

# Accelerator Complex Status

## End week 41 (Monday 15 October 2018)

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### TI (Jesper Nielsen)

Reasonably calm week for the technical infrastructure.

Thu 11/10/18 at 10:53, Electrical power supply (EMD208/E18), which powers the cooling station for the RF test bench in SM18, tripped. The reason is being investigated.

Thu 11/10/18 at 15:07, BA81 FDED-00020 circuit tripped on leak alarm. TI called CV who were already aware as the North Area had contacted them to extend the leak trip sensor limit as they were working on ED circuit. Unfortunately CV did not get enough time to change limit and circuit tripped.

Details: <https://wikis.cern.ch/display/TIOP/2018/10/15/TI+Summary%2C+Week+41>

### CLEAR (Roberto Corsini):

No beam operation took place last week in CLEAR, as was planned. The main activity was the preparation of the machine for the VHEE medical irradiation experiments to be performed in the next two weeks, in collaboration with Strathclyde and Manchester Universities, respectively.

The preparation is nearly finished, in particular:

- Some quads are now connected with new power supplies, with proper cabling to increase their max current to 280A. Final tests with temperature measurements are still to be done.
- The temporary dump for the experiments is in place.
- The experimental set-up for the Strathclyde experiment is in place, linear stages and camera have been tested.

A few small activities need completion, but nothing major. However, the vacuum window placed at the exit of the shortened beam line broke, and will be substituted on Monday only. Therefore, no pumping down over the week-end as foreseen. We still hope to start with beam on Tuesday next week.

### LINAC2 (Francesco Di Lorenzo):

Linac2 is running quit well with 18 flash overs during the week.

### LINAC3 (Francesco Di Lorenzo):

Linac3 is running quit well. On Thursday Detlef Kuchler did the re-fill of the ovens in the LINAC 3 source . The source tripped on Saturday around 2 AM and was restarted by Detlef Kuchler around 6 AM.

### LINAC4 (Bettina Mikulec):

Very good progress in understanding some long-lasting issues of Linac4.

The linac tripped several times per day due to transmission losses (watchdog). These were finally identified to be due to sudden movements of the tuners that receive a spurious signal from the cavities, resulting in a power increase and voltage drop of the affected cavity and subsequent beam losses. On Friday late afternoon B.

Bielawski deployed a software filter that suppresses these tuner movement spikes. Since then not a single watchdog trip until now.

There were also many RFQ trips recently due to spikes of reflected power leading to voltage drops and discharges in the RFQ. In order to protect the cavity, the modulator trips. It is believed that this is due to beam losses in the RFQ, as the RFQ acts as an aperture restriction. Last week the RF team has decreased the Switch and Limit to prevent high power RFQ trips, which also reduced significantly the RFQ/modulator trips despite of an increase of the source current on Thursday.

The longest-lasting fault of 7.5 h happened on Thursday when an FGC62 power converter of a corrector magnet tripped with a fault, which blocked the WIC and therefore the BIS. The piquet changed a faulty electronics board, which then led to a failure of the FGC3 module. The EPC team then tried to exchange these module, but of all modules present as spares in Linac4 none was functional (to be followed up by TE-EPC...). Finally they could replace the faulty module with one from their lab.

We are running since Wednesday evening with the nominal chopping pattern without issues. It seems that between these short chopping pulses the chopping inefficiency is around 3%. It still has to be checked whether this un-chopped beam would or not be transported to the PSB where it would be lost at injection, or if some settings could be optimised to improve the chopping efficiency.

While going around the hor. bending magnet in the transfer line, it was observed that there is a significant energy spread along the beam pulse. To be followed up.

Improvements were made on the controls level to handle multi-cycle operation.

### **LEIR (Nicolo Biancacci):**

In summary W41 was excellent for LEIR, with high availability (almost no faults) and remarkable results achieved:

- Follow-up of the investigation on radial loop pickups issue: The radial position is measured as the average of two TPUs: TPU1 and TPU2 which are PU 32 in the ring and PU 31 in the ring. The radial loop could be closed on average and on TPU2, but not on TPU1. This was back tracked to bad connector on the beam orbit crate (RA F 032): the Delta signal was not received. The connection was fixed. An additional problem was also found: TPUs are cabled inverted in the LLRF, as well as their calibration factors. This was fixed with negligible impact on the performance.
- The oven was refilled on Thursday and beam was immediately recovered afterwards with no relevant issues. After switching back to coupled mode, from Linac3meas cycle in standalone, Detlef Kuchler detected a sudden loss in transmitted current. Tank3 settings are found different which result in different energy/transport: to be checked in detail and made homogeneous.
- During source refill an access was made to identify the source of the vertical LEIR instability: the UQFHV41 (BTF pickup) was reconnected this time and the beam went unstable again. This points without doubts to this device as source of

instability. Next steps: re-measure in detail with VNA, and definitely disconnected it.

- The EARLY beam was completely re-optimized in order to overcome the losses at capture present since the last few weeks: an optimization of the cooling working point was essential.
- The transfer line transport to LEIR was re-optimized in order to reduce to 5-10% the total transport losses (more than 30% before).
- The EI.BPM130 is now connected to a High Frequency system to compute the position (the other transfer line BPMs work in Low frequency). This has been proved to be immune from electrode charging. The systematic logging of the position at this location already helped us in detecting an issue in the EI line during an unwanted trim to the nearby correctors.
- On Friday, very good and high intensity beam was provided to the SPS. A quick tune of the transfer to PS was necessary.
- During the weekend, the very stable 33uA current from Linac3 translates in continuous LIU beams from LEIR ( $N > 9e10$  on average for the Nominal cycles).
- Concerning faults, ER.QFN2040 went in status=ERROR a couple of times.

### **PSB (Fanouria Antoniou):**

A very good week for the PSB with a machine availability of 99.5%, corresponding to a total downtime of 46min. We had only 2 trips: A trip of the BI1.QNO50 lasted 46min and required the change of the control power supply.

Otherwise, the beams requested for the LHC MDs were successfully prepared and as usual, we had a busy MD program with several machine studies: Resonance compensation, emittance measurements, Finemet cavity setting up, horizontal instability studies, transverse feedback. The reference measurements continued also during this week.

### **ISOLDE (Erwin Siesling):**

Another busy but very successful week at ISOLDE:

Focus was on the GPS run for the ISOLDE Solenoidal Spectrometer at the second HIE ISOLDE beamline where we have sent very heavy  $^{206}\text{Hg}^{46+}$  at a maximum energy of 7.38MeV/u since Wednesday-night.

A difficult setup with a very temperature sensitive Pb target using the max nr of STAGISO cycles from PSB we could get. (Many thanks to the PSB OP team for always keeping the max nr of STAGISO available!).

With one of the electrostatic quadrupoles at the Front-End of GPS out of order the setting up and tuning of the beam through the low energy part became particularly difficult but after a few iterations and also retuning of the RILIS lasers to optimise the ionisation of the  $^{206}\text{Hg}$  we managed to improve production and overall transmission. The users received at best 1.2E6pps at their setup which was even slightly higher than in their (over-estimated) proposal.

Users are very happy with the nice spectra they see.

We stopped the run this morning and are preparing for a negative ion run on GPS starting later this week.

We also irradiated a MEDICIS target and there were some tests done from GPS to the new GANDALPH setup at LA1.

Few issues:

- The GPS QS30 quadrupole horizontal plane focus is out of order which makes low energy tuning difficult
- The RILIS edgewave pumplaser broke on Friday-afternoon which caused a downtime of 4 hours to have it replaced by the spare. This new RILIS setup had then a few hick-ups during Friday-night with a humidity and water flow interlock. Once solved the weekend was very smooth with lots of data for the users.

### **PS (Klaus Hanke):**

A good week for the PS with >96% availability.

There were a number of RF trips throughout the week but not causing significant down time. Most of the down time is associated to power converters.

On Monday Wire Scanner 65H was made again operational by the BI expert (front-end power supply changed). On Tuesday cavity 80-08 was tuned for ions. There were also short trips of KFA13 and KFA21. On Wednesday ions were set up to the East dump. In the evening there were 44' stop due to the PSB (R1).

Thursday there were power problems, first 1:42 stop due to the PR.WFNI + PR.WFNP, and then later again 41' for the same problem; later 10' trip of the POPS. Wire scanner 65H was blocked in an unknown position (not in home, but not in the beam either) and the BI expert advised us not to use it until they have checked it.

Friday 2h11' down time due to F61S.QFO01, required First Line intervention.

The rest of Friday and the weekend very quiet, with some RF and PFW resets. To be noted increasing frequency of the trips of C11, which needs to be looked into by the expert on Monday. Wire scanner 65H was declared operational by BI and used during MDs on Friday afternoon.

On request of the LHC the OP team set up BCMS with 1.4e11 and also checked 8b4e.

### **AD (Laurette Ponce):**

The week was dedicated to restart the e-cooler and physics beam in AD.

On Monday, vacuum activity were completed after the leak detection, then e-cooler was reassembled and first HV test could be performed late Monday.

- Tuesday to Thursday were dedicated to conditioning of the e-cooler.
- Nominal voltage of the e-cathode was reached on Thursday evening and we could open valves and inject beam, check cooling and extract first beam.
- Physics resumed on Friday with 2.8-3e7 pbar extracted and 80% deceleration efficiency.

- Over the week-end, we had issue with C10 cavity (not noticed by users) and 2 issues with GEM not reaching IN position for ALPHA and AEGIS. No piquet, expert came on site but could not solve the problem. To be followed up Tomorrow.
- 5 users took beam over the WE (ALPHA, ATRAP, AEGIS, BASE and ASAKUSA) + ELENA/Gbar on Friday.

### **ELENA (Sergio Pasinelli):**

Happy end of the week for the pbars.

#### **Pbar:**

After the restart of the AD, the pbar beam was sent to ELENA which can managed to extract and sent it to Gbar.

For the details on the AD

see <https://indico.cern.ch/event/764709/contributions/3174976/attachments/1732935/2801622/IEFC-AD-Cooler-update.pdf>

#### **H-:**

After an hard work done by the specialists on the source transformer during all the week, H- beam was injected into ELENA at 85KV for several minutes. During these periods H- were extracted and sent to the LNE50 beam stopper.

Unfortunately, several trip due to the 400Hz generator stopped the source.

Investigation is ongoing in order to understand why two 400Hz generators broke.

For the details on the ELENA see:

<https://indico.cern.ch/event/763402/contributions/3168434/attachments/1730095/2796427/AD - rapport FOM.pdf>

[https://indico.cern.ch/event/764709/contributions/3174978/attachments/1732888/2801521/18\\_10\\_12\\_IEFC\\_ELENA.pdf](https://indico.cern.ch/event/764709/contributions/3174978/attachments/1732888/2801521/18_10_12_IEFC_ELENA.pdf)

### **SPS (Hannes Bartosik)**

It was a quite good week for the SPS with a beam availability of about 93%. Since Thursday the LHC was taking indiv beams for their high beta run at 450 GeV, which required relatively frequent refilling. Nevertheless the impact on the North Area physics could be kept minimal. Since Sunday evening the BCMS beams are requested by the LHC for physics production. At the first extractions of 48 bunches the interlock BPM reference positions had to be slightly adjusted. In addition some issues with losses at the PS-to-SPS transfer were encountered, possibly linked to a cavity issue in the PS.

The accumulated intensity on the SFTPRO beam was good this week. However, for some period on Tuesday reduced intensity on T6 was requested by the users due to a problem with the spectrometer of COMPASS. Furthermore, it should be mentioned that there was a problem on the databus of the North Area power converters on Friday evening / night resulting in inverted polarities on several converters in BA81 (as occurred already a few weeks ago). This could be fixed only after several hours by the piquet who replaced a broken cable using the one of a presently unused power converter (PC NR11\_084) due to lack of spare cables. This converter is presently out of order but will be made available again by the specialist on Monday.

Lots of progress was made on the preparation for the ion run. On Tuesday the basic setting up of the SFTPRO prototype cycle was completed. On Friday the long LHC ion filling cycle (with a maximum 12 injections from the PS) was played and setup for the first time. Up to 3 batches could be accelerated successfully to flat top. However, the interlock on the maximum current of the QD main quadrupole was triggered after a few hours of running in the same configuration (this power converter is at the limit for the 450 GeV cycle in the Q26 optics) and tripped the mains twice. This will be followed up by the EPC specialists early next week.

During the dedicated MD on Wednesday 25 ns beams of variable intensity were taken with crab cavities. Strong pressure rise in the vicinity of the cavities were encountered and required some scrubbing. Nevertheless important measurements of induced voltage and the a3 RF multipole components of the crab cavities could be taken.

The long MD on Thursday was devoted to the studies of the horizontal instability with BCMS beams of  $2e11$  p/b. It was observed that the beam suffers a deadfall instability with coupling along the bunch train. The instability growth rate could be reduced by optimising the damper settings at 20 MHz.

Main faults of the SPS this week:

- 1) Recurring BETS issue on Monday could be finally resolved by exchanging the GTO switch trigger unit of the MKD
- 2) A problem with the thyatron heater of the MKP generator 1 required the exchange of an electronics control card
- 3) SMD9, one of the main dipole power converters, is presently out of order as it broke during a trip of the mains on Friday.

### LHC (S. Redaelli and E. Bravin):

Physics production until Thursday morning. Tuesday morning the LHC production passed the **60 fb-1 mark** for the average integrated luminosity delivered to ATLAS and CMS (CMS has 2 fb-1 more than ATLAS). Unfortunately another cryo issue in point 8 (cold compressor broken) on Tuesday late evening gave another 24 hours of downtime.

The high beta run at injection started Thursday morning with the setup of the 11m beta\* configuration for vdm and RP data taking. The setup was completed in one shift, and in the afternoon the machine switched to the high beta at injection configuration. Physics data taking started Thursday evening and lasted until Saturday evening (~ 48 hours), each fill being around 2-3 hours long. Some fills used crystals for collimation, others only used a two-stage collimation system. In all cases the primary collimator / crystal was set at 2.5 sigma. The vdm program started Saturday evening, but was delayed due to high losses in IR7 (and beam dumps) when injecting multiple bunches. The problem was eventually traced to the crystals that had not been moved out of the beam after the RP data taking. The vdm program was finally performed in 2 fills between 03:00 and 13:00 on Sunday. Late Sunday afternoon first RP data taking fill at beta\* of 11m.

Monday (08.10) evening another round of ion cycle commissioning (optics corrections), unfortunately interrupted by a QH discharge.

A cold compressor filter in point 8 started clogging over the weekend and it was decided to regenerate it today. A leak that is most likely at the source of the clogging was found during the morning and will be repaired. Cryo conditions are expected end of the afternoon or early evening.