Minutes of the HSC section

81th meeting on Monday 20/06/2016 (14:00-16:00, 6/R-012)

HSC members: Javier Barranco Garcia (JBG), Mario Stefan Beck (MSB), Eleonora Belli (EleoB), Olav Berrig (OB), Nicolo Biancacci (NB), Edoardo Bonanno (EdoB), Xavier Buffat (XB), Lee Robert Carver (LRC), Giovanni Iadarola (GI), Kevin Li (KL), Elias Metral (EM), Mauro Migliorati (MM), Adrian Oeftiger (AO), Tatiana Pieloni (TP), Tatiana Rijoff (TR), Annalisa Romano (AR), Giovanni Rumolo (GR), Benoit Salvant (BS), Michael Schenk (MS), Claudia Tambasco (CT), David Amorim (DA).

Present/Excused: JBG, MSB, EB, OB, NB, EdoB, XB, LRC, GI, KL, EM, MM, AO, TP, TR, AR, GR, BS, MS, CT, DA, MatthewC, Antoine Maillard, Vasilis Vlachodimitropoulos, LottaM.

1) Newcomers / visitors

- Antoine Maillard, summer student with BenoitS, arrived on 13/06 for ~ 2 months and he will work on aspects of transverse beam stability.

2) Comments on the minutes of the previous 80th meeting + Actions

- Produce the same DELPHI TMCI plot (as for the LHC) for the SPS with Q26 (and Q20) => DavidA.

- Status of the LHC instability monitoring? Do we see some conditoning at injection? Can we decrease the chroma and/or octupoles? => LeeC, XavierB and KevinL (when we will be allowed, i.e. after ~ mid July…).

- Pop corn instability:
  
  - Chromas have been measured after TS1 and found at ~ the same values.
  
  - Action (BeamBeam): plot the variation of chroma due to beam-beam during the stable beam.

  - Try and measure the bunch by bunch tune shift in stable beam => EoF request written by XavierB.

  - Status over the last fills? => Seems everything is fine. There was an issue few fills ago with the fill with the lowest intensity…
- Beam-induced RF heating => Seems BGI is heating… => See slides from BenoitS today.

3) General infos

- SL meeting:
  - VIA fellows (5+2 reserve for dept) => Deadline for department to make proposals is probably in autumn but would be good to start to collect possible subjects. Please let me know in case you are interested.
  - HL-LHC (which was never officially approved) has been formally approved last week:
    - However, more money will be needed for the civil engineering => Exercise to try and reduce the cost…
    - Crab Cavities => Only half will be installed.
    - Q4 (larger aperture) is not in the baseline for the moment (it is a limitation for some types of flat beams) => Will therefore be more difficult to achieve the ultimate performance.
    - Do we need to coat the collimators?
    - Xing angle to be used (based also on the LHC experience which is ~ OK with chromas of ~ 20-25 in stable beam):
      - YannisP et al. are looking at it from the point of view of dynamic aperture and beam lifetime.
      - What are the effects of crossing angle on coherent beam stability => Action: XavierB et al.
    - Other savings?
  - BernhardtH will act as the students liaison officer for the department.
  - Foreseen ABP info meeting on 30/06 with talks from BenoitS on ImpedWG and GiovanniR on ComputingWG => To be confirmed or postponed…
  - Ongoing discussion about the physics beyond collider programme => Reminder about kick-off meeting on 06-07/09/16.
  - IEFC => Due to the condition of the SPS TIDVG dump, all MDs should announce intensity and energy to be used.
LHC follow-up:


  - Following some studies by LeeC and XavierB, an ~ 6 Hz oscillation is observed for the full beam => Does not seem to be harmful for the beam but there is something to be investigated further.

- Some considerations about the effect of bunch length and BCMS on e-cloud (GiovanniR): [https://espace.cern.ch/be-dep/ABP/HSC/Meetings/20160617_considerations_for_hsc_meeting.pptx](https://espace.cern.ch/be-dep/ABP/HSC/Meetings/20160617_considerations_for_hsc_meeting.pptx)

  - We consider that SEY = 1.40.

  - 1.2 ns => 1 ns: we could expect ~ 10% increase.

  - For quads, we would expect in fact a small increase (tbc) and nothing is observed.

- BCMS

  - We could gain ~ 5% in heat load, i.e. almost no change.

  - No big dependence expected on transverse emittance.

  - Stability: with smaller transverse emittances, the beam will be more prone to instabilities.

  - BCMS in the injectors: ~ 1.9 microm last year from SPS (but this beam was not fully optimized). This year, ~ 1.4 microm at PS extraction but it was not taken yet in the SPS.

  - The same scrubbing (or no scrubbing) effect is expected with BCMS.

  - From beam-beam point of view, it should be fine: depending on the transverse emittances in collision, the head-on part will increase slightly (or considerably?) and this could change a bit the picture.

  - Issue of too much cryo at the end of long fill => The simple formula for heat load had to be updated (GianniI).

- BGI temperature (BenoitS): [https://espace.cern.ch/be-dep/ABP/HSC/Meetings/LHCBGImeasuring.pptx](https://espace.cern.ch/be-dep/ABP/HSC/Meetings/LHCBGImeasuring.pptx)

  - This equipment is clearly not optimised for impedance as several resonances are observed in simulation.
- They had no temperature probes until LS1.

- Reminder: 1 beam has 2 BGIs (1 H and 1 V).

- Stable temperature seems to be 50 degrees => Calibration needs to be reviewed.

- From the observed pressure rises, fill after fill, it seems that if there is heating there must be also deformation otherwise it would be more reproducible.

- Conclusion: It is only used for ions, it is only R&D etc. and therefore this is not a main worry for the LHC operation => As long as the vacuum is fine with vacuum people, then there is no pb. To be followed up however by the impedance team.

- Bunch by bunch tune shift during stable (to try and confirm the “central stripe” mechanism) => EoF request written by XavierB.

- LMC => We need to be prepared for the next one (where the effect of bunch length will be discussed) and the one after as concerns the BCMS beam. Relevant people informed.

  - For this Wednesday (bunch length), GiovanniR will prepare few slides with FanouriaA to cover effects on e-cloud heat load and IBS.

  - For the Wednesday after, ongoing discussions with YannisP => An internal meeting might be organized at the end of the week.

- Meeting on SPS flange impedance and grounding on 14/06/2016.

- Impedance requests from Marco Calviani for all STI equipment (TIDVG#4 is the most urgent one based on the current issue).

- WP2 actions => Proposition for our future talks at WP2 meetings (to be confirmed by GianluigiA et al. as the frequency of meetings during summer will change…):

  1) Heat-load (G. Iadarola) => Already planned and confirmed: 28/06/16.


  5) Do we need a Wide-Band Transverse feedback in the LHC/HL-LHC (K. Li) => Confirmed: 26/07/2016.
6) Effects of the crossing angle on the coherent beam stability? (X. Buffat) =>
Confirmed: 09/08/2016.

- Email I sent you from MassimoG about CALS => Please tell me (and MassimoG) in case of any request/suggestion etc. BenoitS is already in contact directly with CO for heating and instability studies in the LHC.


- BBLR MD
  
  - Decay rate plotted against crossing angle, showing a strong dependence with crossing angle, with beam 2 worse than beam 1.
  
  - Decay rate has a strong dependence on the strength and number of the long-range beam-beam interactions and it is seen in both the intensity and luminosity data.
  
  - At the smallest crossing angle of 118 µrad corresponding to a beam-beam separation of 5.5 to 7.6 σ, the chromaticity was reduced from 15 units to 2 units and the lifetimes were observed.
  
  - At the same crossing angle and chromaticity, the Landau octupole current was reduced from 476 A to 0 A and after optimisation of the tunes, the lifetimes were observed.
  
  - Lifetimes improve from below 10 hours to above 30 hours, recuperating lifetimes obtained at a crossing angle of 290 µrad.
  
  - Both beam lifetimes improve.

- Be careful: the crossing angle alpha is the full Xing angle, whereas it was defined as half.

- The idea is to compare the intensity lifetimes with the DA model as done by MassimoG =>
  
  Partitioning of phase space:
  
  - \( r < D_\infty \): KAM area confining the particle motion
  
  - \( r > D_\infty \): Chaotic motion governed by a Nekhoroshev like estimate.

- Firstly intensity decay is converted into dynamic aperture by turn => Fitting procedure.

- Variation of DA with turn number and crossing angle for nominal bunch behaves as expected with smaller crossing angles resulting in a smaller dynamic aperture due to larger losses.

- Comparison DA to lifetime => Follows a square root relation for 3.5 Mturns.
- Comparison simulation vs. Experiment:
  
  - Fairly close agreement of the experimental result and the sixtrack simulations for the last 5 crossing angles (within ~5%).
  
  - However there are no errors included which could have a large impact.
  
  - Crossing angle had a 10-20% error at the time of MD
  
  - Unlike the simulations the experimental data includes proton burn off => One needs to remove the effect of proton burn off from the experimental data. It is ongoing.
  
  - Inelastic cross section: 60 mb used => To be updated.
  
- In summary:
  
  - Bunch by bunch intensity lifetimes have been analysed for the LR MD as a function of crossing angle ($\alpha$), # of LR, Q’ and octupole strength.
  
  - Scaling laws show a non linear dependence of $\alpha$ and the # of LR.
  
  - Analysis indicates that reducing the chromaticity and octupole strength allows the LHC to operate at a smaller crossing angle without effecting beam stability (with only the non colliding bunch going unstable) and hence obtaining a gain in luminosity.
  
  - A model for the intensity loss relation to dynamic aperture (from MassimoG) has been applied to the data and directly compared to dynamic aperture simulations.
  
  - Ongoing work on the burn off model.
  
- Comment from TatianaP: we start to see sthing below ~ 4 sigmas DA => Should be possible to run in the LHC at ~ 250 microrad (reminder: we are currently at 370 microrad).


- NicoloB presented his draft slides for his talk tomorrow at the LBOC.

- Summary
  
  - TCSG impedance measurement at 6.5 and 6.0 sigma:
    
    - Found higher impedance than expected of about a factor 1.2 to 1.6 considering V plane only.
- H plane more difficult to be measured due to noise lines on the tune.

- Growth-damp “experiment” => Considering the factor from impedance we are probably close to stability diagram edge at 188 A. Decreasing/Increasing the damper gain we right/left moved the stability limit making the bunch unstable/stable.

- Instability after 6.0 sigma scan => Due to halo scraping: mode -1 is excited and in B1H grows slowly as it is at the edge of stability.

- Octupole current threshold => We went there already unstable in both B1 and B2. B2 showed excited mode -1 already prior the scan. Mode 0 gets also unstable at 75 A.

- Comments

- Typo: it is 8E-5 and not 0.8E-5.

- One should mention that last year we operated at 8 sigmas and that this year we are at 7.5 sigmas (after our approval) and that this works ~ as predicted.

- There are 11 TCSGs and it is difficult to measure the tune shift => It will be difficult to see/measure only 1 collimator, but at least we should ask to install it in V where we have more resolution. And a higher intensity would help also.

6) Long term data storage for critical parameters (XavierB): [https://espace.cern.ch/be-dep/ABP/HSC/Meetings/LongTermDataStorage.pdf](https://espace.cern.ch/be-dep/ABP/HSC/Meetings/LongTermDataStorage.pdf)

- Info required from us.

- EOS is supposed to replace afs at some point.

- RiccardoDM implemented there a database (called pagestore). For the moment, there is no back up of this and please don’t erase anything there!

- XavierB started to log data.

- Please, report bugs/etc. to XavierB and/or RiccardoDM.

- Comment from TatianaP: the bunch by bunch lumi is already stored somewhere (in case we have an issue with space..., which is not the case for the moment).

7) Miscellaneous

- The next (82th) meeting will take place on Monday 27/06/2016 (in room 6/R-012 from
14:00 till 16:00) => Agenda:

1) General info and follow-up (EliasM)

2) Compensating long-range Beam-beam with octupoles in the HL-LHC (TatianaP)

3) Talk about the SLAC Wide-Band Feedback system (Claudio Rivetta and Ozhan Turgut, from SLAC)

4) AOB (everybody)

- 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, 22/06/2016.