

# Accelerator Complex Status

## End week 18 (Monday 9 May 2022)

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### Technical Infrastructure (Jesper Nielsen):

Statistics:

- About 5'800 alarms.
- 633 phone calls (438 incoming, 195 outgoing).
- 88 ODM created.

Events worth mentioning:

- Mon. 02.05:
  - AUG in BA1. A water leak caused a problem with a vacuum pump, and the vacuum piquet saw the leak and a cable in water, causing a little smoke (old cable with poor insulation) and he actioned the AUG.
  - No power in building 180 and 190, network alarms in building 9066, 581 and 591
- Thu. 05.05, Water leak AD target area. The leak was on a connection to the magnet.
- Fri. 06.05, Power cut in nTOF, ventilation systems lost communication, PS did not have communications either. Confirmed by nTOF, power quickly restored by EL piquet.
- Sat. 07.05:
  - Electrical perturbation, confirmed by RTE. Trip of RF cavities for PS.
  - Mobile phones at CERN cannot call fixed phones. Loss of communication with several equipments for telephony in the main hub in Meyrin, building 58. (U58-SA-IPZ-XBR4L-1, U58-SA-IPZ-XBR4M-1, TONE-0058-GW). Intervention by IT 3rd line piquet. Fall back solution to TI mobile phone worked as intended during this incident.
  - BIW alarm in SPS, a door was detected as open in BA80. Door contact was adjusted by access piquet and patrol was done.

Details: <https://wikis.cern.ch/display/TIOP/2022/05/09/TI+week+summary%2C+Week+18>

### LINAC 4 (Jean Baptiste Lallement)

Another very good week for Linac4. Would have been perfect without a reset of a transfer-line quadrupole power converter, on Friday evening, that took one minute, bringing down the availability to 99.99%.

### PS Booster (Jean-Francois Comblin):

It was an excellent and quiet week for the Booster, with an availability of 99.9%. Just a few resets were needed, for a total downtime of 11 minutes.

Wednesday Isolde took for the first time the staggered beam on the GPS target.

On the 3 eVs variant of LHC25 some improvements have been done on longitudinal emittance and tails reduction.

In order to save energy, the economy mode is switched on progressively on the FGCs.

As usual, the MD planning was busy, with Isolde 1.7 GeV studies, test of High-level parameters of TFB, transverse impedance measurements, just to name a few.

### ISOLDE (Erwin Sielsing):

A very good week for ISOLDE.

At GPS a used liquid metal (Sn) was placed on Monday and Cd collections at the GLM have been taken place ever since using the STAGISO proton beam.

No technical issues, just twice a small hick up with the PSB protons going to high in overall current which can be harmful for the target (proton current went from the requested 0.25uA to 1uA for a short while but was adjusted quickly when noticed).

We will change the target this afternoon.

At HRS we changed for a UC plasma target on Wednesday and had beam available for the users as of Thursday evening as foreseen.

Interesting run at HRS with the users switching beam back and forth going to ISOLTRAP for beam characterization of the beam and then to LA1 for collections of 225 and other Actinium, an interesting isotope for medical applications and cancer research.

Very good run so far with only one technical issue this morning when the ISCOOL 48V interlock module power supply gave up (First Line is on it as we speak).

For the physics results Karl will surely say a word at the FOM tomorrow.

Perhaps also interesting to mention: The stable beam reference setups done by the OP team during the recommissioning phase of the low Energy part is paying off. Setting up stable beam to the different lines for the different type of targets is now significantly easier and faster.

### PS (Denis Cotte):

Une excellente semaine 18 pour le PS avec une disponibilité des faisceaux proche de 97%.

Il y a eu trois principales sources d'arrêt faisceau de la machine PS :

- Mardi matin, SIS nous coupait tous les faisceaux suite à une perte de souscription sur les FGC des "Low Energy Quad" et des Pole Face Windings. (10 minutes sans faisceau)
- Mercredi matin, un faux contact sur un câble LLRF des cavités 40/80MHz empêchait leur utilisation pour délivrer les faisceaux LHCINDIV et LHCPILLOT. (Un peu plus de 1h30 pour diagnostiquer et résoudre le problème)
- Enfin, samedi matin une perturbation du réseau électrique causait des problèmes sur nos cavités accélératrices 10MHz pendant environ 3h.

Le faisceau nTOF parasite (sur le faisceau EAST) à été amélioré suite aux demandes des utilisateurs, longueur de bunch à 40ns minimisation du pré-pulse, minimisation du temps entre le trigger et l'arrivée du bunch vers l'expérience nTOF.

Ces settings ont été propagés sur tous les cycles EASTs.

Plusieurs version du faisceau LHC25 3eVs ont été prise depuis le PSBooster. Les mesures sur le palier haute énergie au PS font état d'une emittance d'environ  $E_v=1.2$  mm.mrad et  $E_h=1.9$  mm.mrad.

Pendant le week-end, la propagation des résultats du dernier "Energy Matching » sur les cycles MTE a commencé. Les autres cycles opérationnelles ayant déjà tous ces dernières modifications implémentées.

Sinon, tout au long de la semaine, le PS a continué de fournir les différents faisceaux à ces clients (TOF, EAST, AD, SPS) lorsque ceux-ci étaient en état de le recevoir.

### PS - East Area ():

No report.

### AD - ELENA (Pierre Freyermuth):

This week was a bit 'complicated' for the AD.

- Monday a new amplifier for the RF finnet cavity is installed in the ring.
- On Thursday a large water leak developed in the AD Target area. Accesses were performed by magnet specialists to fix the broken ceramic water pipe of a quadrupole. Water did not damage any critical component and was dried. The water that flowed into the collecting tank was also pumped to the surface. Target was put back operational the same day the afternoon.

Our EPC colleagues, led by Gilles Legodec, spent a lot of time to solve the issue with the BHZ-TRIM power supply.

- Friday afternoon it was decided to attempt a deceleration cycle without the use of this power supply, using optic parameters yet calculated by Davide. This at the expense of pulling more power from other power supplies, and possibly ageing them quickly, as some are at their limits. After some fine adjustments of the working point by Laurette and RF settings by Simon, a good intensity is output from the AD.
- Friday evening one of the module of the Finmet Cavity failed, preventing it to run, thus decelerating any beam. However, the system should be able to work with 4 out of 5 module. Both RF experts was in holidays but Matthias guided me on the phone to make the appropriate changes on the PLC. The cavity then restarted and we saved the weekend physics.

This week in ELENA was also punctuated with some smoke.

- On Friday, a power supply of the H- ion source failed. An electronic card was damaged. Our source colleagues helped us with the diagnostics and the card fix. It is still not fixed and the work will continue as soon as Elena can be accessed.
- The beam from the AD working without the BHZ-TRIM is slightly different and ELENA injection has to be adjusted.
- during the night Alpha did not received Pbars, I spend a bit of time with our PS colleague to explain what I know of the extraction lines. A fast deflector was in fault and could be reset. We take the opportunity Alpha and Asacusa take the beam to observe the beam profile on the last grids.
- Sunday morning Asacusa had some trouble with a fast deflector as well. PS team, after many reset trials and the help of the First line piquet in CCC, finally manage to put back the power supply back online.

### SPS (Carlo Zannini):

It was a quite difficult week for the SPS. In this week we were supposed to have AWAKE and SFTPRO beam all along the week, short parallel MDs on Monday-Tuesday and a dedicated MD on Wednesday as well as to serve the LHC beam commissioning.

On **Monday** the SPS was not able to deliver any beam up to 19:00 due to a water leak on MBB11490. An emergency stop in the tunnel was needed due to a sublimator cable flashing in the water. Restarting all the systems required additional interventions and the beam was back in the SPS only around 19:00. During the night scrubbing at flat bottom with batches of 72 bunches and  $2.2e11$  p/b was performed. Due to the significant vacuum activity in particular on MKP4 only 3 batches were injected.

On **Tuesday** the beam availability was very good all along the day. The short parallel MD on beam based cavity voltage calibration took place together with the LIU studies on the LHC25ns cycle with 1 batch of 72 bunches accelerated at flat top with more than  $1.8e11$  p/b (26 turns from the PSB). Both variants 2eVs and 3eVs were taken. The transmission for both variants was around 95%. With the 3eVs  $1.5 \mu\text{m}$  transverse emittance was measured at flat bottom. Transverse emittance blow-up was kept below 10% increasing chroma and adjusting tunes. During the night, scrubbing was continued with the long flat bottom cycle at an intensity of  $2e11$  p/b and 4 trains of 72 bunches.

On **Wednesday** during the day took place the dedicated MD in Coast on the emittance growth with Crab cavities. The MD finished around 18:00. From 19:00 it was observed that the AWAKE cycle could not go throughout the energy ramp. A significant degradation of the orbit has been observed and later discovered to be related to an inter turn short circuit on the MBB22090. All beams were stopped at 22:00 to prepare the intervention/exchange of the magnet.

Beam was back in the SPS on **Friday** at 11:30. The orbit on AWAKE and LHCpilot after the magnet exchange has been found significantly degraded at flat top and was locally adjusted. The settings were copied for all the LHC users and new references (AWAKE, LHC4) were created. The impact of the magnet exchange on the SFTPRO orbit has been found less important and, therefore, the orbit of this cycle was not touched. From the afternoon until Saturday at 6:00 the new magnet was scrubbed

with the LHC25ns cycle with 4 batches of 72 bunches at flat bottom with an intensity of about  $2 \times 10^{11}$  p/b. In parallel beam was given to AWAKE and LHC for beam commissioning.

On **Saturday** morning low intensity beams from  $2 \times 10^9$  to  $1 \times 10^{10}$  protons were given to LHC for splashes. On Sunday afternoon low intensity pilot (around  $3.5 \times 10^9$  protons) was given to LHC for MKI waveform and synchronization. To reduce the duration of this LHC beam commissioning activity the SPS supercycle has been shortened to about 34 s (1 SFTPRO, 1 AWAKE and 1 LHCpilot).

**SFTPRO**: no beam to NA due to the water leak on the TDC2/TCSC until Saturday. Water leak occurred in the evening of April 28th and has been solved on Saturday May 7 at 11:30. When restarting an issue with a power converter of the extraction bumper occurred at around 12:30. Beam was back for physics at 13:40 but unfortunately at 14:00 an access problem occurred (lost of patrol in BA80 caused by a broken door). The problem was solved around 19:00 and the beam was back for NA at around 19:30. An additional pit stop was needed due to a water pressure fault on the bend 043.525 between 21:10 and 22:00. A difference of 7A was observed at top energy on main dipoles. This was mitigated adjusting the tunes during the investigation of the issue and solved at around 3:00 AM on Sunday. The beam intensity for SFTPRO was then increased from  $1.5 \times 10^{13}$  to about  $2 \times 10^{13}$  protons to target the sharing of  $25 \times 10^{11}$  on T2,  $70 \times 10^{11}$  on T4,  $50 \times 10^{11}$  on T6 and keeping a transmission of 98%. Beam was given to **AWAKE** whenever was requested granting always two AWAKE cycles except Sunday afternoon when the duty cycle was shortened to accommodate the LHC beam commissioning. Due to the several issues occurred in the SPS along the week AWAKE did not take beam on Monday, Wednesday and Thursday.

*All along the week it was tried to replace the SFTPRO beam time with MD time. Unfortunately, the additional issues encountered along the week were strongly limiting this plan.*

#### **Main issues/fault of the week:**

Inherited main issues:

- water leak located at the first TCSC (TT20 side) preventing beam for NA
- SBDS intervention on the PFN of MKDV2 not successful spurious dump still observed
- Communication problem with mains. Change of power supply during Sunday night did not help

Issues/faults of the week:

- *vacuum at atmospheric pressure* around 8:00 AM on Monday in sextant1 close to momentum scraper then realized to be caused by the water leak on MBB11490
- *Water leak on MBB11490*: during the inspection an old sublimator cable has been observed flashing in the water close to MBB11470. Emergency stop needed in the tunnel. Wire was then isolated and the water leak on MBB11490 temporarily fixed with a patch. Moreover, due to the emergency stop in BA1 some side effect was also observed (e.g. MKP breakers had to be switched on manually). In the shadow of this fault several interventions took place. It is worth mentioning the intervention of 4h on 200 MHz cavity impedance line and the investigation of the PFN MKDV2 issue.
- DCPS MKDH repeated faults (solved during Monday night)
- Communication issue with mains (solved on Tuesday morning)
- *Inter turn short circuit on MBB22090*: since 7:00 PM on Wednesday a significant degradation of the orbit at high energy has been observed. The diagnosis with virtual kicks pointed to a main dipole short circuit on MBB22090. All beam were stopped at around 10:00 PM and the intervention to investigate/replace the magnet took place on Thursday morning. First a capacitive discharge test was done to verify that the magnet was the correct one, therefore, the magnet was exchanged. At around 5:30 PM the vacuum team did the first vacuum leak detection test with success and in the evening the ionic pumps were flashed. In the shadow of the magnet issue several interventions, inspections took place. Relevant for the main issues of the week the additional investigations on the PFN of MKDV2 and the inspection of the old sublimation system. On Friday the water cooling after the magnet change was

confirmed to be ok. Some additional vacuum works in BA2 due to the magnet change between 9:00 and 10:30. Beam back at 11:30

- SBDS issue on the PFN of MKDV2 fixed on Friday morning
- The intervention to fix the TDC2/TCSC water leak took place on Friday afternoon. The cooling circuit was modified as described at the IEF (option 4). On Saturday at 11:30 it was confirmed that the intervention in BA80 on the TDC2/TCSC was successful. No water leak was detected.
- Issue with a PS cavity on Saturday around 7:00 AM (1 hour stop)
- Issue with a power converter for the extraction bumper on Saturday at 12:30 (1 hour stop for NA)
- Patrol lost in BA80 on Saturday at 14:00: the new patrol was possible only at 17:15 (there was high intensity beam for 20 minutes). During the patrol a door was found to be broken. The repair of the door finished around 19:00. Therefore, the patrol of BA80 took place and finally the beam was back for NA at around 19:30 (more than 5 hours stop for NA):
- Water pressure fault on bend043525 (about 1h stop for NA on Saturday starting from 21:10)
- Difference of 7A at top energy on the main dipoles for SFTPRO. Solved at around 3:00 AM on Sunday removing the SMD7 from the configuration.
- Some pumps are off in BA2 from Saturday night in the region where the magnet exchange took place. The piquet was informed and gave the green light to continue like this.
- Problem with a Quad power converter on Sunday (about 1h beam stop for NA)
- MKDV fault at around 21:00 (blocking for about 30 min.).

#### SPS North Area ():

No report.

#### AWAKE (Edda Gschwendtner):

First week of 2022 proton run

- Protons: we received beam from SPS on Tuesday, Friday afternoon, Saturday, Sunday. We alternated between 1E11 and 3E11 intensities. We also tested enlarged-beam proton optics to simulate a second plasma cell foreseen in Run 2c.
- We propagated beams in vacuum until Wednesday and heated up the vapor source on Wednesday night to start with plasma experiments
- Electrons: most work focused on alignment using the new BTV. We stayed at ~220 pC since this charge is enough for eSSM
- Laser: the new alignment works well, although reference on "virtual line" needs to be verified/adjusted daily
- No significant hardware issue on the main systems (laser/electrons/rubidium)
- Tested newly installed Cherenkov Diffraction Radiation BPMs, with electron-only and proton-only, to prepare for electrons+protons
- Started with new data acquisition for digital cameras (BTVDC), but moved back to PXI system after reset and timing issues. The new system will continue commissioning using spare cameras.

**Plan for week 19:** once the electron-seeding setup is fully established and reproducible, continue with physics program (electron seeded self modulation, electron-seeded hosing, 3D scans of proton beam, timing scans of proton/electron delay...).

#### LINAC 3 ():

YETS.

#### LEIR ():

YETS.

#### **CLEAR (R. Corsini & P. Korysko):**

Last week was dedicated to FLASH radiotherapy dosimetry studies with CHUV. Three series of sample irradiation were done: a chemistry experiment (peroxyde production at different doses and dose rates), and two biological ones, involving plasmids and zebra fish eggs. Data to be fully analyzed in the next weeks, the preliminary dosimetry analysis show reasonably good stability and reproducibility. No relevant operational problems.

Full operation reports can be found in the CLEAR Weekly Operation Meeting series, here:

<https://indico.cern.ch/category/10682/>

#### **LHC (Jörg Wenninger & LHC Coordination webpage):**

The local corrections were applied at FT (1.33 m, 60 cm and 30 cm), reducing the beta-beating at 30 cm to around 20%. At the end of the week the OMC team finally managed to perform the measurements on the ballistic optics.

The first nominal bunches were injected and captured on Tuesday, followed by a first round of orbit setup. The ADT BPMs were setup with nominal bunches, but the loop could not yet be closed.

MKI and MKD waveforms were measured with probe beams, BPM offsets were measured with K-modulation (nominal bunches) and the collimator BPMs were checked and calibrated with beam. A second round of crystal tests was performed at injection.

The LHC suffered important downtime from the SPS on Monday (consequences of a water leak on a dipole), on Thursday and on Friday (short in dipole coil, magnet exchange). The weekly availability is below 60%.