

Accelerator Complex Status

End week 17 (Tuesday 3 May 2021)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- Slightly more than 4500 alarms.
- 793 phone calls (549 incoming, 244 outgoing).
- 89 ODM created.

Events worth mentioning:

- Tue. 27.04: TT2 fire alarm. The alarm was reset by the fire Brigade, in agreement with the fire detection expert. The alarm did not come back afterwards. The sensor was changed preventively after an access the day after.
- Wed. 28.04: Electrical perturbation, caused the PS to trip. RTE confirmed an opening of the breaker on the 225kV line Genissiat-Serriere.
- Sat. 01.05: Several trips of cooling for North Area cooling. No alarms were active, but the system stopped on leak warning. Investigations are ongoing as to why the alarms weren't visible. EN-CV found a bug in the program of refilling the vessel, that caused it to trip. The values that caused the interlock were modified during the intervention.

Details: <https://wikis.cern.ch/display/TIOP/2021/05/03/TH+Week+summary%2C+Week+17>

LINAC 4 (Giulia Bellodi):

Beam availability this week was around 95%.

Most of the downtime was due to repeated chopper trips caused by a glitch in the CDU firmware (which wrongly detects a head voltage error while the amplifier seems to supply the voltage as desired). This is normally reset in a few minutes by the operator via the sequencer, but can nonetheless be quite painful for operation due to the high recurrence of events.

More than 60 trips were recorded during the week, getting more frequent in the weekend (sometimes at the level of one trip every half hour).

RF experts are aware of the problem, but a prioritization needs to be made on resource assignment. In the meantime a software has been set-up to monitor the situation and gather data needed to fix the problem.

Another issue this week concerned trips of the SIS-LEBT settings comparator, triggered by abnormal FGCs behaviour.

Some of the trips were triggered by the source einzel lens FGC calibrating its ADCs to 0V, +10V and -10V while cycling (this should only occur when the FGC is OFF, problem under investigation). In other separate instances the SIS triggered due to a communication issue with FGC devices in the LEBT, leading to the exchange of a FGC unit on Friday.

A power converters exchange for the LEBT steerers was also carried out on Thursday.

PS Booster (Jean-Francois Comblin):

We had several long beam stops this week in the Booster. There were 2 planned accesses in the PS: one Monday during the whole afternoon, and another on Tuesday during 3 hours. We also had

problems with the simulated B-Train for a total downtime of 4 hours. This is still under investigation by the specialists.

Main achievements:

- During the two PS accesses, POPS-B specialists did some tests and installed a new version of the FGC3 code. This reduces the current error of the BDLs and Quads by a factor of 3, which is now closer to specifications. We should expect more improvements soon.
- BE.BSW: Specialist updated the software to solve the instabilities.
- BCT expert updated the ring BCT algorithm calculation. This solved the increase of intensity we saw previously on the samplers.
- The FMR sensor has been replaced and re-calibrated. It caused problems during Easter break, tripping POPS-B.
- FGC diagnostic tool "PowerSpy" is now available from Working-sets.
- Software of the H-/H0 monitor system was updated to improve the signal/noise ratio.
- Settings corrected that caused some of the servoloops to open too early in the cycle.
- A Clean-up was done on the settings to be able to do PPM copy between cycles without problems.
- MTE: Synchro settings updated to ensure that the beam is no longer perturbed when the synchro loop is closed.
- AD is getting towards good conditions. Intermittent losses on R1 at flat top were removed. Synchro was improved on all rings.
- TOF is now reaching $940E10$, but the longitudinal emittance is still a bit too large.

Open issues:

- We still have several problems with the LIU wire scanners.
- There is a problem with the simulated B-Train. It happened 3 times and the specialist had just reboot a BSIM card. This is not yet fully understood and still under investigation.
- The makerule PSBI2IREFMR caused some problems when trying to reduce the number of points in some functions.
- Test of RF inhibit unsuccessful.

ISOLDE (Erwin Siesling):

A busy and quite successful week with great achievements booked regarding the gradients for the HIE ISOLDE SRF cavities:

GPS

Several GPS target and Front-End related hardware and functional tests were carried out (SY/STI and BE/CEM C. Mitifiot).

Unfortunately during the different tests phases at the Front-End side the plasma target (#678) had been coupled without the target valve fully open making it impossible to extract beam. Luckily we got away with it with only a small scratch on the electrode tip. A change for a different plasma target (#698) was necessary after which the new GPS gas-system hardware tests could be carried out successfully. The migration of the gas-system application to the CCM still remains to be carried out. Presently running on a virtual machine (BE/CEM C. Mitifiot, BE/OP E. Fadakis).

Furthermore plasma target set-up and validation tests were done for the GPS front-end and separator for several noble gasses.

We hope to have also the HRS gas-system installed and ready for testing in the coming week(s), before protons become available for ISOLDE (25th May).

HRS

At HRS target #719 has been delivering stable beam for tests for RILIS.

On Tuesday afternoon twice the HRS10 sector (front-end) stopped pumping due to a glitch of the 'pump ON allow' interlock – we have investigated thoroughly (TE/VSC J. Ferreira Somoza) but did not manage to identify the exact cause (power glitch?). The issue did not re-occur since.

Friday-morning some remaining installation work of fibres in the ISCOOL HT cage for the new ISCOOL gas-flow system took place (B. Slater, C. Mitifiot).

In parallel HRS robot target change sequences were carried out (F. Riccardi) to verify calibration and correct functionality before protons to ISOLDE (25th May)

This coming week the main action at HRS will be the modification of the separator scanners SC482/483 by BI on Tuesday (SC483 to be moved between the semgrid BSG470 and faraday-cup FC490 for calibration and slits spectrum observation) – many thanks to the BI team (A. Miarnau, W. Andrezza) for having been so proactive on this issue.

REX/HIE ISOLDE

Secondary gas injection system installed in the REX BTS line on Monday (for EBIS/REX and HIE setting up purposes).

Promising and successful tests with stable 40Ar11+, 12+ and 9+ from the EBIS through the REX Linac using this external gas-injection system during the rest of the week (J.A. Rodriguez, M. Lozano)

Tests of the new REX/HIE silicon detector application as well as the EBIS slow extraction application on Friday (E. Piselli)

HIE ISOLDE SRF gradients: Great achievement from Daniel Valuch who has managed to reach a total gradient of 104.67 MV/m out of 120 MV/m (87% of nominal) with max SRF cavities' gradients set for 5.5MV/m since Friday morning, a new record for HIE ISOLDE.

Over the weekend Daniel managed to beat his own record in locking nine out of the twenty cavities at 6 MV/m bringing the total gradient to almost 110 out of 120MV/m, almost 92% .

For some of the less performing cavities some strong vibrations at low frequencies are observed. We do not know if this comes from mechanical vibration, or from liquid helium. We will investigate in the tunnel at the next possible convenient occasion.

The situation is significantly more stable than in the last years and we would sincerely like to thank the cryo team (N. Guillotin, T. Dupont and all) for their hard work in delivering such a stable system.

General:

Friday tests of the modified target zone ventilation system (S. Acera, EN/CV) for which the different zones were patrolled.

All hardware was tested successfully, however full tests of the ventilation controls communicating with the ISOLDE access system are yet to be carried out with CV (Sebastien Acera) and Access Control (Didier Chapuis). DSO test of the target zone foreseen Friday 7th May.

Friday-late-afternoon: A fire alarm in the target zone (179) was triggered related to an IS37 that was taken off after the ventilation work was finished – possibly due to dust in one of the fire detectors.

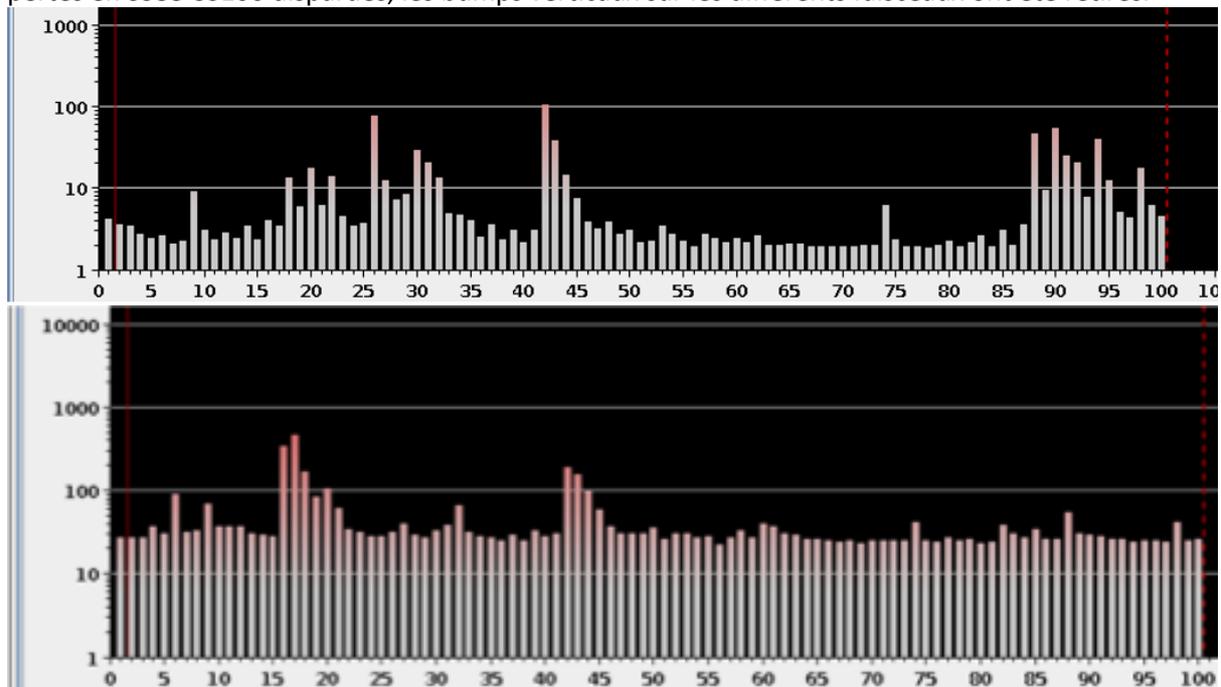
When wanting to re-enter the target zone the concrete shielding door could not be opened even though all conditions seem to be met. The problem will be addressed this Monday.

PS (Denis Cotte):

Encore une semaine rythmée par la fourniture des faisceaux MTE et LHCINDIV au SPS, le setting-up de faisceaux multi-bunches LHC, TOF et l'optimisation du « shadowing TPS15-SMH16 » le tout, entrecoupé de plusieurs accès dans la machine PS.

Lundi après-midi, l'endoscopie dans le secteur 80-90 révélait la présence d'une éponge dans la chambre à vide dans MU87 en amont de la cavité C80-88. Elle a été retirée.

Les conditions faisceau initialement prévu pour le lendemain matin revenaient plus vite que prévu et grâce à la disponibilité des piquets et des experts, le faisceau était de retour dans la soirée. Les pertes en SS88-SS100 disparues, les bumps verticaux sur les différents faisceaux ont été retirés.



Mardi, les BLMs de TT2 commençaient à donner des informations que l'on pouvait corréliser avec le faisceau notamment la trajectoire en TT2 et la proximité de la dump D3. Une modification des timing « Beam IN » et « Beam OUT » a été demandé et implémenté de façon à être synchrone avec le passage faisceau mais aussi afin de réduire la fenêtre entre BIN/BOU.

Mercredi, SPS prenait MD4 (une variante du faisceau LHCINDIV) avec la PU96 de retour dans la boucle radiale.

Plusieurs améliorations (par les spécialistes BI) sur les réglages des SEMFil/SemGrid et des transformateurs d'intensités de la ligne TT2 ont permis d'optimiser l'extraction PS ainsi que les trajectoires afin de minimiser les pertes en début de la ligne TT10.

La matinée de Jeudi était dédiée aux accès dans la machine avec :

- la qualification du reconditionnement des C80(88-89) -> Les 2 cavités sont de nouveaux opérationnelles après les tests d'Azzedine Jibar.(SY-RF)
- le changement du relai gap de la C10-76 par Valentin Desquiens(SY-RF) -> cavité opérationnelle.
- l'approfondissement du diagnostic du tuner coincé de la C200-1 -> nécessitera une demi-journée d'accès à prévoir pour remettre cette cavité en opération. (5/6 cavité OK)

Le retour du faisceau initialement prévu vers 9h était retardé tout d'abord à cause de problèmes sur les injecteurs LN4-PSB puis dans la foulée suite à un déclenchement de POPS ou l'intervention du piquet EPC était nécessaire pour redémarrer. Le faisceau au PS était finalement de retour vers 11h.

Vendredi, plusieurs mesures montraient une claire corrélation **entre** :
des valeurs élevés de BLMs en TT2, une ligne de base déformée des BCTs de TT2
et la mise en route des équipements DFA242 & DFA254.

Dans l'après-midi, le « Dummy Septum » TPS15 était de nouveau déplacé en position IN à 80.5mm et commençait alors des scans avec les bumpers d'extractions afin d'établir les meilleurs paramètres pour le « shadowing TPS15-SMH16 ».

Dimanche, le “shadowing ratio” (BLM 16 / BLM15 for the MTE islands) était autour de celui de 2018 et la préparation du cycle nTOF a commencé.

Pour l'instant, la disponibilité faisceau du PS affiche **91%**, en attendant la vérification des **70 fautes AFT** déclarées cette semaine.

Autres infos :

Le « scrubbing run » avec le faisceau LHC25ns à $I_p=1.3 \times 10^{13}$ ppp a été arrêté et sera repris en même temps que celui du SPS.

LHCINDIV(LHC-type beam) et le faisceau MTE (Core et Full-5t) à basse intensité ont été fournis au SPS toute la semaine.

AD (Laurette Ponce):

Main activities:

- Successful restart of AD ring main power converters
- Heat run for testing the pause functionality (needed for stochastic cooling recommissioning): identified the limiting circuit on the quad with sextupoles circuits, the pressure limitation have been removed as a temporary solution allowing to stay 1 hour in pause.
- Electron cooler tested with timings: nominal performances achieved

Problems encountered:

- several EPC controls issues identified during the powering tests related to the old PowM1553 class, fixed for the ring circuits, still to be fixed for the extraction line towards ELENA.

ELENA (Laurette Ponce):

The main activities were:

- Detailed measurements on the deceleration cycle (kick response, chromaticity measurements) and test of the scrapers to measure beam sizes.
- Optics measurements started in the AEGIS line after fixing software problem with the fix last monitor of the line.
- Test of the multi-injection to increase intensity, but electrostatic elements does not support multi pulses during cycle.

Problems encountered:

- several trips of the electrostatic elements in the transfer lines, EPC will deactivate the wifi on the ISEG CPU that could be at the origin of the problems. To be noted that there is no piquet defined for these power converters so only experts intervention. Commissioning of the line delayed this week because expert was not available.
- investigation on the Btrain NMR probe continued
- controls issues related to database connection problem

SPS (Kevin Li):

Week 17 is the first 'official' week of beam commissioning after the extension of HWC for 2 weeks. This week was foreseen to be dedicated mainly to RF capturing. In parallel, however, there have been many additional activities going on.

Capture of the LHCPILOT, with all 6 cavities aligned, was achieved by Monday evening. There have been issues with the phase loop which did not follow the predicted behaviour once it was closed on the beam. Intensive studies of the beam based loops continued for a good part of the week using the LHCPILOT cycle. The issues could finally be tracked down and resolved by Thursday. At this point, we were ready to move into the ramp. By Friday the LHCPILOT could be brought to 450 GeV for low intensities. For nominal intensities, there seems to be a longitudinal instability (not unexpected after the impedance reduction campaign) which needs further investigation. The Fixed Target beam (2us core at $5e11$) was also successfully captured with all 6 cavities and the energy matching was carried out. The impact of eddy currents was studied on this cycle as well as on the cycle used for the aperture measurements.

These influence both the orbit as well as the tunes and seem to have an impact on the beam lifetime. Investigations on this matter will continue. A first set of chromaticity measurements was done on both the LHCPILOT and the Fixed Target beam using the radial steering of the new beam control. This worked seamlessly.

Kick response measurements were carried out. These revealed strong fluctuations in the ALPS and different studies were launched. It turns out, that the LHCINDIV intensity falls exactly between two calibration curves of the system where the performance is non-optimal. Solutions are being investigated by the ALPS team. Kick response measurements were carried out over the weekend on the Fixed Target beam. These look much better, which can be explained due to the multi-bunch beam for which the ALPS performance is expected to be significantly superior compared to single bunches.

Aperture measurements were carried out and show bottlenecks in 217 and all over sextant 5 in the vertical plane. The horizontal plane looks mostly clean. This will also be investigated further trying i.e., manual local bumps to understand better the origin of the aperture restriction especially in BA2.

The beam dump system has been soft started to prepare for moving into the ramp on Thursday evening. At this point we made sure to have at least one cycle with a dump at flat top to keep the MKDs pulsing at high energy in order not to lose conditioning. On the weekend vacuum spikes were observed on the MKDV1. The DCPS has been replaced after several trips in a row. After an expert investigation it was decided to move the dump back to flat bottom with the conditioning validity flags masked and taking beam only on the MD4 for aperture scans. This will need to be followed up in order to allow for moving through the ramp again.

TAG42 and BA5 floor artwork has been completed, as have the BA access point maintenance works. After initial issues such as losing of patrols, the procedures have been discussed and optimized. Towards the end of the week, the maintenance works became truly transparent. The FCGs have been validated with COAST recover and the previous issue with power levels being forced to zero are now resolved. Tests of the Laslett tune correction were attempted several times, but so far have not been successful, mainly due to bad conditions. The e-cloud monitors have been checked by Holger and works have been done during an access. Holger is following up on the observations on his side.

Plans for this week:

- Get in touch with EN-STI to start planning dates TIDVG commissioning
- Sort out MKDV and moving dump back to flat top
- LHCINDIV ramp commissioning - combat the observed instability
- SFTPRO acceleration, commissioning of radial loops, setting up of transition crossing,...
- Wire scan commissioning: make some of them operational this week

- Automatic correction of radial position drift during flat bottom... using ML denoising of radial position from QC...
- Set up ALPS correctly for LHCILOT and SFTPRO1 and to work fully at flat top → double optics orbit correctio for BBA (first iteration towards end of week...?)
- Calibration of TT10 fast BCT?
- Validation of the beam energy tracking
- Bucket scans for TSU synchronization.

AWAKE (Giovanni Zevi Della Porta):

WEEK SUMMARY: We completed laser experiments studying propagation through Rb vapor with laser frequency on/off-resonance with Rb. Once measurements are finished, we brought back the laser to its "nominal" setup.

- **Vapor source:** behaved well up to highest achievable Rb density ($1e15 \text{ cm}^{-3}$). No more dead temperature probes.
- **Laser:** completed measurements at all Rb densities ($2e14, 5e14, 7e14, 1e15 \text{ cm}^{-3}$). Reinstated "nominal" setup (with standard oscillator). Lost "Laser PC2" (SSD died): laser still works, but some tuning of motorized mirrors will require presence in laser room until this is fixed.

Next week: Start 2 weeks of access. Characterize laser to ensure "nominal" setup is fully OK (energy, alignment). Access for beamline modification (two short sections instead of one long section), for facilitating installation of Cherenkov Diffraction Radiation BPM scheduled for October.

LINAC 3 (Richard Scrivens):

Stripper measurements: Continued used of a $125 \mu\text{g}/\text{cm}^2$ stripper foil and making very regular measurements of the central momentum and spread.

Source Radiation Measurements: In collaborating with RF and BE-CEM, x-ray emission measurement were made on the unshielded source. The full measurement took 2.5 days of dedicated time, and the results are to be studied – but already show the shielding is very effective.

LLRF: Issue of some erroneous measurements after a crate crashed, it is being followed why both the crate crashed and the measurements didn't come back.

Warm Interlock Controller: A WIC PLC went into passivation mode (internal issue?), taking out $\sim 1/3$ of the magnets and power converters. Quickly fixed once the WIC was seen to be the issue.

CLEAR (Roberto Corsini):

Last week operation was dedicated to three experiments: 1) Optic Fibre Beam Loss Monitors, 2) AWAKE spectrometer screen calibration, 3) AWAKE Cherenkov button BPMs. All the experiments have achieved successfully their objectives. No major faults. Beam time was about 4 days, the rest being taken by accesses to install/rerttrrieve equipment.

Detailed report:

https://indico.cern.ch/event/1026607/contributions/4310612/attachments/2237340/3792547/WeeklySummary_week%205.pdf

LHC (Jörg Wenninger & LHC Powering Test webpage):

S12	S23	S34	S45	S56	S67	S78	S81
Training	Phase 2	Training	Training	Phase 1	Cooldown	Training paused	Phase 1

Training in S78 stopped, investigation of dipole [B28L8](#) that triggered quench heaters at 110A. Short detected between one coil and a quench heater. **Thursday decision to warm up S78 and replace magnet B28L8.** Very slow landing of S34 towards 7 [TeV](#), still missing 9A, with circuit blocked by MP3 (diode current).

Circuit	Circuit quenches	Last quench current	Equivalent E	Target reached?
RB.A78	69	11585	6.79	NO
RB.A34	63	11941	6.99	NO
RB.A45	24	11546	6.76	NO
RB.A12	17	11539	6.76	NO

