Beam Commissioning Working Group

Minutes for 27 September 2019

Present: V. Kain, **A. Huschauer,** S. Albright, F. Antoniou, H. Bartosik, G. Bellodi, D. Cotte, G. P. di Giovanni, M. Gourber-Pace, K. Hanke, B. Mikulec, F. Tecker, F. Velotti, V. Baggiolini

Meeting objectives

A report from CO on the delivery of beam performance tracking tools, and a report on the Linac4 3 MeV run.

Approval of Minutes and Matters Arising - V. Kain

The minutes of the 20th of September will be approved next meeting.

- Today is the deadline for IST planning, V. Kain asks which machines have a completed schedule:
  - G. P. di Giovanni says the PSB has made good progress, but is not yet complete.
  - K. Hanke says the PS has a meeting later today, to continue with the planning.
  - V. Kain says the SPS has a first version of an IST planning but the EPC MACAO ISTs need approval by the LS2C.

CO Feedback on Beam Performance Tracking - M. Gourber-Pace

Presentation

- The performance will be defined across the chain, with metrics based on required beam parameters and reproducibility.
- Performance tracking will have machine specific aspects as well as metrics tracked through the accelerator chain, which have been prioritised as:
  1. A web application to track performance for different beam types, which will be ready for the restart of the injectors (mid-2020).
  2. Cycle-by-cycle event based analysis, which will be a more long term project.
- CO will provide a standardised infrastucture for working with Python scripts through Gitlab, and tools to automate their deployment, monitor their behaviour and publish the results to NXCALS.
- A new web TIMBER interface, connected with NXCALS will be available by the end of 2019.
- Beam metadata will be updated to include a Beam ID, Beam Instance ID ad BCD Stamp, which will be included in NXCALS.
- The cycle-by-cycle analysis is aligned with the future plans for the CO system, but cannot be defined yet. The proposal is to develop this in 2021/22 when future developments are better defined.
- V. Baggiolini will coordinate the activity and be the main interface with OP.

Discussion

- H. Bartosik asks for explanation of how the new beam metadata will work if e.g. the same cycle appears multiple times in the super cycle. M. Gourber-Pace says the Beam Instance ID will be different for both of them, but if the BCD runs in a loop the Beam Instance ID will not change, which is why the BCD Stamp will also be included. V. Kain explains that the Beam ID + Beam Instance ID + BCD Stamp will allow full identification of any cycle.
- G. P. di Giovanni asks if all Beam Instance IDs will be unique and increasing for all time. V. Kain says there is a limit, so it will loop at some point, but combined with the other information it will still work, the details of handling the rollover could be part of the API. V. Baggiolini says it depends how and where the analysis or data combination will be done, this is to be disucussed.
- H. Bartosik asks if the online plots are to be produced by the web TIMBER, or as V. Kain follows asking if the intention is to continue with the current EOS system, V. Baggiolini says the intention is not to disrupt the current work, but to explore if web TIMBER can meet the requirements.
- V. Kain says the proposal looks very good, but emphasises that the bottleneck to the Python scripts is the background processes to get the data displayed. If the web TIMBER application isn't fast enough it may be necessary to revisit how the data is handled.
- H. Bartosik asks how the charts will be displayed and customised in web TIMBER. V. Baggiolini says this is to be investigated as they progress with web TIMBER and if they can replicate the performance of Bokeh. H. Bartosik asks if they will implement Bokeh in web TIMBER, V. Baggiolini says that is not yet known but the objective is to give the same functionality as is used now.
- V. Baggiolini says that if anyone has specific requirements or proposals for web TIMBER he would be interested to hear them.
- V. Kain suggests working with some existing scripts to trial the proposed functionality as soon as possible. V. Baggiolini says that every few weeks there will be an updated operational example available and interested people can come to a meeting to see how it's progressing, test the application, and make proposals.
- V. Kain confirms that middle 2020 the online analysis will be discussed again, M. Gourber-Pace says yes.

Linac4 3 MeV Run - G. Bellodi

Presentation

- The 3 MeV run ran from the 5^{th} of August to the 23^{rd} of August. The TIMBER current plot has beam from the source in red, and at the end of the RFQ in blue. The machine was only operational during working hours.
- Timing was migrated from LN4 to PSB, about 3 days were required to recover running performance.
- A few additional issues came up during the run with equipment and software, these were solved during the run.

- Ion source autopilot development continued during the run and a GUI has been developed. Several modules are available to act on different parts of the source to maintain performance.
- A polarity study on the solenoid was used to investigate the transmission with different solenoid conditions, which showed that the nominal configuration is the most effective.
- An investigation of the 2 MHz noise on the BCT signal suggests there is approximately 2 % ripple to the beam structure after the RFQ, but more work is required to confirm it.
- This run used discrete Caesiation. Continuous Caesiation was discussed at the Machine Protection Panel, which recommended trying to replicate the test stand results on Linac4. Continuous Caesiation was started with the sector valve closed and will be continued during the LBE run.

Discussion

- V. Kain asks if the delay from timing migration was expected, G. Bellodi says no. B. Mikulec says that this shows that for any restart a few days of debugging time should be expected.
- H. Bartosik asks if there's an explanation why the 2 MHz ripple appears larger after the RFQ than after the source. G. Bellodi says there is no clear explanation. H. Bartosik asks if these measurements can be repeated at higher energy, G. Bellodi says this has been discussed and is planned to be done.
- H. Bartosik asks if the frequency ripple data can be recorded parasitically. G. Bellodi says the results presented here were dedicated because the BCT had to be set up correctly. B. Mikulec says there are now two channels for the BCTs, so in principle it should be possible to do it parasitically in the future.
- H. Bartosik asked for clarification of what the slope in the beam signal after the RFQ was. B. Mikulec says this was current vs time of the pulse. G. Bellodi said the autopilot was being used to optimise pulse flatness in that example.
- V. Kain asks if the continuous Caesiation will affect the autopilot. G. Bellodi says no, the autopilot acts on the source RF power to regulate the current, so it should have no effect.
- V. Kain asks how the 2% ripple at 2 MHz compares to the specifications for the beam. G. Bellodi says the 2 MHz is believed to come from the source RF, and they need to see if there is any impact at high energy. H. Bartosik says the main concern is that because the PSB RF is about 1 MHz, it could lead to a systematic structure at arrival in the PSB, so this was the first attempt to measure it.
- B. Mikulec says the bumps seen in the beam current due to the source RF ripple are still be to be resolved, and there are some followups required as a result.
- V. Kain asks if during the 3 weeks they were able to do all the work they wanted, and if the problems encountered were expected. G. Bellodi says that there wasn't a lot planned for how the 3 weeks would be run, and the only significant problem was the timing and FGC issues before starting.
- V. Kain asks how long is expected for low energy beam set up when restarting the beam after a shutdown, B. Mikulec says about 1 week assuming all hardware commissioning has already been completed.

AOB

The next meeting will be on the 4$^{\text{th}}$ of October, with a discussion on Hardware Commissioning for each machine in preparation for the LS2 days. In the near future a test case is required for the performance tracking tools to be provided by CO, and it must be decided how the commissioning progress will be followed starting 2020.