Accelerator Complex Status

End week 30 (Monday 2 August 2021)

Technical Infrastructure (Jesper Nielsen):

Statistics:

- About 4'700 alarms.
- 600 phone calls (443 incoming, 157 outgoing).
- 107 ODM created.

Events worth mentioning:

- Wed. 28.07:
  - lost patrol BA1 - Due to known problem with communications card.
  - Lost patrol TAG 41 - Due to known problem with communications card.
- Thu. 29.07:
  - At 07:37, Electrical cut of power supply for transverse feedback for PS. Indeed the power supply was on a rack that was identified for LINAC4, and therefore the green light had been given to do this intervention.
  - At 23:31, Electrical perturbation recorded and confirmed by RTE on a 225kV line between CORNIER-RIDDES and CORNIER- ST TRIPHON. -19% for 100ms recorded at CERN.
- Fri. 30.07:
  - At 00:16, Trip of RF SPS following an electrical perturbation. No beam at this moment. RTE confirmed the perturbation on the 400kV lin between GENISSIAT - VIELMOULIN.
  - At 17:27, PS beam loss following electrical disturbance on 400kV line Albertville - Montagny Les Lanches.

Details: https://wikis.cern.ch/display/TIOP/2021/08/02/TI+week+summary,+Week+30

LINAC 4 (Giulia Bellodi):

A fairly smooth week for Linac4 operation.

On Tuesday evening CCDTL03-4 went in fault due to a problem on the klystron ventilation system. RF experts were called on site to replace the unit and the intervention took approximately 3hrs.

At the beginning of the week, it was noticed that L4 SEMgrids erratically reported a NOT_connected status, triggering the SIS to shorten the pulse length to 100us. A solution to the problem requires changes both on the SIS application and BI controls sides. After discussion among the groups involved, a decision was taken to disable the SEMgrids server for the time being until the main experts are back from holidays in a few weeks.
Wire scanners are still operational and available for transverse beam size measurements if needed, as they are connected to a different server.

During the weekend L4T.RQF.091 tripped on Sat early morning, and the EPC piquet was called to reset the control card of the power converter.
A couple of chopper trips and a RFQ breakdown error also occurred.

Total beam availability for the last 7 days was around 98% (3.6hrs downtime).

PS Booster (Jean-Francois Comblin):

This was a good and quiet week for the Booster. The availability was a bit more than 96 %.

Most of the downtime was due to faults in the Linac 4. In the Booster, the main problem happened Thursday night, after an electrical glitch, when all the RF cavities tripped. The piquet was called and reset all the amplifiers. The other faults were the usual resets of power convertors. Sunday night, the beam was stopped at Isolde due to a vacuum leak in the BTY line located in the primary zone. This will be followed up Monday morning.

On Wednesday, there was a scheduled 2-hour stop to switch the BI3.BSW1L1.2 power converter from the spare back to the dedicated one. We profited to allow an access in the machine to let the RF specialists do measurements on finemet cavities.

Next week, there will be beam for physics for PS, SPS, Isolde and the parallel MDs will continue as usual.

ISOLDE (Alberto Rodriguez):

It has been a busy and eventful week at ISOLDE. It has also been a very important week for us since we delivered our first post-accelerated radioactive ion beam after LS2. This is a major milestone for the facility.

We have used the HRS front-end to produce a 30Mg+ beam that was transported through the ISCOOL cooler/buncher and accumulated into the REX-TRAP before it was injected into the REX-EBIS for charge breeding. After measuring the ionization efficiencies for different charge states, we chose 30Mg11+ for acceleration in the REX/HIE-ISOLDE linac to avoid stable contaminants at lower charge states. Following the request from the users, we used 16 superconducting cavities to accelerate the beam to an energy of 8.52 MeV/u. We started delivering the radioactive beam on Thursday night and we continued until Sunday night when we unfortunately had to stop due to a vacuum leak in the BTY line.

On the GPS side, our SY-STI colleagues finished their molecular beams development on Monday and several collections were done on the GLM/GHM lines on Monday and Tuesday.

PS (Denis Cotte):

A fairly good week for the PS with around 91% beam availability.
Throughout the week the PS delivered the SFTPRO beams (approximately ~ 5E12 p / p), AD (around ~ 1.4E13 p / p), AWAKE (up to 3E11 p / b) and also nTOF with low intensity (around 2.5E12 p / p) at the beginning of the week for studies of the FTN line (about 8E12 p / p) at the end of the week.

The main beam stops this week were:

- Wednesday, during the planned access for an amplifier change on the C10-76 cavity. During this access, EPC switched the PI.SMH26 (injection septum) and PR.WDNP (PFW) power supplies back from the spare supply to the operational supply. The restart proved to be a little more difficult than expected due to an incompatibility issue with the latest version of the LTIM class. This problem prevented the generation of the 10MHz and 200MHz cavity voltage programs. Then an RF module had to be changed for the distribution of the PS revolution frequency.The beam initially scheduled for 11 a.m. was finally back around 5 p.m.
- Twice this week, electrical disturbances on the 400Kv network caused the loss of the 10MHz, 40 / 80MHz cavities. (First time was during the night of Thursday and Friday in the evening)

- Thursday morning, a power cut for work in building 152 brought down our Transverse Feedback system for about an hour, mainly impacting the LHC and MTE beams.

On the beam side now, the ions were back to the PS at the start of the week, injected into the PS on Monday evening, then accelerated and ejected onto D3 on Tuesday with the 2018 settings for TT2. No more ions available this weekend following the 400Kv glitch on Friday.
Several studies throughout the week to optimize the beam size on the last SemFil / Grid before the nTOF target took place. Eventually, an acceptable size of about 14mm by 14mm at an intensity a little above 8E12 p / p was found. NTOF was therefore provided with a flow of 80E10 proton per second on the target at the end of the week. The factor 2 is still present between the model (optics) and the current in the quadrupoles of FTN which requires some investigation by EPC. Finally, a version of the TOF beam with a lower Bfield ramp rate was supplied this weekend in parallel with the operational version.

The LHC multi-bunch beam (25 ns) with only the first injection was gradually increased in intensity to an equivalence of 2.8e11 p / b for transverse emittance measurements in the two planes.

PS East Area (Bastien Rae):

- Smoothing on going, should be finished next end of next week.
- DSO test plan for the 17th of August.
- No delay foreseen for beam commissioning.

AD (Laurette Ponce):

AD commissioning:

- Most of the week dedicated to set-up of the 2 GeV stochastic cooling: many HW measurement checks have been performed, BTF function measured. Despite some good intensity decelerated to 300 MeV plateau on Monday, performance are not yet recovered and cooling st 2 GeV is not yet good enough to allow setting-up of the ramp to 300 MeV and the electron cooling.
- E-cooling: first adjustment of e-beam energy done on Monday, electron orbit measurement performed on both 300 MeV and 100 MeV plateau.
- still missing ~40 % of intensity at injection but good stability over the week. Some re-adjustment of the dogleg dipoles current allowed increased of 15% .
- A lot of time spent in PAUSE at 2 GeV to allow SC setting, so LLRF progress slowed down. Some work capture, phase and radial loop. Setting up of extraction synchro postponed to next week.

Issues:

- Triangular shape of FGC_62 in DI line still not fixed.
- Change of HW gain on the BPM FESA class to allow good orbit reading, to be followed up when BI expert is back.
- lost almost 1 day of beam time on Wed due to planned access and then RF problem in PS.

ELENA (Laurette Ponce):

- Work continuing on preparing cycle for pbars.
- Study of multi Hminus injection to gain intensity.

SPS (Kevin Li):

Week 30 has been a relatively good week in terms of delivery of physics beams. In addition, it was focused on the follow-up and preparation of mitigations for several outstanding issues, that have emerged from the previous week: T10 instrumentation, AWAKE beam jitters, TT20 vacuum leak, MKDV in combination with the HiRadMat beam, auto tunes,...
Major events and issues:

- Access system - patrol needed for TAG41 early Monday morning; in this particular case, the re-arm procedure did not work due to SW issues. Shields have been installed in BA2 during the access on Wednesday. TT61 access card exchange could not be done on that Wednesday and will need to be planned for the future. Access card replacement required around 1-2h per zone without beam and no access ongoing.
- TT20 vacuum leak - the TT20 vacuum had gotten worse throughout Monday and it became clear that an intervention would be needed in the coming days. It was decided to plan the intervention for Wednesday morning during the dedicated MD slot in order not to impede the physics program. The leak detection had discovered a large vacuum leak on one of the moving bellows of the TT20 Y-chamber in front of the TED. This leak could be temporarily fixed only after several attempts, finally using a Vacseal patch. A replacement chamber had immediately been prepared and will be ready for installation as of next week. For the moment, the vacuum in TT20 has recovered very well. The intervention took most of the Wednesday MD time.
- Auto tunes - coordinating with EPC, a first set of tests on the auto tune for the Laslett corrections was done on Wednesday afternoon without beam, first. In the evening, the beam was taken back and the correction was successfully tested on the first injection. The second injection was taken on the HiRadMat cycle on Thursday to confirm that the tune correction was also operational on the second injection. The issue with the auto tune thus seems fixed.
- MKDV deconditioning - the HiRadMat beam was taken back on Thursday. The plan had been to get back to 4 batches of 72 bunches and to deploy and develop the longitudinal blow-up with the long buffers. In parallel, development and tests of the longitudinal damper were foreseen. Beam availability during the morning had been sparse. Just before noon a single batch was kept circulating with the MKDV1 dynamic pressure saturating just below the vacuum threshold. A second batch was attempted but could not be kept longer than a few 100 ms before it would breach the vacuum threshold. This turned out to be yet a further worsening of the situation compared to the previous week. This behaviour of an already conditioned element is unheard of. It took some time before understanding, after several checks and discussions with the different experts, that in the current situation the most effective means to recover the MKDV vacuum was to attempt a reconditioning of the kicker in a mini-scrubbing run. It was negotiated with physics to take back the long flat bottom scrubbing beam and make sure it is set up and ready when needed for scrubbing. This has been done Friday over noon time; the scrubbing beam is now set up and ready to take on MD5. The current plan is to move to a dedicated mini-scrubbing on Wednesday next week.
- T10 instrumentation - as follow-up from the previous week, with persisting issues with the T10 beam instrumentation, further investigations have been expedited in collaboration with BE-EA, SY-BI, SY-STI, TE-VSC. The TBI vacuum conditions were checked, to exclude any system malfunctioning originating from poor vacuum, as had been the case a couple of weeks before. With BI investigating the instrumentation further, on Tuesday it was discovered, that the calibration factors on the T10 BSIs had not been set. Setting the correct calibration factors finally gave measurable signals in the BSI; an additional factor was added to obtain consistency between the measured values on the BSI and the experimental beamlines. This allowed or positional and angular scans of the BSMs and the establishing of new reference positions. In parallel, BI kept scrutinizing around the TBI SEMs used for the miniscans; by Friday it became clear that the bias voltages required by the instrumentation had not been applied. After fixing this as well, not only the vertical miniscans gave meaningful beam signals, but also the added factor on the BSI calibration could be removed, with the BSI now giving readings withing 10% of the expected values. The remaining issue now is with the BBSH for the horizontal beam size measurement, which is an imperative information needed by the beamlines. Despite all fixes, these still do not show any signal. On Monday morning there will be an access for a visual inspection to investigate any damage of the device, such as broken wires, for example. In

parallel, SY-STI and TE-VSC are preparing a spare TBIU for the case where a replacement might become necessary.

- AWAKE jitters - the AWAKE beam had been available and used at both 1e11 as well as 3e11 ppb. Beam quality had been good in general, but the experiment was struggling with extraction time jitters, which became increasingly limiting towards the end of the week, as the experimental program progressed. On Friday morning a firmware upgrade of the RF beam control was made, in order to provide a setting to help fix this issue. The fix only partially solved the problem. For high intensities, the jitters returned in a yet less deterministic manner. After further investigations, a phase loop instability, emerging during rephasing, was found to hamper the reproducibility of the extraction. Mitigations were studied on Friday evening using adiabatic bunch shortening and a modified voltage program to improve the tracking for the phase loop. After putting this mitigation in place, up to 3e11 ppb could be delivered stably to AWAKE throughout the entire weekend.
- Work has been ongoing for the automatic spill correction to reduce the 50 Hz and the 100 Hz components on the extraction spill. While the 50 Hz component appeared to be hard to correct during the first half of the week, by the end of the week, the algorithm was able to effectively suppress the 50 Hz component on the spill. On the other hand, so far all correction on the 100 Hz have not had any effect. It is currently not clear why the corrections are not able to reduce the 100 Hz component. Investigations are ongoing.
- Loss of cavity 5 over the weekend; required another re-phasing of the cavities.

General situation of beams + follow-ups:

- SFTPRO beams running stably at 1e13 ppb. Still issues with spill corrections. Flat bottom losses are also relatively high and still need to be understood and improved. T10 beam instrumentation not yet fully sorted;
    - T10 instrumentation needs further follow-up; 100 Hz correction to be further checked.
- AWAKE beams running reliably now up to 3e11 ppb; experiment has been happy with beams;
    - Check and understand better the phase loop instability after the adiabatic voltage ramp.
- HiRadMat needs scrubbing. Cannot be taken back with 4 batches at current MKDV vacuum levels. Beam lifetime at flat bottom still rather poor; most likely this is linked to the general observation of poor beam lifetime at flat bottom in the machine. Longitudinal blow-up to be tested with long buffers and at full intensity once re-scrubbed. Longitudinal damper to be deployed on beam;
    - Mini-scrubbing, attempt ramp, perform longitudinal stability development.

SPS North Area (Bastien Rae):

- Good week for the North Area
- Issue with an access door in H6 that was always open despite de status on the zone à expert solve it (~3hrs downtime).
- COMPASS had the safety green light to start taking data on Friday.
- Very good progress on P42 and K12.
    - Steering and focusing done, now last steps include optimizing K12 divergence at the KTAG/CEDAR and optimizing transmission from T4 to T10 in P42.
    - Will check together with OP what can be done about divergence at T4, which seems to be large.
    - Thanks to BI and CEM for finding the correct T10 TBIU position, now BBS ‘mini’ scans can be done
- K12 problem On the weekend one of the FISC seems to not read the count and to not moving correctly à to be check by expert today.
- This week either Wednesday or Thursday, We would like to increase, if possible, the intensity on the targets with ideally 25 on T2, 60 on T4, 150 on T6.
- North Area is now on the AFT. à thanks to AFT experts for their help with implementation.

AWAKE (Giovanni Zevi Della Porta):

WEEK 30 SUMMARY: Second week of proton run. Observed electron-seeded self-modulation of a proton bunch in plasma!

Monday, July 26: Recovery from Access System crash due to failed card. Setup laser and electron beams (aligned to proton trajectories). First attempt at electron seeding, using high-charge electron bunch, tested different electron trajectories. Found a 2.5 ns time jitter in proton events, asked SPS to will investigate
Tuesday, July 27: Setup laser and electrons. More electron seeding studies with low-charge electron beam. Temporary fix by SPS RF for the 2.5 ns jitter in proton time.
Wednesday, July 28: access during Machine Development, and through the evening. Focus on aligning the vapor source diagnostics and the streak cameras. Mysterious loss of patrol possibly due to a loose contact between the CCC and the access system.
Thursday, July 29: complete alignment of downstream-to-upstream streak line, then patrol TAG41. Setup laser and electrons. Proton timing issue (jitter of 2.5 ns) seemed solved, but unfortunately then a 100ps jitter became apparent. Cannot check event-to-event reproducibility for electron-seeding studies.
Friday, July 30: Set up laser and electrons. Most day spent tracking down RF proton issue (100 ps jitter): it seemed to go away with the new firmware installed in the morning, but when we increased intensity (from 1E11 to 3E11 protons) and it came back. Investigation continued by SPS RF experts, and eventually bunch rotation settings were adjusted and jitter disappeared. Started taking protons for physics around 6.30pm. Electron seeding studies with low-charge electron bunch, ~2.5E11 proton bunch. Focus on alignment and started using eBLM scans to check electron trajectory on iris.
Saturday, July 31: Set up laser and electrons. Decided to focus on electron/proton alignment. Asked SPS for a coarse BLM scan with protons, to find exact trajectory w.r.t. center of plasma cell irises. Then a finer scan of the iris edges to increase accuracy. Electron seeding studies with low-charge electrons, low-charge protons (1E11), looked very promising, with clear signs of phase reproducibility!!
Sunday, August 1: Smooth protons from SPS all day. Started with 1E11, then moved to 3E11. Motorized flipper needed for electron bunch length measurement stopped working (verified with a short access). Set up laser and electrons. Reproduced electron-seeded self-modulation with low-charge electrons and 1E11 protons: same results as yesterday after careful alignment. Moved to 3E11, and saw electron-seeding after increasing electron bunch charge.

Program of Week 31 (last two days of proton run): explore parameter space that makes electron-seeding possible (electron beam charge and size, proton bunch intensity, electron/proton alignment.

LINAC 3 (Detlef Kuchler):

- Wednesday some MD's were done: measurements in the LBS line, tests of the CSD scanning app, RFQ transmission measurements and LEBT scans.
- As "result" of the MD's LEIR had a poor injection efficiency. The cause is not yet fully understood and needs further follow up.
- In the night to Thursday a quad tripped and a bending got into an unknown state.
- In the night to Friday a couple of quads and tank 3 tripped.
- During the weekend the oven became finally empty (after 59 days!). It will be refilled today and the beam should be back by the end of the day.
- The energy measurements were done daily.

LEIR (Nicolo Biancacci):

- NOMINAL beam commissioning started: accumulation, capture and acceleration completed.
- EARLY beam delivered to PS since Monday 26/07: transfer line optimization in progress.
- Source "empty" on Sunday, refill will be completed by the end of today.
- "L3_monit" data on LEIR momentum tracking available on BPT.

Fixed issues

- installed new tubes in CRF41, now selected as default cavity for operation.
- CRF43 firmware updated. Servo-loops issue is still under investigation.
- Frequency synchronisation to PS: the LLRF team found a module used for Bup/Bdown switched off. Enabling it solved the synchronisation issue.
- TFB system often in fault due to low cooling water pressure. The RF team raised the interlock level during access on Wednesday.

Outstanding issues

- Extraction line steering to PS: LEIR extraction lines are non-multiplexed while PS is multiplexed. YASP does not accept the two different categories for steering -> this issue is being addressed today.
- After Linac3 MD day on Wednesday, the beam could not be properly injected anymore in LEIR with important transfer line positions change observed. An important hysteresis effect of the ITF correctors is suspected. Linac3 MDs are temporarily postponed to after the LEIR beams commissioning.

LHC (Jörg Wenninger & LHC Powering Test webpage):

S12	S23	S34	S45	S56	S67	S78	S81
CompletedSector @ 20K	Cooldown	**Completed**	**Completed**	**Trained**	**Training** (paused)	Room T, repair	**Training**
77 / 11950 A	29 / 11538 A	**71 / 11950 A**	**87 / 11950 A**	**76 / 11600 A**	27 / 11235 A	69 / 11585 A	14 / 11063

Slow progress with powering and training due to accesses and absence of persons. The new R2E PCs of point 7 (both RRs) have been brought to the surface for a modification. Training of 67 paused following the observation of abnormal earth currents after the FPA during a training quench.

On Wednesday 28th, **incident with the TIM radiation source** (A2 report to be made) when a person came within 2m of the TIM with the source shield open. The incident was due to poor communication with the LHC shifter, displacement of the safety barrier leading to S56 and a wrong mode (automatic restricted) on the PM56 access point.