MINUTES of the 124th Meeting of the SPSC
Held on Tuesday 17 January and Wednesday 18 January 2017

OPEN SESSION

1. Status and plans of the ASACUSA Experiment  
   Ryugo Hayano
2. Status and plans of the ALPHA Experiment  
   Jeffrey Hangst
3. Status and plans of the ATRAP Experiment  
   Gerald Gabrielse
4. Status and plans of the BASE Experiment  
   Stefan Ulmer
5. Status and plans of the AEGIS Experiment  
   Michael Doser
6. Status and plans of the GBAR Experiment  
   Patrice Perez

CLOSED SESSION

Present:

1) present Tuesday only

Apologies: R. Losito, J. Monroe, A. Stahl
1. **DRAFT MINUTES OF THE 123rd MEETING OF THE SPSC HELD ON 18 OCTOBER AND 19 OCTOBER 2016**

The minutes of SPSC123 were approved (CERN-SPSC-2016-042, SPSC-123).

2. **CHAIRMAN’S REPORT FROM RB218**

The Chairman reported on the Research Board (RB) meeting, RB218. The following points were presented and, where necessary, discussed:

1) The SPSC presented the results from DIRAC and congratulated the collaboration on the publication of its K⁻ atom results.

2) The Committee discussed the status of the NA61 experiment and welcomed the news that the VTX magnets are now fully operational allowing stable data taking.

3) The committee noted the progress of the UA9 collaboration tests on beam collimation with bending crystals. The committee expects to see a description of the studies, which remain to be done to complete the UA9 programme before final allocation of beam time in 2017 is approved.

4) The SPSC was pleased to see the progress by the AWAKE collaboration and noted the preparation of plans for running after LS2.

5) The committee presented the updated results from the OSQAR Collaboration on axion and chameleon searches, and noted that the SPSC has requested further studies of the setup to evaluate the physics potential for 2017 running. The RB also noted that the implications of OSQAR use of the SM18 hall infrastructure was being assessed by the IEFC Committee.

6) The SPSC noted the progress made by the CAST Collaboration in 2016 and recommended approval for their 2017 data taking.

7) The committee presented the analysis of the 2015 Drell-Yan data by the COMPASS collaboration, and recommended approval of their 2018 Drell-Yan run.

8) The SPSC described the proposal for the ALPHA-G experiment, which will study the gravitational behaviour of antihydrogen and recommended approval of the project.

The Research Board noted points 1, 2, 3, 4 and 5 and endorsed points 6, 7, 8.

3. **STATUS OF ACCELERATORS**

Rende Steerenberg presented the status and plans of the injector accelerators.

At the end of 2016 run, the injectors for five weeks provided lead ion beam the SPS north area. When the ion run started, protons to the North Area, East Area, nTOF and ISOLDE were stopped, to allow for sufficient cool-down for the de-cabling campaign which takes place during the annual shutdown. However, in parallel to the ions, the injectors provided protons to the AD and to AWAKE.

All beams were stopped 12 December 2016.

2016 has been a difficult year for the LINAC2 and frequent adjustments were needed to keep up its performances. However, a beam availability time of 97.3% has been reached. During the annual end-of-year shutdown further investigations will be made on the source of the LINAC2 problems.
The PS Booster had an average beam availability of 94% with the main cause of down time being the LINAC2, issues with the RF system due to ageing, kicker and septa systems, power converters and external power glitches. In 2016, $1.35 \times 10^{19}$ protons were extracted from the Booster, well over 50% were delivered to ISOLDE.

Despite major breakdowns related to the power supplies for the PS main magnets, the average beam availability out of the PS varied from 88% for the East Area up to 92% for the SPS fixed target beam. The main causes of down time were the PS main power supplies, the beam unavailability from the Booster, the LINAC2 beam unavailability and multiple reasons related to the RF acceleration systems. The PS accelerated $3.7 \times 10^{19}$ charges of which again more than 50% were sent to the nTOF facility. The total intensity was lower than in 2015 due to the issue with the SPS internal dump.

The SPS had a difficult year with the internal beam dump that suffered from a vacuum leak, but beam could nevertheless be delivered, although with a lower intensity and flux. The average beam availability out of the SPS was around 80%. The issue of the intensity spikes on the slow extracted beam spill to the North Area has been solved after a thorough measurement and simulation campaign that took place over several months reducing every time the part of the machine where the intermittent fault was situated. Finally, a bus bar was found to make contact with the magnet cover, but only once the magnetic field was high. The cover was modified and the spikes were no longer observed up to the end of the 2016 run.

The AD had a good year with a machine availability of 93% and stable running with more than $3 \times 10^7$ antiprotons per 100 seconds cycle extracted at 100 MeV/c.

The ELENA construction was close to completion some beam diagnostic instrument and the electron cooler remains to be installed. The beam commissioning started on 14 November 2016 and the beam was seen to make several turns around the machine a few days later. Unfortunately, on 25 November 2016 the isolation transformer of the source broke and beam commissioning needed to be stopped. The source will be repaired and the commissioning with beam will resume February 2017.

For the 2017 run the following schedule for the injector accelerators is foreseen. Toward the end of quarter one the machine will be closed and LINAC3 and LINAC2 are planned to provide beam. This will then be followed with the re-commissioning with beam in the different machines. The East Area, nTOF and AD physics should resume on 1 May 2017 while the physics in the North Area and beam to AWAKE should resume on 8 May 2017. At the same time, LEIR will start to operate for xenon ions. Setting up the other injector accelerators for xenon will then follow, in parallel to the operation with protons to be ready for xenon delivery for physics in the North Area during eight weeks at the end of the 2017 run.

4. STATUS OF EXPERIMENTAL AREAS

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

In the East Area beams were delivered smoothly to all users, including the CLOUD experiment. After the end of the proton period a test was done in Machine Development time to extract fully stripped primary lead ions onto a dump just upstream of the primary area. The success of this test allows to prepare an Engineering Change Request for preparing the possibility to send primary ion beams into the irradiation facilities IRRAD and CHARM. During the shutdown, the T9 zone will be slightly modified to house the large BabyMIND detectors and a focussing
magnet in the CLOUD beam line will be replaced. The magnet patrol in the primary area will be done after a cool down period.
The East Area Renovation has been approved as a project and a first Cost and Schedule Review has taken place in December 2016. The layout is essentially defined and fixed apart from some optimisation of magnets and power converters. The remaining discussions concern mainly some civil engineering aspects.

Also the North Area beam lines operated quite smoothly during the last weeks of the proton run and during the heavy ion run. However, the spill structure was often quite bad, due also to many super-cycle changes, LHC filling and MD sessions. On 2 November 2016 a problem with the passage of a bus bar was identified and this solved a long-standing problem with spikes in the extracted intensities. Replacing the power converter for the focussing quadrupoles solved the issue with 30 Hz noise. From then on the spill structure was significantly better, allowing increasing the intensity for the NA62 experiment. The 50 Hz noise is still present from time to time. A correlation with the Dynamic Economy mode in the SPS has to be tested again early in the 2017 run. The Full Economy mode in the North Area beams is now fully operational. The ion beam commissioning and ion beam energy changes went smoothly, with many efficient user changes in the H4 and H8 beam lines. The beam intensities were in some cases limited by radiation protection constraints.

Due to the vacuum leak in the SPS internal dump, beam intensities had to be kept quite low in the SPS ring. This mainly affected the COMPASS experiment. NA64 has been running with three to four times more intensity than in the July 2016 run.

For 2017, COMPASS requests to run at nominal intensity and also NA62 will request more beam on target, now that also the radiation effects to electronics have been reduced significantly with an extra shielding wall. As a consequence, the total North Area beam intensity requested for 2017 is significantly higher than in 2016. It is therefore important that the SPS internal dump will be replaced and the losses at extraction and in the primary lines can be reduced, such that radiation protection constraints will not limit the total number of protons extracted. A dedicated working group is studying and optimising these losses.

Significant work is going on in the EHN1 hall extension, both by the Neutrino Platform teams and by the technical teams for the infrastructure. The final definition of the requested beam impact points on the cryostats is imminent, hence allowing specifying and ordering the tilted support structures. In the existing halls, shutdown activities are progressing, including the replacement of the power converter for the COMPASS spectrometer magnet.

The AD run was smooth and efficient with good beam quality. The installations for GBAR are in progress. The ALPHA and ASACUSA zone extensions should be completed by mid February.

AWAKE managed to have three days of physics run at the end of 2016. In the last night of the run, the collaboration observed in three detectors the strong self-modulation instability and therefore the plasma waves generated by the proton beam. More detailed studies on the self-modulation as well as the installation and commissioning of the electron beam are foreseen for 2017.

5. PS AND SPS USER SCHEDULES

Henric Wilkens presented the first version of the AD, PS and SPS users schedules for 2017.
At the AD, the ATRAP, ASACUSA, ALPHA and AEgIS experiments, are scheduled along the normal shift-sharing scheme. BASE is schedule for shifts during three weeks end of June 2017 and three weeks in August 2017 to re-commission the experiment. After these periods, BASE will have priority on the night shifts from Monday to Wednesdays, in case they need to refill their trap. Daytime shifts for the commissioning of the ELENA machine are foreseen three times a week, starting in June 2017.

As in previous years many experiments applied for beam time in 2017, leading to fully booked beam lines at the SPS North Area, and little free beam time at the PS East Area. A number of beam tests with compatible beam conditions have been scheduled simultaneously, notably during the operation of the H4 beam line with muons (GIF, RD51 and CMS GEM/RPCs), or in the H8 beam line based on past experience of good collaboration (UA9/Totem, and LHCb and ATLAS muons). These sharing of beam time were instrumental in allowing all request to be at least partially scheduled.

Next to experiments and R&D programmes reviewed by the SPSC and the LHC experiments test beam campaigns, the recognised experiments CBM (RE21) and PANDA (RE22), a number of groups with interest in future neutrino experiments, future linear collider experiments and calorimetry requested beam time in 2017. Also the “Beamline-for-Schools” outreach programme has been scheduled in the PS-T9 beam line.

The PS/SPS User schedules will be made public in the next days after the 124th SPSC meeting.

6. DISCUSSION OF THE OPEN SESSION

6.1 ASACUSA

The SPSC congratulates the ASACUSA Collaboration on their recently published measurement of the antiproton-to-electron mass ratio by one-photon spectroscopy of cold antiprotonic helium. The Committee is pleased to see that new data taken with two-photon spectroscopy in 2016 already improves the precision of the measurement.

The SPSC notes with pleasure the progress made by the Collaboration in producing a beam of antihydrogen suitable for a measurement of the ground-state hyperfine interval. The Committee also notes the significant challenge in increasing the flux of ground-state antihydrogen to make that measurement feasible, and supports the collaboration’s plan to address this challenge in 2017.

The SPSC is pleased to see the result of the analysis of data taken in earlier years on the annihilation cross section of low energy antiprotons in carbon, and encourages the collaboration to publish this result.

6.2 ALPHA

The SPSC congratulates the ALPHA collaboration for their pioneering achievement with the first observation of the 1s-2s transition in trapped antihydrogen. The SPSC is looking forward to a new measurement with improved precision in 2017. The SPSC acknowledges the progress of the ALPHA collaboration towards the installation of major components of the ALPHA-g apparatus in the AD at the end of 2017.
6.3 ATRAP

The Committee welcomes the solution of the unanticipated technical problems and is looking forward to the first antihydrogen results with the new ATRAP apparatus. The SPSC acknowledges the progress with the Lyman-alpha pulsed light source and looks forward to the first evidence for antihydrogen cooling in 2017.

6.4 BASE

The SPSC congratulates the BASE Collaboration on their publication on the improved single particle measurement of the magnetic moment of the antiproton. The Committee is pleased to see that the collaboration’s efforts in 2016 have led to the first detection of single antiproton spin transitions. The SPSC notes the excellent prospects for a greatly improved measurement of the antiproton magnetic moment during 2017.

6.5 AEGIS

The Committee acknowledges the progress made by the AEGIS Collaboration since the last annual review. The SPSC looks forward to the collaboration's first antihydrogen created with the charge exchange method.

6.6 GBAR

The Committee acknowledges the progress made since the last annual review in the different parts of the GBAR experimental set-up. The SPSC looks forward to see the progress towards the milestones during the coming year.

7. FOLLOW-UP ON EXPERIMENTS AND PROPOSALS

7.1 ACE

The SPSC is pleased to see the publication of the final results of the ACE collaboration reporting their measurements of the relative biological effectiveness of antiprotons. The Committee notes the successful conclusion of the ACE experiment and considers the review of the experiment to be completed.

7.2 NA61

The SPSC congratulates the NA61 collaboration on the successful integration and first test results from the new vertex detector.

7.3 NA63

The SPSC received with interest the proposal from the NA63 Collaboration to measure radiation reaction in the moderate field strength regime. The Committee recommends that two weeks of positron beam time be allocated in 2017.
7.4 NA64

The Committee **congratulates** the NA64 Collaboration for publishing their results on the search for invisible decays of sub-GeV dark photons. The SPSC **recommends** that five weeks of beam time be granted in 2017.

7.5 EOI015

The Committee **received with interest** the Expression of Interest for the development of near detectors for neutrino long baseline experiments based on gas TPCs, SPSC-EOI-015. The SPSC **will further review** the project.

7.6 UA9

The Committee **recommends** that the requested beam time at the H8 beam line be allocated, one week in H8 with proton beam and 3 weeks with pion beam. Concerning beam time at the SPS ring, the Committee **expects** that precise goals, which are in agreement with the goals of the CERN accelerator experts, be presented to the SPSC referees.

7.7 AWAKE

The SPSC **congratulates** the AWAKE Collaboration for observing for the first time proton-beam induced plasma wave self-modulation.

8. DOCUMENTS RECEIVED

- CERN NA63: Status for 2016 and plans for 2017, CERN-SPSC-2016-043, SPSC-SR-200;
- AD-7/GBAR status report for the 2017 CERN SPSC, CERN-SPSC-2017-001, SPSC-SR-201;
- Near Detectors based on gas TPCs for neutrino long baseline experiments, CERN-SPSC-2017-002, SPSC-EOI-015;
- ASACUSA STATUS REPORT Recent progress and plans for 2017, CERN-SPSC-2017-005, SPSC-SR-203;

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

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