

Accelerator Complex Status

End week 20 (Tuesday 25 May 2021)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- Slightly more than 3'600 alarms.
- 698 phone calls (491 incoming, 207 outgoing).
- 93 ODM created.

Events worth mentioning:

- Mon. 17.05: BLM frontend issue - No beam in PSB/PS from Sunday evening to Monday morning. The FEC was rebooted and switched to GPN network instead of TN after the reboot.
- Sat. 22.05: Power glitch 225kV, multiple alarms PSEN which disappear quickly. PS lost some cavities. Confirmation RTE: glitch GENISSIAT-VERBOIS.
- Mon. 24.05: Electrical perturbation. Multiple electrical alarms received. Thunderstorms in the area. Cavities down in PS. RTE- confirmed related to fault on 400KV Cornier-Genissiat.

Details: <https://wikis.cern.ch/display/TIOP/2021/05/25/TI+Week+summary%2C+Week+20>

LINAC 4 (Piotr Skowronski):

It was a very good week with 99% availability.

2 events are worth mentioning:

- CCDTL0304 klystron tripped on vacuum spike and it took 45 minutes to restart it because of interlock on arc detector.
- On the LLRF crate of PIMS0304 there was alarm from 6VA power supply. The power supply was exchanged (17 minutes down time), however, it did not solve the issue. Additional measurements confirmed that the voltage fluctuations are too big and most likely one of the cards consumes too much power. On next beam stop the specialist will attempt to identify the card.

PS Booster (Alan Findlay):

No significant downtime for the PSB during the last week, with just the usual series of resets and short expert, piquet or first-line interventions. More details at the FOM.

ISOLDE (Alberto Rodriguez):

The main highlights of the week at ISOLDE:

- Final interventions in the target zone completed by SY-STI and other groups with some help from OP (installation of SEMGRID target in GPS front-end, panoramic pictures, shielding of camera, Montrac robot tests...)
- Proton beam permit fully signed
- Source of a leak in the new gas injection system for HRS was identified and solved
- Mass scan application in current regulated mode (new functionality) for the HRS separator was commissioned
- Proton integrator and Proton beam configuration applications recommissioned (needed for the first proton beam of the year this week)
- Two NIM crates used as part of the beam gate system (to setup delays signals by the users) that had been uninstalled by mistake were found and reinstalled. They will be fully tested this week.
- RILIS laser team worked on the development of 40Ca and 208Pb beams using the GPS front-end

- COLLAPS experimental station continued their commissioning using the 40Ca beam developed by the RILIS team
- On the linac side, recommissioning of the beam instrumentation using 40Ar continued. Several problems were identified by OP and solved by our SY-BI colleagues (digitizer for one of the FCs replaced, limit switches for a couple of actuators had to be adjusted). A problem with the count rate functionality of the silicon detectors (required for the beam energy measurements) is still being investigated.

PS (Heiko Damerau):

A good week for the PS dedicated to beam loss studies, the continuation of the setting-up of the high-intensity SFTPRO beam, as well as the preparation of the LHC25ns beam for the SPS scrubbing run. Single bunch LHC-type beam (LHCINDIV) and the SFTPRO (core only at low intensity) were delivered to the SPS during the entire week with a decent availability of about 97%.

Following an extensive campaign to understand the origin of the skew sextupolar resonance resulting in increased beam loss, the dipole magnet of the vertical BGI in SS84 has been identified as the root cause on Tuesday. Switching the magnet off removes the resonance. Resonance compensation is very promising to at least mitigate the issue. Although pulsed operation of this laminated magnet is possible, it was initially kept powered in DC during all cycles.

Data for loss maps with and without the vertical BGI magnet in SS84, as well as the horizontal one in SS82, has been collected throughout the week and analysis is ongoing. Both tunes are separately swept in both directions to obtain a complete picture of the resonances through beam loss.

On Wednesday the PS was stopped from 7h30 until about 13h15. Since the SPS could not take beam due to a vacuum intervention, time was given to the PSB to perform POPS-B tests.

A main activity was the setting-up of the beams with 25 ns bunch spacing. Both variants (triple splitting and BCMS) were prepared at the same time to assure consistency of settings. Due to larger bucket area at the post-LS2 energy of the intermediate plateau for the RF manipulations, the triple splitting is now executed with just one 10 MHz cavity per harmonic. The bunch intensity has not yet been pushed beyond 1.3×10^{11} p/b, but the 1 eVs longitudinal emittance during the acceleration through transition corresponds already to the LIU requirements for twice that intensity. Around transition this practically fills the bucket and the maximum RF voltage must be kept longer to prevent longitudinal losses due to insufficient bucket area. This may also become an issue for the BCMS beam with slightly larger longitudinal emittance. On the transverse side, the PFW current functions have been optimized. Measurements with the new wire scanners remain tricky and the horizontal emittance of the LHC25ns beam at the arrival on the flat-top is about 1.8 mm mrad. The vertical emittance is similar at the end of the flat-bottom.

For the high intensity SFTPRO beam, the PSB successfully provides longer bunches to reduce the longitudinal space charge effect at the flat-bottom. The exact benefit remains to be quantified.

The internal dump in SS48 got stuck in the beam pipe for a couple of times during the week. While the reason why the electromagnet could not capture it is under investigation by the SY-STI experts, the dump remains fully operational.

Several activities were followed by the operations team during the weekend. Loss map studies continued to complete the data for different configurations the BGI magnets on and off. Additionally the setting-up of the beam for AD, as well as TOF have progressed well.

Both, 72 bunch and 12 bunch variants of the 25 ns beam are available for the SPS.

AD ():

No report received as result of Whitsun Monday.

ELENA ():

No report received as result of Whitsun Monday.

SPS (Verena Kain):

The 2021 golden orbit for LHC beams was established in the ring and the golden trajectory in TT10. Setting up of the transverse damper on single bunches was started.

On Wednesday, the vacuum intervention in LSS2 took place to exchange the transition piece before the TCE collimator where a vertical aperture bottleneck had been measured earlier. Several other interventions were scheduled in the shadow. Also, the HIL-WIC for the main power supplies is fixed now to be able to seamlessly switch to the QS in case. The extractions kickers were conditioned during the accesses to prepare for the next day.

Aperture measurements after the Wednesday intervention confirmed the improved aperture at location 217.

On Thursday all fast extractions were set up: LHC1 and 2 (LHCPILOT cycle), AWAKE and HiRadMat (low intensity cycle). The fine kicker delay setting up for the high intensity cycle of HiRadMat still needs to come (foreseen during the scrubbing run). The re-phasing to the AWAKE Laser frequency does not converge reliably yet, extractions suffer from non-reproducible extraction energies and pre-pulse jitters for the time being. This will be further investigated in the coming week. On Saturday beams were extracted all the way down to the AWAKE plasma cell as well as the HiRadMat dump. Another milestone reached...

Last but not least, slow extraction onto the TT20 TED was set up on Friday after the ZS conditioning that needed to be carried out after the vacuum intervention. Switching to COSE was a matter of minutes. Also, the ZS alignment algorithm for the anodes was tested straight away. It set up the ZS within < 30 iterations (9 degrees of freedom) and significantly reduced the losses. The algorithm BOBYQA by Powell was used for that. The final alignment will be done after the girder alignment, foreseen for the coming days. The completed alignment is pre-condition to start with the crystal alignment for further loss reduction.

Issues:

The Auto Tune correction on the QF and QD is still not operational - tests required with EPC. The wire scanner does not reliably deliver profiles, independently of the issue with the data-bunch alignment - to be followed up with BI.

AWAKE re-phasing.

Not a single SEM grid or split foil is working in LSS2 or TT20. All return data, but nothing looks like a beam signal. BI experts needed.

Cycle-to-cycle change of radial position at start of slow extraction. Investigate remedies (e.g. switch to synchro loop towards to the end of the ramp,...)

Noise on QF and QD for FT beams at 14 GeV.

Investigations on dispersion mismatch for LHC beams ongoing.

Next steps:

- change of bucket alignment, pre-pulse delays after RF firmware upgrade: BI, RF, PS
- 12 bunches: RF setting up towards multi-bunch
- Auto Tune correction with EPC
- $2e+12$ for MTE (take islands + core): check synchronisation with BST and TIDVG.
- Damper setting up: LHCINDIV, scrubbing cycle, HiRadMat, AWAKE, SFTPRO
- Wirescanner operational for scrubbing run
- SBDS failure scenario test Wednesday

- crystal alignment for Thursday

AWAKE (Giovanni Zevi Della Porta):

WEEK 20 SUMMARY: First of 2 weeks of electron beam. In addition, first protons (since 2018) seen by AWAKE, thanks to SPS commissioning. Trigger and DAQ for most instruments are OK: between the proton beam and the electrons-in-plasma experiments in March, we have tested all diagnostics with all beams (e, p, laser) in 2021.

- **Electron Beam:** reinstated on Monday, then worked on measuring quadruple alignment and continued commissioning new optics.
 - **Electron Source:** chiller for RF cavity needed to be refilled with water, will keep an eye on it
 - **Upstream streak camera:** observed electron beam in streak mode, but only after increasing charge to ~600 pC. Optical line will need improvement to observe lower charges (~100 pC).
 - **Halo/Core system** (for transverse proton beam measurements): re-established also on Station 2. Station 1 was OK since February.
 - **PXI digital camera system:** PXI team developed new tools for (1) a more effective reboot procedure, (2) switching between 1Hz and SPS trigger, (3) easily adjusting the PXI delay
 - **Preparation for Proton Beam:** heard on Monday that SPS starts AWAKE proton beam commissioning and we might receive first protons later in the week.
 1. Decided to focus on diagnostics commissioning, and on the ability to observe the beam. Kept laser and electron beams off.
 2. Switched all diagnostics (BTVs, Streak, Spectrometer, PXI cameras including Halo/Core) from 1Hz to SPSExtraction trigger (using test signal SEX.AWK-W180-CT for most), with plenty of help from Ben Woolley, David Medina, Thomas Zilliox and timing-support.
 3. On Friday, asked SPS about AWAKE-related interlocks, and found that one was connected to a malfunctioning laser mirror motor (LBDP1). Got help from BE-CEM-MRO (especially Krzysztof Szczurek) to get this mirror in OUT position in the software, and accessed AWAKE to verify that its position was indeed OUT.
 - **Proton Beam:** received ~45 minutes of proton beam starting around 13.15 on Saturday afternoon. Successfully observed beam on most devices (Proton BPMs, Proton BLMs, Electron BPMs, BTVs, PXI cameras), and did not have enough time to find the beam on the streak camera. Recorded full events in Event Builder. After ~45 minutes, LBDP1 went into "unknown" state, so the beam was stopped, and it was not possible to address the LBDP1 issue during the weekend.
- PLAN FOR WEEK 21:** continue electron beam program, then move to electrons-in-plasma (scans in charge and size using the new optics). Measure plasma light with and without electron beam: attempt to measure electron wakefield intensity. We might receive more protons for commissioning in the future, when SPS comes back to AWAKE-extraction commissioning.

LINAC 3 (Detlef Kuchler):

- Monday: Source and linac were set to a 150ms repetition rate. This is a preparatory test to see if we would be able to fill LEIR quicker (at the moment we fill with 200ms repetition). No issues. Source and linac were running stable and with good performance (>30eμA Pb54+ out of the linac).
- Tuesday: Source tripped over night. Restart without problems.
- During the week several energy measurements for the stripper studies done.
- Thursday: Check of the settings needed for the oxygen test run this week (without beam). Some training of tank1 needed (higher than usual power levels needed for the O2+ beam).
- Thursday: Removal of FC5 in the ITFS line. VSC team found that the vacuum recovery of the line is very slow.
- Friday: RFQ transmission measurements.

CLEAR (Roberto Corsini):

The week was spent on the EOS bunch length measurements. The BI team were not ready until Tuesday and when their work began we encountered several issues. Firstly, there was an issue with low bunch charge. After significant work it was noticed that an iris was clipping the laser beam in the optical transfer line. There were also several issues on the EOS side, with a full laser realignment taking up half of Thursday and most of Friday.

The full report can be found here: [WeeklySummary 7.pdf](#)

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

S12	S23	S34	S45	S56	S67	S78	S81
Training	Training	Trained	Training	Training	Cold	Warm up for repair	Phase 2
55 / 11879 A	25 / 11481 A	71 / 11950 A	66 / 11843 A	7 / 11100 A		69 / 11585 A	

Removal of iQPS boards with 200 mV thresholds from S34, installation in S56 for quench campaign. Powering test of all sectors but 67 are essentially completed, with exception of course of the RB training, PGCs and a few isolated tests. Problem with PGC test of XL2, as triplet in S12 quenched repeatedly.

Circuit	Circuit quenches	Last quench current	Equivalent E	Target reached?
RB.A78	69	11585	6.79	NO
RB.A34	71	11950	7.00	YES
RB.A45	67	11848	6.94	NO
RB.A12	56	11882	6.96	NO
RB.A23	26	11499	6.74	NO
RB.A56	10	11138	6.52	NO





