Accelerator Complex Status

End week 24 (Monday 21 June 2021)

Technical Infrastructure (Jesper Nielsen):
Statistics:
• Close to 11’000 alarms.
• 900 phone calls (617 incoming, 283 outgoing).
• 205 ODM created.
Events worth mentioning:
• Tue. 15.06: ODH alarm in UA17. Fire Brigade on-site, local measurements were OK. Faulty sensor will be replaced.
• Wed. 16.06: RF rack tripped due to high temperature in building 353. CV piquet intervened rapidly on-site and increased the flow of the chilled water, which deceased the inlet temperature with 3 degrees.
• Thu. 17.06: Electrical perturbation, in 400kV line FRASNE-GENISSIAT. 13% dip for 70ms was measured at CERN, only some resettable alarms in RFQ4 of Linac4 were seen. No alarms in PS, which looks like the efforts on making the RF more robust against perturbations is going in the right direction!
• Sat. 19.06:
  o ZORA communication problem, caused loss of patrol in SPS BA1.
  o One of the PSEN servers down. Rapid intervention by BE-CSS restored full functionality and redundancy in only 1 hour!
• Sun 20.06: Electrical perturbation, confirmed by RTE. -12.7% for 75ms, cut the PS, booster RF cavities and the mains of the SPS.
Details: https://wikis.cern.ch/display/TIOP/2021/06/21/TI+week+summary,+Week+24

LINAC 4 (Alessandra Lombardi):
LINAC4: 98.3% availability.
• Source : retuned gas on Sunday morning to avoid oscillation
• RF :
  o un-intended switch off when the PSB was put in special mode (understood)
  o PIMS11-12 issue being followed
  o Test with direct PLC control for the RFQ tuning was done during the week. Successful.

PS Booster (Foteini Asvesta):
It has been a difficult week in the PSB as we suffered from a water leak in one of our main quadrupole magnets.
Main faults:
• Beam operation was interrupted for a few hours from the PSB injection watchdog and in particular the high loss interlock. Investigations together we the experts showed that no loss actually occurred in the PSB and the problem was coming from wrong settings on the BCT gains. The issue has been resolved with an update of the application that is used to control the injected turns in the PSB and automatically sets the BCT gains.
• Power glitch on Thursday night brought down the cavity modules and the transverse feedback. The TFB could be reset by the operator, however, some of the cavity modules required the intervention of the experts to be brought back. (A second power glitch
occurred a few hours ago, which once again brought the cavities down but the operator was able to reset them without any issues.)

- **Water leak on S7 Finemet cavities.** Once the cavities were back from the power glitch on Thursday, an alarm for water leak on the S7 cavities required the experts to come on site and access in the ring.

- **Water leak on BR.QFO161.** During the intervention for the cavities the experts observed a leak on one of our main quadrupoles. An access was arranged first thing in the morning to assess the situation. The leak was unlike anything observed in the past and a temporary solution, namely hammering it, was deployed to get us through the weekend. The situation will be closely followed up by the experts who will again access the machine tomorrow morning to examine the state of the magnet. Further discussions will be needed to determine the strategy for more permanent solutions. Currently the options seem to be to try and repair the braising on site, however, it seems to be a very difficult location for such a repair and it is not clear how long it might last, or to completely exchange the magnet which is in the vicinity of the septum and would require quite a long stop. More details will follow from the experts in the coming week.

**Interventions & issues:**

- Several interventions were done during the access required for the QFO161 magnet.
  - Change of configuration of the BTY quadrupoles to allow smooth ppm operation
  - Installation of mu-metal around the PMT of the LIU WS to see if it can help with the magnetic screening observed from the position & angle correctors, the installation was completed however the issue was not solved. Experts are following it up.
  - Intervention to attach the cooling cables in front of the cavities in period 6 as during the access some movement was observed.
  - Ferrite installed on the exit cables of the BT.BPM40 amplifier for which some jittering was observed.

- **Simulated B-Train:** Sudden loss of the Simulated B-train has been causing issues with the beam lost in the machine since a long time. During this week the issue was closely followed up and many tests were conducted. The problem seems to occur when a new clone is mapped and included in the supercycle. It seems to be coming from the FESA class and even though it is not yet resolved at the source, it was found that a simple reset of the class from the operators can fix the situation during operation.

- **LIU WS:** Several issues have been resolved and understood both in terms of the equipment and the applications. The LIU WS are used systematically and reliably for operations and studies.

- **Ring BCTs:** Issues with the BCT readings of low intensity beams following a high intensity beam. The low intensity beams are getting cut by the WD even though no real losses are observed. The experts have acquired a lot of data regarding this issue and are working towards a solution. So far the only work around is to avoid putting low intensity beams following high intensity ones.

- **Transverse Feedback:** An amplifier needed to be exchanged for Ring2.

**Studies & Progress:**

- General fine tuning and setup of all operational users to further improve the performance.
  - Studies to improve the splitting of the MTE user.
  - Painting settings improved emittances on ISOLDE and East & parasitic TOF users.
  - B-beating compensation studies on the ramp cycles during the fall of the injection chicane and working point evolution studies for the LHC beam to push the brightness.
  - Setup of AD & East users together with the PS colleagues.
• **Studies on the instability observed at the flat top** to characterize the effect and understand if it would cause a limitation for the performance.

**ISOLDE (Miguel Lozano):**
It has been a pretty good week at Isolde.
We took protons on Tuesday and Wednesday on GPS and deliver radioactive beam to GLM.

On the HRS side, we made the first proton scan and release curve (90Kr) with the new tape station. We encountered some issues that are being addressed regarding beam gates, tape station, HRS HT power supply and some applications. On Wednesday we changed the target and after setting up to CRIS they took the weekend for beam optimization.

At HIE-Isolde we finished the phasing of the superconductive cavities and reached an Energy of 10.24 MeV/u for a 40Ar12+ beam.

**PS (Benoit Salvant):**
It was a rather difficult week for the PS, with 76% availability.
The main issues of the week on the PS side were:
• On Tuesday, a PS access was given to investigate a suspected water leak on the warm water cooling circuit. It turned out that the circuit was leaking into another circuit at the level of an exchanger. A replacement of this water exchanger will need to be foreseen.
• During a particularly warm Wednesday afternoon, the temperature in the RF control room in building 353 increased beyond 32°C and tripped several timing servers. The SADES piquet was called and worked until temperature decreased in the room. It seems that the temperature regulation of that room had been malfunctioning for a few days before the issue occurred. The following day, the temperature restarted to increase and another intervention of the EN-CV specialist allowed restoring stable temperature in the room. The abrupt switch off of the timing servers seems to have had consequences as several cavities could not restart after the temperature came down. The RF power piquet was called to restart two 10 MHz cavities. In total, about 4h were lost. The RF team informed that one should cut all beams in case the temperature is above 30°C as there is a chance of equipment damage if the servers are cut at the wrong moment. A final intervention was organized on Friday morning to replace a used belt, and the temperature has been well under control since then. A request was sent to move back the temperature warning threshold for TI at 30°C, and to use the defined procedures in case the temperature is too high.
• Several accesses and interventions in the PS could be organized during the PSB intervention on the magnet. In particular, SY-EPC managed to reduce the ripple on PR.ODN.
• Cavity issues required calling the piquet (40MHz AC40-78 on Tuesday, AC10-76 and 81 on Thursday, for which an access was needed, AC10-11 and AC10-56 on Saturday night),
• Injection/extraction system issues (many trips of KFA71 and one of KFA13 that required the intervention of the ABT specialist, SMH16 active filter issue solved by the piquet on Saturday)

The PS delivered LHC-type beams with up to 72 bunches per injection and tunable bunch intensity for SPS scrubbing, as well as the MTE beam for the North Area setting up. To be noted that at 1.5e11 p/b, the LHC25 beam is at the limit of longitudinal stability without coupled bunch feedback.

AD requested three types of beams for the AD target setting up starting tomorrow:
• 1% of the nominal intensity for initial setting up of the BCTs and screens of the FTA line without the AD target from Monday
• 10% of the nominal intensity towards the end of week 26 (still without the AD target)
• Nominal intensity.
These three flavours were set up this week by the operation team, finding inventive ways to accelerate the beam with such a low intensity.

As PSB ring 4 was unavailable due to a watchdog issue, the SPS suggested producing the SPS scrubbing beam with only 3 PSB rings by injected 3+3 instead of 4+2 bunches into SPS. To be kept in mind in case such an issue occurs when LHC is running.

Setting up of the TOF continued and the EAST beam commissioning was started.

Studies with the Wiresscanner (offset studies) and the BGI (evolution along the cycle and impact if losses) continued during the week.

**AD (Laurette Ponce):**
- AD target:
  - Horn pulsing tests postponed to next week, in parallel of operation with target OUT-OF-BEAM
  - Test of target interlocks finished on Friday, but integration in the PS external conditions not yet done.
  - Polarity measurement of D1 performed
  - Fixed temperature problem on 2 first dipoles of the dogleg
  - Timings problem on FGC62 fixed, but synchronization between devices (Pow1553 and FGC62) could not be checked because of access in the target area.
  - Beam permit not yet signed so could not check neither beam request synchro with PS.
- AD ring:
  - Discovered a bug and noise problem on the Btrain, team is working on fixing algorithm problem.
  - Work on stochastic cooling controls system on-going, new cabling of the PLC on-going
  - BCCC ready for operation
  - Problem with 3 BPM amplifiers in AD ring under investigations.

**ELENA (Laurette Ponce):**
- Bake-out of the ion switch sector on-going after re-installation of the 4 profile monitors.
- Work on the source: open vacuum for inspection, leak tests, tests of different gaz cartridge
- Work on the electron cooler: investigations on electron cooler pick-up signals at intermediate energy with electron beam modulation.
- DSO tests validated for pbar operation and experimental zones operation (AEGIS, ASACUSA, ALPHA, BASE, GBAR).

**SPS (Hannes Bartosik):**
The main focus of last week’s beam commissioning activities of the SPS was the first acceleration of 72 bunches of the LHC beam to flat top.
- Starting from very low intensity (4e10 p/b) the intensity was gradually increased with a close monitoring of the pressure around the MKDV. The MKDV pressure activity was observed to start at around 8.5e10 p/b, and this is the intensity that was reached at the end of week. To be continued next week.
- For the moment only the 200 MHz system with phase loop, synchro loop and one turn delay feedback can be used. Longitudinal instabilities (quadrupolar) were observed in the last part of the ramp for intensities starting from about 5e10 p/b. To stabilize the beam will require the 800 MHz system.
• Vertical instabilities due to e-cloud were also encountered in the ramp, as for this low intensity the e-cloud density is concentrated in the center of the chamber. First signs of reduced e-cloud instability were seen for the highest intensities accelerated so far (8.5e10 p/b).

Other activities from last week:
• Scrubbing on flat bottom during the nights with 4 batches of 72 bunches with 1.45e11 p/b injected. The MKP delays were adjusted to reach 250 ns batch spacing. On Saturday it was realized that the closed orbit had changed and the reason for this is unclear. Due to the different orbit some parts of the machine showed higher pressure rise than before and required some gradual storage time ramp-up to stay within interlock thresholds.
• The correct MKP voltage balancing for injections at 26 GeV was put in place
• 2 batches of the MTE beam could be successfully injected on the SFTPRO cycle. The RF capture of the 2nd batch worked nicely, and the abort gap was verified. Furthermore the RF gymnastics before the slow extraction was implemented with the latest LLRF firmware version. The beam is ready to be sent down towards the targets as soon as the beam permit is active.
• BI deployed new firmware for the TT10 BLMs and this cured the issue with the spurious interlock triggers
• Each morning from 8:30-10:00 EPC colleagues were working on the Quadrupole mains. They resolved the 150 Hz ripple on the QD by adding capacitors to ground, and they found a voltage probe at the output of the converter to be responsible for the glitches in the ramp. By replacing it with the voltage probe used pre-LS2 the glitches disappeared.
• On Friday the RF team started with the hardware commissioning of the Fixed Frequency Acceleration using a special ion cycle
• A vacuum leak was found in sector 6 (at the chamber replacing the test-ZS) and fixed
• The commissioning of the 800 MHz system continued

Main outstanding issues
• The new LLRF had several trips this week, each time requiring investigations and intervention by the RF specialists for a few hours. Some of the trips were related to crashes of the FEC for the cavity controller, at least once due to overheating of the corresponding power supply. Additional cooling was installing in this crate. For the other trips the investigations are ongoing. In addition, on Sunday evening an intermittent problem of the phase pick-up signal was observed - this will be followed-up on Monday
• In the night from Friday to Saturday we lost the patrol in BA1. The access piquet had to manually reboot a card of the access system. A similar issue had occurred in the night from last Sunday to Monday in ECA5.

**SPS North Area (Bastien Rae):**
We have seen a vacuum leak in the P42 beam line. It’s not clear where the leak is since the beam line is very long. We will investigate this leak today. Depending on why and where the leak is it could be that we need to delay again the closure. We will give you the final decision at FOM tomorrow.

**AWAKE (Giovanni Zevi Della Porta):**
**WEEK 24 SUMMARY:** Week-long intervention on Rubidium cancelled last minute. Instead: short accesses, pump down, and set up electron beam for upstream streak alignment and beamline optics commissioning.
• **Rb recycling:** intervention cancelled at the last minute (the two planned visits from UK colleagues will be done in one visit in July), to be rescheduled in early July
Accesses:
- pump down vacuum, check for leaks after last week interventions. Found a penning gauge broken, to be fixed next access
- visit to prepare scaffolding for Expansion Volume BTV installation
- realign wakefield diagnostics in preparation for data next week
- position samples for RP monitoring
- fixing lights in TT41 and TCC4 (see below)

Post-proton Lights issue (from past weeks): TT41 and TCC4 had lights mostly off. Called TI, and received several interventions: ~50 lightbulbs replaced in TT41, faulty switch fixed in TCC4. Investigation ongoing to understand why emergency lights are ON in TAG41 but OFF in TT41. Maybe it is a feature and not a bug.

Access System: Patrolled with SPS OP, but then not able to get "Delegation" from CCC. Fixed by Access System intervention (faulty connection)

Laser: shutter LSSE2 stopped responding. Replaced with a spare by Laser Team

Electron beam:
- Optics: commissioning new optimizer ("Method 3") for fine scans of beam sizes needed for electron-seeding experiments
- Upstream streak camera (low light yield): performed a detailed scans of position and angle of electron beam on the screen, and ruled out misalignment of the optical line as cause for low yield. Next: looking into optical line design to improve light transport.


LINAC 3 (Rolf Wegner):
- The Linac3 source tripped a few times this week for different reasons. Restarts were quite easy and the beam recovered quite quickly to good quality.
- Three scheduled intervention were done: a) on the Ventilation system, b) on the Control system affecting SPS, LEIR, Linac3 etc. and c) on the Stripper to install 6 additional foils – now 14 out of 16 slots are equipped with foils of different density.
- A few issues had to be solved: a) a stripper end switch connection had to be repaired and b) a few power converters had to be restarted after the glitch on Thursday evening
- Regular beam energy measurements were taken.

CLEAR (Roberto Corsini):
Last week was dedicated to Cherenkov button BPM measurements, with the possibility to resume as well thee Photonic crystal tests.
A test irradiation with gaschromic films in water was also performed in preparation of the CHUV plasmid experiment.
Data files on beam current/position measurements were parasitically recorded, in preparation for Oxford remote summer students activities.
Several issues (cameras, laser, water station) stopped operation a few times. All were solved but impacted the beam time available (total beam time loss about 2 days).
Full report: https://indico.cern.ch/event/1051296/

LHC (Jörg Wenninger & LHC Powering Test webpage):

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Phase 1 powering started in S67 at the end of the week, close to 50% of the tests already completed.

Machine checkout tests of IQC reveal massive data reception delays of 1-2 minutes that break the system, TE-MPE informed. The global PM event system is working, some analysis modules must still be adapted to post-LS2. FMCM tests were performed on 2/3 of the NC circuits, all tests successful. Simulated injection timing now reliably available.