

Accelerator Complex Status

End week 10 (Monday 15 March 2021)

Technical Infrastructure (Clement Pruneaux):

A reasonable week.

Statistics:

- Slightly more than 6000 alarms.
- 892 phone calls (598 incoming, 294 outgoing).
- 122 ODM created.

Events worth mentioning:

- Wed. 10.03: CCC ventilation break down caused by a faulty bearing. Quickly replaced by on-call service team on Saturday morning. Opposite bearing should be replaced soon. Coordination ongoing.
- Wed. 10.03: Lots of Scada communications alarms in LHC1 caused by an IT outage.
- Fri. 12.03: Fire alarms in Isolde caused by CV ongoing works (stopping preventively ventilations for maintenance without IS37).
- Sat. 13.03: Evacuation alarms in BA5 for unexplained reason, as the machine was closed.

Details: <https://wikis.cern.ch/display/TIOP/2021/03/15/TI+Week+Summary%2C+Week+10>

LINAC 4 (Giulia Bellodi):

Tuesday :

Since the reboot of the BCT FECs the L4Z watchdog cut the beam .The issue was that for the programmed destination the destination name was LINDMP, whereas it was DUMP for the dynamic destination. As the watchdog didn't find a valid destination in its list, it inhibited the beam.

Wednesday :

A problem was found with the AFF of the debuncher cavity: when using a supercycle with different destinations, the debuncher AFF gets confused. A change should be made so that the debuncher AFF should not learn from cycles with dynamic destination DUMP. To be followed up with LLRF.

Thursday :

At lunchtime all RF went down due to a FGC gateway overload (possibly due to a FGC blocking in executing while processing a command or to a very large number of publications). In case of a new occurrence EPC-CO should be contacted immediately, in order to retrieve fresh logs to trace the activity.

In the evening all RF went down again at 19h due to a communication issue of the klystron PLC, which cut all 16 klystrons. An upgrade to the PLC software for more debugging information (plus a clean reboot so that any internal communication issue is cleared) is planned to be done today.

Friday :

A joint OP/ABP MD took place in the morning for characterization of the chopped beam head (to check the possibility of a reduction in length).

In the afternoon the RFQ breakdown protection was activated by a stop of the RFQ tuning.

This was caused by a water flow drop from the CV side, which interlocked the RFQ cooling/tuning system.

CV later confirmed that, due to an increase of water conductivity, it was decided to replace the ion exchange column before the weekend. On all machines those interventions are made in operation and without any impact. On Friday however a mistake was made during the intervention, causing the drop in pressure which triggered the interlock on the circuit. It was regrettable that the team

performing this intervention didn't inform the CCC in advance, nor contacted them after the problem occurred. CV will follow up with its staff and contractors.

The weekend was calm. The total machine availability during the week was just over 94%.

PS Booster (Fanouria Antoniou):

The **PSB beam availability** this week was mainly affected by:

- The two Linac4 faults on Thursday which caused a downtime of the machine of around **~4.5h**(3h48min + 52min)
- The POPSB intervention of Friday (**~13h**)

POPS-B intervention

- A **new regulation** was proposed for eliminating the **large oscillations observed at the beginning of acceleration**, which is one of the main limitations for the moment. This regulation was tested and proven to work very well on the spare so it was decided to be applied in the real load. For this, a 2h intervention was foreseen for Friday morning. The intervention finally lasted for ~6h and unfortunately, the new regulation **did not work on the real load**. It was then decided to restart POPS-B under the previous configuration. The restart of POPSB was also difficult and took many hours. Finally, the machine was back with the POPSB in the initial configuration around 22h. To be noted that still a special procedure is needed for restarting POPSB, as described in last weeks report.
- A full dedicated day was requested for next week by EPC, for trying the ILC approach.

Other Problems faced this week:

- Abrupt losses observed for the LHC25 beam in R3 last Friday were associated with the malfunctioning of the new **Transverse Feedback**. This was identified to be due to several Read-Only-Memories used as look-up tables being corrupted. Reprogramming the same firmware re-writes these ROMs and solved the problem. The same problem appeared again on Thursday. A firmware change for replacing **_all_** look-up tables by memories, and have them written at every cycle to be applied probably during the 1 day stop of next Monday. Currently, R3 is again back to the old TFB.
- On Wednesday, our BI expert found out that the **tune kicker** is not functional anymore. Unfortunately, that was the spare one as the other one broke during LS2. The tune measurements are being done with the TFB chirp option, however, the tune kicker is useful for optics measurements as well.
- After the POPSB restart on Friday, **continues trips of KFA10** did not allow to come back to normal operation for another 2 hours.
- Many trips and missing pulses of several kickers were observed also the previous days. This is being followed up by the experts.

Several **parallel activities** took also place this week and the **main advancements** are listed below:

- A new calibration of the B-train was performed. This time a calibration of R3 and R4 was done while the regulation was in R3 and R4. The regulation was then switched on R1 and R2 for the calibration of these two rings. We are now in a quite good state both at injection and extraction (where the btrain calibration is done).
- Injection steering optimisation and transverse painting studies. Sensitivity studies to injection mismatch and investigation on the tails observed in the vertical profiles (WS).
- Loss maps studies continued in all four rings.

Concerning the **beams preparation**:

- The B field at extraction was adjusted to the one of the PS injection for the **LHC25** beam. The corrected functions for the special bends were also copied and the orbit was corrected. The beam is in quite good shape in **R3**.
- The RF group advanced very well with the **MTE** beam as well. The splitting was optimized for R1, R3 and R4, while due to the poor machine availability towards the end of the week, the R2 optimisation was not finalized.

Points **to follow up** next week:

- 1 full day intervention was requested by EPC to try the ILC method for reducing the large oscillations of the MPS when going to acceleration. To be further discussed with EPC.
- 1 day stop of Linac4 tomorrow. Several interventions were scheduled in PSB as well:
 - Re-cabling of XNO311L1 and XNO816L1 and multipoles reconfiguration
 - BI will check the BWS R2H filter wheel
 - Investigation on the BTP.DVT10 (if accessible)
 - verification of the remaining BTY quads in the PSB tunnel
 - Check shielding solution for BI line to mitigate the LBS.BVT10 stray field
 - Re-installation of the POPS-B BIC interface
 - Measure the resistance of the H0/H- patchbox.

ISOLDE (Simon Mataguez):

- Successful RILIS tuning lasers checking for 152Sm beam with the target installed on GPS.
- FrontEnd11 on HRS side completely installed and start pumping (BUT yesterday, lost the status of the FrontEnd (Pump On allow) and the system stopped pumping, to be clarified)
- Local ion source refurbished on REXEBIS side.

PS (Frank Tecker):

Monday/Tuesday:

- MTE bunch splitting set up at 3.08 GeV plateau. Transition crossings on MTE and TOF beams adjusted. Both extracted to D3, MTE with up to 4 bunches from the PSB.
- The internal dump was tested up to an intensity of $2e12$ protons per pulse. An interlock condition that caused a strange behaviour before was fixed and is working fine now.
- started commissioning of TFB system
- Tuesday: **SMH42** fault
 - 16:29 - Vacuum rise in the sector of SMH42 to $\sim 2e-5$ level.
 - 18:17 - SMH42 was restarted and raised in 5kA steps.
 - 18:27 - SMH42 fault, modified current shape @ 20 kA (I_{nominal} 30 kA), vacuum spike observed at the same time.

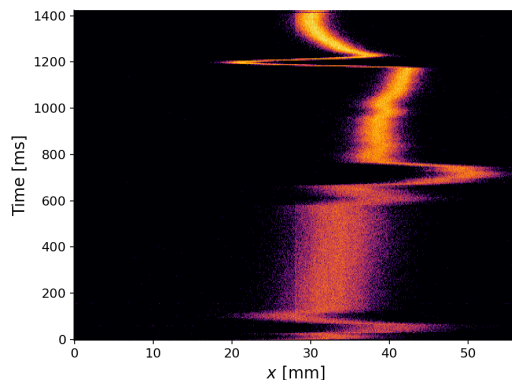
Wednesday/Thursday:

SMH42 was disconnected and opened in situ. A damaged insulating piece was found responsible for electrical arcing. This was removed from the septum, and replaced with a newly designed insulation part. Subsequently both magnets (also bumper 42) were reconnected and successfully pulsed at atmospheric pressure for visual inspection up to their nominal current, before disconnecting the magnets and re-installing the bellows. The magnet was closed and vacuum pump started at 14:18 on Thursday.

The bakeout started on Friday morning. We expect to resume the BC on Thursday this week. A few accesses took place in the shadow of the stop. More are planned Monday when the SWY is accessible in the morning.

Work on instrumentation had continued.

- The BPM system gain jumps have been understood and fixed.
- A first set of measurements has been taken on FWS 54H
- The BGI calibration for the horizontal plane is mostly done, as can be seen from the waterfall plot of one complete LHCIndiv cycle below (courtesy Hampus Sandberg).



As a summary:

The PS saw extremely good progress during the first 5 and 1/2 days of beam commissioning.

- We progressed faster than anticipated - also thanks to beams available from the PSB
- The settings generation worked very well and saved a lot of time

The **beam status** is so far:

- **LHCINDIV** single bunch beam accelerated through transition using new longitudinal scheme and extracted at 26 GeV/c to D3
- **SFTPRO** bunch splitting re-established at 3.08 GeV and accelerated to 14 GeV/c with bunches from all PSB rings
- **TOF** bunch extracted at 20 GeV/c and bunch rotation implemented

We are investigating if the 14 GeV orbit measurements are exploitable for a realignment of the main units, with a possible alignment this Wednesday or Thursday. If this is not possible we will acquire new 14 GeV orbit data for a planned alignment on Monday 22/03.

EPC uses the stop to perform a modification of the roof of POPS transformers from Monday to Thursday morning.

Otherwise, we are following up a few issues and are waiting for the restart.

AD (Laurette Ponce):

In the AD the hardware commissioning of the main power supply could not be started the HWC due to a problem on the interlock cable from the access system: the VETO could not be lifted on the mains. Investigation by EN/EL on the cable will be done on Monday.

Otherwise:

- Test on the C10 cavity progressing well,
- Leak detection on the S/C kicker: the biggest leak seems to be on the circuit which was not repaired in 2000.

ELENA (Laurette Ponce):

- Deployment of RF segments not done due to availability problem of the experts. They fixed a bug with the frequency correction function, some more to be also worked-on
- performed studies on the hysteresis effect with the deceleration cycle and with a special magnetic cycling before injection
- adjustment of the fast deflector delays for optimum bunch distribution in available transfer lines.

SPS (James Ridewood):

Summary week 10:

- Main dipoles, QF and QD all pulsing together reliably - fine tuning in progress. Dynamics tuned OK. Some noise remaining EPC working on MUGEF to FGC signal cable, DCCTs and ADCs
 - QF issue was traced to a faulty component on crowbar firing circuit - retrofitted to QD and QS Modification being applied to Sextupoles and octupoles circuits too - normally W11
 - QS still to be repaired commissioned
- Damaged cables of MBE.2103 replaced and tested for current and polarity
- BEQ1 trip being followed up by TE-EPC and ABB
 - Dynamic tests foreseen to continue Mon, Tues W11
- Quadrupole TE-MSC thermal checks
 - One enlarged quadrupole showing signs of excess heat on inner coil - suspected blocked filter
 - weekend intervention foreseen 27th March - drain of main magnet circuit required
- WIC interlock for handling spare main dipole and quadrupole convertors requires reconfiguration
 - Reloading and testing foreseen W11.
- SBDS commissioning
 - MKDV and MKDH conditioned.
 - Simulations confirm operation at ~28kV for MKDV1 OK
 - MKDH cable repaired
 - SBDS commissioning continuing with BETS tracking - MBI pulsing required
 - Good news - TSU armed on all played cycles Friday evening (SFTPRO, LHCPILOT, HIRADMT, AWAKE)
- MKP TMR temperature sensor issue - TE-ABT confirm not blocking and can be repaired at a later date
- Access system
 - AWAKE, BA80, BA81, TCC8 and ECN3 integrated into the global access system and tested by EN-AA
 - TAG42 and BA7 pre-tested for EAST, WEST, TI2, TI8 and AWAKE DSO tests foreseen 19th March
- Girder, anode and cathode position and movement tests
 - MSE4 - mechanical play - TE-ABT investigating
 - MST6 - FESA class errors for movement - TE-ABT investigating
 - TPSC4 - not completing movement as expected for position and angle - FESA/PLC issue - TE-ABT investigating

Planning week 11:

- TI8 tunnel and TI8 LHC TE-MSC thermal camera checks foreseen Monday to Wednesday
- MPS dipole and quad noise reduction measures
 - New MUGEF to FGC signal cable pulling and DCCT and ADC precision measurements/checks/tuning
- SBDS remote test control - BETS tracking - MBI pulse required
- WIC main power supply spare interlock correction implementation and tests Monday to Wednesday lunchtimes
- BEQ1 dynamic tests with EPC and ABB
- Gradual removal of BIC jumpers
- AUX PS tests continue at BA80
- Radiation monitor BIC tests - Pushed back from W10 due to faulty module

- Access system DSO tests for EAST, WEST, TI2, TI8 and AWAKE Friday 19th (and Saturday 20th if required)

AWAKE (Josh Moody and Giovanni Zevi Della Porta):

WEEK SUMMARY: 2nd week (out of 3) dedicated to improving the laser focusing system with off-axis parabolic (OAP) mirrors, to allow higher laser energy without damaging optical elements. Access System integrated with SPS.

- **[Form past weeks: Electron spectrometer magnets:** all problems addressed thanks to the EPC team. 2 problems (threshold too high, slow turn-on) were solved through configuration. 1 problem (apparent large noise) identified as old/known and can be ignored.]
- **TAG41 accesses:** RP measurements in CNGS area, crane inspection (TCC4), CV troubleshooting on cathode gauge (TCV4), Fast Beam Current Transformer electronics replacement (TSG4), beam interlock (CIBU) maintenance (TSG4)
- **Access System:** [2 full days of exclusive work] AWAKE access system is now integrated with the rest of SPS. We no longer have our own control panel, and will call SPS to change access mode etc.
- **Upstream and downstream streak cameras:** continued alignment work during laser-off periods
- **Vacuum:** pumped down laser/proton beamline to allow laser tests in vacuum.
- **Laser** (set up for OAP tests in vacuum)
 - Checked coarse effect of alignment shifts during pump-down on IR Laser room CAM
 - Aligned to virtual laser cameras (VLC)
 - Used mirrors upstream of vacuum compressor combined with MP1,3 mirrors to minimize aberrations and make best spot at VLCs
 - Aligned to BTV350 in low power mode with MP4,5
 - Investigated main amplifier Nd:YAG pump laser oscillator flashlamp fault that occurs very frequently now. Manufacturer contacted. Short-term solution: replace the oscillator's flashlamps and observe for further breakdowns

Next week: run the laser pulse energy up to specification, then vent the line and inspect all optical elements for damage. Depending on results, we may or may not pull out the OAP telescope and revert to the Run1 final focusing scheme.

LINAC 3 (Detlef K  chler):

- As reported last week the source was off due to problems with both microwave generators. Thursday two technicians of the Sairem company came for a repair. Both generators could be repaired in place.
- Sairem1 (the older generator, used as spare) had a problem with an insulation internal of the HV supply of the generator which was burned through (due to a faulty installation by the producer). The damaged pieces were removed.
- Sairem2 (the operational generator) had a broken NTC inrush current limiter on one of the three phases. It was temporarily replaced by a shunt. Sairem will send a replacement part. Until the final repair the generator should not be switched off.
- The source was restarted on Friday. The beam was back with good performance on Friday afternoon.
- Richard used the beam on Saturday to make some quad scans with the QuadScan application in the ITH line.

Other issues:

- On Wednesday the faulty HV break in the waveguide was repaired and tested.

- Beginning of the week there was an issue with the position sensor of the movable extractor. It showed some varying position information. A local intervention fixed it. But it is not 100% sure if we are now at the 0mm position (can only be verified by opening the source). If we want to use the movable extraction long-term a new position measurement (similar to the one for the ovens) has to be developed and installed.

LHC (Jörg Wenninger):

S12	S23	S34	S45	S56	S67	S78	S81
Cold	Cold	Phase 2	Phase 1	Cool-down	Warm up	Training	Cool-down
						13 / 11055 A	

First training quench of the post-LS2 campaign on Mon. 8th March at 14:39 in S78 at 10173 A (target is 11950 A). The maximum current reached is 11095A, de-training by 40 A at the last quench.

Sector 34 now in phase 2 powering for IPQs and IPDs, 97% of the tests completed.

Sector 12 confirmed non-conformities :

- NC on RCBH11.R1B1: circuit may be condemned (or limited in current)
- NC on RCO.A12B1/2: one of the two will have to be condemned
- NC on RCBXH/V1.L2: one of the two will have to be condemned.