Accelerator Complex Status

End week 16 (Tuesday 26 April 2021)

Technical Infrastructure ():

A rather calm week, despite the technical stop in the injectors.
Statistics:

- Slightly more than 4500 alarms.
- 849 phone calls (571 incoming, 278 outgoing).
- 115 ODM created.

Events worth mentioning:

- Thu 22.04:
    - MEQ59 compensator successfully switched on again after Technical Stop intervention.
    - Leak on mixed water circuit in sux1 detected on trends for too frequent filling of circuit, found to be on detector cooling FCUE-00002 compressor for Evaporative cooling. Piquet on-site to do repairs before a stop of the circuit occured.

Details: https://wikis.cern.ch/display/TIOP/2021/04/26/TI+Week+summary%2C+Week+16

LINAC 4 (Luca Timeo):

In general
At the time of writing, the availability is 97.3%.
Along the week, Linac4 experienced some random trips on the RF equipment. The RFQ went once in recovery mode after breakdowns.
Tuesday
SY-RF, BE-ABP and BE-OP did a joint MD to check the possibility of measuring beam losses on the chopper plates while changing upstream quadrupoles' current. Data analysis is still ongoing.
BE-OP investigated the source trips following a LocalPermit NOT_OK for which the BIS acts on the chopper but does not on the TailClipper. A discussion concerning the possible solution will take place soon.
TS1
No major problem occurred. The source restarted smoothly after the intervention on H2 injection.
ABT successfully installed a new foil (new material used) on the stripping foils loader.
The restart of some klystrons was difficult due to their reference voltages were not correctly saved in LSA. Investigations are ongoing.
Weekend
The chopper tripped several times. Specialists are informed.
The source had some stability problems. BE-ABP remotely increased the quantity of injected gas three times.
SIS LEBT comparator cut the source probably due to a fault on the Einzellenz. To be investigated further.

PS Booster (Simon Albright):

The most significant part of the week was the technical stop. The beam stopper was put in at 0130 to cut all beams, as no low intensity beams were required at the time. After the RP survey, the accesses started at 0815. On Wednesday morning, it was found that the BI4.BSW1L1 was leaking, the necessary exchange extended the technical stop. The main actions taken during the stop were:

- Wirescanner replacements by BI

- QFO30 realignment, measurements after the technical stop showed that the realignment was effective and all four rings now have similar natural orbit excursions in both planes
- New electronics and improved interlocks for the H0/H- monitor installed in Ring 4
- New amplifiers installed on the Finemet cavity in Ring 4 Sector 13
- BI4.BSW1L1 exchange. This unexpected work required teams from several departments, who we would like to thank for their very hard work, which minimised the inevitable delay.

After the change and alignment of BI4.BSW1L1, we were ready to take beam in all rings at about 1930. Due to a series of faults requiring piquet and specialist intervention, we were back in regular operation shortly after 01:00 on Friday morning. Friday was a busy but productive day, during which the machine performance was recovered and by the end of the day we had recovered the performance we had before the technical stop in all rings.

During the week, we made a lot of progress commissioning the operational beams:

ISOGPS:

- 800E10 protons per ring now achievable
- Working point and RF modifications have given improved transmission
- An intermittent loss moments before extraction on Ring 4 has been solved

AD:

- A new cycle has been made, based on the current high intensity TOF clone
- The target intensity can be reached, fine tuning is required to meet the beam specifications

TOF:

- 800E10 protons can be reached in Ring 2
- Longitudinal performance currently prevents stable high intensity operation

LHC25:

- In collaboration with the PS, we are testing a 2 eVs variant
- If there is no negative impact of operating at 2 eVs, this will be the new standard

MTE:

- 500E10 protons per ring comfortably reached, up to 650E10 has been tested
- Before synchronisation, the beam is in good condition, with slight RF improvements needed to maintain the quality through to extraction.

ISOLDE (Simon Mataguez):

- RILIS tuned lasers with the target installed on GPS.
- CRIS tuned with the target installed on HRS (RFQ set to bunching mode)
- HRS separator magnets tests: influence of hysteresis on beam
- Today, ready for both GPS and HRS for the intervention: New Target on GPS and software modifications for both..

PS (Heiko Damarau):

An eventful week for the PS between beam commissioning activities (mostly loss studies), technical stop and delivery of beams to the SPS.

During the first part of the week the scrubbing with the 25 ns beam continued up to an intensity of 1.3e13 p/p. The bunch length during the adiabatic shortening before extraction could be reduced be increasing the RF voltage, showing the improvement thanks to the scrubbing. For the SPS, the low-intensity SFTPRO beam has been prepared, extracting only the core of the MTE.

Access during the technical stop starting on Wednesday was given at 10h30. The radiation survey confirmed the hotspot in SS88 downstream. The dose rate is highest (> 40 mSv/h contact) on top of the MU88 vacuum chamber, on the upstream side of the main magnet, just after the bellow.

A minor re-alignment was hence performed by lifting the downstream flange of C80-88 by 1.3 mm to straighten the bellow. This did not change the losses though.

Following minor issues to recover from the technical stop, the PS was ready for beam again in the late afternoon of Thursday. However, due to the beam availability from the PSB, first beam was only accelerated during the night on Friday around 1h30.

A special, transversely large beam was prepared for aperture measurements and bump scans on Friday to further study the losses in the region SS80-100. Trying to transversely blow-up the beam it was impossible to populate a beam size beyond +/- 12 mm, pointing to an obstacle in the beam pipe. Extensive vertical bump scans during the weekend showed that a vertical bump upwards around SS88 can reduce losses, but they already start in SS82. To be confirmed during the beam commissioning meeting this morning, but an access with endoscopy will most likely be organized today.

On Friday the single bunch LHC-type beam (LHCINDIV) and the SFTPRO (core only at low intensity) have been delivered as requested by the SPS. During about 1h30 the SFTPRO was not available due to an issue with the new digital receivers of the pick-ups for the radial loop (harmonic number programmed incorrectly).

With the delivery of beams to the SPS the AFT has also been restarted for the PS. With little statistics accumulated so far, the overall availability of beams was almost 99%..

AD (Davide Gamba):

- EPC tests postponed as nobody from the team is present (holidays period)
- Electron cooler powered to nominal values, performance similar to 2018 run, decision not to exchange the gun before the restart.
- discussion on LLRF upgrade: all functionalities will not be ready for the start-up because of ressources issues.

ELENA (Davide Gamba):

The week in ELENA had the following main objective/results:

- All install lines have now seen beam!
- Advance on transfer line commissioning by ABT:
    - Beam to AEgIS:
        - First beam reaching our last monitor available in this line. Studies ongoing to verify optics as for other lines. So far the situation seems good, i.e. is likely that ABT will soon give the green light to bake-out this part of the line.
        - Found a mis-configuration of the name of one SEM - fixed by expert.
        - Need some hardware fix on the our first SEM which is fixed (by construction) inside the beam - expert will have a look next week.
    - Beam to ASACUSA2:
        - Additional observations performed, but limited by a few power converters that did not fully recovered after TS (expert on vacation, will be probably fixed next week)
        - SEM grid already found last week with 2 vertical planes: we don't have a spare to replace, so for the time being we will keep it this way.
- Detailed tune measurements and correction along acceleration/deceleration cycle
    - Investigation on hysteresis-like effects: observed what look like a quadrupolar focusing effect due to Eddy current induced on the vacuum chamber by C-shape dipoles as expected during design

- Continuation of chromaticity studies

Additionally:

- Issue with FGC that were restart in the morning seems now fixed by expert - Thanks!
- Test of possibility to create h=3 cycle: some missing feature spotted in the LLRF system which was promptly fixed by LLRF expert. Investigation on possible delays between different main power converters: from first observations, everything seems to work as expected.

Problems encountered:

- Instability of the b-train system: investigation by experts to improve stability and repeatability of the measurement. Problem with NMR probe crosstalk being investigated.
- After TS, e- cooler filament went off and during its restart it seems like an uncontrolled DC e-beam was started, probably to missing configurations of some electrodes. To be careful in the future.
- H- source keeps exhibiting orbit drifts which partially affect operation.

SPS (Francesco Velotti):

The SPS week was spent between continuation of HW commissioning for RF and the beginning of beam commissioning. It all started with with the finalisation of some tests that were left over from the HW commissioning: for the SBDS reliability run, we tested the COAST cycle and try to arm the TSU. This was successful but some issue were nevertheless found and fixed in the SIS mainly. Only one issue, regarding the COAST recovery and mains behaviour is still on our todo list to fix. There was then an update of the MUGEF to properly deal with the logging of FII currents in TT10.
Tuesday was also another busy day and seen the achievement of an important milestone for the RF commissioning: it was successfully deployed the WR2RF and beam control classes. This allowed the synchronisation with the PS and SBDS arming using the real distributed frequency. In the afternoon, the EPC team took over and carried out dynamic performance measurements of the new SVC BEQ1 with the supplier ABB. The purpose was to investigate potential improvements of the 18 kV voltage regulation provided by the SVC.
Wednesday and Thursday was TS. The main events to report from the TS were: no significant issues encountered in the maintenance work on the mont-charge (this allowed to avoid large re-patrolling), vacuum opening for the BGI close to the MKDV1. The latter left the vacuum pressure about one order of magnitude lager than pre-intervention which may have a terrible effect on the already-critical MKDV1. This called for a very slow conditioning after the TS and a strategy to be decided for the coming days if dumps above 260 GeV will be required. Apart from the MKDV1, the other main issue found after the TS was with the mains - up upgrade carried out over the TS of FGC3 led to impossibility to restart the mains until the experts fixed the issue. The rest of the Thursday evening was spent waiting for beam from the PSB and fight against MKP and MKDV receptive issues. Finally the ABT piquet replaced a faulty system in the MKP and at around 3 AM an INDIV was injected.
Friday was finally dedicated to beam commissioning. The RF team worked in parallel on cavity setting up and tuning with beam. The INDIV bunch was quickly captured. By the end of the day 4 cavities were aligned with beam and 5 setup without beam, leaving only one to be setup with no beam for the following week. Phase-loop closure was done but with puzzling results for the moment. In parallel, we also completed the energy matching with the PS, optimisation of the INDIV injection. On the BI side, a first beam in expert mode was also seen on the new WS and the BTVD properly setup for multi-cycle operation.
In the evening, the MTE-core beam was injected on a short cycle dedicated to aperture measurements. This allowed us to go into the weekend and carry out initial aperture measurements at QDs. Together with injection optimisation, this was the main plan over the weekend and terminated by Sunday early afternoon. From then on, the machine was put on standby and all PC off - David was the only operator in shift for Sunday afternoon, where a faulty card of the access system

needed replacement in BA1. No other tests or measurements could be performed without bunched beam.

Main interventions needed for next week:
- discussion with RF for access needed for PS (~1 day)
- beam stop for MKP rack replacement (from Wednesday): a couple of hours
- RF setup cavity controller of last cavity
- RF keep working on the cavity phasing on PILOT cycle.

AWAKE (Edda Gschwendtner):

AWAKE Week 16 (19-23 April 2021)

WEEK SUMMARY: Repair of vapor source and continuation of laser experiments studying propagation through Rb vapor with laser frequency on/off-resonance with Rb

- **Vapor source**: 2 of the 3 failed control thermal probes on the vapor source were replaced, enabling the vapor source to reach higher Rb densities. The original cause for the failure is not yet known.
- **Laser**: completed measurements at lowest Rb density (2e14/cm**3)
- **Laser/DAQ**: issue with the gated camera occasionally dropping triggers from the CTU. Short term solution: adapt camera impedance and threshold. Longer term: use a signal generator box to create a TTL 0-5 V signal.

Weekend and next week: Continue laser measurements at 5e14/cm**3 and 7e14/cm**3 Rb densities. Once measurements are finished, uninstall dedicated laser oscillator. Potentially some electron beam at the end of the week.

LINAC 3 (Detlef Kuchler):

- Monday: ITL.DHZ02 failed for the second time and was replaced by a spare. The reason is unknown but the specialist is following up the issue.
- Monday: first test of a Python based application to do the charge state scans for the source (to replace in the future the present LabVIEW based version). Basic functionality is shown.
- Beginning of the week it was realized, that since 14.04. there was no more logging of the linac BCT's in NXCALS. The issue was tracked down to a wrong selector for a couple of devices (also from LEIR). After it was corrected it was working fine again. The reason for the wrong selector is not known.
- During the week Richard made tests concerning the problem with the debuncher cavity reported last week.
- After the technical stop there were some issues with the Autopilot server due to changes in the Python version (GHOST uses the same server). A restart of the modules solved the problem.
- During the technical stop the return pressure of the LEIR water station was regulated to the nominal 2.5 bars (issue reported last week).
- At the beginning of the weekend the digital LLRF was down. A crate crashed, but could be restarted by the specialist.

CLEAR (Roberto Corsini):

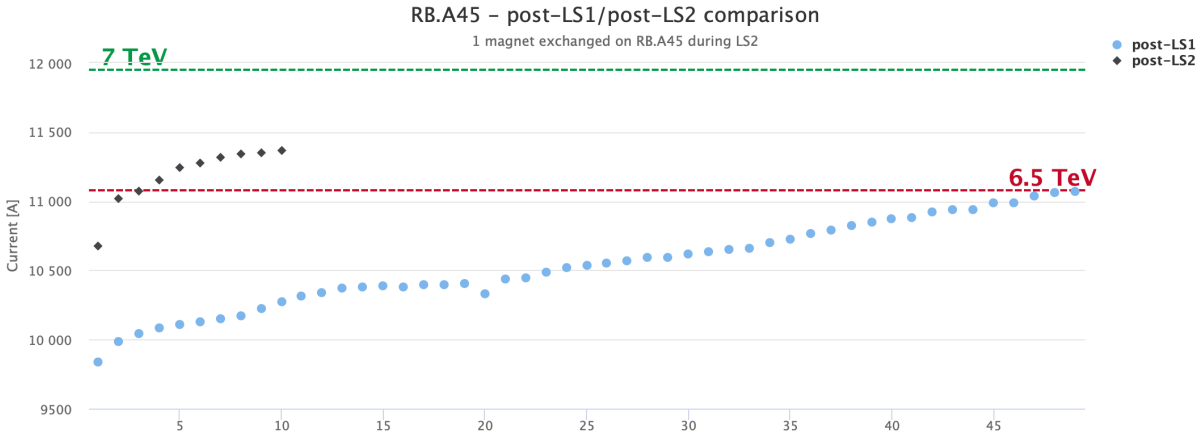
The week was dedicated to studies in collaboration with SY/BI and the AWAKE team.
After access and installation on Monday morning, measurements on optical fiber based Cherenkov Beam Loss Monitor took place, studying signal dependence from angle and beam intensity. On Thursday beam was given for AWAKE Cherenkov BPM tests. On Friday a first prreparatory measurement on the AWAKE spectrometer was done, in view of a full recalibration, to be completed in the next days. Beam operation was quite efficient with no major faults.

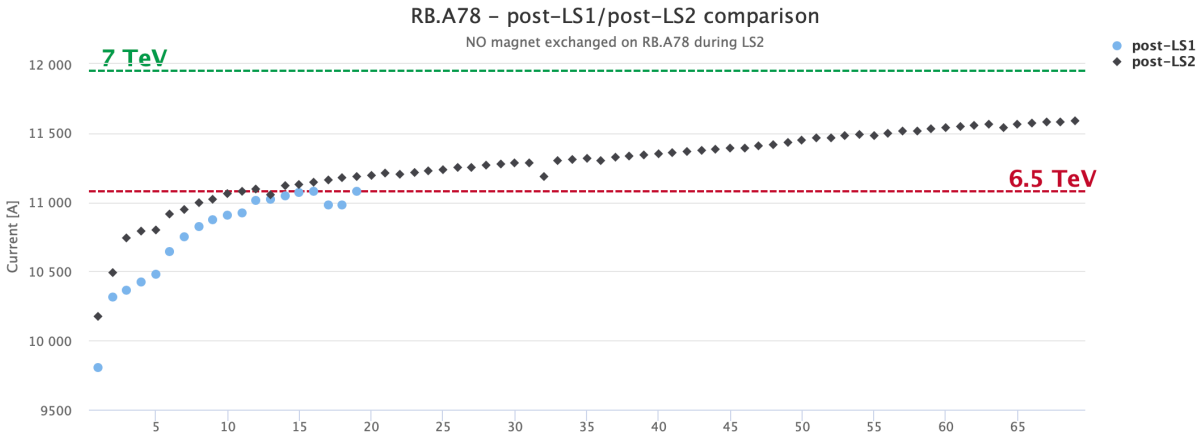
LHC (Jörg Wenninger & LHC Powering Test webpage):

S12	S23	S34	S45	S56	S67	S78	S81
Training	Phase 2	Training	Training	Phase 1	Cooldown	Training	Phase 1
4 / 11039 A		52 / 11865 A	10 / 11370 A			69 / 11585 A	

S45 back at 6.5 TeV with 3 quenches, compared to 45 after LS1.S12 almost back at 6.5 TeV at the first quench, but large detraining quench number 4 (-200 A).

Circuit	Circuit quenches	Last quench current	Equivalent E	Commissioned?
RB.A78	69	11585	6.79	NO
RB.A34	52	11865	6.95	NO
RB.A45	10	11370	6.66	NO
RB.A12	4	11039	6.47	NO


RB.A45 – post-LS1/post-LS2 comparison
1 magnet exchanged on RB.A45 during LS2
post-LS1
post-LS2
7 TeV
6.5 TeV
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
5
10
15
20
25
30
35
40
45


RB.A78 – post-LS1/post-LS2 comparison
NO magnet exchanged on RB.A78 during LS2
post-LS1
post-LS2
7 TeV
6.5 TeV
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
5
10
15
20
25
30
35
40
45
50
55
60
65