

Accelerator Complex Status

End week 27 (Tuesday 11 July 2022)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- About 4'500 alarms.
- 608 phone calls (419 incoming, 189 outgoing).
- 97 ODM created.

Events worth mentioning:

- Mon. 04.07, A relatively small electrical perturbation on the 400kV line Genissiat- Cornier, caused a trip of the LHC and Linac 3.
- Fri. 08.07, Loud noise next to the CCC, BEQ1 compensator tripped, not many alarms in TI, mainly trip of compensator. Alarms from EPC on electrical breaker EMD125/BE (max I>> and max I0) → A transformer had a fault, seen on the supply (SMB11/BA3). Spare transformer in service and the compensator could be restarted.

Details: <https://wikis.cern.ch/display/TIOP/2022/07/11/TI+Week+summary,+Week+27>

LINAC 4 (Giulia Bellodi)

Linac4 had a 98.7% beam availability this week.

The main faults were due to:

1. A scheduled beam stop on Wednesday evening for a FGC software update (1 hour downtime)
2. An RFQ trip triggering a level-3 breakdown protection system recovery on Sunday afternoon– 30 minutes downtime

Other than that, there were some other minor trips of :

- power converters on the L4L.RCH.111 steerer magnet and L4T.RQD.151 quadrupole (twice for the latter, which prompted a replacement of the converter unit in the shadow of the FGC update)
- CCDTL3-4 modulator
- Source Einzel lens.

PS Booster (Chiara Bracco):

Almost 97% availability for the PSB this week with no major problems.

The longest stop was due to the planned intervention, on July 6th, which lasted a bit longer than foreseen (1.5 instead of 0.5 hours) due to a slow restart of a power convertor in linac4 and to let time to EPC to complete the tests on POPS-B. The aim of the test was to try to reproduce the issue that caused the trip of POPS-B after the electrical intervention of June 30th. A preliminary analysis showed a clear link between EN/EL operations and the trip of POPS-B but the mechanism is not yet fully understood and diagnosis not trivial. Probably some additional time for further studies will be needed.

Several other interventions were successfully completed in parallel to the POPS-B test (new FGC SW on class FGC_62 to mitigate the issues with restarting EPC devices after an electrical glitch, new SW to mitigate a timing problem on the FGC FEC, fix of FGC PSU failure on BI3.BSW1L1.4, reinstallation of ferrite at H0/H- monitor of ring 3, replacement of L4T.RQD.151 power unit and restart of linac4 laser motor)

On Saturday evening, the H0/H- current monitor of ring 2 triggered the BIC at several occasions. This time the problem did not seem to be related to any anomalous behaviour of the last corrects used for the orthogonal steering nor of any other magnet in the injection region. Also checks on the monitor itself did not highlight any evident mis-behaviour. The issue disappeared without any intervention but further investigations will be performed to understand the cause for it.

On the beam production side, regular transverse emittance measurements for the operational LHC beams are now being carried out. In the context of an MD on high intensity LHC beams, after some optimisation of the transfer line steering, it was possible to achieve at extraction $3.3E10$ ppr with an emittance of 1.6-1.8 μm in both planes for all rings.

An MD to test the new 1.7 GeV optics for ISOLDE but still at 1.4 GeV is foreseen at the beginning of this week.

ISOLDE (Erwin Siesling):

For the Low Energy part of the machine it has been an excellent week from the machine point of view.

At GPS tests were carried out with ISOLTRAP on Tuesday/Wednesday in preparation of their HRS run. GPS target changed on Thursday and will be used this week, possible also for yield checks with new BTY optics with 1.4GeV proton beam in the frame of 1.7GeV proton beam from PSB later on.

At HRS the radioactive beam was ready for ISOLTRAP as per schedule on Friday-morning. They have been running with Sb (Antimony) beams and very little proton intensity solely onto the target convertor. From the machine point of view a very stable and good run. Mixed results at ISOLTRAP where they had difficulties with their setup.

At REX/HIE we are dealing with yet some severe issues.

The main issue is now the overheating of the REX RFQ RF amplifier each time it is restarted. It's heat exchanger seems to be working at very low efficiency, possibly due to obstructions in some of the circuits. This is directly related to the electrical power cut due to EN/EL work on Thursday 30th June when for unknown reason the 20 degree mixed water flow went for parts of the circuit in opposite direction taking accumulated dirt and fine metal dust into the system.

The 20 degree mixed water circuit has been purged, cleaned and water been analyzed several times on pollution. The remains are the different circuits and heat exchangers in the REX RF room, specifically the one for the RFQ amplifier.

Despite the very hard work by the CV and RF people the issue was not solved last week. Today we hope to find a solution.

This is seriously endangering the upcoming HIE Physics run foreseen in less than 1 ½ wks from now. There are still 15 SRF cavities to be phased for HIE ISOLDE and the setup to be done. Without the REX RFQ available this is impossible to continue.

We have very good follow up and help from the different groups. Manpower is also offered from SY/STI if necessary. From that point of view things are under control.

A small correction on the 20 degree mixed water pollution issue:

After more profound investigation the CV team (Sebastien Acera and Serge Deleval) concluded that the issue with the dirt in the 20 degree mixed water system did not occur due to the electrical cut on Thursday 30th June but was already introduced the day before and caused by a malfunctioning of the chiller station which took dirt accumulated over time in the buffer tank into the circuit.

PS (Benoit Salvant):

It has been a busy week for the PS with an availability of 88% until now, with many trips from various systems throughout the week as well as many interventions from specialists and piquets from equipment groups.

The PS delivered beams to all its users, in particular very dynamic requests of LHC beams with various flavours and intensities for LHC scrubbing, LHC filling, LHC tests and SPS MDs.

The main issues were:

- On Monday morning, the PS complex had to wait for the RP specialist to intervene on the radiation monitor that lost batteries during the night (7h15 downtime for all beams). When that was recovered, the RF issue that had started earlier and was preventing producing INDIVs and probes for SPS was fixed by a team of 4 LLRF experts who systematically unplugged and replugged RF cavity cables in the PS central building (no INDIVs or probes to SPS and LHC for almost 12h, one day before the LHC media event).
- On Wednesday afternoon, heavy losses started to occur suddenly for most beams and could not be understood by the operation and LLRF teams. They disappeared suddenly after 1h30. It was understood by chance shortly afterwards that an intervention on the spare 10 MHz cavity had caused its relay gap to open unexpectedly.
- On Thursday and Friday, LHC fillings for scrubbing were affected intermittently by a wrong injection phase. The RF specialist fixed the issue on Friday morning by advancing the timing, at which the fine synchro would start.
- On Sunday afternoon, POPS tripped on a cooling fault. The SY-EPC piquet came on site, and called a second SY-EPC piquet. They increased the cooling flow rate and managed to restart POPS (3h downtime).
- Several systems tripped repeatedly this week and are being followed up with the specialists:
 - Several bad pulses occurred on SMH42 this week (notably one 30 minutes before the injection time foreseen for the LHC event on Tuesday afternoon).
 - 10 MHz cavities continued to trip with a high rate this week, in particular the cavity C10-56. HL-RF piquets had to come many times on site. One problem is that the spare cavity (C10-11) did not hold well when put into operation and caused losses, particularly for the AD beams.
 - There were also many trips of KFA71 throughout the week.

The nominal power converter for BHZ378 is ready to be put back into operation and requires a stop of 30' to maximum 1h. A 1h-access is also needed to fix the cavity C20-92 amplifier.

Intermittent losses on EAST T8 BPM1 are being followed up. The issue with the publication of the TOF semgrid was solved by the BE-OP and SY-BI.

PS - East Area ():

No report.

AD - ELENA (Sergio Pasinelli):

The relevant week events for the Pbar Complex are the following:

ADE

- We have had several trips on the Main Trim and Main quad. Following the procedure First Line was called to find the reason for these trips. After investigation of FL and EPC-CO on the last trip, it seems that the unresettable fault comes from the magnet and the cooling water circuit.
- Ejection kicker was in fault during the weekend and specialist was called. The thyatron trigger was the source of the fault

- During the Wednesday MD, we have tested a cycle shortened by 12 [s]. This time reduction on the ADE cycle was made on the last ramp/plateau. We have kept efficiency of the deceleration roughly the same as we have in the current cycle.
- We have also created a short cycle (60 [s]) for the MD on the target.

ELENA

- A less E-Cooling efficiency on the first plateau was observed. The fault was due to a bad switching between the power supplies on the plateaus 1 and 2 on the E-Cooler. Switch box was repaired and put back in place.
- Measured beam size at the entrance of ASACUSA2 wildly disagrees with the model in the vertical plane. During the weekend quads scan were done. Dispersion scan must be scheduled.
- Quads scans were done for Gbar.

SPS (Verena Kain):

Week 27 in the SPS was dedicated to the LHC media event, LHC scrubbing and 3 days of LIU long parallel MD next to FT physics.

At the moment of writing the overall availability for the SPS is 82.8 % for the entire week (83.7 % for NA, 90.4 for LHC). Most faults from the SPS injectors and second most due to issues with power converters for the time being. The MBE.2103 (only concerns the NA) tripped repeatedly and asked for an intervention on Friday which however then took in total about 4 h. On Friday also SMD11 of the main bends next to the CCC broke down (quite spectacularly, fire and loud bang). It is now taken out of the configuration and needs to be fixed urgently next week. Sunday evening the ZS started to not being able to hold its voltage anymore. The intervention for this issue is still ongoing. It will further reduce the availability.

Otherwise cavity 4 keeps tripping frequently. It is already under scrutiny with the RF team.

The media event was rather straight forward for the SPS. But everything was planned around it. On Monday for example - the first LIU MD day of week 27 - the high intensity BCMS beam caused significant outgassing at 40060 (pressure rise $> 1e-5$ mbar). The MD was stopped in view of the media event.

On Wednesday the dedicated MD was to continue with TT20 optics studies (including P42) and splitting efficiency measurements. It turns out that the BSPs in P42 give reliable and good measurements. In parallel to this, BCMS with high intensity was taken again, pushing the intensity to about $2.5e+11$ injected. (No issue with vacuum anymore...will be investigated at latest during the YETS.) Emittances follow the standard 25 ns brightness curve.

The issue with the AWAKE high intensity instabilities was studied on Thursday. The RF experts suspect an issue with the phase loop i.e. the problem does not occur if the phase loop is switched off after some time in the cycle. Further investigation needed at the beginning of the AWAKE run week 28.

Thursday afternoon the LHC started scrubbing again. 288 bunches could not be injected reliably that evening for beam 1 unit later that night a collab between LHC and SPS optimised chromaticity settings and scraping in the SPS. From then 288 bunches could be used for LHC scrubbing. However, beam 1 does not have much margin. Steering on the weekend helped as well. We are now scraping in the order of 5.5 % (almost all of it in H). A strategy discussion is needed with the LHC next week. Parallel to LHC scrubbing on Friday, another LIU MD was carried out. At the beginning 48 bunches of standard beam with up to $2.6e+11$ ppb were injected. The transmission on the flat bottom was however rather bad (15 % losses) and the team switched to BCMS later on with much better

transmission and even going into the ramp with this beam (~ dump @ 90 GeV) - ending up with 2.2×10^{11} ppb (12 % transmission until that moment).

Also work on SX spill quality continued with correlating e.g. spikes with RF switch off times and preparing the ES algorithm as potential improvement to the current algorithm to control the 50 and 100 Hz ripple in the spill. First results are already promising (does converge!), not clear yet whether it will be fast enough to follow the often rather rapid changes of phase and amplitude of the noise. Tests will continue in the coming week.

Next week:

- strategy discussion between LHC and SPS
- time for Arthur to change radial pickup frontend plus calibration.
- continue investigation of cavity 4 trips
- probably no LHC scrubbing before the weekend
- Monday: fill the LHC with 4 bunches on indiv cycle.
- Loic to check MBE.2103 offset on DCCT.
- Continue investigation: spike in spill at moment of RF switch off. Test cure.
- Update required of PPS CCC Touch Panels software. Needs 1-2h of testing. To be organised with access team.

SPS North Area ():

No report.

AWAKE ():

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LINAC 3 (Richard Scrivens):

- Beam delivered to LEIR on 4 July.
- After difficult injecting, further analysis shows the Linac momentum is ~5‰ lower than 2021. Corrected with de-buncher cavity, but root cause to be looked at in more detail.
- Three RF trips and 1 Power Converter trip.
- Source stability is excellent.
- Ghost auto-tuning of source HT is running.

LEIR ():

Beam was injected on 4th July and made circulating.

CLEAR (R. Corsini and P. Korysko):

Last week was mainly dedicated to the VHEE focusing experiment with Manchester University, plus one day for CHUV irradiation and some measurements with BI colleagues on Wall Current Monitor (WCM) studies.

For Manchester, a very nice focusing waist in air was rapidly found and measured. On Wednesday irradiation of zebra fish eggs for CHUV was performed - in spite of a small problem with the robot, irradiation was successful with apparently a good control of the delivered dose. VHEE focusing was restarted on Thursday, looking for a reasonable waist in water. Indeed this was much more difficult than in air, but a reasonable one was eventually found and measured. On Friday more measurements were taken comparing conditions in air and in water. During all week, parallel measurement on WCM were taken mainly parasitically.

Main issue: on Friday Klystron MKS11 tripped and could not restart - possibly the charger power supply system has to be changed. To be seen this Monday.

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

The highlight of the week was the **media event on Tuesday July 5th for the first stable beams at 6.8 TeV of Run 3**. The rehearsal on Monday was interrupted by the trip of 2 RB circuits due to an electrical perturbation, and a **training quench at 6.8 TeV of RB56** at 7am on July 5th put some pressure on the event schedule. But the cryogenic conditions were recovered at 3pm in time for stable beams around 16:45.

Beta* levelling was used from the first fill and worked very smoothly. On the second 3b fill, **consecutive training quenches of Rb56 and RB81** (15 minutes interval), led to a 10 hour long cryogenic recovery. The 3rd fill of the first intensity setp - with 12b - went in smoothly after the cryo recovery, leading to the completion of the intensity step Thursday midday. The 75b step started on Sunday, the first two attempts failed due to poor tune signal (dump during snapback) and **the first Run 3 UFO dump** (in adjust). The third attempt succeeded, with a special program for ALICE (ramp solenoid to 12Ka and later to 0A). 8 UFOs above 10% of dump threshold during this first fill. The road to the second fill was again rocking, with a second UFO dump during the squeeze before the fill reached stable beams with ALICE spectrometer and solenoid off.

Scrubbing took over on Thursday, with nice progress on vacuum in the MKIs, on the heat load and on emittance blow-up was achieved over an efficient 60 hours of scrubbing until Sunday morning.