Accelerator Complex Status

End week 41 (Monday 18 October 2021)

Technical Infrastructure (*Ronan Ledru*):

Statistics:

- About 4800 alarms.
- 761 phone calls (548 incoming, 213 outgoing).
- 112 ODM created.

Events worth mentioning:

- Wed. 13.10:
  - Loss of Patrol at TCC8
  - Loss of OP webtools, 513 operator called. The server has been restarted by the best effort
- Fri. 15.10:
  - Loss of Patrol at BA80.
  - Loss of Patrol at BA2.
  - OP webtools, EAM and some others webservices unavailable. TI called the 513 operator, 2 routers of the b.513 were down.
  - The battery's of the UPS EBS11/56 in UJ56 produced some smoke. UPS has been bypassed and battery's were changed on Saturday. UPS online on Saturday at 21:42.
- Sun 17.10:
  - Loss of Patrol at BA80
  - Stop of IRRAD Beam because of an access issue on YEA01.EA2=157. ZORA piquet onsite, the circuit breaker was tripped.
  - Loss of Patrol at BA2.

Details: https://wikis.cern.ch/display/TIOP/2021/10/18/TI+week+summary%2C+Week+41

LINAC 4 (*Piotr Skowronski*)

Up to now we have 96.7% availability.

- On Tuesday broken fan on PIMS0708 caused 2h43min downtime
- CCDTL2 tripped 4 times on cavity flow meter interlock. Each time it needed approximately 10 minutes to restart. The flow meter should be eventually exchanged, however, the RF specialists claim that it should rather wait until YETS because it is a time consuming intervention.
- On Friday ramp rate of LT.BHZ30 was reduced from 3kA/s to 2kA/s. After the technical stop this magnet provoked very slow (3 days) trajectory drift. Subsequent thermic camera measurement revealed vacuum chamber exceeding 50 degrees C, meaning that eddy currents are substantial. The vacuum specialist is not concerned about the temperature, but is worried about magnetic forces that can eventually break the chamber. It was agreed to lower the ramp rate, which increased rms current of the magnet from 300 A to 350 A. Thermic camera measurements shall be done also for the remaining bending magnets in our transfer lines.

PS Booster (*Gian Piero Di Giovanni*):

We started the week worrying about the failure of the R2 lower coil of the special extraction bending magnet, BHZ15L1, from the week before and its impact on operation. As announced at the FOM, a replacement would take between 2 and 3 weeks. Not to mention that a spare will be ready only by the beginning of YETS.

On Tuesday during the BHZ15L1 visual inspection (agreed at the FOM), the magnet experts observed that the shimming plate in R2 exited the gap and traveled close to the vacuum chamber. The bellow was in turn compressed by ~1 cm on one side and pulled on the other side. The experts were worried about breaking the chamber if the machine would continue running. After discussion with both magnet and vacuum experts, we decided to extend the intervention and try to bring back the shimming in position and fix it better. At the time, we did not know what we could find or if we could actually fix the issue. Both teams worked until late in the evening and found what seems to be a suitable solution to arrive until the end of the proton run. The PSB will remain without the Ring2 lower coil working until then. The current speculation is that the coil moved because of the magnet pulsing. The coils of the PSB main magnets move because of the equipment pulsing. We also reached 8 M pulses, in fact the machine cycled an equivalent amount of integrated time of a standard yearly run already. Because of the coil moving, the shimming got loose. So, the shimming started traveling outside the gap, while machining and breaking the coil at the same time. These are all speculations at the moment, though. The magnet team needs to take the magnet out and open it. Which is a priority for the PSB during the YETS.

After that, we had a more regular week with improvements in many areas:

- The BI experts identified the issue with the WD class and are preparing a SW fix. Meanwhile, by simply updating the class to the latest FESA version, it dramatically reduced the number of resets this week.
- ABT experts were regularly called for the trips of the BE1.KFA14L1. During one of the longer interventions, they removed a diagnostic cable which seems to have been the root of the recurrent trips. The kicker has not tripped since then. We will ask to check also BT1.KFA10 which another kicker often tripping.
- We prepared a special cycle with a 320MeV flat-top for MD studies. This MD cycle tripped POPS-B, so EPC re-adjusted the current regulation and will try on Monday morning if it works well.
- As a result of the failed coil in R2 BHZ15L1, the transverse emittance of LHC beam increased. Resteering at injection brought back the desired performance (we use the special magnets trims to correct the orbit throughout the whole cycle). And this was important for the last LIU MD block of the year.
- ISOHRS: improved the losses at during the cycle and retuned the extraction synchronization.
- We started the preparation for the HiRadMat run. The request is to have 1.2-1.3E10 ppr with a transverse emittance of 2 um in both planes, i.e. double the current values. We could reach the target by mis-steering the beam at injection, but the transverse emittances fluctuate shot-to-shot and their value is sensitive to the injection from L4. We will continue the setting-up this week to find a more stable configuration.
- As a side note the R3 wire-scanners have flied >10000 times in each plane. The other rings are about 2000 scans each. The BI team is actively following up on issues, to increase the reliability of the system which is very much needed (we are regularly prompted errors of various type).

As of this morning, the weekly availability of the PSB has been 92%. Not too bad, based on how the beginning of the week unfolded. In the end, thanks to the brilliant and professional work done by both the magnet and vacuum teams, we managed to keep going. We will continue living together with the R2 problem as all operational beams are provided within the specifications. We also started the investigation to check if the PSB can survive without the extra trims working. It was (and should be still) possible for 1.4 GeV, but it is not clear the impact at 2 GeV.

ISOLDE (*Emiliano Piselli*):

Low energy beamlines:

HRS:

Radioactive beam provided to Wisard experiment by Wednesday evening. Many thanks to F.Wenander (BE-ABP) for his precious help to setup this beam with REXTrap.

Few small problems:

- isotope production lower than expected
- Beam instrumentation issue on Sunday morning due to the communication between beam diagnostic server and the beam diagnostic plc (Big help from S.B.Pedersen SY-BI).

GPS:
Radioactive beam provided to GLM users.
Only one small problem on Sunday evening due to a vacuum valve interlock.

HieIsolde-Rex
Beam from HRS to REXTrap and then to Wisard experiment.

Detailed report:
Low energy beamlines:
HRS:
On Tuesday morning proton beam scan and then stable beam tuning for users (Wisard experiment).
On Wednesday yield measurements in the morning (SY-STI target experts). Yields lower than expected.
Stable beam tuning to users. Good settings found late evening thanks to the help of F.Wenander (BE-ABP) for REXTrap tuning. His expertise was really well appreciated. Radioactive beam to the users in the same day.
On Thursday morning I was called in from users at 1h30 because they had very low production of radioactive isotopes from the target. I have checked the transmission, but I could not help them we have then agreed to continue in the same condition for the whole night.
In the morning target experts have tuned again the ion source and users could get back the beam.
On Friday we have repeated a proton scan directly on the users detector. We have thought to do it following the intervention done in the PSB on Wednesday. Isotope production improved by 50%. At the same time, G.P.Di Giovanni has found that PSB ring 2 horizontal steering was different with the reference one. He has set it back.
On Sunday morning I was called in again at 8h30. Beam diagnostic devices were not responding. All Farady cups and grids not working.
After few tests, I have called S.B.Pedersen (SY-BI-SW), who was very kind to spend more than 2 hours debugging the system. We have performed many tests together (PLC reboot, front end reboot, devices disconnection). At the end, Stephane has found that the problem was due to the communication between beam diagnostic server (cfc-197-bisobeam) and the plc (cfp-170-bsisopam). He was able to restart the system and further investigations are addressed to the equipment owner. Users could get beam back at 13h00.
In the evening I was called in again because users could not see any beam. Once at Isolde I have done some small manipulation and users could restart their experiment.

GPS:
On Tuesday we have installed a new target (#534 Sn (Tin)). Stable beam tuning done on the same day and then radioactive beam (STAGISO) to users (GLM) on the same day.
On Wednesday we have tested thermocouple connections (with C.Mitifiot BE-CEM and S.Rothe SY-STI). Everything worked correctly from the controls point of view. Fully implemented in the control system.
Users got beam without any problem until today morning. I was called only once: on Sunday morning at 3h45. Vacuum valve interlock. I have helped users by phone.

Hie-Isolde-Rex
Beam from HRS to REXTrap and then to Wisard experiment.

PS (*Bettina Mikulec*):

Tuesday: FTN line MD

- On Monday chromaticity and tune were measured to determine the initial conditions before extraction.
- Quad scan was done and allowed to show a good correspondence with the model when using the new initial conditions.
- The MD had to be interrupted due to the PSB BHZ15L1 repair —> the aim is to continue tomorrow and try out a new optics that hopefully predicts correctly the beam size on the SEM grid upstream the target.

Wednesday dedicated MD for turn-by-turn injection studies

- Managed to get started only after midday due to Crab Cavity setup
- Unable to insert SEM grids 48/52/54 when the ralentisseur was out: problem not understood and being followed up by BI with M. Di Castro
    - Problem overcome by pulling out the "RAL OVERRIDE" cable on SEM grid front end: unsafe situation as pre-LS2, but mitigation measures taken
- Acquisition settings (like integration and sampling period) needed adjusting to see beam
- BSF52 acquisition not working properly (some signs of the beam were present)
- BSF54 acquisition not working at all (was local scope installed for tests removed?)
- BSF48 working well: in limited time available data was taken for turn-by-turn dispersion measurements, mis-steering and with errors on BTP.QNO60; wire mapping wrong
- BGI data was taken in RAW_DATA mode and turn by turn data taken for analysis. Vertical bump at BGI82 of 2 mm at injection needed to reduce beam loss. Beam loss from SEM grids IN too large to make parallel measurements.

Thursday LIU MD

- Earlier in the week, the LHC25 3BP, LHC25 2BP and the BCMS25 cycles were refined.
- Additional work needed Thursday morning by RF team on the coupled-bunch feedback.
- Emittance measurements were taken of all 3 cycles
    - Average emittance for LHC25 cycles ~1.6 mm mrad @ extraction and ~1.1 mm mrad for the BCMS25 cycle

Friday delivering ions to the SPS after Linac3 source refill

- Rebucketing had been adjusted earlier in the week by the RF team.

Additional points:

- Several times during the week (and already before) almost all power converter in F61/62/63 and some in T8 tripped
    - WIC ‘fast abort’ due to short transients on water flow signals
    - CV tried to increase the speed of a pump, but the same fault happened again twice afterwards
    - CV and WIC experts will check the water flow threshold in an access Wednesday
- The intensity delivered to EAST shows a strong dependence on the preceding cycle. A clear correlation could be found with the B8L circuit and investigations are ongoing to try to mitigate this problem.
- Several perturbations due to kicker trips during the week.
- The parasitic TOF cycle was set up during the weekend; to be tested tomorrow when it will be possible to try sending the EAST bunch to T8.
- 1 vertical wire scanner is out of order; 15 minutes beam stop needed to test if the repair has worked.
- Patrol lost in T8 S1 Saturday afternoon.
- IT outage Friday late afternoon.

PS - East Area (*Bastien Rae*):

Start of physics today behind the secondary beam lines.
T9:

- The initial tuning with a 15 GeV hadron beam was done, following which the electron beam was checked at different energies for the neutral channel and with Target head 3 (Hadron target) and Target Head 1(electron enriched target). The converter is permanently fixed in the beam with 5 mm Pb.
- The electron purity for energies < 3 GeV is > 90% with the purity decreasing for higher energies (as expected).
- The high pressure threshold Cherenkovs have been installed and the software integration is being checked. The low pressure threshold Cherenkovs are planned to be installed on Monday morning.

T10 :

- The beam has been tuned on Monday, optimizing the beam position in the user zone and the transmission.
- The beam profile at the beam line start is strongly non-Gaussian in X-plane. Transmission is optimal with the bend settings ~20% below the calculated values and the reasons are being investigated.
- RP test has been successfully completed on Tuesday.

AD - ELENA (*Laurette Ponce*):

Good production week for AD/ELENA despite access in PSB Tuesday afternoon and dedicated MD in PS on Wed.

Main activities in AD and ELENA:

- BASE resumed pbars trapping on Monday evening
- Radial loop set-up active on all decelrations in AD
- Operation with Hminus source of ELENA extended working hours to ease steering for GBAR and BASE
- Injection oscillation correction in ELENA and working point measurement on ejection plateau
- Performed AD ring sublimation in the shadow of the PSB access on Tuesday to try calm down the vacuum activity in the C10 cavity-e-cooler-stochastic cooling pick-up region. Problem still there but less frequent that beginning of the week.

Main issues:

- AD horn PLC problem 2 times outside working hours. AD horn is not part of the piquet service, the ABT piquet kindly accepted to intervene over night Tuesday and late evening Wed.
- Vacuum problem on the cryo pump in stochastic cooling pick-up and/or/ C10 cavity. We profitted of the access in PSB on Tuesday to perfom sublimation in AD ring.
- Radial loop to be disactivated after the vacuum spike on Sunday (not understood).

SPS (*Giulia Papotti*):

Week 41 at the SPS was characterised by the restart of an AWAKE run, and bad luck with the access system.

AWAKE took beam with a couple of days of delay: the start of the run was on Wednesday evening. Since then they take intermittently 1-2-3e11 ppb.
To be noted, cavity 5 tripped very frequently at the restart of the run, and conditioned away within approx 20 minutes.

The NA physics production continued steadily.

The usual problems are still being investigated: the intermittent spike at the start of spill (a spike on the LSE.52402 extraction sextuple was much reduced, the H tune just before extraction was cleaned up), the 50-100 Hz (complaints by NA62 especially on Friday afternoon), the symmetry changing quite often.
The SMD5 was removed from the mains configuration as it could be a main source of noise (observations are ongoing).
An intensity increase is expected for next week.

For the LHC, two periods of LHCPILOT/INDIV were exceptionally negotiated in the supercycle for Friday and Sunday.
A TI8 circuit (RBIV.87715) is being carried over as a main issue from the previous week into the next one: the debugging was continued on Monday, and despite the circuit seemed to be ok on Friday at lunchtime, it re-tripped on Friday evening, and, after work by First Line, again also on Sunday.
This will be followed up again with the experts on Monday.

The dedicated MD was devoted to the crab cavities.
The initial setup was done with two cavities pulsing at 1.3 MV but due to short flattop and tuner drift on MD4, they had to resort to a single cavity at 1 MV for the emittance growth MD.
A total of 3-coasts were performed as a function of injected phase noise.
The effect of octupoles with injected noise was also measured.
Analysis is underway to compare the results with 2018 and simulations.

The long parallel MD was devoted to the characterization of the LHC beam variants (standard 2 bp, standard 3 bp, BCMS) concerning transverse emittance, intensity, transmission.
The transmission of the BCMS beam is not yet as good as it could be.

Concerning the parallel MDs:
- the MD3 cycle (LHC beam on Q26 optics) was fixed (it used to trip RF for all users);
- data was acquired for the confirmation of the voltage calibration;
- the LHCION1 was taken to work on the radial loop instability, which could be reproduced from the LHCION2: make rules and loop gains were corrected; the main cause for the instability is the too fast synchrotron tune (with higher voltage), which makes loop delays non-negligible compared to the synchrotron period.

At the time of writing, AFT shows an 83.7% availability for the week.
The main reasons for downtime, other than the injector faults, were the access system trips (7 at the time of writing: BA7+ TNC, TCC8, BA80, BA2, TCC8, BA80, BA2), and the MKDV (3 h on Monday).
Several accesses were given to HiRadMat throughout the week in preparation for the next run.

Last night there was a failure of cable affecting the access system in BA2. A new cable was pulled and the situation was reestablished, causing roughly 3 hours downtime.

SPS North Area (*Bastien Rae*):
H2: NA61 installed à no major faults
H4: HERD installed à no major faults
H6 :

- ATLAS ITk was main user last week and this week EP RDET is the main user with ATLAS ITk, LHCb and dRICH as parasitic users.
    - Users are coordinating among themselves to alternate between high intensity and low intensity runs.

- Radiation issues were minimal last week after the RP modification of the alarm levels following the measurement with the mobile detectors

H8 : Wednesday change to CMS MTD (main) + LHCb (parallel, 3 setups) + FASER (parasitic) went well. However, beam parameters (size, intensity) required by different users are only partially compatible, so there is a lot of discussion and frequent setting modification are required

K12:

- SPS-OP is looking into the intensity spike at the beginning of the spill, today at 13:00 we have a session together with NA62 and OP to check
- from Wednesday beam dump run for NA62 à plan to increase the intensity gradually

M2:

- AMBER installation is ongoing with the safety visits done on 12th and 14th October. Safety clearance to operate without flammable gas over the weekend. There will be another safety check this week before the tpc is filled.
- The Radiation issue in PPE211 has been solved following the measurement by RP which found the levels to be much lower near the region where the installation works are ongoing. Therefore, RP raised the alarm levels in this zone and AMBER could continue their work.
- Hydrogen filling to be done on Sunday/Monday. Fire Brigade will also have on site trainings.
- The optics has been checked with the final tuning to be done once the complete installation is done.

AWAKE (*Giovanni Zevi Della Porta*):

Last week was the first week of AWAKE October run.

- **Monday**: Laser oscillator not locking. Eventually tracked to an SPS-to-AWAKE optical fiber not working. Switched to a new fiber.
- **Tuesday**: Access for marker laser alignment and warming up vapor source. Asked SPS for protons, but even when AWAKE was in the cycle we were not receiving extraction triggers. Eventually tracked down by RF experts to a wrong selector and a bug in the "synchro" app.
- **Wednesday**: Access during Machine Development, mainly focusing on alignment of the marker laser and the vapor source and plasma light diagnostics. First protons in the evening, confirming that triggers and AWAKE-SPS communications were OK.
- **Thursday**: After setting up protons and laser, the electron source would not come up: access revealed SF6 level was low, so refilled it. Then, electron setup revealed a new problem: changing beam size shot-to-shot, as if the phase was changing in each shot. Some improvement by changing the oscillator lock parameters, but still significant jitter remainedd, and we lost the lock again after few hours. Electron beam at low charge was good enough to re-establish electron-seeded self-modulation of the proton bunch
- **Friday**: Dedicated to trying to solve the electron-size-jitter issue. Laser expert access to check alignment and jitter of entire system. RF expert attempted different tunings of the klystron and electron gun system. RF/Timing expert performed remote checks, but nothing showed up. RF/Timing checks will continue on Monday. No electrons for the weekend
- **Saturday**: without electron beam, focussed on laser/proton timing scans to find the threshold between unseeded and seeded self-modulation at different proton intensities. Scans performed at 1E11. Tried to reach 3E11, but SPS operators could not find a stable configuration, so used 2E11. Large jitter in rubidium density measurements observed. Streak room PXI crate (supporting several cameras on the beamline) went down in the evening.
- **Sunday**: access to understand jitter in rubidium density measurements, but jitter no longer visible. Streak room PXI crate cannot be resurrected even with access: experts will come on Monday. Set up protons and laser, and SPS operators were able to get us 3E11. Scans of proton/laser delay at 3E11, 2E11, 1E11 intensities.

LINAC 3 (*Giulia Bellodi*):

Monday: stripping foil change to 100ug GSI type (arm2 foil2) .Tank1 RF was re-adjusted after reduction in the driver tube gain.
Tuesday: LEBT retuning to re-gain goal intensity of 30uA on BCT41, as requested by LEIR
Wednesday MDs :

- ITL profile measurement for tomography,
- LEBT optimization tool tests (maximise transmission on BCT15 and now also on OASIS FC3 signal, steerers scanned as well) and integration in CCM
- GSI Foils measurements and joint MD on stripping with LEIR

Thursday: investigations on energy drift reported by LEIR. Nothing evident on RF side , though a drift is observed in Timber on Tank2 RFLOOPS: PulseMeasurementPPM:antennaMag signal, under investigation.
Friday: source intensity dropped in the morning and oven1 was found to have depleted. Switched to oven2 but power supply in fault , changed for spare unit after swapping connectors.
Beam back at lunchtime – after some tuning the full intensity was back by 15h for SPS tests.

LEIR (*Michele Bozzolan*):

Activities:

- Tuesday: instability during cooling study
- Wednesday: joint L3/LEIR MD : test with different stripping foils thickness.
- Thursday: periodic cavity switch. kickers off not restarting, olved by expert. e-position measurements. MD on machine learning
- Friday: beam to SPS for ion commissioning

Issues:

- Tuesday 12/10: Timing upgrade → B-train loss of DCBCT (wrong current in fixed display), power cycle of the crate needed. No injection in PS → PS injection inhibit (because of PSB down), Inhibit is for both protons and ions. Proposed to put the inhibit status in vistar
- Wednesday 13/10: After the end of the joint MD L3 energy drift observed
- Thursday 14/10: ER kicker down. Fixed by expert intervention.
- Friday 15/10: LINAC3 down until 2PM.

CLEAR (*Wilfrid Farabolini*):

This week was fully dedicated to the CLIC BPMs experiment with the main experimenter coming from the UK for his second week. After several years of efforts, it seems that eventually these diagnostics have overcome previous difficulties and are approaching the expected performances, with a measured resolution better than 1 micrometer. Further analysis is still to come on the massive quantity of data taken during this week. Apart of an access on Monday morning requested for a visit of Pr. Eric Adli and some Norwegian students, no further access was necessary for the experiment. As during the previous week, the beam was remarkably stable, just requiring some optimization when switching to 3GHz laser frequency.
Full reports can be found as usual here: https://indico.cern.ch/category/10682/.

LHC (Jörg Wenninger & LHC Coordination webpage):

Powering tests for beam test completed. Next steps are the training campaign in S23 and S78.
LHC injection BIS configurations restored (experiments, vacuum). LHC BIS and LBDS re-configured for beam and LASS connected to LBDS. Thursday 14.10 first opening of all vacuum valves, BLM system ready for beam, first pre-cycle. Friday 15.10 at 20:15 the beam permit loops are closed and the LBDS armed for the first time after LS2. Unfortunately a UPS issue in point 5 (battery overheating/fire) occurred Saturday late evening and stopped all progress for 24 hours. On Sunday, after an access to exchange a vacuum valve controller in UA87, BIS and LBDS checkout MP tests all day.

S12	S23	S34	S45	S56	S67	S78	S81

Completed	Phase 2	Completed	Completed	Completed	Completed	Phase 2	Completed
77 / 11950 A	0 / 0 A	71 / 11950 A	87 / 11950 A	76 / 11600 A	62 / 11600 A	0 / 0 A	55 / 11600