MINUTES of the 123rd Meeting of the SPSC
Held on Tuesday 18 October and Wednesday 19 October 2016

OPEN SESSION

1. Status and plans of the NA61 experiment  Eric Zimmerman
2. Status and plans of CAS  Klaus Desch
3. Status and plans of the OSQAR experiment  Štěpán Kunc
4. Status and plans of the UA9 experiment  Walter Scandale
5. Status and plans of the AWAKE experiment  Edda Gschwendtner
6. Status and plans of the DIRAC experiment  Leonid Nemenov
7. Proposal addendum: The ALPHA-g Experiment  Jeffrey Hangst

CLOSED SESSION

Present:
M. Brugger (replacing R. Losito), M. Diehl, E. Elsen, X. Fléchard, R. Forty, L. Gatignon, M. Kowalska, G. Lanfranchi, M. van Leeuwen, J. Monroe, P. Moskal, J. Nash1, C. Rembser (Scientific Secretary), G. Salam, G. Schnell, A. Specka, A. Stahl, F. Terranova, C. Vallée (Chair), H. Wilkens

1) present Tuesday only

1. **DRAFT MINUTES OF THE 122nd MEETING OF THE SPSC HELD ON 21 JUNE AND 22 JUNE 2016**

The minutes of SPSC122 were approved (CERN-SPSC-2016-042, SPSC-122).

2. **CHAIRMAN’S REPORT FROM RB217**

The SPSC Chairman welcomed Jordan Nash, his designated successor who will start his mandate in 2017, and he introduced him to the Committee.

The Chairman reported on the Research Board (RB) meeting, RB217. The following points were presented and, where necessary, discussed:

1) The SPSC presented the results of the COMPASS Deeply Virtual Compton Scattering (DVCS) 2012 pilot run and the significant detector improvements implemented for the ongoing DVCS run. The Committee also summarised the successful 2015 Drell-Yan run and the COMPASS wish to take further Drell-Yan data in 2018.

2) The Committee reported on the difficulties encountered by NA63 in their attempt to measure radiation reaction effects in 2016, and expressed its wish to receive more quantitative information from the collaboration in order to assess the relevance of a new run in 2017.

3) The CLOUD Collaboration was congratulated for its breakthrough on the understanding of pure biogenic nucleation of clouds and its impact on the modelling of pre-industrial climate.

4) The SPSC expressed its satisfaction about the ongoing finalisation of the OPERA data analysis, and the efforts led together with CERN to ensure a long-term preservation of the data.

5) The progress in the analysis of the ICARUS CNGS and cosmic events was presented, and the Collaboration encouraged completing the analysis of their data samples.

The Research Board noted all the points. In addition, following the decision to postpone to the long shutdown LS2 the connection of ELENA to the existing AD experiments, AD operation was granted this year until the end of the LHC Lead ion run.

The Chairman presented highlights of the kick-off workshop of the Physics-beyond-Colliders Study Group, which took place 6 September 2016 and 7 September 2016 at CERN, and summarised the next steps of the study group to prepare a document as input to the European Strategy Update process (2019-2020).

3. **STATUS OF ACCELERATORS**

Lau Gatignon, for Rende Steerenberg, presented the status and plans of the injector accelerators.

Since the last meeting of the Committee in June 2016, the accelerators have been operating stably.
For the PS, beam availability for the standard operational beams has been high. Since the beginning of the 2016 run up to 13 October 2016, the availability of protons to the East Area test beams, to the East Area irradiation facilities, to the AD and to the SPS has been about 90%. The main issues, which caused downtime, were problems with the power converters (the POPS with its capacitive power storage and the old rotor machine with mechanical power storage). Other downtime arose from the inavailability of beam from LINAC2 and the PS Booster, failures of electrical infrastructure, a vacuum leak on internal PS beam dump and problems with the RF system.

The SPS is operating stably, however with reduced intensity and reduced duty cycle because of a vacuum leak on the SPS high energy internal beam dump. As a consequence, the delivery of protons to the North Area experiments and beam tests with $7.38 \times 10^{18}$ protons was 85% of what was planned to up to 12 October 2016 and 70% of the total for 2016. The strategy for overcoming the problems with the internal dump will be discussed in a dedicated meeting of the LHC Injector and Experimental Facilities Committee (IEFC) and the LHC Machine Committee (LMC) at the beginning of November 2016.

The intermittent glitches on the SPS focusing quadrupole family are still occurring and perturb the extracted beam spill. Although the issue is not yet solved, much progress on the diagnostics was made since the last SPSC. The source of the glitches has been narrowed down to an intermittent earth fault in or between four quadrupole magnets that is only present when the magnetic field is on. The measurement results are compared with a simulated model with an earth fault that can be adjusted to match the measurements as closely as possible. During the next stop of the SPS on 19 October 2016, diagnostics probes will be repositioned to identify the exact location of the fault. In case the magnet or bus bars is faulty, they will be exchanged during the EYETS.

The second issue with the slow extracted spill are the low frequency intensity variations (ripple). For the 50 Hz ripples a compensation system is in place, but the ripples in the broad frequency range of 30 to 35 Hz, which are present from time to time and vary following super cycle changes, cannot be compensated. Investigations to identify the source of these frequencies have not yet been successful.

The AD has been running stably since the start-up with more than $3 \times 10^7$ antiprotons per 100s cycle, with ejection energy of 100 MeV/c. The current beam availability for the experiments is 88%.

The commissioning of the ELENA hardware has started, however with some delay. In an AD users meeting at the end of September, the experiments agreed with the plan to install the ELENA transfer lines during the Long Shutdown LS2.

For the AWAKE facility, the magnet heat run which has been delayed because of changes to the schedule of the LHC technical stops is now complete. The beam commissioning during the last two weeks in September has been successful and the SPS proton beam has been synchronised with the AWAKE laser within 20ps. Currently the end flanges of the plasma cell are being installed and the plasma cell will be commissioned, aiming for three weeks of commissioning of the plasma cell together with the laser. At the end of the 2016 accelerator run, one week of physics studies are planned.

The 2016 proton physics run for the East Area, the North Area, nTOF and ISOLDE will end on 14 November 2016.
From that day onwards, Lead ions will be sent to the North Area until the 12 December 2016. Preparations for the ion run are ongoing, and ions have been injected, accelerated and extracted from PS.

4. STATUS OF EXPERIMENTAL AREAS

Lau Gatignon reported on the status and operation of the experimental areas.

In the PS East Area there were very few technical problems, mainly current instabilities in two power converters in the T9 experimental area. These instabilities caused a larger beam spot, which affected the INSULAB beam test. During the successful “Beamline for Schools” run in September, a water leak was detected in a quadrupole in the T11 beam for CLOUD. The leak could be repaired in situ, but the required access to the primary zone implied a stop of the whole East Area for two times four hours. Otherwise all beam lines have had smooth operation since the last SPSC.

On 15 September 2016, an additional Radio Protection monitor was installed and commissioned in the T9 experimental zone to ensure additional protection from an accidental transport of low-momentum primary beams along the beam line. An additional platform and access door were added to the T11 zone for CLOUD. The corresponding access system change was validated on 5 October 2016, just in time for the start of the CLOUD run.

The operation of the North Area beam line was in general very smooth. However, the experiments relying on high-intensity, NA62 and COMPASS, suffered from spill quality problems, 30 Hz and 50 Hz ripples and intensity spikes at the beginning of and during the spill (the latter caused by small QF current glitches). In addition, the overall intensity was limited because of a vacuum leak on the high-energy internal dump (TIDVG) in the SPS. This affected in particular the COMPASS experiment, which received at most 70% of the requested proton intensity, and - for some periods - all North Area users due to a significantly reduced duty cycle.

The extra shielding just upstream of the NA62 T10 target has had a positive impact on the radiation doses to NA62 electronics. NA64 had excellent beam conditions for their test run in July. A new web interface has been provided for users and experts, allowing quick monitoring of the status of each beam line from any Internet browser.

The EHN1 hall extension was handed over to CERN on 5 September 2016, with some reservations, which are currently being solved by the contractors. The experiments have started their installation work in the pits. In parallel, infrastructure installation is progressing. The beam design of the H2 and H4 very low electron (VLE) beams are being finalised once the users agree the final specifications.

The Committee notes with pleasure the hand-over of the EHN1 extension building to CERN. The SPSC recommends that the Neutrino Platform teams take the opportunity to measure the fluxes of muons from the existing beam lines into the pits before installations block the access required for the measurements.

A CERN working group on experimental magnets has been established and the group has made an inventory of magnets, collected technical information, looked at the use for physics for each of the magnets and identified urgent, medium-term and long-term actions. In the North Area,
the experimental magnets dominate the overall power consumption and power saving measures could be of particular interest for some of these magnets.

The SPSC notes the ongoing effort of the review of the experimental magnets in the secondary beam areas and is looking forward to the measures taken to ensure stable future running of the experiments.

The operation of the AD has been very good this year.
The zone extensions for ALPHA and ASACUSA have been approved and the work will be carried out during the shutdown at the end of the year.

An Engineering Change Request is required for a new experimental Area for AEGIS, so that the resource requirement can be considered in the planning of the Long Shutdown LS2.

The installation of the ELENA ring and its bake-out has been completed, apart from the injection and ejection regions, where the bake-out is foreseen for the end of October.

The electron cooler for ELENA is expected to arrive by the end of 2016. It has been decided to postpone the installation of the low-energy transfer lines to the new experiments until LS2. Therefore, only GBAR will take 100 keV beam from ELENA before LS2. The planning for installation work during LS2 remains to be optimised.

Since the previous SPSC meeting, AWAKE concentrated on beam and infrastructure installation and commission, all successful so far. It is expected that the installation of the plasma cell flanges will be completed in time to allow first self-modulation studies before the end of the 2016 run.

5. PS AND SPS USER SCHEDULES

Henric Wilkens presented the changes in the AD, PS and SPS user’s schedules which were implemented since the last SPSC meeting in June 2016 and showed the draft of the injector accelerator schedule for 2017.

The operation of the East Area beams has been very smooth since June, both for the beam tests in the T9, T10 and T11 experimental areas and the irradiation facilities.

The North Area fixed target physics is ongoing with restrictions on the delivered intensity. While NA62 currently has requested only 35% of their nominal intensity, COMPASS is receiving less protons than requested, and will likely collect only about 70% of the anticipated number of protons on target for 2016 by the end of the run.

The Lead ion fixed target run, from 14 November until 12 December 2016, will consist of ten days at 13 AGeV/c and at 30 AGeV/c, followed by eight days at 150 AGeV/c.

The AD users schedule, which now includes the run extension of one month up to 12 December 2016, was presented.

In the draft of the injector accelerator schedule for 2017 for the AD, PS and SPSC physics and beam tests the following dates are foreseen. For the East Area, from 1 May 2017 up to 20 November 2017, 203 days with beam are scheduled. The experiments at the AD can expect 231 days of physics, from 1 May 2017 until 18 December 2016. For tests and experiments in the North Area, 168 days with protons at high intensity are included to the draft schedule (8 May 2017 until 23 October 2017) plus 56 days of running with Xenon ions (23 October 2017 up to 18 December 2017), here including 14 days of beam setup for various ion energies. For AWAKE, 224 days of proton beam availability are included in the draft schedule.
6. DISCUSSION OF THE OPEN SESSION

6.1 NA61

The SPSC notes with pleasure the progress in the analysis of data from the Argon-Scandium, Beryllium-Beryllium and proton-proton runs and congratulates the Collaboration on its publication of results from proton-Carbon collisions, proton-proton collisions and with the T2K replica target.

The Committee welcomes the news that the NA61 VTX magnets, both equipped with a new magnet safety system, are again fully operational which allows stable data taking for the NA61 experiment.

6.2 DIRAC

The SPSC congratulates the DIRAC Collaboration for the publication on the observation of $K\pi$ atoms, which has been selected as an Editor's Highlight in Physical Review Letters. The Committee looks forward to the upcoming publication about the scattering lengths in the $K\pi$ system and to future publications about the lifetime of $\pi\pi$ atoms.

6.3 AWAKE

The SPSC appreciates the effort made by the AWAKE Collaboration in completing the installation and commissioning of the experiment setup for the first physics run in 2016, and is looking forward to first results on the observation of the SMI in proton beams.

The SPSC is pleased with the progress in implementing the electron source, beam line and diagnostics, and encourages the Collaboration to maintain its effort to achieve acceleration of injected electrons before the end of 2017.

The SPSC takes note of the plans for running AWAKE after the LS2.

6.4 UA9

The SPSC notes with pleasure further progress in exploration of different approaches to crystal preparation and collimation methods. The Committee congratulates the collaboration for the successful test of collimation with bending crystals of LHC protons at top energies and of LHC ion beams.

The SPSC is concerned about the lack of thorough understanding of the operation of the Cherenkov detector for proton flux measurement.

The Committee encourages the Collaboration to put more effort on simulations and analysis of the obtained data.

For further review of the beam time request for 2017, the SPSC would welcome a description and the priorities of studies, which remain to be done to complete the UA9 programme, as well as an indication of new studies, which should be submitted as a document for further review.
6.5 CAST

The Committee is pleased with the new preliminary results on the photon-chameleon coupling and photon-axion coupling based on data sets recorded in 2013-2015 and encourages the CAST Collaboration to proceed with the publication.

The Committee takes note of the problems experienced with the InGrid detector and on the Silicon Nitride thin X-Ray windows. The SPSC encourages the Collaboration to complete the repair of the InGrid detector and to evaluate the opportunity of installing 300nm windows to reach the sensitivity that has been originally expected for the 2016 run.

The SPSC appreciates the progress made by CAST in the 2016 run and in the preparation of the cavity and chameleon runs for 2017.

The Committee recommends further CAST running in 2017 and encourages the Collaboration to establish stable data taking to achieve significant physics results.

6.6 OSQAR

The SPSC received with interest the updates from the OSQAR Collaboration on axion and chameleon searches. The Committee appreciates the progress in the design of the new cavity-based apparatus for a light-shining-through-the-wall experiment and in the additional analysis of the 2015 OSQAR-CHASE run.

The SPSC requests further studies on and documentation of the 2017 setup to evaluate the potential for conclusiveness and the physics relevance of an additional Chameleon run next year.

6.6 ALPHA-G (SPSC-P-325-ADD-1)

The SPSC received with interest the addendum to the ALPHA proposal, SPSC-P-325-ADD-1, describing an extension to the ALPHA experiment, the ALPHA-g Apparatus, to study the gravitational behaviour of antihydrogen atoms in the field of the Earth.

The SPSC recognises the scientific value of the ALPHA-g project and the complementarity of the measurement method compared to the AeGIS and GBAR experiments, which are also studying gravitational behaviour of antihydrogen atoms. The Committee recommends approval of the project.

8. FOLLOW-UP ON EXPERIMENTS AND PROPOSALS

7.1 COMPASS

The SPSC notes with pleasure the preliminary analysis by the COMPASS Collaboration of the 2015 Drell-Yan run and the projected precision on the measurement.

The Committee acknowledges the need for additional data in 2018 to reach the required precision for a significant physics result and recommends approval of the 2018 Drell-Yan run. The SPSC encourages the Collaboration to upgrade the CEDARs to allow an extension of the measurements to kaon and antiproton Drell-Yan processes.

7.2 NA64
The SPSC congratulates the NA64 collaboration for the successful test run in 2016 and the results submitted for publication, which exclude a substantial part of the dark-photon parameter space (with invisible decays) that could have explained the g-2 anomaly.

7.3 EOI012

The Committee notes receipt of an Expression of Interest EOI012 on the measurement of short living baryon magnetic moment using bent crystals at the SPS and the LHC. The Committee also notes that the document has also been submitted as an abstract to the Physics-Beyond-Colliders Study group and considers that, for the moment, the project should be investigated in the Study Group.

7.4 EOI013

The SPSC received with interest the Expression of Interest (EOI013) describing $\mu$-flux measurements for SHiP using the NA61 detector. The Committee recognises the value of the measurement of muon production in a realistic target for defining the SHiP muon shielding. To further review the request, the SPSC would need a joint SHiP and NA61 proposal, which should include details on schedules and on sharing of resources. This agreement could set the frame for future combined test runs.

7.5 EOI014

The SPSC received with interest the Expression of Interest of the ENUBET project, EOI014, to carry out precise measurements of flux in accelerator neutrino beams. The Committee will further review the project.

8. DOCUMENTS RECEIVED

- Draft Minutes of the 122nd Meeting of the SPSC, Tuesday and Wednesday, 21-22 June, 2016, CERN-SPSC-2016-029; SPSC-122;
- Measurement of Short Living Baryon Magnetic Moment using Bent Crystals at SPS and LHC, CERN-SPSC-2016-030; SPSC-EOI-012-2016;
- Addendum to the ALPHA Proposal; The ALPHA-\(g\) Apparatus, CERN-SPSC-2016-031; SPSC-P-325-ADD-1-2016;
- DIRAC collaborations status report, CERN-SPSC-2016-032; SPSC-SR-193-2016;
- AWAKE Status Report, CERN-SPSC-2016-033; SPSC-SR-194-2016;
- $\mu$-flux measurements for SHiP using NA61/SHINE, CERN-SPSC-2016-034; SPSC-EOI-013-2016;
- CAST Status Report to the SPSC for the 123rd Meeting, CERN-SPSC-2016-035; SPSC-SR-195-2016;
- Enabling precise measurements of flux in accelerator neutrino beams: the ENUBET project, CERN-SPSC-2016-036; SPSC-EOI-014-2016;
- OSQAR Annual Report 2016, CERN-SPSC-2016-037; SPSC-SR-196-2016;
- Report from the NA61/SHINE experiment at the CERN SPS, CERN-SPSC-2016-038; SPSC-SR-197-2016;
- UA9 report for 2016, CERN-SPSC-2016-039; SPSC-SR-198-2016;
• Status and further Analysis Plans of the NA49 Collaboration, CERN-SPSC-2016-041; SPSC-M-789-2016.

SPSC documents on the CERN Document Server (CDS):
http://cdsweb.cern.ch/search?sc=1&p=SPSC

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