Accelerator Complex Status

End week 39 (Monday 4 October 2021)

In general:

With only 6 week to go until the end of the 2021 run, week 39 was quite busy week with the start of nTOF physics, a full week of parallel LIU MDs, which have been converted in continuation of SPS commissioning and the LHC TI2 beam test on Friday and Saturday. In all it was also a good week for the majority of the accelerators and facilities with good beam availability for the users.
The coming week will be another busy week with, besides delivering beam for physics, the ion commissioning in the SPS every day from 07:00 until 20:00 and the LHC TI8 beam test on Friday and Saturday.

Technical Infrastructure (*Jesper Nielsen*):

Statistics:

- Slightly more than 4000 alarms.
- 813 phone calls (551 incoming, 262 outgoing).
- 93 ODM created.

Events worth mentioning:

- Mon. 27.09, BA80 cooling temperatures slightly above the thresholds which caused the SPS North Area converters to trip.
- We. 29.09, Local power cut of building 904, 927. Cut of fire detection, racks for CMS, various IT starpoints. The problem was a bad connection on a relais inside the breaker, which was replaced by EN-EL.
- Fri. 01.10, POPS-B tripped after the cooling station had switched to standby pump. The other pump was faulty and smoke was seen in the room by the fire brigade.
- Sun. 03.10, Electrical breaker (EBD2/BHS) tripped in substation for building 904. Caused cut of starpoints, fire and gaz detection, etc. The cause is still not know.

Details: https://wikis.cern.ch/display/TIOP/2021/10/04/TI+week+summary,+Week+39

LINAC 4 (*Piotr Skowronski*):

Up to Sunday evening, 99% availability.

- On Monday SIS reacted because power supply for source extraction was late in delivering data, quick reset.
- On Friday afternoon CCDTL0405 tripped, reset took 20 minutes of beam time
- On Friday night DTL1 tripped. After 2 failed resets first PIPO and later RF specialists were contacted, who managed to restart the klystron. 1h downtime.
- We have occasional interlocks from BCT watchdogs without any good reasons. They are immediate to reset. The specialist was contacted and additional logging was enabled to help finding the origin of the problem.

PS Booster (*Alan Findlay*):

We had a number of faults this week that tripped the beam, and couple of beam stops to repair things.

Wednesday the BI.DIS10 dropped out and it took an hour to get a fix in place, then all beams were back.

It was also noted that BR3.QCD3 was not following the reference current, but this was a non-blocking issue that would need follow up later.

Wednesday we organized a quick beam stop to put the final fix in place for the BI.DIS10(faulty cable changed). There was also a check the power convertor for BR3.QCD3 which was OK, so the problem suspected to be in the machine, probably with the connections.

On Friday the axel of a cooling pump broke taking down POPSB. Although the spare was immediately available, they wanted to check the situation before restarting, as this is a rare occurrence. An hour later we were given the green light and beam was back.

We have organized to have the BR3.QCD3 connections checked tomorrow during the 08h00-09H00 beam stop and access, along with a wirescanner connection check. We will also have a couple of upgrades on the surface, one in the cavity control PLC and the other BI3.BSW1L14 FGC.

Otherwise there were the usual regular resets but all taking a short period to recover from.

ISOLDE (*Simon Mataguez*):

For ISOLDE it has been a good week, all has been running smoothly. Few small issues but nothing blocking physics for long time.

On **GPS**, Target#734 UC VD7 for the ISS experiment at HIE ISOLDE. 212Rn (212Rn50+ beam @ 7.61MeV/u)
Run started Friday 24th September, Very good 212Rn production and good feedback from the ISS experiment. Stopped Wednesday @10.00.
Simulation a “winter physics”_ feasibility of collections in November: experiments could run after protons finish in November.
Target cooled down and irradiated cold with protons until Thursday. On Friday target heated and production of Xe isotopes investigated.
Friday’s evening, target cooled down again for exchange on Monday morning for LIST unit.

On **HRS**, Target#735 UC n (installed Monday 27th September) Setup for 50kV. RFQ in bunching mode. Beam to COLLAPS. with laser spectroscopy on wide range of Pb isotopes to be studied: 187-208Pb
The machine was set up Tuesday and ready for Wednesday (Protons scan and Yields done the morning).
COLLAPS take beam until Wednesday morning.

On **REX-HIE side**
Since Thursday, Beam to Wisard from REXTRAP local ion source.

MEDICIS
2 target irradiated.

PS (*Alex Huschauer*):

The PS had excellent availability of ~95%, with most of the downtime coming from its injectors. Yesterday at around 23:30 one of the PFW circuits (PR.WDW) tripped and required piquet intervention causing a downtime of 1 hour. During the weekend many power converters in the EAST area repeatedly tripped, but could be immediately reset. As this occurred multiple times, the SY-EPC piquet was called, who will continue to investigate on Monday morning.

Protons were on a regular basis sent to the EAST area. For IRRAD, the intensity was increased to 60E10 p on Wednesday and steering as well as optics modifications allowed to deliver beam profiles which satisfy the needs of the users. Commissioning can therefore basically be considered as finished, and calibration works are ongoing from the experiments' side. Beam was also sent to the T9 and T10 targets, where the commissioning of the secondary lines is still ongoing. In addition to the slow extracted beam, a fast extracted beam was sent to the EAST dump in order to test and improve the BCT calibration. During Sunday night, a fast extracted ion beam to the EAST dump has also been set up.

For what concerns LHC-type beams, both 48 and 72 bunch variants were provided to the SPS during their parallel commissioning / LIU MD week. Both variants now use a 40 MHZ cavity during acceleration as Landau system to stabilise the beam longitudinally. Emittance measurements performed at PS flat top seem to be in good agreement with the emittances measured in the SPS at the end of the flat bottom. Furthermore, a series of emittance measurements is being performed at PS injection to investigate potential horizontal emittance blow-up between the PSB and the PS.

To prepare for the upcoming SPS ion commissioning week, both EARLY and NOMINAL beams were injected from LEIR into the PS. Transition crossing was adjusted and the extraction synchronisation was optimised by increasing the extraction field and adapting the radial position on the flat top. After resolving an issue with the phase loop, the 80 MHz cavity now correctly pulses and the re-bucketing works on these users. Applying the 2018 optics settings in TT2, the beams have been successfully sent to the D3 dump since Thursday night.

The AD beam is currently being operated at very high intensity of almost 1600E10 protons. To improve longitudinal stability, some longitudinal blow-up had to be added. Nonetheless, the beam is still being operated at the limit of stability. Furthermore, a new bunch rotation scheme has been tested in MDs, which is based on a phase jump of the 10 MHZ system, which shows good potential to deliver even shorter bunches to the AD target.

PS - East Area ():

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AD - ELENA (*Lajos Bojtar*):

Good week, without major issues in AD and ELENA.
Some improvements were done:

- Optimization of stochastic cooling;
- Enabled radial loop in AD;
- A modest reduction of AD cycle length;
- Optimization on bunch rotation at AD injection;
- Improved AD ejection synchronization with ELENA.

SPS (*Verena Kain*):

2021 record availability in week 39: 89.9 % at the moment of writing (Sunday evening) with the main fault contribution coming from the SPS injectors. Still many cavity trips (i.e. cavity 5). No access system trips!

Busy week in the SPS with LIU parallel MD from Monday to Friday, additional MD on Wednesday as well as LHC TI 2 transfer line test on Friday.
The dedicated MD on Wednesday in TT20 was impacted by the BA80 cooling system maintenance. Beam to targets was only possible until 12:00. The optics discrepancies could therefore not be further investigated. Only final measurements for splitter losses were taken. Also, the test of

Bayesian optimization for crystal setting up in channeling was not successful because the motorisation references had been lost on the front end and the search ranges were hence not adequate. To be repeated still before the end of the run.

LIU MD:
The longitudinal damper was successfully commissioned with beam by the RF team. Only a controls issue still needs sorting out where the damper actions are not transmitted on 1 out of 30 cycles. Work is still ongoing for that. The long. damper was used then for the high intensity tests at the end of the week. Data was also taken to train a reinforcement learning agent for setting up the long. blow up and to model the dynamic effects for tune and chromaticity during the SPS ramp. Another important study this week concerned the bunch-by-bunch tune shift and how to measure and correct it correctly with operational tools.
For the high intensity 25 ns beams, 72 as well as 48 bunch batches were taken injecting up to ~ 2e+11 ppb. The 2BP 48 bunch cycle in the PS was however not as well tuned as the 72 bunch one. So, to test 2 batches of 48 bunches, the 72 bunch cycle with fewer injections from the PSB was used. Although 48 bunches mitigate to some extent the issues with the dynamic pressure rise at the MKDV1 caused by e-cloud, the previous record of 1.6e+11 at flattop (in 72 bunches) could only be marginally exceeded. Long. instabilities during the ramp are kicking in above ~ 1.7e+11 , possibly due to limited power from the RF, and the beam is lost. The usual knobs of long. blow-up (with the current implementation), 800 MHz voltage ratio etc. did not bring sufficient stabilisation. But at least in this manner 2 batches of 48 bunches could be accelerated (albeit not with the correct batch spacing yet).

The TI 2 beam test was carried out on Friday (and in parallel to the long 25 ns beam cycle accelerating beam to 440 GeV). No major issues encountered. The BPMs were not triggering correctly at the beginning with LHC mastership (FESA issue) and the BLMI class needs some attention still (BLM mapping to channels to be checked). Also, the LHC injection kicker could not be timed in due to various issues. The LHC injection kicker test needs to be scheduled again during the coming week. For the LHC test weeks, two cycles have been prepared: one for pilot and one for indiv intensity. This is to allow for on-the-fly switching between the cycles (e.g. LHC filling sequence). They are already saved as compound.

Still suffering every so often from radiation alarms for H6 and COMPASS. Mitigation is required and should be discussed in the coming week. Also, the shift crews are instructed to follow the trend of the vertical drift in K12 and switch off the beam in case it goes beyond limit. In the coming week an automated surveillance of this needs to be put in place.

The ion cycles are ready (except drive issue of main quads on LHCION2).

SPS North Area ():

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AWAKE ():

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LINAC 3 (*Detlef Kuchler*):

- Wednesday morning some of the stripper foils were exchanged by GSI 100 and 130 µg ones. One of this new 100 µg foils is in use since Wednesday.
- In parallel CV switched the pump in the LEIR demin water station to the spare one.

- The restart of tank 2/3 did not work as there was a problem with the OCEM power converter. The colleagues from EPC had to change a relay and a high voltage safety relay. The beam was back 17:21. (Due to this issue the joint Linac3-LEIR MD had to be cancelled)
- Source and linac were running stable. The HV breakdown rate of the source is still much lower than before the last oven refill (20-30 per day).
- The routinely energy measurements were done.

LEIR (*Reyes Alemany*):

Main activities:

- Beam optimization needed after LN3 foil exchanged on Wednesday 29th
- TFB test/commissioning
- Impedance MD
- PS stray field studies

Fixed issues:

- E-cooler had several faults Sunday and Monday (26 & 27 Sep); fixed after changing two auxiliary power supplies of one PLC crate. Sunday 3rd of October e-cooler in fault again, but with different number of e-cooler systems down. Remote reset fixed the situation, therefore, probably not the issue we had beginning of the week.

Outstanding issues:

- multiple mysterious failures on Thursday afternoon; main quads seem to have failed in some manner, but without proper alarm; situation resolved itself Friday morning without a reason being discovered
- Missing OASIS signal for ITE.BHN40, this signal is needed to be able to trace issues with this circuit since we do not have any other diagnostics about pulse shape.

CLEAR (*Roberto Corsini for Luke Dyks*):

The week started with a professional visit to the CLEAR hall by two members of the BERGOZ company staff. Unfortunately due to other commitments from operator staff, Tuesday and Wednesday saw no beam time. Over the first part of the week, the results from previous dosimetry scans were analysed. In addition the commissioning of the robot arm was continued. Beam operation began on Thursday. The moveable YAG screen was re-installed in the in-air test stand without the water phantom. Scans of the position of the screen were completed and the beam size evolution was compared with the same scans in the water phantom. On Friday, this was continued with screen 910 used as a scatterer.

3 GHz operation was setup and investigated. Charges of up to 45 nC were transported to the in-air test stand. The gun BCM saturated at a lower level. It was noted that transport drops slightly when double pulse operation is setup. Long term stability scans were undertaken. Thanks to work of Edu the stability with the double pulse operation was very good. A total stability of 43.7 +/- 0.7 nC (1.6%) was achieved.

(Luke Dyks, CLEAR weekly supervisor)

Full reports can be found as usual here: https://indico.cern.ch/category/10682/

LHC (*Jörg Wenninger & LHC Coordination webpage*):

TI2 transfer line test on Friday October 1st (8:30 to 22:00) with probe bunches.

- Kick response done, to be analyzed but looking good (visually). A BPM plane inversion was spotted and immediately fixed.
- Aperture scan done, aperture lightly larger than in 2018 (> 10 sigma, final value after analysis).
- Issues with BPM acquisitions could be fixed, issue with a older FESA version used so far for the TL BPMs.

- MKI8 could be pulsed based on beam requests from LHC. MKI2 pulsing failed due to BETS interlock.
- Program of tests for ALICE had to be postponed.

S12	S23	S34	S45	S56	S67	S78	S81
Completed	Phase 1	Completed	Completed	Completed	Trained	Cold	Completed
77 / 11950 A	0 / 0 A	71 / 11950 A	87 / 11950 A	76 / 11600 A	62 / 11600 A	0 / 0 A	55 / 11600