Minutes of the 120th Meeting of the SPSC
Held on Tuesday 19 January and Wednesday 20 January 2016

OPEN SESSION

1. Status and plans of the AeGIS experiment           Michael Doser
2. Status and plans of the GBAR experiment           Yves Sacquin
3. Status and plans of the ACE experiment             Michael Holzscheiter
4. Status and plans of the BASE experiment            Stefan Ulmer
5. Status and plans of the ATRAP experiment           Gerald Gabrielse
6. Status and plans of the ALPHA experiment           Jeffrey Hangst
7. Status and plans of the ASACUSA experiment         Ryugo Hayano

CLOSED SESSION

Present:
A. Bueno, M. Diehl, E. Elsen, X. Fléchard, R. Forty, L. Gatignon, A. Ianni, M. Kowalska\(^1\),
G. Lanfranchi, M. van Leeuwen, J. Monroe, P. Moskal, B. Panzer-Steindl, C. Rembser
(Scientific Secretary), G. Salam, G. Schnell, S. Schönert, F. Sikler, A. Stahl, R. Steerenberg,
M. Tarbutt, F. Terranova, R. Thompson, C. Vallée (Chair), H. Wilkens

\(^1\)Present on Tuesday only

Apologies: R. Losito, A. Specka

1. DRAFT MINUTES OF THE 119th MEETING OF THE SPSC HELD ON
20 OCTOBER AND 21 OCTOBER 2015

The minutes of SPSC119 were approved (CERN-SPSC-2015-041, SPSC-119).

2. REPORT FROM THE CHAIRMAN

The Chairman welcomed the new members of the Committee, M. van Leeuwen, A. Stahl,
M. Tarbutt and F. Terranova, and thanked the outgoing members, A. Ianni, S. Schönert,
F. Sikler and R. Thompson, for their dedication and contributions over the past years.
The Chairman reported on the Research Board (RB) meeting, RB214.

The following points were presented and, where necessary, discussed:

1) The Committee presented the DIRAC publication of their first observation of metastable pion atoms and expressed its recommendations for sufficient support to the collaboration for a timely finalisation of their priority analyses.

2) The SPSC presented the first results from the NA61 successful 2015 Ar-Sc energy scan. The Committee also mentioned the repetitive problems encountered with NA61 superconducting magnets, including that which prevented nominal running late 2015. The SPSC expressed its recommendation to consolidate the magnets’ control and operation in the future.

3) The Committee congratulated the UA9 Collaboration for achieving first demonstration of crystal channeling at the LHC and expressed its recommendation for sufficient SPS run time in 2016 to pursue their programme.

4) The steady progress of the AWAKE Collaboration in designing and implementing their experimental set-up was summarised and first beam time recommended in 2016 to test proton bunch self-modulation in a plasma.

5) The Committee showed the publication of the latest OSQAR limits on Axion production, and presented the outcome of their attempts to look for chameleons in 2015.

6) The SPSC presented the successful completion of the CAST data taking to look for solar axions, and presented their plans to search for relic axions and chameleons in 2016, 2017 and 2018. The Committee recommended CAST running in 2016 with INGRID detectors and encouraged R&D on KWISP mechanical membranes and on microwave cavities with the support of new collaborators. The Committee also supported consolidation of the CAST cryogenic control system to allow efficient running in the coming years.

7) The results of the review of the DUNE prototype (DUNE-PT) proposal (SPSC-P-351) were summarised, and the project recommended for approval as part of the neutrino platform, with a request to provide a detailed technical design report of the detector components prior to installation at CERN.

8) The Baby MIND proposal (SPSC-P-353) was presented and its magnetised iron detector recommended for approval as part of the neutrino platform, with the request to implement its beam test in an existing low energy beam line, and the request to clarify the schedule interplay with the WAGASCI experiment at JPARC.

The Research Board noted points 1), 2) and 5) and endorsed points 3), 4) and 6), including for the latter point a review of the consolidation needed for the cryogenic system. Points 7) and 8) were also endorsed under provision of a review of the CERN resources involved in the projects. DUNE-PT and Baby MIND are assigned CERN experiment reference numbers NP4 and NP5 respectively.

3. STATUS OF ACCELERATORS

Rende Steerenberg presented a review of the operation of the injector accelerators in 2015, reported on the ongoing activities during the yearly shutdown and gave an overview on the schedule of the start-up of the machines for the 2016 run.
The high intensity proton run for the experiments and tests at the PS and SPS was completed on 16 November 2015, but the operation of the injectors with protons was maintained to continue filling the LHC. This also allowed a prolongation of the AD physics run by one week.

During the 2015 proton run, the SPS beam to the North Area was extracted from the PS using the Multi-Turn Extraction (MTE) scheme. The scheme was continuously improved until the end of the run. The MTE will be used again from the start up in 2016 onwards. The hardware for the old Continuous Transfer (CT) extraction will remain available and will be maintained during the Year End Technical Stop (YETS) to ensure that it could be used as a fallback scheme in case of serious problems with the MTE hardware for which not all spares are available yet.

The fixed target run with lead ions took place from 16 November 2015 until 1 December 2015. The UA9 experiment took lead ions in the SPS on 3 December 2015.

In preparation of the lead ion run, LINAC3 very quickly retrieved operational conditions with 22 μA of beam current, which corresponds to 90% of the expected value. A new stripper foil allowed an excellent transmission of the beam from LINAC3 to LEIR. In LEIR the beam intensity was equal or higher than 6x10^8 ions per bunch with a transverse emittance of 0.6 μm at 1σ. From the PS about 5x10^8 ions per bunch were extracted with 0.8 μm transverse emittance at 1σ. The SPS received four bunches of each 1.2x10^8 ions and accelerated them up to 30 AGeV/c. After acceleration, the de-bunched beam of 3x10^8 ions was slowly extracted to the experiments over 10 seconds, which after collimation provided about 10^5 ions per second.

The accumulated (LINAC2, PSB and PS) proton beam availability amounted to an average of 94% for all facilities. The accumulated (LINAC3, LEIR, PS) availability for lead ions was excellent with 98%.

From 14 December 2015 onwards, the activities of the Year End Technical Stop (YETS) in all accelerators and facilities are ongoing.

At the PS Booster a campaign to identify and disconnect unused cables has been started and to avoid that eventual problems related to the disconnection campaign will cause problems, the hardware commissioning and test period for the PS Booster in 2016 has been extended. For the PS Booster a new transverse beam shaving scheme will be implemented in 2016, which will allow intensity reduction, which is required for some East Area beams. This new scheme is not expected to influence the East Area beam quality, but will allocate the losses in the PS Booster to dedicated locations and absorbers.

At the AD many activities currently take place, such as renovation of one of the main bending magnets, the renovation of the cavity control and the consolidation of the cryogenic beam current comparator. If the latter cannot be ready in time for re-installation, it will not be available during the 2016 run. This does not have an impact on the beam quality, but will cause some inconvenience for the machine operation to read out beam intensity throughout the AD cycle. The AD ring will be closed on 21 March 2016, tests and commissioning will start and delivery of beam to the experiments is expected from 25 April 2016 onwards.

In the SPS one of the electrostatic septa, which is used for the slow extraction towards the North Area, will be replaced during the 2015/2016 YETS. This may cause some conditioning problems at start of the 2016 run, with a possible impact on the proton flux to the North Area.
All YETS activities in all machines are progressing according to the schedule and no delays are presently expected for the 2016 start of the injector accelerators.

For the restart of the machines in 2016, PSB will close on 1 February 2015 to start the prolonged hardware tests. The other machines will follow with shorter hardware test periods. The first beam to be delivered is the LHC low intensity beam on 21 March 2016. The different fixed target beams will become available in the last half of April 2016. The re-commissioning of the lead ion accelerator chain for the 2016 run will start in the first week of May 2016. All preparations for the start up are currently on schedule.

The ELENA project is well under way and the extraction line from the AD to the experiments is currently being installed, requiring a modification of the AD shielding. For ELENA itself the installation of the supports is underway and the first element is installed.

Work is ongoing to keep the possibility of having 500 MeV antiprotons directly from AD to the ACE/AEGIS experimental zone.

The latest date to decide on the low energy transfer lines from ELENA to the experiments remains September 2016.

4. STATUS OF EXPERIMENTAL AREAS

Lau Gatignon summarised the last weeks of the 2015 run as well as the status and activities in the experimental areas.

Up to the end of the 2015 run, the East Area continued running very smoothly for CLOUD, as well as for the test beams and for the IRRAD and CHARM facilities. An optimised temperature regulation in the hall allowed reducing temperature variations to a level acceptable for CLOUD. During the shutdown some consolidation activities will take place, including the upgrade of the TV screens for beam monitoring and a replacement of the old vacuum pumps. One quadrupole in the proton transfer line to the East Area is being replaced. For the long-term consolidation, important discussions will take place in January and February 2016.

Also the North Area operation has been smooth until the end of 2015, both with proton and ion beams, apart from the impact of the super cycle (SC) changes and SC duration on the beam delivery.

The multi-turn beam extraction (MTE) was used routinely, also for higher intensities. Work is continuing to diagnose and eventually improve the occasional ripple on the current of the focusing quadrupoles, which caused spikes on the instantaneous beam intensity.

The beam intensity for NA62 was gradually increased and at the very end of the 2015 run, nominal intensity was successfully provided to the experiment under nominal conditions. The change to ions went very smoothly. Without the spectrometer magnets (VTX), NA61 did important detector tests.

During the shutdown the cooling in the BA82 building will be improved, alleviating cooling problems of magnets in the COMPASS and NA62 lines during very hot summer periods. Additional shielding will be installed in the beam line upstream of NA62 to reduce radiation dose to the NA62 electronics.

A mobile beam dump will be installed in front of the GIF++ facility thus increasing the autonomy for source operation during access to adjacent zones.
The problems with the T2 and T6 primary target movements are being investigated and a repair will be done. The components of the obsolete very low energy beam in the H8 line will be removed and be reused for the new beam lines into the EHN1 extension. Some magnets in various beam lines will be repaired or replaced. The work for the EHN1 extension is well under way with the handover of the building foreseen for mid August 2016. The detailed installation procedures of the experiments must be provided to finalise the planning and to start the procurement of the experiments’ components.

Also the AD performed smoothly until the end of the 2015 run. Especially ASACUSA did benefit from the multiple extraction performance. BASE had stored some protons in their reservoir trap before the end of the run and is still continuing the measurements using these protons. An agreement has been reached for the shielding of the GBAR LINAC and LEP yokes are currently being prepared for their installation as shielding elements. A possible impact on the AD alignment will be closely monitored while the heavy shielding is installed. It was pointed out that an Engineering Change Request would be required in case the AEGIS experiment requests to be moved into a new location.

The AWAKE installation is progressing as planned, with recent emphasis on the beam line installation, plasma cells, fire safety aspects and beam instrumentation. The AWAKE area has been reclassified as a supervised radiation area. AWAKE is on track for the start of beam commissioning in July and physics start in October 2016.

5. PS AND SPS USER SCHEDULES

H. Wilkens presented the first version of the AD, PS and SPS users schedules for 2016. At the AD, the ATRAP, ASACUSA, ALPHA and AEgIS experiments, are scheduled along the normal fair shift-sharing scheme. BASE is schedule for shifts during three weeks in June 2016 to re-commission the experiment. After this period, BASE will have priority each week on the night shifts from Monday to Wednesday, in case they need to refill their trap.

As in previous years, also in 2016 many experiments and tests applied for beam time at the CERN PS and SPS. This leads to fully booked beam lines at the SPS North Area, and also at the PS East Area lines only very few free time slots are left. Next to experiments and R&D programmes reviewed by the SPSC and the LHC Committees test beam campaigns, the recognised experiments CREAM (RE19), PANDA (RE22) and CALET (RE25), and a number of groups with interest in future neutrino experiments, future linear collider experiments and calorimetry requested beam time in 2016. The “Beamline for Schools” outreach programme has been scheduled for one week in the PS-T9 beam line.

The PS/SPS User schedules will be made public in the next days after this SPSC meeting.

6. DISCUSSION OF THE OPEN SESSION

6.1 ACE

The SPSC is pleased to see that there has been progress made by the ACE collaboration in the analysis of all datasets using the current version of FLUKA. The SPSC urges the collaboration to complete the analysis of systematic effects as soon as
possible and to publish the results including the comparison of the Relative Biological Effectiveness (RBE) of antiprotons with carbon ions and protons. The Committee encourages the collaboration to make the data publicly available once the publication is complete.

6.2 AEGIS

The SPSC acknowledges the progress made by the AEGIS collaboration since the last annual review, including the formation and first laser-excitation of positronium. The Committee is looking forward to the first antihydrogen formation in 2016.

6.3 GBAR

The SPSC acknowledges the progress achieved by the GBAR collaboration on the various components of the experiment. The SPSC is looking forward to the installation of critical components into the AD experimental zone in 2016.

The Committee encourages the collaboration to proceed with the benchmark tests at CEA Saclay measuring the charge exchange cross sections in proton-positronium collisions.

6.4 BASE

The Committee congratulates the BASE collaboration for the publication of the high-precision comparison of the antiproton-to-proton charge-to-mass-ratio.

The SPSC is pleased with the rapid progress made by the BASE collaboration in developing the necessary techniques for measuring the magnetic moments of the proton and the antiproton.

The Committee notes the good prospects for an improved measurement of the antiproton magnetic moment during 2016.

6.5 ATRAP

The SPSC notes the improvements made to the apparatus for both the magnetic moment and antihydrogen experiments despite the appearance of unanticipated technical problems. The Committee notes the change in the structure of the collaboration and acknowledges the progress with the new pulsed laser at 121nm.

The SPSC looks forward to the first antihydrogen and magnetic moment results in 2016 with the improved apparatus.

6.6 ALPHA

The Committee takes note of the improved operation of the ALPHA 2 trap and the first trials of spectroscopy.

The SPSC congratulates the ALPHA collaboration for the improved limit on the charge of antihydrogen and on the positron charge anomaly.
The SPSC is looking forward to the first evidence for 1s-2s resonant transitions with trapped antihydrogen.

The SPSC acknowledges the future plans of the ALPHA collaboration to perform gravity studies with antihydrogen. The SPSC requests a proposal addendum for this project.

6.7 ASACUSA

The SPSC is pleased to see progress on all aspects of the ASACUSA programme. The Committee supports the ASACUSA plans for 2016.

The SPSC encourages the collaboration to publish the results of the studies on the 2012 data of the single-photon transitions in antiprotonic helium and the antiproton cross section measurements as soon as possible.

7. FOLLOW-UP ON EXPERIMENTS AND PROPOSALS

7.1 P-350 (SHIP)

The SPSC has reviewed the proposal for “A Facility to Search for Hidden Particles (SHiP) at the CERN SPS” (Technical Proposal P-350 and Physics case P-350-ADD-1), submitted in April 2015 following an earlier submission of the Expression of Interest EoI-010 in October 2013. The review included several lists of questions sent to the proponents, which were all answered including submission of a proposal addendum P-350-ADD-2 in October 2015.

In the review process the Committee was impressed by the dedication of the SHiP proponents and their responsiveness to the Committee’s requests. In particular significant progress has been made since the EoI, along the lines of the SPSC112 recommendations, including optimisation of the proton beam dump design, broadening of the physics case and adaptation of the SHiP scheduling to external constraints. The CERN SPS offers a unique opportunity for the proposed programme and the SHiP proponents have the potential strength to build the proposed detector setup.

The main physics motivation of SHiP is to explore the domain of hidden particles, searching in particular for new scalar, fermionic and vector particles. These would be produced in a proton beam dump at 400 GeV, either directly or from decays of charm or beauty particles. The experiment would be sensitive to a hitherto unexplored region of parameter space, spanning masses from a few hundred MeV to a few GeV and over two orders of magnitude in squared couplings. The main experimental signature involves two charged decay tracks, and will be complemented by decays to neutral particles. The experiment is also proposed to be equipped with an emulsion target, which would allow for unprecedented tau neutrino and antineutrino measurements and valuable QCD studies. Furthermore it would extend the hidden sector search to scattering of dark matter particles. The facility could accommodate additional detectors extending the range of dark matter searches. The SPSC supports the motivation for the search for hidden particles, which will explore a domain of interest for many open questions in particle physics and cosmology, and acknowledges the interest of the measurements foreseen in the neutrino sector. SHiP could therefore constitute a key part of the CERN Fixed Target programme in the HL-LHC era.
The SPSC supports the updated SHiP schedule, which takes into account the HL-LHC preparation constraints during LS2, and defers any significant civil engineering investments for SHiP to the period following full approval of SHiP. The SPSC notes that, in this updated schedule, the time scale for the SHiP comprehensive design study, required for a final decision, coincides with the expected revision of the EU HEP strategy. The Committee also notes the plans of the incoming CERN Management to set up a working group to prepare the future of the CERN Fixed Target programme after LS2, as input to the next EU strategy update. In this context the SPSC recommends that the SHiP proponents proceed with the preparation of a Comprehensive Design Report (CDR), and that this preparation be made in close contact with the planned Fixed Target working group.

Preparation of the CDR should include further optimisation of the beam dump facility in the direction of a multipurpose area, test beams of detector prototypes where needed, detailed simulations of the detector response to all signal and background signatures, further theoretical studies of expected signals and comparisons with alternative search programmes. The Committee encourages the proponents to define a programme of measurements concerning production of charm in a SHiP-like target, important for normalisation purposes. The SPSC also encourages the proponents to further explore the potential benefit of inputs from the ongoing NA62 experiment to strengthen the experimental evaluation of SHiP backgrounds and systematics. The resources needed for the preparation of the SHiP CDR in the coming years should be secured within a MoU between CERN and the SHiP proponents’ institutes.

7.2 P-348

The Committee has received with interest the addendum to the P348 proposal, outlining the P348 physics runs in 2016 and 2017. The SPSC appreciates the responsiveness of the P348 collaboration to the Committee’s requests and recognises the physics potential of the proposed run.

The Committee recommends that P348 be approved as an SPS experiment.

The SPSC also recommends approval of the P348 beam request in 2016, i.e. two weeks of test run and 4 weeks of physics run, to investigate the region of the invisibly decaying dark-photon parameter space that would explain the muon g-2 anomaly.

The SPSC awaits the results of the 2016 run before reviewing plans beyond 2016.

7.3 NA61

The SPSC received with interest the answers to its questions about the NA61 Addendum SPSC-P-330.

The Committee recognises the potential of a high statistics lead-lead energy scan with increased acceptance with respect to NA49 and the interest of open charm measurements in lead-lead collisions.

The SPSC recommends 28 days of lead-lead data taking for the first part of the lead-lead energy scan with minimum bias collisions and for tests of a new vertex detector for open charm measurements.
7.4 NA63

The SPSC reviewed with interest an update on the status of the NA63 experiment and the proposal for a run in 2016 to measure radiation reaction effects for positrons passing through aligned crystals. The Committee takes note of the difficulties encountered in measuring sub-GeV electrons and positrons in the apparatus during the electron run in 2015. The SPSC recommends two weeks of beam time be allocated for an NA63 run in 2016 for the proposed radiation-reaction measurement.

7.5 SPSC-I-244 (ARIADNE)

The SPSC received with interest a Letter of Intent (SPSC-I-244) for testing a two-phase Liquid Argon Time Projection Chamber with photographic capabilities at the CERN Neutrino Platform. The Committee will further review the project.

8. DOCUMENTS RECEIVED

- Addendum to the proposal P348: further information requested in the review process, CERN-SPSC-2015-042; SPSC-P-348-ADD-1-2015;
- ASACUSA STATUS REPORT - Recent progress and plans for 2016, CERN-SPSC-2016-001; SPSC-SR-174-2016;
- AD-7/GBAR status report to the 2016 CERN SPSC, CERN-SPSC-2016-002; SPSC-SR-175-2016;
- Agenda of the 120th Meeting of the SPSC, Tuesday and Wednesday, 19-20 January 2016, CERN-SPSC-2016-003; SPSC-A-120-2016;
- BASE - Progress Report 2015, CERN-SPSC-2016-005; SPSC-SR-177-2016;
- Reply to the SPSC questions on Addendum CERN-SPSC-2015-038 entitled "Beam momentum scan with Pb+Pb collisions" by NA61/SHINE at the CERN SPS, CERN-SPSC-2016-006; SPSC-M-788-2016;
- Status report for the AD-6/AEgIS experiment for 2015, CERN-SPSC-2016-007; SPSC-SR-178-2016;
- ARIADNE, a Photographic LAr TPC at the CERN Neutrino Platform, CERN-SPSC-2016-008; SPSC-I-244-2016;
- Short Status Update on the WA105 experiment (2016) at the Neutrino Platform, CERN-SPSC-2016-009; SPSC-SR-179-2016;

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

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