

Accelerator Complex Status

End week 46 (Tuesday 21 November 2022)

Technical Infrastructure (I):

Statistics:

- About 3'800 alarms.
- 569 phone calls (385 incoming, 184 outgoing).
- 87 ODM created.

Events worth mentioning:

- Tue. 15.11, Building 510 evacuation. A user accidentally triggered a break glass unit.
- Fri. 18.11, NA62 GTK stops, cooling station fault. No ongoing experimental activities as the SPS is running with ions.

Details: <https://wikis.cern.ch/display/TIOP/2022/11/21/TI+Week+summary%2C+Week+46>

LINAC 4 (Eva Gousiou)

The overall availability of Linac4 this week has been **96.5%**; the ~6h downtime were mainly due to:

- **Scheduled stop** for the **RFQ klystron** oil replacement [4h, Tue 13h30-17h30]
- **Pre-chopper controller**; a remote intervention was not possible and finally an on-site intervention for the replacement of the controller, PXIe crate, was needed [2h, Wed 8h-10h]
- **Trip of the L4L.RCH.111 power converter controller**; this has been a repetitive fault in the last weeks; the FGC controller was finally replaced in the shadow of Tuesday's scheduled stop and no further fault has occurred since [7min, Tue 13h-13h07].

PS Booster (Alan Findlay):

With 96% availability, the PSB had another good week. The majority of the downtime was due to the agreed L4 interventions on Tuesday afternoon.

We took advantage of the L4 interventions to allow an access for an inspection of an ongoing water leak on BR.QDE5, but the expert confirmed that we could continue until the end of the run.

During the intervention, the RP piquet noted hearing a compressed air leak, reported it to Markus who identified it as coming from the sector valves and informed the vacuum team. They quickly intervened, put a temporary replacement air regulator in place and will follow up the final repair in the EYETS. Many thanks to all for the rapid response.

The BSRT Calibration beam was checked & prepared with the 5 different emittances requested saved as tags. These were tested with the PS and SPS during the weekend and appear to be acceptable. This should now be ready, if requested this week.

There was the usual end of run intense MD activity, but all clients were served as best we could.

ISOLDE (Miguel Lozano):

Dear all , it has been a good week in general at Isolde.

On the GPS side we delivered 68Ni18p at 6 MeV/u to the ISS experimental station. The run went well and finished on Friday morning when we switched to HRS.

From HRS we have been delivering K beams to the VITO experimental station during the weekend and we will continue like this until next Wednesday.

The main issues of the week were beam gates and timing related , the need of rephasing 3 more superconducting cavities after we lost one cavity in cryomodule number 3 and a power supply that had to be replaced after the HRS RFQ.

Other than that, it was a good week.

PS (Matthew Fraser):

The PS had an excellent week of reliable operation with no important faults to report. The planned stop on Tuesday afternoon behind the Linac4 intervention and SPS RP survey was exploited effectively for various activities: check of SMH16 insulation, installation of dosimeters on BGIV and BSW22 FGC fix. RF, ABP and OP experts successfully reworked the n_TOF cycle to achieve the requested 28 ns bunch length. The extraction was reworked with the TPS15 OUT and a clean extraction could be achieved even with a relatively large DP/P. Preparations went well to prepare three different low energy ion beams for the CHIMERA run and first irradiation test of ESA devices at CERN, planned from Wednesday afternoon until the end of the run. The slow extraction is now fully driven by the transverse damper excitation (RF knock-out) which has allowed for very low intensity and stable spills. The observed losses at injection on the NOMINAL ion cycle were improved but further work is needed. Finally, a promising loss reduction technique called phase space folding was applied in the PS during MD studies over the weekend (as was previously done in the SPS). The ODN octupole chain was powered during the slow extraction of the 24 GeV/c proton beam to the East Area permitting stronger extraction sextupole strengths to be applied, reducing beam loss in the ring during extraction by up to 30%..

PS - East Area ():

No report.

AD - ELENA (Davide Gamba):

It has been a quiet week in AD/ELENA, but not without interesting facts:

- PUMA has started taking beam.
 - First setup done with H- beams on Tuesday.
 - On Wednesday pbar beam was successfully observed on the BTV installed in the PUMA experimental area (originally, a SEM profile monitor was supposed to be installed at this location but the hardware was not available and BI proposed to replace this by a BTV).
- All our present users are taking beam (AEGIS, ALPHA, ASACUSA1, ASACUSA2, BASE, GBAR, PUMA), with up to 5 users requesting beam in parallel from time to time.
- During a short MD on Tuesday morning the impact of beam position on pbar yield was studied, finding that the optimum yield is obtained for beams within:
 - (from 0.5 to 1.5) mm in Vertical
 - (from -2.5 to -1.5) mm in Horizontal
- Studies to identify and possibly cure the high radiation levels we observe in AEGIS area are continuing:
 - observed an interesting correlation (still to verify the causality) with target temperature (which depends on the actual AD repetition rate)
 - a mobile radiation monitor has been installed in AEGIS zone: it looks like the present hotspot is close to old AD ejection line: it might be possible to improve the shielding in this area during the YETS.
- Studies to understand if we could pulse the AD injection line only a few shots before injection are starting, but actual tests with the hardware are likely to be performed only during the YETS.

- This will allow for some energy saving, increase magnets lifetime, and it will likely simplify the consolidation of power supplies for this area.
- No major issues were observed, but:
 - s-cooling high power amplifiers keep failing: this might have had an impact on s-cooling performance, but which are not so visible due to failure of the BCCCA (intensity measurement) a few weeks ago.
 - s-cooling 3.5 GeV/c notch filter feedback was found off: this could also have had an impact on performance over the last couple of weeks.
 - on Thursday evening the main vacuum valve of the ELENA source shut, possibly due to an internal interlock, but with no evident reason. This caused the closure of the fast valves of the ELENA ring, hence preventing beam to reach the experiments for about one hour. The event could be correlated with recent issues with the vacuum system of the source, which will be investigated during the YETS.

SPS (Michael Schenk):

This week started with the end of the North Area (NA) proton run and the start of the two-week NA Pb ion run, followed by long parallel MDs on Wednesday, and the LHC ion tests from Thursday on into the weekend. The AWAKE run 5 has been ongoing since last weekend with a break from Monday to Wednesday evening. Besides, LHC has also been taking proton fills for physics.

The machine availability at the time of writing is ~87 %, without major faults and downtime dominated by faults/interventions in the injectors.

SFTPRO: delivery of protons to NA stopped Monday at 08:00.

SFTION: following DSO tests on Monday morning, setting up of slow extraction (COSE) started mid-afternoon. Once the beam permits were signed, the TT20 TED was taken out and steering to targets T2 and T4 was attempted in the early evening. Given the limited beam instrumentation, this was a challenging undertaking and resulted in non-satisfactory performance on targets Monday through the night. Setting up was hence continued on Tuesday after the RP survey. One main issue found was that some of the quadrupoles in the beam lines were not pulsing properly. This manifested among others as an only 3 s long spill (feedback from NA61). After “redriving” the settings, the beam was consistently on targets at nominal spill duration and setting up could be finished Tuesday evening. The BSI calibration factors were corrected once more on Wednesday to display proper intensities on targets (Page 1). The beam availability for the experiments and stability on targets (symmetry & sharing) has been good since then except for occasional periods when it was affected by the recurring LEIR orbit corrector fault (until Wednesday evening when it was resolved after several interventions), a recurring LEIR quad trip, and a LINAC3 RF amplifier issue on Saturday (1.5 h). Besides, the intensity delivered by the LINAC3 source has not been as stable and required occasional tuning throughout the week, incl. during the weekend.

LHC (protons): fill on Monday suffered from frequent SPS RF cavity trips triggered on SFTION (resolved in the evening by adapting threshold on radial pickup signal). Fill on Tuesday (~2 h) required adjustment of scraper settings. From then on the LHC could be filled more efficiently again. Following the ion tests, the machines were reconfigured for proton physics on Saturday afternoon. On Sunday, frequent refills were necessary due to LHC RF issues. The BCMS intensity was lowered to $1.35E11$ ppb. Also, faced issues with main scraper and had to fall back to spare setup.

LHC (ion tests): following some adjustments (a.o. mask TI2 SW permit), a workaround for the “rephasing”, lowering the total voltage from 10.5 MV to 10 MV, rebalancing amplifiers of cavity 2,

and re-adaptation of BQM settings, slip-stacked beam (8 b with 50 ns spacing) as well as trains with up to 3 ion bunches were successfully transferred to the LHC. Between Thursday and Saturday, several ion fills were made both with slip-stacked and non-slip-stacked beam. What needs to be looked into for next year is the placement of the bunches on the MKE waveform as well as why there occasionally has been a “jitter” on the first filled bucket in SPS, requiring adaptation of the BQM (beam pattern).

AWAKE: after taking beam during the previous weekend, AWAKE only came back after the long parallel MDs on Wednesday evening, with a slight delay due to a ~1.5 h extension of the MD. Beam was taken also on Thursday morning (1E11 p variant), but no longer from midday (as agreed between coordinators), given the start of the LHC ion tests. On Friday, the 3E11 p variant was requested, however, the production was not straightforward due to various issues that had to be resolved at PS and SPS (~2 h). The beam availability was good for the rest of the day and also on Saturday (back to 1E11 p and change of optics). On Sunday, the frequent LHC refills also affected beam availability for AWAKE.

MDs: two long parallel MDs took place on Wednesday — on intensity reach (8b4e beam) and on longitudinal stability and feed-forward checks (BCMS). An extension of the 8b4e MD was granted by the physics coordinator to perform a scan in batch spacing to study the impact on the vacuum activity near the 800 MHz cavities.

Other

- RP survey took place 30 h after stop of NA proton physics, i.e. on Tuesday at 14:00.
- During the weekend, emittance measurements were performed at flat top on the LHCINDIV cycle for the different transverse emittance variants prepared in the PSB (in view of LHC BSRT calibration).
- Ion interlock was triggered twice by accident (two ion cycles back-to-back).
- PC RBIH.87833 stays at 500 A during SFTION1 and on ZERO users. Behaviour not seen on LHC1.

Interventions

- During DSO tests (Monday): TI intervention on ventilation after fire alarm in BA6; fire brigade and RP accessed BA6 to reopen fire doors in LSS6; repaired switch for 200 MHz cavity 5 water temperature fault; MSE BB4 intervention.
- Wednesday: HiRadMat access for 1 h.

Follow-ups & requests

- Test is foreseen in SPS with the LHC ion cycle with 14 injections, Thursday afternoon. Still under discussion and to be decided on Monday together with NA physics coordinator.
- Request before Wednesday's MD: idea to install sonometry in LSS3 (access of ~30' cool-down + 1 h work). Would be ready from Monday afternoon.
- Plan to run an LHC proton fill in dedicated mode at beginning of week (already discussed at User meeting — OK).
- LHC MD on Tuesday: will request single batches of 48b BCMS at 1.8E11 ppb. Beam has been prepared in PSB (MD7003 clone). R1 to be added to go from 36b to 48b. To be tested in SPS beforehand.
- When AWAKE not extracting beam, try to push voltage and attempt slower voltage jump.
- BQM had to be adjusted several times among others due to a “jitter” observed on first bunch. Cause is not clear, to be investigated.
- Noisy BCT4: to be looked into by T. Levens.
- Request to play SFTPRO1 without beam after end of run. 1 week for RF tests.

SPS North Area ():

No report.

AWAKE (Edda Gschwendtner):

Access and proton run

- Monday, Tuesday, Wednesday: access
 - Realignment of Rb diagnostics
 - Plasma light diagnostic tests with ionizing laser
 - Realign laser marker line and laser virtual line
- Wednesday: MD until 8pm, then received protons (1E11p) until 10.30. Observed micro-bunches on both streak cameras, confirmed that laser contrast issue was fully resolved
- Thursday: protons (1E11p) from 9.30am to noon (then LHC ions). Aligned proton trajectory to vapor source (iris scan)
- Friday: difficult SPS set up for 3E11p, all problems solved around 11pm, then beam until 8pm with few LHC fills. Proton/laser timing scans for plasma light diagnostic and a short dataset with wide-bunch proton optics
- Saturday: stable beam (1E11p) between LHC fills, from 10am to 5pm. Electron/proton timing scans to study plasma density ramp at entrance.
- Sunday: continuous attempts to fill LHC, only a few <1hour periods for AWAKE. Attempted to take a hosing dataset

Plan for week 47: physics, with access on Wednesday during MD.

LINAC 3 (Detlef Kuchler):

It was a busy week. The linac intensity was in the range above 30 μA , but only on Friday I found a tuning of the source that also the source stability became acceptable. Before, there were regular (up to ten per hour) drops to lower intensity.

Saturday morning the source intensity dropped permanently. The gas valve that is included in the feedback loop for the gas

regulation went off. This needed a slow restart of the source. 3 h downtime.

Only half an hour later the tank1 tripped and needed a local reset. 1 h downtime.

The night from Sunday to Monday the amplitude of tank2 became unstable. It seems it was a bad contact in the feedback loop.

The exchange of some modules solved the issue. 3 h downtime.

The time on Tuesday during the RP survey was used for some MD.

Whenever possible energy measurements were done.

LEIR (Nicolo Biancacci):

Highlights & Issues:

Mon-Tue:

Continued operation on CRF43 after intervention on cavity CRF41.

Tue:

Delivered beam to PS-SPS for NA.

CRF41 fixed and BI access for vertical Schottky + orbit pickup.

ER.DWV42 frequently in fault. Several interventions from EPC piquet (current regulation + analog cards replaced).

CRF41 inspected in the shadow of SPS RP survey: tube exchanged, now hot-spare again.

Wed:

Intervention on ED.DWV42: full crate replacement, issue eventually fixed.

Trip of QDN2040 in the evening, intervened piquet to restore operation.

Thu:

Delivered beam to SPS for LHC filling on Thu/Fri.

Source + machine stability improvement before LHC fill.
QDN1030 in fault, intervened piquet to restore operation.

Fri:

Tuned Linac3 cavity 2 to improve extracted intensity to 10e10c.

Sat – Sun:

No faults, unvaried beam quality.

Degraded beam quality due to Linac3 tank 2 amplifier. Recovered on Mon morning.

MDS:

Machine learning MD for Schottky image recognition.

CLEAR ():

No report.

LHC (LHC Coordination webpage):

The machine continued to operate with good efficiency during the first part of the week, breaking again through the MKI temperature interlock limits. Just before the ion test, triggering of the longitudinal blowup in stable beams was fully automated.

The **ion test** began Thursday midday and by 6pm the ion bunches and ion 50 ns trains (slip-stacked in the SPS) had been injected. The first ramp attempt was dumped in the early part of the ramp on an internal trigger of LBDS B1. The fault was indentified to be due to the surveillance of the PLL frequency, and Friday morning the tolerance was increased temporarily for B1. This was immediately followed by the **first stable beams at 6.8 Z TeV** with individual bunches and later with a second fill based on slip-stacked trains. Unfortunately the phase loop of B2 had again issues, and 20-30% of B2 was lost in the two ramps for stable beams. Saturday morning two fills for crystal collimation test and validation.

The recovery from the ion run was rocky due issues with the RF of B2 came back. Since Saturday evening, multiple ramps were lost due to off-momentum losses following issues with RF B2, with bunches numbers ranging from 380 to 2462. Only single bunch and 12b ramp succeeded because of the smaller losses. On Sunday morning the threshold of the phase loop of B2 was increased further, at the expence of not being able to measure the injection phase of B2 with probes at injection, but this action did not help. After a hard reboot of some RF low-level crates, it was not even possible to maintain long trains of B2 at injection. This was tracked after a few hours to a missing ADT re-synchronization.