

Accelerator Complex Status

End week 37 (Monday 20 September 2021)

Technical Infrastructure ():

Statistics:

- Roughly 19'000 alarms.
- phone calls (827 incoming, 211 outgoing).
- 94 ODM created.

Events worth mentioning:

- Water leak in racks in BA3. The water infiltrated from the ventilation installed above the faraday cage, where the condensation drain was blocked.
- Weasel found in ESD9/7E electrical cabinet. Power was cut by EN-EL and fire brigade intervened to remove the weasel. The powercut only impacted the backup power, transparent to machine operations

Details: <https://wikis.cern.ch/display/TIOP/2021/09/20/TI+week+summary%2C+Week+37>

LINAC 4 (L. Timeo):

It was a smooth week. At the time of writing, the availability was 99.8%.

On Monday

In the afternoon, the RFQ went in recovery mode once.

On Wednesday

In the morning, few hours before putting the beam stopper IN in preparation for the TS2, the RFQ's modulator detected some instabilities on the cathode voltage and tripped to protect the klystron.

In the afternoon, after the restart of Linac4, there was a swap of pumps on the klystron water circuit that caused pressure and flow drop. The event affected all equipment on such a circuit, causing their trip. The whole RF smoothly restarted apart from PIMS0506's modulator. With the remote support of J. Parra-Lopez, PIPO intervened on-site to change the *state control board*. Then the FGC3 electronic resumed working correctly. Those afternoon's occurrences happened within the framework of the TS2 (the PSB could not take beam yet). Therefore, they do not contribute to the downtime.

On Thursday

In the morning, there was a joint SY-RF, BE-OP, and BE-ABP machine development to optimise the RFQ thermal tuning. The latter seems to affect the transmission through the accelerating structure. Results were promising (gained 0.5 mA). To be investigated further.

In the afternoon, BE-OP noticed that the trajectories in LTB and BI line drifted away in the H plane and have been slowly recovering the initial positions without external intervention. BE-OP is investigating the source with the experts.

On Friday

BE-ABP reported that after the intervention carried out by the SY-RF (G. Piccinini and S. Chicarella) on the filament power supply of the source RF amplifier (performed during the TS2), the source pulse to pulse reproducibility and flatness improved.

PS Booster (G. Di Giovanni):

It was a good week for the PSB with an availability of around 97%. Most of the downtime was actually driven by problems with the PS on Sunday afternoon requiring an access in the SWY, and in turn stopping the beam in the PSB for a couple of hours.

Technical Stop:

- The interventions in the tunnel during the technical stop were all carried out successfully and on time, including the exchange of two wire-scanners (one pre-LS2 type and another one of the LIU type). As a matter of fact, at the time of the closure of the machine on Wednesday afternoon, the vacuum had already recovered an acceptable level to circulate beam. Unfortunately, the patrol in the PS Switchyard was lost and had to be redone the day after. At the same time, the POPS-B intervention on the surface was running late and a few configurations were lost, requiring the experts to work until late evening to recover the situation. For this reason, we agreed on restarting on Thursday after the PS patrol and allowing the Linac4 team to carry a special MD on the RFQ tuning.
- We finally got beam shortly before 12h00, ahead of time wrt to the announced end of the TS2 (14h00). During the restart, we met some difficulties because of a change of functionality in the FGC gateway which ended up systematically triggering the SIS. The same magnets interlocking the SIS are also interlocked with the BIC (SIS is there for redundancy), so we disabled the SIS check for the time being. EPC experts and OP are following the issue closely.
- After the TS, we have been experiencing several trips of the extraction septa which takes only a few minutes to recover from. The ABT experts looked into it on Friday and nothing was found at the magnet level. The EPC expert is back on Monday, so we will contact him in the morning.

Miscellanea:

- We prepared a version of the TOF beam produced with Ring3 to increase the PSB flexibility to provide such a beam with multiple rings. The operational TOF beam is produced with Ring2 and, in case of problems with this ring (as it happened last week), we could now switch to another ring.
- As announced at the last FOM, we inserted the smaller scraper masks in period 8. This is the baseline configuration of the PSB with a smaller bottleneck to concentrate losses in period 8, which were otherwise distributed elsewhere in the machine. We observed a slight loss of performance for high intensity beams like TOF and ISOLDE (no issues for the other beams), in terms of intensity extracted, mainly in Ring2 and Ring4 which can always be recovered

with injecting 1 more turn. We are now in the process to understand the reason and see if we can retune the setting to recover the original intensity. The idea is to run with the small mask in until the end of the year, to have a meaningful comparison of the two configurations (mask in and out).

ISOLDE (S. Mataguez):

On GPS, Target#711 UC Ta. Setup with 238U. HV =30kV. Isotopes studied: 231Ac and 229Ac. Beam to GHM and LA1 stopped Tuesday @15.00pm. Feedback positive.

Friday, preparing the ISS run of next week, electrode blocked – investigation on-going.

On HRS, HRS: #733 YO Ta. Zn and K mass marker. Setup for 30kV. RFQ in bunching mode. Beam to ISOLTRAP (IS625). Main isotopes 58Zn.

The machine was set up and ready Wednesday, beam gate YHRS.BG.4600, re-configured as users' previous run.

Friday morning, HTFactory.HT1 TREK failure, exchange with the GPS one by SY-ABT (T. Gharsa) Sunday 2.00am, during data collection on 61Zn, rate fell down drastically. Proton scan done, no improvement.

Since then, operation ran rather smoothly.

On REX-HIE side

Preparing the ISS run of next week.

PS (D. Cotte):

Une bonne semaine pour le PS avec une disponibilité faisceau d'environ 95%. (hors TS2)

Le début de la semaine était focalisé sur la reprise du steering des faisceaux vers la zone EST en collaboration avec RP pour minimiser les pertes sur les moniteurs RP et les BLMs de la zone.

Le premier aimant de la ligne T8 influençait les faisceaux qui passaient par la ligne F62 (T9, T10/11). La mise en place du mode économique par destination sur cet aimant a résolu le problème.

Une version éjection rapide était aussi mise en place vers T8 pour régler des problèmes d'acquisition sur le transformateur F61.BCT par les experts BI.

A partir de mardi matin, les faisceaux étaient progressivement coupés en prévision du « Technical Stop 2 ».

Mercredi, les derniers faisceaux étaient stoppés vers 3h30 du matin, suivi du survey RP vers 7h30 et des différents accès dans la machine à partir de 8h30.

Pendant la matinée, la porte entre PS-Ring et PS-SWY était forcée, ce qui nous faisait perdre la patrouille de ces deux zones.

Les accès se prolongeaient jusqu'à 23h à cause d'un problème mécanique sur le Septum électrostatique 23(SEH23) ainsi qu'un souci de synchronisation du système d'accès PS avec ADAMS.

Le septum SEH23 est maintenant en LOCAL et bien positionné pour notre extraction en zone EST, on ne peut cependant plus le déplacer en REMOTE.

Jeudi matin, les différentes patrouilles étaient effectuées, le piquet TE-EPC intervenait sur différentes alimentations (PFW, ONO39, BSW12, BTI247 ...) un peu difficile à redémarrer et le faisceau était de retour au PS vers 13h30.

Les mesures du « RP survey » montraient un point chaud dans la ligne FTN sur le bending FTN.BHZ456 (18mSv/h).

Une nouvelle version du faisceau TOF basée sur les optiques 2018 était mise en place et restera en production pendant au moins 15 jours jusqu'au prochain survey RP.

Pendant le TS2, l'interlock du système BLM a été revu de façon à uniformiser la façon de couper le faisceau depuis les BLMs du PS-Ring, de TT2 et de la zone EST.

La dernière partie de la ligne T8 a été réaligné.

Vendredi, un accès fut nécessaire pour changer l'amplificateur final de la cavité C10-96 -> 1h30 sans faisceau

Dans la soirée, le « Beam Permit T9 » était signé permettant d'envoyer avec succès le premier faisceau vers T9.

Pendant le week-end à noter le crash d'un serveur du système d'accès vendredi soir qui a été résolu le lendemain matin.

Dimanche soir vers 19h, le système WIC déclenchait un « FAST ABORT » sur une série d'aimants auxiliaires du PS Ring.

L'expert diagnostiquait un problème sur le Bumper14. Un accès dans le PS-SWY était nécessaire interrompant les faisceaux PS et Booster. -> 3h30 sans faisceau PS. -> 2h sans faisceau PSB.

Le problème venait d'un conducteur du système d'interlock WIC pincé sur le support de l'aimant et provoquant un défaut de terre.

[PS - East Area \(B. Rae\):](#)

First secondary beam in T9!

AD - ELENA (L. Ponce):

AD:

- short week for physics because of the TS started Tuesday at 15h30, beam back on Thursday 14h.
- re-optimization of the DI line and 300 MeV cooling. AD is now running with a transmission around 80% and $2.7e7$ pbars at extraction.

ELENA:

- optics check in ALPHA line
- BASE started receiving pbars after TS.
- new optics tested in ASACUSA1 line to better fit users requirement on beam size
- fixed an error in the logics of the timings distributed to the users

Issues:

- power cut in ACR (3rd time on Monday morning), switch to spare transformer in anticipation of the intervention planned for the TS
- problem with the target longitudinal movement during optimization of target-horn position. (intervention of CEM piquet + STI specialists over the week-end)
- LTIM CPU overload, fast deflector not triggered so no beam distributed to the users, origin under investigation (intervention of timings expert on Sunday)
- triggering of fast valves in ELENA in relation with vacuum activity in LNE07 (several intervention of vacuum piquet)

SPS (K. Lee):

The Technical Stop week for the SPS had its ups and downs. The week started with physics, followed by a low intensity run for cool down in preparation of the Technical Stop. 30 hours of Technical Stop works were carried out, with the repair of the TT20 vacuum chamber near the TEDs taking the major part of the time. After the Technical Stop there was a 24 hours COLDEX run, where scrubbing took place parasitically. After COLDEX, we moved back to delivery of NA physics which continued all over the weekend.

The Monday physics run before the Technical Stop went without major events; still frequent cavity trips of cavities 2 and 5. The crystal (TECS) was realigned in VR as it had drifted slightly.

Tuesday was start of the cool-down to prepare for the Technical Stop in the SPS. This time was dedicated to making the COAST work in preparation for the crab cavity MD. A fix of the RFFGs had been implemented and the timings for cavity and beam control had been corrected to be well configured for coastable cycles. Moreover, it was noticed that the mini-conditioning of the RF cavities had to be turned off manually, as this would keep running also during COAST. A temporary fix has been implemented for the FGC63 to work also in COAST. This will time-out in 24 days from the day of COAST. With everything prepared in this manner, COAST was successfully entered already in the morning. Trims were tried and COAST was entered and recovered several times to ensure full functionality. All beam instrumentation is mostly working in COAST mode, except for the DCBCTs; BI-IQ is already aware of this. The afternoon was then kept for some further RF crab cavity tests, mostly without entering COAST. When trying to move back into COAST in the evening for emittance measurements, it was discovered that there is a bad link between ATIMData and ATIMs, which overrides the timings configuration for COAST whenever a CTIM is changed. RF-CS is aware of this and is implementing a fix. The evening/night was then dedicated to emittance measurements in COAST. Unfortunately, the measurements were interrupted by a water leak in BA3, coming from the cooling ventilation on top of the Faraday Cage, which took out an entire Ethernet crate, and other

devices (HBFB, BQM), and led to a loss of communication with most FC devices. The BQM has still not been restored and needs to be followed up in the coming week. This led to an early entering of the Technical Stop for the SPS.

The Technical Stop has been coordinated by EN-ACE. All foreseen works could be carried out successfully and according to plan. The Technical Stop finished on Thursday almost on time for the SPS, with some minor hick-ups upon return (water leak on QD12710 in 12720, and RP robot that got stuck between BA2 and BA3, because it ran out of battery...). After sorting out an issue on LSE.40602 the machine was ready for the COLDEX run around 14:00.

The COLDEX run was split into two parts. The first part was dedicated to measurement on flat bottom, which was the main interest for COLDEX. In parallel, the measurement time was used for scrubbing at flat bottom to recondition the MDKV in preparation for next week's HiRadMat run. For this, the machine was put into flat bottom scrubbing conditions with raised thresholds for the MKDV and the SBDS conditioning valid flag masked. By Friday morning 6:00 the MKDV1 was scrubbed with 4 x 72 bunches at $1.35e11$ ppb down to $5.2e-8$ mbar. The machine was then prepared for operational conditions (nominal MKD thresholds and conditioning valid unmasked) and the kicker softstart was launched. The machine was ready to continue the second half of the COLDEX run with the goal of having 4 batches of 72 bunches at around $1.2e11$ ppb brought to flat top. Restart was hampered by an IPOC interlock on the SBDS which appeared right after the softstart and prevented the SBDS arming. After longer investigations, it was decided by the experts to temporarily mask the IPOC interlock on the SBDS; beam was taken then by 9:15. Two batches could be brought to flat top rather quickly and without problems. But the beam from the PS was in a very bad shape, in particular the second batch, which made scrubbing highly inefficient. After another period of investigations it turned out that the supercycle composition in the PS led to a remanence effect that impacted FREV for the second part (last 2 booster rings) of the second batch sent to the SPS, sending it off reference. The supercycle in the PS was changed and the beams sent to the SPS improved considerably. A third batch could then be taken. A few injections later, the MKDV had a vacuum spike above threshold with 3 batches at flat bottom, which essentially ended both the COLDEX run as well as the preparations for HiRadMat. Sadly enough, the goal of having 4 batches of 72 bunches at flat top on the HiRadMat cycle was not reached. The COLDEX run itself, however, has been successful for COLDEX, and the experiment was able to take some meaningful and high quality data.

During the access to retract COLDEX, the LHCPILLOT cycle was taken back to test a new fiber link between the LHC and the SPS and to check the rephasing. The fiberlink looks good. The issue with rephasing to the LHC failing from time-to-time could be traced back to a 16-bit counter in the beam control. A fix has already been put in place and is ready for testing.

Friday afternoon, the machine was switched back to NA physics, now with 140 units on T6. The return has been somewhat bumpy due to instabilities and frequent beam losses in the ramp. Further inspection showed that the front-ends of the transverse damper were saturated; furthermore, cavity 2 was struggling to deliver the necessary voltage and kept entering the limiting regime. We decided to turn off the OTDFB for cavity 2; this considerably improved the situation and the beam remained stable.

The weekend was exclusively dedicated to NA physics delivery. On Saturday morning the BA2 access system tripped with the usual fault and patrols lost and required an expert intervention; BA2 already has some simple shielding installed since a couple of weeks. After the intervention, the kicker softstart was launched and, as already the day before, the SBDS could not be armed after the softstart. An access was finally required in ECA5 to fix a broken relay on the beam energy control - this issue led to a down time of 7 hours, the longest of the week at the time of writing. After the fix,

NA physics could be restored and ran stably until Sunday evening, where the beam delivery was interrupted by an interlock control problem on the PS side.

Items to be followed up in the coming week(s):

- NA splitter losses are problematic for the experiments - should continue investigation of the large emittance variant, which is ready from the PS;
- Fix ATIMData and ATIM link to correctly generate and maintain coast settings;
- Test LHCPILLOT rephasing fix;
- Follow up on BQM issue;
- Start slow for HiRadMat - though scrubbing at flat bottom has been done (MKDV), all 4 batches have not been brought to flat top and scrubbing has stopped since Friday morning;
- EPC checks still to be scheduled to provide a ~2 hour slot; this week was not possible for EPC;
- Issue with frequent cavity 5 trips not yet resolved;

SPS North Area (B. Rae):

H2, H4 :

- Tuning of H2/H4 with electrons in both lines ongoing. No showstoppers, and good communication between the users.

H6:

- Radiation level very high in the monitor above the roof shielding even with H6 and H8 off at 12 $\mu\text{Sv/hr}$ (alarm at 40 $\mu\text{Sv/hr}$). This makes having a decent rate for the tertiary beam in H6 very difficult.

H8:

- The high-intensity parallel beam with comparably small beam size has been tuned for UA9/STI, based on the UA9-settings from 2018. The beam has about 6E6 particles per spill on XSCI.042.403 scintillator, and 2E6 particles per spill on 20 mm x 20 mm scintillator used by STI as a trigger.

M2:

- Compass moved to longitudinal configuration for the data taking over the weekend due to the ongoing polarisation tests at least until Monday..

AWAKE (E. Gschwendtner):

A quiet week due to collaboration meeting, access after proton run

- Complete switch off laser and vapor source system
- Proton-line magnet power supply intervention and tests (RBI 81607)

LINAC 3 D. Kuchler):

Monday/Tuesday oven1 was repaired (filament replaced) and both ovens were refilled. Based on the present experience this should allow us to run until the end of this run without another oven refill.

Some beam was back in the afternoon of Tuesday.

Wednesday was the technical stop

- Several leaks in the cooling circuits of the source were found and fixed. Unfortunately, two more were found before the source was started. But to repair these two would mean a downtime of the source of at least two days (leaking welds).
- EPC did some tests of the OCEM power converter for tank2 and tank3.
- The controls upgrades/updates were completely transparent. No issue was found during the restart.
- The source was restarted 15:00.

Thursday, 8:20, the beam was ready for LEIR.

Friday morning the stripper foil was changed on request of LEIR. On Friday afternoon the LEIR team tuned the linac RF to gain some intensity.

Source is running stable since the restart. Some small adjustments were needed. The intensity out of the linac is stable and above the requested $30\text{e}\mu\text{A}$.

LEIR (R.Aleman):

Main activities

- TS on Wednesday:

-- survey completion by BE-GM

-- VGI fan replacement by TE-VSC

-- Sextupole fixation check with TE-MS: sextupoles are found to move when adjacent quadrupoles reach their maximum current (~300A) : fixation plates being fabricated as a short term fix.

- Work on transverse Schottky applications.

- TFB setup finalisation.

- NOMINAL beam: Delivered stable beam with intensity 10% above target from Fri to Sun.

Fixed issues

- QFN2040 power supply issue on Tue (15V ripple) fixed by EPC.

- Ecooler FESA issue fixed by SY/BI.

Outstanding issues

- Regulation on main quadrupoles: likely related to sextupole movement, fixation plates being fabricated as a short term fix. To be installed once ready.
- Issue on baseline shift on BPM ETL.UEHV30 being followed up with BI.
- RF commissioning of CRF43 being followed up.

[LHC \(Jörg Wenninger & LHC Powering Test webpage\):](#)

Last tests of the current powering test campaign (remaining PGCs). ELOA completed in S23 (powering phase 1 start next week), ELOA started in S78.

PMI2 interlock DSO test passed on Thursday 16th September. LHC DSO tests passed on Friday 17 September.

[CLEAR \(R. Corsini\):](#)

This week was entirely dedicated to CHUV beam preparation for the next FLASH irradiations with high doses (scope up to 40 Gy) delivered on a large area (10mm diameter @ 90% of the peak). After accurate beam and laser settings a beam charge of 32nC (110 bunches) was routinely obtained with a transport higher than 80 %

Many tests have been achieved with data records including images from the screen still to be fully post-processed. It seems that the YAG screen is degrading after a long immersion in water (to be investigated).