Accelerator Complex Status

End week 24 (Tuesday 20 June 2022)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- About 3'800 alarms.
- 608 phone calls (407 incoming, 201 outgoing).
- 123 ODM created.

Events worth mentioning:

- Mon. 13.06: During a planned intervention on the transformer EHT3/BE1 a reconfiguration of the ME59 was required, which caused a small perturbation followed by a trip of POPS-B. The reason why POPS-B tripped on such a small perturbation is not understood, EPC and EL would like to do a test, doing the same manipulation when measuring on the 18kV supply for POPS-B with an oscilloscope. This test will be proposed in the FOM this week.
- Sun, 19.06, Fire alarms received from RF TX3 klystron in BA3. Fire brigade onsite, smoke was coming from the equipment, and a water leak was found inside. The water had leaked onto electronics equipment, which had caused the smoke. Intervention planned for Monday working hours.

Details: https://wikis.cern.ch/display/TIOP/2022/06/20/TI+Week+summary,+Week+24

LINAC 4 (Luca Timeo)

The availability of Linac4 during week 24 was ~96.5%. The downtime was mainly because of

- [~4h 15 min] non-resettable BAD_PULSE logic: the culprit seemed to be the EINZELLENS power converter's FGC that appeared not ready. PIPO intervened on-site first. Then the SY-EPC control expert remotely. The reboot of the CFC-400-RL4SRC allowed restarting of operation. The fault is likely ascribable to a timing problem related to missing events generated by FGCD1KHZ-CFC-400-RL4SRC. The timing team is working to resolve the issue as SY-EPC, which aims to make their code more resilient to such events;
- [~1h 10 min] DTL1: the LLRF team needed to re-adjust parameters as a consequence of the changed klystron working point (occurred in week 23);
- [~15 min] chopper: two close faults. Ok, after the second reset;
- [~10 min] Einzellens: the power converter tripped and a reset sufficed;
- [~5 min] SIS test system: it caused the overload of the CFV-400-ALLSRC, provoking random data delay and triggering the BAD_PULSE counter. In future, SY-RF will reduce the information exchange with SIS to prevent this problem.

The degraded beam delivery was due to

- [~25 min] CFV-400-BGRIDLN4A: communication problems triggered the SIS, which shortened long pulses. Users longer than 100 turns were affected.

PS Booster (Gian Piero Di Giovanni):

It was a good week for the PSB with ~95% availability.

The main faults were due to Linac4. The PSB related faults were mainly two:

- A maintenance of the SUSI emergency exit in B245 caused a trip of POPS-B. It took ~40 minutes to recover because we launched some investigation to check if anyone had accessed for instance the reference magnet cage. We are following this up with the EN-AA and SY-EPC to find a better

configuration for the maintenance which should not trip POPS-B and we have requested to announce similar tests at the FOM.
    - On a side note there was another short trip of POPS-B at ~8h30 on Monday which took ~20 minutes to recover from. Again, this was not an issue with POPS-B, but a standard operation done on the network switch which was not expected to trip POPS-B. The TIOC is following this closely and possibly we will request some time for a test with all experts on site to understand the origin of the issue.
- An issue with 4 cavity cells down in R1. It unfortunately went unnoticed by OP for almost ~1 hour because there was extremely low duty cycle with no beam using R1 in the SC but AD and, somehow, no issue was reported immediately back.

We have been observing a low loss of performance in term of intensity extracted from the PSB (~1%) for the very same number of turns. It is not a show-stopper as it can be recovered with 1 more turn, but we are trying to understand the origin. An hypothesis is that it could be related to all the changes done on the Linac4 last week, as we finally never had the chance to measure the bunch shape or check the energy matching.

The new 3.0 eVs LHC beam has been made the new LHC operational beam. Improvements have been made on the LIU WS application to ease the life of the BE-OP team with the systematic monitor of the LHC brightness.

RF continued the work on R4 FW to propagate stable settings to all other operational beam, namely LHC, AD, HRS as GPS and MTE had been adjusted last week already. We seem to have gotten to the bottom of the issue and now the future plan is to update the remaining 3 rings with the new FW. But for this we need all experts and some time for the deployment and recalculation of compensation tables. We plan to bring it forward at the FOM when the time comes.

Other than that, the week was mainly focused on physics. Most of the MD users were at IPAC.
Still some good progress on the MD preparation:
- A cycle for the LHC RF calibration was rechecked in the PSB over the week-end.
- A new cycle with single bunch beam at different transverse emittance (1 um to 5 um) for the BSRT calibration has been prepared.
- Progress were done on the preparation of the 1.7 GeV optics. A new optics has been calculated by SY-ABT experts and the plan is to test it remotely on the BTY line. Local tests looked encouraging though.

ISOLDE (Emiliano Piselli):
It has been a good week for the low-energy part of the facility.
HRS:
On Tuesday we have worked on the stable beam tuning. Rilis has optimized their laser.
On Wednesday proton beam scan and then stable beam tuning to IDS, to CRIS and to LA1.
Radioactive beam to users since Wednesday night.
On Thursday a beam instrumentation intervention in LA1 took place. A BD box was exchanged with a spare one because of a short circuit in the FCup repeller voltage.
GPS:
On standby. We have done few test looking at noise level on some beam instrumentation.
REX-Hie:
We have been working on REX, on the phasing of the 7GP1, 7GP2 and 7GP3 structures for a beam with A/q = 4.0. We are having difficulties achieving the beam transmissions we had in the past. We are trying to understand the issue.

PS (Denis Cotte):

C'était une semaine plutôt bonne pour le PS jusqu'à la journée de dimanche.
Quelques interruptions du faisceau à cause des injecteurs, quelques courtes interruptions pour effectuer des « reset » de cavités RF 10MHz et des « reset » de modules de kicker tout au long de la semaine.

Vendredi, le faisceau MTE a été repris par le SPS à l'intensité de 2e13 ppp et nécessitait un peu de setting-up dans la soirée pour minimiser les pertes dans TT10.
Plus tôt dans la semaine, les faisceaux EAST avaient été homogénéisés, un débitmètre en zone secondaire continuait de poser des problèmes et déclenchait un interlock WIC sur des équipements des lignes T9 et T10 mais un accès prévu aujourd'hui Lundi doit résoudre ce problème.
Les faisceaux LHC12b et LHC72b (jusqu'à 72 bunches) étaient disponibles au PS et ont été envoyés au SPS puis au LHC.

Très tôt dimanche matin, un problème sur le retour d'information d'un « beam stopper » de la ligne FTN (STP126) empêchait toute modification de la chaine de sécurité de la Zone « nTOF target ».
Il était dès lors impossible de passer en mode BEAM ou en MODE ACCES dans cette zone nTOF. Ce problème fait descendre la disponibilité faisceau de la machine PS à 80% sur la semaine, bien que seul le faisceau TOF soit impacté.
Après avoir testé les deux systèmes indépendamment, les experts s'orientaient dimanche matin sur un possible problème du châssis d'interface qui nécessite d'être déconnecté pour être vérifié. Cette manipulation engendre cependant la perte de la chaine amont TT2 avec toutes les conséquences sur les autres faisceaux SPS, LHC, AD.
L'expérience nTOF étant désireuse de basculer en mode accès dès que possible, dimanche après-midi fut consacré à trouver une solution pour bipasser la mauvaise condition du stopper 126 en accord avec la safety unit afin de donner accès aux utilisateurs nTOF dans la matinée de Lundi.
En parallèle, la réparation du châssis reste nécessaire et sera planifiée avec les différents clients de la machine PS.

PS - East Area ():

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AD - ELENA (Lars Joergensen):

AD:
Earlier on in the week we had a few trips of the Horn. Wednesday evening this happened again and the experts available were unable to fix it. Hence no beam from 19.30 to 08.00 Thursday morning.
After this the AD behaved admirably for the est of the week ..... well until Sunday afternoon really.
The BHZ Mains tripped several times and the time between the faults got shorter and shorter. We suspected the heat might have had an influence and switched the AD off for 45 minutes to allow the cooling water to really reduce the temperatures.
ELENA:
ELENA worked very well all week without any major problems.

SPS (Giulia Papotti):

The availability of the week is about 48%, mainly due to the ZS, while for AWAKE and LHC it is about 90%.
The week was dominated by the ZS recovery.
The fault started the previous Sunday (and was similar to the fault that occurred one week before).
A first access took place on Monday to investigate, then on Wednesday and Thursday to intervene.
The ion trap feedthroughs of ZS1 and ZS2 were cleaned by sandblasting, and all cables changed (for ZS1-2-3-4-5, including cable-presence pin removal).

After restart, some sparking took place, and it happened mostly for super cycles without LHC beams (i.e. dedicated SFTPRO+AWK).
The expert was called a couple of times for heavier sparking events, and on Thursday night he opened slightly the gap of the ZS2.
On the SFTPRO, The RF settings for the spill were changed to anticipate further the RF off time (from 400ms to 300ms from the start of the flat top), and to test the dependence on the fine regulation of the counterphasing. The first feedback is positive and a further step might be tried out next week.
The losses were again reduced by "degrading" the orbit in the V plane (the suspect is in 419, so a kick was introduced in MDV.41507). The resulting transmission improved both during the ramp and at the flat top.

LHC scrubbing started during the week, and trains of different length from 12 to 72 were extracted (the ZS was not blocking for this).
Time had to be invested on a number of subjects: extraction interlock investigations (ALPS + FEIs, also affecting the kickers, requiring expert investigations), testing of scraping at high energy vs lower energy (losses at high energy prevent it to be used with longer trains, while at lower energy the performance seems to be sufficient at present, but might give concerns in the long run e.g. with orbit stability and corrections).

Concerning AWAKE, the experiment spent the week investigating the issues with seeding at 3e11ppb.
For this, different flavours of the single bunch were provided: 1e11-2e11-3e11ppb and different bunch lengths at extraction (1.0-1.2-1.4ns).
The 3e11ppb bunch was investigated in detail on Friday together with AWAKE colleagues, and seeding could be recovered mainly by increasing the 200 MHz total voltage at the flat top, as this allowed to reduce intra bunch motion that would result in an uneven particle distribution in the bunch (profiles would be “bumpy”, and not smooth).
This could be achieved while the LHC was not filling. Unfortunately when the LHC started filling again another instability came back and spoiled the beam quality. This second instability starts in the middle of the cycle, and has a different signature than the previously described one, it was observed in the previous AWAKE run, but it had recently disappeared.
The suspected correlation with the supercycle change is surprising, and requires further investigations.
A further request from AWAKE is for bunches to be more gaussian (similarly to 2021).

To be noted also:

- the beam dump BEC issue seems solved now (after a couple of accesses and an improvement in the cabling from the PFN to the BETS).
- at times the slow extraction moves and the radial position changes unsolicitedly, RF experts informed and investigating.
- EPC investigated TI2 power converters following neighbourhood noise complaints.
- cooling of cavity 2 amplifier is patched (7h of downtime on Monday), another long intervention is required to improve it.

SPS North Area ():

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AWAKE ():

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LINAC 3 (Richard Scrivens):

The source is running with beam through the RFQ.
Some source timing were not reacting to changes in delays, and this required changing the CRTV.
The buncher at 250keV/u is not yet available for beam commissioning. After commissioning the new amplifier, the cavity has been very slow to condition, and on Thursday it was discovered the tuner could not cover its full mechanical range. RF quickly organized an intervention which could rectify the situation, and now the cavity is again conditioning after having been vented (but not opened). The maintenance of the other tuners is being discussed.
Although beam could be passed through the rest of the Linac at low intensity, almost no full validation has been possible yet without the buncher. RF hope to deliver the buncher today.

LEIR ():

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CLEAR (W. Farabolini - CLEAR Weekly Supervisor):

This week was dedicated to R2E neutrons measurements. An aluminum target (cylinder of diam. 100 and length 300 mm) was installed on the in-air test stand with a shielding wall of lead bricks on one side. PCBs to test (various types of memories) were installed using a dedicated frame support on side and on top of the target. A second experiment was aimed to study the linearity of RPL dosimetry detectors in the range of MGy. These RPL were installed on the rear part of the shorter target (200mm long). A third experiment was aimed to measure neutron energy using time-of-flight (TOF) detected by a diode installed on the wall of the CLEAR.
The expected neutron production being quite low, a large charge per train were requested on the target (50 and 75 nC) as well as a high repetition rate (10 Hz).
The experiment went very well and all the users' objectives were achieved despite many troubles due to the high environmental dose level (turbo-pump controller and cameras damaged).
The last 2 days of the week were used to fix the damaged systems and for a visit of CHUV aimed to prepare their set-up of the coming week.

LHC (Jörg Wenninger & LHC Coordination webpage):

The week began with a stable beams fills at 450 GeV. This was followed by loss maps and interlock BPM validation in view of train injections. During the loss maps an issue was discovered with TCLIA.4R2.B1 (a two beam collimator in the region D1-D2) which generated loss spikes on the beam 2 horizontal loss maps. The reason was tracked to a longitudinal displacement of the injection protection element towards the IP by 2-3m (ALICE request) coupled with the beam separation bump which brings the two beams closer together in the region of the TCLIA (this is not changed since Run 2). As a consequence the margin between beam 2 and the jaw is at the level of 7-8 sigma. For the moment this jaw is retracted which seems to be an acceptable solution for the current optics (phase advance MKI - TDIS).
First injections of trains of 12, 24 and 48 bunches took place on Tuesday and the machine went directly into the **scrubbing** phase. Intially only 12b trains could be stored, 48b trains were unstable and generated beam dumps. Overnight from Tuesday to Wednesday 24b trains could be stored. Strong vacuum activity in new components like TCLDs, TDIS and MKIs limited the number of bunches on beam 1. On Saturday the train length was already increased to 48b with lower octupoles to improve the lifetimes. On Satuday evening fills of **1836 bunches with trains of 48b** had been stored, before stepping up to 72b trains. Unfortunately the night of Saturday to Sunday was lost to due a ADT resynchronization issue. On Sunday the scrubbing team decided to carry on with 48b trains. On the SPS side the beams had to be scrapped a lot (7%) to control the losses at injection into the LHC. It seems the beam cores are very small - emitances in the LHC 1.2-1.4 microns - but with very important tails.
The last optics corrections for waist shifts of beam 2 in IP5 were implemented Friday. On Sunday the complete **nominal cycle was executed for the first time with betalevelling from 60 cm to 30 cm** .

The levelling is very smooth, beams remain well in collision, only small adjustements had to be made. The TCTs were centered for collisions to prepare settings. For the power converter settings point of view the nominal 2022 cycle is ready.
The point 4 cryoplant was regenerated (filter clogging) on Thursday, duration approx 10 hours.
On Sunday a MKB flashover occured on MKBV of B2 during a standard dump at 6.8 TeV. Operation can continue at injection, but an intervention and reconditions is required for the MKB.