

# Accelerator Complex Status

## End week 44 (Monday 5 November 2018)

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### TI (Ronan Ledru)

Monday evening, around 20:15 there were two electrical perturbations on separated by 5 minutes that caused quite some machine equipment to trip.

Details: <https://wikis.cern.ch/display/TIOP/2018/10/30/TI+Summary%2C+Week+44>

### CLEAR (Alexander Curcio):

The first two days of operation (Monday and Tuesday) were still dedicated to the Manchester University users.

The experiment of tight focusing of high-energy-electrons in water has been completed for beam energies 100 MeV and 50 MeV.

On Wednesday an access has been called at 8.30 to open the machine and starting the work on the beamline.

The vacuum service provided some help for replacing the gaskets of the CLIC bpm's. The setup for electron irradiation in water has been dismantled, the previous pieces of the beamline have been put back.

On Thursday all these pieces have been aligned and joined together in order to pump the vacuum. At the end of the day, small leaks have been detected and solved.

On Friday (today), a window on the spectrometer line has been replaced, all the cameras along the beamline have been checked and aligned, the beam charge monitors put in the original places.

Setups for next experiments of THz radiation have been finalised.

The primary group for pumping the vacuum has been started.

During the weekend the vacuum is expected to go down to normal values for the activation of the ion pumps.

The CLEAR operation will likely restart at the beginning of the next week (Monday-Tuesday).

### LINAC2 (Richard Scrivens):

Very smooth running, a short fault due to the electrical perturbation on Monday night.

### LINAC3 (Richard Scrivens):

The source stopped during the electrical perturbation on Monday night, but could be remotely restarted.

1 hour later (and unconnected) one of the 1200A solenoid coils in the source went open circuit.

After diagnostics, on Tuesday at mid day it was decided to start a full dismantling to install the spare coil.

By the end of Tuesday the source was open on the support in the tunnel.

TE-MSA made a rapid certification of the spare (which was untested for 10 years).

On Wednesday morning the (800kg) magnetic circuit could be dismantled, rotated and opened.

By the end of the afternoon TE-MS-C could return the spare, and it was squeezed into the yoke.

Thursday the magnetic circuit was remounted and connected to the cooling and power supplies. A fast measurement of the internal field was made and seen to be as expected. By the end of the day the source was pumping.

Friday morning the vacuum was good enough, and the final reconnection and remounting of shielding was made.

In the afternoon the source could be restarted for conditioning.

Conditioning was slow and difficult. A preliminary test of beam to LEIR was made on Saturday, and on Sunday the source was tuned continuously to keep just at the minimum intensity needed for checking out the injector chain.

High intensity out of the Linac at the moment can only be maintained for a few minutes, and then rapidly decays. A rapid restart after the source has been opened for 2 days has never been done before, so timescales are unknown, but it will be at least a week before the source is getting to good stability.

### **LINAC4 (Bettina Mikulec):**

Excellent week in terms of availability for Linac4 (98.5%) BEFORE the weekend...

On Saturday evening a LEBT solenoid tripped and is awaiting intervention.

Also early this morning the source RF HV power supply tripped once more - Monday morning last week a broken 20 kV capacitor inside the 2 MHz amplifier had to be replaced.

During the week the following activities took place:

- Source RF power supply was adjusted after the observed RF power instabilities (ageing tube).
- Sensitivity measurements for BCTs and BPMs in view of post-LS2 commissioning beam → min. pulse length 120 ns
- Stripping foil tests every night
- On Friday a cavity loop module was replaced with its revised version on CCDTL5/6 and the phase shifter between the cavities adjusted. Tomorrow additional cavity loop modules will be replaced for several cavities that do not yet contain the new version, which will require a rephrasing of the linac.

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

The night between Monday 29th and Tuesday 30th the Linac3 source failed on the SOLEXT (extraction side solenoid). This required part replacement and source venting. At the same time, in LEIR, the CRF41 had the final amplifier blower damaged due to a power glitch. It was tried to switch the operational cavity to the hot spare ER.CRF43 but it went into resettable fault (screen bias). The reset did not remotely work from the RF PLC but it was possible from the EPC control panel. The issue required intervention of both RF and EPC experts and it was back-tracked to a defective communication on the opto-coupler card in the EPC electronic crate. Changing the card fixed the communication issue between EPC and RF panels. On Wednesday, the issue on the CRF41 was identified on the pressure transducer that monitors the tube sockets' air flow. On Thursday the RF piquet accessed the machine and repaired it successfully.

On Friday the Linac3 source was successfully restarted, and beam was sent through the RFQ and Tank1. The source tuning continued on Saturday when 18-21 uA were delivered to LEIR allowing initial tuning at low current.

On Sunday, the EARLY beam was sent to TT40, TT60. A fault on CRF41 (HT sum) required the piquet intervention.

Due to beam unavailability, MD studies were suspended with exception of the WR-Btrain reliability run.

### **PSB (Gian Piero Di Giovanni):**

Another excellent week for the PSB week with better than 99% availability, as in the previous one.

Some issue were observed with the extraction synchronisation of ISOLDE beam in Ring4 when using the recently updated firmware of the Finemet cavities, so we reverted to the standard ferrite system while the RF experts investigate.

The operation crew was kept quite busy trying to manage the hectic daily MD schedule, the COLDEX run and the preparation of a last minute LHC request of a VdM-type beam needed to repeat the low energy high beta scan, which was requested in order to fill the gap created by the delayed start of the ions run.

### **ISOLDE (Eleftherios Fadakis):**

On HRS, TISD successfully tested a prototype target which has the neutron converter in the middle and the target material is around it.

On GPS, delivering beam( $9\text{Li}^{3+}$ ) to the scattering chamber in XT03 from Wednesday until Monday morning.

Started with a pilot beam of  $12\text{C}^{4+}$  which users used on Monday night to calibrate their experiment.

Physics where performed with  $9\text{Li}^{3+}$  at 8MeV/u. This is a challenging beam due to the very light mass of Li and to the fact that stripping foils need to be used to clean the contaminants.

Despite a very good overall transmission ( ~100% for the low energy part, ~4.4% efficiency of TRAP and EBIS and ~74% for HIE LINAC) users were getting around  $2.5\text{E}5$  for a 2 microAmp proton beam current instead of  $1\text{E}6$  due to low target production. Line heating tripped two times during these days causing down time of few hours.

I would like to thank our PSB colleagues, for doing their best to provide the maximum amount of protons possible (even on MD day(s)). This compensated, even if slightly, for the low target yields and helped to increase the particle per second arriving on the experimental station.

### **PS (Ilias Efthymiopoulos):**

A busy week for the PS machine with 80.6% uptime according ot AFT tool(total – for all destinations). The PS delivered beams to all destinations including protons for SPS, nTOF, AD, East Area and LHC as well as Ions ( $\text{Pb}^{54}$ ) early in the week and again

on Sunday evening. On Tuesday (31/10) morning the bipolar power supply of the extraction bumper BSW22 failed. The origin of the failure was water dripping on the power supply from the roof of the building that short-circuited the power thyristor of the supply. Other elements of the supply were damaged as well from the shock. The BSW22 bumper is part of the PS extraction to SPS that needs to be pulsed in one polarity (negative) for the MTE beam and the opposite (positive) for all other beams (SPS/AWAKE, AD, nTOF, LHC). The spare bipolar power supply was re-cabled in 2015 to BSW14 bumper to optimize the MTE extraction. As the problem was difficult to fix, it was decided to connect the BSW22 bumper with a spare unipolar power supply, such to maintain the possibility to serve the majority of the users (including SPS for the COLDEX MD on Wednesday, AD, nTOF and LHC) but sacrificing the MTE beams. The BSW22 power supply was finally repaired on Wednesday (01/11) afternoon, requiring a stop of approx. 2 hours of all beams, and a total of approx 30 of down time that explains the poor statistics of the week.

On the good news, on Tuesday (31/10) PS reached the annual planned delivered intensity on nTOF target. We are now at  $2.23E19$  pot, or +2.7% higher from the year's goal of  $2.17E19$  pot.

Studies on the 10Mz C11 cavity performance that was equipped earlier with a first-of-series model of an amplifier, foreseen to be used in all cavities revealed a problem, in particular for the high-intensity beams. We have to plan for a 2h access this week to put back the pre-series model of the amplifier that was working fine earlier. It is an important test that would allow to timely identify possible issues with the new design of the amplifiers.

PS runs also a full MD program with several sessions ongoing (50 MD user cycles played for the last two weeks!), with all teams trying to collect data before the proton run ends for LS2.

### **AD (Bruno Dupuy):**

The AD was running well this week, with good intensities.

Only one problem:

The rotation bunch cavity C10-26 is tripping several times this week. The intensity was reduced by 30% during this perturbation. The specialist has been coming locally because the restart was becoming impossible remotely. The devil seemed to be hiding in the filament power-supply resistor (repair from 11h to 19h this Saturday). Other disruptions smaller, but without serious hardware problems.

### **ELENA (Tommy Eriksson):**

A brief summary of last week's activities:

- Beam shared between ELENA commissioning and Gbar experiment, sometimes running in parallel.
- Many fruitless attempts to reduce the 50% losses we have during the last ramp down to 100keV : Working point tuning throughout the cycle, tests of new working point on the opposite side of the diagonal, RF parameters, influence of vacuum gauge magnets in proximity of the circulating beam, cycle optimisation (roundoffs, ramp lengths), studies on RF self bunching and possible noise etc.
- Completing the optics model w. kick response measurements

- Gbar transfer line: SEM monitors tested and beam profiles obtained in 3 different locations. Only 1 set of electronics available which was moved between the different monitors.
- Gbar transfer line: work on optics validation (kick response and Q scans), steering to Gbar
- Some progress on setting up the Gbar decelerator (together with the Gbar team)
- LL RF FESA class upgrade to accommodate for easier cycle programming and more features, some time was needed for debugging.

Now we have started the very last week of ELENA beam commissioning for quite some time...

### SPS (Verena Kain)

The beginning of the week was still mainly dedicated to finishing off the last LHC MDs. The partially stripped ion beam foreseen for Tuesday could not be delivered due to the LINAC3 source solenoid break down. Ions were then only back in the SPS Sunday afternoon with very low intensity. The extraction with ions in Q26 is set up to the TT40/TT60 TED after the extraction and TCDI setting up with Q26 protons the day before. The trajectory for beam 1 will need further adjustment to recover the required change of the extraction bump after aperture optimisation. This will be done Monday morning.

On Tuesday at about 13h00 one of the extraction bumpers in the PS broke down and it could only be replaced with a unipolar one. As the MTE beam needs negative polarity and all the other beams positive, the NA did not receive any beam from Tuesday about 13h00 to Thursday evening after the MD. The PS bumper was repaired again Wednesday afternoon.

The 24 h COLDEX run foreseen for Wednesday 8h00 could only start properly at about 13h00 due to a problem with the BA4 lift and then insufficient beam quality for some time. Another two hours were then lost from 15h00 to 17h00 due to the final tests for the repaired extraction bumper in the PS.

The COLDEX run was then followed by an important slow extraction MD on Thursday, where several major breakthroughs for loss reduction and automation could be achieved. Octupole phase-space folding to reduce the density at the ZS wires was successfully tested and resulted in a 50 % loss reduction. Later on during the day this was combined with the bent crystal shadowing the ZS in channeling mode which gave another 40 % loss reduction. The factor 4 loss reduction required for the BDF/SHiP facility is hence almost within reach. In parallel noise injection on the main circuits was performed to characterise in more detail the transfer function to the beam and also the slow extracted intensity. And last but not least an automatic ZS alignment algorithm (9 degrees of freedom - all anode ends except the ZS1 upstream) was tested based on the Powell algorithm. The team achieved an alignment time of 40 minutes from scratch (all anodes at zero) compared to the typical setting up time so far of  $\sim 1$  shift.

From Thursday evening to Friday morning the crystal was left in beam aligned for volume reflection mode giving a 20 % loss reduction in the LSS2 extraction region. The losses were stable throughout the night.

The North Area agreed to 2h of no beam/reduced intensity on Friday to finish the fixed target as well as some of the dedicated LHC reference measurements. All fixed target beam references are taken. The main outstanding reference measurements are the COAST ones now.

Sunday evening ~1h30 were lost for LHC and NA as the injection pre-pulses were not distributed from the Faraday cage.

### **LHC (D. Nisbet & S. Redaelli & 8:30 meeting):**

End of MD4 on Wednesday morning, followed by TS3 until Friday 17:00. Due to a breakdown of the ion source, the restart after TS3 relied on protons during the weekend. The cycle setup and Q26 transfer were completed by Sunday morning. This was followed by TCT alignment and aperture check for + crossing angle. The - crossing angle could not be measured due to a limitation in a vertical corrector strength once all corrections are in place.

Saturday morning the PM85 lift was repaired upon arrival of the necessary spare parts, requiring a 5-hours stop. The vdm scans at injection were repeated during the night from Sunday to Monday, but was interrupted by issues with an RF trip and the beam dump system that triggered on Monday morning.

When ions become available stably the setting up with ions will be first priority. The LHC team thanks all the persons that intervened over the busy weekend.