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Editorial:

Dear readers of the BE Newsletter.

By early May 2018, all operational machines have started with beam following the YETS. The LHC has finished its commissioning period and has started physics while increasing the number of bunches colliding in order to gain luminosity before LS2 starts at the end of this year. Good-old LINAC2 continues to provide nearly 100% availability before it is replaced with LINAC4 with its complex stripping of H- ions to protons at the PSB injection. More news about LINAC4 later.

In this edition of the BE newsletter, you will again find evidence of the wide range of activities done by people in the department.

I hope that you find the material interesting and it motivates you to contribute with an article in French or English.

L. Jensen BE Newsletter editor-in-chief
**HL-LHC Crab cavities**

A prototype cryo-module containing two double-quarter-wave crab cavities was installed during the last YETS in the SPS LSS6. The cryo-module is now being cooled down with liquid helium and prepared for RF conditioning, before it is tested with beam.

Crab cavities are a key feature of HL-LHC project during LS3. They mitigate the loss of luminosity due to the increased crossing angle between the two interacting beams once the new inner triplets are installed. The larger crossing angle is implemented to keep the beams separated, but at the expense of a lack of overlap between bunches at the interaction point. Crab cavities apply a transverse momentum kick to the head and tail of proton bunches and rotate these in the crossing plane restoring head-on collision as seen in figure 1 below.

![Crab cavity bunch rotation](image)

Figure 1: crab cavity bunch rotation

Sixteen cavities (8 at ATLAS and 8 at CMS), are now baselined for the HL-LHC Project. Fabricated in bulk niobium, the cavities are hosted two by two in one cryogenic vessel to ensure thermal insulation of the cold mass at 2K. Cavity tests and learning operation in high energy and high intensity proton beams are considered necessary before launching the series production for HL-LHC. Crab cavities have already been operated with electron beams but never with proton beams and it must be proven that such cavities can be operated during energy ramp-up and are safe in case of failures. An extensive test program will be carried out during dedicated machine development slots of the 2018 run.

The string of two cavities and connecting bellows was assembled at the end of 2017 into a cryo-module, designed at CERN and in the UK. The module was cooled down for the first time to 2 K in the SM18 RF facilities and successfully tested at low RF Power. The complete installation of the cryo-module and most of the infrastructure for the tests was completed during the 8 weeks of the year-end technical stop as can be seen in figure 2 below.

![Crab cavity system installed in the SPS](image)

Figure 2: crab cavity system installed in the SPS

Rewarding the tenacious collective effort from more than 20 involved teams, the whole installation was achieved in the 8 weeks of the YETS. Once cryogenic commissioning completed, the system will undergo an extensive testing program starting with low beam energy and intensity while learning about beam stability, reaction to trips, HOM power, and crab cavity induced emittance growth. The tests will also validate the cryogenic system under dynamic load with beam and the vacuum system, in particular the performance impact on carbon coated vacuum chambers nearby.

G. Vandoni, R. Calaga BE-RF

**My work as BE-DAO**

My name is Jeanette Kotzian and I am your DAO (Departmental Administrative Officer) since December 2016. In 2010, I started my career at CERN as administrative assistant working for the Austrian MedAustron Project attached to a BE-OP section led by Michael Benedikt. After 2 years, I joined the BE Central team in order to replace a retiring colleague. The BE Central Secretariat team is composed of three members: Cassandra Heighton, Anaïs Vandekerchove and myself.

You may also have asked yourself, what is the role of your DAO, so I would like to explain shortly what we do. In our daily work in administration, we deal with a large variety of tasks; we are here to, to provide support (while applying CERNs rules). We interact...
with other services like HR, Finance, ATS, DAOs from other departments, as well as with your administrative assistants within the BE Groups and to you, of course. A major part of administration is also seeking improvements to procedures.

The list of topics we handle include:

- New people arriving along with the organisation of the BE Welcome Event (see later in this Newsletter)
- Saying “au revoir” to those leaving
- Contract formalities (extensions, terminations, transfers, changes in working hours etc.)
- Visa letters for visitors
- Staff promotion exercises
- Subsistence payments to visitors
- Admin meetings with administrative assistants to exchange and inform, handling keys and lock requests etc.

Besides that, we assist your group assistants in case of heavy workloads, in conference organisation as well as for answering questions and providing advice on the application of procedures.

All the above is what I enjoy about my work: the variety, the flexibility and being challenged by you, dear BE members, to assist with your queries within the framework. A very charming part of my work concerns changes in family situations, such as birth, marriage/PACS etc. In case of a “happy” event I am delighted for the person; sometimes we even receive a photo of the new-born which makes me smile, especially being a parent myself. Nevertheless, loss/bereavement is also handled by our service and such matters require tact, discretion, empathy and confidentiality.

Some people consider “BE administration” as strict machines following rules without any exceptions, or that our sole reason of existence is just to burden the life of others. None of this is true; we have a framework to respect, called CERN Staff Rules & Regulations (SRR), but we do our utmost to satisfy every request. Please bear this in mind next time you contact your DAO 😊

So long and thanks for all the fish!

Jeanette Kotzian (BE-HDO)

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**Diamond BLMs for LHC collimators**

Diamond based particle detectors are known for their radiation hardness and fast response and can be used to detect fast beam losses, thus complementing the existing LHC BLM system. Diamond BLMs are installed in an increasing number of locations around the LHC injectors. In the LHC, they are installed in injection, dump, and collimation regions at IR7. Here, beam losses occur during all operational phases of a proton fill, from injection losses lasting a few turns up to the steady state losses from colliding beams. Figure 1 below shows the installation of diamond BLM (one per beam) next to a primary collimator in IR7.

![Figure 1: Diamond BLM installation in LHC IR7](image)

Polycrystalline diamond detectors (10 mm x 10 mm x 0.5 mm) along with amplifiers and ROSY acquisition PCs were purchased from the Austrian company CIVIDE. The ROSY system provides the acquisition and triggering functionalities of a digital oscilloscope and includes an FPGA for online signal processing. The ROSY boxes running the Linux operating system are installed in LHC service galleries and are connected to the CERN technical network for remote access.

The system produces a high sampling rate waveform and time-histogram in parallel. In the histogram mode, the system synchronizes to the LHC turn clock and increases the corresponding bin when a loss signal exceeds a user-defined threshold. A Python script was developed to configure the system and store detector data from both types of measurements for offline analysis. The script uses PyJapc library to obtain LHC machine parameters to start and stop acquisitions. An independent graphical user interface (GUI) was developed to provide online monitoring and a quick look at the detector data without interrupting the data acquisition process.
Data from the LHC Fast BCT is used to obtain the filling-pattern in the LHC during a fill. Figure 2 below illustrates the corrected loss data with respective intensity loss observed over the same time span.

Figure 2: Corrected loss data with a zoom on the first 12 non-colliding bunches and the first two trains. In red the corresponding bunch intensity measurement.

The intrinsic properties of diamond detectors and post-processing analysis techniques developed here have demonstrated the potential diagnostics capabilities of using diamond BLMs in operations and their use is expected to grow in the future.

Chen Xu (BE-BI) & Arkadiusz Gorzawski (BE-ABP)

LINAC4 from commissioning to reliability and beam quality run

LINAC4, the future injector of protons to the PSB, was commissioned to its final energy (160 MeV) in October 2016. The accelerator was officially inaugurated on May 9th 2017 and it underwent a reliability run in two phases starting summer 2017 until and the YETS 2017-2018. While the commissioning validated the main beam dynamics and layout choices, the reliability run has proven that there are no show-stoppers for the linac4 to become the sole proton injector in the LHC injection chain.

The availability during the run was a solid 90%, and Figure 1 below shows the main causes of faults during the 19 weeks long run.

LINAC4 is integrated in AFT, the CERN-wide Accelerator Fault Tracking system. This system allows extracting statistics. In the case of LINAC4, not yet connected to the CERN accelerator chain the meaning of fault tracking is slightly different. The reliability run was targeted at identifying weak points in the LINAC and fix these before LS2. During the run, we did not find a single point of failure but rather a distributed collection of failures.

From February 2018, the LINAC4 is undergoing a beam quality run, with the aim of demonstrating the necessary shot-to-shot stability, chopping pattern and alignment as requested for producing a uniform beam for the LHC and within the target emittance of 1.5 µm. So far, the beam quality is almost within specification, with few parameters still needing improvements. In particular, during this run we will try to explore the unprecedented flexibility given by the combination of pre-chopper (after the source) and the chopper (after the first stage of acceleration). This powerful combination of beam shaping devices allows a custom-made beam to fill the PSB 1 MHz bucket.

An example can be seen on figure 2 below where a 700 µsec beam pulse from the source is shortened to 270 µsec at the low energy by the pre-chopper and then further chopped at 3 MeV in order to:

1) Cut away the rising edge of the pulse, during the space charge neutralisation build-up;
2) Create 1 µsec long empty “holes” to allow for the rise time of the PSB distributor when filling in the four PSB rings;
3) Finally chop off 150 out of the 352 Linac4 bunches for better matching at injection in the 1MHz PSB bucket.

Figure 1: Statistics of the beam availability during the LINAC4 2017 run and causes of down time.
Our numerous computer screens often impress visitors to the CCC, and wall-screens (a.k.a. “vistars”) are an important tool to give a real-time overview of the machine status. For the ACR, a display made of an old flip-dot display (that I bought on eBay!) from the front of a London bus (figure 1 below) was produced. Such displays are characterised by a lovely cascading motion when the image is changed and the dots reorder themselves.

Having found the device (advertised as non-functioning), I had the 1.8m long package delivered from England to Geneva and using good-old Google, reverse-engineered the circuit to identify that one of the binary counting components was broken.

The resulting screen that can be seen in Figure 2 below, updates roughly once a second, displaying the daily statistics for the AD machine to its operators. The flip-dot vistar doesn’t show anything an LCD could not but the AD is a special machine and I thought it deserved something different from the rest.

The CCC (CERN Control Centre) in building 874 is the hub of the BE-OP group’s activities, and is where we control most of the infrastructure required to create and deliver high-energy particle beams to CERN’s experiments. It is a well-known stop for visitors to the laboratory, and is often featured in publicity material.

Some machines (such as LINAC2, LEIR and the AD) need less constant supervision and have separate control rooms to be used when necessity calls. The Antiproton Decelerator (AD) is presently undergoing a lot of development with the ELENA commissioning and some high-profile experiments.

After the beam-quality run that should end in mid-May 2018 a substantial upgrade will be performed during the summer months, ready to deliver beam a gain in the fall, for a final reliability run!

‘Flip-dot’ display in the AD control room (ACR)

The CCC (CERN Control Centre) in building 874 is the hub of the BE-OP group’s activities, and is where we control most of the infrastructure required to create and deliver high-energy particle beams to CERN’s experiments. It is a well-known stop for visitors to the laboratory, and is often featured in publicity material.

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In order to harmonise the welcoming of new members at CERN, HR put in place a new way of welcoming which is effective since 1st April 2018. This programme includes all statuses of MPE’s (Employed member of the personnel, ex. STAFF, FELL) as well as the MPA’s (Associated member of the personnel, ex. TECH, DOCT, PJAS, TRNE and VIA).

The welcoming phase is split in three phases: before coming to CERN, the 1st week and throughout the career. The phase “Before I Arrive” ([https://hr-dep.web.cern.ch/content/i-arrive](https://hr-dep.web.cern.ch/content/i-arrive)) deals with all formalities that may be completed by distance. The 2nd phase “My first week” ([https://hr-dep.web.cern.ch/content/my-first-week](https://hr-dep.web.cern.ch/content/my-first-week)) provides details about the Induction Session at the Globe held each 1st working day of a month and all formalities linked to it. Again, it is possible for the newcomer to download a checklist to facilitate the overview. The last phase “Life@CERN” ([https://hr-dep.web.cern.ch/content/life-cern](https://hr-dep.web.cern.ch/content/life-cern)) assists in terms of social and working life as well as the integration in the region.

Overview of the agenda on the day of the arrival at CERN, held in the Globe:

- **08.00-09.00**: Admin formalities by Cards Office and Records Office
- **09.00-09.30**: Coffee
- **09.30-09.40**: Agenda of the day + Welcome by HR Department Head
- **09.40-10.15**: Interactive Quiz in small groups
- **10.15-10.30**: Grouping newcomers per department in front of dept. sign
- **10.30-11.00**: Transfer to Department by walk/bike/car/shuttle
- **11.00-12.00**: Welcome in Department by DAO in Prévessin

Lunch Break

Afternoon: Supervisors, Group Secretariats welcome and installation in office

We are delighted to receive any feedback on this new on-boarding programme to enable the HR Department to adapt and improve the “bienvenue” of new arrivals!
### Reminder of deadlines

#### Dates of forthcoming Selection Committees in 2018

**ASSOCIATES AND FELLOWS COMMITTEE (AFC)**

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<th>Date</th>
<th>Event</th>
<th>Deadline for Application</th>
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<td>20th November 2018</td>
<td>Deadline for Fellows</td>
<td>3rd September 2018</td>
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<td>Deadline for Associates</td>
<td>14th September 2018</td>
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NB: Applications from Non-Member State theoretical physicists who seek a post-doctoral position at CERN will be considered at a meeting to be held on:

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<tr>
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<tbody>
<tr>
<td>22nd May 2018</td>
<td>Deadline for Postdocs</td>
<td>15th October 2017</td>
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**TECHNICAL STUDENTS COMMITTEE (TSC)**

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<td>Deadline for application</td>
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**TECHNICIAN TRAINING EXPERIENCE (TTE)**

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<td>15th September 2018</td>
<td>Deadline for application</td>
<td>31st August 2018</td>
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<tr>
<td>15th November 2018</td>
<td>Deadline for application</td>
<td>31st October 2018</td>
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Please note **deadlines** in bold and **Selection dates** underlined.
BE Newsletter Contacts

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