

# Accelerator Complex Status

## End week 11 (Monday 21 March 2022)

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### Technical Infrastructure (Clement Pruneaux):

Statistics:

- About 7'000 alarms.
- 792 phone calls (579 incoming, 213 outgoing).
- 83 ODM created.

Events worth mentioning:

- Mon. 14.03, Smoke alarm in BG811 (909) coming from a socket box F1 in EBD450/G8. Contractors were working in the room and were connected to the socket box. EN-EL locks the burned feeder and resets the other feeders.
- Wed. 16.03:
  - at 11h34, TT70 evacuation alarm, ongoing investigation as nobody was in there.
  - At 13h31, Trip of 863 cooling tower and WS SPS, alarm cooling plant BEQ1 --> 2 seconds later trip of BEQ1 and trip of SPS. Loss of 24V for communication between BA4 regulation tank and BA6. A cable was decabled during works on SAREP in BA6 (CHAMN network consolidation campaign).
- Thu. 17.03, at 16:23 loss of TIM equipment caused by a broker problem. TI received various alarm for TIM equipment communication problem (no more alarm feedback possible in the control room on the concerned equipment). At 17h10, Communication back to normal.

Details: <https://wikis.cern.ch/display/TIOP/2022/03/21/TI+week+summary%2C+Week+11>

### LINAC 4 (Jean-Baptiste Lallement)

A pretty good week for the Linac4 with only one minor fault and a source RF intervention.

- The 2 MHz RF source tube replacement took place as scheduled on Monday afternoon, from 14:00 to 18:00. A stable 35 mA beam was made available in time for the injectors restart.
- On Friday, the LEBT software interlock caused a 10 min. beam stop. Everything sorted out after source HV power supply and LEBT SIS resets.

As you will have understood, beside the source RF intervention, a very good week !

### PS Booster (Simon Albright):

Overall, it was an excellent week, the availability was over 96%, with only 5.3 hours of blocking faults.

An ongoing problem with the LLRF systems, which is affecting a couple of cavities, is currently under investigation by experts. For a few hours on Thursday morning, Ring 4 was reserved for RF tests, which improved the situation but it has not yet been solved. The Ring 0 test system has now been revived and will be used for more invasive tests than can easily be done on an operational system. In the meantime the problem can be masked by opening the servoloops on affected harmonics and cavities, which does not degrade beam quality.

Otherwise, we had the usual selection of minor faults requiring system resets, but nothing noteworthy. The operational beams are all available with nominal parameters. Finally, we had a typically wide variety of MD activities aiming to further our understanding of the machine and improve performance.

### ISOLDE (Simon Mataguez):

For ISOLDE it has been a good and intense commissioning week.

On **GPS**, Target#634 LIST Target UC VD7 for the LIST (Laser Ion Source and Trap)

Tests- commissioning on LIST target all the week.

16/03 Fire Alarm in TT70 – patrol lost due to FB intervention.

On **HRS**, Target #738 CaO VD7 (installed Tuesday 15<sup>th</sup> March). Many trips before to get the right temperature.

Thursday: Setup for 40kV. RFQ in bunching mode.

Friday investigations on a jitter visible in most of the profile measurements devices after the central beamline with the BI support.

**Positive result:** The power supply YHRS.QP820-V seems to be one of the source of the **jitter!**

### On **REX-HIE** side

Tuesday, the problem of No RF in TRAP – **Solved** by A.Butterworth (SY-RF) and G.Kruk (BE-CSS)

16/03 Trap local ion source maintenance done.

17/03 Emergency stop pressed accidentally. Very difficult to come back to the initial situation (one working day needed), a CPU did not start properly after the stop.

18/03 Hardware test/ commissioning of HIE on going: movements of all the BI devices in the tunnel checked

Tunnel closed and patrol done: the Cryo team will start the circulation of cold He gas in the cryo modules.

### PS (Bettina Mikulec):

Week 11 was marked by a very dense program: first beam to n\_ToF and first beam to EAST, as well as first LHC multi-bunch beam to the SPS.

**Commissioning of new optics for beamline to TOF (FTN)** by Y. Dutheil, following the modifications of the line during the YETS:

- Aim was to be able to increase beam size on target, and week 11 was reserved for the optics studies
- Delivering during afternoons/nights beam to n\_ToF
- Understanding of line optics is very good; up to 16 mm (from 7 mm) in V beam size was reached, although associated with losses. A good compromise should be chosen (to be discussed on Monday/Tuesday).

### **Beams:**

- **TOF:** the cycle with  $>800E10$  p has been prepared over the weekend; maybe some more fine-adjustments for loss minimisation
- **EAST\_FAST:** the cycle is ready to be used by the EA for instruments calibration
  - H tune at extraction lowered to 6.15; ideal would be 6.1 following simulations from ABT (to extract at 1st turn and reduce losses) —> ongoing (maybe add kick from KFA4)
- **EAST\_T8, EAST\_T9** and **EAST\_N** (slow extracted): optimisation and studies of the slow extraction throughout the week
  - On Monday measurements together with RP: step-wise increase of intensity to the EAST dump to check radiation levels measured at entrance of the zone
    - During the tests, there was 1 cycle sent to EAST\_DMP destination in a super-cycle length of 42 seconds. The limit for non-designated area low occupancy is  $2.5 \mu\text{Sv/h}$ , which was already surpassed with an intensity of  $30E10$  p. Additional

measurements will be done, after which it should be discussed if the shielding should be improved.

- Longitudinal and transverse checks
- A lot of work done on the settings side for extraction and beam transfer (logicals implemented; automatic scaling of devices including FUNC\_LIST; HL knobs at extraction)
- Cycles sent to T8 and T9 targets
- **AD:** operational cycle prepared for next week as well as cycle with odd number of bunches (5 bunches produced)
  - Better understanding of phase and synchro loop oscillations after the phase jump → ongoing
- **LHC25:** delivered to the SPS for scrubbing over the weekend (1.2E10 ppb)
  - Friday night and Saturday the HL- and LL-RF piquets had to be called in; C80-88 was found in counter-phase
  - Injection oscillations for the 2nd injected cycles were due to a different MRP at PSB extraction

#### **Other points:**

- **Accesses:**
  - Monday morning for Linac4
  - Tuesday morning to repair the amplifier fan for C10-86
  - Friday morning to check issues with the XSEC in F61 (diagnostics for EAST beams) → short-circuit inside the tank → removal of tank to be repaired in lab → will require another access next week to re-install
- Ripple of WFNP solved on Tuesday (bandwidth settings of FNI and FNP were wrong; adding a Bdot compensation reduced induced current by a factor 2 more)
- Several kicker trips and interventions during the week
- BGI84V: low sensitivity for vertical detector due to large H beam pipe → gas injection needed for lower intensity cycles and low energy
- F63.BHZ04A/B issue (switching magnet between T9 and North branch):
  - Realised that when this magnet was in fault that beam with destination N was sent to T9
    - Changed eco-mask and moved the magnet in a different particle transfer
    - An SIS interlock will be implemented to avoid this situation
- Important MRP fluctuations observed at injection depending on the supercycle composition (and associated losses for high-intensity cycles) → MD being prepared to follow up these effects

#### **Improvements:**

- Several Inspector applications with improved functionality:
  - Enabling/disabling of H TFB blow-up for MTE 5-turn/core
  - PS status and RF-Scope
  - New Python script from LL-RF team incorporated for easier control of the LHC splitting efficiency
- Dedicated YASP configuration for T8 prepared by Joerg
  - Help from Roman (CSS) to change beam process type
  - Marcel prepared UCAP devices for the T8 special BPMs to be able to use them as monitors
- ABT used an optimiser for EAST extraction septa alignment optimisation.

#### **PS - East Area ():**

Commissioning of secondary beam lines this week in view of start of physics next week.

#### **AD - ELENA (Laurette Ponce):**

**ELENA:**

- Progressing with the Hminus beam commissioning
- Polishing of captures/debunches/deceleration by LLRF
- Bug on the FGC\_93 causing the trip of e-cooler power supply fixed on Friday.
- A lot of work on the TRIC card for intensity measurement and triggering problems of instrumentation due to second injection fixed.

**AD target:**

- Ready to take beam: Horn and EPC hardware tests completed, magnet inspection done and target movement tests done

**AD:**

- Leak on the injection kicker after reconnection fixed on Friday.
- e-cooler HV tests completed
- Machine patrolled and closed, ready for the EPC and C10 cavities commissioning.
- Problem on the QUAD-MAIN2 power supply found by EPC Friday afternoon, more investigation on Monday on damaged cable in the power converter.

**SPS (Kevin Li):**

Week 11 has been the second week of beam commissioning in the SPS. One of the milestones for this week was the switching to multi-bunch LHC beams and preparing for scrubbing which should start Monday next week (week 12). There have also been a few carry-overs from last week (week 10). In particular, an aperture restriction, that had been found in 510-511, was scheduled for repair during Monday full day. The intervention has been extensive and finished only late in the afternoon. Several non-conformities were discovered and fixed, among them, misaligned vacuum shields of the pumping ports in the MBA-MBB transition and badly positioned RF fingers. The MBA had to be displaced and the vacuum was broken. Pumping took until Tuesday later in the morning. The aperture was remeasured later on Tuesday and revealed that the intervention had indeed been successful as the aperture limitation in 5 was lifted. The SBDS commissioning was completed on both SFTPRO and LHC beams. Moreover, a first iteration of the 800 MHz phasing was performed. Wednesday morning was dedicated to an open issue from the previous week, to retest the MKE4 pulsing after a timeout fix had been put in place. The test itself was successful, and also the MKE6 was retested for completeness. This test, however, also revealed a problem with the timing system, appearing for requests with destination set to LHC. The requests do not pass and beam cannot be reliably injected into the SPS. The timing system experts have been investigating and suspect a bug in the system. This needs to be followed up.

Multi-bunch beams were then taken on MD5 for the first time on Wednesday afternoon with all girders in and the ZS at nominal voltage. The SFTPRO was still kept in parallel. Orbits and tunes were roughly corrected and a first round of scrubbing with 12 bunches was done overnight. On Thursday, commissioning of the longitudinal damper was started on an LHCINDIV first. Problems linked to very long bunches and the actual synchrotron tune were discovered and need to be further investigated. Golden orbits and trajectories were established in the SPS and the PS for the LHCPILOT and were reused for the MD5. 12 bunches were taken back in the afternoon and were used for wirescanner commissioning. The BI teams worked, among others, on optimizing the phasing of the multi-bunch beams; the devices ending with '8' are optimized and should be used preferably for WS measurements. The WS application was tested in the SPS (SPS Pyrescanners) in various configurations, as well as writing from and reading to logging; all works very well. The transverse damper was set up for both the SFTPRO as well as the LHC beams. By Thursday evening, the MD5 cycle had been fully set up and prepared for multi-bunch beams and was ready for scrubbing (including sorting out a problem with the bucket selection and over-injection of batches). Hence, the

night was used to move from 12 bunches to 24 bunches, which is one of the most tedious steps after a long stop.

On Friday, the crab cavities were moved in. A DSO tests was performed in the morning in the shadow of a PS access. In the afternoon, the cycle was prepared for dedicated flat bottom explosive scrubbing. The thresholds of the MKDs were raised up to  $5e-6$  mbar in agreement with ABT experts. The intensity ramp-up was started on Friday late afternoon. Kicker delays were optimized and the beam was set up to handle higher intensities. Some measurements were done to optimize the RF settings, as bunches appeared to be very long in the SPS (3.8 ns). The measurements suggest a potential problem with the cavity phasing of cavities 3 and 6. Hence, it is not sure that the modeled total voltage corresponds to the effective total voltage. The total voltage was later raised from 4.5 to 6 MV to reach a more nominal bunch lengths around 3 ns. This needs to be further investigated together with the RF experts. The scrubbing team came in to take measurements and help guiding the intensity ramp-up. By Saturday evening we had 4 x 72 bunches circulating and a fifth batches of 72 bunches injected. Due to strong coupling as a result of the Laslett tune shift, the beam was lost right after the fifth injection. Some fine tuning of the Laslett corrections was done on Sunday, and since then the machine is scrubbing with 5 x 72 bunches at  $1.2e11$  ppb. The per-bunch intensity is currently limited by the PS. Scrubbing is evolving very well. The classical MKP temperature limit will probably be reached by mid-night tonight. The plan is to stop scrubbing at this point, and to resume during the day, to have ABT experts to monitor the MKP behavior for high temperatures, as well as RF experts to investigate multiple batches.

As the past week together with preparation and execution of scrubbing has progressed very well, we could envisage advancing to move into the ramp already by mid next week. The original MKD threshold must imperatively be resorted before inserting a high energy ramp cycle into the supercycle!

List of resolved/open issues:

- Done:
  - SEM grids and BTV at targets movements: checked;
  - AWAKE magnet installed and deconsigned; try pulse them;
- Open:
  - Various cycles: eddy current data taking for correction model
  - Monte charge BA3 repair: team had no time this week
  - QS tests (QS still in safe): Quentin King contacted, he needs to check with Charles and Olivier and will get back to us; probably needs an intervention on the MBI for several hours;
  - TT10 + TT60 fire door: still to be checked
  - Defibrilators need to be removed from tunnel access points: check with firefighters whenever there is a slot; is on the access list;
  - TI8, TI2 two power converters: still to be finished - Loic
  - Converter re-config: done and converter ready; can be swapped back as of Monday; needs 2 hours;
  - Cavity trips 3 and 6: cavity 6 changed elbow; cavity 3 still to be done; needs about 3-4 hours; on surface; polar loops currently off on all cycles for cavities 3 and 6;
  - AWAKE power converter test (MBI.816 TI8/AWAKE) planned for next week 23rd;
  - Timing system problem with LHC destination: check with Greg
  - TPSC4 bad status: open - still appears in SIS: check with Yannick
  - DSO tests NA - mostly done; final set scheduled for 29th March for testing the "replis" on the upstream north transfer chain which covers BA80 and BA81; no TT20 extractions possible then
  - Crab cavities are still in: need to be moved out when moving towards ramping.

### SPS North Area ():

YETS.

### AWAKE (Edda Gschwendtner):

**Week 11 (14-18 March):** Conclusion of of beamline interventions to make room for HF BPM and install ICT. Electron gun cathode exchanged.

- **Beamline:** closed, pumped down vacuum.
- ICT installed on the beamline, cables are already pulled and will be connected in Week 12
- Blank pipe installed at HF BPM location. HF BPM should be installed in Week 15
  
- **Electron Gun:** cathode exchange
- New cathode installed
- RF-conditioning done
- Cathode transport-carrier still connected, can be removed once quantum efficiency of new cathode is measured
  
- **TSG4 shielding** to protect Access System from radiation: first half complete; second half probably week 15
  
- **Laser:**
- 2 potentially separate issues related to the (newly installed) control system: cannot see internal cameras, cannot control Propulse
- In contact with supplier for a remote trouble-shooting session ASAP.
- We can get UV for electron gun and QE efficiency measurement, but we cannot send IR along the beamline for alignment studies

**Week 12 plan:** Cathode QE measurements; laser troubleshooting and hopefully alignment studies; TAG41 closed Wednesday PM for TT41 magnet tests; DSO tests Friday morning.

### LINAC 3 ():

YETS.

### LEIR ():

YETS.

### CLEAR ():

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### LHC (Jörg Wenninger & LHC Coordination webpage):

S12	S23	S34	S45	S56	S67	S78	S81
Completed	Training	Completed	Completed	Completed	Completed	Completed	Completed
77 / 11950 A	17 / 11306 A	71 / 11950 A	87 / 11950 A	76 / 11600 A	62 / 11600 A	21 / 11600 A	55 / 11600 A

Training in S23 ongoing, slower than in the spring of 2021.