Accelerator Complex Status

End week 9 (Monday 8 March 2021)

Technical Infrastructure (Ronan Ledru):

A reasonable week.
Statistics:

- Slightly more than 9000 alarms.
- 830 phone calls (577 incoming, 253 outgoing).
- 97 ODM created.

Events worth mentioning:

- Tue. 02.03: Big upgrade of TIM firmware and servers. Almost 3 hours of downtime, alarms were monitored directly in degraded mode through TIP alarm screen during the intervention.
- Wed. 03.03: Trip of BEQ1 compensator, assistance of EN-EL requested to switch back on.
- Weekend: there was a serious problem with CCC ventilation, a bearing had broken on one of the ventilators and needed replacing. The return fan was left running and the doors of the ccc left slightly open to draw the fresh air in.

Details: https://wikis.cern.ch/display/TIOP/2021/03/08/TI+week+summary,+Week+9

LINAC 4 (Bettina Mikulec):

It was a week characterised by some new improvements that allowed flattening the energy along the pulse and therefore facilitated energy matching with the PSB.
Monday:

- The debuncher was found detuned Sunday night, which was corrected Monday morning. Bartosz has added an indicator in the RF Global View panel for such cases to be caught faster in the future.
- Some energy fluctuations along the Linac4 pulse were observed; they were solved by the RF team first by adjustments on DTL1 (phase and Switch&Limit setting after the DTL1 intervention over the previous weekend), but the main improvement came from disabling some logging on PIMS0506 that overloaded the CPU and caused AFF not to send corrections (done Tuesday morning).

Thursday:

- **Energy matching with the PSB redone** (improved method making use of the straightened energy along the pulse); new PIMS1112 amplitude and new debuncher phase copied to all cycles.
- New Linac4 steering up to L4T in the horizontal plane from dispersion-free steering studies of Isabella. **Steering** of the transfer lines revised together with the PSB injection steering refinement performed by the SY-ABT team.
- Piotr **applied a PIMS1112 correction to flatten the energy along the pulse** to all currently used cycles (dependent on chopping factor). He wrote and **released a GUI that allows to calculate and test correction functions**.

Friday:

- The **DTL1 modulator** tripped once more like Friday last week, most probably due to a current spike that broke the anode. The specialist repaired the fault within 1 hour. He will now prepare a replacement of the active anode to a passive anode. A potential date for the exchange could be the first TS end of April (1 day is needed for this intervention, but with the tunnel closed…).

Sunday:

- The Linac4 L4T watchdog tripped over some period of time. To be analysed today what could have been the reason.

PS Booster (Gian Piero Di Giovanni):

This was the last week of standalone beam commissioning in the PSB, as it marked the beginning of the PS beam commissioning on Wednesday late evening/night.
This week we **officially started the PSB coordination weeks and the AFT** (from Thursday) to track the PSB down time.

We **provided the planned beams for the PS setting-up** (INDIV and TOF-like) during this week.
We also **matched the extraction energy** with the PS injection on Thursday:

- An increase of ~80 G was needed to match the PS injection.
- The large increase is partially due to the fact that we were setting up the beam at 2.00 GeV (instead of 2.01 GeV, because of the PS RF harmonics at injection).
- Probably the remaining discrepancy is an indication that the B-Train calibration needs to be reviewed.
- This change required a review of the extraction setting-up, mainly to adjust timing of kickers and BI equipment.

We had a few issues with the interplay between PSB and PS timings, which somehow allowed the PSB to send beam to the PS only from ring 3. The problem seems related to the tail-clippers timings and it will be reviewed with timing experts on Monday.

The **beam availability for the PSB commissioning was severely impacted on Wednesday because of POPS-B:**

- Unexpectedly, after a few planned interventions in the morning, POPS-B could not restart.
- The origin was identified in the maximum negative current in the quads circuits which is around -500A. The current, needed to reach the extraction WP, is well within the allowed peak current (~750 A), but unfortunately it seems to cause issues due to the induced voltage on the MPS.
    - Identifying the origin of the problems took several hours.
    - We are now forced to employ the following **procedure to restart POPS-B**, everytime it goes in FAULT:
        - Play a supercycle with only users with a maximum negative currents in the QUADS circuits around -200 A.
        - Restart POPS-B.
        - Only afterwards, we can set the supercycle with a more standard commissioning configuration.
    - This situation is far from optimal for operation, so EPC is following this issue.
- After being able to restart POPS-B early in the afternoon, **one of the BIC cards broke and needed to be patched up:**
    - Because of this patch, the QUADS are not anymore part of the BIC equation until a new card is available.
    - F. Boattini explained that these are recent custom-made cards, so no spare is yet available. SY-EPC will certainly prepare more cards in the near future.
    - We could finally restart beam operation at 17h30, on time for the PS to start taking beam.

A lot of parallel activities during the week. A few highlights below:

- Loss map and resonance compensation studies identified the need to **flip the polarity in one the normal sextupole magnet (XNO311L1)** to increase the effectiveness of the corrections. In fact, normal sextupole and octupole resonances dominate the losses along the cycle. This change of polarity requires an intervention in the tunnel.

- Successful MDs to prove that the PSB can employ the **special injection/extraction bending magnets as orbit corrects throughout the cycle in all 4 rings**:
    - This will be beneficial for beam optimization, as our orbit correctors run out of steam at high energy.
- **Blow-up studies progressing**. This work is crucial to be able to increase intensity and preserve an optimal longitudinal particle distribution. **Observed a phase accumulation during blow-up**confirmed to not be a ring-specific problem.
- Started the preparation of **MTE**:
    - **Issues with the beam splitting at extraction for the MTE** preparation caused by a**phase shift seen following 2 GeV cycles**.
    - RF experts are following this item with priority.
- PSB Injection:
    - **L4-PSB energy matching** reviewed after the excellent improvement on the Linac4 side to flatten the energy along the pulse.
    - **The new optics to accommodate for new injection WPs** have been validated with beam.
    - **The steering in the BI line was reviewed for all energy spread setting:**
        - Despite the effort from SY-BI, the BPM signals for large energy spread (e.g. 450 KeV RMS, needed for the LHC beam production) is not fully reliable.
        - A new procedure has been tested:
            - The optics was set for large energy spread while the debuncher kept to lower energy spread.
            - The steering optimized and then the energy spread increased to match the expected value. The difference in trajectory between low and high energy spread is within reason (H: max 1.5mm, V:1mm).
- **Wire-Scanners:**
    - The very **first profiles of LIU WS** have been posted in the elogbook. More work is certainly needed, but it is important step forward.
    - **Issue with the WS2H** which is always saturated. An **intervention in the tunnel** is needed.
    - General issue to get good vertical profile signals. Investigation ongoing together with the SY-BE experts.
- **LHC25 preparation:**
    - We started more systematically looking at the preparation of the LHC standard beam.
    - The intensity reach was possible in all for rings thanks to resonance compensation work done previously and after reviewing the TFB setting.
        - For ring3 we had to employ the old TFB because the new TFB was not equally effective. The TFB team will look into it on Monday.
    - More work is needed to clean-up the longitudinal setting and have reliable transverse emittance measurements.

A couple of medium-term issues which we are following with the experts on a regular basis:

- **POPS-B regulation:**
    - A new framework called FRESCO was made available for the MPS and it is currently being debugged. It will allow a new approach to calculate the regulation parameters moving from an analytical approach to an optimizer/machine learning type of identification.
- We experienced a few issues with the **watchdog** which was cutting the beam and then coming back to work without a clear explanation.
    - We **identified and fixed a bug in the cruise control application** which could explain a few of the issues encountered.
    - We continue monitoring the situation with the help of SY-BI experts.

ISOLDE (Emiliano Piselli):

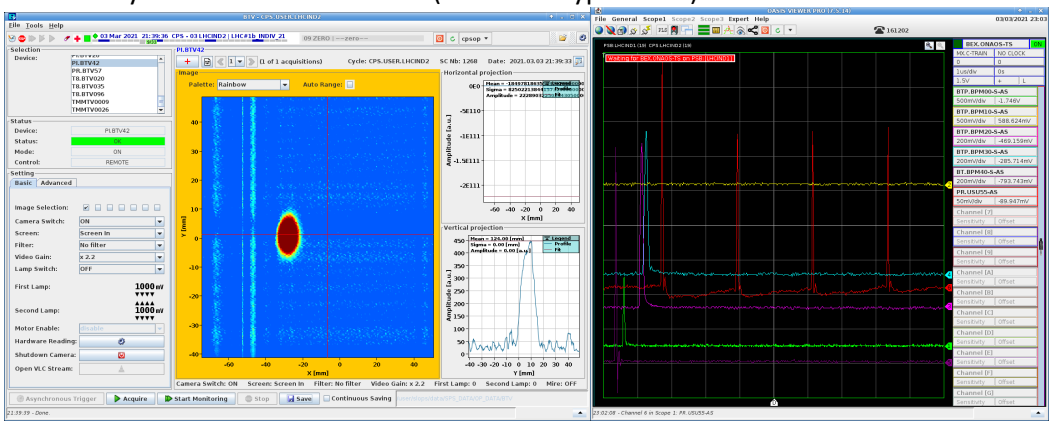
On Tuesday RILIS has tried to tune lasers with the target installed checking for Sm beam. It was not successful due to the target and target experts (SY-STI) decided to change it the day after for a new one.
Target change done on Wednesday and, on the same day, we have tuned stable beam using K mass marker and heating up the target line to check our settings.
Unfortunately, we have found the target heat power supply not working correctly and we have called first line piquet. They came on Thursday morning and they have replaced a PLC in the HV cage. After that RILIS team was able to check the new target with their system. They have struggled to get laser alignment and optimization done for 152Sm, but they have found several hints that the ion source was probably significantly colder than expected from the calibration. It was decided to take the target of on Monday and to perform a visual inspection of it.

PS (Denis Cotte):

Inititally the first beam injection was scheduled for Monday 1 March, but due to the issue with the new injection Septum this was delayed until Wednesday evening 3 March.
The first part of the week was dedicated to the reconditioning of our injection septum PI.SMH42. Several accesses in the machine to monitor the temperature around SMH42 and for 10MHz cavity amplifiers have been made. Meantime, O.Michels carried out the adjustment of PFW compensation with the Bdot signal coming from MU magnet.

Wednesday was a great day! Much of the day was dedicated to SMH42 reconnection (stripline, water, covers installation) in parallel with others accesses mainly for RF(10MHz cavities) and BI(FWS grounding)

- First pulses of injection septum SMH42 around 18h, first pulses of injection kicker KFA45 (following a reconditioning) around 18h30.
- Wednesday evening, the **PS was ready for beam**.
- After fixing last quadrupole issues in BT, the beam reached BTV42 around 19h and performed already several PS turns at 23h. (LHCINDIV type beam)



- Beam crossing transition around 1am Thursday.

Live event media on ***Thursday 04/03 morning.***
Thursday around noon, SMH42 tripped because of a sublimation. Instruction added in logbook to switch SMH42 OFF every day before noon during 15 minutes for the coming 2 weeks.
In the afternoon, BTP kick response performed : BTP.DHZ10 inverted, BTP.DVT10 does not kick the beam… followed by first tune measurements, PS orbit test, YASP, BSM, Tomoscope, BGI (First profiles available on CCC Vistar) and LHCINDIV reached D3 dump with generated settings from model.
In the evening, optimization of transition crossing on LHCINDIV.

During the night several kick responses performed on DVTs(correct), DHZs(calibration curve inverted in LSA), DHZOC(calibration curves inverted in LSA for DHZ60). Test of TT2 SemFils (works fine)
Friday : kick response in TT2 (fine in V, inverted for BHZ117,147,167)
First beam on internal dump 48. Commissioning to be continued on Monday.
In the afternoon, several PS accesses to repair a small water leak on SMH42 and C46 and several front-end reboots.
Later we started working on MTE beam.
During the week-end, we started working on TOF beam.
We successfully tested the generation of low energy working point and also high level knobs Qx_LEQ and Qy_LEQ.
Some difficulties to cross the transition on MTE and TOF beams from Saturday (to be followed by RF expert on Monday).
On Saturday a low intensity TOF beam was sent to D3 dump with generated settings (extraction + TT2).
Sunday, SMH16 was pulsing too low to extract MTE, to be checked on Monday by EPC and some synchronization pulses were lost somewhere between PS and Booster machines.

This week, the aim is to get valid orbit measurements at 14Gev to calculate, and perform the beam based re-alignment of the PS.
In parallel, we'll try to analyze and correct all the small problems encountered with the first beams in PS but nothing blocking for the moment.
All in all, I very good start with beam thanks to all works performed during LS2, HW test and Cold-Checkout periods !

AD (Davide Gamba):

For stochastic cooling kicker, leak detection by vacuum colleagues has identified 2 leaks located in the 2 circuits that are well documented (one leak in the same circuit as 2000, the other one in another circuit). More investigation on Monday to quantify both leaks.

ELENA (Davide Gamba):

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

- Advance on transfer line commissioning by ABT:
    - finished the characterisation of the bad wires in all accessible SEM (4 monitors still not installed in ASACUSA2 line)
    - finished detailed scans of fine delay settings for the different fast deflectors in the transfer lines
    - proof-of-principle extraction of 4 bunches to 4 different experiments (1 to LNE50, 3 to LNE00)
- Studies on acceleration/decelerating cycle with H-:
    - Several measurements of tune and chromaticity at different times along the cycle with/without electron cooler magnetic system on. We keep observing a discrepancy between the programmed working point and the measured one at low energy, while at high energy the model seems to be reasonably predictive. The electron cooler magnetic system has clearly an impact, but it does not seems to be the source of this discrepancy.
- Advancements in e-cooling-related studies:
    - Further tests on the effect of e- vs H- beam orbit in the e-cooler and longitudinal cooling: e-/H- orbit acquisition seems indeed to be a reliable mean to optimise the good overlap between the two beams.
    - Combining most BPMs in the ring is proven to be the most sensitivity tool to measure Schottky
- Tools and systems:

    - Further debugging of new beam request server, which is not yet fully operational.
    - Attempt to re-put in place LLRF system to allow for multiple RF segments along a single cycle. Bugs were discovered, so the system was rolled-back to the previous version.

Additionally:

- Intensity measurement monitors (LPUs) in the transfer lines have been equipment both with current dividers instead of attenuators + filters in the acquisition chain: this is believed to give the most accurate intensity estimate of the delivered beam.
- EPC has performed tuning of the orbit correctors power supplies after their maximum ramp rates have been increased by a factor 10 (460 A/s instead of 46 A/s). Presently the PC stability is around 50 ppm at DC and a maximal error in the range of 1000 ppm at maximum ramp rate.

Problems encountered:

- Instability of the B-train system: a noisy probe was changed on Tuesday on the operational b-train system. Since then, it seems to be working fine.
- Fast deflectors often tripping probably due to mis-configuration of "warning" timing. This seems to be generally under control.

SPS (Stephane Cettour Cave):

Summary week 9:

Main power supply:

- QD pulsed with the FGC
- Still a problem on QF and QS
    - QF under investigation (probably found a problem on crowbar Friday evening TBC on Monday morning with test)
- First measurement on BEQ1 done with dipoles only. To be completed when QF/QD ready

Aux PS continuing according to schedule

- BA1, BA2, BA3, BB3, BA4, BB4, BA5, BA6, TI8, TI2 completed
- Improved noise and following function on MSE6, MST6, MSE4
- Next BA80

Polarity checked

- BA1, BA2,TT20, BA3, BB3, BA4, TT40, BB4, BA5, BA6, TT60, AWAKE, Hiradmat completed
- Next TI2, TI8

Checked all extraction BIC equation except AWAKE
Checked BPM TT10, TI8, TI2, AWAKE, Hiradmat
Checked calibration pulse on BCTs
Solved timing event problem for FEI
Continued debugging the FEI and FII
State SBDS

- MKDV1 -> long pulse conditioned till 31kV (awaiting confirmation from TIDVG team calculation if 28KV will be sufficient for 2021)
- MKDV2, 3 –> Long pulse conditioned till 35.4kV
- MKDH1, 2 -> conditioned till 8kV
    - Cable repair in progress in parallel

General status remarks:

New interlocking systems, ALPS, BLMs, new SEM interfaces, FII, FGC 63, > 1000 SIS interlocks… already operational, well integrated and tested.
Starting to be concerned about overall system readiness: several high priority SPS systems not ready yet:

- FESA devices and final FESA version for Wire Scanners not available.
- RF: Cavity control (basic version promised in two weeks for LSA import; not everything will be ready for start up with beam)
- RF: WR2B: should become available this week

- RF: Remote power control of all cavities promised to be ready 1 week before beam.
- RF: Various aspects and processes under test (loops, RF gymnastics, re-phasing, COAST recover) and not finished.
- Beam dump kickers conditioning late due to hardware problems (albeit, as soon as conditioned; ready to go for final tests like tracking etc.)
- Main circuits: QF; QD not tuned yet

Many aspects with lower priority to come only during run: dI/dt interlock for BCTs, all SPS QC analysis,…

Plans for week 10:

Main power supply:

- Main quads debugging QF, QS
- When main quads will be ready we will do dynamic test on BEQ1 with ABB and EPC

Aux PS continuing according to schedule
SBDS test, BETS….
Heat run, check function following and polarity check on TI8 and TI2
Heat run on TI8 LHC side and check magnets with thermal camera
Test input Ring BIC radiation monitor
Test cable BTV BA2
Access system

- Insert BA80, BA81, ECN3, TCC8, AWAKE and ECA5 under SPS control
- EN-AA pre-tests in preparation for upcoming DSO tests.

AWAKE (Giovanni Zevi Della Porta):

WEEK SUMMARY: Access Week, with primary goal of improving the laser focusing system with off-axis parabolic (OAP) mirrors, to allow higher laser energy without damaging the compressor gratings.

- **Upstream streak camera**: continued optical alignment, using manual slit-control (since motorized one has been sent to manufacturer)
- **DAQ (PXI system)**: temporarily solved the problem preventing remote reset of PLC. Another intervention will be needed to replace the remore-reset system completely
- **TAG41 access**: Civil Engineering inspection
- **Vacuum**: vented laser/proton beamline to allow laser work
- **Laser** (preparation for installing OAP):
    - Alignment of OAP with HeNe in TSG40 (AWAKE laser room)
    - Maintenance of Fiber oscillator
    - Alignment of existing final focusing to virtual laser cameras (VLCs) in low power mode
    - Replacement of final focusing telescope with larger power
    - Realign to VLC and take more transverse profile images
- **Laser** (OAP installation and tests):
    - Place OAP in compressor, align to VLCs
    - Do final small scale optimization of OAP telescope alignment to achieve best possible spot on VLCs.
    - Take transverse profile images with OAP telescope and modified telescope in place.
- **Next week**: pump down the laser/proton beamline and test the performance of the new focusing system in vacuum.

LINAC 3 (Rolf Wegner):

- On Monday the faulty source microwave generator (Sairem2) was investigated but could not be restarted. The spare generator (Sairem1) was connected and beam was back on Monday afternoon.

- On Tuesday normal beam operation was continued with beam and stripper foil measurements.
- On Wednesday two issues stopped the source high voltage: a) a small water leak between two plastic cooling pipes, one on HV and the other on ground potential and b) a small hole in the insulating plate for Sairem1 wave-guide connection to the source. The first problem has been solved, the repair of the second one is in progress.
- Moreover, also on Wednesday, the Sairem1 generator broke with the same fault message as the Sairem2 ("HV supply fault, fault during HV") and could not be restarted.
- The supplier (Sairem) has been contacted for support on Wednesday and Friday. Joint investigations are ongoing, a Zoom meeting will take place on Monday morning at 9 am. In case of need, an intervention of Sairem in Linac3 must be considered as well.
- No lead beam can be produced until the microwave generator is repaired.

LHC (Jörg Wenninger):

S12	**S23**	**S34**	**S45**	**S56**	**S67**	**S78**	**S81**
Cold	Cold	**Phase 1**	**Phase 1**	Realign @ 20 K	Warm up	**Phase 2**	Cool-down

S34 phase 1 tests essentially completed, with 90% of the tests done.
Little activity overall due to the numerous interventions over the ring.
QPS board exchange in S78 in view of the dipole training campaign to start in W10 (Mon. 08.03).