

Accelerator Complex Status

End week 34 (Monday 30 August 2021)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- About 6'300 alarms.
- 688 phone calls (448 incoming, 240 outgoing).
- 101 ODM created.

Events worth mentioning:

- Wed. 25.08:
 - NA62 cooling circuit was stopped for planned works, however SPS was extracting to the north area for a MD at the same time. It was not clear how and where the communication about the intervention was lost.
 - Evacuation of ATLAS. No real alarms were found on-site, possibly due to an intervention on the SNIFFER installation that took place at the same time.
- Thu. 26.08:
 - BA1 access card failure.
 - During a planned power cut of building 513, to test autonomy of UPS's, it was overlooked to switch the safety network over to the normal network (ESD1.02*23) in order to ensure that LINAC4, ISOLDE, AD, ME25 and ME23 would continue to stay powered, which resulted in a power-outage during 10 minutes. When power was switched back on, one of the UPS's had run out of battery and caused a rather big power outage of building 513 itself. It was visible on tools like phonebook, EDMS, EDH, ADaMS and IMPACT that didn't work for several hours until everything had restarted again.
- Sat. 28.08: BA3 Power supplies cooling pump P12200 stops with a fault and tripped the mains of the SPS. A faulty pump was left off and switched to standby pump instead.

Details: <https://wikis.cern.ch/display/TIOP/2021/08/30/TI+week+summary%2C+Week+34>

LINAC 4 (Eva Gousiou):

The Linac4 operation has been somehow eventful this week with the availability at **95.8%**. The ~7hrs downtime was mainly due to:

- **Electrical network** unexpected interruption which caused the loss of power in bldg. 400 followed by the loss of several essential **IT services** [1.3h, Wed]

An additional downtime was due to **operations** restarting the machine, when some active interlocks were missed; we have since improved our control panels to ensure that these are more visible [0.9h, Wed]

- PIMS0102 **modulator** failure which required an after hours on-site intervention; the issue was on the **IGBT driver** board which was replaced. Since this is the second incident in a month, a review would be considered during the upcoming TS [4h, Tue]
- In the shadow of this issue, there was a **Chopper amplifier** failure (it stopped pulsing), that also required on-site intervention; the amplifier was replaced. The faulty one had several damaged components but it has now been fully repaired [1.3h in the shadow, Tue]
- Communication loss with a **BI FEC** causing all the beam pulses to be limited at 100us from SIS; this made the beam practically unusable for PS and SPS. After rebooting the FEC the issue was solved [0.5h, Sat]
- A **Source RF** failure that can be considered uncommon (no trace of another occurrence in the last year), was quickly recovered after a reset [0.1h, Sat].

PS Booster (Gian Piero Di Giovanni):

It was a difficult week in the PSB with various faults and problems.

The major fault happened yesterday night at around 23h00. The root cause seems a communication issue between the distributor and its front-end. After many attempts by the ABT piquet and BE-CEM experts during the night, they run out of solutions and needed a wider team of experts to address the issue. As the distributor could not be reliably operated under such conditions, we had to stop beam operation all night. Hopefully, we will get more news and a fix in the morning.

During the week, the major faults were coming from the B-Train system. We had two separate cases where we lost the B-Train in all rings for all users. These events were different from the ones experienced in the past, which was randomly affecting only specific rings/users. In both instances, the software reset did not help, so the FEC had to be rebooted requiring to stop POPS-B. This action added more time to the recovery process, as we need to allow POPS-B to discharge in a controlled manner and to restart after the FEC reboot. Later in the week, the B-Train experts seem to have found the origin of the problem with the help of the FESA experts. They released an updated version of the class in Ring 2 for testing on Thursday. At the next problem we should be able to confirm if this new software is finally resilient to the problems experienced in 2021. If we do not have issues until the TS, we will plan a stress test during the TS.

Additional downtime was related to issues with the Linac4 or to recover from the loss of powering following the intervention in B512 on Thursday.

For the rest, a few MDs were carried over for testing a new electronic configuration to provide reliable position measurements for large energy spread beams with the BPMs in the BI line, to set up dispersion measurements at the WS location and to continue the validation of the calibration curves of the main magnets in the PSB.

ISOLDE (Emiliano Piselli):

For ISOLDE it has been a good week and from the machine point of view all has been running rather smoothly. Few small issues but nothing blocking physics for long time, except for the PSB problem started on Sunday evening.

As far as the machine is concerned:

GPS:

We have been running the GPS with a UC2C target #709 for the IS665 for experiments in IDS and LA1 beamlines.

Target was installed on Monday. On Tuesday we have spent most of the day heating the target. It was quite difficult due to the strong outgassing of it and we needed to monitor carefully the vacuum. Most of the heating process has been done manually.

On Wednesday we have set up the machine with stable beam and helped users to tune their beamlines. In fact, since they have shared the machine, users needed to do 2 different beam setting up. RILIS setup followed during the same day.

On Thursday early morning I was called because users didn't know how to reset front end HT. I have helped them by phone.

Then, during the same day, we have done the proton beam scan and then yield measurement done by SY-STI target experts. Users got radioactive beam during the night.

On Friday users have taken radioactive beam. Few adjustments were necessary with RILIS, but no major problems on the machine side until 20h00 when I was called because the target heating went down. I have helped users to restart it and then I went to check the machine before letting them taking again radioactive beam at 22h15.

On Saturday I was called at 13h45 because the target HT was failing as soon as protons hit the target. Once at Isolde I have contacted HT specialists (Roger Barlow & Thierry Gharsa). The problem has been worked around by them and it should be addressed today during working hours. Users could take beam at 15h15.

On Sunday I was called at 5h45 because the line heating went down. I have helped the users to restart it and they could get back beam at 6h30.

No beam to users since Sunday late evening for PSB distributor problem.

This week we have to underline an intense use of the BE-OP "Optimizer application" by users. About 100 different optimization scans have been performed and it has been well appreciated because of the time saved for the final experimental beam line tuning.

HRS:

MEDICIS target irradiation on Tuesday and Wednesday.

REX/HIE ISOLDE:

In standby until mid Sept when ISS will take beam again.

PS (Heiko Damerau):

An average week for the PS with only few major issues, mainly at the beginning of the week. A settings fault of an MD beam tripped the injection kicker and a 10 MHz cavity with every cycle played, causing 2h30 intermittent beam availability until the wrong set value (for the control of POPS) was identified. The TOF intensity had to be reduced due to difficulties with two 10 MHz cavities during the night from Tuesday to Wednesday. The PS was not severely affected by the power cut on the Meyrin site on Thursday, and beams were accelerated again once the pre-injectors were back online. The overall availability, including the night of reduced intensity for TOF and faults of the pre-injectors, was about 80%.

The commissioning of beams for the EAST hall progressed well. First beam was sent to the T9 target in the early morning hours on Tuesday, followed by further beam steering and optimization during the week. First beam to T10 was observed on target on Friday afternoon. An extensive programme of RP measurements has been followed, sending various intensities ($8E10$ p/p and $3E11$ p/p) to the different destinations during the course of the week. As a next step, beam to T8-IRRAD/CHARM is expected early this week. The preparation of the EAST beams was nonetheless complicated by settings inconsistencies (LSA versus hardware and MakeRules when copying between cycles).

A short access was organized on Thursday morning for the RP survey of the FTA and FTN transfer lines. No major hotspots were found in FTA, and the location of the hotspots in FTN are at the expected aperture limitations. Several other interventions could be executed in the shadow of the beam stop.

An energy matching between PS and SPS has been performed for AWAKE and HiRadMat beams. The latter beam has been delivered with an intensity of up to about $1.7E11$ p/b in batches of 72 bunches. For studies in the SPS the first LHC-type multi-bunch beam with a two-basis-period cycle after LS2 has been prepared and the transverse setting-up is almost completed.

For the SFTPRO a variant with larger longitudinal emittance has been checked in the PS which avoids that the bunches are kept unnecessarily short at low energy. The operational beams to nTOF and AWAKE, as well as the SFTPRO and AD were produced throughout the week.

PS - East Area ():

AD/ELENA (Davide Gamba):

On Monday July 23rd the first pbar shots were ready to be delivered to experiments, as planned. At first, it was not possible to send beam to the experimental area as the last vacuum valve for each experiment could not be opened due to the vacuum levels in the experimental areas.

ALPHA and GBAR were the only two experiments fulfilling the vacuum requirements with vacuum levels just below the allowed thresholds, but required vacuum expert to open and keep open the valves. Sorted this problem, both ALPHA and GBAR could see pbars from the very first a few shots. During the week, ALPHA seems to have successfully trapped first antiprotons and GBAR decelerated them. ASACUSA1/2 area could also be closed and beam delivered to the last monitor before their vacuum valve, which could not be opened, yet.

The week was then invested in characterising the present beam quality; learning possible unforeseen issues for delivering stable beams to users; perform “transparent” optimisation of the different systems. Some highlights:

- AD still has about 25% less injected intensity than in 2018. This requires optimisation of the target area. Expert will normally be back this week from holidays.
- About 30% of the beam is lost along the AD cycle. Cooling optimisation and working point correction have still to be done systematically all along the cycle.
- AD is now featuring bunched beam cooling on the last plateau before extraction, which might require special attention to ensure stability and quality of the extracted beams.
- AD extracted intensity is about 2.2×10^7 pbars/cycle.
- Considerable amount of time was invested to get an accurate measurement of the injected intensity in ELENA. We are now confident to inject about 2.1×10^7 pbars/cycle.
- Poor orbit and longitudinal stability between AD and ELENA was observed:
 - Longitudinal stability corrected (better than ± 5 ns time jitter compared to ~ 100 ns FWHM bunch length) by LLRF team
 - Orbit instability probably due to AD extraction septa pulse shape: being investigated.
- About 20% of the beam is lost along the ELENA cycle:
 - this cycle is a clone of earlier commissioned H- cycle, basically untouched as first pbar shot in ELENA arrived mid of previous week.
 - Still need to invest some time in working point and e-cooling optimisation.
- Despite the intensity losses, the extracted beam parameters are very close to the design values (if we trust the instruments! Preliminary values):
 - Intensity of 4×10^6 pbar/bunch (design 4.5×10^6)
 - Bunch length of 150 ns FWHM (design 200 ns)
 - Energy spread of 4.8×10^{-4} rms (design 5×10^{-4} rms)
 - Transverse physical emittance of $1.6 \mu\text{m}$ rms (design $1.2 \mu\text{m}/0.75 \mu\text{m}$ rms H/V)
 - So far, there is no reason to believe that we will considerably exceed the delivered beam intensities compared to the design value. On the other hand, it is still too early to say which will be the final emittances.

On the technical aspects:

- Due to the absence of machine vacuum specialist, intervention of vacuum piquet was necessary every time GBAR wanted to take beam (also during the weekend! Thanks!)

- A mechanism to avoid experiments to receive more bunches than required should be found. At the moment, if one user enter his/her area without removing the beam request, this bunch can possible be deflected toward another experiment, which could be perturbed by the additional bunch).
- Calibrated intensity measurement along the ELENA cycle should be made available, possibly using LLRF capabilities.
- It is confirmed that SEM monitor can strongly impact delivered beam intensity, if inserted in the beam line.
- AD/ELENA Baby-Sitting by PS operator over night has started. Simplified status panels and first basic instructions have been made available to operators. Thanks!

Thanks to all people and teams involved to achieve this great result! Congratulations also to experiments that already started taking beam! And best wishes to all experiments for an exiting physics run!

SPS (Giulia Papotti):

The week started for the SFTPRO with a planned intensity increase to $T2/T4/T6 = 80/60/100$ from $T2/T4/T6 = 80/60/30$ that was running over the previous weekend while COMPASS was not taking data.

By Monday evening we could get to almost 3.2×10^{13} p at the flat top (vs the required 3.5×10^{13} p), and we stopped waiting for the ZS+crystal alignment scheduled to take place the next morning.

Further trials on Tuesday evening and Wednesday morning debugged the cycle one step at a time, and finally the actual target could be reached by Wednesday evening, even though the war with instabilities and losses is yet to be won.

The main improvements were given by an increase of the octupoles (2018 values scaled for the new, smaller, emittances), an increase of the tune separation, a reduction of the transverse damper bandwidth, a correction of the stable phase offset to have the phase loop run closer to 0 error during the ramp.

We've been running all week with the 1-turn delay feedback off for cavity 2 to avoid otherwise very frequent trips, while the LLRF and power colleagues try and find a solution.

The SFTPRO week was abruptly terminated on Thursday afternoon, when VSC notified us of a vacuum leak in TDC2.

A first RP access took place Thursday night, the RP survey Friday morning, and the leak detection took place Friday afternoon.

The leak was located on a bellow right after the BPSH.240212, and caused by corrosion from an acid water leak.

The radiation hot spot is before the BSPH.

The leak was repaired by layering varnish + mastik + varnish + mastik, and ideally this would last until the YETS, and be repaired at the end of it.

The pump down was started with turbo pumps on Friday, while ion pumps could be started remotely over the weekend.

In the best case scenario the VSC equipment will be removed Monday morning.

Checks with low intensity are planned when restarting NA extraction with beam to look at the transmission issue between T4 and T10.

AWAKE restarted taking data this week, and profited from a dedicated super cycle for part of the weekend while the NA is off.

The previous rephasing issues did not re-manifest so far.

Part of the time in the weekend was also dedicated to scrubbing, in particular the MKDH (for which additionally the interlock level were raised from $1.5\text{E-}7$ to $3.0\text{E-}7$ mbar).

We could reach $1.7\text{E}11$ ppb at injection and $1.6\text{E}11$ ppb at extraction (20 PSB turns), for 1 batch of 72 bunches.

Controlled longitudinal emittance blow up was used operationally.

Other studies that took place were:

optimisation of slow extraction with octupoles on Wednesday (with plans changed to accommodate no extraction after 12h, thus cool down for BA80 and access at 16h);

flat bottom transmission studies on Thursday (including tune and energy matching optimisations);

TMCI studies on Friday;

commissioning of RF for frequency modulation for ions on Thursday and Friday (positive results on one cavity).

The usual access system trips took place: BA1 on Tuesday morning, Wednesday evening, Thursday morning; BA80 on Thursday.

Note that the film shielding in BA1 was found fallen, and similar film shielding was installed in BA80. R2E is following up to identify which particles are causing the SEUs.

A few accesses took place on Thursday in the shadow of the planned intervention at the injectors (including recovery of Batmon data for R2E studies on the access system).

A dedicated stop on Thursday was negotiated for RF to deploy a new version of the WR2RF, which was followed by synchronisation checks by the FBCT and the wire scanners.

The long standing issue with cavity 6 was likely traced back to a bad connector, and did not reproduce so far since the cable was exchanged.

The weekly AFT availability is 36% at the time of writing - and anyway only 69% up to Thursday 17:00, when we stopped due to the vacuum leak.

Main reasons for the downtime are: vacuum (70+ h), Injector complex (10 h), RF (8h), IT services (3 h), access system (2.5 h).

Plans for the upcoming week include the low intensity checks for NA extraction, to continue the AWK run, and the standard MD planning.

There are no known required stops at this moment.

SPS North Area (Bastien Rae):

- Very reduced beam availability on North Area targets with unstable conditions
- Last Wednesday really difficult to have beam back after MD expert has to be called.
- H2 (NA61)/H4(NA64) à input from B. Rae
 - Both taking data no major issues
- H6 (CERF) à input from B. Dipanwita
 - CERF taking data since Wednesday.
 - Radiation alarm on Thursday from Neutrino platform PPE174 (threshold at 2.5uSv/h) à after investigation the level is still around 1uSv/h even with all beam lines off (muons flux from TCC2 still suspected).
- H8 (ProTOV) à input from A. Gerbershagen
 - ProTOV behind the dump of H8 taking muons.
 - Still not good purity for electron tertiary ($\sim 25\%$) as 2018 à need further investigation.
- M2 (COMPASS) à input from B. Dipanwita
 - COMPASS is ready for data taking on Monday once the full He cooling power is restored, which is temporarily lower due to heating during target polarization build-up.
- K12 (NA62) à input from J. Bernhard

- Continue investigation of T4/T10 transmission issue, see also [IEFC 27.08.2021](#)
- NA62 taking physics data, no further issues reported.

AWAKE (Edda Gschwendtner):

Successful start of 2nd AWAKE proton run. Re-established electron seeding (eSSM) and continue studying it. Commissioning plasma light diagnostic.

Monday, August 23: Proton beam studies to commission multi-screen measurement of proton beam optics. Protons at 3E11, timing-jitter at the 5% level as expected.

Tuesday, August 24: Electron/Proton steering and focusing studies. Proton optics measurements at 3E11 and 1E11, with different BTVs and different screens.

Wednesday, August 25: Access. CV (replace penning gauge), Timing (fibers for 100ps jitter troubleshooting), Laser (setup for 1Hz amplification), BI (troubleshooting BPM 412319H)

Thursday, August 26: Plasma Light diagnostic tests, with and without Rb/laser/electrons using 1Hz laser amplification. Set up and characterization of 3 electron bunch charges. Protons at 3E11, no significant time-of-arrival jitter observed. Studied proton bunch image focusing on downstream streak.

Friday, August 27: Set up and characterization of 2 additional electron bunch charges. Checked timing and trajectory of the proton beam. eSSM studies with 3E11p, focusing on electron beam alignment. Monitored and improved plasma light diagnostics.

Saturday, August 28: SPS proton bunch intensity at 3E11. Long stop of the proton beam from 15.30. Then electron bunch seeding studies until late in the night profiting from only AWAKE in the supercycle (see attached picture).

Sunday, August 29: SPS proton bunch intensity at 1E11, and 4 extractions per cycle from 15PM. Re-established electron-bunch-seeded self-modulation at this bunch population and improved the electron beam alignment.

LINAC 3 (Giulia Bellodi):

It was a good week of operation for Linac3 until Friday.

An average of 35uA beam was delivered to LEIR on Monday and Tuesday.

LEIR went then on a planned survey access until Friday and Linac3 operation continued with the beam stopped at low energy after the RFQ.

On Thursday the source tripped with a solenoid fault (at the same time as the outage in building 513) and was restarted.

Then on Friday around 11h30 the source stopped again with a fault on the HT supply.

This time a team had to intervene on site to test supply and cables. The system was found not capable to hold more than 250V (instead of the usual 19kV) .

After dismantling the RF break, a punch-through was found and the Teflon break was exchanged with a new piece.

Beam was back around 16h in the afternoon. The fault mostly happened in the shadow of the access in LEIR, which restarted after 15h.

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LEIR (Nicolo Biancacci):

Main activities

- Machine survey (from Wed to Fri) by BE-GM.

Fixed issues

- Regulation issue on CRF41 cavity drive module: SY-RF fixed it.

Outstanding issues

- Issue on ITH.BCT41/El.BCT10 current to charge conversion: the ITH.BCT41 device reports a similar number of charges to El.BCT10 (within 5%) but a 25% higher current. The issue is being followed up by experts.
- Regulation on main quadrupoles: tests done on Tuesday on QDN2040 and QFN2344 by SY-EPC: optimization will continue during W35.
- B field re-calibrated by TE-MS to compensate drift along injection plateau. To be checked with beam.

LHC (Jörg Wenninger & LHC Powering Test webpage):

S12	S23	S34	S45	S56	S67	S78	S81
Completed Sector @ 20K	Cooldown	Completed	Completed	Completed	Trained	Cooldown	Training
77 / 11950 A	29 / 11538 A	71 / 11950 A	87 / 11950 A	76 / 11600 A	62 / 11600 A	69 / 11585 A	55 / 11600

Sector 67 trained to 6.8 TeV. Sector 81 reached the target of 11'600A at the 55th quench. BLM TIM activities in S67. Start of collimator machine protection commissioning.