OPEN SESSION – STATUS REPORTS

1. LHC Machine Status Report: Roderik Bruce
2. ALICE Status Report: Redmer Bertens
3. ATLAS Status Report: Emma Kuwertz
4. CMS Status Report: Jim Hirschauer
5. LHCb Status Report: Preema Pais
6. TOTEM Status Report: Edoardo Bossini
7. WLCG Status Report: Simone Campana

CLOSED SESSION:


Excused: F. Kunne

1. Procedure

The chairperson welcomed the committee members and reminded the committee that the minutes of the previous session were already approved by email.

2. Report from the Director of Research and Computing

The Director of Research and Computing (DRC) reported on issues related to the LHC. The accelerator is running very well, promising another record year, with more than 60 fb\(^{-1}\) feasible at this point. The successful high-energy pp running allows for a look at the programme of special runs and machine developments, for which the guidance of the LHCC will be very valuable. Much focus is currently on the upcoming RRB in October, which should see the final signing-off of the Phase-II money matrix. Some clarification is still needed in this context for the CERN contributions to ATLAS and CMS and the other experiments beyond the specific detector upgrades. For example, the resources for CERN based electronics development, motivated by the need for centralised submissions for example for ASIC designs have to be put in place. The DRC and experiment spokespersons will soon visit Hamamatsu to discuss the delivery of silicon sensors for
both ATLAS and CMS for Phase-II. The DRC also reported that the mandate of the “Physics beyond Colliders” group has been extended until the end of the European Strategy process.

3. **Report from the LHC Programme Co-ordinator**

The schedule changes since the last LHCC were presented. Some delays during the commissioning after TS1 caused the 90m run to end four days later than originally foreseen, however still only a few hours over the allocated budget of one week. Since the luminosity production proceeds well the machine requests more days for MDs. In the discussion this was accepted especially if these MDs are necessary to prepare for a smooth startup in run 3 or to advance in the preparation for HL-LHC.

In spite of some problems causing ~10.5 days of downtime, the data taking proceeds smoothly with an excellent machine availability. The official goal of 60 fb\(^{-1}\) for ATLAS and CMS seems to be attainable (~53 fb\(^{-1}\) have been collected so far) whereas the official goal of 2 fb\(^{-1}\) for LHCb has already been reached. LHCb is nevertheless hoping to collect still more data.

The beam intensities are currently limited to \(1.1 \times 10^{11}\) ppb due to two broken cooling compressors in IR6 and IR8 and due to clogging water-cooling filters in IR2 and IR8. In TS2 these limitations will be removed. So far six beam dumps induced by activity in the 16L2 cell have been observed. A five-hour run with 900 bunches has been established as an empirical recovery procedure after such a dump. So far, the 16L2 induced dumps do not affect the production of luminosity noticeably. However, care has to be taken when trying to increase the beam intensities after TS2 since this could increase the frequency of 16L2 induced beam dumps.

A VdM scan has been performed successfully. The programme required a set of special fills to reduce systematic effects when transferring the calibration from the VdM conditions (single bunches with low pileup) to the physics regime at high pileup with trains. It is not expected that the VdM programme can be simplified in the future since the experiments have to control systematic effects at the sub-percent level.

During the 90m run the requested luminosities have been delivered to the experiments. The machine ran efficiently with bunch spacings of 100ns and 50ns. CMS/TOTEM decided to level at a lower pile-up than originally foreseen, in order not to saturate their data sample with elastic background events. For this reason, the integrated luminosity of 6.12 pb\(^{-1}\) was lower than the originally targeted 8-10 pb\(^{-1}\), but CMS/TOTEM were satisfied with the quantity and the quality of the acquired data.

After the 90m run ATLAS completed a large data sample (250 pb\(^{-1}\) in total) of pp collisions with low pileup, used mainly for their W mass precisions measurements.

For the low E / high \(\beta^*\) special run no configuration has been found so far which would allow TOTEM and ATLAS/ALFA to perform a precision measurement. In previous tests the conditions for TOTEM were found to be acceptable, whereas the background in ATLAS/ALFA was significantly higher and distributed over the signal region, making a meaningful \(\rho\) - measurement impossible. A new collimation scheme has been developed that may improve the situation. The scheme will be tested soon after TS2. Based on the results it will be decided if this special run will be performed this year, or if only one more test to understand the background growth rates at different beam energies (450 GeV and 900 GeV) will be performed before LS2.
The Heavy Ion run is currently being prepared by machine experts. In October a final decision on the beam configuration (75ns bunch spacing or 100ns bunch spacing) will be made. ALICE will continue to level at $1 \times 10^{27} \text{cm}^{-2}\text{s}^{-1}$, mainly to limit the effects of TPC distortions. On the other hand, levelling the peak luminosity in IP1 and IP5 only marginally increases the integrated luminosity for ALICE while it reduces the integrated luminosity for ATLAS and CMS noticeably.

4. Test Beams

The test beams at the PS East Hall and the irradiations have been progressing as expected. There were two noticeable events in the operation of the injector complex up to the PS exceeding 24 hours. On 28th of July the 18kV feeder tripped in the substation in building 269, and then on August 15 a glitch due to an intervention tripped 4 UPS units for the PS Booster. Both power distribution problems generated a cascade of problems resulting in significant recovery times. The user schedule was updated to allow a later run of the P355 (High pressure TPC, for a tentative near detector in a neutrino experiment). A planned beam test of the ALICE ITS project was moved to this summer. Also, the polarised antiproton measurement in T11 (P349) was extended, allowing for a larger data sample. The East Area Renovation project is in full swing, with the civil engineering works completed on the north facade of building 157 and moving on to the south wall. All orders for the main beam line components are out, and the beam lines refurbishment will start right after the end of the proton run in mid-November.

The test beams at the North Area experiences a number of issues. While a more efficient super-cycle, and tightly planned MD programme, led to an expectation of a 20% gain on the number of fixed target cycles, in practice, due to a series of major faults, the number of delivered pulses remains close to the number delivered last year. Notably a failure of a transformer serving the North Area on May 30th took ten days to repair. In addition there were problems on the splitter BLMs in the North Area extraction line, problems on the power converters for the North Area, a vacuum leak on a SPS main dipole, water leaks in the North Area and problems on the HV distribution to the extraction Septum. Concerning the users schedule, CMS replaced its HCAL beam test with tests for the tracker and Ecal. Additional beam time was found for the TIC (R&D for a calorimeter for space applications) and LEMMA (measurement of $e^+e^-$ to $\mu^+\mu^-$ at threshold, for production of low divergence muon beams) as their original beam time was affected significantly by the problems listed above.

The GIF facility is heavily used by the LHC detector upgrade programmes, and beyond. The limited space in the facility limits the number of users which can be served concurrently. An extension of 40m$^2$ is foreseen, and the works and resources needed fit in the overall LS2 planning. Finally, the draft LS2 master planning for the injectors and experimental areas was presented. The tentative restart dates for the proton fixed target programmes are early March 2021 for the North Area, and May 2021 to start the new beam line commissioning in the renovated East Area.

5. Discussion with ALICE

Scientific output and current activities:

- ALICE continues to deliver high quality physics results, with 6 papers submitted since the last session of the LHCC, bringing the total number of publications to
231. Recent results include pp, pΛ and ΛΛ correlations studied via femtoscopy in pp reactions at √s = 7 TeV, a measurement of medium modification of the shape of small-radius jets in central PbPb collisions at √sNN = 2.76 TeV and a measurement of the energy dependence of exclusive J/ψ photoproduction off protons in ultra-peripheral pPb collisions at √sNN = 5.02 TeV.

- ALICE has had a successful year so far, with pp data taking reaching 92% efficiency, and the pp data taking goal on min-bias, high-multiplicity and muon events on track.

- The preparations for PbPb data taking are under way and progressing well. Special pp runs have been taken with particle flux equivalent to PbPb to ensure good PbPb data taking. For PbPb Alice will run at 8 kHz interaction rate, since from about 11 kHz the TPC distortions start to grow faster than linear, however the readout rate is driven by RCU2 and will be kept the same.

Phase-I upgrades:

- An in-depth review of the ALICE upgrade programme took place during the present session of the LHCC.
- The LS2 installation sequence and milestones have been defined in detail and preparatory work and infrastructure has been finalised. The planning of CERN resources needed for LS2 has been agreed upon.
- The ITS project is making excellent progress. The inner barrel is nearly completed, and integration of final readout, cooling and services and commissioning of the whole inner barrel will begin in October. For the outer barrel the schedule preserves a reasonable contingency to completion, provided the nominal production rate is maintained.
- Good progress has been reported on the MFT upgrade: pre-production has been validated for most components and production has begun. The last PRR (Readout) is due in October. A detailed commissioning plan has been defined.
- Steady progress has been reported on the TPC upgrade: GEM production has finished and about 75% of ROCs have been assembled. End of assembly is foreseen for October 2018. Seven final OROCs and 17 final IROCs have been tested at P2. These tests revealed a systematic quality issue of IROC HV connections. A test and repair plan has been developed and an additional new "side-illumination" test in Yale has been added to the QA. All new IROC's produced with extra precautions have not shown any issues. Passivation of high-field regions with epoxy will be applied to all those IROCs at CERN which failed the P2 test. Passivation of all IROC's is still an option. Front-end electronics integration tests are foreseen for the next two months, up to a full sector test (91 FEC and 10 CRU).
- Progress has been reported on the muon system upgrade. The muon identifier part is well on track and has sufficient contingency. The muon tracking upgrade has very limited contingency, which is a cause of concern. An improvement of the DualSampa PCB should improve spark protection. Schedules for the FLEX and PCB are very tight.
- Since the last LHCC the Indian company for CRU production has been selected and the purchase order is in preparation. The committee awaits a detailed status report at the next meeting. The European production could release the Indian production from the critical path.
- The Fast Interaction Trigger (FIT) has entered the production phase. The final
PRR (Readout) is scheduled for March 2019. Due to the delay in delivery of the MCP-PMT sensor the delivery milestone of FIT-C has been moved to March 2019. This makes the schedule for integration within MFT in April 2019 extremely tight.

- The development of the O2 framework is proceeding well but milestones in software development have been delayed. Detector readout, simulation, and reconstruction have been successfully developed for a subset of the detectors.

- The LHCC congratulates ALICE on its continuing rich physics output, and in particular on the progress made on its upgrade programme.
- The LHCC recognises the good progress on the TPC and encourages the collaboration to keep a tight focus and control on the current P2 tests as well as the scheduled full irradiation test of the TPC during LS2.
- The very limited contingency of the muon tracking upgrade is a cause of concern. The LHCC encourages contingency planning to guarantee a thorough test of the complete system during LS2 installation and requests a detailed update on progress by the next LHCC, which should also include a report on completing the MID full chain validator.
- The LHCC is concerned by the rate of progress on the CRU, given the tight schedule for LS2 installation. On FIT the LHCC expects an update on the first production delivery and tests of the MCP-PMT by the next meeting.
- While there is impressive progress of the O2 software performance, the LHCC is concerned about the currently proven performance in data compression and the delay in reaching milestones. The LHCC recommends a review, together with the WLCG, at the next LHCC of the ALICE data formats, network architecture including data flows and latencies, related workflows, and implications for resource demands for Run 3.

6. Discussion with ATLAS

Scientific output and current activities:

- ATLAS continues to make excellent progress on its physics programme, with 786 papers submitted to date, including 40 since the last LHCC. Recent new results include the observation of the Higgs boson decay to b-quarks and tH production, as well as measurements of vector boson scattering and the electroweak mixing angle.
- ATLAS has had a very successful data taking so far in 2018, with a data taking efficiency of about 95%. The detector systems are generally running very well. Commissioning continues for AFP (TOF installation) and FTK. ATLAS Management is currently carrying out an in-depth evaluation of the effort and material needed to complete construction and commissioning of the FTK.
- At the beginning of September, a leak was detected on the LAr Front End cooling (under-pressure system) affecting two crates on the C side of the barrel calorimeter, equivalent to 1/8 of the EM barrel side C (or 1/16 of the EM barrel). The problem has meanwhile been investigated, and the leak was found to be manageable, with all loops currently back in operation. A second redundant vacuum pump was prepared to be switched on in case the air leak deteriorates.
In the muon system the RPC gas leak rate is lower than in previous years, and the increase with time is slower than in previous years.

Phase-I upgrades:

- The LAr and TDAQ Phase-I upgrades are on track.
- A dedicated meeting on the NSW took place during the present session of the LHCC. The project has made substantial progress in understanding the issues but remains a cause of serious concern.
- The NSW VMM3a ASIC residual baseline shift problem can be mitigated by enabling the higher current feedback mode which is part of the stabilizer circuit. Tests with electronics installed on a production chamber should be performed as soon as possible.
- The Micromegas HV problem has been attacked. Improved QC procedures will mitigate one source of problems. A lower working voltage seems acceptable, however, the margin of only ~30V is a cause for concern. In order to develop more headroom against potential HV performance degradation, gas studies will be performed with high priority to evaluate whether the HV working capabilities of the Micromegas can be improved.

Phase-II upgrades:

- ATLAS Phase-II upgrades are progressing with all planned TDRs approved. The HGTD timing layer TDR is expected to be submitted to the LHCC in early April 2019.
- Good progress has been reported on the Phase-II projects, which are on schedule, with MoUs in preparation and further developments of a coordinated and well-defined project management.

- The LHCC congratulates ATLAS on the successful start-up of the detector in 2018 and the large amount of new physics results produced, as well as the good progress reported on the upgrades.
- The LHCC notes that the decision by ATLAS to use one software release to process run 2 data as a way to assure rapid data turnaround has been borne out in practice.
- The LHCC commends the ATLAS Management for quickly moving to perform an in-depth evaluation of the FTK, which is running late in finalising production and in completing the system commissioning. The LHCC encourages the ATLAS management to prepare scenarios in case full commissioning during LS2 will not be possible.
- The LHCC notes that, despite the progress in many areas, the NSW project is still an area for serious concern, in particular for the VMM chip and the Micromegas production. Improvements are evident in the management and control of NSW issues, however the installation of both or even one NSW during LS2 remains in serious doubt.
- The LHCC is very concerned about the long term Micromegas stability and reliability. The LHCC strongly recommends that in parallel to ramping up chamber production, comprehensive gas studies and irradiation tests on full size chambers with final components are carried out on final spec prototypes and the first (pre-) production batches, validating their performance, such that corrective
measures can be initiated in case of problems before the chamber production has progressed too far. The LHCC urges the ATLAS management to avoid any shortcuts on chamber QA and testing due to schedule pressures.

7. Discussion with CMS

Scientific output and current activities:

- CMS continues to make excellent progress on its physics programme, with 796 papers submitted to date, including 47 since the last LHCC. Recent results include the observation of the Higgs boson decay to b-quarks, the observation of $\chi_{b\ell}(3P)$ and $\chi_{b\mu}(3P)$ and new results in a search for low mass $Z'$ in $Z\rightarrow 4\ell$ decays.
- Data taking is proceeding smoothly and with high efficiency of above 94% since the beginning of the 2018 run. CMS has also implemented a “data parking” scheme for B physics data, storing up to 5 kHz of data on tape for analysis with available CPU during LS2.
- At the end of June, after a false fire alarm, one power supply of the endcap HCAL did not recover and replacing it did not recover the respective detector channels, leading to the loss of one wedge (2% of total acceptance). It was found that during recovery this power supply provided substantial overvoltage (due to a rare internal failure mode) damaging the front-end electronics which can only be replaced during LS2. Extra voltage protection has been installed and the failure mode is under analysis by the company.
- The failure mechanism of the problematic DC-DC converters has been fully understood and mitigation measures have been implemented. New chips are already available and will be installed during LS2. A full technical report is in preparation.
- PPS is now an integral part of CMS, and there has also been a first joint publication of TOTEM and CMS.

Phase-I upgrades:

- The Phase-I CMS upgrade is almost complete, providing substantial already during run 2.
- The only remaining part (in addition to improvements for the pixel detector) is the upgrade of the front-end electronics and photosensors of the hadron barrel calorimeter, which is on track for installation during LS2.

Phase-II upgrades:

- CMS Phase-II upgrades are progressing with all planned TDRs and Technical Proposals approved. The timing layer TDR is now expected in early 2019.
- The projects are largely on schedule, with some delays that can either be recovered or are not critical. First studies of pixel sensors in conjunction with the RD53A chip are ongoing. Substantial efforts are also continuing in the upgrade physics study group.

- The LHCC congratulates CMS on its very productive physics programme as well as the substantial progress made on the upgrade projects.
- The LHCC congratulates CMS on the resolution of the DC-DC converter
failures and encourages the publication of the full technical report.

- The **LHCC notes** that preparing CMS for the HL-LHC era requires a substantial investment in infrastructure consolidation and repair, along with the preparation or creation of several new facilities. These are critical for the upgrade programme and there may be a limitation on the availability of the CERN infrastructure groups to deliver all that is needed during LS2. The **LHCC encourages** the experiment to work with CERN technical services to develop a full plan.

### 8. Discussion with LHCb

#### Scientific output and current activities:

- LHCb continues to have a rich scientific output, with a total of 447 publications to date, including 19 new papers since the last session of the LHCC. New results include the first observation of the decay $\Xi_{cc}^{+}\to\Xi_{c}^{+}\pi^{+}$, a measurement of the $\Omega_{c}^{0}$ baryon lifetime and the first measurement of prompt antiproton production in pHe collisions.

- Operations have been very stable for LHCb in 2018 so far. The official target luminosity of 2 fb$^{-1}$ has already been accomplished, with a good chance to reach 2.5 fb$^{-1}$, due to a high data taking efficiency of around 90% and careful fill length adjustments to optimise LHCb data taking.

#### Phase-I upgrades:

- Overall good progress has been reported on the Phase-I upgrades, with most projects proceeding within schedule.

- Good progress has also been reported on the VELO, however here the schedule is tight, although still feasible. The next important steps will be the construction of the first production-grade modules and the C-side RF box.

- The UT upgrade remains critical. The schedule is driven by severe SALT chip delays. The new submission of the chip in September, following simulation studies of the oscillatory behaviour after inclusion of inductive coupling, is expected back in November, and will be the last chance to still be able to install the UT upgrade in LS2. Other parts of the UT upgrade are progressing well, with the hybrids as the next significant challenge.

- A draft computing model TDR has been submitted, which will be examined together with the Software and Computing TDR. There is currently a discrepancy between the resources needed and a flat budget scenario. Mitigation strategies discussed include data size reduction, data parking and further model optimisations. The costs will need to be fully quantified in terms of the equivalent physics gain. Beyond flat-budget scenarios are being explored with the scrutiny group and funding agencies. The TDR will only be endorsed once a reasonable match between projected needs and available resources has been found.

#### Upgrade-II:

- The physics case for the LHCb Upgrade-II has been submitted and assessed by the LHCC.

- The physics case is sound, LHCb would be able to dramatically improve several precision measurements, significantly beyond the reach of LHCb in Run 4 and Belle II. With a flavour physics experiment running in the HL-LHC era the
physics potential of the HL-LHC will be fully exploited. The physics programme is also very much supported by the theory community.

- The feasibility study of adapting the LHCb interaction point to high luminosity running is progressing. The general conclusion is that several possible scenarios have been identified to reach ~50 fb\(^{-1}\) per year in IP8, with however clearly still some open issues, including the cost.

- The LHCC congratulates LHCb on its rich scientific output and successful start-up of data taking in 2018 and commends the collaboration for the progress made on its upgrade programme.
- The LHCC is delighted to observe that the LHCb request of 2.5 fb\(^{-1}\) in 2018 has good chances to be fulfilled.
- The LHCC has strong concerns on the delays in the UT upgrade. The LHCC supports the activities of the LHCb and UT managements in trying to address the issue in the SALT ASIC and in optimising the construction plan for the experiment to successfully complete the UT installation in LS2.
- The LHCC commends the LHCb collaboration for successfully preparing the physics case report for running beyond LS4 and supports the activities of the LHCb collaboration in planning for HL-LHC running through the preparation of TDRs.

9. Discussion with TOTEM

Physics results:

- TOTEM has shown preliminary results on elastic scattering at 2.76 TeV, with evidence for a diffractive dip consistent with earlier observations at 7 and 13 TeV. A joint working group with D0 has been set up, to compare TOTEM results with those in proton-antiproton collisions at the comparable energy of 1.96 TeV. A significant difference would be evidence for odderon exchange in hadronic elastic scattering.
- TOTEM has also shown preliminary results of a new measurement of the 13 TeV cross section, relying on a global fit to the data from the \( \beta^* = 2.5\) km run, with the luminosity determined by the event rate in the Coulomb-dominated region of \( t \). The results are consistent with the published ones from the \( \beta^* = 90\) m data, and can be combined with them, to reduce the overall uncertainty.

Special runs:

- The \( \beta^* = 90\) m run was very successful, yielding 5.82 pb\(^{-1}\). While a fraction of the delivered UFSD timing detectors was not performing nominally, a proper distribution of the better sensors across the detectors and the excellent reconstruction of the timing waveform allowed to achieve the required time resolution of ~50ps. The large rate of elastic events was suppressed via proper calibration of the triggers. Overall the data quality appears excellent, and the preparatory studies toward the data analysis (alignment, optics, tracking, …) are in progress.
- Further analysis of the data collected during the test campaign for the 900 GeV run confirms TOTEM’s confidence that the current LHC configuration would be
good for physics. Only a small reduction in acceptance, increasing the minimum value of $|t|$ from $3 \times 10^{-4}$ to $7 \times 10^{-4}$ GeV$^2$, would be needed, maintaining however ample access to the Coulomb-nuclear interference region. TOTEM is therefore ready for a possible run, following the tests with the newly proposed collimation scheme, which could further reduce their backgrounds. From the experience of the test campaign, two days of data taking should be sufficient to deliver the statistics necessary for the measurement of the $\rho$ parameter.

- **The LHCC congratulates** TOTEM for the thorough exploitation of their data and for the interesting new preliminary results and looks forward to their publication and to a successful 900 GeV run.
- **The LHCC urges** TOTEM to present a plan for the evolution of the detector in view of the completion of their physics programme during run 3.

10. **Discussion with WLCG**

The LCG and the computing systems of the experiments are working well. The heavy ion run will produce significantly larger data rates, but the systems seem well prepared for it. The resource plans of ATLAS, CMS, and ALICE for LS2 and run 3 are within the flat-budget scenario (except for tape for ALICE). The upgrade of LHCb is expected to result in a 10 times higher event output rate with a raw event size increase by a factor of 3. A reduction by a factor 2.5 is assumed, to be achieved by reducing the event level information to that needed in analysis (TURBO) for 3/4 of the analyses.

R&D for HL-LHC computing is progressing in various areas, with much progress reported for example for the CMS data model. The committee acknowledges the progress towards a change of culture of sharing solutions and appreciates the efforts of securing the human and financial resources for the required R&D projects. The HSF CWP was crucial input for the successful IRIS-HEP funding application, which is a very positive example of funding for software development.

- **The LHCC congratulates** the WLCG and the experiments on the successful and efficient use of the computing resources.
- **The LHCC encourages** LHCb to continue the investigations of using TURBO for further analyses. Compression algorithms should be considered.
- **The LHCC recognises** that in order to fully exploit the data taken by the upgraded LHCb detector, a storage resource increase beyond the flat budget scenario might be unavoidable.
- A mechanism to prioritize requests for resources at CERN should be established.

11. **Report on FASER and MATHUSLA**

**The common physics context:**

The physics underlying these Letters of Intent addresses the elusive signature of possible new long-lived, weakly-interacting neutral particles. Such states appear in a multitude of theories beyond the Standard Model, and their search is stimulating nowadays a huge interest, both at the LHC and elsewhere. A large community effort is on-going to propose analysis strategies and possible detector and trigger upgrades within the scope of the
ATLAS, CMS and LHCb experiments. But these studies also show the need for
dedicated experiments, to detect with large efficiency the decay into visible tracks of
these long-lived particles, in absence of trigger and backgrounds limitations. Given the
relevance of the physics scenarios addressed by these experiments, and given their
potential reach, the physics case of FASER and MATHUSLA is strong and the proposed
experiments offer a great opportunity to extend the exploratory potential of the LHC.

FASER

FASER proposes a magnetized tracking telescope, located at approximately 480m
downstream the ATLAS IP, in an unused service tunnel connecting the SPS and the
LHC. A ~1.5m long cylindrical decay volume, of 10cm radius, is embedded in an
alternating sequence of short 0.5T magnets, silicon tracking stations and scintillator
timing/trigger planes. A scintillator/Pb layer in front of the telescope vetoes incoming
tracks and photons, and a Pb/scintillator calorimeter at the back acts as EM calorimeter.
Key components of the detector would be made available by ATLAS (spare STC
modules for the tracking stations) and by LHCb (the EM calorimeter). Excavation work
is needed in the service tunnel, to properly align the telescope towards the IP. The
proponents are competing for a ~1.5MCHF grant, which would allow to cover all costs
of the experiment. Construction and installation are planned to take place during LS2,
with operations throughout run 3. The referees have presented the proponents with a set
of questions, to be documented, with the answers, in an addendum to the LoI. An
emulsion detector is currently taking data at the proposed FASER location, and the first
results confirm the background simulations. Overall this appears as a good low-risk/low-
cost investment.

- The LHCC considers the FASER physics case valid, offering a great opportunity
to explore new domains of BSM phenomena, cheaply and rapidly.
- Given the timescale for the realization of the project, and the funding opportunity
offered by the possible grant, the LHCC encourages the FASER collaboration
to prepare a Technical Proposal, to be reviewed possibly at the next LHCC
meeting. Among other things, the TP must address: a detailed assessment of the
impact of construction and installation on LS2 operations and on CERN’s
technical support, endorsed by the relevant groups at CERN; the confirmation
from ATLAS and LHCb of the availability of the promised hardware
components, and an up-to-date estimate of the costs to be borne by the
collaboration and by CERN, including civil engineering, tunnel infrastructure,
etc.; the collaboration structure and share of responsibilities, including the
appointment of a senior engineer to oversee the technical planning and the
construction phase.

MATHUSLA:

MATHUSLA proposes a large decay volume, located at the surface above IP1 or IP5. A
base surface of 100 x 100 m², with a height of 20m, is considered as a baseline reference.
Five tracking layers, separated by 1m each, lie on the upper part of the detector. In
addition to reconstructing the decay vertex of signal events, a 1ns time resolution allows
these layers to veto the cosmic ray background. A further layer(s) located at the bottom
of the decay volume is under consideration, to improve the signal efficiency and to veto
tracks from the IP. The whole detector is meant to be assembled out of 10 x 10 m²
individual modular towers. While the overall design and strategy to isolate the signal and
suppress backgrounds are clearly discussed and appear rather robust, the design still includes many variables and options, ranging from the geometry and location on the surface (including the possibility of having the decay volume underground) to the choice of technology for the tracking stations (RPC or scintillators). This reflects also on the difficulty to assign a precise price tag to the project, which appears to be in the several 10MCHF range. The referees have presented the proponents with a set of questions, to be documented, with the answers, in an addendum to the LoI.

Current assessment and LHCC recommendations:

- The LHCC considers the MATHUSLA physics case to be valid, covering large new domains of BSM phenomena. In addition, the detector can help decoding the origin of possible MET signals from ATLAS/CMS. The coverage of parameter space (lifetime vs mass), particularly suitable to cover the heavy-mass range, is well complementary to FASER. A potentially rich programme of cosmic ray measurements, in the interesting energy range of $10^{14-17}$ eV, is under study and will be documented in a white paper soon. A test stand is currently taking data at IP1 and will provide valuable input for the validation of the background simulations.

- The LHCC is willing to follow the progress of the detector design when major detector design steps have been taken or the physics scope has evolved, but, considering the size, cost and infrastructure impact of MATHUSLA, the LHCC recommends that the proposal be first discussed in the context of the PBC and the European Strategy process, especially since it has a large overlap with the physics programme of other proposed experiments (for instance SHIP). This proposal uses a unique handle on backgrounds in exploring long lived particles produced at the LHC. The LHCC encourages the proponents of this energy frontier experiment to continue simulation, design and prototyping efforts in parallel with the formal consideration process. When (if) moving to the technical proposal level, it should come back to the LHCC for review.

12. Report on the extension proposal for RD53

RD53: Development of Pixel Read-out Integrated Circuits for Extreme Rate and Radiation

During the June session of the LHCC, RD53 was encouraged to submit an extension proposal that would allow to continue and reinforce the operation of RD53 as a single design team. Institutions involved were urged to keep the current (number of) experienced people fully committed until the end of the project, i.e. until fully functional chips are available for both ATLAS and CMS.

The LHCC received and reviewed the RD53 extension proposal during the present session of the LHCC and found it to be in line with the conclusions of the June session.

- The LHCC endorses the request for a 3-year extension of RD53, bringing the end-date of the project to the end of 2021. A review will be conducted during the September 2021 session of the LHCC to determine if a further extension will be necessary.

13. General Comments

The following comments are applicable to more than one project.
• It is important to set up a well-defined tracking mechanism for the Phase-II projects. Two Phase-II Upgrade Groups (P2UG) are in preparation. Prospective chairs have been identified and the initial mandate has been prepared and is being discussed. Meetings will be held twice a year to track project execution. Central support will be provided for milestones tracking.
• An HL-LHC computing strategy review committee will be set up to guide the process leading to the TDR, also intended to solicit new ideas from both within our field and from other areas of science and industry.

14. REFEREES
The LHCC referee teams for this session are as follows:
ALICE: C. Bloise, J. Dunlop, P. Newman, C. Sfienti (Co-ordinator)
ATLAS: V. Beckmann, R. Calabrese, F. Kunne, W. Wisniewski (Co-ordinator)
CMS: D. Denisov (Co-ordinator), E. Kajfasz, A. Kuzmin, D. Waters
LHCb: P. Krizan (Co-ordinator), K. Krüger, T. Kuhr, M. Kuze
LHCf, MoEDAL, TOTEM: C. Bloise, A. Kuzmin, M. Mangano (Co-ordinator),
   P. Newman
LCG: V. Beckmann, J. Dunlop, T. Kuhr (Co-ordinator), D. Waters
FASER:
MATHUSLA:
R&D projects:
   General: E. Kajfasz (Co-ordinator)
   RD53: E. Kajfasz, R. Calabrese

15. The LHCC received the following documents:
CERN-LHCC-2018-018 Minutes of the one hundred and thirty-fourth meeting of LHCC held on 30-31 May 2018
CERN-LHCC-2018-025 LoI: A dedicated displaced vertex detector above ATLAS or CMS (MATHUSLA)
CERN-LHCC-2018-027 Physics case for an LHCb Upgrade II
CERN-LHCC-2018-030 LoI: Forward Search experiment at the LHC (FASER)

DATES FOR LHCC MEETINGS
Dates for 2018
28 Feb - 1 Mar
30-31 May
12-13 September
28-29 Nov
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