

## Accelerator Complex Status

### End week 27 (Monday 12 July 2021)

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#### Technical Infrastructure (Ronan Ledru):

Statistics:

- Slightly more than 9'000 alarms.
- 795 phone calls (544 incoming, 251 outgoing).
- 152 ODM created.

Events worth mentioning:

- Mon 05.07, Critical fault on the UPS EXS102/1X (b.SX1). UPS bypassed to restore the power on EXD1/15A (b.USA15) pending the intervention of the manufacturer.
- Thu. 08.07,
  - Electrical Glitch on the 400kV line between Viel Moulin and Genissiat -9.73% during 80ms, Trip of the SPS's mains power supply.
  - Heavy rains on the CERN around Meyrin. Several lifts and the gaz detection system of the b.153 flooded. The lift of the booster was almost dry. SM18 and SMA18 flooded.
  - Due to Swisscom major outage, some calls from outside to inside CERN are not possible  
Problem has been solved by Swisscom in the morning

Details: <https://wikis.cern.ch/display/TIOP/2021/07/08/TI+week+summary%2C+Week+27>

#### LINAC 4 (Luca Timeo):

##### In general

It was a smooth week. At the time of writing, the availability was 99.7%. The chopper tripped occasionally.

##### On Tuesday

- There was a scheduled beam delivery interruption (w/o accessing the tunnel). Details were already discussed during the last FOM.

##### On Friday

In the shadow of the access in the PSB, there was another beam delivery interruption (this time also with access into the tunnel)

##### On surface

- SY-EPC intervened on:
  - the controls of L4L.RLF.121. They replaced the temporary Ethernet cable used for investigating the problem with SIS faults due to FGC communication exceptions with a better one (<https://issues.cern.ch/browse/APS-8844>);
  - the 18kV power converter of the source RF amplifier. They replaced a cable that now allows the monitoring of the charging current of the capacitor bank. That improved the remote diagnostics capability;
- BE-ABP made a small adjustment of the source frequency and increased the gas to optimize the beam shape.

##### In the tunnel

- D. Grenier performed a visit to the dump with the other members of the team (training purpose);
- The TSO reported that no water was present at the end of L4T because of the storm that occurred previously.

### PS Booster (Foteini Asvesta):

#### Interventions:

- **Planned** access on **Tuesday**:
  - The **QFO161** magnet was examined from the experts and **no leak** was found.
  - **Tests** for the **H0H-** with the distributor and the KSWs.
  - **Tests** with the **tune kicker**.
  - **Module change** of the R4 **QCD3**.
  - **POPS-B** tests and deployment of a **new control sequence** that simplifies the restart.
  - **Simulated B-train** tests.
- **Access** arranged on **Friday** as a result of the **storm** during Wednesday night/Thursday morning.
  - **Water** was found on the **PSB lift** and needed to be pumped out. The access was arranged the following day after communication with TI and the other machines. During the access no other water leak was identified but **some oil infiltration** was spotted on the **BTY line**.
  - **Water** (again due to the storm) needed to be pumped out from the false floor in **building 245** (POPS-B).

*All issues related to water infiltrations are being followed up so that similar situations are avoided in the future.*

- **Simulated B-train** tests. Extra data were acquired to try and fix the issue with the loss of the simulated b-train that may occur when a cycle is cloned and mapped.
- **Cleared alarms** on **BI3.BSW1L1.4** and **BT2.DVT20**.
- **Measurements** on the **finement amplifier**.

#### Main issues:

- **The injection kicker (KSW) in R2** was switching between the faulty and normal states for various cycles in the supercycle. The experts initially **rebooted the FEC** but later the problem re-appeared leading to a **charger and generator change**.
- Enhanced **extraction losses for the operational AD** started appearing on Monday and the user was frequently cut by the BLMs. Multiple settings were reviewed but the problem kept reappearing. Finally, extensive studies on a fresh clone led to a **new operational user with a factor 10 less extraction losses**.

#### Improvements & studies:

- Intensity studies on the **ISOLDE** user. New variant **reducing losses by a factor >2** (depending on the ring).
- Change of the **RF frequency measurement** timing leading to better and consistent measurements.
- New **application** to follow up on the **energy matching** with LINAC4.
- **Longitudinal** and **beta-beating** studies on the **LHC25** user to improve transmission and brightness.

### ISOLDE (Miguel Lozano):

It has been a pretty busy week at Isolde.

On GPS IS668 took radioactive beam during the week. It went pretty well with minor problems related to beam gate gating clocks. Apart from this nothing to report.

On HRS IS666 spent most of the week tuning and commissioning the new VITO beam line. Unfortunately, on Friday, during a target change, one of the frontend pumping groups failed due to a turbopump overheating after a cooling fan failure. An intervention at the frontend will probably take place this week to address/investigate this problem.

On the REX/HIE-ISOLDE side, we started working on a new set-up for beam with  $A/q=4.0$ . Unfortunately, we didn't progress too far since we had some problems with the normal conducting LINAC RF amplifiers. The field in 7GAP1 was not very stable and we can see the effect on the beam. The RF specialists spent most of the week (Tuesday-Friday) trying to solve the problem. But, they didn't manage to identify the source of the instability.

**PS (Matthew Fraser):**

The PS had considerable downtime during working hours this week due to two long accesses and a recurring fault on the power converter of the W8L.

On Tuesday afternoon the machine was down as the broken operational converter for the W8L was switched to its spare. The spare converter then repeatedly tripped on Wednesday and Friday afternoon on "out of rate limits" induced initially by the ramp down on the AD cycle (no difference in rate compared to pre-LS2) but then again on other cycles. Diagnosing why the converter was tripping was complicated by the presence of noise due to poor EMC shielding of the spare converter.

During the planned access on Tuesday morning TT2 BLM grounding improvements could be implemented, two cavity amplifiers repaired, ODN regulation checked and a cooling problem on the SMH61 confirmed. A preventative replacement of the (out of vacuum) septum is being discussed for later in the year. During the access on Thursday morning grounding improvements could be made to the cable trays in the switchyard, PU's repaired and software updates made.

Given the interlock logic forbids work on the W8L's operational converter whilst the spare is powered investigations on the cause of the original fault were impeded. EPC profited from the access to circumvent some of the interlock logic to safely investigate some parts of the operational converter whilst the spare is operational. The reason for the problem on the original converter is still unknown and further work is needed on the spare.

On a positive note, wire-scanner measurements confirmed this week that the LHC25 beam is very close to the expected LIU brightness limit curve for an intensity of  $2.0 \times 10^{11}$  ppb and longitudinal emittance of 2 eVs.

Significant progress was made at reducing beam losses on AD, TOF and SFTPRO where in most cases we are now comparable or lower to the reference beam loss data recorded in 2018. The most significant improvements came from optimisation of the injection losses, working point and transition crossing. The TOF beam is in a good state at up to  $800 \times 10^{10}$  ppb and ready for first beam and SFTPRO saw up to  $1500 \times 10^{10}$  ppb.

Investigations continue on the EAST cycle showing that the dipole and quadrupole components in the MU's do not scale as the machine is ramped on the 24 GeV/c flat-top, even with a small  $< 0.3\%$  ramp. This is manifested as a slope on the tune along the flat-top. Interestingly (and as we discussed in the CCC) this effect does seem to be related to saturation as the machine was shown to scale at 2 GeV using a ramp on a flat-bottom cycle. One related observation that needs further follow-up was the drift of the B field on flat bottom (dependent on the super cycle composition) inferred from a drift of the MRP at fixed RF frequency (phase and radial loops disabled).

Please note that the DSO tests for TOF may cause perturbations this week on Thursday morning from 9 - 12h, and will be announced at the FOM.

#### AD ():

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#### ELENA ():

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#### SPS (Francesco Velotti):

W27 for the SPS was originally foreseen to be the last week for setting up of the experimental beamlines; coming out of week 26, where the TBIs had found to be under poor vacuum, the week started with the bad news that the vacuum of the TBIUs and TBIDs did not decrease sufficiently over the weekend and that the whole week would be needed to pump them down in order to turn on the ion pumps. Indeed, the pumping took nearly the whole week, but luckily the pumping was completed by Friday morning, allowing to set up TT20 before the weekend. Commissioning of secondary beam lines started and already very good progress on all lines and experimental zones. In parallel, flat bottom losses investigation on HiRadMat cycle took place but with no significant solutions yet.

#### Achievement:

- HILWIC reconfiguration of the mains was done;
- Tuesday access given following intervention in the injectors. LLRF upgrade took place. Not easy to come back due to issue on cooling of the mains;
- Setup second injection on SFTPRO; it was found that second injection was exactly on the abort gap. Set of settings for WR Trigger Units 1 & 2 found to properly inject 2 SFTPRO and to allow enough time for abort gap. Access granted to ABT SBDS experts to change MKD delay by 8.03 us to move WR Trigger Unit1 back to 1605 buckets. All done and now bucket 0 is right after abort gap
- Over night continued with SFTPRO setting up; achieved 97% transmission with intensities ready for physics, i.e.  $1e13$  ppb (up to flat top, not yet extracted);
- HiRadMat cycle taken with single INDIV to scrutinize flat bottom losses. Observed peculiar losses with RF off, these essentially vanished with just once RF cavity turned on; phenomenon still remains to be understood; the hope is that the understanding will help to improve the frequency observed poor lifetime of the HiRadMat beam at flat bottom. The tunes were corrected and chromaticity measurements were taken; none of these corrections had a large impact on the beam lifetime. Work over night on the cycle with one full batch of 72 bunches focused on optimizing the voltage program could improve losses for the multi-bunch beams. More work and studies together with the PS will be needed to better understand and optimize the injection process and injection beam lifetime, however.
- The transverse damper on the SFTPRO was fully setup to run in vector-sum mode (after issue also LSA make-rule fixed); beams are now transversely stable also for higher intensities;
- Friday we finally had the green light to go ahead with NA extraction beam down the line and now BSMs work perfectly fine. Also all changed done in YASP operational - very straight forward to steer on targets and obtain good symmetry. Autopilots also working with no problems.
- Secondary beam line saw beam already at the start of the weekend and commissioning was started. H2 and H4 almost ready, H6 and H8 little issues with beam instrumentation, but in a pretty good shape already. M2 has seen beam too and users already quite happy. Very good progress so far.

#### Issues:

- Unusual losses in TT10 following trip of DFAs, needed to reload all settings in TT2 as, to try to correct it, trajectory ended in bad state. Maybe time to see if we can add golden on SFTPRO in both TT2 and TT10;
- Repetitive issues on PS PFW translated in quite significant down time;

- Repetitive trips of cavities seen all along the week - intervention in the shadow of the PSB intervention restored the situation;
- Found radial loop acquisition FESA class crashed with no possibility for diagnostics (expert had to be called to diagnose and then restart the FESA class) - need to add monitoring of this;
- AWAKE cycle taken but needs some work on RF side to make it operational again;
- Trip of BA4 access door, together a few other hiccups from the access system;
- Issues on 2 magnets in TT20 that required tunnel access - P. Schwartz fixed both (more details needed from experts to understand issues as this came over the weekend). Found 2 valves closed for cooling on the second and issues with a cable in the interlock box;
- MKDV2 TMR contact fault on SBDS needed access to replace TMR - done Saturday night now back in operation thanks to intervention of piquet and equipment responsible (V. Senaj);
- WIC issue on SMD3 took almost the whole night of Saturday to be restored - intervention needed from first line, EPC piquet and R. Mompo. Finally spare WIC chassis put in place and fixed the issue;
- Recurrent issues with QTLF.2102 in TT20 - finally piquet changed card on NR22\_058 to solve the problems;
- ZS started to spark a bit over the weekend when in production and beam constantly extracted;
- Issues on the mini-scans on the targets - this is very important for the experiment and need to be sort out next week;
- BCT in LSS5 not working as expected and this makes SPS-QC normalised and auto-spill not usable. This needs immediate action before going to higher intensity.

#### SPS North Area:

The target diagnostics boxes were made operational with the help of many people from different groups. The beam setting-up has started and physics in some lines can resume on Wednesday.

#### AWAKE (Giovanni Zevi Della Porta):

**WEEK 27 SUMMARY:** Last two days of electron beam before proton run. Opened vacuum on Wednesday.

- **Laser:**
  - Pump still not working, so we only have UV and un-pumped IR
  - Replacement parts will arrive at the end of next week
- **Electron Beam:**
  - Took images of reference beams for all charges and sizes, to use for setting up during run
- **Upstream streak camera:**
  - Attempted electron bunch-length measurements, using un-pumped IR as reference signal, but time profile of IR had a ~20ps reflection preventing measurements. We hope that this reflection will go away when laser is fixed.
- **Vacuum:**
  - Vented vacuum on Wednesday, July 7. Plan to pump down on July 19
  - Replaced target at Laser Beam Dump 2
- **Access:**
  - Cable pulling for BI systems
  - Visit for new RPE (SPS operator who will help AWAKE if needed on weekends)

**PLAN FOR WEEK 28:** Rubidium vapor source intervention (replace reservoirs, maintenance of pumps and temperature probes). Repair and test of laser system.

#### LINAC 3 (Detlef Kuchler):

- The source is now running for 39 days with the same filling. This indicates a lead consumption of lower than 1.5mg/h.

- On Friday in the shadow of the booster intervention the planned actions on Linac3 could be done
  - The magnet team checked ITF.BHZ13 concerning the temperature interlock which happened regularly in the last weeks. They found one faulty contact. This contact was bridged as there are three more available.
  - The RF team replaced tubes in tanks 2 and 3. And they made measurements on the OCEM power converter in view of the future replacement.
- The source tripped two times this week.
- The number of breakdowns in the source extraction system became higher than usual (normal 1-2/day, now up to 10/day). Visual inspection inside the source cage has not shown any obvious. No actions are foreseen at the moment.
- On the source FEC a new FESA class for the coming source interlock system was tested and further developed.
- The regular linac energy measurements were done.

Remark: The pre-warning on the timing intervention on Tuesday came very late. As some of the equipment is very sensitive to missing timing an earlier information that specialists could be present and stop the equipment would be preferable the next time.

#### LEIR ( ):

Following initial issues with the steering of the beam in the transfer line that prevented the beam from making multiple turns in LEIR, let alone accumulation, a wrong setting was found. Following the correction beam could be injected and accumulated.

#### CLEAR ( ):

Shut-down mode to adapt access control system.

#### LHC (Jörg Wenninger & LHC Powering Test webpage):

S12	S23	S34	S45	S56	S67	S78	S81
Completed Sector @ 20K	Room T, repair	Completed	Completed	Trained	Phase 2	Room T, repair	Phase 2 Sector @ 20K
77 / 11950 A	29 / 11538 A	71 / 11950 A	87 / 11950 A	76 / 11600 A		69 / 11585 A	

S56 trained to 6.8 TeV with 76 training quenches. On Saturday 10th, the RBs in 34, 45, and 56 were ramped to 11500A for a long term powering test. The test was unfortunately interrupted after roughly 10 hours when the powering phase 2 conditions were lost because two ventilation doors (UL55, UL26) were suddenly seen open.