Accelerator Complex Status

End week 12 (Monday 28 March 2022)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- About alarms.
- 645 phone calls (438 incoming, 207 outgoing).
- 106 ODM created.

Events worth mentioning:

- Tue. 22.03,
    - Trip of breaker EMD108/M4 on temperature alarm. Lost 400V for chillers and CV equipment.
    - Low level acid alarm in building 676 STEP. Expert called, after verification on site by the fire brigade. It was a false alarm that will be looked into.
- Wed. 23.03, Raw water in BA82 stopped by accident, quickly restarted by technician.
- Sun 27.03,
    - Switch to summertime: All DAQs went in error, manual restart by operator fixed the problem.
    - Loss of patrol in BA5, due to a PLC card failure.

Details: https://wikis.cern.ch/display/TIOP/2022/03/28/TI+week+summary%2C+Week+12

LINAC 4 (Eva Gousiou):

The availability of Linac4 has been **95.7%** this week. The **~7hrs** downtime was mainly due to:

- [6 hrs] **DTL1** abnormal behaviour during the weekend with frequent sparks. In the end the lowering of the modulator voltage (from -101 to -98kV) brought a stability without compromising beam performance for the moment; RF is looking into it.
- [1 hr]**Timing** update; the update itself required 5-10min but the extra time was for the preparation of the RF and Source before and after the update.
- [15 min] **PIMS0102** trip.

PS Booster (Chiara Bracco):

The PSB had a good week with an availability of about 95%.
The stop foreseen on Wednesday 23/03 went almost smoothly and the beam was back before 12:00. A hiccup with an unplanned access to the switchyard delayed the start of POPSB tests on the special bends. EPC could complete only one out of the two foreseen tests but the key information could be collected and they can now calculate the transfer functions and the delays to apply to Vref to activate the feedforward on these magnets.
The problem with the LLRF, causing voltage spikes and beam loss, persists and became more recurrent last week. Ring4/Sector7/LHC25 is the most affected configuration but similar problems appeared on other users and rings as well. The RF team continues investigating and at the moment the solution of disabling the servo-loops for high order harmonics seems to hold.
The trip of all the RF cavities in sector 7 caused a 1.5 hour stop on Wednesday evening. The problem was solved by replacing a faulty optocoupler.
A 3.5 hours stop occurred during the weekend due to a problem with DTL1.
All beams are in a good shape, some work is foreseen to better tune the LHC25 beam in Ring4 which is slightly larger than in the other rings (10% larger transverse emittance and shaky longitudinal profile). The next step is to assess what brightness can be achieved on this beam.

ISOLDE (Alberto Rodriguez):

It has been a busy (and important) week at ISOLDE. Physics started in the GPS separator last night with the collections of 149Dy in the GLM line and 155Dy in the GHM line. These isotopes decay into 149Tb and 155Tb (the actual isotopes of interest) and they are used for medical applications.
On the HRS side, we finalized the preparation of reference setups to different destinations using a plasma target and installed the first physics production target that we plan to use later this week.
On the REX/HIE-ISOLDE side, we continued with the beam recommissioning of the external ion source, the REX-TRAP and REX-EBIS. We also characterized the beam contaminants produced by the ionization of the residual gas in the REX-EBIS. In parallel, the cryo team started circulating cold He gas to cool down the cryomodules (~ 210 K as of this morning).

In case you are interested, here you have a few more details.

GPS separator:

- LIST target studies continued until Thursday morning
- Target #627 installed on Thursday afternoon in preparation for physics at GLM and GHM
- Proton scan on Friday morning
- Laser set-up on Friday afternoon
- Dysprosium 149 and 155 collections started on Sunday evening

HRS separator:

- Reference setups from HRS front-end to different destinations (RC4, RC3, LA1 and LA2) for a plasma target
- Issue with YRC0.KI70 power supply found. Replaced by First line
- Proton scan Thursday morning
- Yield measurements on Thursday evening
- Target change on Friday morning. The plasma target was replaced by target #654 in preparation for physics in VITO with 37K. Target heating during the weekend went well

REX/HIE-ISOLDE:

- Beam recommissioning of external ion source, REX-TRAP and REX-EBIS continued
- A/q scans to characterize REX-EBIS contaminants due to residual gas ionization
- In parallel, cooling down of cryomodules using He gas started on March 21st. Temperature as Monday morning is ~210 K.

PS (Benoit Salvant):

Week 12 has been a very dense week for the PS, with the setting up for EAST and n_TOF before the start of physics tomorrow, setting up of FTA, as well as delivery of high intensity beams for SPS scrubbing. Availability of beams reached 89% since last Monday at 09:00.

Beam status:

- **TOF**: the cycle is ready to be used for physics on March 28
    - A compromise has been found between RP and SY-STI on the beam size on the target: 30 mm (H) & 13 mm (V) at 850E10 ppp on the SEM grid. A radiation survey will need to be scheduled after a month of n_TOF stable running (end of April, after 30h of cooldown).
    - Intense investigations took place on Friday after Michael Bacak informed us on Thursday that he saw satellites reaching the n-TOF detectors before extraction to n-TOF: RF voltage at injection was changed to remove satellites and the B-ramp during transition crossing was changed to recover the same ramp as 2018. This required regenerating

many settings (e.g. intermediate plateau, PFWs, bunch rotation, tune and kicker at ejection). Once complete on Friday evening, n-TOF said that the beam was in very good conditions for physics and expressed their gratitude to the team for the very quick and efficient response.

- **EAST**: the cycle is ready to be used for physics on March 28
    - A lot of tuning continued throughout the week.
    - Finetuning – in particular to reduce losses – will continue.
    - An optimiser on magnet currents for fast extracted beam improved transmission from 70% to 93%.
    - Another optimiser was used to find an improved septum position/angle, which reduced losses in the ring by 27% on the slow extracted beam at 19E10 p.

- **AD**:
    - Tuning of FTA by SY-ABT continued throughout the week and the weekend.
    - Following the large losses observed on the new BLM248, and the fact that they seemed insensitive to trajectory in FTA, it was decided to roll back to the FTA optics used before July 2021. Losses and transmission dramatically improved.
    - The ferrites installed on the BLM cables of BLM 220, 245 and 250 during the access were helpful in reducing the noise.
    - The beam is now aligned on target (some angle is remaining).
    - Losses and transmission along FTA are now comparable to 2021.

- **LHC25**: delivered to the SPS for scrubbing throughout the week (1.4E11ppb to 1.8E11 ppb)
    - The issue with the phasing of 80 MHz cavities that caused them to trip was solved by the piquet at the beginning of the week.
    - The intensity increase requested by the SPS was made possible by:
        - Adjustments to remove the radial position trim and have full voltage before the second injection,
        - the setting up of the coupled-bunch feedback to mitigate longitudinal instabilities,
        - the setting up of the transverse feedback with the SY-RF expert,
        - increasing the RF voltage at injection from 50 kV to 100 kV, which allowed mitigating horizontal instabilities towards 2E11 ppb.

Issues:

- Access: Wednesday morning in the shadow of the SPS access to re-install the XSEC in F61 (diagnostics for EAST beams):
    - Several other interventions took place (ferrites successfully installed on 3 F16 BLMs to reduce noise, inspection of SMH16 cable routes, work on BTVs and test on modified TFB FESA class).
    - When organizing and approving the accesses, we did not realise that there was an incompatibility of an access in the Switchyard with the PSB POPS-B tests. RP and one expert went in the Switchyard via the PSR. In order to allow for the PSB POPS-B tests to take place, we have put the SWY in “Close” mode, which allowed filtering who was going out.
- The main beam stop of the week due to the PS was a trip of a group of 4 cavities (C10-56, 66, 76 and 81) on a “coarse tuning” fault, which could be reproduced by the RF piquet. The source was

however not understood, but the cavities could be restarted after about 5h. Several less severe trips of single and groups of 10 MHz cavities have perturbed operation, but these calmed down towards the end of the week. One cavity trip of C40-78 caused 50 minutes of downtime as the RF piquet needed to intervene during the night.

- A bad pulse of SMH42 on an LHC beam caused a vacuum spike. Both vacuum and septum were checked and beam was back after 40 min.
- F63.BHZ04 tripped several times and the FGC was replaced. In fact, SY-EPC advised using a maximum pulse length of 450 ms instead of 600 ms.
- A degradation of transmission between PSB and PS when injecting consecutive LHCINDIVs was identified to be due to a wrong window for the measurement of the B field.

PS - East Area ():

Physics start today.

AD - ELENA (Laurette Ponce):

ELENA:

- Work to re-setup RF segments after change of logic during the YETS and re-optimize the Hminus cycle with 2 injections,
- Work on the tools to measure intensity, correct injection oscillation, Schottky, tomoscope
- BI and EPC colleagues investigated stability problem of the V cathode power supply, interlocks disabled in the FGC to allow nominal operation, but work on-going to mitigate the current peaks
- Beam extracted to LNE01 and LNE50 for basic checks, no details analysis
- DSO tests of the experimental zones completed, beam permit signatures on-going

AD target:

- Beam from PS since Tuesday morning after fixing synchronization issue: target out of beam and ~10% of nominal intensity for FTA studies
- Optics studies and re-steering of F16-FTA to minimize the loss on BTI247 (ABT colleagues working over the week-end to optimize beam time)
- Commissioning of the new OTR screen in front of the target: parasitic light sources suppression to be investigated.
- Short test of nominal intensity and beam on target on Friday.

AD ring:

- HW tests of power converters and magnet checks completed (all but QMAIN2 circuit)
- Repair of QMAIN2 power converter started on Friday
- Conditioning of e-cooler completed, nominal pulse on Friday.

SPS (Stephane Cettour Cave):

One of the highlights of this week was to continue the low energy "26 GeV" scrubbing run up to an intensity of 1.5E11 per bunch with 320 bunches scheduled. We reached an intensity of 1.75e11 per bunch by increasing gradually and at the same time we heated the MKP4 at the request of ABT to 66 degrees Celsius knowing that the SIS interlock had a value of 60 degrees Celsius. All of this low energy scrubbing was done with the cavity crabs in the beam line. This until Wednesday at 7H30. After which an machine access of Alf day was planned, in the list below "Done" you can see all the interventions that have been carried out.

Wednesday at 12H00 we removed the crabs cavities from the beam line and set the nominal vacuum interlock thresholds for the MKDH and MKDV, to be able to start the second phase of the scrubbing run with the objective of accelerating 288 bunches at 450 GeV with an intensity per bunch of 1.5E11 a flat top. After the first night of high energy scrubbing run we reached 1.2E11 proton per bunch 288 bunches, we noticed an "abnormal level of loss on BLM 51899" that was not present in

2021. After further investigation we realized that this BLM 51899 was placed between the TIDVG and another BLM which is masked at the time of the dump. In addition, we discovered that BLM 51899 had been wildly disconnected between May 30, 2021 and June 1, 2021, which explained why we had no memory of losses on this BLM in 2021. Following this, BI was asked to implement a solution to detect this kind of problem and we also asked that this BLM 51899 must be masked at the time of the dump like the one that follows it in the sequence.
During Thursday night we reached an intensity of 1.3e11 protons per bunch with 288 bunches accelerated to 450 GeV, and we reached a temperature of 74 degrees Celsius in MKP4. Friday to Saturday morning period was used to cool down the temperature of the MKP4 and Saturday morning the scrubbing run resumed with an intensity increasing. The intensity was increased to 1.76E11 per bunch injected with 288 bunches and we obtained an intensity of 1.6E11 per bunch with 288 bunches at 450 GeV. The beam was dumped sometimes due to the interlock on the TIDVG cooling system to be seen with expert on Monday. We reached sometimes the vacuum interlock of MKDH but after reset by the expert and gently increased the intensity it's fine. Probably the limitation to increased intensity more should be in the longitudinal plan need to be confirmed next week.
Sunday afternoon the goal was to restart the scrubbing run at low energy and try to increase the intensity up to 2E11 proton per bunch with 320 bunches. But at the beginning of the afternoon we had problems with cavity 6 tripped due to high a level of reflection. After intervention of an expert it's ok but not fixed. Then we lost the validity of the patrol on BA5 exactly as the morning of March 16, 2022 like you can see in the logbook.
Restart scrubbing at 18H30
Otherwise during the day RF working on the longitudinal damper, measurement of the voltage in cavities 1,2,4,5 which corresponds to a few percent of the requested setting, first rephasing with the LHC carried out successfully, problem on b train radial jump at the start of the ramp investigation in progress followed by Arthur, measurement of the phasing of the 800 MHz cavities at Flat top.
Impact of BHZ377 on Ring optic matching following by Francesco, measurement of eddy current effects during the ramp on SFTPRO and AWAKE, setting up of LHCBCMS and LHCINDIV cycles with an Indiv beam.

List of resolved/open issues:

- Done:
    - AWAKE electron line magnet pulse in DC during 3 hours OK (The circuits are RQID.412347 and RQNI.412432, 10 A and 360 A respectively)
    - SFTPRO and AWAKE cycles: eddy current data taken for correction model
    - Intervention on Monte charge BA3 repair. But unfortunately it miss some items to repair it
    - TT10 + TT60 fire door: done
    - Defibrillators need to be removed from tunnel access points: done
    - TI8, TI2 two power converters: done
    - AWAKE power converter test (MBI.816 TI8/AWAKE): done
    - Timing system problem with LHC and Hiradmat destination: problem solved and released
    - TPSC4 bad status: PT100 not disconnected during HWC: done
    - Crab cavities out of beam
    - Transformer re-config: done
    - DSO test chain TI8, TI2, Awake passed with success on Friday
    - Switching MM pump in BA5
    - Cedric Baud on cooling circuit septa BA6 changed the filter
    - TDC2 BLM replaced by Ewald Effinger
    - Test SBDS interlock with ABT: done

    - Test MSN max current 1350A at FT with a cycle SFTION alone in the SC IRMS acceptable for the magnet and coil temp max ~83 degrees Celsius
    - Update software MKP, MKQ PLC and cards changed
    - SIS updated to control the level of vacuum interlock for MKP1, MKP2, MKP3
    - Joao Carlos Oliveira started the update RF power PLC but not completed

- Open:
    - Monte charge BA3 repair: need another ½ day with access
    - QS tests (QS still in safe): Charles need 2 hours without beam and machine closed to do some measurements after normally it can put QS in normal spare.
    - Cavity trips 3 and 6: polar loops currently off on all cycles for cavities 3 and 6;Often interlock due to reflexion on cavity 6 to be follow
    - 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
    - BA7 access 2 hours on Monday at 14h00 scan 3D
    - BA4 Ewald Effinger need 2 hours to access and add a BLM inLSS4
    - Joao Carlos Oliveira need 3 hours without beam to update RF power PLC
    - Rama will wish put in beam crab cavities; test with beam in the ramp (1 bunch and 12 bunches); test in flat bottom different orbit bump centred on cavities
    - BA5 Hassane Sabri need 8h00 without beam to change non return valve on MM cooling circuit
    - Monday Arthur need to activate the compensation of the stable phase on all cycle tested on Friday
    - Monday need to consign TBSE TI8 and deconsign TED TT40
    - Cooling TIDVG interlock appeared with High intensity at 450 GeV to be seen with the expert
    - Wirescans on flat top still show strange profile. To be checked with BI experts
    - Problem on access system on BA5 to be followed second time in 3 weeks.

SPS North Area ():

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AWAKE (Giovanni Zevi Della Porta):

Recover from vacuum intervention. Test new electron gun cathode. Laser troubleshooting

- Commissioning newly installed electron gun cathode:
- Quantum efficiency measured. Approx. 5 times higher than previous one.
- [To Do] Beam properties will be studied in Week 13, once UV shape is corrected (see below)

- Commissioning newly installed ICT:
- Sent electron beam through ICT: readout OK.
- [To Do] Charge calibration ongoing (BI-IQ)

- Magnet tests:
- Ripple measurements on RPPCL.BB4.RBI.410010 and RPPDT.BA4.RBI.81607 (TAG41 closed)

- DSO test:
- Successfully tested Proton Beam mode in TAG41. Launched Beam Permit document

- Laser:

- Solved control system issues observed in Week 11, thanks to remote intervention from manufacturer
- Water chiller for Propulse stopped working. Received and installed a spare. Propulse up and running again
- [To Do] Energy meters not reading correctly. Needed for IR laser. Troubleshoot in Week 13
- [To Do] UV laser works but beam spot is affected by damaged optics. Troubleshoot in Week 13

- Streak camera alignment:
- Continuing to work on improving light yield on upstream optical line. Goal: single-shot measurement of electron bunch length

Week 13 plan: Troubleshoot laser issues. Measure electron beam properties from new cathode. Electron beam studies. Potential test of proton beam (Thursday).

LINAC 3 ():

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LEIR ():

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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	29 / 11420 A	71 / 11950 A	87 / 11950 A	76 / 11600 A	62 / 11600 A	21 / 11600 A	55 / 11600

RF modules in S34 warming up slowly. The vacuum insulation was degraded with N2 to ~0.3 mbar to enhance heat transfer. S23 continues to train more slowly than in 2021.