

Accelerator Complex Status

End week 23 (Tuesday 13 June 2022)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- About 6'000 alarms.
- 442 phone calls (298 incoming, 144 outgoing).
- 99 ODM created.

Events worth mentioning:

- Tue. 07.06:
 - Short power cut in 513 when an electronics card was replaced. When the new card was installed, all faults were activated by default which caused the power cut.
 - Trip of BA6 septum magnet ED on "user interlock" fault. After investigating it was also found that a filling valve was open at the same time, which could be linked to the interlock that was in fact a "low pressure" alarm (information received later, in TI we only see a "user interlock" alarm)
- Thu. 09.06, Fire alarm building 354 and evacuation building 351. Fire brigade reports nothing suspicious on-site
- Mon 13.06, During a maneuver on the electrical network, a perturbation was created that caused the trip of the PS.

Details: <https://wikis.cern.ch/display/TIOP/2022/06/13/TI+Week+summary,+Week+23>

LINAC 4 (Jean-Baptiste Lallement)

Not the best week ever seen at Linac4 (estimated availability: 80%...)

On Tuesday morning: An avalanche of events (bad manipulation cutting ME43, tunnel ventilation trip, beam mode lost, RF cavities power interlock) caused some significant downtime. During the machine restart, the cavities PIMS 3-4, powered by the same klystron, did not come back to the correct RF phase, inducing incorrect beam parameters at the end of the linac. Once the phase corrected back, the beam could finally be re-established after **2h20 downtime**, although the beam energy at the PSB injection was not exactly the same as before the glitch. In order to clarify the situation, fearing the PIMS 3-4 phase could be lost once again after a restart, it was decided to allocate some time on Wednesday morning to the LLRF team for investigating the issue (**1h30 downtime**). It turned out the cause of the phase loss could not really be explained, but tests were re-assuring on the fact it is a random but very rare event that should not happen anymore. Some other pending activities took place during the stop, and the energy of the linac (phase of the PIMS 3-4), was precisely adjusted at the restart.

On Wednesday evening (20:20), the **DTL1 tripped**. After several resets by the OP team, the piquet EPC was called. After many tries and attempt, and later on with the help of the HLRF piquet, the power could not be re-established in the DTL1 cavity. In the middle of the night, The specialists could not be reached and it was decided to wait for Thursday morning to resume investigation. As soon as they could be reached, they came on site and the cause of the failure could be found, a measurement unit in the klystron oil tank which was replaced by as spare. The machine could then be restarted and the beam sent back to PSB around Thursday noon (**15:30 hours downtime**).

Unfortunately, on Friday early morning at 3:40, the **DTL1 tripped once again**. After the piquet intervention, the specialist of EPC and HLRF came on site and diagnosed the same issue as the day before. The faulty unit which broke again, was not replaced, the klystron settings were re-adjusted to more conservative settings (less voltage and more current), which are believed to prevent such

faults at mid-term if not long term. The beam was resumed around 12:15 on Friday after **8h30 downtime**. After this series of failures, and given the impact on the injector chain, discussion already started on Thursday and will turn out into working group in the coming weeks to identify the weakness(es) of DTL1 RF power supply chain and improve the situation a short-, mid-, and long-term.

With such a week, the weekend could not be totally quiet.

On Saturday evening, the piquet EPC had to intervene to replace a FGC card on the second LEBT solenoid power supply (**1 hour downtime**).

On Sunday afternoon, the DTL1 modulator tripped once again, fortunately, it could be reset, unfortunately, the cavity sparked at the restart and went into the automatic process of field ramping (breakdown recovery process). The cavity came back on its feet after **30 minutes downtime**.

Last night, the DTL3 tripped and cause a **downtime of 10 minutes**. Right after, the DTL1 cavity sparked again and went into recovery mode (**downtime of 1h20**). Note that the 2 weekend events on DTL1 are already precisely looked by the specialists.

[PS Booster \(Jean-Francois Comblin\):](#)

It was not a good week for the Booster with only 79% availability.

Most of the downtime came from the Linac 4 and the DTL1 in particular.

Friday night, POPS-B tripped several times due to the QFO. The piquet was called but did not find the root cause of the problem. He finally replaced the QFO circuit by its spare. This will be further investigated this week.

Specialists profited of the downtimes to do some interventions:

- The distributor was finetuned, following the intervention of last week.
- On POPS-B, a badly connected discharge resistor was fixed. The input filter that was modified during the last TS was totally removed and will be replaced during next YETS.
- LL RF team propagated the script that fixes the gap time error, from ring 4 to all other rings.
- They also measured and installed new cavity compensation tables on all sectors, to solve the issue with the R4 cavity voltage regulation on higher intensity beams. We will see in the following days if it remains stable.

[ISOLDE \(Simon Mataguez\):](#)

For ISOLDE it has been a good and smooth week.

On **GPS**, Target#754 Stable beam tuning from GPS to GHM. Beam to GHM for emission channelling of Ga. Physics Collection started Thursday evening

On **HRS**, Target#755 Physics on target producing Ag (silver) beams to the CRIS experiments until Thursday 09 June 2022 4:10. CRIS run ended with DTL1 Klystron fault on LINAC4.

On **REX**, Investigations on the 7GAP1 RF instabilities/vibrations on going. Since external vibrations lowered, 7GAP1 is stable. Accelerometers have been installed to understand the source of vibrations.

[PS \(Matthew Fraser\):](#)

Ignoring the significant downtime from L4, the PS had a good week with only a few minor faults. The PS takes time to recover from a period of inactivity with unstable MTE and TOF beam production experienced for more than an hour after the first L4 stop. We experienced a similar issue after ITS1 and, although it's expected to be temperature related, the source of the problem and why it seems more pronounced than before LS2 is still to be understood.

The PE.BSW22 tripped and needed expert intervention after the first L4 stop, probably because of the extra number of n_TOF cycles inserted in super-cycle without beam to help warm up the PS.

The intensity on SFTPRO was successfully pushed to 2000e10 ppp on request of the North Area experiments. The stability of the extraction needs further investigation, especially the second batch, which was tripping BLMs in the SPS regularly last week.

The SPS took 12b and 72b LHC25 variants for extraction tests and in preparation for sending trains to LHC.

During the L4 downtime a few interventions could be carried out, including 40/80 MHz cavity PLC updates, investigations for cable routing of the future SMH16 (CONS) and an RP survey to check DFA hotspot which appears to have improved. SY-EPC could investigate the noise induced by the PE.BSWs on PR.DHZ18 and adjust the regulation to reduce the effect. The issue of EM coupling is thought to come via the cable routing, although it is not thought to be new and is likely to have been present for years.

The BI and RF teams demonstrated the use of CO trajectory PUs in the radial loop at low intensities, sufficient to cover pilot bunches and solve the present issues with the low sensitivity RF PUs. Next steps will be a test with ions before ITS2 and potentially an installation during ITS2 to improve the RF beam control.

PS East Area ():

No report.

AD - ELENA (Pierre Freyermuth):

On AD side:

We got time to time a very bad bunch rotation at injection, with half of the beam lost on the first plateau. The issue has been solved by RF then.

We scan the transverse position on the target.

Our SY-STI colleague spent a day to scan the longitudinal position of the target and adjusting the horn strength accordingly. The target has been moved by 40mm (we never tried than much) and the horn is almost at its maximum strength. The Pbar yield increased by 5%.

On ELENA side,

H- source is back in operation after the installation of a new vacuum pump. Gbar experiment is heavily using the H- bunch during working hours.

Solution found for the 20ns jitter on extraction with bunch rotation, to be further investigated by RF.

SPS (Francesco Velotti):

Busy week at the SPS. The week started after a very long stop due to the ZS over the last weekend.

The ZS was closely surveilled and the ABT system responsible tested different ion trap voltage settings to optimise the spark rate. A few sparks were recorded along the whole week, but nothing major until a few hours ago when the same issue seen over the last weekend reappeared. The ZS experts checked the system and signature is really similar, hence access was requested. This implies to cool down the machine for the whole night to allow access for the morning. More news tomorrow morning. AWAKE and LHC single bunch beams are still OK to run as scheduled.

At the beginning of the week, the SFTPRO intensity was also increased to accommodate the new

request from the NA experiments to have sharing of 50/80/135. After the increase, the shift crew found that transmission through the cycle could be improved significantly (almost 4%) by switching off a single corrector at flat bottom - MDV.211. Individual scan measurements show significant correlation with orbit in 217 and in sector 6 - detailed measurements are needed to identify if any new bottlenecks were formed in the machine around these areas. The SFTPRO is now running at about 96% transmission, which was about the nominal value for an optimised cycle in 2021 and 2018.

The TIDP was put completely in and the BLM threshold a increased a little bit to have enough margins - also losses increased in the second part of the week and not clear if this is due to the PS or SPS longitudinal beam quality (most of losses at start ramp and transition crossing). As well as, the BETS issue seems to be back triggering multiple dumps along the ramp of the SFTPRO.

The whole week was impacted by LINAC4 issues which caused almost 24 hours of downtime. Also, there was a very bumpy restart of the PS after LINAC4 returned into operation: SFTPRO and the 12 bunches LHC beam took very long to be back into normal operational conditions. For the SFTPRO, the thresholds on fast running sums of the BLMs in the arcs were increased to give more slack to the PS longitudinal quality. For the 12 bunches, the issue was the wrong field at extraction.

The 12 bunches were taken and extraction test carried out over the second part of the week, following the request from the LHC to have it available over the weekend (now planned for Tuesday though). The scraper was commissioned on PILOT and on the 12 bunches on the final part of the ramp - also commissioning just after the start of the ramp was done, but still missing confirmation of effectiveness with emittance measurements and/or TCDILs losses. Extraction tests were successful only for LSS6 (probably by chance) due to the extraction BPM interlocks. This is now the main unsolved problem for the extraction of multi-bunch beams. It was observed that acquisition windows jitter by a few ms not allowing for stable measurements - during commissioning worked OK after adjusting acquisition window duration (randomly as most of the times masked?) and last year worked correctly for HiRadMat. BI team will investigate this and solve it before Tuesday as LHC will request 12 and 72 bunches.

SPS North Area ():

No report.

AWAKE ():

No report.

LINAC 3 (Detlef Kuchler):

The hardware and beam commissioning is ongoing. The source delivers most of the time around 100 μ A out of the RFQ

(a strange timing issue was found on Monday which could not be solved up to now).

The work on the check lists is ongoing. And also the work on the small amplifiers for the buncher, ramping cavity and debuncher. There a lot of debugging has to be done.

LEIR ():

YETS.

CLEAR (R. Corsini and W. Farabolini):

ast week's (again a short one) program included the continuation of a test of an already installed optical fiber BLM (with BI colleagues) and machine development studies with beam dynamics verification, quad scans and RF monitoring program development. Prior to start the beam, the

conditioning of the recently replaced klystron was also to be achieved. The BLM experiment went very well, with many additional data acquired in a single day, obtained by generating beam losses at various location of the beam line.

One day was dedicated to check quad scan program and to compare the results provided by two different beam dynamic programs with real beam measurements. The two programs give identical predictions but slightly different than the measured beam characteristics. A verification of the models is under way. Another day was dedicated to develop a program that monitor various RF signals in amplitude and phase and compare them with reference data to quickly detect any drifts that can affect the machine. A visit was also given to two German researchers operating a tandem accelerator in Munich, providing the opportunity for interesting exchanges.

[LHC \(Jörg Wenninger & LHC Coordination webpage\):](#)

On Monday second **training quench of the dipole circuit in S23** . Almost at the same time issue on a cryo valve of the RF cavities. By the time the valves was repaired some RF cavities reached 60K. RF conditioning overnight, followed by the intervention on the blower of 7B3 RF power coupler and Tuesday and another night of RF conditioning. In the shadow of those interventions, RB23 was ramped to 11'600A twice: the first time quench at 11'523A, the second time at 11'595A. The cryo system reconfiguration in points 4, 6 and 8 was done Wednesday between 7am and 7pm. Unfortunately a QPS issue required access during the recovery and the at the same time LINAC4 was stopped until Thursday midday.

Optics measurements and corrections at 60-30 cm continued during the week. A first round on Thursday evening and night at 30 cm to determine a global correction. This correction was then tested at 60 cm where it provided good results, but which had to be improved (new correction for 60 cm). The interpolation of the 60 cm and 30 cm to 45 cm (half of each) gave good results. There is still an indication of a waist shift in IR5 for [B2V](#). Following the good progress on the optics, beta* levelling from 60 cm to 30 cm (and back !) was tested with probes bunches. A nominal bunch was ramped, squeezed to 60 cm and collided at 60 cm. With the VDM references for DOROS collisions were found rapidly.

The TDIS was finally aligned after the offsets on the jaw angles were corrected.

Loss maps were performed for the stable beams at injection with the nominal collimation setup at injection for IR7 and IR3 to lower some backgrounds in the experiments. Loss maps were also performed for the nominal injection configuration in view of the scrubbing run that should start in week 24.