WP14 Coordination Meeting: TDIS

July 06th, 2017, 864-1-B04, 14:00 – 15:00

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Agenda: https://indico.cern.ch/event/716081/

Update on e-cloud in TDIS (G. Iadarola)

- New e-cloud simulations considering the final TDIS geometry (older simulations were performed assuming wider jaws, also beam screen is modified). 3 Szenarios:
  - **S1:** Uniform SEY everywhere in the TDIS (back plate, jaws and beam screen (BS)) with SEY values variing between 1.0 and 1.6 giving estimates of the scrubbing effect
  - **S2:** SEY of 1.0 for jaws in Tanks 1 and 2 and SEY of 1.6 everywhere else (Ti/Cu-jaw in Tank 3, back plate and BS). This scenario assumes no coating of the Ti/Cu-jaws.
  - **S3:** Coated Ti/Cu-jaws: SEY of 1.0 for all jaws and SEY of 1.6 everywhere else
- For all Szenarios:
  - Multipacting is stronger at the positions where the two beams are not synchronized (12.5 ns equivalent spacing). Highest electron current between long-range encounters (LREs) with jaws as largest contributor and lower current at position of LREs.
  - Multipacting threshold very high for small gaps and decreasing when the jaws are opened. Therefore, total electron currents increase for larger gaps with a maximum reached at a half-gap of 40mm, then decreasing again.
- Calculated total e-currents:
  - **S1:** Maximum total e-current 750 mA at SEY 1.6 (half-gap 40mm)
  - **S2:** Maximum total e-current 514 mA (half-gap 40mm) with a peak heat load of ~ 55 W/m in the Ti/Cu-jaw. Contribution from jaws (SEY 1.0) significantly reduced.
  - **S3:** Maximum total e-current 457 mA (half-gap 40mm) with a peak heat load of ~ 50 W/m in the 2nd jaw. Majority of e-current caused by BS leading to the proposal of coating the BS.
  - **S2 + coated BS (SEY 1.0)**: almost no e-current left (42/44 mA for 40/50 mm half-gap)
  - **S3 + coated BS (SEY 1.0)**: no e-current (0.18 mA for 50 mm half-gap)
- Coating of Ti/Cu-jaws leads to a total e-current rand heat load eduction of ~ 15 %. Coating of the BS reduces total current and heat load by one order of magnitude. Both, coating of BS and Ti/Cu-jaws, brings e-current to zero and is hence proposed as new baseline. Discussions pending on the vacuum side but the desired coating seems feasible.

- Observed spike in the electron current in one of the present TDIs. Closer investigation on e-cloud as possible reason desirable. Possible before Ion-run?

Updated impedance studies for the TDIS (L. Teofili)

- Simulations have been done with a half-gap aperture of the jaws of 5 mm instead of the current fixed value of 3.8 mm since the value was not yet available at the time of the simulations. However, differences in the results are expected to be small in view of the small difference in the half-gap values. Furthermore, the simulations were just performed with the injected beam neglecting possible cross-talk with the circulating beam.
- Nominally, the device shows good impedance behavior, independent of the half-gap. No HOMs can be observed below 1.25 GHz as electric contacts prevent trapped modes below the cut-off frequency of the LHC pipe. Modes shifted to higher frequencies for larger gaps.
- In case of failing longitudinal RF-fingers bad electromagnetic behavior with HOMs below 1.25 GHz. Similar results for different half-gaps.
- Investigation of the presence of anti-scratching glassy carbon sheets:
    - Significant discrepancies between two different simulation methods. One shows a deterioration of the longitudinal impedance, the other method does not (half-gaps: 15 mm and 55 mm). To be analyzed further.
    - Perfect contact between sheets and absorber-blocks presumed in the simulations.
    - To check for non-conformities measurements on both prototypes and production devices are strongly indicated.
    - Also a potential improvement by decreasing the shunt impedance of the HOMs to be checked.
- Calculated RF-heating in the entire TDIS (5 mm half-gap):
    - Nominal (no RF-finger failure): 465 W due to HOMs, 800 W due to resistive wall impedance
        - Maximal energy deposition in the lateral RF-fingers between the segments
        - Non negligible heating flux on the RF-shielding
    - RF-finger failure: 1003 W due to HOMs, 800 W due to resistive wall impedance
        - Maximal temperature in the lateral RF-fingers. Deformation not an issue as the design allows for its free expansion.
        - The maximal developed stresses in the lateral RF-shielding are not dangerous for the material.
        - The RF-fingers are moving towards more contact. No risk of losing contact.
    - Power loss computation subject to uncertainty of the exact location of the eigen modes in the frequence-spectrum

- Studies on the two Counter-Rotating Beams Proble ongoing. Until now, application of a factor 4 on the heat load induced in the same device by a single beam as conservative estimate.

- Regarding an excess of heat load there is a dependency on only 3 mechanisms: cooling of jaws, radiation and the contact with tank. The water temperature is part of interlock.