Impedance meeting
3 November 2017

Presents: D.Amorim (DA), S.Antipov (SAnt), S.Arsenyev (SArs), M.Beck (MB), O.Berrig (OB), N.Biancacci (NB), F.Caspers (FC), A.Gilardi (AGil) F.Giordano (FG), I.Karpov (IK), G.Mazzacano (GM), E.Métral (EM), A.Passarelli (AP), L.Teofili (LT), D.Ventura (DV), G.Zhu (GZ)

The slides can be found at [https://indico.cern.ch/event/677471/](https://indico.cern.ch/event/677471/)

CST Validation for Beam Impedance Thermal Induced Effects (LT)

Lorenzo Teofili presented the work done to get the map of the dissipated power caused by the beam impedance in CST.

The heat map is obtained from the CST electromagnetic simulation results at a certain frequency. It can then be imported in ANSYS to perform thermo-mechanical simulations.

A benchmark with the PSB absorber scrapper was performed. This device consists of two graphite blocs, one of which can be moved. The peak power is deposited on the first block and the temperature increase of the block is $4^\circ$C.

FC asked how well the material conductivity at this frequency is known. LT answered that the value is measured and depends on the type of graphite used.

FC remarked that if the contact between the encasing wall and the bloc is not good, the bloc part could heat up a lot more. LT specified that a heat shrink fitting will be performed to ensure a tight contact between the bloc and the casing.

A benchmark was also conducted with a pillbox cavity and compared to analytic results. The temperature distribution follows well the electromagnetic field distribution.

A second benchmark with a resistive wall impedance was also conducted. Dissipated power as a function of frequency follows the expected behavior. LT remarked that the dissipated power map has to be normalized because CST doesn’t take into account the beam parameters (revolution frequency, bunch charge...).

To check this new feature in situ, LT proposed to install a thermal sensor on the TDIS mock-up that will be tested in HiRadMat. NB remarked that there will be only one beam shot so the temperature will be transient.

Impedance evaluation of the FCC beam pipe holes (SArs)

Sergey Arsenyev presented an evaluation of the FCC-hh beam screen pumping holes impedance. In the latest design, these holes take up to 22% of the surface. However they are shielded from the beam. Estimates from the LHC with an analytic model would not held in the FCC case.

SArs first performed CST wakefield simulations. In this case the basic period of the beam screen structure needs to be repeated many times.

SArs then performed HFSS simulations using the traveling waves method. The results were compared to CST for different test geometries. Good agreement was reached for the simplest geometry (rectangular bellows) but the more complex structures show larger discrepancies.
SArs highlighted that the spacing between the cold bore and the beam screen has a strong impact on the results of HFSS traveling wave method.

FC remarked that some backward waves will be created by the beam screen supports. SArs indicated that the supports will be in three points, thus minimizing the backward waves.

FC also added that the cut-off frequency of the beam-screen might be low (possibly in the 1 GHz region) because of the double wedge waveguide form.

Mode identification on the TCTWs by means of an RF probe and loop (AP)

Andrea Passarelli presented new impedance measurement results of the TCTW (LHC collimator with embedded wire for beam-beam compensation).

Wire measurements were previously performed by NB et al. for this collimator. Probe measurements were also done but for a different collimator (a normal TCT).

For the TCTW, AP did probe measurements with both a straight and a loop probe. No mode were seen with the electric coupling probe. The magnetic coupling probe showed three modes with similar Q values as those seen on the TCT collimator.

Update on the new formula for longitudinal beam impedance (OB)

Olav Berrig presented an update on the new longitudinal impedance formula.

A first test was done swapping the drive and test particle. The formula predicts that the longitudinal impedance shouldn’t change.

The quadrupolar impedance was also checked with CST and ImpedanceWake2D. On slide 15 EM remarked that the quadrupolar impedance is zero when $\beta_{rel} = 1$. N.Mounet showed that there is a non-zero quadrupolar impedance in a circular device if $\beta_{rel} \neq 1$. The last check used a 90$^\circ$ symmetric structure, with which a zero quadrupolar impedance was found.

NB suggested to use a more resistive material for the simulated device to help check the validity of the formulas and simulations.

Minutes written by: D. Amorim