

Accelerator Complex Status

End week 20 (Monday 23 May 2022)

Technical Infrastructure (Jesper Nielsen):

Statistics:

5'800 About alarms.

- 809 phone calls (574 incoming, 235 outgoing).
- 132 ODM created.

Events worth mentioning:

- Fri. 20.05, Trip of TCR SEQ8, no impact on operations. Coordinated with LHC operations for a switch on in the afternoon during a planned stop.
- Sat. 21.05, ODH alarm at UJ18. At the same time LHC was preparing to pass to injection (BIW was on). Fire brigade on site. No suspicious readings from cryogenic operations. Sensor was in PM18, Oxygen levels dipped and shortly after recovered, adjacent sensor showed no change of oxygen levels, alarm can be considered as false
- Sun. 22.05:
 - Trip of 24 MVAR filter in SEQ8. Left off for the moment, waiting for a good time to switch back on again, will be coordinated with LHC operations and CRYO.
 - Electrical perturbation on the 400kV line "Chaffard Mions" stopped all machine except booster.
 - Trip of EMD409 on I/O fault. SPS calls first line who asked for EN-EL piquet. No fault on EL equipment, EPC found a problem on the power converters.
- Mon. 23.05, Electrical perturbation on 400kV line, confirmed by RTE. -9.1% measured for 70ms. Trip of LHC, Booster, SPS.

Details: <https://wikis.cern.ch/display/TIOP/2022/05/23/TI+week+summary,+Week+20>

LINAC 4 (Luca Timeo)

The availability of Linac4 during week 20 was ~97.8%. The downtime was mainly because of

- [~2 hrs] RFQ: the filament power supply failed. Specialists from SY-EPC and SY-RF intervened for diagnostics and repair;
- [~50 min] debuncher: the system was not remotely operable as expected. Stop for investigation and allow the RF specialist to replace (twice) a driver unit, which was working by itself (both times) but had unsuitable electrical length, preventing the amplifier from safely operating.
- [~20 min] DTL1: the klystron voltage was unsuitable for some MDs. That disrupted the beam delivery;
- [~10 min] CCDTL0304: the modulator tripped to protect the klystron that induced overvoltage;
- [~5min] chopper: tripped because of a discharge for a single pulse.

TS1 unfolded smoothly and ended at ~13:30. Then, the RF team could profit from a ~3.5h slot to reduce klystron voltages (in collaboration with SY-EPC) and readjust the loops' parameters. This action aimed to make klystron/modulators more reliable and enhance Linac4 availability.

In the same time slot, a breakdown protection and recovery system (similar to the RFQ one) has been installed on DTL1.

PS Booster (Gian Piero Di Giovanni):

It was a good week for the PSB with ~98% availability.

Most of the downtime was due to issues with Linac4. The most notable PSB fault happened after the ITS1 when it took ~1h15m to restart POPS-B from the end of ITS1. The issue was tracked down to a

change of configuration which, because of a bug in the software, caused the configuration to be lost. It is a known issue actively being followed up by EPC.

The ITS1 went generally smoothly and the machine was handed back to OP on time. The most hardware intense intervention was the upgrade of the amplifiers of the RF Finemet system. Now we have both R3 and R4 equipped with the new amplifiers and the upgrade of the remaining rings will be done during the next ITS and YETS. The RF team attempted to deploy to the other rings the new firmware currently under testing on Ring4, and which had providing promising results. Unfortunately, issues causing instability shot-to-shot were observed. While the reasons are being investigated, the firmware in R1-3 was reverted to the previous version.

In terms of beams, the highlights of the week include:

- An improved extraction and transfer line steering to minimize the losses to HRS. This was the last missing piece to the optimization work done this year in the extraction and transfer lines to DUMP/ISOLDE/PS.
- An improved HiRadMat interlock, based on timing destination (before it was interlocking on specific timing users) to ensure that LHC-type beam with larger-than-nominal (more than double) transverse emittance would be sent to the HiRadMat destination to mitigate issues which last year caused the breakage of two vacuum windows.
- A new version of the MTE beam used for physics throughout the week, and which included two modifications: A slightly increased energy at extraction for better energy matching with the PS and a larger-than-nominal vertical transverse emittance ($\sim 4.5 \text{ um}$ at $1.7e10 \text{ ppp}$), as requested by the SPS team.

Otherwise the rest of the week was spent in providing beam for physics and MDs.

ISOLDE (Eleftherios Fadakis):

It has been a successful week for ISOLDE without any issues to report.

HRS

Performed stable beam set up on Tuesday afternoon. Many thanks to Erwin for the help.

Proton scan on Wednesday morning and users took over since then.

Users reported a strange beam profile. Turns out a power supply for YHRS.RFQAX11 needed to be exchanged.

They are supposed to run until this afternoon but they might get a prolongation.

Target is underperforming a bit hence the desire for the prolongation.

GPS

Target change on Thursday for #747 UC LIST

RILIS is working on laser optimisation on this target.

REX-HIE

Tested new FESA class for the Silicon detectors

Everything worked fine.

Many thanks to E. Bravin for coming to the control room and do the tests with OP.

Technical Stop

Some quite important updates took place but they were transparent.

We had a new FGC_63 class deployed.

An update of the central timing.

An update of the INCA server

PS (Benoit Salvant):

It has been a rather difficult week for the PS despite the seemingly good availability of around 91%.

The difficulties started on Tuesday evening when trying to recover from the TS. The TS activities finished almost according to schedule, nonetheless beam was back in the PS only around 18:30. We were facing difficulties providing the operational TOF and SFTPRO beams:

- On the TOF cycle unexplained transition and extraction losses appeared and the PS could initially only provide parasitic bunches to nTOF. Gradually the situation improved and the flux was increased by adding dedicated cycles in the super cycle.
- The SFTPRO beam could only be provided after significant re-adjustment of the MTE splitting and optimisation of the extraction trajectories.
- Without any obvious reason the beam stability steadily improved and around 23:30 all operational beams could again be provided to their users.
- Investigations are ongoing to understand if temperature variations before/after the TS could have contributed to the encountered difficulties.

Considering the time required to fully recover from the TS and comparing it to the short duration of the TS, quite a lot of beam time to the users was lost and the performance recovery turned out to be very inefficient.

Following the AD target exchange, the AD beam was sent with half of the nominal intensity for a period of 3h after the restart. Afterwards the intensity was increased back to nominal and no issues were encountered.

On Wednesday the intensity ramp up on the SFTPRO cycles started, moving in two steps from $1.2E13$ to $1.5E13$ p extracted per PS cycle. Throughout the entire week beam stability was problematic. Multiple times the TT10 BLM measurements went above threshold and the PS extraction trajectories had to be adjusted. Investigations are ongoing to better understand this phenomenon. However, given the complexity of MTE it is clear that sufficient time needs to be allocated to an intensity ramp-up and feedback from the SPS is crucial to optimise the PS beam. Preparing the beam only to D3 is hence not sufficient for a complete setup.

Additional important points from last week are:

- KFA45 started to pulse erratically on Friday evening. Module 2 was understood to be the cause and putting it in standby solved the issue during the weekend. AD and TOF injections had to be adjusted to lower the kick and therefore module 3 tripped several times. To be followed-up with the expert on Monday morning.
- HiRadMat beams were provided at the requested large emittance of ~ 2.5 mm mrad.
- The SFTPRO beams are now delivered at increased vertical emittance (4.5 mm mrad at $1.8E13$ p) as requested by the SPS.
- On Saturday several 10 MHz cavities tripped on a coarse tuning fault and a piquet intervention was necessary
- On Sunday an electrical glitch caused the 10 MHz cavities to trip. Furthermore, a water flow error occurred on two FTN bending magnets, requiring an intervention of first line.
- The RP survey of the FTN line performed during TS1 clearly shows that the modifications of the line pay off and we can continue to provide the requested large beam sizes on target

PS - East Area ():

No report.

AD - ELENA (Lars Joergensen):

It has been a pretty good week at the Antimatter Factory, but of course not without a few problems.

AD

Monday

During the night, Sergio (last weeks supervisor) was called to help fix a trip of the Quad-Mains. A re-set seems to fix the problem. The beam is stopped at 08.30 for the TS. OP7-Exceptional for about an hour is done to give the experts access to try to find out why the BCCCA has been a bit unstable the last week or so.

Tuesday

Blind access to get a dewar in to make sure the BCCCA is full.

Accidentally the Electron Cooler filament has been switched off for the TS. We start switching it back on again. This takes many hours to switch on.

The TS is utilized to swap the AD target to a spare to allow the target team to study in detail any degradation or any other noteworthy observation to gain more knowledge about the processes ongoing. After restart of the Target, we perform a slow conditioning.

During re-start Tuesday evening, the AD ejection septum would not start. After expert intervention, the AD was up and running again!

During the evening the Horn trips a few times but after resets it comes back to life.

Wednesday

During the night the Horn refuses to be re-set. After some tests, we give up for the night and have called the experts to make the resolution of this problem a priority when they come on-site. The problem is solved by 08.30 in the morning.

AD MD during the day involves optimization of SC at 3.5 GeV, Scraper measurements tests, optimization of the target.

The electron energy of the electron cooler is also optimized.

Friday

Finemet cavity trips a few times. Experts fix it.

Saturday

Loses at 3.5 to 2.0 GeV/c. SC apli reset. Expert have a look and tune delays, etc. and get it working again.

ELENA

Tuesday

Access point maintenance as part of TS.

Wednesday

MD to better understand why bunched-beam-cooling just before ejection appears to be detrimental to the beam, while it is needed by Gbar and seems okay to other experiments. Due to a fault with setting of delays, I am not sure if we really can draw any conclusions yet and we will most likely have to re-do this next week.

Sunday

Problems with Central Timing makes the ELENA beam request server come crashing down. Greg saves the day by finding and fixing the timing fault.

SPS (Giulia Pappoti):

On Monday, the pre-technical stop cool down was used for a coast MD for crab cavities (which successfully proved the suppression of emittance growth by machine impedance as predicted in

simulation - with improved noise generation), studies on crystal shadowing, and studies on emittance growth in coast.

On Tuesday the technical stop took place, and the subsequent recovery was long and painful. A couple of planned interventions (i.e. BA3 montecharge maintenance, and a sector door fix) initiated patrol losses, which were then propagated to many other access zones... finally most patrols were lost (BA2, BA3, BA4, BA5, BA6, BA7, TT61, ECN3).

The shift crews spent long hours (12:30-22:30) re-patrolling the machine, while the access coordinator and the SPS coordinator stepped in to man the access console and the CCC. Issues with the access system complicated the picture further: the console software displayed a bug which prevented handing out tokens for access, the list of people in access per zone was not remotely available at the most critical times, the ECN3/TCC8 access chain suffered from a MAD software update of the morning, a returned token was badly detected (these last two fixed by the piquet remotely in the evening).

Discussion are ongoing for possible improvements for such programmed stops in the future (e.g. to discourage movement from BA to BA via the tunnel).

For the SFTPRO, the intensity was increased from $2.0e13p$ to $2.6e13p$ to get to 25/70/100 units on T2/T4/T6.

Beams with improved PSB-PS energy matching and increased V emittances were taken (this to reduce splitter losses).

The intensity increase was done in steps, and care was required by both PS and SPS crews to optimise the losses, especially in the TT2/TT10 transfers.

The ZS suffered increased spark rates over the weekend: the root cause could not be identified clearly, even though a correlation with the supercycle composition is suspected (the worst being 2x SFTPRO + 2xMD1).

The sparking of the ZS1 was eased by opening the gap slightly by the expert.

Beam instabilities also hampered efficiency, and were improved mostly by tweaking radial position at transition and vertical damper loop gain, plus Q and Q'.

The HIRADMT run was scheduled starting on Wednesday.

Single pilots and indivs (up to 4 per cycle) were extracted on the first day.

The run was then terminated because of problems on the experimental detector.

On Friday the HIRADMT2 cycle was nevertheless played to retake the multibunch LHC operational beam.

Four batches of $1.3e11ppb$ $1.6/1.6\mu m$ in H/V could be accelerated to the flat top with up to almost 98% transmission (1.65ns at flat top).

Most of the time was required to adjust the machine, e.g. tunes, chromaticity and Laslett automated corrections, rather than re-scrubbing: no showstoppers were identified (nevertheless the shift crew advanced cautiously and carefully with time in the cycle and the number of batches).

The LHC restart on Wednesday was slightly slowed down by a few issues (MSE6 girder position with wrong limits, leftover from the TS, and the TED being in conflicting modes for AWK and LHC, leftover from the AWK run).

Parallel MDs took place on Thursday and Friday on the subjects of: coherent betatron tune shift measurements, TMCI studies at injection, and PS2SPS transfer studies.

Machine availability at the time of writing: 83%

Main faults:

- recovery from the TS (for the SFTPRO - about 8h)
- ZS (3.5h)
- RQID.88100 and RQID.87900 (FGCs changed, 1h)
- an intervention by the RF power piquet on cavity 5 (<1h)
- the main contributor is the injectors (>10h)

The plan for the incoming week includes the continuation of the intensity increase for the SFTPRO cycle, and taking a few shots up to 12-24 bunches on HIRADMT2 for a BI expert.

[SPS North Area \(\):](#)

No report.

[AWAKE \(Edda Gschwendtner\):](#)

Vacuum access for several BI interventions (BTV screen, Cherenkov BPM buttons, proton BPM)

- Vacuum opened on Monday after RP survey

Vacuum interventions

- Replaced OTR screen on BTV 412442
- Installed Cherenkov buttons in BPM 412351
- Installed proton buttons (taken from 412351) into malfunctioning BPM 412319
- Replaced foil on Laser Beam Dump 2 (LBDP2)

Other interventions

- Repaired filter wheel of BTV 412353
- Installed motorized mirror on upstream streak camera line
- Measurements on ChDR BPMs
- Realigned optical lines of BTV 412442 and upstream streak line
- Reset hardware limits for Laser Beam Dump 1 (LBDP1) which was occasionally sending veto signal to SPS

Pump down started Thursday afternoon

Plan for week 21: access system maintenance in TAG42, streak cameras timing and gain checks with LEDs, replacement of damaged laser filter (FMOUNT1).

[LINAC 3 \(\):](#)

YETS.

[LEIR \(\):](#)

YETS.

[CLEAR \(\):](#)

No report.

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

The stop for the installation of the second half of VELO ended Tuesday evening, but the night was spent recovering from issues. First beam was injected Wednesday morning and a last full cycle was completed with probe on the flat machine.

On Thursday the crossing and separation bumps were switched on at injection together with the ALICE and LHCb spectrometers and the ALICE solenoid. This was followed by a cycle with nominal bump configuration to 30 cm using a probe bunch. With the orbit configuration defined at injection,

work could proceed towards high intensity setup at injection: the first item was the collimation system alignment and the adjustment and verification of the abort gap keeper (AGK) for the nominal 4x72b scrubbing beams. The MKI delays were tuned by 30-80 ns.

In parallel to the work on the nominal cycle, commissioning of the VDM ramp-desqueeze was started with optics and coupling measurements on FT. The beam-beam long range compensators (BBLRs) installed in the TCT jaws of points 1 and 5 were tested on Sunday with probes at injection.