

Accelerator Complex Status

End week 8 (Monday 1 March 2021)

Technical Infrastructure (Ronan Ledru):

A reasonable week.

Statistics:

- Slightly more than 8500 alarms.
- 829 phone calls (601 incoming, 228 outgoing).
- 115 ODM created.

Events worth mentioning:

- Tue. 22.02: A leak detection alarm on cooling circuit FDDE-00161 was received. A water leak was found and isolated on the magnet BTM.QN020. Fire Brigade cleaned the area and let the magnet team deal further with the problem.
- Fri. 26.02: Several fire detection alarms in the SUH2. A crack on the compressor outlet piping create a cloud of Helium + oil. The Fire brigade pushed the emergency stop of the compressor.
- Sat. 27.02: Fire detection alarm in UX85. Some gas was released from the detector cooling circuit, several installations were left OFF for the weekend.

Details: <https://wikis.cern.ch/display/TIOP/2021/02/28/TI+week+summary%2C+Week+8>

Electrical interventions for this week:

- Tuesday: Consignation of EM103*23 (18kV buildings 226, 597, 585, 591). No machine equipment in those buildings.

LINAC 4 (Jean-Baptiste Lallement):

It was a good week with no major event until Friday afternoon. In the shadow of the PSB stop, the Linac4 team took advantage of the beam time, on Tuesday and Wednesday, to carry out various MDs (beam phase and energy stability along the pulse, PIMS section longitudinal beam dynamics) and have some small fixes and upgrades (CCDTL1 antenna attenuator replacement, buncher3 controls, etc....).

On Friday mid-afternoon, the RF power was lost on DTL1. The fault was pretty difficult to diagnose and our EPC and RF colleagues spent all Friday evening and a big part of Saturday to solve the issue. Thanks to their commitment, the operation could resume on Saturday afternoon, after a 25 hour beam stop (for completeness of the report, more details are given below). In the night from Saturday to Sunday, most of the RF power (RFQ, DTLs, CCDTLs and PIMS) was lost due to a glitch on the cooling circuit (to be confirmed). Operation resumed within 2 hours and beam was made available for PSB measurements on Sunday.

Mail from R. Wegner related to Friday-Saturday DTL1 RF power issue (27/02/2021 – 17:06).

First of all a big thank you for the great work and dedication to Julien and Pablo in Linac4, David remotely and the availability of Olivier and Bartosz !

A short summary for the exhausted colleagues – Julian, please don't hesitate to add/correct when you are recovered:

** the short DTL1 klystron oscillation yesterday at 15:15 provoked an over-current from the modulator which interlocked as desired*

** however, a number of components broke: the voltage divider inside the modulator and the divider inside the klystron HV tank*

** a regular sag was seen yesterday in the high voltage (cathode and mod-anode) and current. This was very complicated to diagnose the origin as the modulator and klystron are connected*

* deep measurements and investigations have been performed today by Julien and Pablo. They also disconnected DTL2 modulator and used it to supply the DTL1 klystron.
* finally the fault was found to be inside the high voltage cable between modulator and klystron mod-anode.
* after the exchange the DTL1 system could be restarted successfully.
* The Linac happily is back in operation now.
A final LLRF adaptation of open-loop gain and phase is required on Monday by the LLRF expert to reduce the work of the polar loop.
Best regards from
Julien, Pablo and Rolf

PS Booster (Bettina Mikulec):

Several interventions and breakdowns last week slowed down the commissioning progress.

1) **Water leak on BTM.QNO20** in the night from Monday to Tuesday stopped all commissioning activities; the magnet was exchanged on Wednesday and activities could resume Thursday morning.

- Parallel activities:
 - Modification of the interlock of the MALT in the three circuit breakers of POPS-B (Tuesday night)
 - Switch back ATLAS power (switch 66 kV to another source and back to re-install repaired heating pipes) on Wednesday morning —> stop and restart Linac4 source and RF twice
 - Several interventions Wednesday in the tunnel and outside (including new FGC, MTG and BCTTRIC releases as well as B-train HW and SW changes)
 - Stray field measurements of LBS.BVT10 confirmed order of magnitude of perturbation —> additional shielding in BI line to be installed
 - Lock in and test the switching magnet BT.BHZ10 —> successful in the end, but it required specialist interventions to correct some bugs
- Difficult restart on Thursday (vacuum level had recovered at 7:50am) due to PSB injection watchdog problem and because all power converter tables were lost after the FGC upgrade and had to be retrimmed
- 2) **WIC intervention to add the Q-strip power converters to the WIC surveillance equation Friday morning;** required an **access** of 2 hours.
- 3) All activities with beam had to be stopped Friday at around 15:15 due to the **DTL1 issue**.
- 4) **Sunday morning around 1am** the whole **Linac4 RF tripped with an External Fault** and it took quite some time to restart it. The reason is not yet clear and will be followed up on Monday.
- 5) **BI.SMV10 tripped at 2:30 Sunday morning;** the electro valve was changed Sunday early morning in an **access**.

Additional points:

- The cycles TOF_PS_BC_2021 and LHCINDIV_2021 can be used to inject into the PS; still some longitudinal fine-tunings could be beneficial.
- Some RF improvements/bug solving on the high-intensity TOF and LHC25A cycles.
- POPS-B tests: F. Boattini deployed a new RST voltage regulation; unfortunately the new regulation does not yet solve the issues. There is another discussion planned on Monday to decide how to advance, as it clearly limits the performance.
- Calibration curves for the multipoles have been added to LSA.
- Following the nice improvement to flatten the start of the Linac4 pulse (beam loading effect; use a correction function for the amplitude of the PIMS1112 cavity), the energy variations of the incoming beam are much smaller and therefore a better energy matching to the PSB could be performed.
- Points to be followed up besides the POPS-B regulation issue:

- Beam position measurements in the BI line for large-energy spread beams (e.g. the LHC production beams); very bad raw signal as beam is practically debunched
- LIU wire scanners.

ISOLDE (Erwin Sielsing):

Overall, we are in a good shape and have had stable beam from GPS to all the beamlines of ISOLDE.

GPS, new extraction electrode tip:

At GPS the main activity was the change of the extraction electrode tip in the new Front-End #10 on Wednesday for a new type with 4 extra lateral holes around the middle one.

The ‘normal’ hole in the middle is used to send the RILIS lasers for ionization and to extract the ions from the target. The four lateral holes can be used by additional lasers when a special type of (PLIST) target is coupled which has reflecting surfaces within a quadrupole structure right after its ion source. The reflected laser beam interacts with- and causes perpendicular illumination of the effusing atoms. The effect is a reduction of Doppler broadening and higher resolution laser spectroscopy. Experiments conducted at Mainz University, where this tip is in operation for over a year, have shown a resolution enhancement greater than a factor 10 (Reinhard Heinke et all.).

The work of changing the electrode tip took a day (cooling down the target, removing it, installation of the adapted new tip, re-clamping the target and restarting the heating and HT before beam was back through the GPS separator).

Obviously, the key questions at ISOLDE are how this new electrode tip would behave in the machine with regard to the beam using the same ion source:

No abnormalities were observed once we had the beam back. Vacuum nominal, no specific increase of HT trips (60kV) and the total and separated currents (tested for 39K) remained the same. A great relieve was to see that the scanner profiles and transmission were exactly the same as they were with the standard (single hole) electrode tip.

We will do more tests during the coming weeks (using RILIS ionization of Sm) but these first results are important: It means we can leave this tip in place for the entire run since it seems the new 1 + 4 holes tip will not hamper normal operations. As soon as protons are taken and RIB is extracted from the target the electrode tip becomes highly activated and contaminated and changing it becomes a complicated business.

HRS, installation of FE#11:

On the HRS side the installation of the new Front-End #11 is being finalized. The alignment issue of FE#11 not being properly aligned with regard to the HRS separator magnet now seems to have been pinned down to the FE side itself. When checking the robot calibration the vertical offset of 3-4mm was clearly noticed meaning that somewhere in the alignment method at the FE (target zone) side there is an issue. The FE is easy to align but the question remains where/how the offset is introduced. STI and Survey are investigating.

In parallel Joachim’s STI team (Stefano Marzari & Co) is working with CV (Sebastien Acera) on a solution to increase the compressed air pressure for the FE target coupling system: the clamps and shutter. The nominal 6-6.5 bar does not seem to be enough for the pneumatic components to function fully faultless. In the past a pressure booster was used but the new FEs design is expected to be such that the 6.5bar should be sufficient. Investigation is ongoing and solution being found to bring the non-regulated 8bar compressed air pressure we have at ISOLDE to the FE pneumatic controls (in the HRS separator zone). The GPS FE target coupling suffers from the same issue.

We are confident to have both FEs fully commissioned and operational before the arrival of the protons from PSB (25th May).

REXTRAP:

On the REX side work is continuing on the REXTRAP inner structure. Some clear evidence of discharges came alight explaining the effects seen during last years’ recommissioning run. The cause is now being understood and new parts are being made. Another example of how important last

years' restart and recommissioning run has proven to be. We are confident to have the REXTRAP back in good shape in time for the '21 REX/HIE run.

The REXTRAP local ion source refurbishing has finished and the sector is closed and under vacuum.

Other and ongoing:

Apart from these main activities several smaller interventions and final installation work have been carried out, not always compatible with operations but scheduled with least impact and to the best we can.

Timing and controls:

Timing tests have started for the new Tapestation as well as several applications for which we ask PSB from time to time a few ISOGOS and ISOHRS cycles in the Supercycle.

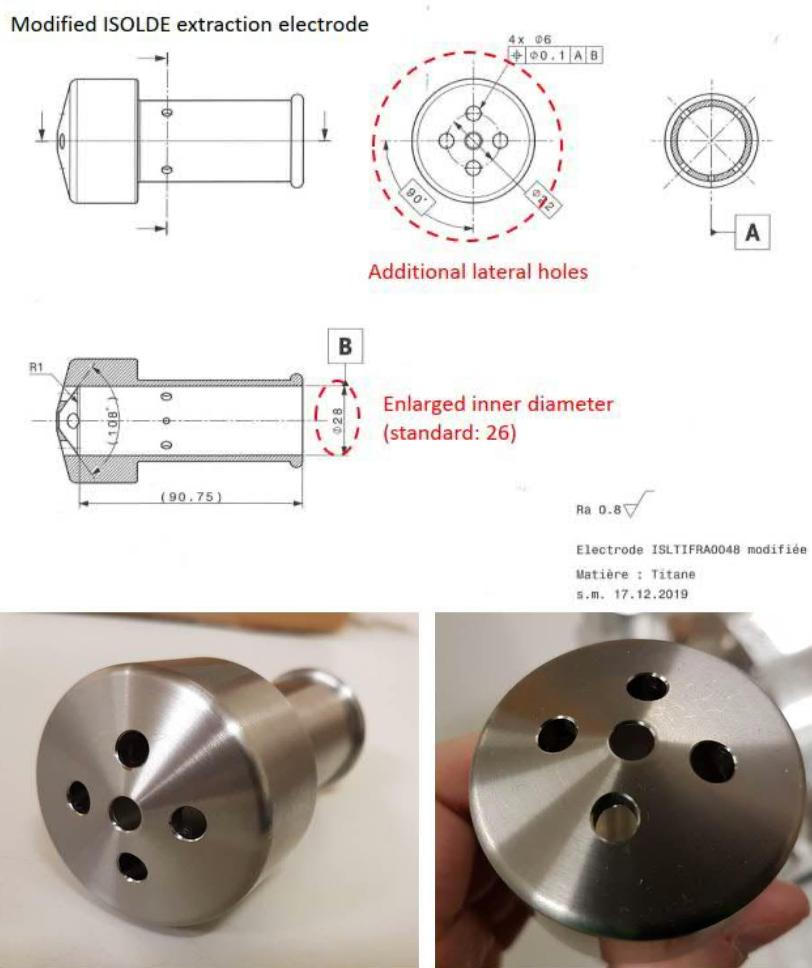
Upcoming REX/HIE ISOLDE activities:

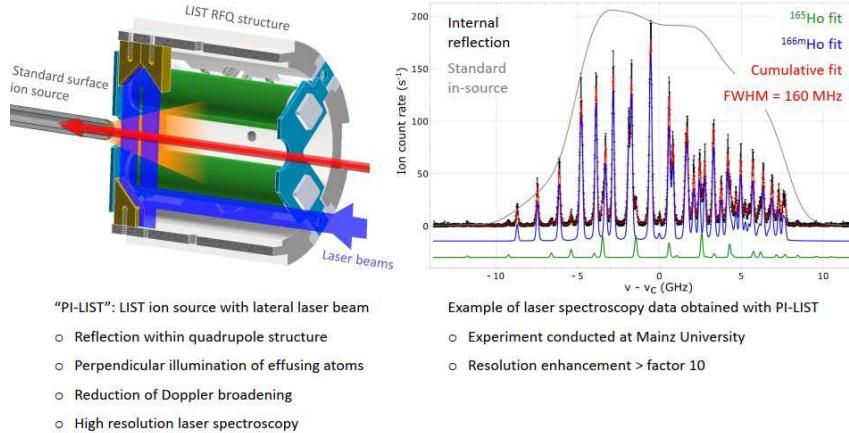
In the frame of the REX/HIE ISOLDE tunnel DSO test, one of the main prerequisites for the RF Permit, a full test was carried out on Thursday and Friday. Both HIE and REX RF systems were tested to drop with regard to the access system interlocks. All is ready for a smooth DSO test this Monday-morning, 1st March.

This coming week the recommissioning of the 4 Cryo Modules will start (Walter Venturini, Daniel Valuch) with first the interlock tests followed by RF tests at warm and tests at the cryo plant. The actual cooldown and RF tests during the different phases will start as of the 18th March (4 + 1 wk (cryo tests)) and the CMs will be handed over by the RF team to OP for beam commissioning by mid-May.

Here some pictures/images of the different subjects described above:

Below: The new 1+4 holes extraction electrode tip (courtesy Reinhard Heinke SY/STI):





Below: The REXTRAP inner structure with one of the electrode rings clearly carbon coated due to discharges (Courtesy Miguel Lozano Benito BE/OP):



PS (Marc Delrieux):

The repaired SMH42 has been re-installed in the machine on Thursday. We did a blind access via the big MAD to avoid switching to general and losing all PSR patrols. Bake-out started on Friday morning after leak detection and continued over the week-end. Accesses by ABT every day around 8 am and 5 pm to monitor the bake-out. *The plan is to stop the bake-out on Sunday evening or Monday morning. Then 48h are needed to decrease the temperature to 50 °C and to connect the water on the magnets. Then on Wednesday morning : striplines connection, covers installation...first pulses expected on Wednesday 03/03 afternoon.*

- RF repair of the 10 MHz amplifiers. Two amplifiers exchanged per day (access every morning between 8:30 and 10:30 from Friday 19/02 to Thursday 25/02 included). Wednesday 24/02 RF also replaced the amplifier of C36 in the SWY in the shadow of the PSB water leak intervention. Despite this we have today only 5/11 cavities operational
 - C11, C356, C86, C91, C96: OK
 - C46: No vacuum in this sector (local), needs to be tested once the vacuum is back to normal.
 - C51: Cavity is ok but issue with PLC interlock, C. Oliveira (RF-CS) is working on it.
 - C56: Cavity trips
 - C66: Tuning issue (local)

- C76: Cavity trips when trying to pulse, we are still investigating this issue, might need an access next week, t.b.c (local)

Other intervention :

- Tuesday, final check for BLM position in PSR, and HV box change of BGI84
- Wednesday, final check for BLM position in SWY
- Tests of BT.BHZ10 on Wednesday morning in collaboration with PSB
- All necessary patrols (TFP, PS exterieur, PS sector 5 – cabling works until 26/02 11 am) have been performed.
- D. Bodart installed the compensation cards on MU101 on Friday afternoon
- On Wednesday we had to resend all FGC functions after an FGC update. Some “EPC internal” parameters were also lost so that several converters didn’t pulse for a little while.

Before beam :

- O. Michels still has to implement the PFW compensation (planned Monday 01/03). This was not done yet for several reasons (which I won’t give here).
- A. Goldblatt (BI) wants to access to check what needs to be done for the grounding of the signals cables of the new wire scanners.

AD (Laurette Ponce):

The Hardware permit for C10 cavity test has been signed and the ring is in beam mode under OP7 Total. RF test on-going, accesses for fixing the stochastic cooling kicker to be coordinated.

ELENA (Laurette Ponce):

Main activities of last week in ELENA:

- Continue optimization of the acceleration/deceleration cycle: manage to extract the beam towards Gbar, beam observed on profile monitor.
- Continue fine tuning of the beam distribution using the cycle with four bunches, scan of the start of fine delays of fast deflectors in the transfer lines
- Continue test on e-cooling with Hminus beam: alignment of electron with Hminus, observation with Schottky signal based on BPM signal.

Some issues:

- Problem with noise on a marker of the Btrain (again), same problem as couple of month ago. We are now working again with the spare system and experts investigating a longer term solution.
- Profile monitors: one of the 4 monitors to be sent to acceptance tests is bad, need to be fixed before installation.

SPS (James Ridewood):

Summary Week 8:

- Main power supply:
 - Main quads V loop setting up from Wednesday
 - Dipoles available in nominal since Wednesday
- MKE4, MKE6 pulsed synchronously with the extraction pulse
- MKDH, MKDV almost conditioned with short pulses after changed of TMR1 on MKDV1
 - Voltage? MKDV @~31.5kV on Friday
- Aux PS worked on septa magnetic, MBE.2103, TI8, TI2
- Polarity checked BA2, BA3, BA4, BA6, BA7, TT20, TT40, TT60, AWAKE
- BLM reset issue solved and tested
- Heat run on all Aux PS
- Heat run on Aux PS TI8, LHC side-> done
- Minor water leak on TIDVG - solution in progress
- Debugging of extraction chain test modes

- Video signal noise problem on BTV in BA2 - under investigation
- Fire door mechanical issue in BA2 solved
- Gateway put in service for TT10 FGC_63 and issue on BIC solved
- Debugging of FEI application for TI2 and TI8

Planning week 9:

- Main power supplies:
 - Main quads pulsing with dipole in nominal conditions
 - Wednesday to Friday dynamic tests on BEQ1 with ABB and EPC
- Aux PS continuing according to schedule
- SBDS pulsing with energy tracking
- Polarity check few remaining magnets - principally those which are interlocked
- Heat run on all Aux PS and functional stability checks
- Injection interlocktesting including MDSH1197 and BHZ377 & BHZ378
- BPM tests in TT10, TI8, TI2, AWAKE

AWAKE (Giovanni Zevi Della Porta):

WEEK SUMMARY: Electron beam on spectrometer and downstream streak camera. Began testing new beamline optics.

- **From past weeks: AWAKE BLM:** HV power supply replaced, problem solved
- **Access System:** Patrol delayed by <1 hour due to a Siemens card going into "passive" mode without warning. Replacing the card fixed the issue.
- **Electron spectrometer:** for the first time since 2018, electron beam on the spectrometer screen
- **Electron spectrometer magnets:** observed three strange behaviors, and have asked experts to investigate. (i) 412435 shows about +/-4A of noise even at currents close to 0. (ii) 412435 cannot be set to values lower than 18A. (iii) 412432 is very slow at changing current (30s to increase by 4A)
- **Downstream streak camera:** for the first time since 2018, electron beam on the downstream streak camera, together with marker laser. Electron beam length measurement both online and offline.
- **Electron beam line:** began testing new optics for electron beamline (designed to account for incoming optics from injector, and to provide waist at plasma entrance)

Next week: Access and vent vacuum to install new laser focusing system (Off-Axis Parabola)

LINAC 3 (Richard Scrivens):

Monday

The week started with low source performance, but sufficient to progress with other setting up. The new logbook was down for the first hour of the day.

Started to use the first of the GSI produced stripper foils installed the previous week. The aim is to make regular energy distribution measurements as they are used.

Tuesday

Update of the power converter FGC code by EPC to allow the 100ms spaced pulsing of converters to work.

A calibration of the ITFS spectrometer was made.

Wednesday

The source and RF was stopped for ~1hour for the electrical and timing interventions.

A source CSD scan was made.

Bi-Weekly stripper foil energy spread measurements made.

Repeat of LBS and debuncher calibration in order to assess its reproducibility.

The increases of the source oven power did not lead to much increase in beam current.

Thursday

Continue to increase oven power. Conclusion an oven refill is needed to recover.

Friday

Oven refill made. By the end of the day the source and Linac performance was excellent, with 32 to 36uA of Pb54+ at the Linac exit.

Higher microwave power is needed, which could be a sign that the aluminium coating on the chamber is being removed.

Weekly stripper foil energy spread measurements made.

Saturday

Source Microwave generator had tripped off and cannot be restarted remotely. On Monday it is planned to investigate locally, and if needed exchange to the second spare generator.

LHC (Jörg Wenninger):

S12	S23	S34	S45	S56	S67	S78	S81
Cold	Cold	Phase 1	Phase 1	Cool-down	Warm up	Phase 2	Cool-down

First week of powering phase 1 in S34 with excellent progress, 75% of the S34 powering tests are completed.

Phase 2 in S78 waiting for QPS card exchange in view of dipole training. S78 RQ training quench 55A below the target of 11300A.

Connection cryostat LHC.LEJL.5L6 realigned (from 8.3 mm to 0.4 mm). Preparation for cool-down of S56 started.

Warm up of S67 to room temperature for repair of short on [Q8L7](#).

Cryoplant in point 2 stopped after fire alarm in compressor building due to an oil leak.