

Accelerator Complex Status

End week 21 (Tuesday 31 May 2021)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- Slightly more than 5'000 alarms.
- 525 phone calls (396 incoming, 129 outgoing).
- 75 ODM created.

Events worth mentioning:

- Mon. 24.05: Electrical perturbation, confirmed by EDF-RTE. Follow-up ongoing with RF for the PS to make more robust the equipment that tripped recently on "coarse tuning error".
- Thu. 27.05: BEQ1 compensator tripped on water cooling failure, and interlocked the SPS. At first a cooling problem was expected, but after investigating with OP-SPS, OP-TI, EN-CV and SIG it was understood that when the SPS is stopped some regulation valves are closed on SIG supply, which is normal, but the BEQ1 sees the low water flow on the primary cooling and tripped the BEQ1. It will be looked into by the TIOC to propose an interlock based on the cooling water temperature on the secondary side instead (as it is also done now for the CRYO, who had the same interlocks before, on the primary water flow). the graph shows the flow that dropped (blue line).
- Fri. 28.05: Multiple alarms in PSEN indicating an electrical perturbation impacting PS, SPS, LHC and Meyrin sites, alarms clear shortly afterwards. SPS: A damper down (minimal to no consequence). CPS: All cavities down in PS. Mail from RTE to confirm a transient fault in the 400kV line of Cornier-Genissiat

Details: <https://wikis.cern.ch/display/TIOP/2021/05/31/TI+Week+summary,+Week+21>

LINAC 4 (Giulia Bellodi):

It was an excellent week for Linac4 with 99.5% beam availability.

There was a scheduled stop on Thursday to perform a series of requested interventions:

1. A VME crate exchange for PIMS0304
2. An upgrade of klystrons PLC and FESA class to correctly propagate missing flow-meter reading information
3. An FGC intervention on the source 2MHz RF amplifier

The beam was stopped for 5 hours.

Other than that there were some minor interruptions due to a few converter and one DTL1 modulator trips.

PS Booster (Fanouria Antoniou):

We had a calm week in the PSB with very good availability and not major faults. The availability of the machine was mainly affected by the programmed stop of Thursday (LINAC 4 intervention), followed by a POPSB fault when restarting the machine.

Main achievements of the week:

- **Beam to ISOLDE:** One of the main activities of the week. Beam was sent successfully to ISOLDE for the first time after LS2 (commissioning of the BTY line)!
 - While initially the beam could not be seen at the target SEM Grids, the problem was finally attributed to a vacuum issue. After the vacuum recovery, the beam was nicely seen and measured at the Grids.

- The steering of the BTY line was done for the first time using the optics model. After some debugging the model now works quite well. Further optimization will continue in the next weeks.
- A vertical offset of ~5mm observed on the SEMGRID, even when sending the beam perfectly parallel to the beam axis. This is believed to be explained by a known vertical offset of ~4.2mm between the BTY line and the center of the SEMGRID target grid.
- A problem on the BTY.QDE209 being saturated was reported and EPC will follow up in the next days.
- During the weekend, reference measurements were acquired both for ISOGPS and STAGISOGPS.
- **POPSB:** During the programmed stop of Thursday, EPC applied a new POPSB regulation for the internal circuit (BR23). This new regulation gave an improvement on the POPSB oscillation at injection and consequently a nice improvement of the tune oscillations at injection.
- **MTE beam:** optimization of the longitudinal emittance and bunch length for better ring by ring uniformity, after the PS request. Transverse ring-by-ring emittance uniformity to be checked and optimized this week.
- **AD:** Jitter on the bunch spacing was reported by the PS. Synchro settings were adjusted to correct this. To be confirmed with the PS if more adjustments are needed.

Main issues of the week:

- When restarting the machine after the Thursday programmed stop, the new POPSB regulation was causing some spurious trips of the power converter. EPC then apply a different set of coefficients which solved the problem.
- The problem with the simulated B-train reappeared this week (1 incident). While an ALARM in LASER was setup, this did not work as expected. The B-train team was informed and the investigations are ongoing.
- On Thursday we had several interlocks of the H0/Hm dump without clear indications why (not related to any observed losses at injection. Foils checked each time and everything seemed ok). The interlock signals are now connected on OASIS to help understanding these interlocks.

ISOLDE (Emiliano Piselli):

Protons on GPS on Tuesday. PSB crew has started many measurements trying new BTY optics. SY-ABT was involved on the calculations, and they have been measuring the different beam types which will be delivered to Isolde. Measurements performed using movable SEMGRIDS placed on the GPS front end and fix SEMIGRIDS on the BTY line.

We have had some issue due to inconsistency between the vacuum control system and the real status of the vacuum itself, but we have managed to restart it properly after some time and measurements could take place.

Many thanks to all the PSB section and supervisors!

- Isolde GPS fix display is actually still showing some faulty status after LS2 interlocks changes. Work ongoing to fix it (BE-CO and BE-OP SIS experts involved).
- Isolde HRS RFQ beam tuning performed trying to improve efficiency with higher mass. Very good results obtained.

Hielsolde-Rex

- SY-EPC has intervened to fix a broken FGC power supply. Intervention done perfectly.
- A blocking problem with the count rate functionality of the SD installed at Hie-Isolde has been fixed by E.Bravin (SY-BI). Enrico spent significant of time on it. Big thanks to him!
- We have started cavities phasing. Different energy measurements performed.

PS (Denis Cotte):

Tout au long de la semaine, la machine PS a continué de fournir les faisceaux "Single bunch LHC-type beam" (LHCINDIV) et SFTPRO (core only) avec 91% de disponibilité faisceau pour le SPS.

De plus, cette semaine le PS a fourni pour la première fois une variante 12 bunches du faisceau LHC25ns ainsi que le faisceau MTE (5 turns @ $I_p = 4.5 \times 10^{12}$) en fin de semaine.

La semaine commençait avec l'homogénéisation des timings de transfert entre machines PS-SPS sur les faisceaux LHCINDIV et MTE.

Mercredi, une grande partie de la journée était dédié aux accès dans la machine pour différentes interventions et inspections :

- vérification du routage des câbles BLM, BCT, BPM de TT2 dans le PS-SWY,
- changement de l'amplificateur de la cavité 10MHz C36,
- inspection et ajustement des dumps internes TDI47, TDI48.

Cet arrêt a aussi permis d'identifier deux grands contributeurs du bruit présent sur les BLMs de TT2 en l'occurrence LTB.QNO40 et LTB.QNO60.

Les études pour comprendre les pertes et les différentes lignes de résonances de la machine continuent avec différentes configurations : avec et sans aimants BGIs alimentés, avec et sans compensation des skew sextupoles.

Suite à une première analyse de ces données, une première version du diagramme des résonances a été présenté par Frank à l'IPP jeudi dernier.

Le setting-up du faisceau AD continue, une intensité d'environ 1×10^{13} avec des pertes raisonnables a été atteinte. La partie extraction ainsi que le setting-up RF (principalement injection et transition) nécessitent encore quelques optimisations.

Vendredi et pendant le week-end, une version du faisceau LHC25ns BCMS avec PFWs à basse énergie pour réduire la chromaticité dans les deux plans a été testée et mesurée avec succès. La prochaine étape consiste à propager ces settings sur le faisceau opérationnel.

Les mesures d'émittances LHC25ns72b continuent. Ces mesures nécessitent un ajustement précis de la phase/offset du premier bunch par rapport au train révolution PS et restent assez délicates à effectuer. De plus, il s'avère que l'offset change suivant le Photomultiplicateur utilisé pour la mesure. Les premiers résultats révèlent un "blow-up" dans le plan vertical sur la partie basse énergie. $1.25 \rightarrow 1.75$ mm mrad. Coté RF, la tension a été ajusté de façon à maintenir un « constant bucket area » pendant l'accélération 2Gev \rightarrow 3Gev.

Enfin, suite à l'inspection du dump TDI48 et l'ajustement des timings de son électro-aimant, nous n'avons plus noté de blocage de ce dump.

AD (Laurette Ponce):

The 5 modules of the injection kicker reached the nominal voltage of 80 kV. ABT colleagues will performed reliability tests this week with a nominal AD cycle. The injection septum stripline refurbishment is on-going and new test will be done end of next week at the same time as the ejection septum.

ELENA (Laurette Ponce):

The main activity in ELENA last week was the test of the LLRF and debugging of the multi RF segment functionality. A lot of observations have been done and investigation on beam phase loop instability. A new deployment of the FPGA code on Thursday did not fix the problem. We will probably have to stay with the actual situation till end of June as experts will now work on deployment for the AD. We had several trips of source HV again that we could reset, but on Friday evening, we lost the vacuum gauge in the source and we do not have spare. We will try to find a fix on Monday, but there is a risk that we cannot restart Hminus operation before the plan stop on 7th of June for the profile monitors replacement.

SPS (Giulia Papotti):

The SPS made good progress despite the shorter week and a "terrible Thursday".

Concerning the LHC beams, the 12 bunches were injected on Wednesday, and circulate now up to the end of the flat bottom. Vacuum activity was observed around the machine since the very first shots, with beam in for only few 100 ms: scrubbing has started, with ecloud monitors switched on to acquire data.

Concerning the fixed target beam, the ZS and the crystal were aligned (Tuesday and Friday respectively), also using the optimisers. By Friday evening, the full MTE beam, islands and core ($<5e12$ p), could be injected. It was chosen to stop the activity due to the late hour, combined with high losses in TT10 that would have required further investigation.

The transverse damper was setup for the LHCPILOT, HIRADMT2 and SFTPRO1 users.

The RF cavity conditioning continues, and is mostly limited by cavity 1. Concerning the LLRF: the radial position jitter at the flat top of the fixed target beam was solved (configuration fixed); the AWAKE rephasing improved (cogging bug fixed, configuration fixed on Awake synchro in BA4); work started for the 800 MHz cavity controller (clocks regenerated from the WR ok, more work required, especially on the controls side). An instability of the phase loop for high gains, and the radial pickup analog front end need further followup.

Bucket 1 was aligned for LHC and fixed target beams, after an initial request by SY-BI to be able to maintain a delay setting as non-PPM.

Now settings on the "frev,inj,CPS", injection pulse generator, MKP delay (and at the PS) are nicely similar or equal for the two beams.

Concerning the beam instrumentation, the wire scanners are advancing (bunch by bunch selection ok, but PM possibly needs followup), the Miniscan application is working, most SEMs give some reading (2 still need tunnel interventions). The BSI is not operational yet, and is a priority for the upcoming week.

The failure modes of the beam dump kickers were tested, emulating the failure of 1 MKDV or 1 MKDH, with results consistent with the expectations. The kicker waveforms were further measured on Sunday. The noise on the QD/QF was tackled further, and improvements were obtained, but more interventions are required next week. The Laslett tune automatic correction now works. Final aperture scans were also performed after the intervention of last Wednesday.

An outstanding issue is a circuit breaker in BA3 which tripped a few times, and at times cannot be rearmed, symptom is missing R3 data for ALPS, but other equipment could be the cause. A tunnel + surface investigation is needed.

AWAKE (Edda Gschwendtner):

WEEK 21 SUMMARY: Second of 2 weeks of electron beam. Electrons in plasma with new beam optics, and first test of new wakefield diagnostic.

- **Electron Beam:** reinstated on Monday, used Monday/Tuesday to commission new optics (allow different beam sizes for same charge). Thursday: used new optics in electrons-in-plasma experiments, measured the energy/charge loss of 6 electron beams in plasma: 150 pC (three sizes S M L), 350 pC (M L), 600 pC (L). Friday: set up beam for wakefield diagnostic tests.
- **UV Laser:** compressor improvements increased electron beam charge, to be closer to the 2020 one. Max charge is now ~ 700 pC for a reasonable beam
- **Access System / Lights:** patrol broken when person took a token and immediately put it back in its slot before entering TAG41 with no token (PAD allowed entrance, but error correctly broke patrol). Investigating why RadVeto did not switch off automatically 30 minutes after the end of proton beam mode. Investigating why lights did not turn on again when the area was opened after the end of proton beam mode.
- **Plasma wakefield diagnostic:** set up and aligned (with warm vapor source). Can observe significant light when laser travels in Rb vapor. At the moment, no visible difference between laser+Rb (no wakefield) and laser+Rb+electrons (wakefield).

PLAN FOR WEEK 22: beginning of access periods of 2 or 3 weeks. Week 22/23: PXI upgrade, pulling network cables, laser motor replacement, vacuum opening downstream of vapor source (for Station 2 screen replacement and LBDP3 mirror replacement). Week 24: potential Rb recycling.

LINAC 3 (Richard Scrivens):

Tuesday: With the source off in preparation for the oxygen measurements the following days, the Pb was refilled with used Pb in the oven ready for the next Pb run (this is to test the difference between new and used Pb with the modified oven, this oven to remain unpowered for the following oxygen tests).

Vacuum gauges switched off on the source, for an unknown reason.

The source operation was also switched back to 100 ms cycling rate (from the 150 ms of the week before).

From Wednesday, the beam permit for light ions was signed, and the linac was scaled to O2+ operation, which has a rigidity difference of about 11%. Stripping was made to O8+ to remove as much as possible Pb contamination into the beam.

A very high intensity of O2+ could be produced, but this saturated the beam current measurements, the pulse intensity was therefore reduced.

It must be reminded that this is not the operation mode that will be used for an LHC run.

Later the repetition rate of the linac was increased at the lower intensity, to give more signal for neutron production.

Aluminium, tungsten, iron, copper and nickel target were tested.

After the radiation measurements, it was decided to keep the oxygen beam permit to allow measurements of the transmission into the ITFS line to be made next week, before changing back to Pb.

Preliminary results of the neutron production will be give on Tuesday.

CLEAR (Roberto Corsini):

The week was dedicated to Wake-Field Monitor (WFM) studies, in collaboration with K. Sjobak from Oslo. In particular the new remote movement system for the

CLIC accelerating strcture was tested with beam for the first time, with excellent results. No main issues for beam operation, and the beam was very stable.

Data of WFM response in various conditions were taken and are being analysed.

LHC (Jörg Wenninger & LHC Powering Test webpage):

S12	S23	S34	S45	S56	S67	S78	S81
Training	Training paused	Trained	Training	Training	Cold	Warm up for repair	Phase 2
68 / 11943 A	29 / 11538 A	71 / 11950 A	75 / 11862 A	22 / 11236 A		69 / 11585 A	

S81 ready for dipole training, waiting for the 200mV boards. S12 is a few A away from the target current. Target for S45 set to 11850 A as a test to understand the flat top quenches and the quenches arriving close to flat top. S45 experienced 4 FT quenches at 11850A until it stayed at that current for 4 hours. Following this test, training of S45 was resumed to claim the 100A margin. S56 very slow trainer, similar to 78. ELQA in sector 23 on dipole [A23R2](#), the diode was confirmed to be shorted (internal damage, not at the level of the leads).

Circuit	Circuit quenches	Last quench current	Equivalent E	Target reached?
RB.A78	69	11585	6.79	NO
RB.A34	70	11950	7.00	YES
RB.A45	75	11862	6.95	NO
RB.A12	68	11943	7.00	NO
RB.A23	29	11538	6.76	NO
RB.A56	23	11240	6.58	NO



