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ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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**RESEARCH BOARD**

**MINUTES OF THE 248th MEETING OF THE RESEARCH BOARD HELD ON WEDNESDAY 6 MARCH 2023**

Present F. Alessio, R. Bello*, T. Bergauer, T. Cass, K. Foraz*, R. Forty (Secretary), F. Gianotti (Chair), G. Giudice, B. Goddard, H. Heylen, E.B. Holzer, J.M. Jimenez*, R. Jones, M. Krammer, M. Lamont, J. Mnich, J. Nash*, M. Pfutzner, S. Roesler (replacing B. Delille), F. Simon

*via video

Apologies B. Delille, E. Porcari

Items

1. Procedure
2. News and announcements
3. Decision on the experiment(s) for the ECN3 upgrade
4. Report from the SPSC of 6-7 February
5. Report from the INTC of 7-8 February
6. Report from the REC of 8 February
7. Report from the LHCC of 28-29 February
8. Any other business

## 1 PROCEDURE

1.1 F. Gianotti opened the meeting. The minutes of the last meeting [1] were approved without modification. There were two matters arising from items 3.2 and 7.24 of those minutes, concerning DRD3 and nTOF respectively, that are discussed in the following paragraphs.

1.2 A new R&D collaboration on solid-state detectors, **DRD3**, was preliminarily approved at the last meeting so that work towards establishing the collaboration could progress. Approval was on the condition that the new collaboration structure be established in a timely fashion following the guidelines provided by the DRDC, and the new management appointed. T. Bergauer gave an update on developments that had been reported at the recent meeting of the DRDC. Although there has been progress, notably in the election of the spokesperson and Collaboration Board chairperson, the DRDC remains concerned that the timeline for formalising the full management structure is lengthy. The DRDC is also concerned about feedback it has received from the community about the lack of inclusivity and transparency in the setting up of the management structure, and strongly suggests that a wider consultation takes place in the Collaboration Board regarding this process, in particular the election of working group and/or work package convenors. **The Research Board endorsed the recommendation of the DRDC that the current provisional approval status of DRD3 be extended, until the management structure has been fully defined and the proposal updated. The importance of the DRDC recommendations being taken onboard was emphasised, and in case this is not accomplished in a transparent manner by the time of the next DRDC meeting in June, an alternative approach for establishing the collaboration would need to be sought.**

1.3 A letter of intent had been submitted to the previous INTC meeting concerning the proposed future experimental programme at **nTOF** on the short (until the end of LS3) and long (LS4 and beyond) timescale, along with the needed facility upgrades. Approval of the long-term programme will depend on priorities and guidance from the next update of the European Strategy for Particle Physics (ESPP), while the short-term plans require scrutiny by the technical teams. B. Goddard reported on the set of proposals for possible upgrades that have been made by the collaboration. More detailed input is needed to define the technical requirements so that the accelerator teams can evaluate feasibility, timelines,

costs and resources. The definition of a complete and prioritised list of items for LS3 is ongoing. Concerning possibilities in LS4 and beyond such as a new target and measurement station, a task force has been set up with the collaboration to define neutron beam characteristics, as an input to define the target technology, and will produce a specification for the neutron beam later this year. For this long-term part of the programme, clear perspective on the future of the facility is needed, including physics directions. F. Gianotti noted that plans and priorities for LS4 and beyond will be a topic for discussion in the context of the next ESPP update, for which the deadline for input is expected to be March 2025. Any changes to nTOF that are proposed to be implemented in the short term will be subject to the usual arbitration as part of the annual Medium-Term Plan (MTP) process.

## 2 NEWS AND ANNOUNCEMENTS

2.1 F. Gianotti reported that the mid-term review of the Feasibility Study for the FCC had been completed with an extraordinary session of the Council on 2 February, and had been very well received by all the review committees, which noted the huge progress that has been made so far. No technical showstoppers have been identified, although many topics require further work, such as preparing for the best use of spoil from the tunnelling. The funding model also needs further development. It is planned to complete the study in March 2025.

2.2 The schedule for the next ESPP update will be proposed at the forthcoming Council week, with the intention of the Strategy being prepared ready for update by the Council in June 2026. The deadline for the community input to the process would be set at the end of March 2025. F. Gianotti clarified that the next update is intended to be a full Strategy process, covering all aspects of the field. Concerning a future collider at CERN, the Council will most likely ask for a preferred scenario along with alternatives.

2.3 The CERN management has prepared a policy on private donations for the core scientific programme, to be submitted to Council for feedback in March and approval in June. This goes beyond the existing policy, developed in the framework of the CERN & Society foundation, which only targets donations to projects related to societal impact and public engagement such as the Science Gateway, and may be relevant to the funding of a future

collider. Appropriate recognition will need to be provided to donors while not allowing them to influence scientific choices.

## 3 DECISION ON THE EXPERIMENT(S) FOR THE ECN3 UPGRADE

3.1 J. Mnich recalled that, at previous Research Board meetings, two options had been discussed for the experiments to use the upgraded beams serving the **ECN3** experimental area: one option was a possible coexistence of the HIKE and SHADOWS experiments, for kaon and feebly interacting particle studies; the other was SHiP making use of a Beam Dump Facility (BDF) for feebly interacting particle studies. The SPSC did not give a clear recommendation between the two options: the physics case was considered to be strong for both, and the SPSC considered that the choice should be based on other arguments, while recommending to focus on kaon physics if the first option were to be chosen. Since then additional discussions have taken place between the CERN Directorate and theorists on the physics case, confirming the split opinions, and a questionnaire was sent to the three experiments to expand on issues including the needed and available financial and human resources, technical aspects and risk. After scrutiny and direct verification with the funding agencies, the financial contributions estimated in the proposals turned out to be over-optimistic in all three cases; in addition CERN will have to cover significant responsibilities as the host laboratory, with a consequent limited financial margin to contribute to the detector. As a consequence, the chosen collaboration will be asked to develop plans to stage or descope their experiment to match the available resources. Based on the presented experimental programme of both proposals, the Directorate proposed to the Research Board that SHiP be selected. F. Gianotti commented that this was a hard choice; the possibility to run both experiments in sequence was explored but was not considered to be feasible. She emphasised that it is exciting to be able to approve a future facility that will provide world-leading results; sustaining a diverse physics programme at CERN will remain essential also in the long term, and delivery of protons for that purpose can be foreseen beyond the lifetime of the HL-LHC exploitation. **The Research Board approved SHiP/BDF to move forward to the Technical Design Report (TDR) phase in preparation for installation in ECN3. The detailed layout of the experiment for the initial configuration will need to be developed in consultation with funding agencies and CERN. In parallel, a staged/descoped detector scenario should be developed as a**

**risk mitigation strategy, which would only be implemented if the gap between the needed and the available resources could not be bridged. The layout along with the staged/descoped scenario should be developed on a time scale of about a year and be reviewed by the SPSC.**

## 4 REPORT FROM THE SPSC MEETING OF 6-7 FEBRUARY

4.1 J. Nash reported from the latest meeting of the SPSC [2], including the annual review of the **AD** experiments GBAR, AEGIS, BASE, ALPHA, ASACUSA, and PUMA. The committee also received an addendum to the P348 proposal by the NA64 collaboration, regarding the search for dark matter with a positron beam and an updated spectrometer, and recognises the value of an enhanced sensitivity to dark mediators at large masses via resonant annihilation. The SPSC recommended the approval of the beam time requests of CLOUD in the T11 beamline and of WCTE (2-3 weeks), both at the end of the 2024 run.

4.2 **GBAR** continued to make progress on the different parts of the experimental setup, in particular with the installation of the antiproton trap and the increase of the positron production yield. The SPSC looks forward to the results of the planned experiments to measure the reaction cross-sections for antihydrogen production and the Lamb shift, and to the optimisation of the experimental setup to achieve a high antihydrogen production yield.

4.3 **AEgIS** has made progress in Phase 2 of the experiment, including a recent publication on positronium laser cooling. The SPSC looks forward to seeing an increase in the antihydrogen production rate, after the resolution of the vacuum problems seen in 2022 and the problems with the positronium target, as well as the installation of the new positron source. The committee looks favourably to the completion of the Moiré interferometer for the gravity tests and for further results on antiprotonic atoms.

4.4 **BASE** has achieved the first coherent spin flip of an (anti-)proton in a Penning trap, and significantly improved detection precision and overall cycle time. With the successful trapping of antiprotons from the ELENA beamline, the SPSC anticipates with interest an improved measurement of the antiproton $g$-factor. The committee supports the request of BASE for several months of operation in a quiet environment without beam, needed for precision measurements, and encourages discussions between the AD collaborations

affected to optimize the scheduling of this time. The SPSC acknowledges the importance of BASE-STEP to push the measurement precision beyond the possibilities within the AD hall and congratulates the team for the successful commissioning of the magnet and trap.

4.5 **ALPHA** had a very successful year in 2023, including the publication of the first results on the sign of gravity for antimatter, the first demonstration of sympathetic cooling of positrons, which is important to reach much colder samples, and improved results on the 1S-2S transition and on the measurement of the Lamb shift. The SPSC notes with interest the implementation of the micro-channel plate detection scheme, which opens the door to a direct comparison between gravity measurements with hydrogen and antihydrogen. The SPSC looks forward to a decrease in the consumption of liquid helium, made possible by the installation of a new transfer line.

4.6 **ASACUSA** has re-established antihydrogen production and solved a helium leakage problem into ELENA. The SPSC is eager to see first results concerning the antihydrogen beam formation and the newly developed induction decelerator for the antiprotonic helium experiment.

4.7 **PUMA** has continued to make progress in the completion of the different parts of the experiment: the offline ion source, the antiproton pulsed drift tube, the traps and detectors. The SPSC looks forward to seeing the first complete setup in 2024, as well as the completion of the beamline at ISOLDE.

4.8 Concerning the **M2 muon beamline** schedule, the SPSC supports the NA64 request for an extended run before LS3, to cover the light Z′ mediator parameter space suggested by the muon $g-2$ anomaly; the scenario in which the data-taking occurs in a single run of at least five weeks is recommended, exploiting the AMBER down-time in 2024. The SPSC supports the AMBER request for a pilot run at the end of the SPS proton beam time in preparation for the proton-radius measurement, advising that the necessary equipment be commissioned as completely as possible. The SPSC supports the request of additional test runs at the M2 beamline for the AMBER Drell-Yan and MUonE setups, provided that they have a minimal impact on the possible physics runs in 2024 and do not constrain the antiproton run to last less than six weeks.

4.9 Concerning the proposed **low-energy beamline** for NA61, the SPSC recognises the important contributions that measurements at the H2 beamline with low-energy hadrons would make for several atmospheric and accelerator-based neutrino experiments, as well

as for spallation neutron projects, even if made after LS3. The committee received with interest an engineering change request that details the technical feasibility of this option and takes note that the proposed programme cannot be carried out in the PS with the existing apparatus. The SPSC encourages the proponents to further involve the concerned neutrino experiments (especially the longer-term future projects) in the procurement of the necessary resources and to establish a plan for the corresponding post-LS3 beam time requests, taking into consideration that the H2 beamline serves many users. **The Research Board confirmed that installation of a low-energy beamline serving the NA61 experiment could only be considered after LS3 and would require submission of a new proposal.**

## 5. REPORT FROM THE INTC MEETING OF 7-8 FEBRUARY

5.1 M. Pfutzner reported from the latest meeting of the INTC [2]. In 2023, forty target and ion source units were manufactured for **ISOLDE** and MEDICIS operations as well as for offline developments, with successful operation of several non-standard units. The efforts to address the backlog in eliminating old targets include 37 targets that have been dismantled and conditioned for elimination. Activities in the Year End Technical Stop (YETS) included upgrades aimed at addressing target coupling issues encountered in recent years and the ongoing extension work for B197. A comprehensive Cost, Scope & Schedule review for the ISOLDE Improvement Programme took place in December, during which equipment groups presented their plans, budgets and scheduling strategies; an ongoing review and arbitration process is underway. **MEDICIS** had a year of significant success in 2023: a record efficiency was attained for Ra, underscoring advances in operational capabilities, with 25 radioactive transports executed efficiently. The delivered activities have shown a steady increase since its start in 2018, and a review of MEDICIS up to LS3 received positive community endorsement, affirming its pivotal role in the production of novel radioisotopes for medical purposes.

5.2 Tasks carried out during the YETS for **nTOF** included routine maintenance and endoscopic magnet checks in the TT2A line, and an upgraded design of the SEM grid detector in the FTN line that features an enlarged aperture, leading to increased beam clearance and the anticipated reduction of beam losses. The spallation Target #2 autopsy and waste packaging review identified challenges related to the size and incompatibility of

Al with mortar, requiring development of a specific conditioning solution for the target; no showstoppers were identified and the proposed timeline was approved, pending a final dry run in ISR8. For the first half of the 2024 running period, the preliminary allocation is for $12.2 \times 10^{18}$ protons to EAR1 and $8.2 \times 10^{18}$ protons to EAR2, providing beam to eight experiments.

5.3 Thirteen proposals (including a letter of clarification) plus two letters of intent were granted shifts at ISOLDE, and four proposals plus two letters of intent were granted protons at nTOF, as listed in the following paragraphs. In total, 206 shifts at ISOLDE (out of 242 requested) were recommended for approval, and $27.25 \times 10^{18}$ protons for nTOF (all of those requested). **The Research Board approved the INTC recommendations for the ISOLDE shifts and the nTOF proton delivery.**

5.4 **CLL-057** *Probing the doubly magic shell closure at $^{132}$Sn by Coulomb excitation of neutron-rich $^{130,134}$Sn isotopes* [3] was **approved for 18 shifts** and will continue to be known as **IS702**.

5.5 **I270** *Using in-trap decay to provide inaccessible and low-yield isotopes to the ISOLDE facility* [4] was **granted 6 shifts**.

5.6 **I272** *Development of neutron-rich Cu ion beams* [5] was **granted 6 shifts**.

5.7 **P593 Add.2** *Terbium-149 for targeted alpha therapy* [6] was **approved for 14 shifts** and will continue to be known as **IS688**.

5.8 **P684** *Single-proton-hole orbitals in the N=126 nucleus $^{205}$Au* [7] was **approved for 16 shifts** and will be known as **IS746**.

5.9 **P685** *Laser and nuclear decay spectroscopy study of the neutron-rich high-spin states in the $^{212,213}$Bi isotopes with LIST* [8] was **approved for 10 shifts** and will be known as **IS747**.

5.10 **P686** *A study of seniority-2 configurations in N=126 and 124 isotonic chains* [9] was **approved for 10 shifts** and will be known as **IS748**.

5.11 **P687** *Emission Mössbauer spectroscopy of topological kagome magnets* [10] was **approved for 11 shifts** and will be known as **IS749**.

5.12 **P688** *Measurement of neutron capture cross section on $^{134}$Cs through surrogate reaction (d,pγ) at ISS* [11] was **approved for 25 shifts** and will be known as **IS750**.

5.13 **P692** *Charge states of transition metal ions and local magnetic structure of dilute magnetic semiconductor (Ga,Fe)N:Mn – an emission Mössbauer spectroscopy study* [12] was **approved for 8 shifts** and will be known as **IS751**.

5.14 **P694** *Spectroscopic factors in the r-process nucleus $^{135}Sn$* [13] was **approved for 24 shifts** and will be known as **IS752**.

5.15 **P695** *Mapping single-particle neutron strength towards the mid-shell in semi-magic lead isotopes* [14] was **approved for 15 shifts** and will be known as **IS753**.

5.16 **P696** *Magnetic origins of epitaxial MAX phase $Mn_2GaC$-based thin films probed by Emission Mössbauer Spectroscopy* [15] was **approved for 7 shifts** and will be known as **IS754**.

5.17 **P697** *Probing the local environments and optical properties in halide perovskites with short-lived radioactive isotopes* [16] was **approved for 15 shifts** and will be known as **IS755**.

5.18 **P698** Laser & decay spectroscopy and mass spectrometry of neutron-rich mercury isotopes south-east of $^{208}$Pb [17] was **approved for 21 shifts** and will be known as **IS756**.

5.19 **I269** *γ-ray production by high energy neutrons in water* [18] was **granted 3.3 × $10^{18}$ protons**.

5.20 **I271** *Neutron detection efficiency measurements of NMX detector with enriched $^{155}Gd$ and $^{157}Gd$ converters at EAR2* [19] was **granted 5 × $10^{16}$ protons**.

5.21 **P507 Add.1** *Measurement of the $^{235}U(n,f)$ cross section relative to n-p scattering up to 1 GeV* [20] was **granted 4.7 × $10^{18}$ protons** and will continue to be known as **nTOF52.**

5.22 **P689** *Study of $n+^{63,65}Cu$ reactions and their relevance for nuclear technologies and astrophysics* [21] was **granted 8.0 × $10^{18}$ protons** and will be known as **nTOF86.**

5.23 **P690** *Activation measurements of the $^{135}Cs(n,\gamma)$ cross-section at nTOF-NEAR* [22] was **granted 6.2 × $10^{18}$ protons** and will be known as **nTOF87.**

5.24 **P693** *Measurement of the zirconium-88 neutron absorption cross-section at EAR2* [23] was **granted 5.0 × $10^{18}$ protons** and will be known as **nTOF88.**

## 6 REPORT FROM THE REC MEETING OF 8 FEBRUARY

6.1 J. Mnich reported from the latest meeting of the REC [2]. One new request for Recognized Experiment status had been received from ePIC, and seven extension requests from MAGIC, CTA-PP, CALET, Mu3e, DarkSide-20k, COSINUS, and CRESST, discussed in the following paragraphs. **Hyper-Kamiokande** was approved as RE45 last year, but had made very significant requests at the time of the last meeting, going far beyond those typically associated with the status of a Recognized Experiment. Following contacts between Hyper-Kamiokande and CERN, the requests have been moderated and are now compatible with the RE status. Assembly activities for the experiment can be accommodated by the CERN Neutrino Platform.

6.2 **ePIC** is the first experiment proposed at the future electron-ion collider (EIC) at BNL (US). It is designed for research on strong interactions in regions complementary to existing facilities (e.g. ALICE and the North Area experiments). The DoE review process is underway, with a combined CD2/CD3 stage (construction start) expected in mid-2025, and data taking from 2030 on. DoE funding is linked to the review process, and commitments by other funding agencies are being made. There are 43 collaborators from CERN Member States, and synergies with CERN for detector technology, DAQ and computing. A dedicated agreement is being negotiated concerning the ALICE ITS3 technology that is of interest for ePIC, with two engineers from the collaboration to be based at CERN. The REC recommends that recognition be granted, on the understanding that, as for any other RE, it shall not imply granting of test-beam time, which will need to be applied for separately. **The Research Board granted Recognized Experiment status to ePIC as RE47 for an initial period of three years.**

6.3 The following recommendations were provided by the REC concerning the extension requests. **MAGIC** (RE17 since 2008) is recommended for extension by three years; their computing resource requests are at the limit of what should be done for a RE and should not increase. **CTA-PP** (RE23 since 2011): establishing the ERIC (European Research Infrastructure) organisation has been delayed for reasons outside their control; once the ERIC is established, CTA wishes to conclude a collaboration agreement with CERN similar to that of SKAO; the experiment is recommended for extension by three years or until the ERIC is established, whatever is sooner. **CALET** (RE25 since 2012) is recommended for extension by three years on the understanding that this shall not imply

granting of test-beam time, which will need to be applied for separately. **Mu3e** (RE36 since 2018), **DarkSide-20k** (RE37 since 2018), **COSINUS** (RE41 since 2021) and **CRESST** (RE42 since 2021) are all recommended for extension by three years. **The Research Board approved all of the recommended extensions for RE17, RE23, RE25, RE36, RE37, RE41, and RE42.**

6.4 COSINUS and CRESST were recognized in 2021, and along with **NUCLEUS** they form a collaborative "cryocluster" of experiments for dark matter and neutrino studies; NUCLEUS was initially rejected for RE status but was subsequently recognised after progress had been made. As a result, the three-year extension cycle is not synchronised between the collaborations, while it would be desirable to consider them at the same time. The REC recommends synchronising NUCLEUS with the others, for example by running a lightweight procedure for a one-year extension of NUCLEUS in 2026 and then considering all three in the standard way in 2027. **The proposal to synchronise the RE status of COSINUS, CRESST and NUCLEUS was endorsed by the Research Board.**

## 7. REPORT FROM THE LHCC MEETING OF 28-29 FEBRUARY

7.1 F. Simon reported from the latest meeting of the LHCC [2]. Significant maintenance and consolidation work took place successfully during the YETS for all of the LHC experiments. A shift of the 2024/25 YETS by six weeks is under discussion, which would extend pp running in 2024. The duration of the YETS (19 weeks) will not change at the LHC, whereas the injectors will gain four weeks of physics. The LHCC recognises the operational benefits of the shift of starting date and notes that this change can be accommodated by the experiments and would have significant benefits for test beams due to the longer availability of the injectors in 2024, but would have negative impact on SND and FASER. The LHCC also notes that collection of the largest possible data set during pp running is the highest priority for the 2024 run. The LHCC therefore expects that SND and FASER plan for maximal flexibility of emulsion exchanges during 2024 to avoid any interference with LHC operations, making use of planned stops and opportunistically arising downtimes of sufficient duration; SND and FASER are encouraged to explore means to further increase flexibility, such as an alternative storage solution at Point 1. Four fast dumps of experiment magnets occurred in 2023, two each for ATLAS and CMS. The LHCC is impressed by the thorough investigation that has been made and notes the

excellent collaboration of the CERN cryogenic teams and the technical coordination of the experiments. The LHCC fully supports the measures implemented to improve the robustness of the systems and to reduce the risks in the operational procedures. **The Research Board restated that FASER and SND emulsion exchanges in 2024 must not interfere with the LHC operations, and that planned stops and opportunistically arising downtimes should be used for these interventions.**

7.2 **ALICE** has maintained a steady rich physics output with high-impact results. Pb-Pb data-taking in 2023 was successful with the fully operational upgraded detector, allowing enhanced statistics compared to Run 2. The source of field distortions in the TPC (related to a leak in a cooling pipe) has been identified and mitigated. The PHOS detector is operated by Russian teams, and the possible extension of the 2024 run would require its decommissioning prior to the heavy-ion period. The LHCC recognises the progress in calibrations, alignment, reconstruction and simulation. Given the plan for Pb-Pb data taking in both 2024 and 2025, the LHCC notes that a robust and reliable apparatus is required to fully exploit this opportunity and a maximum commitment by the collaboration will be needed. The LHCC commends the clear road map for the 2024 run preparation and supports the request for additional disk space of 30 PB to gain operational margin. The LHCC encourages the collaboration to complete the ALICE 3 Scoping Document for April, define the optimal magnetic field strength and bore radius, and finalise the decision about the inclusion of the calorimeter in the baseline; the impact on key physics channels of using the existing L3 magnet instead of a new higher-field solenoid should be clearly documented. **The Research Board emphasised that the option of reusing the existing magnet should feature as one of the scenarios in the Scoping Document for ALICE 3.**

7.3 ALICE submitted two TDRs for upgrades to be installed during LS3, for the **ITS3** [24] and **FoCal** [25]. ITS3 is a new pixel vertex detector intended to significantly improve heavy flavour measurements and measurements of the QGP temperature from $e^+e^-$ pairs in Run 4. It is an all-silicon detector made of MAPS and using bent wafers and stitching technology. A light-touch Upgrade Cost Group (UCG) review of the costing found it well motivated and of appropriate quality, the schedule is well-understood with appropriate contingency, and a reasonable analysis has been made of the main project risks. The Forward Calorimeter (FoCal) upgrade will enable the study of gluon saturation and non-linear QCD evolution by measuring forward isolated photons, mesons, jets, particle

correlations and quarkonia, and the exploration of jet quenching at forward rapidity, investigating the origin of long-range correlations. It comprises a Si-W ECAL with pads and pixel layers, and a Cu-scintillating fibre HCAL. There has been an extensive R&D programme since 2010, as part of the CALICE R&D programme, and FoCal also profited from the CMS HGCAL developments. The UCG review found the detailed schedule and milestones to be credible; descoping/staging scenarios exist, which would be easy to implement if needed, and the risks are reasonable for the phase of the project. The LHCC recommended approval of both TDRs. **The Research Board approved the ALICE ITS3 and FoCal TDRs.**

7.4 **ATLAS** has a wealth of very interesting new physics results produced with both Run 2 and Run 3 data. The LHCC notes that the coverage of central shifts is more challenging than expected and stresses the importance of broad participation of the collaboration in this essential aspect of operations. Triggers have been prepared for the start of the run and the cause of lower efficiencies in the 2023 Pb-Pb run has been understood; the LHCC looks forward to seeing all the Phase-1 triggers fully operational during this year. The LHCC is pleased to see that the areas of computing and software are making steady progress, and the Computing and Software TDR is on schedule for 2025.

7.5 **CMS** has a wealth of very interesting new physics results produced with both Run 2 and Run 3 data and has made thorough and timely preparation for the upcoming run. The LHCC congratulates CMS for the successful YETS operations, during which all planned work was carried out, including repair of a broken crane. The LHCC looks forward to the findings of a Task Force on “Time to Publication” and appreciates the reported progress on the W mass analysis. The LHCC recommends that CERN works with CMS to establish security measures in response to the recent thefts of material at Point 5. The LHCC appreciates the efforts on recuperation of R134a and the progress towards recuperation of SF6; ongoing efforts and decommissioning of cooling systems in LS3 are expected to result in a reduction of yearly emissions from 80 kt$CO_2$e in 2012 to 15 kt$CO_2$e in Run 4. The LHCC encourages the collaboration to pursue strategies to further reduce R134a leaks from the RPC barrel system and to increase the effort on the ageing tests using alternative mixtures/gases.

7.6 The **Phase-2 upgrades** of ATLAS and CMS continue to make excellent progress, but both existing and new technical problems, as well as supply chain issues, have resulted in

renewed moderate loss of schedule, making it consistent with zero float for the most critical projects. The LHCC takes note of the success of the interactions with the Fraunhofer Institute for Manufacturing Engineering and Automation, and encourages the collaborations to perform similar exercises for other projects with critical schedule situations. The LHCC notes that several upgrade projects require additional personnel and resources to proceed on schedule and urges the collaborating institutes and funding agencies to respond to this need. The personnel of the technical support groups at CERN is limited and, given the significant needs in LS3, the LHCC recommends that CERN technical support groups carefully plan their work schedule and assess their personnel in order to be compatible with the experiments' installation plans.

7.7 **LHCb** has continued to produce excellent physics output with top-quality flavour physics results, with precision unattainable by other experiments. The LHCC encourages the efforts to include the 2023 data in the physics analyses. Outstanding work has been done during the YETS and significant progress made in preparing the detector for data taking in 2024. The LHCC is pleased to see the successful re-installation of the VELO and the progress achieved in data-taking stability for the Upstream Tracker; commissioning is encouraged to continue to prepare the detector for global DAQ as soon as possible. The LHCC welcomes the effort made by the collaboration to offer high-quality data to the public and supports the continuation of such efforts. A TDR on DAQ enhancement for Run 4 has been submitted and is under review. The LHCC notes the progress in the scoping studies for Upgrade II and encourages preliminary results to be made available in April.

7.8 LHCb submitted a TDR for upgrades to be installed during LS3 concerning **Particle Identification Enhancement** [26]. They will enhance the physics capabilities in Run 4, compensating for radiation damage in the ECAL, and improving the detector performance for particle identification, while also anticipating key features of Upgrade II. The innermost modules of the ECAL, affected by radiation damage by the end of Run 3, will be replaced with a new design based on SpaCal technology; in the outer regions, the existing Shashlik modules will be rearranged. For the RICH, the front-end electronics will be replaced with a new ASIC with excellent timing capabilities so that Cherenkov photons can be time-stamped for background reduction. A light-touch UCG review showed good understanding and reasonable quality of the costing, a reasonable schedule and a good

analysis of risks. The LHCC recommended approval of the TDR. **The Research Board approved the LHCb Particle Identification Enhancement TDR, noting that the resources from CERN would be decided in the context of the 2024 MTP exercise.**

7.9 **WLCG** and the experiments have made successful and efficient use of the computing resources, and the LHCC encourages them to continue working together to have a coherent view of resource accounting and HPC usage. The LHCC welcomes the activity to validate software for the power-efficient ARM architecture and is pleased to note the progress in the Open Data programme. The LHCC encourages the HEP Software Foundation community to document the outcomes from the PyHEP developer workshops to help define a roadmap and priorities for the coming years. The LHCC recommends that ALICE closely follows the compression strategy of the data and its impact on future storage needs. A focus session was held on MC event generators, and the LHCC encourages the experiments to test and integrate the new generator software optimisations into their production, and to work together with EP-SFT to deploy a platform for automated validation of generators to reduce the time to adoption. Supporting MC generators is a key element for the long-term success of the LHC experiments, including the development and support of the appropriate tools and the career paths for those working in these areas.

7.10 **FASER** successfully completed the YETS tasks and made progress on the preshower detector construction; the requested two weeks of test beam will be critical to prepare the successful operation of the detector in 2025. The LHCC recognises that the plan to extend the 2024 LHC run would significantly penalise the statistics and performance of FASER.

7.11 **SND** successfully installed a third veto layer. The LHCC is looking forward to receiving a letter of intent for the Run 4 upgrade plans and strongly suggests to also include two options with reduced scope, one which does not involve any civil engineering, and one with significantly reduced civil engineering requirements that do not imply a lateral enlargement of the TI18 tunnel. **The Research Board recommended to focus on scenarios with either no or minimal civil engineering for the SND upgrade in LS3.**

7.12 **MoEDAL** successfully installed its detectors in the cavern at Point 8. The LHCC requests an update concerning the MAPP electronics boards; in absence of concrete progress, the LHCC requests by its next meeting a clear and concrete roadmap to address the issue and complete the MAPP detector on time for the 2025 run.

7.13 A new experiment at the LHC is being prepared to measure the dipole moments of charmed baryons, exploiting particle channelling and spin precession in bent crystals. A proof-of-principle precursor named **TWOCRYST** has been approved by the LMC for installation at IR3 in the next YETS, to take data in 2025 in order to check the technical feasibility. A letter of intent is in preparation for the subsequent physics experiment, that would be installed during LS3 without any civil engineering required.

## 8 ANY OTHER BUSINESS

8.1 The User Schedules for the PS and SPS in 2024 were presented by E.B. Holzer [2], noting strong demand, especially at the end of the proton run: extending the injector proton run by six weeks in 2024 would be beneficial for the test-beam users as well as the physics experiments. **The Research Board approved the release of the User Schedule until the end of June; the subsequent schedule will depend on the proton run duration.**

8.2 The **next meeting** of the Research Board will be held on 5 June 2024 at 9 am (a change from the earlier schedule). The dates for the meetings in 2025 were agreed: 19 March, 11 June, 17 September, 3 December.

## ENCLOSURES

1. Minutes of the 152$^{nd}$ SPSC meeting held on 6-7 February 2024 (CERN-SPSC-2024-008/SPSC-152).
2. Minutes of the 75$^{th}$ INTC meeting held on 7-8 February 2024 (CERN-SPSC-2024-025/INTC-75).
3. Minutes of the 16$^{th}$ REC meeting held on 8 February 2024.
4. Minutes of the 157$^{th}$ LHCC meeting held on 28-29 February 2024 (CERN-LHCC-2023-010/LHCC-156).

## REFERENCES

[1] Minutes of the 247$^{th}$ meeting of the Research Board (CERN-DG-RB-2023-525/M-247).

[2] The presentations are available at https://indico.cern.ch/event/1370082/

[3] Probing the doubly magic shell closure at $^{132}$Sn by Coulomb excitation of neutron-rich $^{130,134}$Sn isotopes (INTC-2024-016).

[4] Using in-trap decay to provide inaccessible and low-yield isotopes to the ISOLDE facility (INTC-2024-015).

[5] Development of neutron-rich Cu ion beams (INTC-2024-024).

[6] Terbium-149 for targeted alpha therapy (INTC-2024-020).

[7] Single-proton-hole orbitals in the $N$=126 nucleus $^{205}$Au (INTC-2024-001).

[8] Laser and nuclear decay spectroscopy study of the neutron-rich high-spin states in the $^{212,213}$Bi isotopes with LIST (INTC-2024-002).

[9] A study of seniority-2 configurations in $N$=126 and 124 isotonic chains (INTC-2024-003).

[10] Emission Mössbauer spectroscopy of topological kagome magnets (INTC-2024-004).

[11] Measurement of neutron capture cross section on $^{134}$Cs through surrogate reaction (d,pγ) at ISS (INTC-2024-005).

[12] Charge states of transition metal ions and local magnetic structure of dilute magnetic semiconductor (Ga,Fe)N:Mn – an emission Mössbauer spectroscopy study (INTC-2024-010).

[13] Spectroscopic factors in the r-process nucleus $^{135}$Sn (INTC-2024-012).

[14] Mapping single-particle neutron strength towards the mid-shell in semi-magic lead isotopes (INTC-2024-013).

[15] Magnetic origins of epitaxial MAX phase $Mn_2GaC$-based thin films probed by Emission Mössbauer Spectroscopy (INTC-2024-017).

[16] Probing the local environments and optical properties in halide perovskites with short-lived radioactive isotopes (INTC-2024-018).

[17] Laser & decay spectroscopy and mass spectrometry of neutron-rich mercury isotopes south-east of $^{208}$Pb (INTC-2024-019).

[18] γ-ray production by high energy neutrons in water (INTC-2024-009).

[19] Neutron detection efficiency measurements of NMX detector with enriched $^{155}$Gd and $^{157}$Gd converters at EAR2 (INTC-2024-021).

[20] Measurement of the $^{235}$U(n,f) cross section relative to n-p scattering up to 1 GeV (INTC-2024-014).

[21] Study of n+$^{63,65}$Cu reactions and their relevance for nuclear technologies and astrophysics (INTC-2024-006).

[22] Activation measurements of the $^{135}$Cs(n,γ) cross-section at nTOF-NEAR (INTC-2024-007).

[23] Measurement of the zirconium-88 neutron absorption cross-section at EAR2 (INTC-2024-011).

[24] ALICE ITS3: A bent wafer-scale monolithic pixel detector TDR (LHCC-2024-003).

[25] ALICE Forward Calorimeter (FoCal) TDR (LHCC-2024-004).

[26] LHCb Particle Identification Enhancement TDR (LHCC-2023-005).