

[CEI Section meeting](#)
Notes from the [meeting held on 26 January 2023](#)

Present: D. Amorim, C. Antuono, N. Biancacci, X. Buffat, E. de la Fuente Garcia, L. Giacomel, S. Johannesson, S. Joly, A. Kurtulus, C. Lannoy, C. Lannoy, S. Lopaciuk, N. Mounet, K. Paraschou, G. Rumolo, L. Sabato, B. Salvant, L. Sito, F. Sommerfelt Groenvold, E. Vik, C. Zannini

Excused: G. Iadarola, P. Kicsiny, L. Mether, E. Métral, E. Waagaard

- News and matters arising

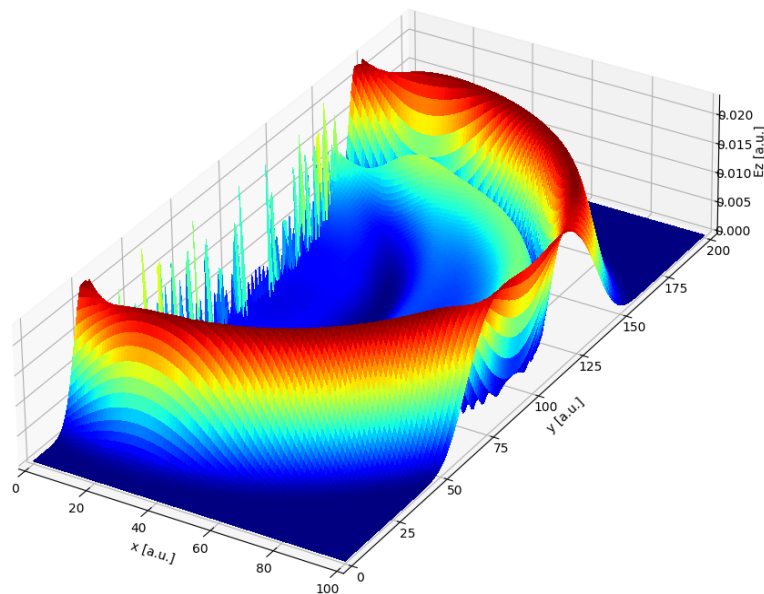
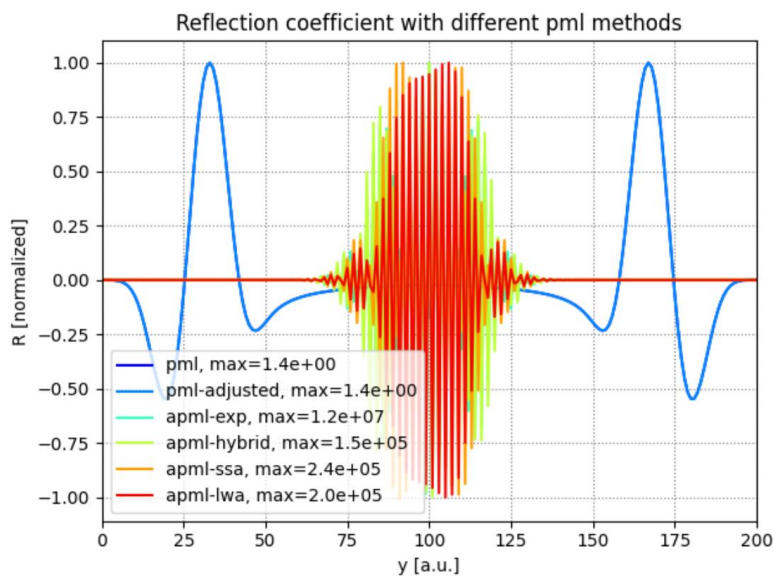
- General information (G. Rumolo, [slides](#)):
 - The seminar took place (26 January 2023) on the contributions of high energy physics to healthcare through technology organized by CERN KT Healthcare.
 - Registrations are open for upcoming CAS schools (2023) :
 - CAS on **RF for Accelerator**, from 18 June to 01 July 2023, Berlin, Germany, (**Lists need to be confirmed by the end of March 2023.**), [link](#).
 - CAS on **Introduction to Accelerator Physics**, from 25 September to 08 October 2023, Santa Susanna, Spain, (**Deadline is the 10th of July 2023**), [link](#).
 - CAS on **Normal- and Superconducting Magnets**, from 19 November to 02 December 2023, St. Pölten, Austria, (**Deadline is the 4th of September 2023.**), [link](#).
 - Covid extensions have been granted to all CEI PhD students ending in 2023.
 - MuCol study has been approved again by the European Commission, so the expected financing will be available for the next steps.
 - Impedance Lab requirements and needs will be discussed in more detail after the MERIT period (probably around March), but budget available now for urgent expenses and a separated budget line of 5k CHF/year is being created for maintenance with possibilities of carry forward and enlargement if needed for special expenses.
 - The Injectors Performance Panel MD day will take place from 30 to 31 January 2023 at CERN. The agenda is available on the [indico page](#).

- Round Table (all)

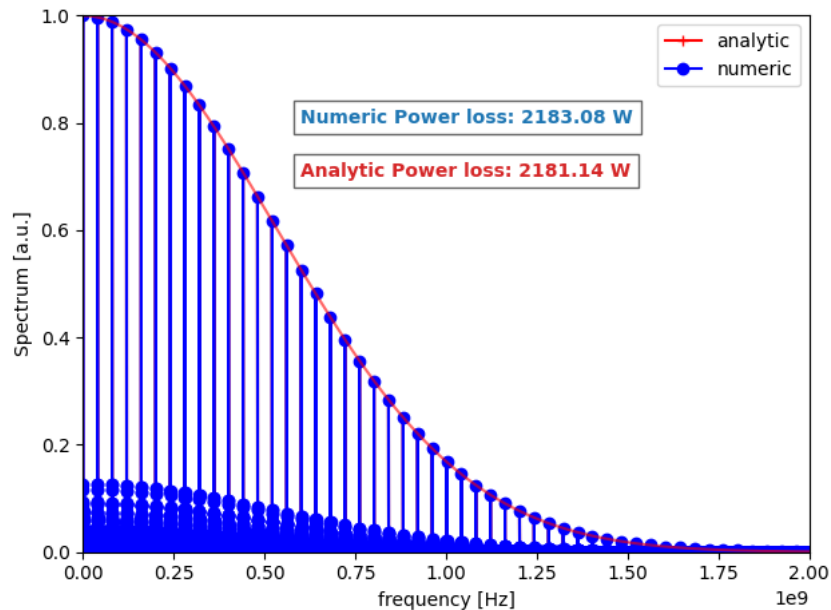
- **C. Antuono:**
 - Wireless Method formula:
 - Waveguides: extension of the analytical formula to compute the impedance beyond the thick wall regime (journal paper ongoing as an extension of the one of IPAC 22).
 - Resonant structures: analytical approach ongoing to find the proper formula.
 - Wireless Method: coupler to excite the DUT:
 - Waveguides: it works above cut-off.
 - Resonant structures: it determines the impedance resonant frequencies (with more accuracy than WM).
 - Issues with the application below cut-off: work ongoing to design the coupler in order to increase the coupling also below cut-off.

- Talk to be given on Monday at the IPP MD day.
 - Meeting on Friday with prof from Sapienza to discuss the past 6 months of PhD and the following ones.
- **D. Amorim:**
 - MuCol Rapid Cycling Synchrotrons:
 - Implementing a lattice generator, starting from A. Chancé script for magnet configuration to obtain a MAD-X sequence and Twiss table.
 - The lattice will be used in Xsuite for collective effects studies + starting beam-beam effects simulations.
 - Further tests using genetic algorithms for the RCS chain parameters optimization, in complement to parameters table developed by F. Batsch.
 - MuCol 10 TeV:
 - Brainstorming meeting to discuss magnet design options and requirements from optics, impedance, and radiation shielding.
 - If going for a tungsten at room temperature shielding (for cooling power optimization), a ~1mm thick copper liner would be required seen the frequency range.
 - Finished implementing the last corrections for a PRAB article on tune shifts measurements in the LHC during Run 2, to be submitted soon.
 - Teaching assistant for the longitudinal beam dynamics course at JUAS (taught by Alex Lasheen) during the week of January 9th and the PyHEADTAIL tutorials (taught by Benoit) during the week of January 16th.
 - **N. Biancacci:**
 - Gave a tour in LEIR, LEIR local control room and Roy Billinge room for the JUAS 2023 school. Very interested and motivated students.
 - Working on IPAC 2023 paper on injection efficiency modelling for LEIR.
 - Review of Phani's thesis and Master presentation. Phani will defend today at 15h00 in ``La Sapienza'' university → good luck to him!
 - Continuing the work on numerical mode matching with A. Passarelli from INFN-NA: checked consistency of cavity modes analytical formulae w.r.t. CST. Now checking it for beam pipes modes.
 - **X. Buffat :**
 - Running SPS TMCI studies to prepare for MDs at full steam on HTCondor thanks to significant amount of new Tesla A100 GPUs. Just found and fixed the cause for unexpected results (a bug in the lattice setup leading to negative chroma).
 - Testing new implementation of the 'mimick bunch' approach for coupled bunch instabilities with PyHEADTAIL/xsuite to efficiently study instabilities with the crab cavity fundamental mode, HOM and amplitude feedback in the presence of beam-beam.
 - Corrected simplicity of the dispersion in the linear lattice element of Xtrack for non-ultrarelativistic beams. Ported X/Y rotation and translation elements from MAD-X to Xtrack. They are needed to study the electron-ion collider lattice.

- Working with M. Soderen and G. Trad on a robust implementation of the ADT-BTF for chromaticity measurement. There are few unexpected complications linked to the implementation of a dedicated UCAP node for BTF computations and fits.
- **E. de la Fuente Garcia:**
 - CIEMAT's Workshop presentation 18th January about FTEC project progress.
 - IPP MD day(s) presentation on growth rate vs chromaticity measurements in the SPS.
 - ATS Internal Note about Wakis on the making.
 - Fixing the STL importer in WarpX: Finally found the issue! performing further tests increasing geometry complexity.
 - PML study with warp. Meeting with Jean-Luc and WarpX people from Berkeley on 06-Feb to address this.

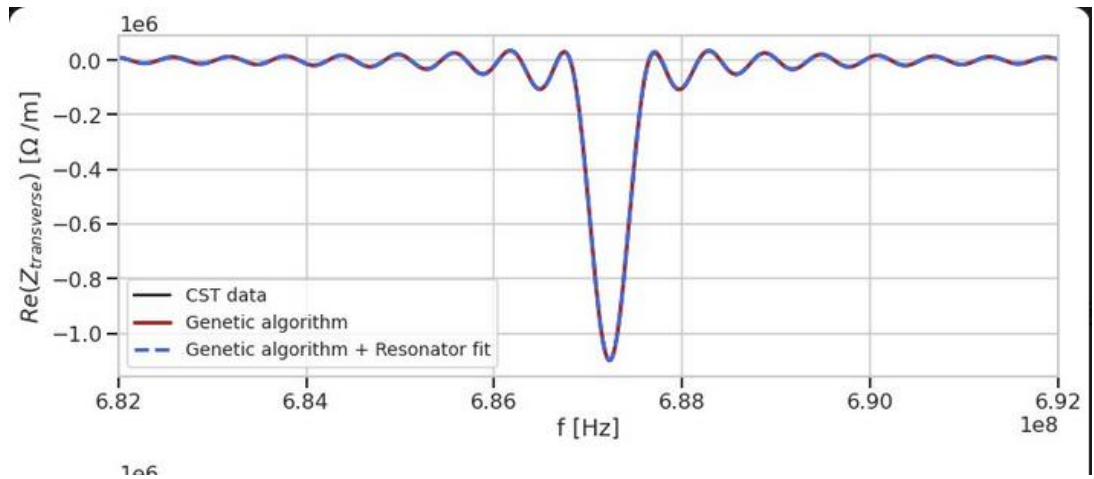


- Analytic formula for FFT implemented in BIHC package (package is ready to use and well documented (Github link: <https://github.com/lsito/BIHC>).

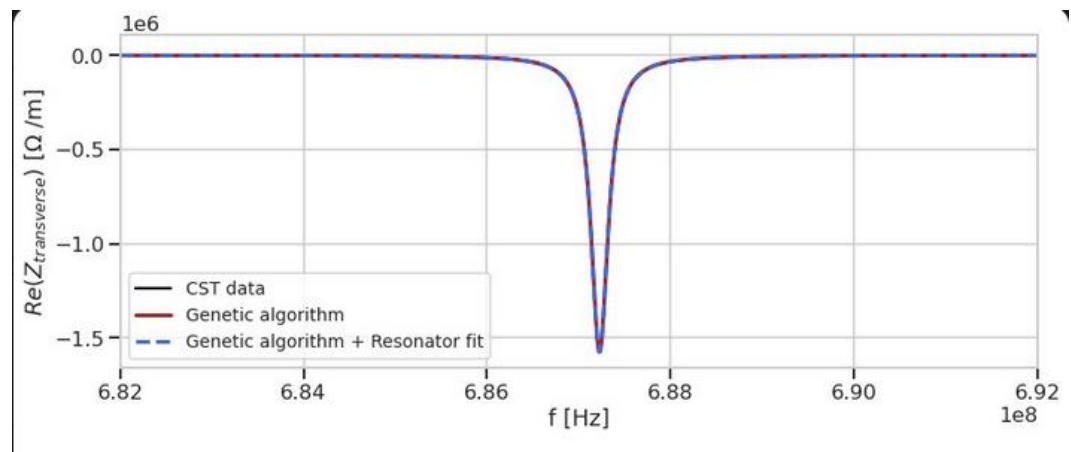


- **L. Giacomel:**
 - USPAS.
- **G. Iadarola:**
 - Chamonix.
- **S. Johannesson:**
 - FCCIS talk.
 - WP2 presentation.
 - Annual report for EPFL was accepted.
 - E-cloud simulations for a scan of chromaticities for different configurations of the quadrupolar forces from ecloud. Results presented at WP2 presentation.
 - Doing simulations with the ecloud distribution from the LHC dipoles with SEY 2.0. This with purpose to have more accurate simulations to compare to my MD data.
- **S. Joly:**
 - No USPAS.
 - Study of partly decayed wake function in the case of CST simulations. When dealing with high Q components, needed wake length to reach full decay of the wake might be excessively time-consuming. Possible to derive new wake function formula for such a wake and use it to fit CST

data with my genetic algorithm. Algorithm returns R_s , Q and resonant frequency for fully decayed wake.

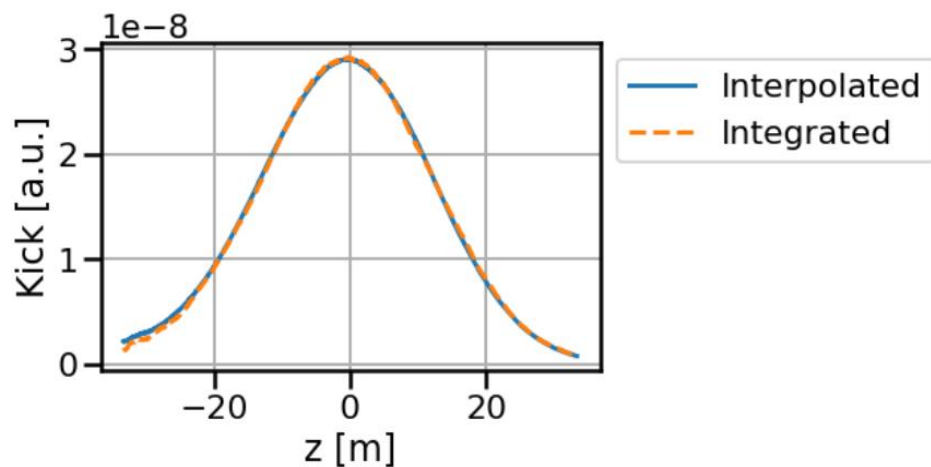
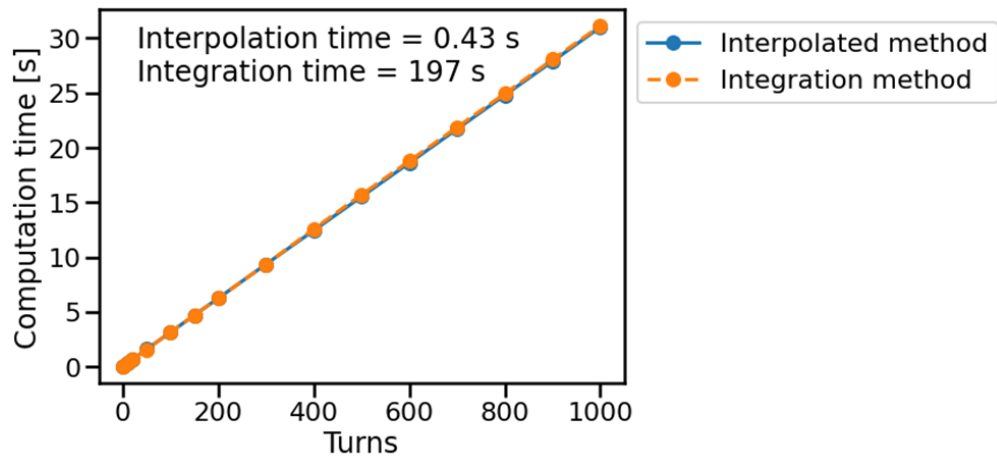


Wake length = 500 m, wake decayed of half of its maximum amplitude. Algorithm returns $R_s = -2.3 \times 10^7 \text{ Ohm/m}$, $Q = 3073$ and $f_{\text{res}} = 6.87 \times 10^8 \text{ Hz}$



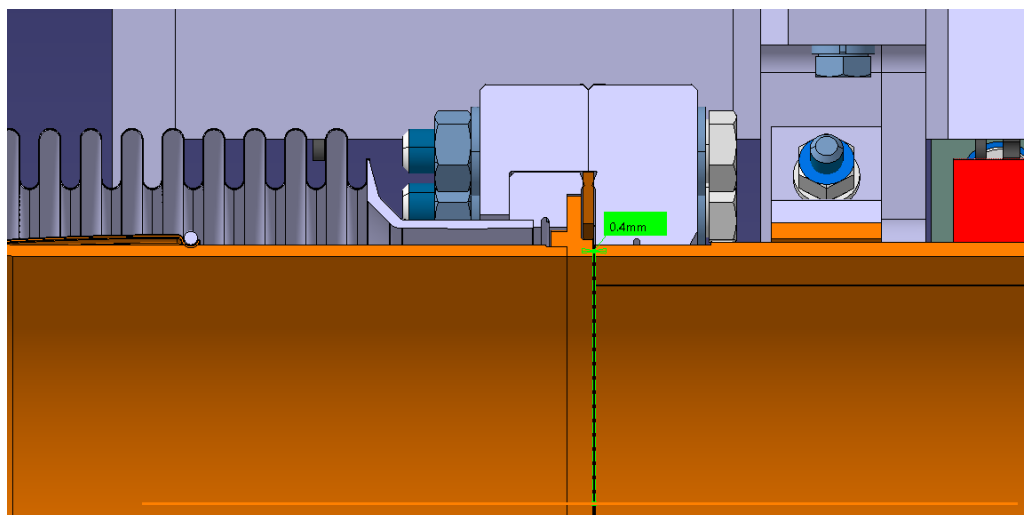
Wake length = 4000 m, wake fully decayed. Algorithm returns $R_s = -2.27 \times 10^7 \text{ Ohm/m}$, $Q = 3031$ and $f_{\text{res}} = 6.87 \times 10^8 \text{ Hz}$

- Integrated wakefield method benchmarked and pushed to PyHEADTAIL, waiting for merge request to be accepted. Study case of the PS wall impedance at low energy (sharp ISC for small times requiring large number of slices). Benchmark comparing convergence of PyHEADTAIL wake potential vs number of slices. Interpolated method (default) with 3000 slices vs Integrated method (new) with 600 slices.



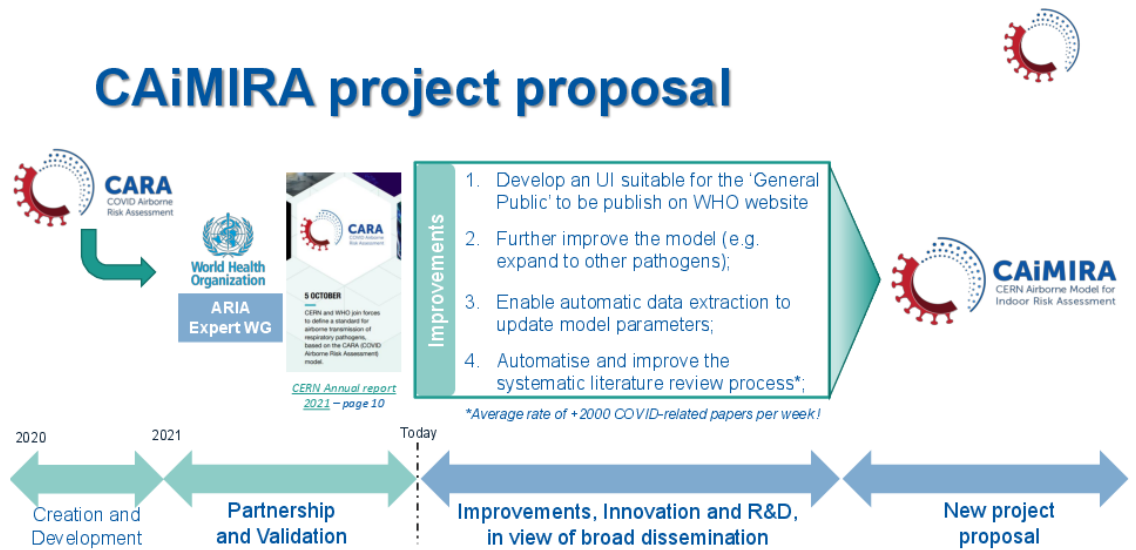
- Reduction of needed number of slices by factor ~ 5 for similar computation times (not taking time needed to integrate wake table, only need to do it once at the beginning of the simulation).
- Starting benchmark of frozen and PIC space charge PyHEADTAIL implementations using the PS at injection as a study case.
- **A. Kurtulus:**
 - Working on the investigation of the 942 MHz mode (for Xdriving impedance) on TCSPM with field monitor on CST in order to understand its contribution to the driving impedance.
 - Convergence studies on transverse impedances of TCSPM on CST.
 - Presentation of my recent works at ETH Zurich.
 - Talk to be given next Thursday at the ABP Group Information Meeting.
- **C. Lannoy:**
 - USPAS.
- **S. Lopaciuk:**
 - Fixed an issue where prebuilding tracking kernels wouldn't work without an editable install of Xtrack.
 - There were some issues with the tests for Xsuite last week, which were caused by minor numerical instabilities: now fixed.

- Performed some refactoring in tests so that testing on different contexts is better visible, and writing new tests on multiple contexts should be easier.
 - Updated Xsuite docs to add instructions for installing on Macs with M1/M2 (uses Miniforge).
 - Currently refactoring the xpart. Particles class (removing the 'legacy' Pyparticles).
- **L. Mether:**
 - Chamonix.
 - **E. Métral:**
 - Mainly JUAS => Many thanks to all the lecturers and students.
 - **N. Mounet:**
 - Significant work on DELPHI: Significant work on DELPHI:
 - Test script written with various configurations/cases checked.
 - Code optimization to speed-up of the Vlasov matrix computation, fully in Python (factor 100 improvement in best cases) → typical LHC single-bunch calculations are now much faster, while in coupled-bunch we gain a factor 2-3.
 - All this is also a big step towards the DELPHI/eDELPHI merging (approach now compatible with eDELPHI).
 - Other (unsuccessful) attempts: sparse diagonalization (might still be useful for generalization of the multibunch case to any filling scheme, which involves much larger matrices), simple multithreading parallelization.
 - Just answered negatively to request to allow a stainless-steel drift tube in TCTPXV (diameter <130mm, no clear justification) and to have 0.4 mm gap (electric discontinuity of the pipe):



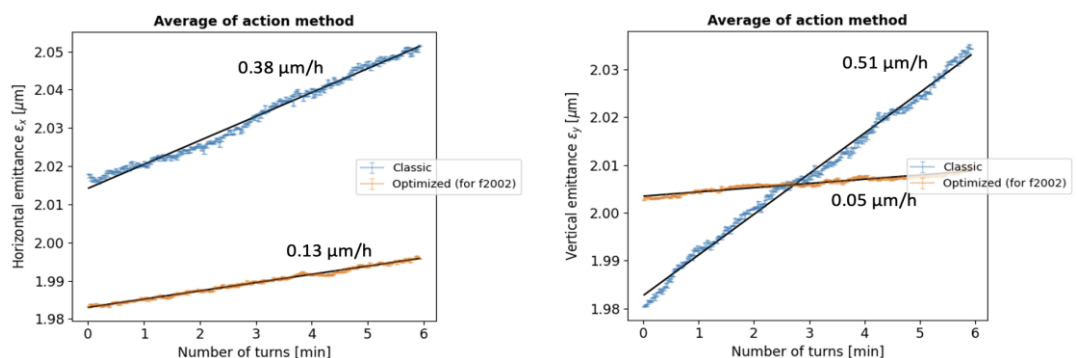
- Lorenzo showed an update of the impedance predictions for HL-LHC at the [WP2 meeting on Tuesday 17th](#) (using the updated DEPHI code):
 - Main message is that without doing anything for the crab cavities, we need 600 A at least in HL at flat top (not ok for dynamic aperture during the transition from flat top to stable beams).

- Research plan written by Christophe (after one year of PhD) and just submitted to Prof. Seidel at EPFL.
- Appointed deputy project leader of CAiMIRA (continuation of CARA, funded by CERN KT and WHO, with HSE, IT and WHO involved):

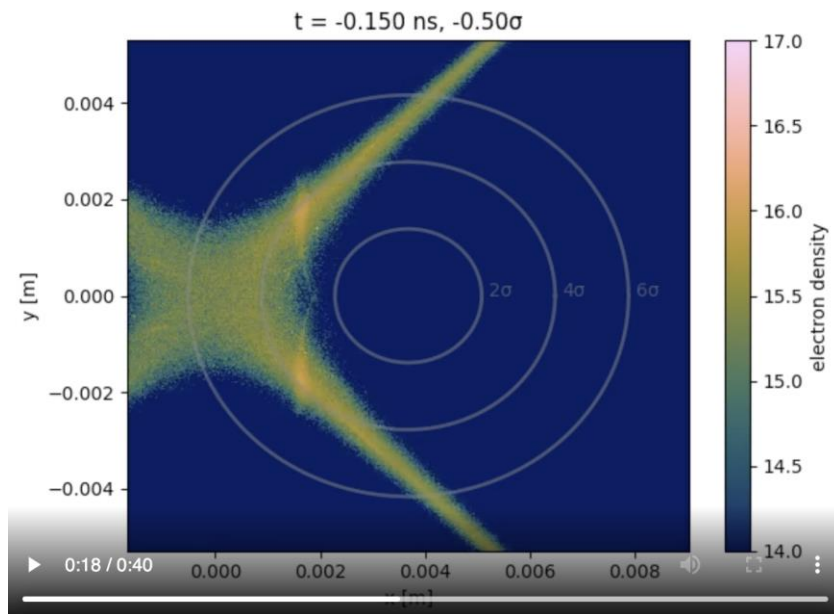


• K. Paraschou:

- Incoherent e-clouds at injection energy: Optimizing the **2Qx-2Qy resonance** by changing phase advance between the LHC arcs (thanks to Rogelio), incoherent emittance growth is strongly reduced (thanks to Josephine for the simulations). Currently investigating by extending the Resonance Driving Term formalism to cover synchrotron resonances (to second order perturbation theory). Next steps include more simulations to investigate the effect of non-uniform distribution of e-clouds in the different half-cell quadrupoles. After simulations confirm the lattice optimization can work for any (or at least the realistic distribution), MD will be designed:



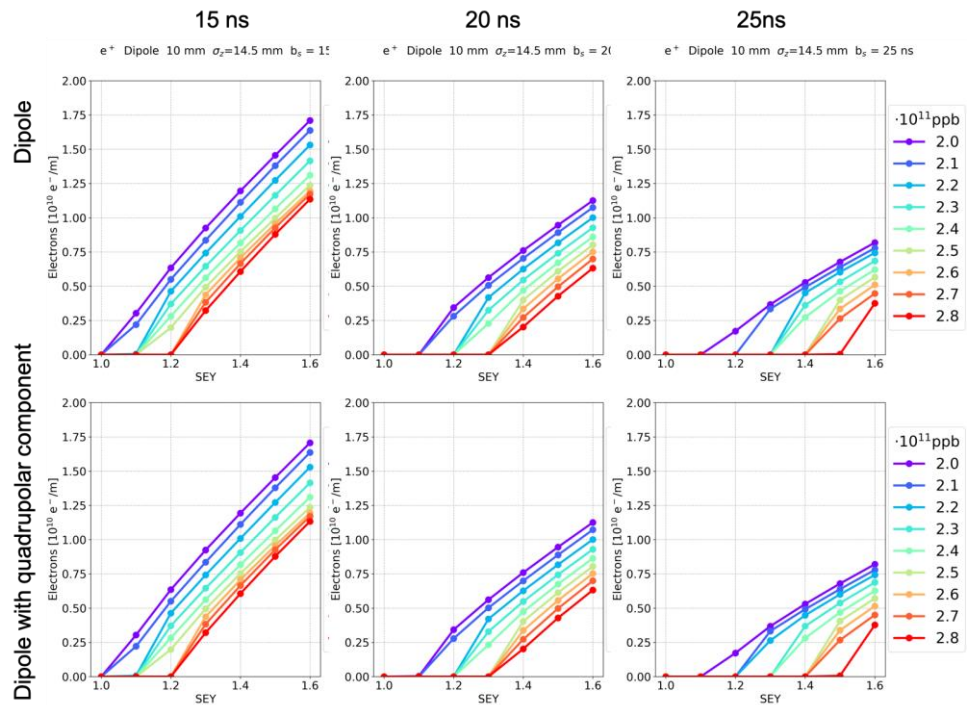
- Incoherent e-clouds at collision energy: First pinches in the Inner Triplet quadrupoles have been simulated. To continue with Xsuite simulations and to check the math on the concatenation of the maps (lumping of the different e-cloud kicks in the Inner Triplets):



- **L. Sabato:**

- Presentation at FCCIS Workshop 2022.
- Writing the EPFL annual report.
- Preparing the tutorials for the next semester course: “Advanced Concepts in Particle Accelerators”.
- Analysing the simulation results of the electron cloud build-up simulations for FCC-ee:
 - Changing the geometry of the beam chamber: radius (from 35 to 25 mm), and winglet depth (from 120 mm to 115 mm).
 - Changing the bunch length (from rms 14.5 mm to 4.38 mm).
 - For a larger range of bunch intensities (from one tenth to the full bunch intensity $2.8e11$ ppb).
 - For dipoles (1.415 mT) with a small quadrupolar gradient (-9 mT/m).
 - In a single plot, the total e-cloud densities in the chamber versus SEY for different bunch intensity with different colours are reported.
 - In the different columns, the bunch spacing varies from 15 ns to 25 ns (the simulations with 30 ns bunch spacing are still running).
 - In the first row, there are the plots with the dipole case and in the second row, there are the plots with the dipole with a small quadrupolar gradient.

- The small quadrupolar gradient does not affect the e-cloud densities.



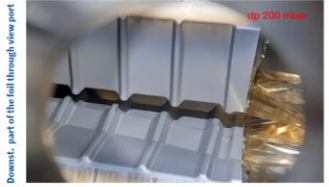
- B. Salvant:**

- Chamonix on Monday and Tuesday: main points:
 - Hannes: Need of extra MD days after schedule for MKDH → 3 days already there. Need more? - 800 MHz tagged as an important limitation.
 - Delphine: dedicated filling, consequence on dedicated MDs in injectors and short parallel. More pressure on OP crew.
 - Brian: interplay between injectors and LHC → some flexibility but LHC takes priority when beam is lost.
 - Filip: status of Velo → critical issue following an incident.
 - Enrico: BGI and rotational wire scanner will require significant impedance studies.
- IPP MD days next week!
- Discussion on TCLD RF fingers with SY-STI: no clear conclusion.
- Impedance measurements on radioactive collimator: SY-STI very reluctant to open their spares unless there is a strong need.
- 5R4: no clear smoking gun from endoscopy in the Schottky or around it. TE-VSC will have a look at the neighbouring valve.
- Gave JUAS PyHEADTAIL tutorial last week with David and Sebastien. Great that we managed to get students to launch the PyHEADTAIL

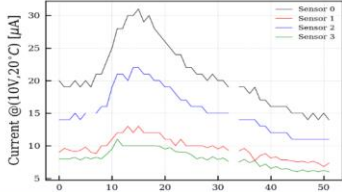
examples from SWAN. Unexpectedly, displaying the movies on the browser was very slow for the first group.

Status of the VELO following the vacuum incident

- **Failure of the VELO vacuum safety system:**
 - Needed to change gas injection system (GIS) setpoint to cope with warm-up of the VELO under Neon (Jan 9th evening).
 - Uncontrolled warm-up of the VELO before intervention (Jan 10th, ~6am) ⇒ $\Delta P_{\text{beam-detector}}$ decreased while GIS could not compensate.
 - Failure of a relay in the velo vacuum safety system ⇒ safety valve connecting the beam to the VELO volume at $\Delta P_{\text{beam-detector}} = -10\text{mbar}$ did not open, and wrong response of the pressure balancing system, increasing further the differential pressure to -200mbar.
⇒ **plastic deformation of the RF-Foil has occurred**
- **VELO detector is still functional:**
 - No damage to the microchannels (no CO2 leaks)
 - No damage to the sensors (leakage current behaving as expected)
⇒ **priority for LHCb is to not damage the VELO**



Downstr. part of the foil through view port



LHC Performance Workshop 2023
23 January 2023
23

Scheduling Feedback

23

- Main goal is to have high luminosity stable beam production, but we had very dynamic scheduling throughout the year
 - Plans for tests, special runs, etc. often changed with few days or even few hours of notice to experiments
 - ▶ Also often last minute requests from experiment side
 - Particularly hard during periods with low availability or special tests
- Flexibility increases machine efficiency, but difficult to plan
 - Challenging to have multiple activities in parallel or right after each other
- **Time during working hours of high value to exp. and machine**
 - Commissioning and tests require many experts to be available
 - Can be frustrating when planned stable beam fill etc. cancelled/moved
 - ▶ Often driven by machine availability, but should strive to find balance
- Had regularly scheduled access (4-8 hours) most weeks in 2022
 - Typically on Wednesdays to overlap with SPS MDs
 - Hope access requests will reduce in 2023, at least towards then end...
- Possible interference with/constraints from other programmes
 - Injector MDs, AWAKE runs, HiRadMat runs
 - Schedule around by keeping fills a bit longer, avoid tests on certain days, etc.
 - ▶ In practice was not a major issue for 2022
 - Still, in case of beam loss, LHC normally takes priority

- **L. Sito:**
 - USPAS.
- **E. Vik:**
 - Finished first part of IW2D python API, taking python data class objects as inputs and giving pandas data frames as outputs. It calculates impedances for flat geometries using cppyy. Performance (speed, accuracy, memory use) basically identical with C++ executables.
 - Upcoming work:
 - Impedance for round/axisymmetric geometries.
 - Interface utilities (file IO, caching of calculation results, etc.).
 - Higher order terms.
 - Wakes.
 - Updated IW2D README (mostly installation), testing, package structure.
 - Changed a loop order for a ~8x speedup of higher order impedance calculations.

- Various bugs fixed.
- Working on presentation.
- **E. Waagaard:**
 - JUAS.
- **C. Zannini:**
 - Quite some work to address all reviewers comments on the paper on metamaterials to be submitted by the end of the month.
 - Writing an internal note on SPS transverse stability limitations.
 - Preparation for the IPP MD day.
 - Procurement of lab tools for R&D activities.
 - Investigation of the possibility to perform a test at the end of the run to exclude the involvement of the PSB extraction kicker in the instability observed at about 1.7 GeV.
 - An MKDH lamination is in the impedance lab (kindly provided by M. Barnes) — Leonardo investigating possible measurements setup for the evaluation of the lamination EM properties.
- **F. Sommerfelt Groenvold:**
 - Just joined the section at the beginning of January
 - Getting familiarized with the fast beam ion simulations to study the CLIC Main Linac and provide vacuum specifications
- **AOB**
 - Our [next CEI section meeting](#) will take place **on Thursday 2 February at 14:00 in Room 6/R-012**. Eskil will present 'The improvements to the IW2D code'.

Minutes by Adnan Kurtulus