

Accelerator Complex Status

End week 12 (Monday 29 March 2021)

Technical Infrastructure (Jesper Nielsen):

A reasonable week.

Statistics:

- Close to 4000 alarms.
- 926 phone calls (647 incoming, 279 outgoing).
- 107 ODM created.

Events worth mentioning:

- Tue 23.03: Power cut 18kV transformer ME9 - EBD1*9. The transformer tripped due to a high temperature measurement, caused by a faulty sensor. Power cut of compressed air in Meyrin and building 201 cooling station. Quickly repowered by secondary transformer until temperature sensors were replaced.
- Wed. 24.03: Evacuation alarm in all SPS, due to a human error during a maintenance on the access system in BA3.
- Wed. 24.03: During works on the rack DSS in LHCb a local power cut was triggered by error that caused a stop of cooling, and IT networks in the area.
- Thu. 25.03: Trip of EOD110/4H caused power loss to Cryo control rack at point 4. The circuit breaker opened, a FEC is thought to be the cause of the short circuit, but is still being investigated.
- Fri. 26.03: Trip of mains of SPS due to a trip of the SVC BEQ2. It was caused by a communication error of the SVC control system from ABB (called the MACH control system).
- Sat. 27.03: Trip of CRYO compressors 6 and 8 in LHC8. The cause of the trip was a high intensity that caused the opening of the protection breaker. Investigations ongoing for the root cause.
- Sat. 27.03: Alarm in cooling station DQRS R37 FDED-105 between two tests quench. EN-CV on-site to reset, but alarm came back again, and disappeared by itself again during the quench test, this time without intervention. Follow-up and more investigations when possible to access.
- Sun. 28.03: During 1 h (4h to 5h) no communication to several OPC servers. Caused by the change to summer time. Issue will be created with BE-CSS.
- Sun. 28.03: BEQ1 SVC tripped, the reason was not found, the CVS was switched back on again.

Details: <https://wikis.cern.ch/display/TIOP/2021/03/28/TI+Week+summary%2C+Week+12>

LINAC 4 (Luca Timeo):

In general:

The week was relatively quiet, and the beam availability was 96.6%. On Sunday, a new version of SIS was released.

OP suffered from a few trips of the chopper and power converters. The other issues are detailed below.

Wednesday:

- Downtime due to ABP-HSL human error (the test stand tuning ended up acting on the LINAC4 source). To avoid it can happen in future, A. Lombardi asked Marine Pace for an independent operational account, which will be specific to the test stand.
- Started experiencing connection problems with the LEBT power converters. That triggered SIS.

Thursday:

- The connection problems with the LEBT power converters became more frequent, and SY-EPC started deeply investigating.

- Also started suffering from low-energy watchdog trips due to the transmission efficiency degradation. The threshold was slightly adjusted to cope with the problem.

Friday:

- BE-CEM replaced the FEC/gateway related to the LEBT power converters. Since then, the issue seems solved.
- BE-ABP suspects the transmission degradation is due to the intensified electron current that adds up to the H- current at the LEBT BCT. Today, they will change the temperature of the source's cesiation system from 55 to 65 degrees. It will remain far below the upper limit of 80 degrees. They expect the change to be very smooth, and to appreciate the result may require many days.

Over the weekend:

- The buncher 3 tuner, from time to time, suddenly moved and briefly detuned the cavity. AFF wrongly learned from such behaviour and produced distortion in the RF pulse. Resetting the AFF solved the problem. Yet, OP suffered from several hours of beam degradation and few minutes of downtime.

PS Booster (Bettina Mikulec):

Another very busy week last week with lots of activity and also follow-up of operational issues.

Main improvements:

- Good progress on the front of resonance compensation, optimisation of working point etc. by the ABP team.
- Beam-based extraction/recombination kicker waveform measurements and continuation of injection studies by ABT (including studies of observed tails in vertical profiles).
- The RF team improved the longitudinal parameters of the LHC25 beam to achieve smaller transverse emittance at extraction.
- POPS-B tests:
 - On Tuesday Fulvio put in place an improved regulation for the inner rings, which led to a decrease of the oscillations at injection and flat top of a factor ~ 4 (half than what was hoped for)
 - On Friday some improvement of factor ~ 2 to the outer ring regulation, which proves more difficult
 - Some POPS-B trips perturbed operation; EPC is trying to understand if the trips were related to the tests
 - This effort will continue.

Operational issues/progress:

- Refinement of operational beams: MTE, TOF, LHC25, LHCINDIV, LHCPILLOT
- Energy matching with the PS refined to equalise the rings $\rightarrow$ use BdLs to compensate by-ring differences
- Follow-up of recurring problems with the specialists on kicker trips
- Frequent watchdog trips perturbed operation:
 - Linac4 low-energy WD trips related to a decreasing RFQ transmission $\rightarrow$ see Linac4 report
 - PSB injection watchdog: finally the issue was understood; as the PSB intermediate ring transfos do not changing gain automatically, the gain has to be set through the Cruise Control application; this was first done calculating the average intensity, which was wrong - now the gain is calculated using the peak current.
- BLM settings reviewed
- TFB settings to be reviewed today with the specialist.

ISOLDE (Miguel Lozano):

It's been a very productive week at ISOLDE.

The main goal of the week was to commission the HRS frontend and the separator magnets. Stable beam was extracted from the frontend and several tests related to target coupling, cooling, and alignment were successfully performed.

We also tested all the Beam diagnostics elements from the frontend to the RFQ and found some issues that are being addressed by our BI colleagues or by our controls and application developers. On the HIE-ISOLDE side the cavities conditioning has started and everything is going according to the plan.

From tomorrow the RFQ should become available to continue with the last part of the commissioning.

PS (Frank Tecker):

Overall again a very good progress. I would like to thank everyone involved.

The main points are:

- The 2nd iteration of the MU alignment in the vertical plane was successful. The orbit is as expected.
- By-ring energy matching was done with the PSB.
- A first MTE transverse splitting and extraction was successfully established.
- Work also on LHC Pilot, TOF, LHC25, started AD beam setup.
- Phasing for 40, 80, and 200MHz cavities was done
- TFB loop delays were setup in both planes.
- Internal dumps tested up to $8e12$ intensity
- BGI measurements with gas injection
- Wire scanners started to have first bunch-by-bunch measurements.
- Some improvements were done on the BLM system.

One point to mention though are very frequent short interruptions in the beam delivery by Linac4/PSB watchdogs.

AD (Davide Gamba):

We could test the main power supply on Tuesday and performed polarity tests of correctors before re-locking down the ring for S/C cooling repair.

ELENA (Davide Gamba):

The week had the following main objective/results:

- Tried to empirically adjust the H⁻ injection line optics/steering to be less sensitive to source orbit oscillation: non conclusive results, yet.
- Tests of new knobs to correct e-cooling magnetic system perturbation partially successful:
 - Another iteration is needed to make a clean/easy correction (at least at first order).
- Investigation on main dipole hysteresis effects:
 - The measured b-field at injection seems to depend on the structure of the super cycle
 - Some first investigation pointed in the direction that b-train is not very accurate accurate (computed ~ 350 Hz error wrt to 144 kHz revolution frequency), while others point in the direction of a real effect (order of 20 Hz error wrt to 144 kHz revolution frequency).
 - Effect probably not critical, but it can be further investigated.
- Deployment of multiple RF segments capabilities in the LLRF system
 - Still some work to do on the tooling (mainly on the LSA makerules) to ease the setup of the complex set of timings and parameters for complex cycles.
- Setup of a complete pbar-like cycle using H⁻, including e-cooling at both 35 MeV/c and 13.7 MeV/c plateau.
 - First observation of H⁻ energy dragging with e-cooling at 13.7 MeV/c.

- Still a lot of work to setup properly all RF segments and minimise losses during de-bunching/re-bunching, as well as to measure/optimize e-cooling

Additionally:

- continuation of transfer line installation works

Problems encountered:

- the beam orbit drift coming from the H- source reappeared, and, to some extent, is perturbing normal operations
 - a small drift with a period of ~15 minutes have been observed. The source has yet to be identified.
- still waiting for signature for the beam permit of LNE02 beamline which is in principle ready to accept the first beam.

SPS (James Ridewood):

Summary last week:

- SBDS commissioning continuing
- Polarity checks and current verifications for TI2 and TI8
- BEQ2 tripped due to comms issue
- TMR changed on MKP. Only the PT100 temperature sensor was changed last time but failed again quickly afterwards
- Minor water leak identified and resolved on old beam dump circuit at BA1. Leak stopped but more permanent fix is foreseen during technical stop
- TPSC4 broken. To be replaced with bare vacuum chamber
- Frequency generator issue identified on SPS injection BIC. Generator replaced and jumpers removed at the same time
- AWAKE (TT41) FEI tests complete with exception of 2 power supplies
- Preparation of TI2 magnet thermal camera checks (consignation Friday 26th)
- Issue on LHC access system interlock status of RBI.29314 (TI2) and RBI.87833 (TI8) magnets observed during SPS extraction DSO tests. Diagnosed, resolved and retested in conjunction with EPC and access specialists
- ZS anode position drift – expert investigating
- MSE6 girder issue in FESA – Experts will investigate but blocked by PS priorities
- RF Power – Status returned OK and control OK except for cavities 2 and 5 which is foreseen W14
- 8 FMCM circuits tested. Remaining 4 will be tested next week
- FGC_63 controlled PCs in TI8 and TI2 not very stable with current steps. the PCs develop an oscillation
- Repair of QS progressing well now in single test
- BLM TT40 TI8 tested
- Debugging of the external event from RF to MTG to synchronise laser pulse with extraction event

Plans for this week:

- Continued SBDS commissioning with SPS in TEST mode
- TPSC4 replacement for vac chamber foreseen for Tuesday morning ~1/2 day
 - Prep works Monday lunchtime
- TI2 magnet thermal checks until ~Wednesday
- Preparation for SPS ring phase 2 DSO tests and North area primary chain DSO tests 7th, 8th, 9th April
- Crab cavity interlock pre-tests Monday evening
- Completion of last few outstanding FEI checks and 4 remaining FMCMs

- Last few remaining polarity checks
- Continued interlock checks
- Control of spare MKDH cable on Monday
- Continued work on QS commissioning
- Installation and test of the fast interlock from the WIC to fire beam dump if a main circuit trips.

AWAKE (Giovanni Zevi Della Porta):

WEEK SUMMARY: First of 2 weeks of electron beam. Worked on commissioning the new beamline optics and the (old) spectrometer, and characterizing the downstream streak camera with laser and electron beams.

- **TAG41 accesses:** visit of new TSO, visit of CV in preparation for Run 2.
- **Downstream streak cameras:** resolution measurement campaign: took marker laser images with different camera settings, to characterize resolution. Electron bunch length measurements with different charges: aim to make this measurement a daily operation, so we need more experience online and offline.
- **Laser:** lost the lock of the oscillator twice this week. Since this requires a manual intervention in TSG40, it will be investigated in April to (a) avoid the issue altogether and (b) develop remote-controlling capabilities to avoid access.
- **Electron beamline optics commissioning:** commissioning the new optics for Run 2a is a good chance to re-establish Data/MAD-X agreement, so we took data at several BTVs with 2 optics configurations (old, new) and 3 beam charges (150, 350, 600 pC), to be analyzed offline. We also attempted to measure momentum spread (measuring beam size on a BTV immediately after a bend while scanning K), but results are not intuitive (beam gets smaller at larger K's), so probably multipolar components in bend magnet are not accounted for. To be investigated.
- **Electron gun cathode quantum efficiency measurement:** preliminary results indicate healthy cathode. Full analysis is ongoing.
- **Electron beam measurements on spectrometer screen (electron propagation in vacuum):** commissioning the spectrometer system after the long shutdown. Magnets work well, and we use the dipole at its new minimum current (7A) since we are imaging the 18 MeV beam. The beam is not aligned to the quads (possibly due to Earth's B field), resulting in steering in the dispersive dimension of the dipole when changing quad currents: this needs to be measured and corrected when measuring energy. Charge calibration seems low, under investigation.

Next week: 2nd week of Electron Beam. Will attempt electron propagation in Rb plasma, to measure energy and charge loss.

LINAC 3 (Rolf Wegner):

It was a good week with a continuously running source and Linac. The machine setup and optimisation continued (adjustments of ramping and debunching, BCT calibration, emittance measurements, stripper foil measurements).

On Tuesday beam was sent to LEIR.

This morning (Monday 29 March) Linac3 has been stopped for work on the cooling and ventilation system, electrical installations, cleaning, replacement of the source plasma chamber and other activities.

LHC (Jörg Wenninger):

S12	S23	S34	S45	S56	S67	S78	S81
Phase 1	Cold	Training	Phase 1 (paused)	Cold	Repair	Training	Cold

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Phase 1 in S12 well advanced with 60% of the tests completed.

Phase 2 in S34 well advanced, RB training started.

Machine ready (patrols) for training over the weekend in S34 and S78. Unfortunately interrupted for 24 hours in S78 by cryo stops in points 6 and 8 (problem on 3.3 kV).