OPEN SESSION - Status Reports

1. LHC Machine Status Report: Frederick Bordry
2. CMS Status Report: Gianluca Cerminara
3. ATLAS Status Report: Andreas Salzburger
4. LHCb Status Report: Edwige Tournefier
5. ALICE Status Report: Peter Christiansen
6. TOTEM Status Report: Jan Kaspar
7. LHCf Status Report: Gaku Mitsuka

CLOSED SESSION:


* part-time
** by phone

Apologies: B. Gorini, R.-D. Heuer

1. EXECUTIVE SUMMARY

ALICE


The LHCC proposed additions to the Technical Design Report (TDR), which concern the integration of the numerous trigger and readout systems, in order to allow a concluding assessment in the LHCC session in June 2014. At the same time, the LHCC suggested to limit the evaluation of the resources to the Muon tracking Chambers (MCH) / Muon Identifier (MID) and Fast Interaction Trigger (FIT) systems to keep the work manageable for the UCG.

- The LHCC received the TDR and remained concerned about the lack of system tests and recommends further simulation and prototyping in test beams, including various gas amplification stages and technologies in parallel to the baseline, which uses a 4-layer Gas Electron Multiplier (GEM). Discussions continue and will be intensified over the coming period.

ATLAS

Inner B-Layer (IBL)

- The LHCC is pleased to see the corrosion problem of several wire bonds comprehensively addressed. Full installation of the detector seems feasible at this stage.

CMS

- CMS and TOTEM have signed a Memorandum of Understanding and implementation plan for a joint Precision Proton Spectrometer physics programme.

- An overview of the elements of a Technical Proposal for Phase 2 upgrades was presented with the goal of submission in September 2014. Much of the discussion focused on R&D and calorimetry options for the forward direction.

LHCb

- The LHCb TDRs for the Vertex Locator (VELO; CERN-LHCC-2013-021) and Particle Identification Detector (PID; CERN-LHCC-2013-022) were recommended for approval by the LHCC.

Tracker Upgrade Technical Design Report (CERN-LHCC-2014-001)

- The LHCb Tracker Upgrade comprises two trackers, a Scintillating Fibre Tracker (SciFi) and the Upstream Tracker (UT). Initial discussions on the TDR have taken place and further evaluation will follow to enable conclusion at the LHCC session in June 2014.

TOTEM

- The LHCC is pleased with the signing of the Memorandum of Understanding by CMS and TOTEM for a common upgrade project.

- Completion of the TOTEM consolidation project and of the preparatory work for the CMS-TOTEM upgrade is making good progress. No outstanding technical issue is reported, but completion of the necessary installations before the deadlines is on a critical path.

- The LHCC welcomes the progress towards the deployment of vertical timing detectors for the latter part of Run II, and requests TOTEM to provide a complete TDR, which should include an assessment of the physics performance.
LHCf
- The collaboration between LHCf and ATLAS is proceeding well and the Committee encourages continued discussions.

Upgrade Cost Group (UCG)
- The LHCC received reports on costs and risks from the UCG on the following TDRs:
  o ALICE Inner Tracking System (ITS) (CERN-LHCC-2013-024)
  o ATLAS New Small Wheel (NSW) (CERN-LHCC-2013-006)
  o ATLAS LAr Trigger (CERN-LHCC-2013-017)
  o ATLAS Trigger/DAQ (CERN-LHCC-2013-018)
  o LHCb Vertex Locator (VELO) (CERN-LHCC-2013-021)
  o LHCb Particle Identification (PID) (CERN-LHCC-2013-022).

The UCG recommends approval of these TDRs. Specific assessments are available.

WLCG
- The document presenting the update of the computing models of the WLCG has received final comments from the LHCC and the release of the document is imminent.

2. PROCEDURE
The Chairman welcomed P. Newman to the Committee.

The minutes of the one-hundredth-and-sixteenth LHCC meeting (LHCC-2014-002/LHCC116) were approved.

3. REPORT FROM THE DIRECTOR FOR RESEARCH AND COMPUTING
The Director for Research and Computing reported on issues related to the LHC. He reported that the work for the Long Shutdown 1 (LS1) is advancing well for both the machine and the experiments. He underlined, that due to the extensive work of LS1, substantial re-commissioning will be required. He also reported on discussions at the Resource Review Boards (RRBs). The Phase 1 upgrades of the experiments have been accepted and are being followed-up by the LHCC. Phase 2 is being discussed in light of the physics results coming out of the LHC and the available resources from the Funding Agencies. For the LHC computing, a resource-loaded road map is being put together assuming constant funding. GEANT4 is being updated through external collaborations. Finally, he reported that the study for the Future Circular Collider (FCC) was launched in February 2014 and is open to international collaboration.

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, i.e. following the Long Shutdown 1 (LS1). They reported on the preparations for the sector tests and the commissioning of the LHC accelerator. Discussions are underway to co-ordinate the activities of the LHC experiments and those of the machine so as to minimize any conflicts during the period of Run II preparations. The Co-ordinators also reported that discussions are ongoing regarding machine requirements for the LHCf physics runs and for the ATLAS luminosity measurement, and they also commented on the procedures being set up for the LHC machine to operate with 25 ns bunch spacing.
5. REPORT & DISCUSSION WITH LHC EXPERIMENT UPGRADE REFEREES

In preparation for the March session of the LHCC, the Committee received two TDRs. The ALICE experiment submitted the TDR for the Time Projection Chamber (CERN-LHCC-2013-020) and LHCb presented the Tracking TDR (CERN-LHCC-2014-001). The Committee congratulates both experiments on the submission of these well-written TDRs.

The LHCb Tracker upgrade consists of the replacement of two existing systems: the Trigger Tracker (TT), and the three downstream tracking stations T1, T2 and T3 (T-Stations). The silicon-strip-based TT will be replaced with a new silicon-strip-based Upstream Tracker (UT). The T-stations, currently using straw tubes for the outer stations and silicon strips for the inner stations, will be replaced with a single scintillating fibre technology. The upgrade is motivated by the 40 MHz readout requirement. The upgraded detector is fast enough for pattern recognition in the High-Level Trigger (HLT). Furthermore, occupancies and radiation damage can be kept in check with the upgrade and the overall performance improved. A track finding efficiency exceeding 99.9% is targeted for the upgrade. The formation of a track trigger, using the magnetic field between the Vertex Locator (VELO) and UT will also be made possible with this upgrade, with a momentum measurement of $\Delta p/p \sim 15\%$, allowing for a drastic reduction in the number of candidate tracks passed to the fibre tracker. The UT consists of four all-silicon planes in the X-UV-X configuration at the same z-locations as the TT. Three types of silicon sensors will be used: $10 \times 10 \text{ cm}^2$ silicon strip sensors with $190 \mu m$ pitch in the outermost region, and sensors with half the pitch and some with half the length surrounding the immediate area around the beam. All sensors are individually read out with the SALT chip. The opening for the beam is kept as small as possible to keep B-meson reconstruction inefficiency $< 6\%$ for $B_s$ reconstruction. The well-established stave concept, with embedded CO$_2$ cooling, is used for assembly with sensors on either side of the stave. This assures full coverage and significant reduction in material budget in the far forward region.

The Fibre Tracker has three stations with four 4 detection planes (X-UV-X) each. The stereo stations have the same 5 degree stereo angle as the UT. There are twelve fibre modules per detection plane. The fibre-ends at the equator are mirrored and each module has separate readout of the top and bottom segment. Each module end – top and bottom – has 16 Silicon Photomultiplier (SiPM) arrays, with each array having 128 channels that read out the fibre mats. The detector has to satisfy a stringent set of requirements. The photodetectors and fibres have to withstand a radiation dose up to 80 Gy and 35 kGy, respectively. The photodetectors will be cooled down to $-40^\circ C$ to maintain efficiency and to minimize radiation damage. A resolution of better than $100 \mu m$ in the bending plane is required with a mass budget of less than 1% $X_0$ per detection layer. The baseline solution for the readout of the SiPMs uses the PACIFIC ASIC and a dedicated FPGA for clustering of the fibre hits. Bandwidth utilization is optimized using a “concentrator” chip, which enables readout of the 590k channels at 40 MHz.

The upgrade of the LHCb Tracker is well motivated given the anticipated degradation of the performance of the current detector and to ensure compatibility with the overall upgrade to 40 MHz of the whole detector including the High Level Trigger (HLT) triggering capability.

The ALICE experiment presented an update of the status of the upgrade of the Time Projection Chamber (TPC). The main goal of the TPC upgrade is to allow for a continuous readout with 50 kHz. This rate cannot be achieved with the current gated Multi-Wire Proportional Chamber (MWPC) readout, which is limited to 3 kHz. The technology of choice for the upgrade is a multilayer Gas Electron Multiplier (GEM) readout. The ALICE requirements for TPC operation with continuous readout are an ion back flow (IBF) into the drift space less than 1% and an energy resolution of 12% for a $^{55}$Fe signal. A quadruple GEM stack with a Ne-CO$_2$-N$_2$ gas mixture with a mixture of foils with various pitches met these requirements for various operating
conditions. Extensive Monte Carlo simulations were performed under the conditions of an IBF of 1% and a gain of 2000. These studies showed that the TPC standalone momentum resolution with GEMs is slightly worse than for MWPCs, but that the global track resolution including the Inner Tracking System (ITS) is the same. The $dE/dx$ resolution is the same of the upgraded configuration compared to the current detector. The simulations also show that the TPC retains its performance under pile-up conditions. The space charge distortions with continuous readout, however, are significant. Assuming again an IBF of 1% and a gain of 2000 with the Ne-CO$_2$-N$_2$ gas mixture, a Pb-Pb collider run at 50 kHz will result in the accumulation of ions from 8000 events in the drift volume and distortions at small r and z reach 20 cm for r and 8 cm for z. To obtain the specified tracking resolutions, corrections at the per-mille level are required and the space charge fluctuations need to be taken into account. Using a fluctuating space-charge map in the Monte Carlo, based on real data, to simulate track distortions, it was determined that the space charge map could be considered static over a timescale of 5 ms, that is, every 5 ms the map needs to be updated. It is of critical importance for the experiment to have a very robust and high performing online track finding algorithm. Because of the continuous readout of the TPC, the TPC raw data has to be reduced by roughly a factor of 20 to be manageable. This is achieved through an online track reconstruction scheme where hits not assigned to tracks get discarded. As a result, the online reconstruction will have to be exceedingly high performing and requires inclusion of space-charge distortion corrections at the 5 ms level. A three-stage online calibration algorithm has been developed and tested. The procedure starts out with a reference map from Monte Carlo, which incorporates the readout geometry and known gain and IBF non-uniformities. An average correction map is then determined from high-statistics, high $p_T$ track samples, updated several times per fill. This accounts for slow variations of luminosity and ambient conditions. At the third level, this average map is scaled by the average of the actual TPC running conditions, updated every 5 ms. This calibration and correction algorithm was tested in Monte Carlo and a momentum resolution is obtained which is within a factor of two from the environment with no distortions. Offline the track reconstruction undergoes a last level of correction, when a high precision space charge map in conjunction with external tracking information from the ITS is used. Tremendous progress on the technical design of the TPC is being made. Given the high physics value of the detector, the Committee remains concerned about the viability of the preferred technology solution. More details regarding a review are in the ALICE section of this report.

Since both TDRs were obtained with little time before the meeting, full evaluation of these reports will take place in time for the next session of the LHCC in June 2014, while discussions continue with the referees.

The Committee also heard an update of the CMS Phase 1 upgrades. Three subsystems will be upgraded: the Pixel Detector, the Hadron Calorimeter and the Trigger. The current Pixel Detector will be replaced with a four-layer barrel and three forward-disk pixel system with a new readout chip capable of higher hit rate. Installation of SiPMs for the barrel and end-cap calorimeters together with new electronics constitutes the upgrade of the calorimeter. The muon and calorimeter Level-1 trigger systems and global trigger processor will be upgraded to handle higher luminosities without loss of efficiency for key physics channels. The Pixel Detector upgrade is progressing well and first modules are being built and tested. Pilot pixel sensors will be installed during LS1. Work on the calorimeter upgrade is also proceeding well. The demanding QIE10 ASIC provides integrating ADC and TDC functionality and prototypes show excellent performance and radiation hardness. The GBTX serializer chip is, however, of some concern and future progress needs to be monitored. As for the trigger upgrade, many components for the optical infrastructure are in hand and are being tested. A significant amount of firmware, however, still needs to be developed. A full vertical slice test is running in Building 904 since September 2013, exercising both algorithms and emulators. There is good overall progress on the Phase 1 upgrades for CMS.
6. REPORT FROM THE UPGRADE COST GROUP (UCG)

The LHCC heard a report from the Upgrade Cost Group (UCG).

The UCG reviewed the ATLAS New Small Wheel (NSW; CERN-LHCC-2013-006), the LAr Calorimeter (CERN-LHCC-2013-017) and the Trigger/DAQ (CERN-LHCC-2013-018) Technical Design Reports.

- The ATLAS NSW project aims to ensure the performance of the muon tracking and trigger capabilities in the forward ATLAS region as the LHC luminosity increases during Phase 1 and Phase 2. The project consists of 32 muon stations, each one composed of 8 Small-strip Thin-Gap Chambers (sTGC) and 8 Micromegas detectors assembled together. The UCG findings are: a) all needed information on costing, manpower and risks was provided by ATLAS; b) No major concerns were reported for the sTGC; c) the front-end electronics are not yet fully designed and d) to ensure quality and schedule, the LHCC should monitor progress frequently, especially for the Micromegas construction. The UCG recommends to the LHCC approval of the ATLAS NSW cost estimate.

- The physics motivation behind the ATLAS LAr Calorimeter upgrade is to maintain the Run I electromagnetic calorimeter rates at future higher Run III luminosities without raising thresholds. This can be achieved by increasing the transverse and longitudinal granularity of the existing LAr calorimeter using new electronics. The UCG findings are: a) information provided on costing, manpower and risk is based on prior experience and current costs, and is reasonable and consistent; b) the performance should be carefully studied to prevent deterioration in detector performance from increased noise, e.g. resolution in missing $E_T$; and c) the critical choice of the analog-to-digital converter for the LAr Trigger Digitizer Board (LTDB) is still to be made. The UCG recommends to the LHCC approval of the ATLAS LAr Calorimeter upgrade cost estimate.

- The ATLAS Trigger/DAQ upgrade is designed to provide efficient triggering and data collection with low trigger thresholds for post-Long Shutdown II (LS2) operation and consists of various electronics boards to enhance the Trigger/DAQ features. The UCG findings are: a) cost and manpower estimates are reasonable; b) risk of a specific board not being ready in time for installation by LS2 is low; some boards are extremely complex and costly; and (d) a large number of computer experts are required in the optimization of processing on the Higher-Level Trigger (HLT) farm. The UCG recommends to the LHCC approval of the ATLAS Trigger/DAQ upgrade cost estimate.

The UGC reviewed the LHCb Vertex Locator (VELO; CERN-LHCC-2013-021) and Particle Identification (PID; CERN-LHCC-2013-022) Technical Design Reports.

- The LHCb VELO is a completely new silicon detector to provide improved track reconstruction at higher occupancies. The UCG findings are: a) the project is very ambitious in scope and only four years available to replace the current VELO in one single step; b) the cost estimates are reasonable; c) to ensure success of the project the LHCC must closely monitor the funding situation; and d) the RF foil is very demanding and critical for the project. The UCG recommends to the LHCC approval of the LHCb VELO upgrade cost estimate.

- The ATLAS PID upgrade increases the read-out rate from 1 MHz to 40 MHz and applies a new software trigger. The front-end electronics of all systems, and in some cases whole detection systems themselves, must be replaced. The UCG findings are: a) to ensure success of the project the LHCC must closely
monitor the funding situation; b) the Ring Image Cherenkov-1 (RICH-1) must be re-designed to fit within the same volume; c) the RICH-2 Hybrid Pixel Detectors (HPDs) are to be replaced by 1” Multi-anode Photomultipliers (MaPMTs) with new front-end electronics and lenses. The UCG recommends to the LHCC approval of the LHCb PID upgrade cost estimate.

The UCG reviewed the ALICE Inner Tracking System upgrade (ITS; CERN-LHCC-2013-024).

- The ALICE ITS upgrade is motivated by the need to provide low-mass high-precision tracking at small radii to measure secondary vertices of heavy-flavour decays down to zero $p_T$ at interaction rates of up to 50 kHz in Pb-Pb collisions. The UCG findings are: a) the ALICE ITS upgrade is a challenging project with an aggressive time schedule; b) the manpower profile is adequate; c) ALICE should establish a good quality control programme to ensure uniformity in manufacturing of modules and staves at the different production sites; d) the yield for sensor production should be scrutinized, as a higher-than assumed yield could translate into considerable cost savings if promptly recognized and addressed. The UCG recommends to the LHCC approval of the ALICE ITS upgrade cost estimate.

7. LHC EXPERIMENT STUDENT POSTER SESSION

An exhibition of student posters was held in the Main Building and covered students' work on a wide variety of LHC physics topics. The LHCC Members had ample opportunity to interact with the students and there was broad participation in the event from interested parties. As for the previous such annual sessions since 2011, this event was again deemed to be a great success and is expected to be repeated in future.

8. DISCUSSION WITH ATLAS

Physics

Since the LHCC last met, 10 papers were submitted for publication and 30 papers are currently being circulated in the Collaboration. The experiment is strengthening its commitment to complete the Run I papers in a timely fashion. The electron/photon re-calibration has been finalized, demonstrating a much-improved understanding of the detector geometry and calibration. This improved understanding will translate into reduced systematic uncertainties. A few of the many interesting measurements highlighted in the LHCC Open Session included:

- First observation of electro-weak Z+dijets (WW fusion → Z)
- $W+$charm production
- $W+J/\psi$ production

Long Shutdown (LS1)

At the LHCC session in December 2013, ATLAS reported a significant problem with IBL construction effort. Evidence of corrosion was discovered on a large number of the assembled staves causing the experiment to halt production and re-evaluate its construction process. Since then, the Collaboration has either refurbished or manufactured 20 staves (14 are needed for the full assembly). At the time of the March 2014 session of the LHCC six of the 14 were tested and mounted. The remaining 8 were to be installed in the coming three weeks. The IBL is now back on track to be installed this spring as planned keeping to the plan. Given that some checkout time has been sacrificed to meet this schedule, end of work in the cavern has been moved by one month later, which allows for just 1-month of close-up contingency.
The Pixel Detector was moved into the pit at the time of the December 2013 LHCC meeting, well ahead of schedule. All the services are in place and are being connected. At the time of the March 2014 LHCC session, the process was about 2/3 complete. The Collaboration is running two shifts to ensure timely completion. Of the 98.8% of the channels working prior to installation, less than 0.2% has been lost during the connecting process.

A few small problems have developed with the thermo-syphon, which was built to cool the inner tracker during Run II. Bearings on two of the pumps require reworking and the inner welds on the condenser exhibit signs of rust. Both issues are being addressed by manufacturers. The implication is that the initial commissioning will be done with the Run I cooling plant.

The calorimeters are in good shape and the muon systems are progressing well. The slow progress reported in December 2013 in leak fixes with the Resistive Plate Chambers (RPCs) has been addressed. A second crew has been added and the repair rate is now satisfactory. Success of the Small Wheel repair on the surface has prompted the collaboration to move the repair fixturing underground to deal with some minor issues with the other Small Wheel.

A physics review was conducted of the ATLAS Forward Physics (AFP) system. There is sufficient physics merit and scientific interest in single and double diffractive states to prompt the Collaboration to pursue this effort further. Physics will require a few days of dedicated low-luminosity runs. A technical review of the hardware is scheduled for late March 2014.

The Collaboration has established a re-commissioning plan. At the heart of it are 6 “milestone weeks” - during each week ATLAS will read out an increasingly large part of the entire detector. The first one has already occurred and was successful. The next one is scheduled for later in March 2014 and may include cosmic triggers.

Software and computing continues to be a main focus of the Collaboration during this shutdown. The first release was built with the new analysis model. The next build has been delayed slightly (a few weeks). The Collaboration is still on track to begin the Data Challenge 2014 in April. ATLAS will spend a few months making Monte Carlo files and reprocessing data files using the new analysis model. Those files (along with the latest software build) will be used by the Collaboration in July 2014 to do analysis and provide feedback on the system. The reconstruction software has already been sped up by a factor of two based on pure technical fixes – no alteration in the physics. Further speed-up is still being sought. Finally, Monte Carlo truth tables have been streamlined which will reduce the storage space for Monte Carlo data dramatically.

Upgrades

The ATLAS upgrades are on track. Several groups are engaged in the muon New Small Wheel construction preparations and a test beam effort at Fermilab will occur in the coming months. Micromegas technology is in advanced prototyping and companies are being qualified now. The Fast Track Trigger (FTK) boards are now in pre-production and the emphasis is not board checkout but rather testing pieces of the full chain. The AM6 chip remains the critical path item. For the Phase 2 inner trackers, first prototype strip stave using a ¼-micron version of ASIC is proceeding well. Quad pixel modules have been produced, are being irradiated and in test beam and power delivery technologies are being investigated. For the Phase 2 trigger, the Collaboration is converging on a region of interest scheme and looking at expected trigger rates to see what is required to preserve the critical physics.

9. DISCUSSION WITH CMS

Physics

CMS has solid plans for accomplishing the major physics objectives with a focus on finishing Run I publications, pursuing upgrade studies and preparing for Run II. CMS
has appointed a ‘physics officer’ responsible for each of these areas to assist the physics coordinator. CMS has 295 publications with twenty-five additional publications in preparation, and with about 100 more expected from Run I. The target is to publish the majority of ‘legacy’ papers such as the Higgs analyses in 2014, with understanding that some precision measurements will take longer. This plan will enable focus within the physics organization to turn to the Run II/Upgrades.

The organization of a cross Physics Object Group forum has led to improvements in reconstruction of all physics observables. The $E_T$ clustering has been completely rewritten. A readiness exercise is planned for September 2014 using Monte Carlo samples generated with anticipated 2015 conditions that will exercise the full analysis chain, particularly for new physics channels. The second step of the readiness exercise is to target specific analyses to maximize speed and physics potential for 2015.

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 $W W gg$ which has a sensitivity to anomalous couplings, to search for Standard Model forbidden $Z Z gg$ and $gggg$ couplings, and to measure the dijet production of gluon-jets.

**Long Shutdown (LS1)**

The work scheduled for LS1 is considered an underpinning for the long-term operation of CMS. As outlined in previous LHCC sessions, the programme of work has the following major elements: (1) muon upgrades, including the installation of the 4th layer end-cap Cathode Strip Chambers (CSC) and Resistive Plate Chambers (RPC) and the YE4 shielding wall, plus upgrade of the M1/1 CSC frontend electronics and placement off-detector of part of the barrel muon electronics; (2) the first stage of HCAL photodetectors consolidation/upgrade (HO, HF); (3) tracking system upgrades and consolidations including the installation of the 45 mm 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 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 and Cathode Strip Chamber (CSC) readout 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 has reached the halfway mark. The SL53 building supplying office space, conference rooms and a visitor centre is on schedule for completion. The overall schedule was assessed at a recent Technical Coordination workshop, and the schedule adjusted such that the RE4 horizontal quadrant can be installed during the beam pipe bake out and to delay the beam pipe pump-down work until January 2015. The current assessments of the schedule show that CMS is on target for beam by 20 February 2015 and for earlier milestones of cosmic-ray data collection, with and without the magnet energized.

For the muon system, chamber installation and electronics refurbishment is on schedule with the positive z side complete. An unexpected problem with the ME1/1 refurbishment was discovered during a long-term test. A C3 filter capacitor on the LVMB7 board was omitted. This was corrected for the z- side chambers (which had not yet been installed). The majority of the z+ side chambers will be fixed *in situ*.

The new Beryllium beam pipe has passed vacuum tests and is ready for installation.

The first tests of silicon tracker cooling at -10°C were successfully completed in November 2013. In December 2013, after warming up for cooling plant maintenance, insulated pipe bundles of C$_6$F$_{14}$ distribution show evidence of external condensation and icing. The areas of condensation appeared linked to areas of the skin vapour barrier with visible damage. The damage was repaired. In addition, dry gas is being re-
directed into the bundles to insure humidity control. To ensure a long-term mitigation of the problem with reasonable backup capacity, an additional dry gas source is strongly advised.

The Tracker passed the Tracker Master Cold test in February 2014, it has actually been operated at -20°C for prolonged periods and several transients from room temperatures to -20°C and back to room temperature have been exercised without problems.

**Run II Preparations**

For the online system, sub-detector control computers are being replaced, with a number of systems migrated, and completion anticipated by April 2014. 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 High-Level Trigger (HLT), and the DAQ for the luminosity monitor. Most of the DAQ2 components have been demonstrated with small-scale tests and the orders have been placed. The changeover schedule will begin in May 2014, with commissioning subsystem by subsystem with an anticipated completion by July 2014. Within the electromagnetic calorimeter system, the recovery of single event upsets in firmware is making good progress.

Three key demonstrations are planned for the computing infrastructure. The Data Management system will be 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 through xrootd (access 20% of data across wide area; 60k files/day, O(100TB)/day). 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. The software package CMSSW-7-0-0 was completed on 14 February 2014 to provide functionality for tests of Run II reconstruction of 2 billion events across several pileup 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. CMSSW-7-2-0 planned for November 2014 will feature the reconstruction software ready for 2015 start-up.

The status of DAQ and detector will be checked regularly with short technical cosmic-ray runs through the year. Cosmic-ray data taking with whole Detector (B=0 and B=3.8 T) to collect enough tracks for early alignment and calibration is planned for October and November 2014.

**Upgrades**

**Phase 1 Upgrades:**

The Phase 1 upgrades include the construction of a new Pixel Detector, installation of new photodetectors and electronics for the Hadronic Calorimeter and a new Level-1 trigger system.

For the Level-1 trigger system, the plan is to have the parallel data path for the Electromagnetic Calorimeter (ECAL) part fully installed and commissioned by March 2015. A full crate slice test of 30 cards using ECAL and Hadronic Forward (HF) inputs has successfully been completed. The legacy calorimeter trigger will be re-commissioned in time for the July 2014 global cosmic run. After improving the jitter cleaning the production of the optical splitter (OSLB) and RM mezzanine board (ORM) has been launched. The ORM and OSLB boards have been received and three quarters have been tested and are ready for installation. Commissioning is expected to begin in April 2014, with the system fully commissioned in July 2014, a schedule slip
of two months that is within the contingency. 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 Drift Tube (DT) and Resistive Plate Chamber (RPC) concentration is expected in April 2014. 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.

The pixel system successfully passed a 2-day Engineering Design Review in December 2013 and the CO₂ 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 with 1.2 \times 10^{15} \text{1MeV neutron 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 Barrel Pixel (BPIX) sensor order has been placed, good modules have been produced and are being tested and the pre-production HDIs 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 Hadron Calorimeter (HCAL) Barrel and End-cap upgrade, SiPM R&D has successfully concluded, resulting in a device that has ~3x 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 FPGA has been of concern, particularly for the 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. The tracking system and end-cap calorimeters will be replaced. For the muon system, the end-cap Cathode Strip Chamber (CSC) stations will be completed with new detectors (GEM/RPCs) possibly also extending the coverage in the forward direction. The front-end electronics will be replaced on the barrel electromagnetic calorimeter and some of the muon system. The Level-1 trigger will include tracks and so requires a latency of ≥ 10\(\mu\)s. The new detector readouts will be designed to allow an input rate to the High Level Trigger (HLT) of ~ 0.5 to 1 MHz, with a similar reduction factor as in the present system. The HLT 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 programme for Phase 2 in a Technical Proposal (TP) in the fall of 2014, with a Technical Design Report for each upgrade project (~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. Discussions are taking place with funding agencies to obtain funding for the R&D phase. A report on the calorimeter options will be made in June 2014, with an anticipation that only two of the three options will move forward to the R&D phase.
10. **DISCUSSION WITH ALICE**

**Physics**

The ALICE Collaboration continues to produce physics publications albeit at a slightly reduced rate these past three months with one physics paper and one detector performance paper submitted since the previous LHCC meeting. Five papers were accepted for publication in this period, adding up to a total of 76 physics papers that appeared in peer-reviewed journals. The somewhat lower number of submissions is in parts due to high-level conferences preceding this period and the efforts focusing on the upcoming Quark Matter conference, the major meeting in the field of heavy-ion physics; 34 proceedings were submitted in the past three months. The collaboration has about 30 papers that are currently being worked on that they expect to publish prior to the start of Run II.

Preparations for Quark Matter 2014, to be held in May 2014 in Darmstadt, Germany are proceeding well. A total of 31 abstracts for oral presentations were accepted and 92 posters by ALICE will be presented at the conference. The Collaboration plans a major approval campaign in April 2014. All analyses are completed or close to completion with some Monte Carlo simulations being on a critical path.

**Long Shutdown (LS1)**

The work scheduled for LS1 involves maintenance and consolidation in preparation for LHC Run II, completion and moderate upgrades of detectors, as well as work underpinning the stable operation and long-term operation of ALICE.

The LS1 effort is going according to plan and the 2013 schedule was completed successfully. No problems were reported during the End-of-Year closure. Many systems were switched off in order to limit risks (HV, LV, racks, gas, cooling) and avoid major failures due to extreme weather conditions. The detector control systems, as well as all safety systems, DSS, and interlocks remained operational. Once-a-day inspection tours by ALICE personnel as well as remote monitoring ensured an uneventful End-of-Year break. The LS1 activities in 2014 are progressing well and are so far on time.

ALICE reported a substantial improvement 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 Readout Boards (ROB) due to legal issues with the involved companies and by technical problems with the produced Multi-Chip Modules (MCM). ALICE reported that the ROB production has picked up substantially over the last 3 months and that the schedule is back on track. Two of the super-modules (#12 and #13) are now at CERN and one is on its way (#14). One existing module (#17) was removed from the space frame and repaired. Since the top and bottom of the frame, where the missing models are to be installed, are the most critical positions for deformation of the entire space frame support structure, counterweights have to be installed to unbalance top/bottom by a maximum of one. The design of the counterweights is critical. In case of delayed production of the remaining two super-modules, the weights will have to remain in the detector during the next run until the end-of-year shutdown when they can be finally installed. In order to minimize the material in the acceptance before the Electromagnetic Calorimeter (EMCAL) and the Photon Spectrometer (PHOS), the counterweights consist of thick lateral plates putting the majority of the mass in the shadow of the space frame.

In order to install the three TRD modules at the bottom of the space-frame the base of the mini-frame which holds services on the A-side of the detector has to be removed. ALICE is currently preparing and testing a suspension jig to hold the mini-frame during this operation. The installation of the bottom TRD modules is planned to start mid-May 2014 and is scheduled to last until end of June 2014.
The upgrade of the ventilation infrastructures was completed. The new systems allow the flow of 10,000 m$^3$/h air into the L3 magnet. The upgrade replaced the ventilation system from the LEP area; 80 m of duct pipes were exchanged, whose installation required temporary 27 m high scaffolding inside the PX24 shaft.

The chilled water upgrade for ALICE is now in its second phase with the arrival of the new 1.8 MW chiller. It is part of the CERN supplied chilled water production consolidation at Point 2 for LHC cryogenics, ALICE, and general ventilation infrastructure. Complete installation and commissioning will take approximately four months. A fifth chiller will be installed in 2015 and will serve as backup.

Renovation and installation of the new ALICE control room is ongoing and will be completed by May 2014.

ALICE is confronted with much technical infrastructure maintenance in and around Point 2 that frequently causes service interruption. These interruptions are known in advance but still need careful scheduling to not interfere with the collaborations LS1 task list. ALICE negotiated stable conditions as of 1 June 2014.

ALICE makes good progress with their consolidation and upgrade activities on many detector sub-systems. An important step was the consolidation of the Silicon Pixel Detector (SPD) cooling. The clogging of filters, which lowered the C$_4$F$_{10}$ flow below the minimal value required for total heat drain was solved by painstakingly drilling out the affected filters. The new Freon flow is now set to 2.1 g/s adding some contingency to the nominal value (1.8 g/s). Tests showed that it is possible to even push the flow 1.5 times beyond nominal. Further activities on the inner tracker included the replacement of ten pressure regulators for the Silicon Drift Detector (SDD), the modification of 154 CAEN low voltage power supplies for the Silicon Strip Detector (SSD), and consolidation efforts of the cooling system. The low-voltage distribution of six TRD super-models was reworked and the TRD and TPC cooling tanks were replaced. In the Time-of-Flight (TOF) system, all faulty TDC Readout Modules (TRM) were exchanged. The Photon Multiplicity Detector (PMD) was removed for maintenance and repairs and will be reinstalled mid-2014. For the EMCAL the Readout Control Unit (RCU)-based readout was changed to a point-to-point read-out using the Scalable Read-out Unit (SRU) developed by RD51. The repair of the Muon Chambers was completed solving the occupancy problems during Run I. The low-voltage bus bars of 90 chambers were repaired. Until a full test of the system can be conducted with the full DAQ in June 2014, a standalone DAQ will be used to study the health of the system.

The upgrade and consolidation of the PHOS detector are well underway. The plan is to use the upgraded EMCAL readout electronics; which implies modification of all frontend cards, the introduction of new Trigger Control Units (TCUs) and changing from RCU to SRU. The detector and support cradle were removed from the main frame and a large fraction of the elements that will be installed are already at CERN or on their way such as the Trigger Control Units (TRU). Of the 16 ordered SRUs, 8 are already produced. Two of these boards showed problems of delaminated PC boards. The production of the remaining boards was temporarily suspended until new PCBs are produced.

In order to improve the stability 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 foresees completion of mass production of the RCU2 units by June/July 2014, and installation starting in September 2014. Recent tests of the design revealed that one of the main FPGAs (SmartFusion2) suffers from single event latch-ups. The manufacturer is aware of this issue but a revised version will not appear before the end of the year. A possible workaround might be to add a latch-up protection piggyback board, a solution that still needs to be scrutinized. ALICE recognizes the situation as critical and closely follows up the issue.
ALICE presented their close-to-final re-commissioning schedule, which envisioned the closure of the L3 magnet in November 2014 and the beginning of cosmic-ray and technical runs with full field in December 2014. The DAQ is now being reinstalled after full replacement and extension of the hardware. The goal is to have the DAQ fully available by 1 June 2014 for global commissioning. First technical and cosmic runs without field are planned for July 2014.

After careful consideration of several options ALICE decided on the design of the new central section of the beam pipe. The Beryllium section will have an outer diameter of 38 mm and an inner diameter of 36.4 mm, i.e., a 0.8 mm wall thickness. This layout is identical to what was assumed in the simulations for the Inner Tracking System (ITS) upgrade and is also acceptable for the new MFT detector. The design leaves 2.8 mm room between the pipe and the ITS / Muon Forward Tracker (MFT). A mechanical adjustment precision of 2.5 mm will be required. The final design is under way and awaits approval from the LHC Experimental Beampipe (LEB) group.

**Upgrades**

ALICE has presented three upgrade Technical Design Reports 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 will be considered in the June 2014 LHCC meeting, where also the cost review will be conducted. During the March 2014 LHCC session, ALICE submitted the TPC Upgrade TDR for review by the LHCC.

The cost review of the ITS took place before the LHCC meeting. After a full assessment of the costs in preparation for the UCG review, ALICE has found that the total project cost has increased to 13.3 MCHF from the TDR value of 12.0 MCHF, which is largely attributed to external labour. The Committee sees no major concerns. Project management and all groups involved have good experience from past involvement in the current inner tracking system and new groups bring fresh expertise to the project. The UCG was impressed by the level of detail the collaboration provided during the review. The cost and manpower estimates were found to be reasonable and the ITS was recommended for approval.

After LHCC review and discussion with the referees, the Trigger and Readout Upgrade TDR will be updated in the next weeks. The cost review at the next LHCC meeting will be limited to three subsystems: MCH, MID, and FIT. Final recommendation by the LHCC could be provided right after the UCG review at the June 2014 meeting.

The TPC TDR was officially submitted and presented to the LHCC during the Upgrade Meeting. The Collaboration and the referees agreed on a review schedule for the coming months. Given the central role of the TPC and the complexity of this critical upgrade, the LHCC will contact external experts to aid the LHCC in the review.

ALICE intends two submit two additional TDRs, one for the Online and Offline Upgrade (O2) and one for the Muon Forward Tracker (MFT). The Collaboration intends to submit the O2 TDR in September 2014; the date for the MFT is not determined yet. The referees will get an update in the status of the MFT during the meeting with ALICE before the LHCC meeting in June 2014.

**11. DISCUSSION WITH LHCb**

**Physics**

The LHCb Collaboration continues to produce high-quality scientific papers. Since the last LHCC meeting, 13 papers were submitted, accepted or published. Another 38 papers are under final review and about 100 analyses are targeted by the physics Working Groups to be of high relevance. The goal is to complete these analyses and the related papers before the start of the new data-taking period. Interesting new results were presented at the LHCC Open and Closed Sessions on B-hadron lifetimes, production cross sections, B-hadron decays, CP-violation and searches for new physics
with rare decays. The most exciting result was the first direct observation of photon polarization in $b\rightarrow s\gamma$ decays. In the Standard Model, the photon is almost fully left-handed, while new physics can introduce a significant right-handed component. The LHCb Collaboration measured the up/down asymmetry in $B^+ \rightarrow K^+ \pi^- \pi^+ \gamma$ decays in four bins of the $K\pi\pi$ invariant mass showing a $>5\sigma$ significance for the photon polarization.

**Long Shutdown 1 (LS1)**

The LS1 work proceeds well. The consolidation of the Dipole Magnet has been successfully completed in January 2014 after solving all technical problems related to the removal of the old protection between the coil and the supports and a dedicated *in situ* machining of the supports for the installation of the new material. A general maintenance and consolidation of the gas system, power lines and cooling plants is underway, as well as repair and improvement of the sub-detectors. For the Ring Image Cherenkov (RICH) system, a new version of the spare Hybrid Photon Detectors (HPDs) exists that have better vacuum. A replacement of the malfunctioning photodetectors is scheduled. The replacement of 15% of the PMTs in the Hadron Calorimeter (HCAL) is under way. For the LED calibration in the Electromagnetic Calorimeter (ECAL), the replacement of the clear plastic fibres with radiation-resistant fused-silica fibres is proceeding well and will be completed in a few months. The LEDs will be replaced as well. Preparations of the routing for the upgrade readout optical fibres from the UX to the SX are progressing fine. In order not to interfere in a complicated way with other physics programmes, such as MoEDAL, the LS1 schedule was adjusted and the operations of field mapping, beam pipe re-installation and vacuum closures have been shifted by a few months at the end of the shutdown period. Everything looks running smoothly. The LHCC finds that the LS1 programme of work proceeds well and no show-stoppers have been identified.

**Upgrades**

The work for the LHCb upgrade is proceeding well. Major milestones were reached with the delivery of the Technical Design Reports (TDRs) for the Vertex Locator (VELO) and the Particle Identification (PID) system (RICH, Calorimeter and Muon System) in December 2013 and that for the Tracker (Upstream Tracker UT and Central Tracker CT) system in March 2014. The LHCC expects the completion of the LHCb TDR submissions in June 2014 with the release of the Trigger and Online systems. The LHCb Collaboration has accepted Aachen (Germany) as full member and the Wuhan (China) group as associated member. From the financial point of view, the negotiations with Funding Agencies proceed well. Italy and France have agreed to the LHCb upgrade. It is expected that Germany, Netherlands and Switzerland will also provide their approval soon. CERN is providing its promised support, while the NSF (USA) contribution will be released in May 2014. The UK response is still under approval. Both technically and financially, the UK institutions play a crucial role in relevant parts of the LHCb sub-detectors, such as the VELO and the RICH. The completion of the TDRs has provided a reasonable estimate of the total upgrade costs. The total costing at the TDR level is still inside the overall upgrade envelope of 57 MCHF.

The VELO and PID TDRs have been scrutinized carefully by the Committee. A dedicated set of questions and technical details were posed to the Collaboration in January 2014. The LHCb Collaboration sent formal replies separately for each TDR to the LHCC before its March 2014 session, clarifying the situation in a convincing manner. The VELO TDR addresses all concerns that arise from such an ambitious project. It presents a convincing technology and describes well the physics motivations and detector requirements. Moreover, it states mitigation paths for which risks are high and elaborates on the remaining R&D to be completed. A number of options are left open for the final technology choices but the associated R&D programme is sound. All risk issues that come to mind are addressed. The PID TDR contains three, nearly independent sections for the RICH, the Calorimeter and the Muon Systems. The
overall system is well described and the physics performance is well motivated. The most demanding upgrade concerns the RICH system. Technical choices are well explained. The bulk of the cost arises from the replacement of the Hybrid Photon Detectors (HPDs) with Multi-anode Photomultipliers (MaPMTs). There are options with larger areas MaPMTs or lenses in the RICH-2, which hopefully can be implemented to save cost. The upgrade of the Calorimeter and Muon systems mostly consists of a replacement of the readout electronics that poses no major concerns. For both TDRs, the cost details are clearly stated. A dedicated review on cost was carried out by the newly formed UCG. The LHCC conclude that both the VELO and PID TDRs are of very high quality. The LHCC congratulates the LHCb Collaboration and recommends for approval the VELO and PID Technical Design Reports.

The TDR of the tracking system was presented at the March 2014 LHCC session. The tracking system consists of an Upstream Tracker (UT) system and a Central Tracker (CT) formed by scintillating fibres. The UT system, based on silicon strip technology, will replace the existing Trigger Tracker with the main objectives of allowing a fast momentum estimate for the trigger, improve momentum resolution, reduce the rate of ghost-tracks, improve the reconstruction of long-lived particles and improve the trigger reconstruction time by a factor of 2.6. Since the previous LHCC session, LHCb demonstrated much progress. LHCb has shown a mechanical realization of the stave and performed a successful cooling test. The technology choice between a CT based on scintillating fibres and an upgrade of the Outer and Inner Tracking System was accomplished. In a dedicated meeting on 27 November 2013, the internal LHCb committee opted in favour of the fibre tracker, which allows for significantly faster online reconstruction. The technical details of the CT are convincing after the feasibility to use fibres and SiPMs was demonstrated. The overall forward tracking reconstruction efficiency for long tracks is 1% to 4% lower than what was obtained for the existing tracker at low pile-up ($\mu=2$). However, for high-luminosity running, the CT performs significantly better than the present system. A careful study of the tracking TDR will take place before the next LHCC session and a set of questions and comments will be sent to the Collaboration.

The most recent news on the Trigger and DAQ systems were presented at the meeting. Many activities are in progress, including preparation workshops and reviews needed to complete a TDR before the June 2014 LHCC meeting. The LHCb Collaboration is essentially ready to select the technology for both the Online and the Trigger.

Concerning the Event Builder EB, the FTDR solution consisted of a uni-directional EB based on the usage of ~500 distributed readout boards with AMC readout units. These boards were used to 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. A new and favoured alternative was presented consisting of a bi-directional event building where the readout is done with 500 PC servers and a bi-directional router running at 100 Gbits/sec. The AMC readout unit is substituted by the PCI express. This latter solution simplifies the design of the readout unit and can profit from the progress in network technology in the coming years. In this scenario, the preferred implementation is to install the electronics in the surface building bringing the data from the FEE to the PC servers with ~300 m long fibres. The overall cost for the EB at 30 MHz also favours the new option since the cost is reduced by a factor of three (from 9 to 3 MCHF) without accounting for the readout boards and the farm. A DAQ review was held on 25 February 2014 and identified no show-stoppers. An official report is expected for the beginning of March 2014.

Optimization and selection of alternatives for the trigger are also under way. The Low-Level Trigger (LLT) is still useful for regulating the input rate to the farm and it can be executed similarly in the TELL40 or on the PCs. For the HLT, a choice needs to be made between a completely software-based scenario and a hardware-assisted scenario that uses the tracking processing unit (TPU). The HLT sequence is based on the following tracking steps: VELO, VELO-UT, Forward Tracking and Primary Vertex finding. The TPU uses the VELO-UT tracking in a hardware way based on the retina
algorithm providing high reconstruction efficiency and Offline quality of tracks. The cost of the TPU installation is of $\sim 900$ KCHF. A comparison between a TPU-based and a pure software approach for the HLT was carried out estimating the overall reconstruction time in both cases for an instantaneous luminosity of $2 \times 10^{33}$ cm$^{-2}$ sec$^{-1}$. In the pure software case, the total processing time for an event was of $\sim 6$ msec with respect to $\sim 4$ msec in the TPU-assisted case. After tracking, the HLT proceeds by performing a few trigger selections, PID reconstruction and a topological set of requirements. However, the contribution of this latter reconstruction stage to the event processing budget is modest. The excellent improvement in reducing the time for track reconstruction, with respect to the previous option, grants a safety margin in the reconstruction time total budget that is estimated to be $13$ msec for a farm with 1000 nodes running at 30 MHz. In this case, the farm cost is $\sim 3$ MCHF and makes the TPU gain marginal. The LHCb Collaboration will take a decision on these alternatives after receiving inputs from the HLT group, followed by a TB endorsement and a dedicated trigger review that will be held on the 31th of March.

12. DISCUSSION WITH TOTEM

The discussion with the LHCC referees focused on the progress on the collaboration with CMS and on the status of the consolidation and upgrade projects.

The LHCC was pleased to learn that the formal Memorandum of Understanding for a joint upgrade project of CMS and TOTEM was signed, and the leadership of the project has been appointed. The Institution Board, to include all Institutes engaged in the project, is being defined, and work towards a Technical Design Report (TDR) will then initiate. An outline of the TDR structure and schedule should be available by the next LHCC meeting. In parallel, work on the common analysis of data taken during the last phase of Run I is continuing, with a first paper due to appear soon.

The ferrite issues affecting the existing Roman Pot detectors have been thoroughly understood: ferrite dust is released due to mechanical contacts induced by thermal cycles and inadequate mechanical tolerances. These can be fixed by a re-machining of the ferrite elements, and the inclusion of spring-like lifters, to accommodate the thermal expansions. Work is underway to correct the problems for all affected pots. Completion of this work is on a critical path to meet the installation deadline of May 2014.

Upgrades

The preparatory work for the joint CMS-TOTEM upgrade is also progressing well. All the horizontal pots and RF shields that need to be installed by May 2014 are expected to be delivered on time. Dedicated manpower has been earmarked by the PH Department to allow the installation work to be completed on time.

The LHCC takes note of the rapid progress made by the upgrade project for vertical timing detectors. TOTEM has identified the set of services that need to be put in place before the end of Long Shutdown 1 (LS1), including pots mechanics, cables for trigger, data acquisition and timing, low- and high- voltage cables, cooling and patch panels. The selection of the optimal technology choices for the detectors (diamond versus silicon sensors, commercial versus custom-made amplifiers) is also in progress, with test beams foreseen for prototypes in June (1 week at PSI), July (1 week at the PS) and October (2 weeks at the SPS). The goal is to fully define, test and build the detector packages by 2015, and to install them in the tunnel during the 2015-16 Technical Stop. The LHCC welcomes these developments and encourages the Collaboration to proceed with its current plans. The LHCC also requests, however, that a formal TDR be prepared. In particular, the TDR should detail the detector performance, in view of the expected physics goals, and fully document the technologies under consideration, covering performance, risks, construction and installation plans and schedule, impact on the LHC operations, costs and resources needed.
### 13. DISCUSSION WITH LHCf

The discussion with the LHCf experiment during the March 2014 LHCC session has mainly focused on new physics results on neutrons and $\pi^0$ with the data sample of p-p collisions at 7 TeV and 2.76 TeV and p-Pb collisions at 5.02 TeV.

Neutron energy reconstruction, studied with test beam data, shows good agreement with one of the two used generators, in particular with QJSJET2. Energy spectra for p-p events in different bins of $\eta$ show that the two arms of the detector agree between each other within the systematic errors, which is dominated by the energy scale uncertainty. In the high-$\eta$ region, $\eta > 10.76$, the one with the highest statistics of neutrons, only the QGSJET2 generator reproduces LHCf data.

Events featuring $\pi^0$ in p-Pb collisions have been studied. About 50% of the collisions in this configuration are coming from central and peripheral collisions in the regime of soft-QCD and the rest of the events are ultra-peripheral collisions (UPC), in which hadronic interactions are suppressed. To obtain the soft-QCD component, this UPC contribution has to be subtracted. The spectra after UPC subtraction have been shown in different rapidity bins and they are in good agreement with DPMJET and EPOS generators. Predictions by the two hadronic interaction models do not include the UPC component.

The transverse momentum ($p_T$) distribution for inclusive neutral pions in p-Pb collisions show a strong suppression of the production of neutral pions after taking into account UPC collisions. This leads to a nuclear modification factor ($R_{pPb}$) value of about 0.1 at $p_T$ about 0.1 GeV and rising to 0.3 at $p_T$ of 0.6 GeV. All hadronic interaction models predict small values of $R_{pPb}$ ≈ 0.1, and they show an overall good agreement with the LHCf measurements within the uncertainty. Other analyses, which are more sensitive to exclusive $\pi^0$ signals are needed, for example diffractive dissociation, to investigate the reason for this strong suppression. However, the measured $R_{pPb}$ dependency on $p_T$ and rapidity may hint to an understanding of the break down of the $\pi^0$ production mechanism.

The referees also reported on the preparation of the detector for the run at 13 TeV. Radiation damage will be more severe at higher energy: 2-3 Gy/nb$^{-1}$ at 13 TeV. All of the plastic scintillators have been replaced with GSO scintillators in both Arm-1 and Arm-2. GSO scintillator can survive up to $10^6$ Gy. Scintillation fibres have been replaced with GSO bars on Arm-1. Since old silicon detector (on Arm-2) would be saturated for $>1.5$ TeV photons, a new wire bonding scheme has been implemented to avoid saturation effects and pulse height was reduced by ~60%. A new silicon layer location has been studied to maximize energy resolution. All parts, except for new Si modules, are ready and their properties have been tested in test beams at HIMAC (HI beam facility in Japan) and SPS. Two beam tests are scheduled at LNS-Catania for new Si modules during summer 2014, and at SPS for the fully upgraded LHCf detectors in October 2014.

The dedicated beam time for LHCf and for the van der Meer scan is April 27th to May 1st, which is a part of the LHC start up schedule at $\beta^* = 19$m (corresponding to the beam size at the TAN absorber of < 1mm.) and crossing angle = 140 $\mu$rad. Even though it is not a priority, the Collaboration would ask for an additional short (single fill) of low luminosity operation at $\sqrt{s}=7$ TeV for the confirmation of the upgraded detector response.

Collaboration with ATLAS is in progress, some data with common triggers have been collected and data analysis is in progress. The Committee encourages for the future the continuation of the collaboration between the two experiments in order to maximize the physics outcome of the p-Pb run.
14. REPORT AND DISCUSSION WITH THE WLCG REFEREES

General

The LHC computing proceeds very well, the experiments benefit from a stable infrastructure and are able to successfully pursue the planned centralised data treatment during the shutdown. The resources are generally fully used and the available and used CPU exceeds the previous needs estimates and the pledges. The experiments underwent a vigorous improvement programme to optimise the data models and its distribution, the software efficiency, the simulation and the overall computing frameworks. These improvements, some of which are still in the incipient or development level, are crucial for the overall resources matching, given the expected increase in data and processing needs along with an expected flat budget. No report was given on specific WLCG issues during this session.

Experiments

ALICE

A constant and efficient utilisation of resources is observed by ALICE. The first investigations of the software upgrade project have started. The experiments face a tension in human resources available for computing and will discuss it within the Collaboration.

CMS

The usage by CMS of the pledged resources reaches 90% in average. The ramp-up of the High-Level Trigger (HLT) farm continues; the configuration will be compatible with an inter-fill usage. The various development areas are identified and pursued. A dense agenda is now foreseen including milestones for the software preparation and computing challenges for the RUN II.

ATLAS

The usage of computing resources by ATLAS permanently exceeds by 20-40% the pledges. The HLT farm is now exploited and bursts of over 15 kJobs are observed. At present the analysis activities are the main driver in data traffic at centres. The disk situation is fluid at Tier-2, where the space is dynamically managed with a 20% temporary space, but more blocked at Tier-1. The special accelerated simulation hints towards large speed gains, with physics impact to be carefully qualified in dedicated applications. A task force to improve data analysis model is working on data and analysis models for Run II, with the aim to propose new frameworks for the data challenges to come. The preparation for Run II will proceed through 2014, with a large data challenge expected by summer.

LHCb

The LHCb experiment observes constant and efficient processing, with about 35 kjobs. The HLT farm is in stable usage, with some perturbations due to adjacent work on cooling at the pit. The resources request for 2014 is appropriate, with a slight shortfall of disk in Tier-2s, recovered at T2Ds. A tape space deficit is recovered at CERN in 2014, but may be a problem in 2015 with the expected archival of large data sets. A deficit of person power in computing is observed and will be discussed with the collaboration board.

Conclusions

The Committee congratulates WLCG and the experiments for successful computing and for the conceptual progress in data analysis models. Intensive and efficient computing continues and has a central role in the physics output of the LHC experiments using Run I Data. Simultaneously, the experiments engaged a vigorous preparation of Run II, taking on board the accumulated experience, the technology evolution and the continuous progress observed in the adjacent projects, as for example the speed-up in simulation obtained for the last Geant4 version. The
improvements are obtained or planned in dedicated initiatives within each experiment. Open new opportunities for collaboration between experiments are described in the document “Update of the Computing Models of the WLCG and the LHC Experiments”. Although new ideas and strategies are promising, in the context of a flat budget and as a result of significant mutations in the computing models of the experiments, a significant pressure on human and material resources is expected for Run II. Several milestones are soon expected towards the preparation for data taking in 2015, and the first steps towards the technological updates as foreseen in the released document.

15. TEST BEAMS
The PS and SPS Physics Co-ordinator reported on the LHC test beams. In the PS East Hall, the irradiation facility at the T7 beamline and the DIRAC experiment at the T8 beamline have been dismantled. A new irradiation facility will be built on the T8 beamline and will be ready in summer 2014. In the SPS North Hall, a new Gamma Irradiation Facility, GIF++, is being prepared and it will be available for Users in 2015. He also reported on the PS and SPS User Schedules. All beamlines are fully booked and all major users have been consulted and have agreed to the proposed schedules. The schedules will be released shortly.

16. REFEREES
The LHCC referee teams for this session are as follows:
ALICE: J.-C. Brient, P. Newman, T. Ullrich (Co-ordinator)
CMS: A. Boehnlein (Co-ordinator), M. Demarteau, D. Denisov
LHCb: C. Diaconu, G. Eigen, S. Miscetti (Co-ordinator)
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: N.N.
RD53: M. Demarteau

17. The LHCC received the following documents:
CERN-LHCC-2014-001 LHCb Tracking System Technical Design Report
CERN-LHCC-2014-002 Minutes of the one hundred and sixteenth meeting of LHCC
DATES FOR LHCC MEETINGS

Dates for 2014
4 - 5 June
24 - 25 September
19 - 20 November

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