Accelerator Complex Status

End week 19 (Tuesday 17 May 2021)

Technical Infrastructure (Clement Pruneaux):

Statistics:

- Slightly more than 3'100 alarms.
- 449 phone calls (313 incoming, 136 outgoing).
- 76 ODM created.

Events worth mentioning:

- Tue. 11.05: EPC Linac 4 transformer out of service (a mechanical fault that caused the magnetic circuit to move). The hardware was physically moved and exchanged during the night. Test and beam back during 12th morning.
- Fri. 14.05: Stop of FQSTR-00013 cooling circuit (building 201) and of the compressed air production in Meyrin (caused by a circuit breaker trip on cooling station cubicle box). This has led to several faults on Meyrin Cryo installations (CryoLab, West Area, Isolde), 378 demineralised water production, Linac4 and PS cavities. Cooling station and compressed air production restarted by TI operator on shift. Circuit breaker trip to be investigated.
- Sun 16.05: Lack of beams on PSB and PS because of a front-end BLM problem. Migrated by error on GPN instead of TN. No stand-by service available for this and lot of trouble to find a specialist in best effort. An event will be created and followed by TIOC.

Details: https://wikis.cern.ch/display/TIOP/2021/05/17/TI+Week+summary,+Week+19

LINAC 4 (Alessandra Lombardi):

A bit of an eventful week for LINAC4

On Tuesday a Transformer in the modulator for CCDTL 5-6 needed replacing. This caused about 18 hour downtime . The spare transformer had to be transported from LHC point 3 to LINAC4. This happened during the evening of Tuesday so that EPC people could start working promptly Wednesday morning. This opens the discussion of the necessity of spare modulators for LINAC4. As a side we profited to take some measurements on the source.

On Friday an air compressor was down in LINAC4. This prevents the beamstopper from acting (it uses compressed air), and also triggers the vacuum interlock as the vacuum valves are operated by compressed air. 90 min downtime

Few trips : rf and a solenoid.

PS Booster (Foteini Asvesta):

This past week in the PSB we had some nice progress on long standing issues but we also encountered quite a few issues with the extraction kickers.

Main Achievements

- **TOF:**
    - **Instability approaching flat top**, initially believed to be longitudinal, was identified as a transverse horizontal one. The instability was **cured** by moving the tunes close to the **coupling resonance** when the instability is observed. **Skew quadrupoles,** further enhancing the coupling were needed to stabilize the beam. Some longitudinal structure is still observed but it is not causing any losses.

    - Safely **extracted >1000e10 protons** with all specifications, longitudinal & transverse, close to specifications.
- **AD:**
    - Beam close to specifications after **optimizations of the RF voltage functions.**
    - All rings can reach **450e10 protons**.
- **MTE:**
    - Variant with the possibility to **vary the extracted bunch length** prepared and used over the stop for checks with the PS.
- **Transverse Feedback:**
    - **Readjustment of the delay settings** for R1 and R2 solved issues with losses right before extraction for these rings on all users that required very high intensities (AD & TOF).
- **Energy matching:**
    - Created users for all available energy spreads from the LINAC4 to start **monitoring the energy matching**. Data has been acquired over the long stop from the operators to be analyzed next week.

Outstanding Issues

- **Extraction kickers:**
    - Multiple trips of the **R2** kicker, BE2.KFA16L4. Intervention to exchange the thyratron improved the situation but still some trips are observed.
    - Multiple trips of the **R1** kicker, BE1.KFA14L1. For some resets, the front-end needed to be rebooted.
    - In both cases the affected rings were down, but operational beams could still be delivered to the other machines from the other rings.
- **White Rabbit**:
    - Issue with the **simulated B-Train** caused losses in the machine. A known **malfunction of WR Node** caused by reception of a corrupted frame lead to a stop in operations on Wednesday.
- **Wire Scanners:**
    - The old WS in R1V was found to be broken.
- **BLM:**
    - Issues with the frontend for the BLM ring on Sunday, the experts currently onsite.

Next Steps

- Continue optimization & setup on all operational cycles.
- Investigate the increase of **losses** for higher intensities on **TOF**, losses increase from ~3% to ~8% but are still within the 10% budget.
- Investigate step like **losses** (in the order of 3%) that occur from time to time for the **AD** user.
- **Impedance** studies on the flat cycle to validate the model for Finemet cavities.

ISOLDE (Eleftherios Fadakis):

A short but very busy week for ISOLDE.
HRS new GAS injection system is being installed. Still some things left to test before protons. It will be tight.
Plasma target on HRS in place so from OP point of view we are ready to do validation tests once the gas system works.
SEMGRID target coupling test on both front ends. performed tests with their cable and the OP application.

D. Valuch was working on the measurements of the quality factor of the SRF cavities and the dynamic thermal load.
On Friday, the cut of cooling and ventilation at Meyrin site, affected the HIE ISOLDE Cryo Plant.

The LHe reservoir inside the cryomodules got empty.
Seems like for some cavities, very briefly, the temperature increased. Alberto went over to restart vacuum. Vacuum piquet had already started recuperating everything.
We will discuss, the impact on the SRF cavities with SRF experts and CRYO experts.

PS (Alex Huschauer):

During the whole week the LHCINDIV and SFTPRO (MTE core only) beams continued to be provided to the SPS.

From the beginning of the week, investigations on the strong losses observed close to the third order resonance 3Qy=19 continued. When crossing this resonance the beam is almost completely lost, whereas only around 20% beam loss were observed pre-LS2. Data from the survey colleagues clearly shows that all MUs are today significantly better aligned in position and roll angle than they were before LS2, which seems to indicate that the misalignments in the past reduced the resonance excitation. To characterise the resonance, loss map, resonance compensation and optics studies were performed throughout the week and are also going to continue during this week. For the compensation studies using skew sextupoles, we applied for the first time the generic optimisation framework in the PS, which appeared to work very efficiently. During the setup of the optics measurements the new AC dipole functionality, now embedded into the TFB system, could be successfully tested for the first time.

On Tuesday tests with the new longitudinal coupled bunch feedback firmware started on the LHC standard beam and the sensitive BPM93 was checked to work again correctly (showing the proper delta signals) after intervention of the expert.

On Wednesday morning access to the PS was possible following the Linac4 transformer repair and the amplifier of the C10.91 was exchanged. In the afternoon tests with both BGIs and gas injection were performed to further commission the systems.

During the long weekend, several additional studies were performed by the OP teams on shift.

The setup of the MTE extraction continued with special focus on discrepancies between the 2018 and 2021 working points at flat top and beam loss occurring just at the arrival to the flat top. Setup of the PFW and low-energy quads during the MTE splitting is going to continue also this week.

Furthermore, the LHC standard beam has been injected at larger longitudinal emittance (2 eVs) for the first time, but thorough measurements of the transverse parameters are yet to be done.

AD (Davide Gamba):

The AD machine is in GENERAL access mode again and IST started on kicker and instrumentation.

ELENA (Davide Gamba):

The last (short) week was mainly devoted to transfer line studies:

- Characterisation of the optics in the ASACUSA2 line
- Testing the possibility of using optimisation algorithm developed for LINAC4 to optimise the injection line from the H- source.

Additionally, continuation on ring deceleration cycle optimisation:

- Chromaticity measurements and empiric correction along the cycle.
- Tests with multiple RF segments in preparation of optimisation of longitudinal dynamics by RF experts foreseen for next week.

Problems encountered:

- During an intervention for the renovation of the AD timing crate, an ELENA timing cable was accidentally disconnected, stopping operation for most of Monday morning. Additionally, the FGC63 were not responding after the timing restart. The issue is being followed up by EPC.
- During an intervention on the AD injection kicker, also the ELENA kickers were erroneously locked out. It seems like the two systems share the same machine safety interlock.

SPS (Hannes Bartosik):

Overall it was a good week for the beam commissioning in the SPS. The clear highlights were the successful crossing of transition on the SFTPRO1 cycle with the new RF system on Wednesday and the successful beam based alignment performed in the second half of the week.

The LLRF team worked on a new firmware to fix issues related to transition crossing encountered last week. In combination with a recalculated stable phase function around transition and a less pronounced voltage dip at transition, the RF team managed to cross transition on the SFTPRO1 cycle on Wednesday evening. This was an important achievement for the RF beam commissioning and a necessary condition for the closed orbit correction through quadrupole alignment.

Combining the closed orbit data at flat top of the SFTPRO1 cycle and the LHCPILOT cycle, 3 horizontal and 4 vertical quadrupole shifts were calculated on Thursday for the double optics (Fixed target Q26 + LHC Q20) closed orbit correction. Thanks to the survey team (P. Bestmann) and RP (A. Herve) these quadrupole shifts were implemented on Friday, which successfully corrected the closed orbit to around 3 mm rms in H and less than 2.5 mm rms in V in both optics, as expected.

In the shadow of the Linac4 CCDTL transformer repair, the following accesses were performed on Wednesday:

- The misaligned vacuum chamber next to the injection septum, which had been identified as aperture restriction last week, was re-aligned and fixed with a temporary support by the vacuum group. As confirmed with beam later, the alignment was successful and the aperture was restored. To be discussed if the replacement chamber with larger diameter should be installed before the YETS or if the present situation is sufficient for operation.
- Exchange of a rack for the optical fiber link in ECA5 providing Frev to the SPS beam dump system - this was an additional measure following the exchange of an optical fiber on Monday to fix an issue with intermittent signal transmission blocking the arming of the beam dump system
- BPM polarity inversions were fixed, as confirmed later with kick response measurements
- Repair of a water leak found at the TMR cooling circuit of the MKQV in BA1

other activities:

- a new fixed display for the BSRT has been put online and is being tested by BI
- systematic wirescanner measurements in H and V for LHCINDIV and MTE beam to be analyzed by BI to find optimum photomultiplier voltage settings
- RF conditioning of cavity 1 during the long weekend
- preparation and basic setting up of the long flat bottom scrubbing cycle, the AWAKE cycle and the Hiradmat cycles.

AWAKE (Giovanni Zevi Della Porta):

WEEK 19 SUMMARY: Increase UV Laser energy, conclude vacuum intervention, connect plasma light diagnostic.

- **Laser**: adjusted compression to increase energy of UV on electron gun cathode by a factor of 4, thereby recovering the performance of past years.

- **Vacuum/Beamline**: Vacuum pump down completed, but one penning gauge broken, will have to be replaced during the June vacuum opening. Magnet reconnected and tested.
- **Upstream streak camera**: optical line improvements (filter, flipper)
- **Plasma light diagnostic**: set up and connected diagnostics to measure plasma light. This will be tested in the coming weeks, to determine whether it can be used to measure wakefield intensity.

PLAN FOR WEEKS 20-21: Several days of electron beam without plasma (measure quadrupole alignment, commission new optics, measure bunch-length with upstream streak, etc). Several days of 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.

LINAC 3 (Giulia Bellodi):

On Monday and Tuesday the beam was transported through the ITH and LBS lines and first measurements were taken.
On Wednesday 150ms source pulsing tests were performed: it was observed that the first pulse in the 150ms train was missing and CO timing experts were contacted.
Regular stripper foil measurements have been taken during the week.
The source tripped a couple of times during the long weekend.

CLEAR ():

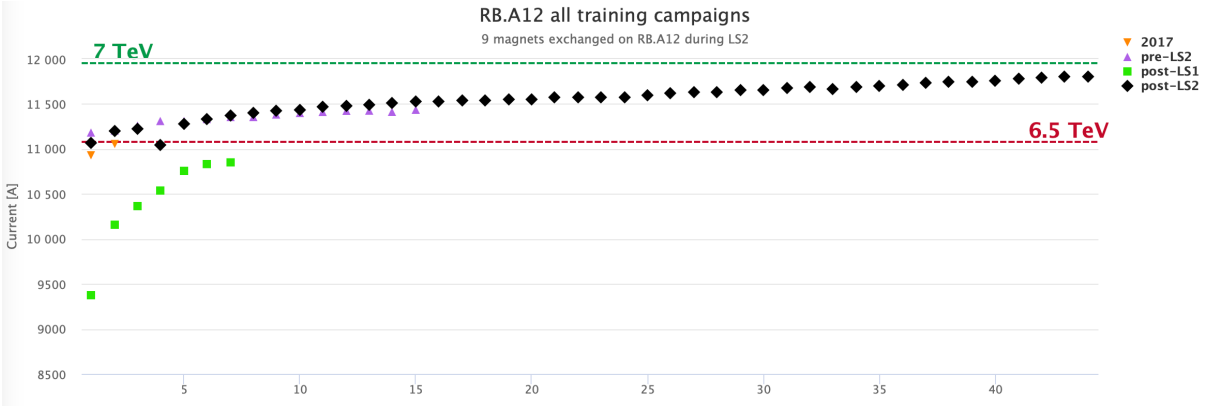
No report.

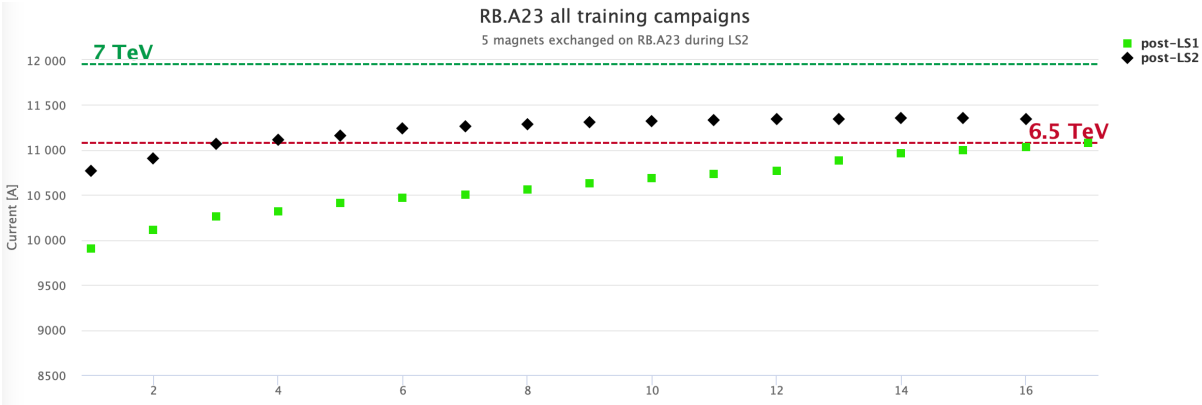
LHC (Jörg Wenninger & LHC Powering Test webpage):

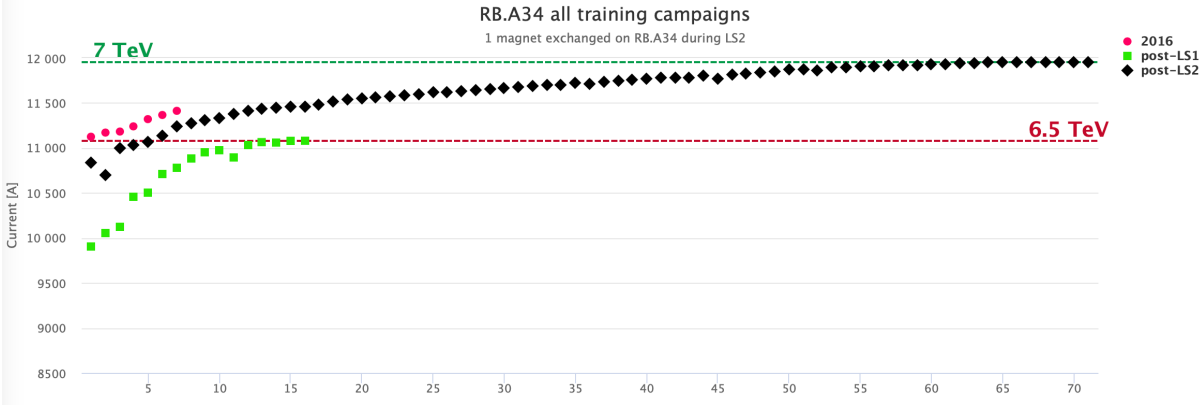
S12	S23	S34	S45	S56	S67	S78	S81
Training	Training	Trained	Training	Phase 2	Cooldown	Warm up for repair	Phase 2
44 / 11802 A	16 / 11349 A	71 / 11950 A	52 / 11779 A			69 / 11585 A	

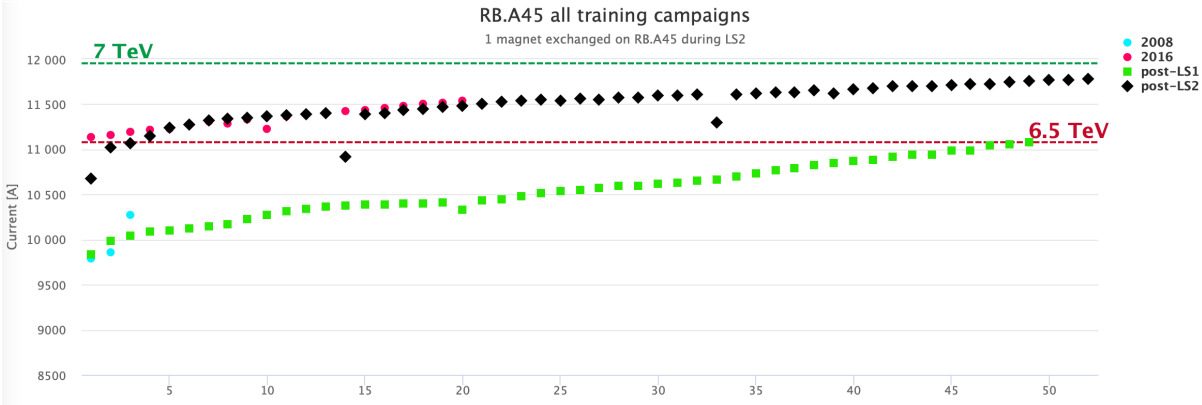
Training curves of S12, S23 and S45 align well with the one of S34. S23 very flat over last 5-6 quenches.

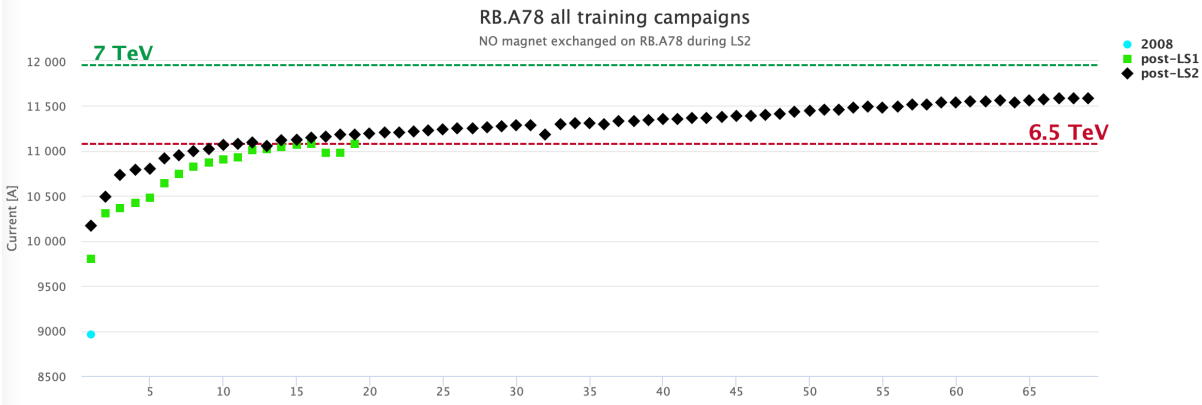
Circuit	Circuit quenches	Last quench current	Equivalent E	Target reached?
RB.A78	69	11585	6.79	NO
RB.A34	71	11950	7.00	YES
RB.A45	52	11779	6.90	NO
RB.A12	44	11802	6.91	NO
RB.A23	16	11349	6.65	NO




RB.A23 all training campaigns
5 magnets exchanged on RB.A23 during LS2
7 TeV
6.5 TeV
post-LS1
post-LS2
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
9000
8500
2
4
6
8
10
12
14
16


RB.A34 all training campaigns
1 magnet exchanged on RB.A34 during LS2
7 TeV
6.5 TeV
2016
post-LS1
post-LS2
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
9000
8500
5
10
15
20
25
30
35
40
45
50
55
60
65
70


RB.A45 all training campaigns
1 magnet exchanged on RB.A45 during LS2
7 TeV
6.5 TeV
2008
2016
post-LS1
post-LS2
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
9000
8500
5
10
15
20
25
30
35
40
45
50


RB.A78 all training campaigns
NO magnet exchanged on RB.A78 during LS2
7 TeV
6.5 TeV
2008
post-LS1
post-LS2
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
9000
8500
5
10
15
20
25
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35
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45
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55
60
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