Minutes of the HSC section

14th meeting on Wednesday 11/06/2014 (09:00, 6/R-012)

HSC members: Olav Berrig (OB), Christian Carli (CC), Elias Metral (EM), Giovanni Rumolo (GR), Frank Schmidt (FS), Elena Wildner (EW), Elena Benedetto (EB), Michael Bodendorfer (MB), Kevin Li (KL), Tatiana Pieloni (TP), Benoit Salvant (BS), Guido Sterbini (GS), Daria Astapovych (DA), Adriano Garonna (AG), Meghan McAteer (MM), Nicolas Mounet (NM), Carlo Zannini (CZ), Nicolò Biancacci (NB), Xavier Buffat (XB), Alexander Huschauer (AH), Giovanni Iadarola (GI), Adrian Oeftiger (AO), Serena Persichelli (SP), Tatiana Rijoff (TR), Letizia Ventura (LV), Claudia Tambasco (CT), Magdalena Kowalska (MK), Andrea Passarelli (AP), Annalisa Romano (AR), Michael Schenk (MS), Vincenzo Forte (VF), Danilo Banfi (DB), Javier Barranco (JB), Joseph Kuczerowski (JK).


1) Newcomers / visitors

- Gianni Iadarola started as COFUND fellow on 01/06/2014 with Giovanni R as supervisor to work on “Ecloud and scrubbing in the CERN accelerators”. Congratulations for the PHD thesis!

- Possible space charge PHD student (Malte Titze) to work with Frank S on space charge (came during the SC collaboration meeting and will come to CERN during few months later this year).

- Alpo Valimaa (summer student) will arrive next week (Monday 16/06) to work with Guido S.

2) Comments on the minutes of the previous 13th meeting + Actions

- None.


3) General infos

- No particular comment from anyone.
- SL meeting:

  - 300 parking spots for CERN staff and visitors and 100 for P+R have been created close to the Globe. This is only temporary (max. 5 years): It is not clear what is going to happen after that. The parking in front of building 33 will be replaced by a green area (work starting after the celebrations for CERN 60th anniversary).

  - Building 38 (CERN hostel) will be unavailable until summer 2015 to allow for repair work.

  - Wooden arcs of the Globe need to be replaced.

  - Cafeteria in building 6 is going to be refurbished starting in June/July for several months. After that a similar service as in building 40 will be provided. Very light service during the works.

  - Central radioactive storage space is full (954 and 955). 917 no more available because in poor state. The South Hall were lightly radioactive material is stored might be used for BIO-LEIR and other R&D activities. Solutions are being studied.

  - A certain number of meeting rooms will be made bookable only with 48 hours advance. This solution is considered too drastic. Ongoing discussions.

    - However, meanwhile, try and cancel the room reservations if you know you will not be able to use it.

  - Re-appearance of woodworms in building 9…

  - Personnel statistics presented to the TREF shows that the majority of recruitments are from industry (52% of all recruitments and 68% of external recruitments).

  - There are no news for the "Frontalier" situation with respect to Health Insurance (01/06/14 is the official date for France).

  - Some budget cuts might come due to the CERN debt, as it seems that the balance will not be reached in 2018.

  - LHC: Cool down started in Sector 67 with LN2 - 2-3 weeks will be required to reach 80K.

  - E. Van der Bij (BE/CO) will work with Fritz Caspers as BE/KT link person and he will replace him when Fritz will retire.

  - BE management changes:

    - Thibaut Lefevre takes over from Jean-Jacques Gras as BE-BI deputy group leader.
- Andy Butterworth takes over from Maurizio Vretenar (moving to the Accelerator Director office as EUCARD-2 Coordinator) as BE-RF deputy group leader.

- Highlights from last week’s Hilumi meeting at BNL:

- A down selection of the crab cavity design has been made (with priority for production by Niowave):
  
  1) BNL
  
  2) SLAC et al.
  
  3) UK option => Stopped.

- If everything goes according to the (very ambitious) schedule we should be able to have 4 full cryostated cavities in time for the SPS test (2 BNL type and 2 ODU - Old Dominion University - types).

- For the triplets:
  
  - Reached close to 12 T at the pole tips of HQ02b (short quadrupole with 120 mm diameter aperture), i.e. field gradient of ~190 T/m, which is ~ equivalent to the nominal HL-LHC triplet request => Good progress.

- Wide-band feedback (summary given by John Fox) => He mentioned mainly the progress made for the modeling but there was also the progress made in the design of kickers (the stripline kicker is in fabrication and the slot line prototype design is advancing well).

- Halo Monitoring/Control: Possible techniques for halo control by noise excitation via a quadrupole or the damper are being studied and will be tested in MD. A conceptual design of a hollow electron lens for halo control has been recently completed at FNAL. The design of a halo monitor will be pursued with help from SLAC.

- Beam-Beam compensation: Beam dynamics studies for the implementation of a Beam-Beam Long Range (BBLR) compensator in LHC (as a test-bed) and HL-LHC are ongoing at FNAL and being ramped-up at CERN. The potential use of an electron beam for BBLR compensation is also being considered.

- During the meeting, there were also some tests with e-lens in BNL to compensate the BBHO => SimonW said that they still see emittance BU due to it. How much?

- TatianaP and SashaV on beam-beam => GianluigiA is still waiting for the quantification on PACMAN effects (effect on orbit, tune and chroma).
- Evian workshop

  - Talks from NicolasM, TatianaP, GiovanniI and HannesB.

  - Outcome tomorrow by MassimoG during the ABP info meeting.

- TSC => Deadline today to DelphineR.

- ABP meeting + BBQ: 09/09/14.

- Talk from GuidoS on “Using MATLAB to script your MDs” is available at the “General Info & Current News” section of the general 2014 Injector MD page: https://ab-mgt-md-users.web.cern.ch/ab-mgt-md-users/2014/.

- SC collaboration meeting + SC meeting => PTC-pyORB1T code development by HannesB: 2D SC code but slice by slice => Very promising. Similar things are being done for beam-beam => Could be good to review (all) the beam-beam and space charge algorithms together.

- Talk by TatianaP at HSS and LBOC on BB recommendation for beam separation.

- 1st PSB beam dynamics meeting from ElenaB yesterday.

- PS LIU meeting with SerenaP summarizing the impedance workshop in Erice.

- 1st HEADTAIL WG re-started => Now led by Kevin Li.

- Talk from GR and CZ at MSWG: MD planning + PSB impedance model.

  - Talk from GR on MD planning for 2014

    - Weeks 39-40 will dedicated to SPS scrubbing run.

    - Comment from KarelC: he would like to know the cycle to be used not the day before as before but the week before for safety reason. StephanC will not be allowed to create a new cycle without the approval of KarelC.

- Talk from CarloZ about PSB impedance model

  - ~ 2 MOhm/m are missing at all energies (160 MeV, 1 GeV and 1.4 GeV) => Which equipment depend weakly on beta? => Maybe more geometrical impedances… to be studied…

  - There are many flanges in the PSB but normally all the bypasses are working and are checked each year => We could maybe make a meas. with 2 or 3 flanges without bypass.

- RolandG will leave CERN in September and will become the new director of ESS.
- Vacation: I will not be at CERN from 07/07 to 18/07 included and from 28/07 to 06/08 included => No HSC meetings on 09/07, 16/07, 30/07 and 06/08.

4) MuSiC: a Multi-bunch/particle Simulation Code with an alternative approach in simulating wakefield effects (Mauro Migliorati):  [https://espace.cern.ch/bedep/ABP/HSC/Meetings/ICE_201406_MuSiC.pdf](https://espace.cern.ch/bedep/ABP/HSC/Meetings/ICE_201406_MuSiC.pdf)

- Common approach to wakefield simulations => E.g. of the longitudinal beam dynamics.

  - At each turn, the evaluation of the effect of the wake potential is proportional to \((Nm-1)*Nm/2\), with \(Nm\) the number of macroparticles.

  => In order to reduce the computing time, in general the bunch is divided into \(Ns\) slices (bins).

- Possible issues

  - SLICES: how many? The greater is the number of slices the better is the accuracy, but each slice must contain sufficiently high number of macroparticles => Increase \(Nm\). Slices represent a non-physical artifice, which can introduce additional numerical noise making necessary, in some cases, a parametric study: e.g. what happens by changing number of slices and of macroparticles in the slices?

  - If the bunch is long compared with the wavelength of the wakefield, a very high number of slices could be necessary, thus increasing enormously the computing time. This problem can be very tricky because by changing the number of slices, say, by a factor of 2, one could get the same (wrong!) result.

  - Inverse DFT of impedance: in order to obtain the impedance model of an accelerator, one usually uses theory and EM codes, such as CST Microwave Studio, GdfidL, .... However these codes give the coupling impedance and the wake potential of a Gaussian distribution. In order to obtain the wakefield to be used in a simulation code, one has to do numerically the inverse Fourier transform of the impedance, thus adding other numerical noise, or use other tricks to find out the ‘Green function’.

  - In order to simulate the coupled bunch instabilities, long range wakefield is necessary. But how long? The EM field in this case remains trapped over many turns, depending on the \(Q\) factor of the HOM ... many machine lengths!

- An alternative approach: impedance fit with resonant modes

  - To study coupled bunch instabilities a time domain simulation code, named LCBC (Longitudinal Coupled Bunch simulation Code), was developed and first used for DAФNE.
In LCBC code, the impedance of resonant modes, responsible of coupled bunch instability, is used directly instead of the wakefield.

Instead of using a convolution, it is possible to demonstrate that, from the mathematical point of view, the same result can also be obtained by using a matrix formalism (introducing a wakefield matrix and a charge matrix).

It is possible to use this approach with any beam configuration (e.g. with gaps to simulate transients) and for any resonant mode.

The advantage of using this approach in a simulation code is that we avoid the convolution integral (and slices) saving computing time, and the problem of the length of wakefield disappears. We just need to order the particles inside the same bunch from the head to the tail and propagate the matrix between two particles: instead of \((Nm - 1)*Nm/2\) operations at each turn, only about \(Nm - 1\) are needed! If we consider a generic impedance, we can take a sum of some resonant modes to fit it and use them in a simulation code with this matrix transport formalism \(=>\) This should be tried with the LHC impedance for instance.

The new code has been benchmarked with theory and other codes:

- multi-bunch, single particle with LCBC (feedback on and off),
- multi-bunch/particle: some preliminary results,
- potential well distortion, synchronous phase shift and microwave instability \(=>\) Would be nice to make the plot “à la Benoit” to see if we can observe a mode-coupling instability.
- wakefield: PS Kickers and pure inductive.

Music and singlebunch codes takes about the same time for 1 bunch and Music takes in fact even more time when we fit with many resonators. Music is not particularly convenient for single bunch; it is a different kind of approach. However, it is much better if you go to the multi-bunch regime.

The resonator impedance can be made of a RLC circuit and RLC circuits can be described with the matrix formalism \(=>\) Hence the idea here to use the matrix formalism.

For beta < 1, NicoloB reminded us of the paper from Diego Quatraro et al. from PAC09 (http://cds.cern.ch/record/1208362/files/th5pfp012.pdf) about the non relativistic broad-band wakefields and suggested to see if we could implement it in the Music transport operations.

NicolasM asked if there was a deterministic way to fit any impedance \(=>\) No, it is an iterative (manual) way for the moment. Can we fit also the resistive-wall impedance? As mentioned above already, this should also be tried with the LHC impedance for instance.

NicolasM mentioned that the matrix formalism seems to work very well due to the cos and
sin functions of the particular wakefield discussed and he was wondering if this could be extended to any function linking 2 particles. Ongoing discussions.

- Possible next step: Extend this to the transverse domain? Could be an interesting subject for the HWG.

5) Update on single-bunch instabilities observed in the LHC & tune shift convergence study with HEADTAIL (DariaA): [https://espace.cern.ch/be-dep/ABP/HSC/Meetings/DariaA.pdf](https://espace.cern.ch/be-dep/ABP/HSC/Meetings/DariaA.pdf)

   - 1st instability analysis in fill # 2447:
     
     - Comparing the measurements and HEADTAIL simulations of the stabilizing (threshold) octupole current vs. Q’, the (perfect) agreement would be obtained for Q’ ~ - 2 units.
     
     - Comparing the measurements and HEADTAIL simulations of the instability rise-time vs. Q’, the (perfect) agreement would be obtained for Q’ ~ - 2 units.

     => Q’ ~ - 2 units would explain all the observations.

   - Comparison between DELPHI and HEADTAIL for the coherent tune shift vs. Q’ => DELPHI gives ~ twice larger tune shifts compared to HEADTAIL. Why? Is it linked to the treatment in HEADTAIL of the effect of a slice on itself? This should be followed up by the HWG.

6) Brief reports of:

- PSB: ElenaB

  See report at ABP info meeting the day after: [https://indico.cern.ch/event/323728/contribution/1/material/slides/2.pdf](https://indico.cern.ch/event/323728/contribution/1/material/slides/2.pdf).

- PS: GuidoS

  PS started the cold check-out 2 week ago. The beam is expected for the 20 June and the first physics on the East Area will start after 4 weeks of beam commissioning the (mid of July). The cold check-out is proceeding without major problems: the test of all the powering of the magnetic circuits is going on. Some problems were detected (mostly on the ancillary magnets (sextupoles, skew quad)) but all of them could be solved with short ring accesses. At the moment, the MPS is still in use but during the cold check-out the POPS will take over. Concerning the RF system and control loops, only during the beam commissioning it would be possible to have consistent tests and checks. For the beam commissioning, the machine will start with plain h =7 or 8 beam (no
compression, splitting or merging). LHC beam are expected to be ready of the end of July.

- **SPS: BenoitS**

  - On May 28th, a vacuum leak was found on a bellow near a quadrupole in LSS1 close to the dump and the MKPs (QDA11910). The quad was removed, a new bellow welded and the assembly was reinstalled, but there was still a leak on the new bellow. Welding tests on the batch of spare bellows (received in 1984) are planned by TE-VSC in the next days. This problem is planned to delay the vacuum closure of LSS1 and therefore the start of the long MKP commissioning. There was a presentation at IEFC this Friday on this issue ([https://indico.cern.ch/event/321213/](https://indico.cern.ch/event/321213/)).

- **LEIR: MichaelB**

  - CO will install LinuxRT in LEIR controls by Friday 13th, then dry-run by Steen Jensen. Until then, no controls in LEIR.

  - DSO test on Wednesday morning.

  - Quad ground shortening problem in ER.QDN2040. Investigation ongoing.

  - May need to start cold checkout in "local" rather than "remote" due to late install of LinuxRT (to replace LynxOS). Start is scheduled for this week Friday.

  - We will test the injection bumper for 10Hz upgrade operation on Wednesday afternoon or Thursday this week.

  - BI dry runs will take place on Friday June 13th and Tuesday June 17th.

  - First tests of cycle creation next week.

  - Chosen more detailed subtopic:

    - LEIR BHN20 yoke cable found, shortening eddy-current around the magnet yoke. The cable is removed now. C. Carli said that, several years in the past (2004-2006), this cable was used to estimate eddy currents around the machine through the vacuum chamber. He does not have any records or a date on this but remembers the current to have been "several hundreds of amperes". The vacuum chamber in LEIR represents a closed circuit along the circumference (no isolator element is installed). Unfortunately, the cable was connected on both ends to the vacuum chamber after the measurement was finished, rather than being disconnected or removed. -> Significant consequences for Ar and Pb machine startup in 2014 and 2015 due to changed machine state.

- **LHC =>** See report at ABP info meeting the day after by MassimoG about the outcome of Evian: [https://indico.cern.ch/event/323728/contribution/3/material/slides/1.pdf](https://indico.cern.ch/event/323728/contribution/3/material/slides/1.pdf).
7) Actions to be taken for the next meeting

- List of all actions: https://espace.cern.ch/be-dep/ABP/HSC/SitePages/Actions.aspx.

8) Miscellaneous

- The next (15th) meeting will take place on **18/06/2014** => Agenda:
  
  1) General info and follow-up (EliasM)
  2) PSB and PS optics (OlavB)
  3) How to access my impedance and instabilities codes, scripts and data (NicolasM)
  4) Brief reports for the different machines: PSB, PS, SPS, LHC and LEIR
  5) Brief reports for the different projects: LIU, HL-LHC and ELENA
  6) Brief reports for the different working groups: SC, EC, BB, IMP and HWG
  7) AOB (EliasM)

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

- Preliminary agendas for the next meetings: https://espace.cern.ch/be-dep/ABP/HSC/SitePages/MinutesOfMeetings.aspx.


Minutes by E. Metral, 17/06/2014.