Minutes of the 51st Impedance Working Group meeting

Location: Zoom

Review and approval of minutes from 50th meeting.

Agenda of 51st IWG meeting, October, 5th, 2021:

- Status of MKP-L: Serigraphy (M. Barnes)
- Update on the MKP-L impedance studies (C. Zannini)
- Layout modification proposal for SPS LSS4 (T. Levens)
- AOBs (2 slides max.):
    - Update on ECRs
    - Update on bench measurements
    - LHCb Velo wakefield suppressors

Present: Nicolo Biancacci, Benoit Salvant, Christine Vollinger, Mike Barnes, Carlo Zannini, Fritz Caspers, Tom Levens, Miguel Diaz, Giovanni Rumolo, Miguel Valente Dos Santos, Kristof Brunner, Michael Sullivan, Freek Sanders, Marko Milovanovic, Adnan Kurtulus.

The chairs welcomed two new IWG participants: Michael Sullivan, senior fellow coming from Manchester University, and Miguel Valente Dos Santos, master student coming from university of Leiria. Both will be working on the contribution to machine impedance models and on impedance mitigation of their machine elements.

Review of minutes from 50th meeting and update on ACTIONS:

ACTION: (Benoit, Christine): To discuss either with STI or Vacuum group about how to perform these thermal simulations.

Benoit informed that a collaboration is being set up on linking EM and thermal simulations through a technical student project shared between CMS, BE-ABP and EN-MME.

Mike asked more information on this project. Benoit said that the goal is to have the student supervised both by experts in thermal simulations and in EM simulations on the topic of the CMS beam pipe temperature. As discussed with Simone Gilardoni (SY-STI), the idea is to continue the work started in SY (ABT and STI) to find a common framework that could be used for other devices such as kickers and collimators.

ACTION (ARP team): present future plans for AFP Alpha detectors at the next IWG meeting.

Marko asked to recall about this request. The idea would be to present the status of Roman pot heating as a follow-up of the presentation given by Ivan at MPP on May 21st (https://indico.cern.ch/event/1040022/ slide 8).
Marko stated that Ivan Lopez will take over this activity from him and agreed to ask Maciej for a presentation in one of the next IWG meetings.

ACTION (for Tom Levens and Manfred Wendt): check the need for having enamelled flanges on the two sides.

Tom Levens said that it was discussed internally within SY-BI and with only one insulating flange the risk that the observed line disturbance remains is considered too high.

Benoit added later that another insulating flange would be removed by BE-BI in the frame of the project presented by Tom during this meeting, even if it should not be considered a compensation, of course.

IWG took note that SY-BI prefers having two insulated flanges, at the expense of increased impedance. Since it is not sure whether the use of insulated flanges will solve the problem, IWG asks the SY-BI team to provide feedback in 2022 whether the problem is solved after the installation of these flanges. Further, IWG stresses that a different solution needs to be found in the case that the number of used insulated flanges in the SPS is identified as limiting the machine performance during Run 3 (all insulated flanges will then have to be re-discussed, not only these two). A comment on the related ECR was put in this respect.

Comment Fritz Caspers: It remains the general question whether enamelled flanges in the SPS are needed at all. From his point of view, most likely they are not.

ACTION (for Carlo and Benoit): continue the MKP-L heating simulation studies with more modules

Further simulations were performed by Carlo with 4 MKP-L modules, in one tank, which confirmed that the first MKP-L does not experience specifically more beam induced heat load than the other tanks. This item shall be discussed in IWG #52.

ACTION: For next meeting we must plan the measurements that are not scheduled yet.

This will be reviewed at the next meeting.

Status of the MKP-L: Serigraphy (Mike Barnes)

For the low-impedance MKP-L, Mike B. presented a comparison of the conditioning results for versions V2 and V3. For V2, the serigraphy is connected to the end-ground plates and a gap exists between the alumina and the HV conductor. The alumina is supported from the return conductor. In this case, it was observed that the vacuum activity is following the pulse lengths, i.e., a strong dependence of vacuum on the pulse lengths is observed. Contrary to this, for V3, the serigraphy is connected to the HV end plates, with the same gap remaining between the alumina and the HV conductor. In the V3 case, vacuum activity and pulse lengths decouple and no dependence of the vacuum on the pulse length could be observed. Further, after conditioning, no change in pressure rise was observed for voltages up to approx.. 45kV, however, a faint flash was visible above 30kV: the later suggests that a reduction of the electric field at the end tips of the serigraphy by a factor of at least 2 is required.

Mike then explained that in many cases, a weak sparking is observed at the pulse input end of the two serigraphy fingers which are closest to the return busbar. Generally, shorter serigraphy fingers should behave electrically better due to a reduced duration of potential difference and hence a smaller chance of voltage break-down.
He then presented simulation results of the V3 geometry pointing out that the HV plate is lower than the ferrites – this leads to a rise of electric field on the sharp corners of the ferrite. Since the alumina plate cannot be moved away from the ferrite, it was simulated to reduce the thickness of the alumina from 2.5 mm to 1.5 mm to increase the gap size. This measure successfully gave an approximate 18% reduction of the electric field in the gap.
Another measure suggested is the cutting of slots in the alumina plates around the ends of serigraphy fingers #2 and #4. This measure still needs to be confirmed in simulations as well as checked for beam impedance contribution.

Next step for the low impedance prototype would be to implement one of these measures and carry out impedance measurements and HV tests in November 21.

- Comments:

Carlo Zannini asked what the length of the fingers is. Mike answered the current length is 600 mm.
Benoit asked if this iteration of the plates will be compatible with the installation during YETS 22/23. Mike confirmed that one more iteration is possible before the new chambers arrive at the end of November 21.
Fritz Caspers asked if the plates were coated with Cr2O3? Mike confirmed that they will be. Fritz then stated that it should be specified that the alumina plates are not extruded plates, but machined, and that an ultra-sonic test is carried out to identify possible weaknesses like voids in the structure.
He also pointed out that the heavy bakeout procedures up to 800^{o} C appears to be risky for a serigraphed component. Mike replied that the temperature is ramped up during a period of 17 hours and remains at flat top for only 10 minutes. The alumina plates are also baked out before serigraphy.

On another topic, Benoit asked about the status of the MKDV. Mike replied that the issues with the MKDV are currently not fully understood. In particular, the long-term outgassing and the quality of the HV insulators, in the installed MKDV, is problematic. However, the quality of the insulators is improved in the latest production. Also, it should be noted that the insulators of the MKP-L are different from those of the MKDV.

Layout modification proposal for SPS LSS4 (Tom Levens)

Tom presented the planned removal of the beam position monitor BPMEA.42171 in SPS LSS4. In addition to this removal, suggested layout changes in the area will also be carried out aiming for an overall reduction of beam impedance contributions.
These measures cover:

1. Installation of new pumping port shields in position 42160,
2. Installation of a new tapered transition upstream and downstream of BPCL.42171
3. Exchange of the large VBBA bellow with a bellow of smaller diameter in position 42160.
4. Suppression of the enamelled flange at the BPCL position.

He further explained that a ringing of the signal was observed in the head-tail monitor in the past which is suspected to be caused by the large VBBA bellows nearby. The hope is that the layout changes will also improve the signal quality.

- Comments:

The chairs commented that the proposed layout changes will certainly be supported by the IWG as a considerable impedance reduction is expected from this work.
Benoit commented that the bellows used are now not-standard. He also asked if it can be simulated whether the ringing will still be available with the new layout.
Fritz Caspers commented that mode conversion is still to be expected at the discontinuities and that the bellows will continue to act as a source of trapped mode ringing.
Christine asked if it would be an option to suppress the new bellow upstream of the BPCL and use a racetrack bellow instead. A number of racetrack shaped bellows is now available for the SPS, e.g., from the septa. This bellow should then be placed upstream of the first taper and could be welded to the taper.

ACTION (Tom L.):
Simulation of the ringing, if possible and check if the proposed solution of using a racetrack bellow is feasible.

AOBs

- Update on ECRs
  BSRT: comments were sent to the authors and added to the ECR after another iteration.

- ARR for MKDV2: IWG agree that this is an ARR and not an ECR.
  - Mike & Carlo confirmed that impedance measurements were made on the new MKDV2.
  - Fritz Caspers wanted to know who supplier of first batch of ceramic spacers was – Mike to check with Vasco and give information to Fritz.

- Measurement procedure for the LHC collimators
  Nicolo Biancacci asked about the status/feed-back for the measurement procedure of the LHC collimators. This procedure has been circulating for some time now and he would like to get final approval. It was agreed that a last check of the procedure will be done by the measurement experts so that a quick approval is possible in the next IWG meeting.

- LHCb VELO, follow-up of action from LMC meeting #422
  Freek Sanders explained that the request of IWG to carry out a yearly inspection via the viewport shall be possible. The viewport is indeed accessible.
  Further, a test set-up for the wake field suppressors (WFS) is currently prepared which will allow a 50MPa connection for a pull-test. However, no tests are planned with an electric current flowing through the WFS, as was suggested by Christine. Stefano

Sgobba was consulted on this topic and he stated that such a test with flowing currents is not needed.
Benoit commented that this information shall be given to Guido Sterbini as a follow-up of the action item. It was agreed that an email shall be prepared which will be circulated for agreement before it is send to Guido.

- Alignment of HL-LHC crab cavities:
  Benoit explained that a large alignment deviation is currently observed for the crab cavities for LHC – considerably larger than what is known from even bigger machine elements. To be re-discussed in one of the next IWGs, if not solved until then.

- Update on Bench Measurements
  The following RF-measurements are currently scheduled (to be completed)
  1. MKP-L (with flat plates) by M. Barnes et al.
  2. BSRT by Manfred Wendt et al.
  3. SPS TECA by Christine et al.
  4. TIDVG#5 by Christine et al.
  5. TCPC by Chiara Antuono, Carlo Zannini et al.
  6. Windowframe magnet (request of M. Barnes), Impedance measurement (longitudinal and transverse is needed) by M. Barnes et al. – Christine, Chiara, Miguel Diaz and Fritz indicated their interest and also offered their manpower on this topic.

ACTION: For next meeting, measurements that are not scheduled yet need to be planned.

IWG minutes: chairs.