Accelerator Complex Status

End week 29 (Monday 26 July 2021)

Technical Infrastructure (R. Ledru):

https://wikis.cern.ch/display/TIOP/2021/07/20/TI+week+summary%2C+Week+29

LINAC 4 (J.B. Lallement):

Very smooth operation from Monday to Thursday…
On Thursday morning, the PIMS 3-4 modulator failed. The EPC piquet together with the expert had to replace the IGBT and a faulty driver. The intervention lasted 5h30 and the operation resumed early afternoon.
On Friday evening, a 3 MeV chopper trip interrupted the operation for 10 minutes.
On Saturday evening, the second LEBT solenoid power supply started to trip from time to time entailing the LEBT SIS triggers. The situation got much worse during the night and the operation team called the EPC piquet for an intervention on the power supply. In total, between the solenoid power supply downtime and the SIS beam interlocks, the downtime was approx. 4 hours.
In short: 2 main faults on the PIMS 3-4 modulator and on the second LBET solenoid power supply, and an weekly availability of about 94%

PS Booster (G.P. Di Giovanni):

Generally it was a good week for the PSB. At least until Sunday.

Most of the downtime is due faults related to Linac4.

On Sunday, one of the slow bumpers in the PSB injection in R3 - BI3.BSW1L1.2 - went in fault. After the initial investigation, the piquet realized that some additional help and time was needed to fix the issue. We contacted the rMPP representatives and got the green light to deliver beam for physics from the remaining 3 rings.
So within one hour from the original fault, we managed to restart beam operation in degraded mode for:

- North Area, to allow beam scans in the lines.
- AWAKE: The LHCINDIV beam for AWAKE was moved from R3 to R2.
- nTOF, that continued taking nominal beam @ 750E10 from R2.
- ISOLDE GPS, that could take beam from R1, R2 and R4 (2300E10 ppp instead or 3100E10 ppp, but we could reach the required 1uA in current by increasing the number of cycles in the PSB)

Meanwhile, the piquets did all the preparatory work to minimize the intervention time.
Once ready, beam operation was stopped again for about 1h30 hour to complete the intervention.
Afterwards, we could resume nominal beam operation with 4 rings.

Otherwise, during the week we only had a few trips which could always be reset.

Interventions/stops:

- **Planned stop for PS& SPS on Tuesday afternoon from 14h00 to 15h30 with access in the Switchyard, ie blocking the PSB**
    - We profited to perform a few minor interventions to clear up warnings in EPC equipment and to deploy a few software updates (FESA classes).
- In the shadow of the Linac4 PIMS3-4 modulator fault on Thursday, the RF experts performed several measurements on the RF Finemet cavities.

Main improvements & studies:

- LHCINDIV extraction synchronization reviewed and homogenized to improve longitudinal stability.

- New RST regulation deployed for the MPS (POPS-B) which further reduced the B-error (peak-to-peak along the cycle) from 2.2G to 1.6G.

Next week

- Beam for physics for the downstream accelerators (PS/SPS) and facilities (ISOLDE) as requested.
- Parallel MDs.

ISOLDE (S. Mataguez):

Both separators delivering beam to different users and the preparation of the linac for the week 30 for the first radioactive beam to high-energy physics experiment after LS2.

On **GPS**, Target#637 -UC-W for **TISD** run. Setup at 30kV. molecular beam development to GLM,
On **HRS**, HRS: #730 Ti foils for **VITO**: 26Na and stable K. Setup for 50kV, ISCOOL in bunched mode.
On **REX-HIE** 22Ne6+ beam delivered

week sees sharing of the beam between GPS and HRS. GPS (days) and HRS (nights).

- **Tuesday 20 July 2021**

MEDICIS
Turned off the proton request in HRS to stop the MEDICIS target irradiation

GPS
TISD run
Proton stopped for 1,5 hour - Access to PS
https://be-op-logbook.web.cern.ch/elogbook-server/GET/showEventInLogbook/3347071

HRS
Retrieve MEDICIS target from ISOLDE followed by target change on HRS (#715 → #730)
and target #717 removed from HRS Shelf and installed on MEDICIS Exchange Point 1.

Issue followed up via (ITC) teams BE-CEM: #717 was retrieved from HRS shelves by Robot Experts and after placing it on the High Trolley, it was found that it was not on the correct position
Issue followed up via (ITC) teams from Ventilation and Access systems.: The target area was switched to access mode via the CCC. Normally there should be a delay of 30 minute. The Flush Mode was only active for 1 minute.

#730 is put online: stable setup during the day, #730 Ti foils for VITO: 26Na and stable K. Setup for 50kV, ISCOOL in bunched mode.. *Transmission 70%.*
beam to users over the nigh

REX-HIE
First beam 22Ne6+ beam at 6.05 MeV/u to the ISS (XT02) - beam to users over the night

- **Wednesday 21 July 2021**

HRS
AM Protons Scan
Night VITO run

GPS
TISD run

REX-HIE

ISS problems with their data acquisition
Stability of REX during the last 72 hours.
No trips during since we started working on the 22Ne6+ beam.

- **Thursday 22 July 2021**

GPS
From 9.30 to 13.15 Proton stopped for 3,5 hour – Linac4 fault

HRS
From 22/07/21 22:00 to 23/07/21 10:00 – **VITO run cancelled**
Absence of AQN for 4 power supplies have created confusion

REX-HIE
20:45 7GAP3 tripped.
XLHT1 CAV1 tripped.
Since beginning of the week, occasional spikes in the 7GP1 field still visible... (cf attachment) could be a blocking issue for the next run.

- **Friday 23 July 2021**

HRS
Tuning Beam line to recover the initial transmission across the RFQ (70%)

REX-HIE
22Ne6+ beam delivered to XTO2

- **Saturday 24 July**

GPS
20:30:29 GPS line heating tripped off.

REX-HIE
XLHT1 CAV1 tripped.

- **Sunday 25 July**

GPS
Proton stopped for 2 hour – 18.00 to 19.30

HRS
VITO run
Proton stopped for 2 hour – 4.00am to 6.00am
Few QP's tripped

- **Monday 27 July**

HRS
- 7.00am HRS target and line heating tripped off. – Control (PLC issue)
-10.00am Target #717 installed on HRS front end.

REX-HIE
Stop Ne beam

PS (H. Damerau):

An eventful week for the PS with many issues. Throughout the week the operational beams SFTPRO (about 5E12 p/p), AD (up to nominal intensity of about ~1.4E13 p/p) beams were delivered. The destinations nTOF (up to 7.5E12 p/p) and AWAKE (up to 3E11 p/b) started to take beam and add to the list of operational users supplied by the PS. The overall availability of the operational beam was only about 80%.

Three accesses were required during the week for repairs of essential equipment. On Tuesday the beam was stopped from 14h00 to 16h30, mainly to exchange the gap relays of cavity C10-36 and the final amplifier of cavity C10-36. Several other activities (e.g. PR.ODN regulation, TT2 BLM tests and various inspections) have been performed in parallel in the ring. The beam stopper FTN.STP428 (impurity in a pneumatic valve) was found blocked in the line towards nTOF on Wednesday evening. The access has been scheduled in the shadow of an intervention in this SPS on Thursday morning. Although the PS was ready for beam as foreseen around 9h30, protons were only back at 13h15 due to a modulator problem in Linac4. The third intervention in the ring had to be organized on Friday evening for the exchange of the final amplifier of cavity C10-66, when the PS was anyway down for a controls issue with the injection kicker. Beam was back at about 20h25.

On Monday the TOF beam was delivered as scheduled to the new target, initially at reduced intensity of 2E12 p/b, but since Tuesday already at almost nominal intensity (7.5E12 p/b) with smaller duty cycle. Transfer line steering has been optimized and extensive studies (dispersion, quadrupole scans) of the beam size on the target have been pursued by scanning the quadrupole settings in the line in close collaboration with the target experts. A factor of two between the FTN quadrupole circuit currents and the optics from the model is most likely due to the cabling topology of the quadrupole circuits.

Following the preparation of RF settings on Wednesday (EARLY cycle), LEIR synchronizes to the signals from the PS and the ions are knocking on the door of the PS. However, difficulties to reliably pulse the ion septum SMH26 prevented their injection into the ring so far. Nonetheless they are already seen on the pick-up ETP.UEHV10DH.

Optics studies to improve the transfer of protons/antiprotons to the AD have been performed throughout the week. In particular the optimization of the extraction settings (kicker and bump) on Friday lead to 25% more antiprotons captured in the AD. The production yield still remains below 2018 levels.

To continue pushing the intensity of the LHC multi-bunch beam (25 ns), a new variant from the PSB (up to LIU intensity) has been tested in the PS. Although the high-energy RF manipulations cannot yet be enabled, the intensity to produce 2.3E11 p/b at extraction has been accelerated (about 1.6E13 p/p). However, trips of cavities at that intensity during the weekend yet prevented transverse emittance measurements.

During the night from Saturday to Sunday the PFW circuit WFNP had to been switched to the spare power converter. Due to regulation issues only the operational cycles SFTPRO and TOF were then delivered during the night. An expert intervention on Sunday morning was necessary to recover the WFNP circuit for all cycles. As ring three of the PSB could not produce beam during few hours on Sunday afternoon, the cycles in the PS were temporarily adapted.

AD (L. Bojtar):

- Work continued on the stochastic cooling. Both the old and the new optical notch filters are operational now. The new optical filter is selected by default as it gives better performance. The deceleration efficiency between 3.57->2 GeV/c is excellent, better than before LS2. Between 2 GeV/c and 300 MeV/c it is similar to the pre-LS2 performance.

- A decent amount of beam is decelerated to 300 MeV/c enough to start the setup the e-cooling next week.

- The intensity of the injected beam is still a factor 2 lower than the pre-LS2 value. We did not invest the necessary 1-2 days for the dogleg optimization until the long standing issue with the pulse shape of FGC62's in the injection line is resolved. This issue is not blocking or slowing down the progress with the machine set up and partially resolved now. (2 ot of 6 power converters fixed.)

-PS RF had often phase changes at the beginning of the week making the AD injection and bunch rotation erratic. Frequent re-adjustment of the AD bunch rotation after the injection was needed. The issue has been understood by the RF experts and corrected.
- The electron cooler was powered up for test , but not set up yet.

- A new optics for the FTA line has been tested , then permanently deployed by Yan and Cedric. It gives a smaller spot size and more intensity on the target by about 10 %.

- The tune measurement is operational now after some initial doubts due to low intensity and poorly cooled beam.

Issues:
- FGC 62 DI.BHZ6034,DI.BHZ44,DI.BHZ45,DI.BHZ64 and DI.BHZ65 went down after central timing reboot. Less beam injected after restart.
- There was a timing problem with the BCCCA, fixed now.

- The ventilator for the water cooling tower has stopped Friday morning. Forced us to not cycling the AD for 2 hours. After the intervention of CV normal operation resumed.

- The orbit system shows large shot to shot variations. The expert is on holiday for two weeks. It might be due to unstable ring power supply too, to be investigated further.

ELENA (L. Bojtar):

Electron cooling on the intermediate flattop is set up

SPS (F. Velotti):

The SPS week 29 was characterised by the hunt for the beam on T10, a few more issues with the access system in BA1 and 2, start of AWAKE physics run and the first round of dedicated and parallel MD slots.
The week started with still no beam seen on T10 but still very nice profiles seen on T4. The BI experts checked a few times all the devices in the area and found nothing out of the ordinary - stepping motors seem to work as expected and signals seen on the FESA classes from injected current also responded as expected. After RP survey of the line and checks of polarities, the secondary line experts requested the re-installation of the devices (1 BPS, 1 BSI and 2 BBSs) that were requested to be removed from the line during LS2. With the TAX with the slightly larger aperture still no beam seen passed them on any of the devices, but beam seen scanning the jaws of a collimator available just downstream. It was then decided over the weekend to move to a larger aperture and a first profile of the beam was seen on the BSGs in the middle of T10 transfer line. Additional scans were carried out and found a few magnets (on Monday meeting will have all the details of this) with wrong polarities. The shift crew then run a few more times the mini-scans on T10 to find the beam, but still unsuccessfully.

A few more lost of patrol were recorded: twice in BA1, once in BA2 and once more in TT41 (a few minutes ago). For the first 3 cases, the shift crew had to re-patrol as the procedure put in place was not working at the time. This has been fixed, though, in the course of the week and now it should be possible to rearm the access system from remote in case particular conditions are met and with the agreement of access system experts. Also, BA1 rack was shielded just at the level of the sensitive card and, after two failures, before the shielding was added, this now seems to have fixed the situation. The technicality for a blind remote rearm were tested in TT61 and now this could be used in case of another issue. The new cards have been ordered and will be fully at CERN end of next week (even though a first batch has already been delivered to CERN), and then they will be tested in BA3.

On Wednesday there was the first dedicated MD of the year and on the Thursday the first long parallel MD too: crystal shadowing with usage of optimisers and continuation of commissioning of HiRadMat cycle on the RF side. The longitudinal blow up was tested and 144 bunches at 1.3e11 ppb were accelerated to flat top. This took some time and the MKDV seemed to have de-conditioned a bit and the acceleration had to be done very slowly.
After the dedicated MD, AWAKE started to take their first physics beam. As first step, the proton bunch was aligned with the plasma cell iris and self-modulation was observed already over the weekend.

On the other-issues side:
- cavity 2 frequent trips following the "limited" label was solved after the access that took place on Tuesday. Since then, frequency of failures reduced, but still not zero (and larger than all other cavities)
- Found an issue on active filter on SMD13, which was then solved and 2 spare stations were restored and ready to be put in in case of need
- Laslett tune shift not working yet - EPC expert still need some work to identify the issue
- Leak close to TED in TT20 found. Vacuum activity at the location seen on the logging since the beginning of slow extraction. VSC team needs access to do a leak detection and radiation survey to understand the source

- Bad-good transmission states seem a few times. Test done rebooting the mains and sometimes found that worked and sometimes not - still not completely clear but now seems more related to mains than anything else. Investigation on DCCT logged current did not show any significant difference in the two states. Further investigation needed.

SPS North Area:

- H2: NA61 had a successful start of the experiment, initially focusing on detector commissioning. Beam commissioning very quickly done and matching user expectations. Next is change towards FASER calorimeter, pure electron beams set-up already done.
- H4: CMS ECAL successfully completed their beam time, LHCb-CAL already taken over and started data taking. RD51 and GIF++ very satisfied, they completed the largest part of their program.
- H6: Nucleon test beam about to be completed, now preparation for Atlas ITK. Happy with beam quality.
- H8: many parasitic users with Faser pre-shower as the main experiment. Preparation for electron beams for Atlas TRT.
- M2: beam ready, but still issues with EP safety clearance for Compass experiment. As soon as their detectors are installed, there will be another fine tuning of the beam. Compass is still recovering from their target issues, but now on a good track for starting physics in a few weeks.
- P42/K12: many issues found thanks to Lau, Niels, and Nikos. Missing and non-working beam instrumentation is clearly not helpful and muon rates on NA62 turned out to be deceiving. Most probably combination of wrong polarity of Bend 2 and TAX reading in P42, plus non-working T10 TBIU, plus five wrong polarities in the two achromats of K12. Now on a good track, but need T10 TBIU working.

AWAKE (E. Gschwendtner):

Week 29 summary: Successful start of AWAKE proton. Re-established self-modulation of the proton bunch! Get ready for electron seeding measurements.

Monday July 19 to **Wednesday** July 21: Pump down vacuum system after vapour source intervention andalignment of upstream streak camera optical line for electron bunch length measurement

Wednesday, 21 July: start of AWAKE run: first protons around 9pm. Strange time-structure of proton bunch, tracked down to a PS cavity. Until trajectory is optimized, AWAKE focuses on timing and synchronization of proton bunch with laser using streak camera.

Thursday, 22 July: No protons until 3pm. SPS trajectory optimization with BLM scans on the vapor source irises to define 'golden trajectory'. Laser trajectory aligned to proton one (but 5mm offset due to a BTV scale setting)

Friday, July 23: One more BLM scan by SPS to check proton trajectory. Solved BTV scale offset and realigned laser to actual proton trajectory
Access to AWAKE (last chance before the weekend): warming up vapor source, checking streak camera alignment, aligning Rb density diagnostics

Saturday, July 24: Realignment of laser to proton trajectory. Protons and marker on streak camera (see first picture)
Filling vapour source with Rubidium --> Back in business: Self-Modulation of the proton bunch on Saturday.
Adjusting proton/laser position to switch between SMI and SSM

Sunday, July 25: Setting up laser, electron and proton trajectory alignment. Setup relative timing of laser/electron/marker/protons to study electron seeding → ready for electron seeding measurements (goal of this year's run)!
But: access system crashed, Piquet called to replace faulty card and re-establish
patrol, but no hope of more beam before the end of the shift.
need patrol, also in TZ80!

Program of week 31:
recover from access system crash, continue electron-seeding self-modulationexperiments (electrons ahead of proton bunch), laser ahead of both.

LINAC 3 (G. Bellodi):

Linac3 delivered beam to LEIR all week with intensities varying between 30-35µa.
Some source/ LEBT retuning was done on Tuesday and the source puller electrode was moved back by 2mm on Wednesday morning (to give a shorter extraction gap). Due to the combination of these changes, the source spark rate stopped growing and stabilized at the end of the week to around 25 occurrences/day. There are some signs of further rate decrease during the weekend, to be confirmed.
The LLRF server was found to be down on Wednesday and was restarted by RF colleagues.
The source MW tripped on Friday/Saturday night and was restarted.
The source keeps running on the same oven since June 3rd.

LEIR (N. Biancacci):

- EARLY beam extraction to PS commissioned, ready to be taken on Monday 26/07 from the PS.
- "L3_MONIT" cycle set setup for the tracking of the Linac3 injected beam momentum distribution.

Next step:
- beam to PS on Monday 26/07
- starting the setup of the NOMINAL beam cycle.

Fixed Issues:

1. Kicker timings were not properly configured: BE-CSS intervened and fixed the issue.
2. Ring orbit BPM acquisition frozen: fixed by FEC restart.
3. Extraction BPM acquisition not triggered: fixed by disabling calibration timings.
4. Extraction BCT gains and timings needed adjustments by the experts.

Outstanding Issues:

1. CRF43 frequently in fault (HT Supply Fault) due to a power supply. This was replaced from CRF41 on Thursday. On Friday a new one was installed in CRF41.
2. Issues with CRF43 cavity servoloops control. Followed up by SY-RF in view of the capture setup of the NOMINAL beam.

CLEAR ():

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LHC (Matteo Solfaroli & LHC Powering Test webpage):

W29: 19.07.2021 to 25.07.2021

S12	S23	S34	S45	S56	S67	S78	S81
Completed Sector @ 20K	Room T, repair	**Completed**	**Completed**	**Trained**	**Training**	Room T, repair	**Training**
77 / 11950 A	29 / 11538 A	**71 / 11950 A**	**87 / 11950 A**	**76 / 11600 A**	19 / 11114 A	69 / 11585 A	3 / 10616

With S81 the last sector started its training campaign. Based on the first few quenches, it is likely to be a slow trainer.