Accelerator Complex Status

End week 28 (Monday 19 July 2021)

Technical Infrastructure (R. Ledru):

Statistics:

- Alarms: <5k last week, ~half than the previous week.
- Phone calls: 456 incoming, 148 outgoing.
- 90 ODM created.

Events worth mentioning:

- SPS was stopped 3 times last week due to faulty access communication cards resulting in lost patrols (2xBA1 Tue/Fri and 1xBA80 Sat night; followed through Major Event 113580). On Saturday beam was stopped until the morning, waiting to obtain the go-ahead of the DSO for a special procedure to avoid repeated patrols in partly quite radioactive areas; unfortunately, the special procedure was unsuccessful and the patrol in BA80 was done Sunday morning.
    - 300 electronics cards are ordered and will be changed in October.
    - EN-AA are investigating a solution to avoid such patrols until October.
- On Thursday switched the BEQ1 SVC OFF and ON during the SPS beam stop; EPC needed to clear the clogged drains.
- On Sunday trip of the BEQ1 SVC, due to a false earth fault. This append in the shadow of the access issue of BA80.

Details: https://wikis.cern.ch/display/TIOP/2021/07/16/TI+week+summary,+Week+28

LINAC 4 (A. Lombardi):

A good week for LINAC4 with excellent availability and little to report.

- Saturday EPC piquet had to come on site to change a FGC module on LTB QDN40.
- Reboot of cfv-400-bpmln4c was needed and eventually done on Sunday (no impact to operation).
- Timing intervention on Thursday morning.

PS Booster (C. Bracco):

Very quiet week for the PSB:

Interventions/stops:

- Planned one hour stop on Thursday during PS access due to need of restarting the general timing
- About 1 hour stop due to a fault on the PC of the recombination septum BT1.RSMV10 (threshold on V2V card increased)

Main improvements & studies:

- New ISOLDE cycle with reduced energy spread: now 80 turns injected with max 2% losses in all rings along the cycle. Losses in ring 3 solved by reducing the horizontal tune from 4.24 to 4.22. It is still unclear the dependency on the user previously played and the intensity injected there.
- LHC25 high intensity: improved longitudinally and 35 turns injected with very low losses. Brightness measurements being performed with and without beta-beating correction.
- AWAKE beam: improved in all planes. Transverse emittance now 1.2 um in H and V planes with 3E11 p and beam nicely bunched.

Next week: Official start of parallel MDs.

ISOLDE (J.A. Rodriguez Rodriguez):

It was a busy and eventful week at ISOLDE with both separators delivering beam to different users and the preparation of the linac for the first high-energy physics experiment after LS2.

On the HRS side, the vacuum team determined that the problem that we had on the turbopump of the front-end last week was due to a faulty temperature sensor. They decided to bypass this interlock since they didn't consider it critical and plan an intervention during the next YETS. Following their decision, we continued with the physics program. A previously used target was installed. Unfortunately, it had a vacuum leak and we had to install another target instead. Set-up of the separator, the cooler/buncher and low energy transfer line to the IDS experimental station took most of the rest of the week. Users have been taking multiple isotopes (several thallium, cessium and barium isotopes) during the weekend and they are very happy with the data they acquired.

On the GPS side, the target team continued with their target and ion source studies. They spent most of the week working with two different targets. Even though the ion source of the second one failed during the weekend, they managed to complete most of their experimental program. Today, we will install a new target and they will continue with their program.

On the REX/HIE-ISOLDE side, we tried to find a solution for the stability problem of the 7GP1 amplifier/structure. We decided to operate this structure at a lower gradient than nominal and prepared a new set-up for the whole machine. Because of the change in ToF between accelerating structures, we had to rephase four of the normal conducting structures and the 20 superconducting cavities.

PS (A. Huschauer):

- The PS has seen a good week of operation, with about 95% availability. Operational beams continued to be provided to the AD (at the nominal intensity of ~1400E10 p) and the SPS (SFTPRO beam at ~500E10 p).
- Beam loss on the AD cycle could be more than halved by adjusting the working point at extraction with the PFW and optimising the extraction trajectories. Furthermore, the longitudinal setup was improved at transition crossing and during the batch compression. The transmission through FTA appears to be worse than in 2018 and studies continue in collaboration with SY-ABT to understand this observation.
- On the TOF beam, the bunch rotation was optimised to obtain the nominal bunch length of ~25 ns with a minimum front tail. Beam loss on this cycle could also be reduced by about a factor 2 by adjusting the working point at extraction. This beam is ready up to 800E10 p to be sent to nTOF.
- The AWAKE single bunch beam at ~30E10 p is now ready and has already been taken by the SPS. Longitudinal tails were removed by adjusting the timing of the extraction bump compensation, which became necessary due to the consolidation of the extraction bump power converters during LS2. This modification, together with increased RF voltage at SPS injection, helped to redue the SPS injection losses.
- Studies on the EAST extraction continued by performing tune and chromaticity measurements at flat top. The PFW LSA knobs allow to nicely flatten tunes and chromaticities along the plateau and a strong decay of the tunes is observed when the PFW are enabled during acceleration, which might be linked to eddy currents and is being further investigated.
- On Thursday morning the TOF DSO tests took place, but couldn't be successfully completed right away. Several objects were still left in the area and had to be removed and a cabling problem identified on the beam imminent warning didn’t allow for the beam permit to be validated.

These issues could however be solved on Friday, the beam permit got signed on Sunday and first beam on the new nTOF target is expected on Monday morning at 10:00. The PS will deliver an intensity of ~200E10 p, which will then be increased during the target commissioning.

- In the shadow of the TOF DSO tests beam was stopped during the morning on Thursday to allow for several accesses to the machine, and the repair of the power converter of the figure-of-eight loop took place as well. A burnt electronic card was identified to be the root cause of the converter failure and it is likely that the presence of dust inside the converter has contributed to this failure. Most probably a thorough cleaning campaign of the converters in the same room has to be performed and this is being followed up with SY-EPC and Fernando Pedrosa.
- During the whole week measurements with the BGIs and the wire scanners continued and good agreement between the different systems is now obtained.

AD (D. Gamba):

- Still missing about a factor 2 in intensity from the target, probably due to a yet-to-finalise optimisation of the proton spot size and position on the target area as well as settings of target position and horn strength.
- Study/optimisation of target longitudinal position could not take place due to issue with broken power supply in DI line, eventually solved when target expert was not available anymore.
- Semi-parasitic attempts to restore 2018 injected intensities with minor adjusting on steering are promising, but still require expert attention.
- Careful debugging of the stochastic cooling components and connections and first setup:
    - Solved some minor hardware issues.
    - First complete setup of s-cooling on the 3.57 GeV/c plateau done.
    - Possible to run with both “traditional” and “optical” notch filter, with slightly different final performance (at least in pause mode after long cooling time).
    - Final emittance for operational cycle, which are still a factor 4 bigger than in 2018 (to be confirmed by careful analysis, as tools have changed and there could be systematics).
    - Still needed: final adjustments of pickup movement along the cycle: first attempts show promising results in terms of emittance reduction.
- Considerable progress on the LLRF setup
    - Some hardware and software issues in the LLRF system were identified and promptly fixed
    - Optimisation of bunch rotation at injection: this system seems to be sensitive to changes that are being made in the PS to optimise the AD cycle there. Final setup likely to be re-checked as the commissioning progresses.
    - Optimisation of the beam capture mainly by adjusting frequency offsets. Presently the RF frequency and the beam seems to be well set on the theoretical values which were also used in previous runs.
    - Optimisation of the cycle to smooth transitions during the ramps
    - First attempts to close the LLRF feedback loops: the phase loop seems to work fine, while the radial loop suffers from poor beam orbit quality. To be continued.
- First verification of the orbit system.
    - Broken cables for one pickup were fixed by BI
    - System is providing a reasonable orbit acquisition, which however exhibit some artefact maybe due to lower than nominal beam intensity. Expert will be away till early August, but the acquisition seems to be good enough for this phase of the commissioning.
    - It seems possible to measure the e- orbit using the standard BPM system as done in ELENA. To be continued.
- About 90% transmission (preliminary) down to 2 GeV/c and some beam survives down to 300 MeV/c despite s-cooling not yet fully setup for 2 GeV/c plateau.

Issues:

- Major fault on a new power converter for quadrupole DI.QFO6020 in the injection line. First line attempted to switch to a spare power converter (of old generation), which unfortunately was found not to be operational. After several attempts and delays also due to missing experts on site (holiday), the spare power converter could be repaired after one day. The new power supply, as far as I know, is still to be repaired.
- Detected a possible problem on the ELENA ion switch power supplies or cabling: EPC is investigating.

Some technicalities:

- Moved the RBAC device groups ELENA into ADE. The original ADE RBAC access rules also apply to ELENA devices now. The elena-op role can access ADE/ELENA devices from anywhere (see APS-9094).
- The multi-non-ppm feature recently introduced in the control system (and so in AD) is not well digested by all systems (e.g. B-train) and/or we should learn better how to properly use this feature not to end up with the machine in inconsistent states.

ELENA (D. Gamba):

- Checked to have the source ready to run with new H_2 cartridges, but did not make any beam due to lack of personnel. ELENA is in principle in good shape to accept beam as soon as it is ready from the AD, so priority is given to the latter.

SPS (H. Bartosik):

It was a very eventful week for the SPS, with the start of North Area physics on Wednesday, beam commissioning activities on the AWAKE and the HiRadMat cycles, but also longer periods without beam due to several issues, most importantly due to a recurrent issue with the SPS access system. Beam availability was about 64%.

SFTPRO:

- The first half of the week was devoted to the preparation for NA physics, in particular sorting out remaining issues with instrumentation and tools (getting the mini scans working required work from the BI side but also on the OP application, adapted normalised losses in the Quality Control, debugging of optimisers for ZS alignment and crystal alignment, display of symmetry on page1, …).
- The slow extraction setup was optimised through ZS girder alignment, ZS anode alignment and alignment of the crystal in channeling mode for shadowing the ZS. The crystal shadowing is now used operationally resulting in a significant reduction of the losses at the ZS, with very good stability observed so far.
- The beam trajectory on the first splitter was optimised to minimise losses. A different loss profile was obtained compared to pre-LS2. However it has to be noted that the collimators and splitters were realigned during LS2. Further investigations will follow in the coming weeks, also when the intensities will be increased to pre-LS2 levels.
- RF experts optimised the RF gymnastics for debunching at flat top.
- Following the good progress, also on the experimental beam lines sides over the last weekend and in the beginning of the week, the official start of physics was advanced to Wednesday. Since then, the SPS is delivering a total intensity per cycle of about 1e13 ppp.
- On Friday, EA physicists together with RP performed accessed the North Area to perform a survey, as there was still no beam seen in the P42 line. They found a bend with inverted polarity. After further scans with beam over the weekend, it seems the beam is finally reaching T10, but still it is not seen on the target instrumentation. BI needs to further investigate in the coming days.

HiRadMat:

- RF experts worked on the setting-up of the controlled longitudinal blow-up. Good settings were found for single bunches, which were later also tested successfully on a full batch of 72 bunches with up to about 1.2e11 p/b and the beam was longitudinally stable. Higher intensities and/or multiples batches could not be tested yet.

AWAKE:

- Final preparation was done for the start of the AWAKE physics run on the coming Wednesday, including the bunch rotation for bunch shortening synchronised with the AWAKE experiment was tested with extractions to the TT40 TED.
- The beam intensity was increased to 3e11 p. Transverse emittances below 1.7 um were reached at SPS extraction after optimisation of the beam production in the PSB and working point adjustments in the SPS.
- Optimisation of transmission was achieved through minimisation of longitudinal tails in the PS, and increasing the bucket area in the SPS.

Main issues & faults:

- A recurrent issue with the access system control cards (Siemens IO cards) resulted 5 times in the loss of patrol in different accelerator zones this week, 3 times in BA1, once in BA6 and on Saturday evening also in BA80. The access system relies on 2 redundant loops that guarantee that there is nobody in the machine, a PLC system and the cabled loop that checks the envelope of the zone. The faults concern the PLC system and the access system piquet has to reset the controls card and OP has to perform the patrol. Given the high radiation levels in BA80, it was decided on that occasion not to perform the patrol like for the other zones, but instead we waited for the OK of the DSO to restore the access system integrity by a special procedure established by Bettina (replacing Rende as OP GL) together with the access system specialist on Sunday morning. Unfortunately the attempt failed, and finally the patrol had to be done anyhow. The issue with the access system trips needs to be followed up urgently, as it results in unnecessary dose to personnel as well as significant machine downtime (this week almost 25h downtime!) and the same fault occurred already several times in the weeks before.
- Cooling issue on bending magnet in BA80 - 6 h downtime.
- Frequent trips of cavity 2 due to an issue with one of the amplifiers.
- SMD8 tripped several times because of over temperature fault. In the end it had to be taken out of the configuration. The experts are aware and will work on it in the beginning of the week.

SPS North Area (J. Bernhard):

- All lines are set up and running besides P42/K12, where we found a wrong polarity in a septum magnet – however not fully solving our issue. We make probably the first 400 m to 600 m and then lose the beam, so another access to TT83/BA81 is planned for today (RP survey, polarity check).

AWAKE (G. Zevi Della Porta):

Week 28 summary: Vapor source intervention (partial success). Laser back online. DAQ checks.

Vapor source:
- Contractor team from UK arrived, began work towards swapping Rb reservoir
- Unfortunately, controller for Ar pressure was malfunctioning, so intervention is postponed to August
- Other interventions took place (without opening Rb system): fixed Galden pump and fixed malfunctioning temperature probes

- Plan to pump down vacuum on Monday July 19

Laser:
- While waiting for new flash-lamps to be delivered, installed a batch of used flash-lamps
--> Laser system back online! Continued training and realignment.
- Will test full beamlines when we have vacuum on July 20

Data Acquisition:
- Event Builder: tracking down residual issues (BCTF, BPM, BQM, Sps2AwakeDelay)
- NXCALS: checking all subscriptions

Streak camera:
- Received the repaired "slit-control motor". Installed and tested, ready to use.

LINAC 3 (R. Scrivens):

The Linac supplied beam to LEIR all week, with intensity >30uA.

- On Thursday, during the PS access, the source charge-state distribution measurement application was tested.
- During the planned timing reboot on Thursday, the RF auto pulsing system was tested, to avoid the need to intervene manually for each timing stop.
- The only faults were two trips of the source during the week, but it could be restarted within an hour.
- The source has been running on the same oven fill since 3 June. However, the source still has a high spark rate.

LEIR ():

EARLY beam transverse and longitudinal plane commissioned.
Injection Transfer Line kick response and optics measurements: data taken, waiting for results of the analysis.
Next step: setup the extraction to PS. Beam to PS is foreseen Monday 26.07.2021

Outstanding Issues:

1. Cavity 41 needs tube amplifier exchange
2. Building 249 has plastic sheets installed at the ceiling to avoid rain water to fall into the power converters. Ceiling needs repair.

CLEAR ():

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LHC (M. Solfaroli):

Powering tests are ongoing:

- S56 is completed, operational tests with all circuits together are being performed
- S67 is completed, apart main dipoles and quads. Dipoles are being trained, a week in advance wrt to schedule. 10 quenches already done.
- S81 is expected to be ready for training beginning of next week
- Tests to check potential operational performance increase are ongoing on already commissioned circuits

Dry runs and other commissioning:

- MKI regular softstarts
- Sequences and tasks cleaning and redesign
- Settings management

- Collimator commissioning in preparation
- Feedback testing
- ...