration etc. It is very impressive how well understood the ATLAS detector is already with still only a very small data set. Furthermore, the offline group is processing the data quickly and distributing it to the ATLAS Collaboration in a very timely fashion. The physics results shown during the ATLAS Status Report in the LHCC Open Session are strong confirmation that the apparatus and group is functioning well and impressive progress is being made.

There were a number of items that the Committee wanted to keep track of in the coming months, either because there is currently an issue or something was identified as a potential vulnerability. The Collaboration is taking these issues very seriously and has made progress in each of the identified areas. A short synopsis is provided below.

- Shift room detector operations staffing – how is the plan going for downsizing its control room operations?

  ATLAS is still in the early commissioning phase of the detector. They acknowledge that it is still beneficial to have a significant shift presence in the control room but recognize that it is not sustainable in the long term and have begun to reduce as appropriate. To operate all of ATLAS and collect, process, calibrate, monitor, and deliver reconstructed data to the Collaboration requires an impressive 700 FTE.

- Performance of trigger and offline - how is it performing once accelerator luminosity begins to stress these systems?

  These topics were not covered in much detail at the prior LHCC session and so the review team asked for more information on status and plans. To date, the luminosity is still too low to fully stress either system. However, thus far progress is being made on both fronts. ATLAS is recording good data and distributing it to the physics analysis teams in a very timely fashion. The Committee was shown a well thought through plan with regards to the trigger commissioning as luminosity increases. While unexpected surprises may arise, there appear to be many “handles” within the trigger to deal with it.

- Cathode Strip Chamber (CSC) readout – at the last review, the CSC was only included in the DAQ when the Level-1 trigger rate was below 1 kHz. What progress has been made with the new firmware?

  The CSC sub-detector is now routinely run in the combined partition and has very stable DAQ operation. Current readout speed is 43 kHz and that is soon expected to reach 53 kHz. CSC tracking commissioning is on-going. Excellent progress is being made but the CSC readout still needs to be monitored until it reaches the full Technical Design Report specification.

- Insertable B-Layer (IBL) Technical Design Report – the LHCC is awaiting its submission.

  The technical specification is very advanced. However, the physics case is lagging. It has been difficult to get people to focus on the Monte Carlo simulation effort in light of the real collision data now in the hands of the Collaboration. The ATLAS Management is working to get a few people to complete these studies and document them so that a Technical Design Report can be available for the September 2010 session of the LHCC.

- LAr OTX Optical Links.

  Problems persist in the lower section as failures have been occurring at the rate of one per month. No new problems have arisen in the past five weeks. The Collaboration believes that the root cause is understood in terms of the width of

the optical spectrum. Fifty OTX optical links remain with this narrow spectrum. Two solutions have been identified – both requiring a different manufacturer and utilize either a single or double fibre. The choice on how to proceed will be made this summer. The complete replacement of all the OTX links remains an open issue.

- Power Supply Reliability for the LAr and Tile Calorimeters.

  LAr Calorimeter - All 58 supplies are operational. Five power supplies are no longer redundant so there is a real risk if there is a second failure in one of these five supplies. No new power supply failures were observed since October 2009. The plan is to replace these in the 2012 shutdown. A vendor was chosen, the production review is complete and the order is in process of being placed. The experiment is establishing a long-term bench test to investigate reliability issues.

  Tile Calorimeter – There have been low-voltage power supply failures (5 out of 256 have failed) in the last eight months. The plan is to correct failures in the 2012 shutdown when they can be opened up. A longer-term replacement is under study.

- Inner Detector Cooling Plant

  There are issues with the reliability of the current design and implementation. Two solutions have been identified to replace the current system with a more reliable configuration. One is a full thermo-siphon to use gravity to establish the correct pressure. This is mechanically simple but requires a large chiller plant on the surface to condensate the liquid. The other solution utilizes much more modern compressors – with vibration-free bearings - but requires a standard chiller plant (-10 ^{o}C versus -70 ^{o}C). Currently, ATLAS is building and testing prototypes of both and plan to be ready for installation during the 2012 shutdown. The experiment would like additional engineering effort to work on this replacement cooling plant. The LHCC underlined the importance of identifying a solution for the Inner Detector cooling plant and encourages the ATLAS Collaboration to continue its efforts in this direction.

- Solenoid Cryogenics

  This issue was not on the LHCC watch list from last time. Over the winter 2009-2010 technical stop, a portion of the cryogenic plant had been warmed up and ice blockages removed. The thought at the time was this was a one-time problem. This was not the case, as the problem persisted. There continues to be problems with ice blockages. The best guess at the moment is that the ice is coming from trapped moisture in the compressor oil. The experiment will install an air dryer in the next few months to remediate this problem. In addition, the experiment identified the primary helium pump as an additional single point failure. The plan is to install a back-up pump that can be valved in when needed. The engineering for this work is in progress.

In the upcoming meetings, the LHCC would like to continue to monitor the above issues. The Committee would also like to resume discussion on upgrade plans once the CERN long range schedule is made public. The September 2010 meeting would be a good opportunity to discuss access plans during the upcoming Christmas technical stop.

8. DISCUSSION WITH LHCb

The LHCC finds the LHCb detector to be in an excellent state and the Committee **congratulates** the Collaboration. Only minor problems due to pollution of the aerogel with the currently-used gas in the Ring Imaging Cherenkov (RICH) sub-detector and some delays in reaching the final alignment resolution in the Inner Tracker (IT) and Trigger Tracker (TT) sub-detectors were reported. The LHCb detector is operated efficiently with a small number of people on shift. The main source of inefficiency of

the experiment is the closing time of the Vertex Locator (VELO), but it is constantly being improved and it is expected that the closing time of the sub-detector will eventually be about five minutes.

The reconstruction and analysis software has proved to be very robust after solving a few initial problems. Currently, the data is split routinely in ten different data streams with an average 5% overlap and much work is in progress to define common micro-DSTs. At present only the Level-0 and HLT1 sections of the trigger are operating, with HLT2 planned to come on-line very soon, even if the luminosity still does not require it. The Committee is impressed by the good agreement between the trigger performance and the simulation. There is also consistency between the observed statistics of the available physics signals and the expectations defined in the Technical Design Report. The LHCC will keep monitoring this consistency as the luminosity grows and more signals become visible.

The experiment has shown enormous potential for beauty and charm physics with the expected 1 fb^{-1} data set to be delivered until end of 2011. The Committee recommends that LHCb revisits its physics expectations in view of the larger number of interactions/crossing expected during the 2010-2011 run relative to the baseline LHC design. The Committee also encourages the LHCb Collaboration to set a clear timetable and priorities for the results to be shown at the upcoming major conferences and for their publication in order to maximize the experiment's physics output.

Given the current luminosity expectations, the LHCb experiment has the potential to complete a large fraction of its initial physics programme by the end of 2011. It is important, therefore, that all possible sources of luminosity loss are reduced to a minimum. In particular, the LHCC supports the LHCb request to implement the beam crossing angle as soon as possible and to operate the machine with an agreed sharing of the luminosity between the various experiments.

The LHCC congratulated the outgoing LHCb Technical Co-ordinator, Werner Witzeling, for his significant contribution to LHCb over many years.

9. DISCUSSION WITH ALICE

The LHCC **congratulates** the ALICE Collaboration for the successful operation of the detector during spring 2010. Most detector components operated smoothly and the physics analysis has made significant progress. Two papers have already been published, one more was submitted for publication and several more publications are in preparation.

The discussion with the Collaboration focused on the following issues, which will require further attention in the future. Firstly, no easy solution is available to address the ongoing cooling problems for the silicon pixel detectors due to the inaccessibility of the Inner Tracking System (ITS). Secondly, a problem with the Photon Multiplicity Detector (PMD), which exhibits a sudden large increase of event size, was traced back to detector sparks. As a result, a loss of pedestal information in the front-end ASICs is observed. For the current proton running, the PMD was taken offline part of the time for further investigation of the problem. A possible solution could be operation of the detector at a lower voltage and implications for detector efficiency have to be investigated. In addition, the funding situation in the UK will result in a managed withdrawal of the UK trigger group starting mid-2011. There is, however, a small chance that additional funds could be obtained within a future grant from the UK Nuclear Physics budget.

Finally, the Committee took note that the ALICE Collaboration plans to submit an addendum to the Electromagnetic Calorimeter (EMCAL) proposal for the July 2010 session of the LHCC. DCAL (Dijet Calorimeter), the proposed extension, would offer a 60% extension of the available EMCAL solid angle and would permit back-to-back hadron-jet, jet-jet and gamma-jet measurements, thereby significantly enhancing the potential of partonic energy loss studies with ALICE.

10. DISCUSSION WITH TOTEM

The referee meeting with TOTEM concentrated on the status of commissioning and operations of the T2 Telescope and of the Roman Pot (RP) detectors, the status of the trigger, off-line software, RP interlocks, the construction status and installation plan of the remaining sectors of the T1 Telescope, and finally a view at the physics plan for 2010.

Minor difficulties with the T2 Telescope systems have been identified and addressed (high-voltage trips, grounding issues with 5/10 planes of one quarter), and the T2 Telescope is expected to be now ready to take physics data. The RP detectors are ready for the first test insertions. The referees noted that no detector performance plots were yet available to illustrate the functioning of the T2 Telescope, and the LHCC looks forward to seeing a comprehensive set of such plots for both the T2 Telescope and for the RP detectors at its July 2010 session.

The remaining hybrids, necessary for the completion of the final T1 Telescope quarter, are now available, and the T1 Telescope construction should therefore be completed by mid-June 2010. Test-beam periods in H8 are then foreseen during June, August and October 2010. The T1 Telescope installation plan has been reviewed with CMS, and a day-by-day preliminary schedule has been prepared. This foresees seven weeks for the installation of the negative-side half, inclusive of time for the detector commissioning on the platform prior to its final insertion. Two more weeks are required to also install the positive side. The readiness of the T1 Telescope for installation at the first available opportunity remains, nevertheless, a serious concern of the LHCC. The Committee recommends that an installation Engineering Design Review, chaired by the CMS Technical Coordinator, be carried out in June 2010, and that the outcome of the review be discussed in a meeting of the LHCC CMS/TOTEM referees with CMS and TOTEM at the next session of the LHCC.

11. DISCUSSION WITH LHCf

LHCf reported on a very successful data taking period at 7 TeV centre-of-mass energy, having collected about 1 nb^{-1} up to the April 2010 technical stop, which represents about 10 million showers and 35K π^0s combining Arm-1 and Arm-2 of the LHCf detector. The energy scale calibration done with π^0s show a good stability at the level of ±1%. Preliminary energy spectra of gamma-like and hadron-like events were shown to demonstrate the good performance of the detector and the low level (~1%) of background events due to beam-gas events. The recent data collected at 900 GeV centre-of-mass energy multiplies the statistics obtained in the December 2009 run by a factor of fifteen. The Committee has been impressed by the progress that the LHCf Collaboration achieved with the first data in this short time and **congratulates** the Collaboration.

The Committee took note of the wish expressed by the Collaboration to run with a crossing angle of 140μrad before reaching maximum integrated dose and having to remove their detectors. This angle gives an important enhancement in the coverage of X_F, P_T, and η, being equivalent of a shift of -20mm of the detectors, and placing them below the beam pipe aperture limitation. LHCf could measure the angle by determining the collision center position with <1mm accuracy.

12. REPORT FROM THE LCG REFEREES

The LHCC heard a report from the LCG referees, concentrating on the current status and prospects for the future. First experience of the World-wide LHC Computing Grid (WLCG) with the LHC has been positive. This is very much due to the substantial effort invested over several years during the intensive testing phase and all Tier centres must take credit for this success. The LHCC **congratulates** the WLCG on the achievements. The resource planning for the coming years, however, remains a concern, in view of the announced budget cuts in France, and the low resource pledges for ALICE. The full effect of introducing non-expert users to the WLCG will have to be seen. The transition from the Enabling Grids for E-Science (EGEE) to the European

Grid Initiative (EGI) is in progress. The WLCG must start to address long-term sustainability of the available system, including the level of effort available for middleware support and the data access for analysis and also the long-term sustainability for some of the Tier-1 centres.

13. REFEREES

The LHCC referee teams are as follows:

ALICE: D. D'Enterria, J.-F. Grivaz, W. Kuehn (Co-ordinator)

ATLAS: C. Cecchi, P. Mato, D. Pitzl, R. Roser (Co-ordinator)

CMS: J. Blazey, A. Boehnlein, E. Elsen (Co-ordinator), T. Mori

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

TOTEM, LHCf, MoEDAL: C. Cecchi, D. D'Enterria, E. Elsen, M. Mangano, P. Mato

LCG: A. Boehnlein, J.-F. Grivaz, C. Hawkes (Co-ordinator), T. Mori

Experiment Upgrades:

Co-ordinator: D. Pitzl

RD39: D. Pitzl

RD42: A. Nomerotski, J. Blazey

RD50: A. Nomerotski

RD51: W. Kuehn

14. The LHCC received the following documents:

Minutes of the one-hundredth meeting held on Wednesday and Thursday, 17-18 February 2010 (CERN/LHCC 2010-005)

15. DATES FOR LHCC MEETINGS

Dates for **2010**

7-8 July

22-23 September

17-18 November

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