CERN RESEARCH BOARD

MINUTES OF THE 208th MEETING OF THE RESEARCH BOARD
HELD ON WEDNESDAY 11 JUNE 2014


Apologies  I. Antoniadis, S. Bertolucci, L. Miralles

Items

1. Procedure
2. Report from the SPSC meeting of 8-9 April 2014
3. Report from the LHCC meeting of 4-5 June 2014
4. Any other business
1 PROCEDURE

1.1 The minutes of the last meeting [1] were approved without modification. There were no matters arising. As R. Heuer and F. Bordry had to leave after item 2 of the agenda to host a ministerial visit to CERN, the remainder of the meeting was chaired by R. Saban.

1.2 No INTC report was scheduled as there had been no meeting of the committee since the last Research Board. K. Blaum gave a short verbal report, explaining that the next INTC meeting would be held in a few weeks’ time; there had been some delay in the preparations for the TSR project, and a review of the situation was planned in July.

2 REPORT FROM THE SPSC MEETING OF 8-9 APRIL 2014

2.1 C. Vallee reported from the latest meeting of the SPSC [2], including annual reviews of AEGIS, GBAR, NA62, RD52, WA104 and WA105, listed in the following paragraphs. The Research Board took note.

2.2 AEGIS: The SPSC appreciates the progress achieved in the performance of components of the baseline apparatus, for study of the gravitational interaction of antimatter through the deflection of antihydrogen in flight. The committee is pleased with the plans for the next steps of the experiment, and is looking forward to the first H-bar formation in 2014.

2.3 GBAR: Good progress has been made on many sub-systems of the GBAR experiment, for study of the gravitational interaction of antihydrogen at rest. The SPSC notes the progress made by the collaboration in investigating solutions to the critical aspects of the setup, and looks forward to receiving a detailed schedule and organisation plan for the development of key components and their commissioning at the AD.

2.4 NA62: The experiment, searching for the very rare $K^+ \rightarrow \pi^+ \nu\nu$ decay, will have a two month data-taking run starting in October, at which about 2 signal events would be expected at the Standard Model rate. Some period at full intensity is requested to identify possible limitations, in preparation for extended running next year. The SPSC congratulates the collaboration for the progress achieved towards the installation and
commissioning of the detector components. The committee encourages the collaboration to take all required measures towards the timely installation of the systems for the first physics run, and recognises the importance of testing the experimental setup at full beam intensity.

2.5 **RD52 (DREAM):** aims to provide improved calorimetry with event-by-event determination of the electromagnetic component, thanks to simultaneous measurement of scintillation and Cherenkov light. The SPSC notes with pleasure the progress made by the collaboration in publishing results from the previous data taking at the SPS and in implementing detailed detector simulations, and looks forward to refined test results from the 2014 data taking with the existing modules. The committee acknowledges the plans for building enlarged lead and copper hadronic modules and requests a detailed description of the setup foreseen by the collaboration for the 2015 beam data taking. The collaboration is encouraged to strengthen their contacts in current and future experiments for further development and application of the dual readout calorimetry. E. Elsen commented that RD52 has also been reviewed by the LHCC, as a possible application in the LHC experiment upgrades. It was agreed that the SPSC would continue to review the project, but that in case of further interest in application at the LHC then the chairs of the LHCC and SPSC should decide on the coordination of future reviews.

2.6 **WA104:** The SPSC received with interest the document describing the technical WA104 - NESSiE programme [3]. The committee supports the R&D on air core magnets and associated detectors that could be used for future neutrino projects, and encourages synergy with the Liquid Argon (LAr) R&D programmes. The SPSC requests a document quantifying the human and financial resources needed for all aspects of the project, including the requests to CERN. The committee acknowledges the envisaged WA104 - ICARUS LAr R&D programme, and requests a technical document describing the activities foreseen at CERN, including the novel features to be developed. The SPSC emphasises the necessity to quantify the financial and manpower resources needed, including the requests to CERN. The committee notes with interest the ongoing discussions with US institutes and laboratories regarding a short baseline neutrino experiment at Fermilab using the ICARUS technology, and looks forward to
the official conclusion of the discussion process. J.M. Jimenez commented that the cryogenics supply at CERN is heavily loaded, and that details of the schedule and requested resources for WA104 are important to help planning.

2.7 **WA105**: The SPSC received with interest the technical proposal describing in detail the WA105 R&D programme [4]. The committee supports the technical goals of the Double Phase Liquid Argon (DLAr) TPC programme and considers it as the WA105 priority for the forthcoming years. The committee requests clarification of the interplay between the $6 \times 6 \times 6$ m$^3$ demonstrator and the $3 \times 1 \times 1$ m$^3$ prototype, in term of technical goals, schedule and resources. Further information is requested on the human and financial resources requested from CERN and the collaboration is encouraged to secure the necessary external resources to build the demonstrator. The SPSC welcomes the possible use of the WA105 facility in synergy with LBNE (the US-based long-baseline neutrino experiment) towards defining the best technical solutions to design a 10–20 kt-scale LAr TPC, and notes with pleasure the official support of the LBNE management to the project.

2.8 The SPSC received with interest the answers to the referees’ questions on the P348 document [5], describing the search for light dark matter using an electron beam dump at the SPS. The committee recommends that the collaboration place more focus on the “invisible” channel, as the more competitive of the two channels considered, and recommends a test run of two weeks at the SPS for the measurement of backgrounds, a study of the performance of the apparatus and an initial search for light dark matter. The results of the test run, as well as detailed simulation studies, should serve as input for a Technical Design Report to be submitted to the SPSC. **The Research Board agreed to the assignment of two weeks’ of beam time for this test.**

3 **REPORT FROM THE LHCC MEETING OF 4-5 JUNE 2014**

3.1 E. Elsen reported from the last meeting of the LHCC [2], including progress on the work during the shutdown, the rich harvest of physics from Run 1 of the LHC that has been a highlight of the summer conferences, and a document that has been submitted
concerning the update of the Computing Models of the WLCG and the LHC experiments. The Research Board took note.

3.2 The majority of Technical Design Reports for the Phase 1 upgrades of the LHC experiments have now been submitted. The LHCC will review the progress of the approved upgrades according to the milestones of the TDRs, on a regular basis.

3.3 During the **start-up** of the LHC machine and experiments in 2015, priority will be given to commissioning the LHC machine first, with a clear and well-defined procedure. The LHC Physics Coordinator and LHCC will help in optimizing the requests for special runs, for example at lower energy or luminosity, or large $\beta^*$, to ensure that common requests are made by the various experiments where possible. It was proposed that the plans of LHCf should be discussed at a forthcoming Research Board.

3.4 **ALICE**: The LHCC has completed its scientific and technical evaluation of the TDR for the upgrade of the Trigger and DAQ [6], but the Upgrade Cost Group (UCG) has requested further information on the costing. The LHCC noted the progress made by ALICE in their investigations for the Time Projection Chamber upgrade that have resulted in lowering the ion backflow; these studies will serve as input to the update of the TDR on the TPC upgrade.

3.4 **ATLAS**: The LHCC noted the excellent progress in the Inner B-Layer (IBL) project, demonstrated by the installation of the detector. The intermittent corrosion problem has been fully resolved. The work on the four approved ATLAS Phase-1 TDRs proceeds well. Discussions on the TDR for a forward proton spectrometer (AFP) have been intensified with a submission goal towards the end of the year. Planning for ATLAS Phase-2 has started, in particular for the Inner Tracker.

3.5 **CMS**: The CMS Phase-1 TDRs are being implemented. Concerning Phase-2 upgrades, important decisions are expected by the end of the year concerning the options for forward calorimeter.

3.6 **LHCb**: The LHCb Trigger and Online Upgrade TDR has been submitted and is being evaluated by the LHCC. The LHCb Tracker Upgrade TDR [7] was recommended for approval by the LHCC and the UCG. It comprises two detectors, an Upstream Tracker (UT) and a Scintillating Fibre tracker. The UT consists of four planes, made of silicon
staves, with higher segmentation in the inner region and a total 11 m\(^2\) of Si tiles. To
ensure quality and schedule the UCG recommends that the LHCC should monitor
progress of the electronics development and production, and that LHCb should get a
quote from an alternative vendor for the silicon. The Scintillating Fibre tracker consists
of three stations downstream of the LHCb magnet with four fibre layers each, read out
by Si PMTs. It is structured as 144 modules, with 1150 fibre mats and a total of 10,000
km of fibres, representing a scale not done before. The UCG recommendations include:
establishing the same comprehensive quality control programs and tools for each
production site; obtaining a quote from alternative suppliers for the Si PMTs; resolving
any remaining cost uncertainties; providing a cost estimate for replacing the inner
region; and protecting against currency fluctuations in purchasing the fibres and PMTs.
The Research Board approved the LHCb Tracker Upgrade TDR.

3.7 **TOTEM:** The LHCC took note of the common physics publication with CMS on the
measurement of pseudorapidity distributions of charged particles. The joint CMS-
TOTEM Precision Proton Spectrometer TDR is being prepared. Good progress was
reported on the deployment of vertical timing detectors for the latter part of LHC Run 2.

3.8 **MoEDAL:** Good progress was reported. Extensions of the installation at the Point 8
intersection region are under consideration, and should be agreed with the LHCb
collaboration.

3.9 **R&D Projects:** The LHCC recommends that the **RD39** project be continued for one
year with emphasis to be placed on the development of the Beam Loss Monitor with the
LHC machine groups; that the **RD42** project be continued for one year and encourages
the collaboration to proceed with the publication on the diamond technology; that the
**RD50** project be continued for one year and requests that studies of HVCMOS
technologies be included in their programme; that the **RD51** project be continued for
four years beyond 2014; that the **RD52** project be continued for one year and requests
that the collaboration submit their detailed plan of work for the coming year; and that
the **RD53** project be continued for two years beyond 2014 and requests that studies of
HVCMOS technologies be included in their programme as a potential alternative for the
LHC upgrades. **The Research Board endorsed the recommendations for extension of the R&D projects.**
4 ANY OTHER BUSINESS

4.1 Future meeting dates: the next meeting of the Research Board will be held on 10 September, and the last meeting of 2014 will be held on 3 December. The schedule for Research Boards in 2015 was circulated after the meeting: 11 March, 10 June, 9 September, and 9 December.

ENCLOSURES

1. Draft Minutes of the 113th SPSC meeting held on 8-9 April 2014 (SPSC-2014-017/SPSC-113).

2. Draft Minutes of the 118th LHCC meeting held on 4-5 June 2014 (LHCC-2014-018/LHCC-118).

REFERENCES

[2] Copies of the transparencies are available directly at http://indico.cern.ch/event/rb208
MINUTES of the 113th Meeting of the SPSC
Held on Tuesday 8 April and Wednesday 9 April 2014

OPEN SESSION

1. WA104-ICARUS Report Claudio Montanari
2. WA104-Nessie Report Laura Patrizii
3. WA105 Report Andre Rubbia
4. Status and plans of the RD52 experiment John Hauptman
5. Status and plans of the NA62 experiment Ferdinand Hahn
6. Status and plans of the AEGIS experiment Michael Doser
7. Status and plans of the GBAR experiment Patrice Perez

CLOSED SESSION

Present:

1) Present on Tuesday only
2) Present on Wednesday only

Apologies: S. Schönert

1. MINUTES OF THE 112th MEETING OF THE SPSC HELD ON 14 JANUARY AND 15 JANUARY 2014

The minutes of SPSC112 were approved (CERN-SPSC-2014-006, SPSC-112).

2. CHAIRMAN’S REPORT FROM RB207
The Chairman reported on the Research Board (RB) meeting, RB207. The following points were presented and, where necessary, discussed.

1) The Committee summarised the physics breakthroughs performed by ASACUSA, ALPHA and ATRAP before the long shutdown, the improvements achieved on their apparatus during 2013 and their plans for new measurements in 2014 and later;
2) The Committee presented the experimental improvements obtained by the BASE Collaboration in Mainz as well as the steady progress in installing the beam line and apparatus at CERN for first data taking in 2014;
3) The progress of the ACE Collaboration in understanding its sources of systematic errors was summarised, and the recommendation to proceed steadily towards a combined analysis of all data samples reiterated;
4) The SPSC summarised the results of its review of the IAXO LOI (SPSC-I-242 - 2013) and expressed its recommendation to proceed towards a technical proposal within a MOU covering the necessary R&D;
5) The Committee summarised the results of its review of the SHIP EOI (SPSC-EOI-010-2013) and, while supporting the physics goal of the project, expressed the need for a wider physics scope, a more detailed technical design and the expansion of the Collaboration to further review the project;
6) The Committee presented the proposal for an electron beam dump experiment for light dark matter search (SPSC-P-348-2013), as well as the points under review;
7) The progress of NA63 in understanding their new detectors to study positron production in crystals was presented, and adequate data taking recommended for 2015.

The Research Board noted points 1) to 6) and endorsed point 7). Concerning point 4), the expected contribution of CERN to the IAXO R&D towards a TDR will be discussed between the CERN departments and the Collaboration. Concerning point 5) a study group was formed to evaluate the feasibility of a proton beam dump at CERN.

3. STATUS OF ACCELERATORS

R. Steerenberg reported on the ongoing long shutdown (LS1) activities, which are coming to an end for most of the machines in the injector complex.

All the general services such as cooling, ventilation compressed air are available and hardware re-commissioning and testing has started in the LINAC, PS Booster, PS. The work for the SPS is on schedule although the BA1 cable campaign remains on the critical path. As in LS1 work has been carried out on major components of the entire accelerator complex, the re-commissioning of the machines will be challenging, but for the moment no show stoppers are identified. The AD suffers from a problem with the strip line that is used to guide the required current of 400 kA to the focusing horn behind the target. A clamp connection that connects the fixed strip line with the movable horn cart has been damaged due to electric arcing as a result of a bad contact. Major part will have to be replaced and other part will have to be cleaned which will delay the restart of the anti-proton production. Initially it was planned to deliver beams to
the anti-proton target on 10 July 2014. With the current repair scenario, beam might be expected on target on 1 August 2014, however it is not excluded that extra testing might be required, resulting a later start, 29 September 2014.

To these dates additional time to setup the AD accelerator with beam is required before delivery of anti-protons to the experiments can start.

One of the many major work sites was the consolidation of the TT10 tunnel, between the PS and the SPS, where the concrete had cracks on more than 90m of the tunnel. These cracks would present a serious danger for the structural strength of the tunnel. For the repair work, all beam line equipment had to be removed over 190m length and large steel beams have been mounted on the tunnel wall to compensate for the outside press exerted on the tunnel. Today all beam line equipment is back in place, but remains to be realigned.

Concerning the plans of the Bio-LEIR project, it was confirmed by the project leader S. Myers that all efforts are made to set up the Bio-LEIR project without compromising the present LEIR programme which provides ions to the LHC and the NA61 experiment. The idea is that Bio-LEIR should run for five to six months per year.

4. STATUS OF EXPERIMENTAL AREAS

Lau Gatignon described the ongoing shutdown activities in the East, North and AD experimental areas as well as in the AWAKE cavern.

In the East Area the construction of the Irradiation zones is progressing. However, there is a delay with the order of the control rooms due to the receivership of the company. A new company has been contracted, but there will be some delays in the facility start-up. As planned, the commissioning of the Irradiation facility will start without ventilation at low flux.

The work on the T9, T10 and T11 beams is on track for a timely start-up. The two broken magnets in the primary proton line have been repaired. The two beam stoppers in the primary line could not be replaced but have been refurbished. A magnet patrol will take place on end of April 2014.

For the “Beam line 4 Schools” competition, 296 proposals were received. With help from the SPSC one winning team will be selected to perform a small experiment in the T9 beam line in autumn 2014.

The consolidation program in the North Area target cavern TCC2/TDC2 is progressing according to schedule. Civil engineering work has been completed, now CV consolidation is under way. In the framework of the primary target consolidation, alignment checks will be made around the targets. The GIF++ construction is well underway, the concrete shielding is completed and the facility should be ready for commissioning by autumn 2014. The design of the shielding for the primary ion beam for NA61 is now available and installation will be in time for the 2014 beam start-up in autumn. This will allow uninterrupted experimental operation switching from protons (2014) to ions (2015). The crane consolidation in TCC8 (the target cavern upstream of NA62) is almost completed and soon the reinstallation of a few beam elements will start. The required infrastructure work (shielding and access door modifications, some small civil engineering works) for the COMPASS Drell-Yan run has been completed.
In the AWAKE cavern the removal of CNGS equipment is well under way and new infrastructure installation for AWAKE has started. The civil engineering work for the laser core and electron beam tunnels should be completed by November.

In the AD hall the BASE installation is progressing according to schedule. BASE will be in a position to start physics in 2014 immediately at AD start-up. The concrete shielding that was removed for the BHZ06 repair has been reinstalled and ATRAP can reinstall their positron source. The infrastructure modifications required for ATRAP due to space reallocations to BASE are in progress.

5. PS AND SPS USER SCHEDULES

H. Wilkens presented the AD user schedule for 2014 and summarised the first draft version of the PS/SPS users schedule for 2014 and the foreseen changes to it.

The injector schedule for the 2015 Argon ion run at the SPS was also shown. The call for beam time request to possible users of the ion beams in H4 and H8 beam line will be announced soon.

6. DISCUSSION OF THE OPEN SESSION

6.1 NA62

The SPSC congratulates NA62 for the progress achieved towards the installation and commissioning of the detector components.

The SPSC encourages the Collaboration to take all required measures towards the timely installation of the systems for the first physics run in 2014 and recognises the importance of testing the experimental setup at full beam intensity.

The SPSC is pleased with continuous publication of physics results by the NA62 Collaboration.

6.2 RD52

The SPSC notes with pleasure the progress made by the RD52 Collaboration in publishing results from the previous data taking at the SPS and in implementing detailed detector simulations.

The SPSC is looking forward to refined test results from the 2014 data taking with the existing modules.

The SPSC acknowledges the plans for building enlarged Lead and Copper hadronic modules and requests a detailed description of the setup foreseen by the Collaboration for the 2015 beam data taking.
The SPSC encourages the RD52 Collaboration to strengthen their contacts in current and future experiments for further development and application of the dual readout calorimetry.

6.3 WA104

The SPSC received with interest the document describing the technical WA104-NESSiE programme (SPSC-SR-133-2014). The Committee supports the R&D on air core magnets and associated detectors that could be used for future neutrino projects, and encourages synergy with the Liquid Argon (LAr) R&D programmes. The SPSC requests a document quantifying the human and financial resources needed for all aspects of the project, including the requests to CERN.

The SPSC acknowledges the WA104-ICARUS LAr R&D programme envisaged. The Committee requests a technical document describing the activities foreseen at CERN, including the novel features to be developed. The Committee emphasises the necessity to quantify the financial and manpower resources needed, including the requests to CERN.

The Committee notes with interest the ongoing discussions with US institutes and laboratories regarding a short baseline neutrino experiment at Fermilab using the ICARUS technology. The Committee looks forward to the official conclusion of the discussion process.

6.4 WA105

The SPSC received with interest the technical proposal describing in detail the CERN WA105 R&D programme (SPSC-TDR-004-2014). The Committee supports the technical goals of the Double Phase Liquid Argon (DLAr)-TPC programme and considers it as the WA105 priority for the forthcoming years.

The Committee requests clarification of the interplay between the 6x6x6m$^3$ demonstrator and the 3x1x1m$^3$ prototype, in term of technical goals, schedule and resources.

The Committee requests further information on the human and financial resources requested from CERN and encourages the Collaboration to secure the necessary external resources to build the 6x6x6m$^3$ DLAr-TPC demonstrator.

The Committee welcomes the possible use of the WA105 facility in synergy with LBNE towards defining the best technical solutions to design a 10-20 kt-scale LAr TPC. The SPSC notes with pleasure the official support of the LBNE management to the project.

6.5 AD6-AEGIS

The SPSC appreciates the progress achieved in the performance of components of the baseline apparatus. The Committee is pleased with the plans for the next steps of the experiment.
The SPSC is looking forward to the first H-bar formation in 2014.

6.6 AD7- GBAR

The SPSC notes with pleasure the progress of many sub-systems of the GBAR experiment. The Committee also notes the progress made by the Collaboration in investigating solutions to the critical aspects of the setup. The SPSC is looking forward to receiving a detailed schedule and organisation plan for the development of key components and their commissioning at the AD.

7. FOLLOW-UP ON EXPERIMENTS AND PROPOSALS

7.1 P348

The SPSC received with interest the answers to the referees’ questions on the document, P348, describing the search for light dark matter using the SPS.

The Committee recommends that the Collaboration place more focus on the invisible channel, the more competitive of the two channels.

The SPSC recommends a test run of two weeks at the SPS for the measurement of backgrounds, a study of the performance of the apparatus and an initial search for light dark matter.

The Committee also recommends that the results of the test run, as well as detailed simulation studies, should serve as input for a technical design report to be submitted to the SPSC.

7.2 AD4-ACE

The SPSC welcomes the close and productive Collaboration between the FLUKA and AD-4/ACE teams necessary for assessing the radiobiological effectiveness of antiproton beams. The Committee encourages the ACE Collaboration to implement the best possible description of the experimental apparatus into these studies.

7.2 AWAKE

The SPSC notes with pleasure the progress made on all components of the experiment and welcomes the CERN involvement on the electron injector.

7.3 OPERA

The Committee congratulates the OPERA Collaboration for the observation of the 4th tau neutrino candidate which leads to a significance for tau neutrino appearance at 4.2 sigma C.L.
7.4 OSQAR
The SPSC takes note of the plans of the OSQAR Collaboration for 2014.
The Committee looks forward to the results on the search for axion like particles.

8. DOCUMENTS RECEIVED

- DRAFT Minutes of the 112th meeting of the SPSC, Tuesday 14 and Wednesday 15 January 2014, CERN-SPSC-2014-006, SPSC-112;
- Agenda of the 113th Meeting of the SPSC, Tuesday and Wednesday, 8-9 April 2014, CERN-SPSC-2014-008, SPSC-A-113-2014;


Christoph Rembser
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OPEN SESSION – STATUS REPORTS

1. LHC Machine Status Report: Roberto Saban
2. LHCb Status Report: J. Michael Williams
3. ALICE Status Report: Marta Verweij
4. ATLAS Status Report: Monica d’Onofrio
5. CMS Status Report: Pierluigi Paolucci
6. TOTEM Status Report: Marco Bozzo
7. MoEDAL Status Report: James Pinfold
8. RD51 Status Report: Maxim Titov
9. RD39 Status Report: Jasu Haerkoenen
10. RD42 Status Report: Harris Kagan
11. RD50 Status Report: Gianluigi Casse, Michael Moll
12. RD52 Status Report: Richard Wigmans
13. RD53 Status Report: Jorgen Christiansen

CLOSED SESSION:


* part-time

Apologies: J.-C. Brient, E. Meschi, C. Touramanis

1. EXECUTIVE SUMMARY

General
The LHCC will review on a regular basis the progress of the approved upgrades according to
the milestones of the respective Technical Design Reports. During the LHC machine and experiment start-up stages in 2015, priority will be given to commissioning the LHC machine first, with a clear and well-defined procedure.

**ALICE**

Trigger and DAQ Phase-1 Technical Design Report (CERN-LHCC-2013-019)

- The LHCC has completed its scientific and technical evaluation of the Technical Design Report for the upgrade of the ALICE Trigger and DAQ. The UCG has requested further information on the costing of the upgrade.


- The LHCC noted the progress made by ALICE in their investigations that have resulted in lowering the ion backflow. These studies will serve as input to the update of the Technical Design Report.

**ATLAS**

Inner B-Layer (IBL)

- The LHCC noted the excellent progress in this project as demonstrated by the installation of the detector. The intermittent corrosion problem has been fully resolved.

The work on the four approved ATLAS Phase-1 Technical Design Reports proceeds well. Discussions on the Technical Design Report for a forward proton spectrometer (AFP) have intensified with a submission goal towards the end of the year.

**ATLAS Phase-2 Upgrades**

- Planning for ATLAS Phase-2 has started, in particular for the Inner Tracker.

**CMS**

The CMS Phase-1 Technical Design Reports are being implemented.

**LHCb**

Tracker Phase-1 Technical Design Report (CERN-LHCC-2014-001)

- The LHCb Tracker Technical Design Report was recommended for approval by the UCG (CERN-LHCC-2014-017).

Trigger and Online Upgrade Technical Design Report (CERN-LHCC-2014-016)

- The LHCb Trigger and Online Upgrade Technical Design Report has been received and is being evaluated by the LHCC.

**TOTEM**

The LHCC took note of the common physics publication with CMS on the measurement of pseudorapidity distributions of charged particles. The joint CMS-TOTEM Precision Proton Spectrometer Technical Design Report is being prepared.

Good progress was reported on the deployment of vertical timing detectors for the latter part of LHC Run II.

**MoEDAL**

Good progress was reported on MoEDAL.
R&D Projects
RD39: The LHCC recommended that the RD39 project be continued for one year with emphasis to be placed on the development of the Beam Loss Monitor with the LHC machine groups.
RD42: The LHCC recommended that the RD42 project be continued for one year and encouraged the Collaboration to proceed with the publication on the diamond technology.
RD50: The LHCC recommended that the RD50 project be continued for one year and requested that studies of HVCMOS technologies be included in their programme.
RD51: The LHCC recommended that the RD51 project be continued for four years beyond 2014.
RD52: The LHCC recommended that the RD52 project be continued for one year and requested that the Collaboration submit their detailed plan of work for the coming year.
RD53: The LHCC recommended that the RD53 project be continued for two years beyond 2014 and requested that studies of HVCMOS technologies be included in their programme as a potential alternative for the LHC upgrades.

WLCG
The document *Update of the Computing Models of the WLCG and the LHC Experiments* (WLCG-ComputingModel-LS1-001) was released in April 2014.

2. PROCEDURE

The Chairman welcomed H. Yamamoto to the Committee.

The minutes of the one-hundredth-and-seventeenth LHCC meeting (LHCC-2014-004 / LHCC117) were approved.

3. REPORT FROM THE DIRECTOR FOR RESEARCH AND COMPUTING

The Director for Research and Computing reported on issues related to CERN and the LHC. He reported that the CERN Council will discuss at its session of June 2014 the Medium-Term Plan (MTP) of the Organization, including the budget for 2015 and the outlook for the subsequent four years 2016-2019. CERN’s cumulative budget deficit is under control since although initially the cumulative budget deficit is expected to increase, it is projected to fall back during the period covered by the MTP. He also reported on the discussions with the Funding Agencies regarding the extent and timeline for the HL-LHC. During this period there is expected to be an impact on the budget by the High-Luminosity LHC (HL-LHC). A cost ceiling, as was done for the LHC, will be put forth also for the HL-LHC.

He also reported that the deliberations of the P5 (Particle Physics Project Prioritization Panel) have been completed and their recommendations have been released in the report *Building for Discovery - Strategic Plan for U.S. Particle Physics in the Global Context*. The collaboration agreement with the U.S. on the LHC is set to expire in 2017 and its renewal is being prepared.
4. REPORT FROM THE LHC PROGRAMME CO-ORDINATORS

The LHCC heard a short report from the LHC Programme Co-ordinators, concentrating on preparations for LHC Run II. They reported on the deliberations of the 5th Evian Workshop held on 2-4 June 2014. The principal aims of the workshop were to suggest operational parameter ranges for LHC re-commissioning and operation in 2015; to establish re-commissioning requirements for beam-based LHC systems; to establish planning for re-commissioning in 2015; to re-visit the overall strategy for 2015 (bunch spacing, scrubbing, special runs and machine developments); and to provide input to Chamonix 2014. A number of issues were discussed affecting directly the experiments. The effectiveness of the beam scrubbing for operation at 25 ns bunch spacing has not yet been confirmed with the conclusion is expected only after the second scrubbing campaign in June 2015. The choice of LHC running energy depends on the completion of the magnet training tests. Concern was expressed at the amount of time requested for special runs given the already tight commissioning and physics schedules for 2015. The LHC experiments’ views on commissioning and early beam were also discussed at the workshop. The experiments agree with the initial commissioning, in particular the plan and schedule for the LHC machine check-out and sector test.

5. TESTBEAMS

The PS and SPS Physics Co-ordinator reported on the LHC test beams. He reported that the re-start of the LHC injector complex is advancing smoothly. The remaining cabling campaign in TDC2/TCC2 at the SPS is progressing very well and the SPS will be operated at nominal intensity for the fixed-target runs in 2014. Construction of the IRRAD proton irradiation facility and the CHARM mixed-field irradiation facility at the PS East Hall is progressing well and the construction of the new Gamma Irradiation Facility (GIF++) in the EHN1 Hall of the SPS is also advancing well. The Co-ordinator also showed the latest versions of the PS and SPS User Schedules.

6. REPORT & DISCUSSION WITH LHC EXPERIMENT UPGRADE REFEREES

The LHCC heard a report on the upgrades of the LHC experiments.

LHCb

The LHCC received the LHCb Trigger and Online Upgrade Technical Design Report (CERN-LHCC-2014-016). The Committee would like to congratulate the experiment on the submission of another well-written Technical Design Report (TDR).

The trigger upgrade has seen an important evolution since the presentation of the Letter of Intent in 2011. At that time a nominal luminosity of $1 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ had been assumed, targeting a gain of a factor of two in trigger efficiency for hadronic final states by removing the hardware level trigger and providing an input rate to the High Level Trigger (HLT) of 5-10 MHz with an overall output rate of 20 kHz. After submission of the Framework TDR in 2012 the baseline luminosity increased by a factor of two and three trigger options were pursued: a pure software HLT, a hardware assisted FPGA-based trigger, and a Low Level Trigger (LLT) in conjunction with an HLT. With the recent technology decisions for the various upgrade components, and the selection of a
bi-directional event builder with the read-out electronics located on the surface, the Collaboration converged on a purely software-based HLT trigger, reconstructing tracks at the full inelastic collision rate. The hardware LLT emulated in software is kept as backup option. All tracks with $p_T > 500$ MeV will be reconstructed online at the full 40 MHz collision rate. Particle identification based on Ring Image Cherenkov (RICH) detector algorithms and a Kalman filter will be run on a subset of events at 1 MHz. An efficiency of nearly 99% compared to offline is predicted with no $p_T$ or lifetime bias. The full tracking is estimated to take only 40% of the online CPU budget of 13 ms per event. It should be noted that a data volume of approximately 4 TBytes/s is processed and reduced to an output rate of 2 GBytes/s with an event size of 100 kBytes. The limitation on the output rate is given by offline computing resources. Studies show that large gains in efficiency can be obtained for inclusive b-decay and exclusive charm-decay modes for increased output bandwidth, which in turn of course requires additional resources.

A compact online system is obtained by locating all components in a single location and the decision has been taken to locate the online system on the surface. This requires long (~300m) optical links to bring the data to the processing centre. Various optical fibres have been tested and the most cost-effective solution meeting the requirements has been chosen. About 8800 versatile links are foreseen. The read-out network will rely on data-centre technology exploiting I/O and memory performance of modern server PCs. The online architecture essentially consists of a two-layer system. The event builder, a farm of about 500 PCs, forms the first layer; the second layer is the even filter, which is a CPU farm of up to 4000 PCs. A critical element is the custom made PCIe40 board, which contains up to 48 bi-directional optical I/Os (Gigabit Bidirectional Triggers, GBTs), which handles data rates up to 100 Gbit/s. This board is the universal building block for the DAQ, the Experiment Control System (ECS) and the Timing and Fast Control (TFC). The architecture is scalable and resources can be added as needed. Modest extrapolation of Moore’s law has been used to estimate the resources required and, for example, 1000 nodes of the type available in 2020 will allow 13 ms for event processing for the HLT. Equipment will be bought as late as possible to optimally use new technologies. For the ECS only evolutionary changes are foreseen. The upgrade of the trigger and online system is quite aggressive, but elegant cost-effective solutions have been found to achieve the physics goals and the project is well organized.

CMS
The CMS experiment presented a status report of the Level-1 calorimeter and muon trigger upgrade for Phase-1. A new resource-loaded schedule has been developed and although the project is generally on schedule, some areas need close monitoring. The upgrade is motivated to improve the signal efficiency and background rejection for electron and tau triggers, to improve the background rejection for muon triggers via improved momentum resolution and to enable pile-up subtraction at Level-1. Overall, the project is making good progress. The Optical Serial Link Boards (oSLBs) and Optical Receiver modules (oRMs) have been installed and new fibre links replacing the old copper outputs have been installed. The new system is scheduled to partake in the July 2014 CMS Global Run. The project requires extra resources for firmware development (4 FTEs). These have been identified and it is expected that the project can stay on track. The overall trigger architecture is a two-layer system consisting of an event builder stage followed by an event filter stage. The various data acquisition cards for the event
building and event filters for both the muon and calorimeter system are in production and those that have already been built are being tested. The new fibres for the muon system have been installed. The porting of the firmware to the new hardware is also progressing well. In parallel, work on the online software is also progressing well though this part of the project is hampered by manpower needs and is short of at least three FTEs. Emulators are being designed to test the whole system. The good progress on the first stage of the calorimeter trigger offers the possibility to start with some of the new trigger features already in 2015. Overall, this upgrade is proceeding well though the schedule is quite tight and more resources are required in the area of software development. Close monitoring of the progress is advised.

ATLAS

The ATLAS experiment presented a comprehensive overview of the full upgrade, both Phase-1 and Phase-2. The immediate work is progressing well and more details are given in the experiment’s report. In previous minutes the Technical Design Reports that have been submitted to the committee have been discussed already in some detail. This report will limit itself to a summary of the tracker upgrade plans for Phase-2. Because of radiation damage and the need to cope with up to 200 interactions every 25 ns, the experiment needs to replace the complete inner tracker for Phase-2. The new pixel detector is proposed to have a 4-layer/6-disk structure. Several types of sensors, \(n\)-in-\(n\) or \(n\)-in-\(p\) planar sensors or 3D sensors are being considered. The 65 nm technology should allow for a reduction in the pixel size down to 50 \(\mu\m\) \(\times\) 50 \(\mu\m\) or 25 \(\mu\m\) \(\times\) 100 \(\mu\m\). Test sensors have been produced and irradiation studies are being carried out with excellent results so far. Prototyping of the mechanical support structures for various concepts is proceeding.

A 6-layer/7-disk layout is being considered for the outer strip tracker. Prototype \(n\)-in-\(p\) sensors with 4 rows of 2.4 cm long strips at 74.5 \(\mu\m\) pitch are being tested. The building block for the outer tracker will be a stave. A twelve-module full-length stave, encompassing 61,440 channels, has been built and tested. ATLAS is also considering alternative technologies for the tracker, such as HV-CMOS, that could bring some of the advantages of the monolithic active pixel sensor technology to the outer tracker. Many technologies are still under investigation for potential use in the pixel system at higher radii, which could allow for a less expensive 5\(^{\text{th}}\) pixel layer. An extended tracker coverage to \(|\eta|\sim 4\) is being studied. Many physics channels, such as vector boson fusion, Higgs production and several electroweak channels would benefit from an extended coverage. A cost-benefit analysis through physics simulations is proceeding in parallel with studies of possible technical options. An updated cost profile was provided for the Phase-2 upgrade, which brings the upgrade cost, including all options, to 275 MCHF. The LHCC recognizes and supports the requirement that there be adequate resources available now to develop optimized and cost-effective solutions.

7. REPORT FROM THE UPGRADE COST GROUP (UCG)

The LHCC heard a report from the Upgrade Cost Group (UCG).
The UCG reviewed the LHCb Tracker Upgrade Technical Design Report (CERN-LHCC-2014-001). The Tracker Upgrade consists of the Upstream Tracker (UT) and Scintillating Fibre Tracker (SciFi) detectors. The UT is made of 4 planes constructed using staves with silicon on both sides, partially overlapping in the x-direction to ensure full coverage and with a higher segmentation in the region surrounding the beam pipe. The UCG findings are: a) the UT group is experienced and uses well-known techniques; b) the risk of employing large numbers of undergraduates in the production is low and manageable, but this needs to be monitored through the project; and c) the schedule seems tight but feasible with the main concern being the schedule for the front-end electronics. The UCG recommends to the LHCC approval of the LHCb Upstream Tracker cost estimate. To ensure quality and schedule the LHCC should monitor progress of the electronics development & production and LHCb should request a quote from the firm Micron for the silicon. The SciFi consists of three stations downstream of the LHCb magnet, each station made of four fibre layers each and read out by silicon PMTs. The detector is built up from 144 modules, 1,150 fibre mats and 10,000 km of fibres, representing an unprecedented scale. The findings of the UCG are: a) the estimates of the cost and manpower are reasonable; b) the requested spending profile matches the schedule; c) the fibre acceptance and mat assembly pose major challenges; and d) the cost of replacing the inner region is not known. The UCG recommends to the LHCC approval of the LHCb SciFi cost estimate. Furthermore, LHCb should a) establish comprehensive QC/QA programmes and tools that are the same for each site; b) obtain a quote from KETEK for the SiPMs to allow comparison with Hamamatsu; c) resolve remaining cost uncertainties; d) provide a cost estimate for replacing the inner region; and e) protect against currency fluctuations in dealing with vendors from Japan.

ALICE

The UCG reviewed the ALICE Trigger and DAQ Technical Design Report (CERN-LHCC-2013-019). The upgrade of the ALICE Trigger and DAQ aims to handle a 100-fold increase in event statistics compared to the current set-up through a 50 kHz interaction rate in Pb-Pb collisions and 200 kHz in proton-proton and proton-Pb collision modes. The project consists of read-out upgrades to several ALICE sub-detectors and an ALICE system-wide Trigger/DAQ upgrade. The Technical Design Report covers 12 sub-systems and the UCG focused its work on the most critical ones – the Muon Chamber Upgrade (MCH), the Muon Identifier (MID), the Fast Interaction Trigger (FIT), the common read-out ASIC (SAMPA) and the Common Read-out Unit (CRU). The UCG findings are: a) the ALICE Trigger and DAQ Upgrade project is challenging with an aggressive time schedule and the production of components, testing and assembly will require a substantial amount of expertise and proficient project management; b) the UCG has identified a number of considerable risks in schedule, integration and management; c) the evaluation of costs and manpower requirements is complicated by the intertwined structure of the various projects; and d) delays or technical problems with the common components such as the CRU and the SAMPA pose risks to multiple ALICE systems. The UCG is impressed by the technical details provided by ALICE. The cost and manpower estimates are generally reasonable. However, the following recommendations must be implemented before approval: a) simplification of the intertwined structure of the upgrade project by centering on the SAMPA chip and the CRU; b) put in place a management structure for this upgrade project; c) produce a clear set of milestones for
the TDAQ upgrade project. Without modifying the Technical Design Report, ALICE should compile a new and concise UCG report addressing the recommendations above and including details of the cost and manpower estimates in spreadsheet form. A follow-up review will take place at the latest during the LHCC session in September 2014.

8. DISCUSSION WITH ATLAS

Physics

The rate of physics publications has increased dramatically and the 100 or so additional and final Run-I publications that the Collaboration has aspirations to publish prior to the start of Run-II is within their grasp. At the time of the March 2014 LHCC session, 10 papers were submitted for publication and 27 papers were in the pipeline. At the June 2014 session of the LHCC, all but two in the pipeline made it to publication and there are now 51 results in the publication pipeline. A few of the many interesting measurements highlighted in the LHCC Open Session included:

- New Higgs mass result with significantly improved systematic uncertainties.
- \( t\bar{t} \) Higgs search.
- A large number of SUSY search results (limits) with the full data set.
- A number of heavy-ion results.
- A set of calibration and performance papers.

Long Shutdown 1 (LS1)

The Inner B-Layer (IBL) construction and installation is essentially complete. The Collaboration was able to successfully advance the construction and installation schedule by over a year with respect to the original proposal. As of this LHCC session, the detector was installed inside the pixel detector in the pit and the services are now being connected up. Once it is complete, the permanent gas seal is made and that side of the detector will be closed up. The pixel detector is fully cabled and the cooling installed. A temporary gas seal was installed such that the detector could be cooled down and read out for short periods of time. All looks very good.

The Transition Radiation Tracker (TRT) is ready for beam. After all the repairable leaks were fixed, the leak rate going forward is about ½ that during 2012. Thus, if this leak rate remains at this level, the experiment can stay within its Xenon cost envelope. However, if the leak rates increase appreciably, then corrective action will be required.

The Liquid Argon (LAr) detector is perhaps the most worrisome at the moment. Recall that during the 2012 run, the experiment installed ~20 new-style power supplies and ran them successfully for a year with zero problems. However, since the shutdown, two problems have arisen that have required the supplies to be twice removed and reworked. The first was a faulty connector and the latest issue had to do with problematic capacitors. Hopefully these are the last of the issues for these supplies. The experiment has refurbished all of the Run-I supplies just in case.

The Tile Calorimeter is in good shape. Only 16 drawers require refurbishment. This can be done once scaffolding for the tracker is removed. It will require about two weeks to complete. Recently, the Cs calibration system has been reworked. A few leaks were repaired and modifications were made such that the system can be drained when not in use and it can be operated at a much lower pressure in Run-II than it operated in Run-I.
The Muon Systems are on track and no issues were reported.

In terms of the forward detectors, the LUCID (LUMinosity measurement using a Cherenkov Integrating Detector) luminosity monitors have been refurbished and are now being remounted on the beam pipe. The ALFA (Absolute Luminosity For ATLAS) stations are also being re-installed after being refurbished. The Collaboration is now looking to find the ~1.5 MCHF necessary for the ATLAS Forward Physics (AFP) project.

ATLAS Milestone Weeks 2 and 3 occurred since the LHCC session in March 2014. During these weeks, the detector groups try to read out a large part of the entire detector. The ATLAS Forward Physics (AFP) has passed both its physics and technical reviews and has been approved to proceed to a Technical Design Report, subject to obtaining the necessary funding. ATLAS has now successfully taken cosmics runs with all but the silicon detector and calorimeter. Milestone Week 4 is scheduled for July 2014 and expects LAr and the silicon to be added in.

Software and computing continues to be a main focus of the Collaboration during this shutdown. Release 19 was built, is now running and validated. Reconstruction software has thus far been sped up by a factor of two and experts still expect to speed it up another 50% or so. With the release being a month or so late, the 2014 data challenge is being modified slightly. Less data will be processed with the new computing model but the plan is still to turn the physics groups loose on it this summer to do analysis and provide feedback.

**Upgrades**

The ATLAS upgrade activities are advancing well. The four Memorandum of Understanding agreements are now awaiting signature by the Funding Agencies. About one-third of the Funding Agencies have signed thus far and no agency has given any negative indication regarding the expected level of support. The LHCC is monitoring the Fast Track Trigger (FTK) upgrade. The AM6 chip remains on the critical path and a delay of 6 months is likely, which will put pressure on the team to commission faster than initially anticipated.

The LHCC is working with experiments to formally monitor progress of Phase-1 upgrades.

**9. DISCUSSION WITH CMS**

**Physics**

CMS has solid plans for accomplishing the major physics objectives with a focus on finishing Run I publications, pursuing upgrades and preparing for Run II. CMS has appointed a ‘physics officer’ responsible for each of these areas to assist the Physics Coordinator. CMS has 309 publications with twenty-five additional publications in preparation, and with \( O(100) \) more expected from Run I. The target is to publish the majority of ‘legacy’ papers such as the Higgs analyses in 2014, with the understanding that some precision measurements will take longer. This plan will enable a focus within the physics organization to turn to Run II and Upgrades.
CMS has signed a Memorandum of Understanding with TOTEM to create the CMS-TOTEM Precision Proton Spectrometer (CTPPS) project. The primary physics motivation is to measure the Quartic gauge boson coupling $WW\gamma\gamma$ which has a sensitivity to anomalous couplings, to search for Standard Model forbidden $ZZ\gamma\gamma$, $\gamma\gamma\gamma\gamma$ couplings and the measurement of di-jet production of gluon-jets. Starting with the September 2014 LHCC meeting, joint meetings of the TOTEM and CMS referees will be scheduled as needed to monitor the CTPPS project.

In order to reprocess the 2011 heavy-ion data prior to Quark Matter 2014, the High Level Trigger farm was used as a cloud resource. The T0 ‘Agile Infrastructure’ was also used. CMS is beginning to see some stress in the availability of computing resources due to flat budgets. CMS has done extremely well at finding efficiencies to make the best use of the existing resources.

**Long Shutdown 1 (LS1)**

The work scheduled for LS1 is considered an underpinning for the long-term operation of CMS. As outlined in previous meetings’ minutes, the programme of work has the following major elements: (1) muon upgrades, including the installation of the 4th layer end-cap Cathode Strip Chambers (CSCs) and Resistive Plate Chambers (RPCs) and the YE4 shielding wall, plus upgrade of the M1/1 CSC front-end electronics and placement off-detector of part of the barrel muon electronics; (2) the first stage of Hadron Calorimeter (HCAL) photo-detectors consolidation/upgrade (HO, HF); (3) tracking system upgrades and consolidations including the installation of the 45mm outer diameter beam pipe, necessary for the installation of the pixel tracker upgrade. A key priority for the shutdown is enabling the tracker to operate 30 degrees C colder than its current operating temperature. Without this intervention its performance degradation due to radiation would become significant beyond 500 fb$^{-1}$; (4) installation of optical splitters in the Electromagnetic Calorimeter (ECAL) and CSC read-out to allow commissioning of the trigger upgrade in parallel to operation and (5) installation of a new central DAQ system (DAQ2) addressing the replacement of computing and network equipment for future connectivity and the support of sub-detectors with new µTCA back-end electronics.

The LS1 work continues to progress, with many projects now completed as CMS enters Phase 9 of the work plan. The SL53 building supplying office space, conference rooms and a visitor centre has had the ribbon-cutting ceremony.

For the Muon System, chamber installation and electronics refurbishment are entering the commissioning phase. The yoke end-cap disk 4 construction at the $+z$ and $-z$ ends is completed. The 4th muon end-cap stations (CSC & RPC) are installed.

The detector is configured for the beam pipe installation: the barrel wheels have been definitively closed for Run II leaving both end-caps open in preparation for the imminent installation of the new Be beam pipe. Beampipe bake out will take place in July and August 2014, with the reinstallation of the pixel detectors through September. The detector will be fully closed during the fall for the magnet test and cosmic ray commissioning. The beam pipe will be pumped down in January 2015. The schedule keeps some contingency to allow for a partial reopening in January 2015 if necessary.
The Tracker passed the Tracker Master Cold test in February 2014, and has been operated at -20°C for prolonged periods and several transients from room temperature to -20°C and back to room temperature have been exercised without problems. To ensure a long-term mitigation of the condensation with reasonable backup capacity, an additional dry gas source will be installed.

**Run II Preparations**

The new central DAQ system ‘DAQ2’ will support the legacy Front End as well as the new µTCA based systems, support upgraded networking and computing technology for the event builder and the new file-based HLT, and the DAQ for the luminosity monitor. The changeover occurred in May 2014. Subsystem-by-subsystem commissioning has started with an anticipated completion by July 2014. The status of DAQ and detector will be checked regularly with short technical cosmic-ray runs through the year. Cosmic-ray data taking with the whole detector (B=0 and B=3.8T) to collect enough tracks for early alignment and calibration is planned for October and November 2014, as noted in the LS1 section.

For trigger coordination, the challenge is to keep the same acceptance for Standard Model (e.g. Higgs) physics, and full sensitivity to new physics as in Run I while coping with increases in luminosity at the same time as an increase in cross sections due to the increased beam energy. The luminosity and energy increases will lead to higher pile-up, increasing the CPU time/event, requiring optimization of CPU-intensive code. The Level-1 menu will utilize improvements in the hardware. Improvements in the quality of the High Level Trigger reconstructed physics objects sharpen the turn-on curves relative to offline. CMS is also planning to increase the High Level Trigger output rate by up to a factor of two.

Three key demonstrations are planned for the computing infrastructure. The Data Management system was tested in April 2014 to demonstrate the functionality and scale of the improved Data Management system. Data federation and data access will provide access to all CMS data over the wide area network through xrootd (access 20% of data across wide area; 60k files/day, O(100TB)/day). Tests of data federation are going well and CMS is investigating using data federation for reprocessing. There is an analysis-focused exercise planned for June 2014 that will demonstrate the full production scale of the new CRAB3 distributed analysis tools. The Organized Production Milestone scheduled for 31 October 2014 will exercise the full system for organized production including the Agile Infrastructure for Tier-0 at IT-CC and the Wigner facility at 12k cores scale. Additional goals are to run with multi-core at Tier-0 and Tier-1 for data reconstruction and to demonstrate that shared workflows improve latency and speed.

The software releases are planned to enable readiness for data collection. CMSSW_7_0_0 was completed on 14 February 2014 to provide functionality for tests of Run II reconstruction of 2 billion simulated events across several pile-up scenarios. CMSSW_7_1_0 targeted for June 2014 will have the final simulation geometry for 2015-2016, integrate ROOT6 and Geant4.10. This release will be used for data taking for global runs starting in July 2014. CMSSW_7_2_0 planned for November 2014 will feature the reconstruction software ready for 2015 start-up,

There has been a campaign to improve the calorimeter clustering for Run II such as including timing information to the particle flow algorithms to mitigate out of time pile-
up. Several techniques are being explored to mitigate in time pile-up, including developing a weighting for neutral particles based on the distance to charged particles from the leading vertex or from pile-up vertexes. The net result in \( \tau \)-identification is that for the same efficiency, the fake rate is roughly a factor of two lower when compared to the 2012 algorithm. The same performance gain is expected for electron and muon identification.

**Phase-1 Upgrades**

The Phase-1 upgrades include the construction of a new forward pixel detector, installation of new photodetectors and electronics for the hadronic calorimeter and a new Level-1 (L1) trigger system.

For the L1 trigger system, the plan is to have the parallel data path for the ECAL fully installed and commissioned by March 2015. The legacy calorimeter trigger will be recommissioned in time for the July 2014 global cosmic run. The production optical splitter (OSLB) and RM mezzanine board (ORM) boards have been tested and are installed. A detailed programme of integration tests was carried out at Bldg. 904 to ensure reliable connectivity both with the legacy and the upgraded trigger. OSLB and ORM installation activities started in April 2014 and are proceeding according to plan in time to participate in the July 2014 CMS Global Run.

A resource-loaded plan has been put in place for the trigger software. The online project is currently supported by 3 FTEs with an additional 3 FTEs needed and actively being sought. The first version of the emulator will be available soon and will have 2015 functionality. Emulators with the full 2016 functionality, including global triggers will be available later this summer.

The new timing and control distribution hardware prototypes have been tested and final production will begin. The Muon Trigger will be deployed at the start of the 2016 run. The status is that the first TwinMux board for the Drift Tube (DT) and RPC concentration is expected in April 2015. The assembled MTF7 card has been received and is being tested. The Barrel Track Finder MP7 preproduction card has been received and is being tested with integration tests of the MTF7 and MP7 scheduled for the fall.

The pixel system successfully passed a 2-day Engineering Design Review in December 2014 and the \( \text{CO}_2 \) plant at the Tracker Integration Facility is fully commissioned. The initial lot of Forward Pixel (FPIX) sensors from 6” wafers have been received and tested, and some have been bump-bonded. Chips are in the beam test now, being irradiated up to \( 1.2 \times 10^{15} \text{MeV} n_{\text{equiv}} \). Prototype opto-hybrids and High Density Interconnects (HDIs) are being tested. Some problems have been found, but there is good progress on solutions. The fabrication has begun on a prototype half-cylinder to be used for an insertion test in 2014. The final BPIX sensor order has been placed, good modules have been produced and are being tested and the pre-production HDI’s are in hand. There is good progress on mechanics and thermal management in general and mechanics mock-ups will be ready for trial installation this year.

For the HCAL Barrel and End-cap upgrade, silicon photomultiplier (SiPM) R&D has successfully concluded, resulting in a device that has \( \sim 3 \times \) higher photo-detection efficiency (PDE) than the Hybrid Photon Detectors (HPD), as well as having much higher gain. Pre-production by HPK and KETEK is expected in Fall 2014 with final-
specification packaging. The GBTX serializer has been of concern, particularly for the Hadronic Forward (HF) upgrade. An alternative solution is Microsemi Igloo2 FPGAs that allow the combination of the data formatting function (ProASIC3L) and serialization function (GBTX).

**Phase 2 Upgrades**

The outline of the proposed Phase-2 upgrades is to replace detectors and components that will suffer from radiation damage and to investigate increased forward coverage, increased granularity and enhanced trigger capability for high-luminosity operation. The tracking system and end-cap calorimeters will be replaced. For the muon system, the end-cap stations will be equipped with new detectors (GEM/RPCs) to provide redundancy to the CSC measurements at L1-trigger level, the coverage in the forward direction will also be extended with a tagging station. The front-end electronics will be replaced on the barrel ECAL and some of the muon system. The L1 trigger will include tracks, requiring a latency of ≥ 10µs; and the new detector readouts will be designed to allow an input rate to the High Level Trigger of 0.5 to 1 MHz. With a similar reduction factor as in the present system, the High Level Trigger output rate would reach up to 10 kHz.

As the Phase-1 upgrades transition into construction and installation projects, CMS is organizing the upgrade efforts for Phase-2 upgrade R&D and planning. CMS will describe the overall program for Phase-2 in a Technical Proposal (TP) in the fall of 2014, with a Technical Design Report for each upgrade project to follow in 2016-2017. The upgrade organization has been refocused on Phase-2 upgrades and significant effort is invested to prepare supporting studies for the TP within a tight schedule that is concurrent to the Run II preparation.

A consolidated R&D plan has been developed and technology choices are being made. The R&D funding is expected to ramp up starting in 2015 and continue through 2018. Discussions are taking place with funding agencies to obtain funding for the R&D phase, at this stage approximately 20 MCHF are expected, and to define specific involvement in the core projects upgrades.

CMS plans to replace the Electromagnetic End-cap calorimeter (EE) for Phase-2 due to radiation damage. Three concepts were considered.

1) an EE built in a Shashlik design and a Hadronic End-cap (HE) Calorimeter rebuild.
2) a Combined Forward CALorimeter (CFCAL) integrating EE and HE functions (DREAM/RD52 concept).
3) a High Granularity CALorimeter (HGCAL) integrating EE and HE functions (CALICE concept) with a Back HE to capture energy tails.

From January to April 2014, a review committee investigated the potential of each concept to fulfill the CMS requirements for physics performance, technical feasibility and integration within the existing CMS, and completion of the project within the anticipated Phase-2 resources and schedule.

Current resources are insufficient to investigate three concepts on the required time scale in order to select a final technical solution. As the CFCAL concept presented the highest
technical and schedule risks, CMS decided to continue studies and R&D for the EE Shashlik plus HE-rebuild and the High Granularity CALorimeter. R&D on radiation tolerant scintillating fibres will continue as an alternative technology for the Shashlik design & innermost part of HE.

For the physics justification in the Technical Proposal. Monte Carlo samples in key physics channels at HL-LHC are being generated. These processes, documented in an ECFA workshop report include Higgs properties and rare processes, Standard Model measurements, and Beyond the Standard Model topics. Full CMS simulations for performance are being generated at the sub-system level, the objects level (including trigger) and physics signatures. The samples generated include a ‘Phase-1’ configuration with no aging and 50 pile-up events (PU) to serve as the reference for target performance. A ‘Phase-1’ configuration with 1000 fb\(^{-1}\) and 140 PU are used to demonstrate the performance degradation that motivates the needs for the upgrades. The Phase-2 performance is simulated with a mix of aged and new systems as would be the case after the Phase-2 upgrade.

As the readout electronics (new or Phase-1) will allow operating at 200 PU, some samples may be generated to demonstrate performance with those beam conditions. The simulation samples include DELPHES parameterized simulations (benchmarked to object full simulation) for physics background studies. FLUKA is being used for detailed radiation studies for upgrade configurations. While the results are preliminary, initial studies at 140 PU indicate the need for track-trigger upgrades and L1 rate increase to maintain current performance.

10. DISCUSSION WITH LHCb

**Physics**

The LHCb Collaboration scientific production continues well. Since the beginning of 2014, 28 papers were submitted, accepted or published and another 13 papers are under final review. While the trend of article production is consistent with that of the previous year, the production of conference reports was reduced. Many new results were presented at the Open and Closed sessions of the LHCC on rare and CP-violating decays, properties of B-hadron and exotic spectroscopy. A 2.5\(\sigma\) discrepancy in the test of lepton universality was observed in \(R_\mu\), the ratio of branching fractions of \(B^- \rightarrow K^- \mu^+ \mu^-\) and \(B^- \rightarrow K^- e^+ e^-\) in the \(q^2\) region between 1 and 6 GeV\(^2/c^2\). While the signal is clearly visible in the muon channel, the electron channel may be affected by background from \(B^- \rightarrow K^+ J/\psi\) in which the e\(^+\) or e\(^-\) may have radiated bremsstrahlung photons such that the \(K^+ e^+ e^-\) invariant mass lies below the \(J/\psi\) mass veto. It was suggested that the analysis be repeated for \(B \rightarrow K^* e^+ e^-\) and \(B \rightarrow K^* \mu^+ \mu^-\) channels.

**Long Shutdown 1 (LS1)**

The LS1 work proceeds without interruptions or major delays. The Dipole Magnet has been successfully ramped to full current and kept in a stable configuration for 30°. A real-time monitoring of the beam pipe position in UX85/1 has been performed matching the stability requirements when turning on the Dipole. The interlock and safety systems have also been tested. Field-mapping is planned for August 2014. The consolidation of
detectors continues as planned. For the Muon System, LHCb has kept improving the
grounding, fixing problematic chambers or related electronics and doubling the HV
channels. Consolidation work should be completed in August 2014 with the substitution
of some noisy GEM chambers. For the Ring Image Cherenkov (RICH) system, the
replacement of the malfunctioning Hybrid Photon Detectors (HPDs) has been completed
on side-A, while operations on side-C are scheduled for October 2014. The replacement
of 15% of the PMTs in the Hadron Calorimeter (HCAL) proceeds well. HCAL-C has
been completed while HCAL-A is still under way. For the ECAL calibration system, the
replacement of the clear plastic fibres with radiation-resistant fused-silica fibres and the
substitution of the new LEDs is finished. Preparation of the routing for the upgrade read-
out optical fibres from UX to SX is under way. The routing of the large guiding tube,
where the fibres will be inserted, is completed. The first test of fibre blowing is planned
for the summer. Pulling of cables for the Herschel counters that will be used for central
exclusive production studies of the forward physics programme has also started.
Operation of cabling for MoEDAL will proceed in July and August 2014 leaving time for
the field mapping and for the start of other consolidations in September 2014, together
with the start of operations for the beam-pipe closure. The LS1 programme proceeds well
without any major delays or problems.

**Upgrades**

The preparation of the LHCb upgrade proceeds as planned. The major milestone of
delivering Technical Design Reports (TDRs) for all systems was achieved. The TDRs for
the Vertex Locator (VELO) and the Particle Identification (PID) systems were approved
in March 2014 and the TDR for the Tracker systems was approved in June 2014. The
LHCC has just received the TDR for the Online and Trigger. After the TDR completion,
the upgrade money matrix is being frozen and LHCb plans to present it officially to the
next Resource Review Board (RRB) in October 2014. Concerning funding, the
negotiations with Funding Agencies proceed well. Italy has given approval. The
Netherlands and the USA have taken their decision but an official statement is expected
only for the end of June 2014. The UK has also formalized its decision that should be
publicly released for the beginning of July 2014. Germany is moving forward with its
process that should be completed before the end of the summer. France, Russia and
Brazil showed also a positive trend in the approval process and will soon clarify their
contributions.

The Tracking TDR was received by the LHCC in March 2014, and has been reviewed by
the Committee. The TDR clearly describes the two systems contributing to the overall
tracking for LHCb, the UT (or Upstream Tracker) and the SciFi (Scintillating Fibre
tracker) systems. Together with the VELO, the upgraded tracker grants a high
reconstruction efficiency, a low ghost rate and good tracking precision up to the
luminosity regime of \(2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}\). A set of comments and questions were posed to
the Collaboration in April 2014. The LHCb Collaboration sent formal replies well in
advance of the June 2014 LHCC session. The answers were clarifying the Committee’s
minor concerns. As a final comment, the LHCC observes that, although the direct
comparison between the current and upgraded tracker in the same high-luminosity
running conditions shows a very large improvement on performances, some loss of efficiency (2% for long tracks and from 8% to 10% for downstream reconstructed tracks) is observed with respect to the current detector at today’s luminosity. The Committee understands that this has been obtained with a very first version of a fully-renewed tracking reconstruction and that there is plenty of room for improvements. The Collaboration will keep investigating this in detail and the Committee looks forward to receiving a status report on further progress as the project proceeds. The cost details are clearly shown and a dedicated review on cost and schedule was carried out by the UCG. The LHCC concludes that the Tracking TDR is of very high quality. The Committee congratulates the LHCb Collaboration for this great achievement and recommends the TDR for approval.

The TDR for the Online and Trigger systems was submitted by the LHCb Collaboration two weeks prior to the June 2014 meeting. This TDR is the result of a long series of meetings and reviews that allowed the Collaboration to select the final technology choice, both for the Online and for the Trigger systems. LHCb is proposing a high performance system aiming to make the Event Building (EB) at 40 MHz followed by a fully software HLT able to track in real time the 30 MHz of collisions in input allowing for a very flexible trigger selection.

The online system evolved substantially from the scheme presented in the Framework TDR (FTDR) both in scope and technique. In the FTDR, a maximum luminosity of $10^{33}$ cm$^{-2}$ s$^{-1}$ was assumed to be handled by a combination of a front-end electronics (FEE) read-out at 40 MHz and a unidirectional EB using ~500 distributed boards with AMC units. These boards direct the FEE data throughput to the High Level Trigger (HLT) nodes via large core routers with a huge memory for handling the network traffic. The TDR solution instead aims to handle luminosities up to $2-3 \times 10^{33}$ cm$^{-2}$ s$^{-1}$ with a drastic change in technique. LHCb proposes a bi-directional EB with a read-out using ~500 PC servers and a bi-directional router running at 100 Gbits/sec. The AMC read-out unit is substituted by the PCI express. This solution simplifies the design of the read-out unit and can profit both from the high-bandwidth, cost-effective data centre technology and from the progress in network technology in the coming years. This scenario assumes the capability of installing the EB farm in the surface building bringing the data from the FEE to the PC servers with ~300 m long fibres. Here, the assessment of the long-range transmission with optical fibres is crucial and an overall test was done to compare OM3 grade fibres with OM4 grade fibres. In addition, ageing and radiation hardness test of all other components have started. The overall path for routing the fibres from the pit to the surface building is under preparation. A test of the overall system capability is therefore expected well in advance to the deployment of the final components.

A significant change has been proposed also for the trigger system. The basic idea is to perform a full software event filter to handle the 30 MHz of inelastic collisions and reduce it to the acceptable output rate to storage. This is thought to be possible due to two basic assumptions: (i) the CPU performance growth from now to 2019 should evolve by a factor 16 and (ii) the new Online Tracking speed, based on a tuning done with the upgraded tracker, will take an overall time of 6 ms/event out of the 13 ms of the event budget. The first assumption has been evaluated as the mean value between the lowest measured CPU growth rate/year, as estimated by the LHCb Collaboration, and the most conservative one provided by an independent high-specialized data centre. The second
assumption comes from direct measurements on fully simulated events. In this HLT scheme, no assisted hardware processors are used to help the tracking. The HLT is subdivided into three parts, a software-integrated Low Level Trigger (LLT), a full-event reconstruction and an event selection part. The LLT is the evolution of the current Level-0 trigger and uses information from the Calorimeter and the Muon stations to provide up to a factor-of-two background rejection with an overall efficiency of 65-80% for B- and D- decays and an efficiency of 85% for muons. In the TDR, the LLT is assumed not to be necessary and is considered only as a back-up solution that can be quickly deployed if needed for unexpected beam conditions. The reconstruction is based on an HLT Online track-finding sequence that is 99% efficient with respect to the offline in reconstructing tracks with $p_T > 500$ MeV/c and yields a factor of four reduction in ghost rate. The HLT assumes the usage of Global Event Cut (essentially on the multiplicity observed in the calorimeter) to reduce the most complex events while maintaining a 90% signal efficiency. The overall GEC effect on the average processing time seems small at $2 \times 10^{33}$ cm$^{-2}$ s$^{-1}$ (5.4 vs 6.6 ms) while it has a much larger effect at the higher luminosity of $3 \times 10^{33}$ cm$^{-2}$ s$^{-1}$. After tracking the rate is reduced to $\sim 1$-2 MHz and the HLT proceeds with the reconstruction of particle identification in the RICH and the application of a trigger topology selection.

Different bandwidth scenarios for the final output rate on disk are shown from 20 up to 100 kHz. Enhanced physics capabilities are shown for higher output rates. In this area, more work is probably needed to study and tune the selections. Impact of a higher storage rate on the offline reconstruction and offline models still has to be evaluated.

The LHCC acknowledges the LHCb Collaboration for their accomplishment in carrying out these developments and for delivering a high-quality TDR. A dedicated reading and a set of technical questions and comments will be sent soon to the Collaboration with the goal of discussing its approval at the next session of the LHCC.

11. DISCUSSION WITH ALICE

Physics
ALICE continues to publish a broad range of results obtained in pp, p-Pb and Pb-Pb collisions. Since the last LHCC meeting in March 2014, 12 papers were completed and one published. In total 93 physics papers have been published or submitted.

ALICE reported on an impressive number of new results ranging from collective flow measurements of identified hadrons (including hyperons), bottomonium and charmonium suppression, as well as charm meson energy loss in Pb-Pb collisions. Surprising results come from the analysis of data taken during the p-Pb run in Spring 2013. While the measurement of high-$p_T$ probes and $J/\psi$ reveal no effects other than the expected initial state cold nuclear matter effects, low-$p_T$ particle spectra and correlations show collective effects similar to those observed in Pb-Pb collisions. The strong suppression of the $\psi(2S)$ in p-Pb collisions observed by ALICE is unexpected and cannot be explained by established models.

ALICE reported an outstanding and successful presence at the Quark Matter 2014 conference in Darmstadt, Germany, the major conference in the field. Overall the Collaboration had 32 oral presentations and 80 posters.

Long Shutdown 1 (LS1)
The work scheduled for the remaining months of LS1 involves maintenance and consolidation efforts and completion of detector upgrades, as well as work underpinning the stable long-term operation of ALICE in preparation for Run II. The upgrade of the Time Projection Chamber (TPC) read-out control unit (RCU2) is a potentially critical item.

ALICE reported substantial progress in their efforts to complete the Transition Radiation Detector (TRD) subsystem. The production of the remaining five super-modules had been jeopardized by delays in the manufacturing of the Read-out Boards (ROBs) due to legal issues with the companies involved and technical problems with the produced Multi-Chip Modules (MCM). The ROB production has picked up substantially and 15 out of 18 super-modules (SMs) are now installed. In a very successful operation on 19-27 May 2014, SM #12, #13, and #14 were installed. In order to install the TRD modules at the bottom of the space-frame, the base of the mini-frame that holds services on the A-side of the detector had to be removed and a suspension jig had to be installed to hold the mini-frame during this operation. After each installation step, a survey of the beam pipe was performed and the net displacements were verified to be < 1mm. The Time-of-Flight (TOF) and TRD showed no detectable displacements with respect to the space frame. ALICE reported that this critical installation went very smoothly and proceeded faster than expected. One TRD super-module was repaired and is waiting for installation. A counterweight was inserted in one of the two empty slots on top of the frame to prevent deformation of the entire space frame support structure. It is still an open question whether the two missing modules can be manufactured and installed during LS1. Should they not arrive before the end of LS1, they will need to be installed during the winter shut-down in 2015.

Five of the eight Di-jet Calorimeter (DCAL) modules are installed by now. The remaining three are at CERN and will be inserted together with the four PHOS modules, which are still being modified to adapt to the upgraded Electromagnetic Calorimeter (EMCAL) read-out electronics. The Photon Spectrometer (PHOS) upgrade includes modification of all front-end cards, new Trigger Control Units (TRUs) and changing from RCUs to SRUs. Work on the PHOS detector is progressing well but remains a critical item. The first PHOS module (M2) is completed and is undergoing final tests. The plan is to complete M1 at the beginning of July 2014 (week 28), M3 at the end of July 2014 (week 31), and M4 at the end of August 2014 (week 35). ALICE has established weekly meetings in order to track progress and identify possible show-stoppers.

The PHOS, PMD, ADA-C, ZEM and ZDC detectors are still removed from the main detector. All other detectors are in place. The RB24 beam pipe and compensator magnet were removed; the central beam pipe is under neon.

The upgrade of the SAA3 wall is well under way. Located on the RB26 side, it was originally installed in order to protect the ALICE detectors from background entering from the away-side of the muon arm. The wall needed to be extended to provide further shielding. The new support structure is completed. All shielding blocks were delivered to P2 and completion is expected in June.

All PMTs of the V0-A interaction trigger have been successfully replaced and tested. The Muon Trigger (MTG) gas consolidation is ongoing. In order to fix gas leaks the peek
piping close to the gas inlets and outlets are being replaced by flexible tygon piping. The plan is to start re-circulation already at the gas start-up in December 2014. New shower counters for the ALICE diffractive physics program were successfully installed in the RB26 tunnel. ALICE’s new Run Control Centre (ARC) is almost complete. Renovation was finished in May 2014 and the installation of PCs and new screens is ongoing. The room needs to be ready for use in mid-June 2014 when the DAQ upgrades are completed and the system is back.

In order to improve stable operation and increase the data rate of the TPC readout, ALICE planned to upgrade the RCU to a new version, referred to as RCU2. The aggressive time plan originally envisioned mass production of the RCU2 units to be done by June/July 2014, with installation starting in September 2014. The first RCU2 prototypes became available in May 2014 and were shipped to TSL in Uppsala for irradiation testing. During these tests several potential problems were discovered. One of the main FPGAs (SmartFusion2) suffers from single event latch-ups. Tests showed that lowering the core voltage helps (1.1 V tested, 1.0 V test to come) extending the projected mean time between failures for the innermost TPC from 2.5h to 12.5h hours for 216 RCUs under expected Run II conditions. The latch-ups occur in the slow control part of the FPGA and do not affect the data or harm the device. A full power cycle of the FPGA is necessary to recover from these occurrences. Furthermore, the tests at TSL showed that after irradiation with a few kRad, the FPGA could not be re-programmed any more, although the board remains functional. Last but not least the TTC optical receiver and Clock and Data Recovery (CDR) show an unacceptable error rate after irradiation of the optical receiver. At the moment it is unclear whether the optical receiver or the CDR is the weak point. ALICE is currently testing alternative CDRs using a dedicated chip on the RCU. The original parts of the TTC system (Truelight TRR-1B43-000 and TTCrx chip) are not available anymore. If the alternatives optical receivers (such as Avago HFBR-2316TZ) work with the new test clock data recovery circuits (Analog Devices ADN281) then no modification of the RCU2 design would be necessary.

Currently, functionality tests and preparation for a second beam test on 10-11 June 2014 at TSL are ongoing. The green light for the RCU2 production could still be given in June 2014. The new backplane prototypes work according to expectations and are ready for production. ALICE is considering several different installation scenarios including plans for a second RCU2 prototype cycle. Since installation of the new RCU2 has to be completed before Christmas 2014, the Collaboration considered this a very critical item.

ALICE presented their re-commissioning schedule for LS1. Global runs to start exercising the various systems will commence in July 2014. At the beginning of September 2014 detector shifts will start and in November 2014 the L3 magnet will close, allowing first runs with magnetic field in mid-December 2014. Depending on the status of the RCU2, commissioning of the new read-out will take place in January 2015.

Upgrades

To-date ALICE has submitted three Technical Design Reports (TDRs) for approval by the LHCC. The Inner Tracking System (ITS) TDR is recommended for approval after passing the UCG review successfully. The Trigger & Readout Upgrade TDR is now with the UCG and the TPC Upgrade TDR, submitted during the last LHCC meeting in March 2014, is under review by the LHCC.
At the meeting with the LHCC referees, ALICE presented updates on the ongoing R&D efforts on the TPC read-out chambers, as well as the status of the Muon Forward Tracker (MFT) and the Online+Offline (O2) TDRs.

On 14 April 2014 the LHCC submitted to ALICE a document with detailed questions and comments on the TPC TDR. This document included comments from external reviewers (Gene Van Buren (BNL), Leszek Ropelewski (CERN), Maksym Titov (Saclay), and Howard Wieman (LBL)). ALICE provided a first set of detailed answers to the LHCC’s questions and reported on ongoing R&D efforts:

- A complete scan of the 4 GEM S-LP-LP-S stack (S=standard pitch GEM, LP=large pitch GEM) option was completed. No improvements relative to the working points in the TDR in terms of ion backflow (IBF) and resolution were found.
- The S-S-LP-S option was optimized and improvements with respect to the results presented in the TDR were achieved. However, this configuration is still inferior to the nominal S-LP-LP-S stack in terms of IBF and resolution.
- ALICE is now working on the implementation of new small pitch (SP) GEM foils (90 μm) as well as medium pitch (200 μm) foils.
- Surprisingly good results were achieved in a first test of a small 4 GEM S-S-LP-SP prototype. In fact, the observed IBF of 0.5% at a resolution of σ=12% is the best value obtained in a 4-GEM system so far. Further tests with a larger prototype will follow soon.
- R&D efforts on a 2 GEM+MicroMegas solution are ongoing. Current tests give an IBF of 0.15-0.2% at resolutions of σ=11-12%. Studies of the validation of the performance of this setup are underway. ALICE is preparing for test beams with a large prototype at the end of the year.

Overall ALICE presented an impressive amount of new results from ongoing studies of gain uniformity, foil variations, ion back flow in magnetic fields, discharge probability, ion mobility, tracking performance, and dE/dx. The LHCC congratulates ALICE on these accomplishments.

Work on the TRD for the MFT is progressing well. Much effort went into the work on the stand-alone tracking using a cellular automaton. Track finding efficiencies of ~98-99% for $p_T > 0.3$ GeV/c are achieved with a single track pointing resolution of ~40 (70) μm in the transverse plane (z axis) for $p_T > 2$ GeV/c. Next steps include further optimization and especially improving the MFT/MCH matching efficiency at low $p_T$. Improved radiation calculations with FLUKA are now available. ALICE is working on the realization of “Full Scale Building Block” (FSBB) prototypes, i.e., sensor prototypes with almost all functionalities and close-to-final sensor design (final size for ALPIDE, 1/3 for ASTRAL). Several prototypes of Flexible Printed Circuit (FPC) boards were produced and are under test. However, the completion of the FPC studies is closely linked to the architecture selection and can only be finalized after the decision on the final MAPS architecture is made (expected in December 2014). Since ALICE has now settled on the final beam pipe design, the MFT group is now optimizing the sensor positioning. In parallel, the read-out mapping of the different configurations is being
studied. Studies of the ladder assembly are done in collaboration with the Inner Tracking System (ITS) project at CERN. First assembly and bonding tests on dummy ladders are underway and procedures for half-disk and half MFT assembly are being developed. The challenge here is to optimize the layout in the available (tight) space between the planned Fast Interaction Trigger (FIT) and the ITS. Design of barrels, cones, and detection plane structures has started. The expected power consumption is 338W/sensor and 500W/PCB. Should this estimate hold, the sensors would be air cooled while water-cooling for the PCB could be necessary. The MFT group plans to submit their TDR in December 2014.

Work on the Online+Offline (O2) TDR is ongoing. The group is currently performing data-flow simulations to define network requirements and system dimensioning. Current estimates show the need for 25 PB of local disk storage to temporarily hold one year’s worth of data. Studies of different computing platforms are underway using the ITS cluster finder as a test case for optimization. A prototype farm consisting of 8 machines and 10/40 GB networks is currently set up. Members of DAQ, HLT, Offline, and FairRoot teams will provide the software framework. For Run III ALICE is planning to develop, in collaboration with GSI/FAIR in Germany, a new software framework called ALFA, which is capable of utilizing hardware accelerators such as FPGA, GPU, MIC, and will provide support for concurrency and a distributed computing environment.

Due to the widening of the scope of the project, the need to integrate new institutes, and the need for more work on design and simulation to optimize the cost, ALICE intends to postpone the submission of the TDR until Summer 2015.

12. DISCUSSION WITH TOTEM

The review of TOTEM's status focused on three main topics: the Long Shutdown 1 (LS1) work and preparation for Run II, the upgrade project with CMS and the vertical timing upgrade project.

In addition, the LHCC learned that the first results of the joint CMS-TOTEM run performed during a dedicated run in 2012 have been submitted for publication. This analysis of the pseudorapidity distribution of charged tracks, overall a range extending out to $\eta=6.5$, provides valuable and unique input for the improvement of the QCD event generators, used for event simulation at the LHC and for the study of high-energy cosmic ray interactions. The LHCC congratulates CMS and TOTEM for this landmark achievement.

The consolidation work is making excellent progress and is on schedule. In particular, all the work needed to correct the ferrite-related problems reported during the March 2014 LHCC has been completed on time. One issue has nevertheless appeared since: the detection of anomalous outgassing during the vacuum test of the set of the two Roman Pot detectors allocated to the 210 m position in sector 5-6. The measurement will be repeated on each of the two detectors separately. This is not judged to be a critical issue, and should not compromise the schedule of the remaining installation and commissioning steps of the Roman Pot detectors. Work packages related to the installation of the new cylindrical Roman Pot, necessary for the joint CMS-TOTEM upgrade project, are proceeding according to plan.
All work packages related to the T1 and T2 detectors are on schedule. The re-installation plan for T1 is already incorporated in the overall CMS planning, and is scheduled for the first week of November 2014. The DAQ consolidation work is also proceeding smoothly, and a factor of 20 improvement of the trigger rate capability with respect to the Run I performance (to 20 kHz) has been verified. Tests with CMS, to validate the compatibility with CMS's DAQ system, are being scheduled.

While a great deal of work remains to be done before the end of LS1, no critical item is currently reported. The LHCC congratulates TOTEM for the overall progress in this area.

The management structure of the joint CMS-TOTEM upgrade project for a Precision Proton Spectrometer has been put in place, including the formation of the project Institution Board. So far this includes 6 TOTEM institutes, committed to work on the project. A first draft of the layout of the upgrade Technical Design Report has been shown to the LHCC. The LHCC looks forward to a progress report at its next session.

Work is proceeding also towards the TDR for the construction of vertical timing detectors for the vertical Roman Pots. This TOTEM upgrade will allow data taking for diffractive studies, using a $\beta^*=90^\circ$ optics, at luminosities a factor of 10 larger than currently feasible.

It is expected that the TDR will be completed by September 2014, on time for release to the LHCC by the time of its next session. It will incorporate the discussion of test beam studies performed on the prototypes during the Summer 2014 (in June at PSI, and in July at the PS). The TDR will include the cost and schedule of the project, and a detailed study of the physics performance, in relation to the proposed physics programme, and in relation to the possible LHC running scenarios.

The LHCC acknowledges the need of special runs dedicated to the commissioning of the $\beta^*=90^\circ m$ optics, and will support the requests for special runs dedicated to the physics. The LHCC recommends a general coherence and coordination of the requests coming from the various experiments, in view of an optimal use of LHC time.

In the context of the overall LHC programme of upgrade projects and special runs dedicated to forward and diffractive physics, the LHCC took note of the status of the work of the "LHC Forward physics Working Group". The Working Group will report during the September 2014 LHCC session on the physics opportunities of this programme, and on the implications of its various elements for the LHC running conditions. This report will serve as a basis for the LHCC discussion of the proposals for special runs that will come from TOTEM and from the other experiments.

13. DISCUSSION WITH MoEDAL

MoEDAL is an experiment designed to search for highly ionizing particles at the LHC (monopoles/dyons) as well as stable and pseudo-stable singly- and multi- charged heavy particles. The detector is based on track-etched detectors and is housed in the LHCb Vertex Locator (VELO) cavern. The MoEDAL detector is made of an array of plastic low threshold (5 MIPs) Nuclear Track Detectors (NTDs) for a total surface of 10 stack sheets of 25 m each, the largest passive array ever deployed at an accelerator. Three layers of light flexible NTD foils, with higher threshold (50 MIPs), compose the Very
High Charged Catcher (VHCC) in order to increase the acceptance. The Magnetic Monopole Trapper (MMT) is an array of Al trapping volumes deployed to stop magnetic monopoles and other very high ionizing particles. The TimePix Radiation Monitor measures the radiation background in real time.

The LHCC was informed by the MoEDAL Collaboration on the progress made in scanning and analysis of MOEDAL NTD’s. A new high-rate optical scanning microscope has been obtained and further developed by one of the groups of the Collaboration, able to scan 100 cm² in only 40 minutes. In general, a large effort has been put in the analysis software in collaboration with LHCb software group. Ten papers and proceedings are in preparation by the MoEDAL Collaboration.

The Committee received a detailed plan for the upgrade of the detector during LS1 to add plastic arrays in some areas that were not previously instrumented, to relocate part of the Al trapping detectors, to add some TimePix detectors and finally to install the new low-mass, low-radiation-length NTDs. Detailed discussion has been presented on the High Charge Catcher (HCC) to be installed on the downstream face of the TT silicon tracker in the acceptance area of the LHCb detector. This will impact in terms of radiation length in front of the LHCb tracker for 0.16% of a radiation length. This installation has already been agreed with LHCb as well as the installation schedule.

14. REPORT AND DISCUSSION WITH THE LCG REFEREES

Introduction

The document “Update of the Computing Models of the WLCG and the Experiments” has been released in April 2014. It presents the computing models and serves as reference for further developments and needs. The simulation and analysis systems are stable and various improvements have further enhanced the ability of the experiments to produce physics results. In addition, a rich development programme is oriented towards Run II, in connection to the new configurations and physics requests, and also influenced by the pressure for flat resources in the next years. Finally, longer term projects emerge around the plans for upgrades Phases 1 and 2, and plans are being realized, at various levels, to prepare the design of the computing for the high luminosity phases at LHC.

Experiments and WLCG

ALICE

ALICE observed steady operations in the past 6 months. The share of the organized analysis has increased from 10% to 16% and now largely dominates the analysis flux. In this context, the overall efficiency has increased to over 90%, also benefiting from a software adjustment related to data access. Gradual software and infrastructure upgrades are pursued towards Run II in order to face the expected challenges: 25% larger raw event size, additional detectors, higher track multiplicity with increased beam energy and event pile-up. Various reprocessing campaigns are imminent (2011 pp, 2012 pp and pPb...
Cosmics trigger data taking will start in September 2014. The preparations for detector upgrades are ongoing. The Technical Design Report on integrated computing is delayed by one year to allow for more studies. Major demands on resources are expected towards the end of 2015 (Pb-Pb data taking).

**LHCb**

LHCb operates successfully, with no major issues. The Tier-1 in Russia is being commissioned. Various re-processings are planned (2011 including legacy stripping). The preparations for Run II are in full swing: the High Level Trigger (HLT) preparation for inter-run usage as well as various software updates. Concerns were expressed about the assumptions for resource planning, in particular about the LHC schedule and integrated running time. These parameters are at present not fully fixed. For the upgrade preparation the required software improvements are in line with the strategy outlined in the recently released paper. New person power has to be found within the Collaboration. Data collection rates for the upgrade phase are still under discussion and major model reconfigurations may be necessary.

**ATLAS**

ATLAS activity is driven by intensive analysis, as for other experiments. While Monte Carlo jobs dominate the CPU usage, the data traffic is driven by user requests. HLT runs regularly with burst above 20,000 jobs concurrently, and is expected to add a few percent to the total computing capacity during intensive data taking as expected in Run II. A systematic investigation on data usage has started and reveals interesting features of the data access: for example 22 Pb out of the analysed 55 Pb have not been accessed in the last three months. More investigations are needed in order to arrive at clear conclusions concerning potential optimizations of data managements, but this exercise is clearly very useful. In parallel, a discussion on the sharing between transient and permanent data types and flows has been initiated. A new reconstruction software release is in final validation step for the data challenge DC-14, with the objective to reach a three-fold CPU speed-up. The preparation of the new analysis model is on track as well. DC-14 will be the first large-scale production of new data formats (xAOD) and the user community is being prepared to make the transition to the new analysis model.

**CMS**

CMS uses intensively the available resources (Tier-1 125% / Tier-2 98%) with high efficiency, including large amounts of simulated events (650 Mevents/month) as well as analysis level data format (AOD 1 Bevents/month). The experiments started to test the Agile Infrastructure at CERN (VM, IaaS) building on previous HLT experience. Significant progress on data federation project has been achieved, with access to 20% of the data across wide area, 60k files/day, $O(100TB)$/day and a sustained file open access of 200 Hz. The Computing Software and Analysis Challenge (CSA14) is scheduled for the Summer 2014 with all the key components in place. In particular, users will perform analysis exclusively using CRAB3 and Data Federation and Dynamic Data techniques and the production will exercise access through data federation. Recent progress has been achieved in various areas, in particular a 17-30% improvement in simulation speed by using Geant 4.10 and the first successful tests of a multi-threaded framework. A production milestone is planned for end October 2014. A systematics analysis of data placement and access is foreseen, similar to the investigation of progress in ATLAS.
The WLCG included recently new sites from Korea, Latin America, Pakistan and Russia. The Wigner centre in Budapest is now in production, with about ~1000 nodes and scaled disk, and similar efficiency as CERN. The EMI middleware support pledges limited to one year, with some area endorsed by the original producers (INFN, CERN, NDGF products will be supported). The ARGUS – SWITCH systems are supported on best-effort basis only and needs support for evolution (identify feds, clouds, etc.). The gLite security products need clarification as well. The resources request were analysed and endorsed by the Computing Resources Scrutiny Group (CRSG). Possible tensions with the flat budget hypothesis have been noted and need to be carefully monitored in the future, in particular by promoting an enhanced feed-back from the collaborators and from the funding agencies during the pledges and procurement processes. In particular, a multi-annual pledges process has been mentioned. The discussions around a wide HEP Software Collaboration have started and a second workshop is foreseen in autumn.

Summary

The LHC experiments and WLCG should be congratulated for continuing to maintain a very successful computing leading to high publication rates. Intensive analysis activities and energetic preparation for Run II are pursued by all experiments and are efficiently supported by the WLCG team. Significant changes are already implemented as planned in the released computing document. Important milestones will be completed in the second half of this year. Given the on-going model optimizations and the amount of computing needed for the start of the data taking, the availability of resources is critical for the next year. More efforts to optimize the computing models and to save resources are in progress, for instance in data placement and cleaning, software, agile infrastructures, etc. The experiments start to figure out how to proceed towards the computing for the upgrade phases. Discussions around a HEP software collaboration have started and represent an opportunity to enhance the cooperation within HEP and beyond.

15. REPORT ON RD39

The RD39 Collaboration is a small group consisting of 23 physicists from eight institutions that works on the development of highly radiation-hard silicon sensors operated at cryogenic temperatures for use as beam loss monitors at the LHC. More recently the group has extended its activities towards diamond detectors operated under the same conditions. Presently, the Collaboration has installed six silicon sensors and two diamond sensors inside the cryostat near the LHC dipole magnet. Radiation hardness studies indicate that these detectors should survive the radiation environment. The performance of the sensors will be tested in Run II. The goal is to eventually install 2,000 sensors in the LHC machine. While the activities towards beam loss monitors are acknowledged, the overall annual progress has been slow and is feared to slow down further given the notice that the main active person will no longer continue. The LHCC is concerned about the progress of this group. The LHCC supports and recommends to the Research Board the activity on beam loss monitoring for the next year. Given the size of the group and the slow progress, the LHCC reiterates its suggestion to merge with one of the bigger RD collaborations (RD42 or RD50).
16. REPORT ON RD42

The LHCC heard a report from the RD42 Collaboration on its ongoing programme to develop intrinsically radiation-hard Chemical Vapor Deposition (CVD) diamond tracking detectors for experiments at high-luminosity colliders. The Collaboration has grown to about 127 participants from 33 institutions. The two main technologies being pursued are poly-crystalline CVD (pCVD) and single-crystal CVD (scCVD) diamonds. Identifying a reliable supplier of high-grade devices has been a persistent problem. There are currently two suppliers, Element-6 (E6) of the U.K. and II-VI of the U.S., which can meet RD42’s specifications. The state of the art in pCVD production currently produces wafers with a charge collection distance exceeding 500 µm (as grown), which decreases to 300 µm after wafer processing.

Building on the success of the ATLAS diamond Beam Conditioning Monitor (BCM), which was used as the standard luminosity monitor at the end of Run I, the Collaboration has been heavily involved in the construction of the ATLAS Diamond Beam Monitor (DBM). The DBM consists of four 3-plane pixelated pCVD diamond stations on each side of the ATLAS experiment. Module construction experienced setbacks due to bump bonding and thermal cycling issues. Bump bonding of the modules was performed at IZM-Berlin but many modules had to be reworked due to connectivity issues. Moreover, some modules had to be replaced because they developed connectivity issues after thermal cycling. Although at the beginning of the project there was only one supplier, E6, the RD42 group successfully developed a second supplier in time for the DBM project. This is a major achievement of the project. Having a second supplier available allowed them to successfully overcome the bump bonding issues and as a result half of the sensors were supplied by E6 and half by II-VI. The RD42 group successfully removed a single-point failure in the DBM project and completed the project on time. The DBM has been installed in the ATLAS experiment and is a clear success exploiting the synergistic relation with the IBL project.

RD42 has also been supporting the Pixel Luminosity Telescope (PLT) for CMS. The PLT is a dedicated stand-alone luminosity monitor that provides a high precision bunch-by-bunch measurement of the luminosity. It consists of an array of three planes of eight pixel sensors each at either end of CMS. scCVD sensors were operated during a pilot run in the CASTOR region, 14.5m from the interaction point, and were exposed to 20 fb⁻¹ of data. The sensors showed a drop in signal at high rate, which could be recovered by increasing the bias voltage. The rate dependence is attributed to the build-up of a polarization in the sensors. The observation of this effect has led CMS to switch from scCVD diamond detectors to silicon detectors for the PLT. Beam tests at PSI are currently being conducted by RD42 to understand these effects. Early results show that irradiated scCVD diamonds show rate dependence, whereas irradiated pCVD diamonds do not show any rate dependence. These studies, however, have been limited to rates of 335 kHz/cm² and will be extended to rates exceeding 1 MHz/cm².

The role of the RD42 Collaboration in developing pixelated diamond sensors for the community is well established and its benefit to the community has been clearly demonstrated. The Committee wishes to congratulate the RD42 Collaboration on the success of completing the ATLAS DBM. The area where the Collaboration seems to be lagging is in the publication of its results and expeditious publication is strongly encouraged.
The LHCC considers that the proposed research programme for next year is reasonable and strongly encourages timely publication of its results. The future research programme includes further irradiation studies and the characterization of irradiated samples; continuation of the validation of reliable production of high-quality diamond sensors at high capacity; and continued overall support of the LHC upgrade pixel projects. In order to continue their research programme, the RD42 Collaboration requests that the CERN RD42 group be maintained at the current level. The Committee notes that the RD42 research programme immediately benefits the LHC experiments and fully supports and recommends to the Research Board its continued research programme.

17. REPORT ON RD50

The RD50 Collaboration conducts R&D on Radiation hard semiconductor devices for very high luminosity colliders involving 275 physicists from 49 institutes. They are structured into four sub-groups that work on defect/material characterization, detector characterization, new structures and full detector systems. They have produced many key results in the past year. These include the understanding of microscopic defects, achieving good progress on TCAD simulations, performing systematic analyses of the charge multiplication mechanism, consolidating data obtained on p-type Silicon and thin segmented sensor. Slim and active edges, studying new structures based on mixed technologies, and using tools developed in the framework of RD50. They have a very active programme for the next years. Particularly ATLAS and CMS have profited from this work and will use n-on-p sensor for the upgrade. The LHCC fully supports the work of RD50 and recommends to the Research Board that RD50 continues in this pace. The LHCC also recommends the Collaboration to extend their R&D to HVCMOS technology, which carries the potential to become a major technology for the Phase-2 upgrade of ATLAS and CMS. Remaining issues of the technology for possible application at the LHC should be rigorously addressed such that a technology comparison can be made.

18. REPORT ON RD51

The LHCC heard a report from the RD51 Collaboration on its progress and plans to develop advanced gas-avalanche Micro-Pattern Gas Detector (MPGD) Technologies. The RD51 Collaboration aims to facilitate and advance the technological development of MPGDs and associated electronic read-out systems for applications in basic and applied research. The group serves as an access point to the MPGD technology for the worldwide community and its research focus has been on the development of techniques for detectors in high-rate environments while improving the space-point resolution and the radiation hardness of the detectors.

The Collaboration has more than 500 people from 91 institutes organized around seven working groups. The main technologies being pursued are Micro-Mesh Gas Detectors (Micromegas), thin and thick Gas Electron Multiplier (GEM) devices, and micro-pixel chambers. The deployment of the MPGD technology in running experiments has increased substantially and RD51 serves a very broad user community.
The Committee took note of the numerous RD51 achievements. Recent support for LHC-related activities includes development of Micromegas for the ATLAS muon system upgrade, GEMs for the CMS muon system upgrade as well as GEMs for the ALICE TPC upgrade. The developments of the Scalable Read-out System (SRS) electronics over last year was considerable with ~30 experimental groups procuring elements of this system and ~20 more orders in the pipeline with 27 students attending SRS electronics school this year. The RD51 activities have been shown to have direct relevance to the LHC experiments as the RD51 MPGD technology is being demanded for the LHC experiments upgrades.

The referee also reported on RD51’s plans for beyond 2014. The plans include continuation of R&D support for the LHC experiments and their upgrades; generic R&D; development and maintenance of software and simulation tools; development and maintenance of software of SRS electronics; industrialization of the MPGD technology; maintenance and extension of the RD51 laboratory and test beam infrastructure; efforts in education and training for MPGDs; and the organization of a series of specialized workshops.

RD51 is a successful R&D Collaboration with well-defined and important future plans. The RD51 Collaboration is asking LHCC to recommend continuing limited support of the collaboration by CERN including access to RD51 test beam facility, access to the CERN printed-circuit workshop (similar to present availability level), providing limited extra office and laboratory space for students and users of RD51, and continuing access to the central computing resources for simulation. In view of the above and given the modest request for resources for further work, the referees recommend to the Research Board that the RD51 R&D project be continued and for CERN to continue to provide the limited requested support to the Collaboration.

19. REPORT ON RD52

RD52 is a small R&D effort (12 institutes, 23 people) dedicated to a 'dual read-out' approach aimed at improving the resolution of hadron calorimeters for future collider detectors. Several prototypes have been developed over the years and deployed in test beams. Initial results were shown from the most recent RD52 prototype. The Collaboration wishes to enlarge the prototype, to reduce shower leakage out of the acceptance, and take further test-beam runs at CERN. As of this moment the dual read-out approach has not been adopted by any LHC experiment for the upgrades or by the detector concepts for ILC and CLIC. The LHCC supports and recommends to the Research Board that the Collaboration continues for a next round of test-beam data-taking with an improved prototype, and looks forward to a report on the progress made in the next RD52 presentation.

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1 RD52 has also been reviewed by the SPS Committee (SPSC) as a generic calorimeter activity. The Research Board decided in its meeting in June 2014 to leave the thorough review to the SPSC until an application to one of the LHC experiments emerges.
20. REPORT ON RD53

This was the first status report to the LHCC of the RD53 Collaboration. Creation of the RD53 Collaboration was approved during the 114th LHCC session in June 2013. The objective of this RD group is to develop pixel read-out integrated circuits for extreme rate and radiation environments, such as the HL-LHC and a linear collider, using the 65 nm CMOS technology as the baseline. There are unprecedented challenges for the vertex detectors at these new facilities. They must be able to withstand radiation levels up to 1 GRad and $10^{16}$ 1 MeV neutron equivalent/cm$^2$, require small pixels (~50x50 µm$^2$), large reticle size, hit rates up to ~2 GHz/cm$^2$, and triggering capability up to 1 MHz, combined with the “standard” requirements of low power and low mass. The goal is to have a full-scale demonstrator pixel chip within the three-year R&D programme of RD53.

The Collaboration currently consists of 19 institutions with about 100 collaborators, about half of which are ASIC designers. The group has quickly self-organized around six working groups with well-defined goals and leadership. Only the I/O working group still lacks a convener. Radiation tests, qualification of the baseline technology, and verification of the behaviour with simulation tools, are some of the most critical elements of the R&D programme. The radiation test program has evaluated both analogue and digital test structures in the 65 nm technology. Good progress in understanding radiation damage is being made, but many open questions remain. The working group on ASIC building blocks – such as RAM, PLL, ADC, DAC, power conversion – has started the design of these so-called IP blocks, addressing the integration into mixed-signal design flow for final pixel chip designs. Given the complexity of these chips, reliable simulations tools are indispensible. The simulation and verification framework for these complex pixel chips has been defined, based on the industry standards Verilog and UVM.

The code has been benchmarked using the FEI4 design and a basic version of the framework is available. Integration with ROOT is foreseen to enable importing hits from detector simulations and for monitoring and analyzing results. The goal is to have a detailed reference model of the pixel chip that will allow verification of final design through simulation.

The Collaboration has well-defined goals. Radiation tests will be ongoing this year and a first common multi-project wafer (MPW) run is planned for the end of the current calendar year that will test first versions of IP blocks and front-end designs. MPW runs are foreseen for each of the subsequent years converging on a verified, radiation hard, and extensively simulated design of all components for the pixel detectors for the HL-LHC.

The Committee would like to congratulate the RD53 Collaboration with a very quick and efficient organization of the collaboration, which has been noticed by the community through invitations at major technical conferences. The LHCC recommends to the Research Board that RD53 be continued for two years beyond 2014. The Collaboration is encouraged to explore the use of emerging HV-CMOS pixel sensor technology together with pixel readout chips developed in RD53.

21. CLOSE-OUT WITH THE DIRECTOR-GENERAL
The LHCC informed and discussed with the Director-General the status of the experiments and their plans for the future. The discussion concentrated on the status of the LHC machine and experiments, the activities during LS1, the upgrade of the experiments and the status of the R&D projects. The discussion also included the report from the Particle Physics Project Prioritization Panel (P5) in the U.S.

22. REFEREES

The LHCC referee teams for this session are as follows:

ALICE: J.-C. Brient, T. Ullrich (Co-ordinator), P. Newman
CMS: A. Boehnlein (Co-ordinator), M. Demarteau, D. Denisov, H. Yamamoto
LHCb: C. Diaconu, G. Eigen, S. Miscetti (Co-ordinator)
LHCf, MoEDAL, TOTEM: U. Bassler, C. Cecchi, M. Mangano (Co-ordinator)
LCG: A. Boehnlein, J.-C. Brient, C. Diaconu (Co-ordinator)
Experiment Upgrades:
   General: J.-C. Brient, M. Demarteau (Co-ordinator)
   RD39: G. Eigen
   RD42: M. Demarteau
   RD50: G. Eigen
   RD51: D. Denisov
   RD52: P. Burrows
   RD53: M. Demarteau

23. The LHCC received the following documents:

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
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<tbody>
<tr>
<td>CERN-LHCC-2014-001</td>
<td>LHCb Tracker Phase-1 Technical Design Report</td>
</tr>
<tr>
<td>CERN-LHCC-2014-014</td>
<td>Update of the Computing Models of the WLCG and the LHC Experiments</td>
</tr>
<tr>
<td>CERN-LHCC-2014-016</td>
<td>LHCb Trigger and Online Upgrade Technical Design Report</td>
</tr>
<tr>
<td>CERN-LHCC-2014-019</td>
<td>ALICE Trigger and DAQ Phase-1 Technical Design Report</td>
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<tr>
<td>CERN-LHCC-2014-020</td>
<td>ALICE Time Projection Chamber Phase-1 TDR</td>
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<tr>
<td>CERN-LHCC-2014-017</td>
<td>UCG Report on the LHCb Tracker Phase-1 TDR</td>
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DATES FOR LHCC MEETINGS

Dates for 2014
24 - 25 September
19 - 20 November