

Minutes of the HSC section

142nd meeting on Monday 04/06/2018 (10:30, 6/R-012)

Present: See <https://docs.google.com/spreadsheets/d/1fZiu3vtf546odhd2ONxtW0mx9p8cV-fURT9Kxi7QCys/edit#gid=0>

1) Newcomers / visitors / departures

- RAHEMTULLA Adam (TECH) with NicolasM to work on analytical wake functions for the resistive-wall impedances.

2) Comments on the minutes of the previous 141st meeting + Actions

- No comment => Please check the actions and to discuss where we are at the next meeting.

- Actions from last meetings:

- Action 1 (SergeyAnt et al.): HL-LHC tolerances to beam position offsets at the Crab Cavities => To be followed up by/with RamaC.

- Action 2 (BenoitS, NicoloB et al.): Provide the (current) impedance model (and wake function model) of all the CERN machines.

- Action 3 (XavierB, BenoitS et al.): Follow-up of LHC instabilities (with automatic tools) => See LHC_TIM meetings (<https://indico.cern.ch/category/10168/>) and web site (<http://lhcinstitution.web.cern.ch/lhcinstitution/>).

- Action 4 (Gianni et al.): Follow-up of heat load differences in the LHC sectors.

- Action 5 (LeeC et al.): SPS horizontal instability studies.

- Action 6 (MauroM et al.): PS horizontal instability at 26 GeV with adiabatic bunch shortening => To be moved to e-cloud team (and S. Antipov)

- Action 7 (TatianaR, MauroM, EiriniK): PSB impedance model and related instabilities => Talk by MauroM at the LIU-PSB beam dynamics on 23/04/2018.

- Action 8 (ClaudiaT et al.): LHC BTF studies and possible instabilities due to noise

1) Try and explain the factor 3-4 between 2016 and 2017 (whereas the impedance model should be the same within ~ 10-20%).

2) What is the exact mechanism leading to instability? Is it the one from XavierB (with the white noise), drilling a hole in the stability diagram?

3) To be studied also in the presence of ADT and see if the modes observed are those from impedance as well as the rise-time.

=> Discussed at the LBOC on 27/03/18. To be continued to fully understand the mechanism behind.

- Action 9 (AdrianO): Continue and finalize the space charge studies on SPS TMCI => Discussed on 09/04/18, on-going and on-going discussions with A. Burov et al.

- Action 10: GianniI raised the question about the bunch length to be used for HL-LHC instability studies. Until now we have been using the rms value from a Gaussian distribution => To be reviewed in the future in case there are good arguments to use another function (such as the q-Gaussian).

- Action 11 (LottaM et al.): Detailed simulation studies to try and explain the 16L2 instabilities in 2017 => Some first simulation results were discussed on 23/04/2018. To be continued.

- Action 12 (MarioB et al.): SPS coherent tune shift bunch-by-bunch: can we reproduce this from theory/simulation using the SPS impedance model (starting first with the resistive-wall)?

- Action 13 (OlavB): Detailed simulation of the quadrupolar impedance to be performed for the 4-pole structure => Done.

- Action 14 (DavidA et al.): Try and solve the numerical issue in https://indico.cern.ch/event/712792/contributions/2937067/attachments/1619147/2574980/LandauDampingForISRinstability_EM_19-03-18.pdf and compare the results with other codes.

- Action 15 (DavidA et al.): Check the TMCI results with tune spread (same numerical issue as above still to be solved) and compare the results with other codes.

- Action 16 (SergeyAnt): Check the effect on $\text{Im}[Z/n]$ of the HL-LHC coated inner triplets.

- Action 17 (OlavB): Understand why a 4-pole structure has exactly the same dipolar impedance as the one with 2 parallel plates.

- Action 18 (OlavB): Finalize the work on multi-polar impedances and document it.

- Action 19 (DavidA): Plot the increase in real and imaginary parts of the impedances (dipolar and quadrupolar) for 2016, 2017 and 2018 compared to 2015. Plot also the case 2017 compared to 2016 for ClaudiaT and her LBOC talk on 27/03/2018 => Done.

- Action 20 (DavidA): Finalize the impedance and related instability studies for the EOS and do the same for Injection and Flat-Top.
- Action 21 (NicoloB, DavidA and XavierB): Summarize all the past comparisons between predictions and measurements of LHC transverse instabilities at high-energy vs Q' WITHOUT ADT.
- Action 22 (Everybody): Some volunteers (2-3 people) for the ABP BBQ on 28/06/18.
- Action 23 (NicolasM): Try and answer to the request from RogelioT's team to estimate the amplitude-detuning contribution of collimators.
- Action 24 (XavierB for week starting on 21/05/18): Beam stability studies for HL-LHC => Try and make the scenarios more robust by ensuring enough spread for the small BCMS emittance also during the collapse of the separation. Subsequent simulation work is needed by RiccardoDM and YannisP's team.
- Action 25 (FrancescoG): In the framework of the beam-induced RF heating, collect somewhere all the "maximum temperatures" for all the different equipment, e.g. due to interlock or past observations, etc.

- New actions from this meeting:

- Action 26 (Instability team): Organise and perform the tests at injection (to try and reduce the coherent activity and associate emittance blow-up) and high energy (to continue and check the margins).
- Action 27 (BenoitS et al.): Finalize the HL-LHC impedance report and send it to GA asap.
- Action 28 (SergeyA et al.): Scaling of impedance and related stability for collimators vs. gap and resistivity (assuming only 1 collimator; all collimators; all the machine)?

3) General infos and follow-up (EliasM)

- SLMs

- Louise Carvalho from the legal office will also take the role of Sudeshna Datta Cockerill (as diversity officer).
- TREF: looking to more flexibility for retirement => Reminder: we have 3 cases for the moment as concerns the retiring age:
 - For people hired before ~ end 1980s: 60 (if > 35 years of contribution to the pension).

- For people hired after ~ end 1980s: 65.
 - For people hired since 2012: 67.
- Some discussions started about the re-commissioning after LS2.

- LHC news

- Some dump analyses.
- BSRT cal fill => Any instabilities? No => Info passed to YannisP et al. and in fact the issued was traced back to a pb with the BWS.
- Dump yesterday at 19:28 => Info from AntonL:
 - Fast rising losses in IR7 (~15 ms). It looks like a 16L2 event, but there were no losses in 16L2.
 - Seems the orbit drifted, likely due to the Q1 quench, which then lead to the losses in IR7. So probably no instability.
- Activity on the last fill to be followed up.
- Next studies (see Action 26 above)
 - Test with reduced injection cleaning gain.
 - Test with increased Ioct at injection.
 - Test with reduced Ioct at end of ramp.
 - Scan chroma, Ioct and ADT gain at end of squeeze
 - Etc.

- Impedance

- HL-LHC impedance report? => See Action 27 above.
 - Scaling of impedance and related stability for collimators => See Action 28 above.
- Several people from the team at the Ecloud workshop this week.

4) NMI and LMCI for bunched beams with GALACLIC (EliasM):
https://indico.cern.ch/event/730170/contributions/3025795/attachments/1659657/2660844/NMIandLMCIwithGALACLIC_EM_04-06-2018.pdf

- Part 2 of this study, showing that when the PWD is including (keeping the PAD distribution), no instability is predicted anymore with GALACLIC for $x > 0$ either for a pure reactive impedance or a broad-band impedance => A different PWD should be studied (e.g. PLD) without the “discontinuity” at $x \sim 0.8$ (factor going to infinity, as pointed out by SergeyArs) and therefore a threshold should exist again even for $x > 0$ (at least for BB impedance).

- Good agreement with Laclare1987 for the particular case of a BB impedance with $fr \cdot \tau_{\text{aub}} \sim 1$.

- Some past studies were also briefly mentioned.

- Part 3 of this study will be discussed next week, where benchmarks between GALACLIC, a simple formula derived in the past (based on 2-mode approach, as for the transverse case discussed below) and tracking codes.

5) On the simple formula for SPS TMCI (EliasM):
https://indico.cern.ch/event/730170/contributions/3019248/attachments/1656108/2660847/SPS-TMCI_EM_04-06-2018.pdf

- Reminder about the simple scaling revealed by several approaches and in particular by TMCI. A simple TMCI approach can be used (using the 2 modes overlapping the peak of the real part of the impedance) and the same result (scaling) as Zotter1982 (<http://cds.cern.ch/record/137720/files/SCAN-0009026.pdf> and other approaches) is obtained. Only the numerical factor is sometimes different depending on the approach (within a factor smaller than 2).

- This scaling (with Q_s times the bunch length square) can be re-written as the slip factor times the longitudinal emittance. Using Q20 the slip factor was increased to increase the TMCI intensity threshold.

- The important point here is (in the framework of the discussions on the effect of space charge): the simple TMCI approach considers the 2 modes overlapping the peak of the real part of the impedance, i.e. these 2 modes correspond to the **radial modes numbers** (very often assumed to be the same as azimuthal modes but not necessarily in the general case)! => To be considered in the studies of the effect of space charge on TMCI...

6) Discussion about LHC follow-up: TIM, e-cloud, RF heating, bunch-by-bunch losses (Everybody):

- No particular comment.

7) Landau damping studies for FCC-hh and beam-beam effects (ClaudiaT):
https://indico.cern.ch/event/730170/contributions/3008605/attachments/1660854/2660899/Landau_damping_studies_for_FCC-hh_and_beam-beam_effects.pdf

- Note that for the LD octupoles the increase of 42% was done already last year and it is the value for instance presented at IPAC18.

- Summary

- Update octupole system: ~ 42% more strength + 4 % more octupoles.

- At flat top single beam stability ensured by octupole magnets (larger for negative polarity) system ($DA > 18 \sigma$ both octupoles polarities).

- Collapse sep. bumps (LR + HO crab on): SD always larger or equivalent compared to the end of squeeze case.

- The new beam screen designs increase impedance of 30% => Recent results of ADT coupled bunch modes show sufficient stability at the end of the squeeze (ADT gain can be further reduced to have more margins).

- Collide & squeeze is a possible scenario with $1.1 < \beta^* < 2$ m (BB long range above 40σ).

- A robust baseline scenario has been studied and beam-beam separation proposed based on dynamic aperture.

- Optimized optics parameters have been shown to allow highest dynamic aperture together with a global compensation.

- Newer optics $L^* 40$ m has to be optimized further with multipolar errors (on-going).

- Head-on beam-beam limit seem far away from chosen parameters but studies show optimized working points in parallel.

- Large beta-beating should be expected (30 %) and needs further understand of implications on loss maps and collimation system

- Alternative scenarios are explored to allow for flexibility in the presence of other constraints.

- Continuous benchmark to LHC data is fundamental to understand predictive power of simulations.

8) Progress/status in the different activities/projects and reports from meetings and in particular the issues/successes in the different machines (Everybody)

- LHC_TIM (XavierB)

- Not discussed.

- ATS-IWG (BenoitS)

- Not discussed.

- HSC-IWG (NicoloB):

- Not discussed.

- E-cloud (GianniI)

- Not discussed.

- Beam-beam (XavierB)

- Not discussed.

- Space charge (AdrianO)

- Not discussed.

- ABP-CWG (GiovanniR):

- Not discussed.

- PyHEADTAIL (KevinL)

- Not discussed.

- DELPHI (DavidA)

- Not discussed.

- NHTVS (SergeyAntipov)

- Not discussed.

- LIU (GiovanniR):

- Not discussed.

- HL-LHC

- TCC:

- Not discussed.

- WP2:

- Not discussed.

- FCC

- Not discussed.

- PBC (EiriniK)

- Not discussed.

- Machines

- Not discussed.

- MDs (past and future)

- Not discussed.

9) Miscellaneous

- The next (143rd) meeting will take place on Monday 11/06/2018 (in room 6/R-012 at 10:30)
=> Current agenda:

1) General info and follow-up (EliasM)

2) MD plans for MD1 (Everybody)

3) Recent TCBI at SPS extraction (KevinL)

4) NMI and LMCI: Part 3 (EliasM and MauroM)

5) Summary of our visit at IMP, Lanzhou, China (XavierB and OlavB)

6) Progress/status in the different activities/projects, reports from meetings and in particular issues/successes in the different machines (Everybody)

- Important events and dates for HSC: <https://espace.cern.ch/be-dep/ABP/HSC/SitePages/EventsAndDates.aspx>.

- Web site: <https://espace.cern.ch/be-dep/ABP/HSC/default.aspx>.

Minutes by E. Metral, 07/06/2018.