Minutes of the HL-LHC WP2 Task 2.4

17th (VIDYO) meeting on Wednesday 29/10/2014 (11:00-12:30, 6/R-018)

Task 2.4 members: Alexey Burov (AB), Alessandro Drago (AD), Alessandro Gallo (AG), Andrea Mostacci (AM), Alessandro Vivoli (AV), Benoit Salvant (BS), Bruno Spataro (BrunoS), David Alesini (DA), Deepa Angal-kalinin (DAK), Elias Metral (EM), Elena Shaposhnikova (ES), Fabio Marcellini (FM), Fritz Caspers (FC), Frank Zimmermann (FZ), Gianluigi Arduini (GA), Giovanni Rumolo (GR), Hugo Alistair Day (HAD), John Jowett (JJ), Kevin Li (KL), Luigi Palumbo (LP), Mauro Migliorati (MM), Michel Martini (MM), Mikhail Zobov (MZ), Nicolas Mounet (NM), Nicolo Biancacci (NB), Oliver Boine-Frankenheim (OBF), Olga Zagorodnova (OZ), Oscar Frasciello (OF), Paul Goergen (PG), Rainer Wanzenberg (RW), Uwe Niedermayer (UN), Wolfgang Hofle (WH).

Present/Excused: AB, AD, AG, AM, AV, BS, BrunoS, DA, DAK, **EM**, ES, FM, FC, FZ, GA, GR, HAD, JJ, KL, LP, MM, MichelM, **MZ**, NM, **NB**, OBF, OZ, **OF**, PG, RW, UN, WH, Juan Esteban Muller + **Alessandro Tomassini**.

1) General information (EliasM):

- None.

- Today's presentation is a kind of summary / rehearsal presentation that OscarF will give at the hilumi meeting in November in Japan.

2) Wake fields and impedances simulations of LHC collimators with GdfidL code by OscarF: https://indico.cern.ch/event/346930/contribution/1/material/slides/0.pdf

- OscarF first briefly reminded the motivation to improve the impedance model and in particular look in more detail at the geometrical contribution of the LHC collimators.

- OscarF started his studies importing the CAD design (thanks to CERN collimation team, EN/MME and Luca Gentini) into GdFidL through an STL file.

- A very fine mesh was needed for the taper structure: 0.2 mm used in all 3 directions, leading to several billions of mesh points ⇒ Very huge computing task!

- As a result, the LHC impedance model was refined and the contribution from the LHC collimator geometrical impedance in the tune shift was found to be of the order of 10-15%.

- OscarF then discussed another study he performed on the new collimators with BPMs

　　- RF fingers were removed and their HOM damping functions were supposed to be supplied by TT2-111R ferrite blocks.

　　- No more symmetry planes applicable => whole structure had to be simulated => More simulation time needed.

　　- The TT2-111R dispersive properties were carefully studied in GdFidL, where a Lorentzian function fit has to be used as only this can be handled in GdFidL for the moment (but we can use up to 10 Lorentzian functions in GdFidL). A simple coaxial probe measurement simulations can be used in order to check for the numerically computed S-parameters to be fully in agreement with theoretical prediction. Furthermore, the 3 codes CST, MMM and GdFidL have been benchmarked on the case of a simple pill-box cavity => A very good agreement can be reached using the best Lorentzian function fit in GdFidL.

　　- The ferrite helps at high frequency for both the longitudinal and transverse plane but the low-frequency (~ 100 MHz) modes are not damped. These results have been checked with wire measurements, revealing similar frequencies for the resonant modes.

- OscarF then discussed another study he performed on the new TCS design concept

　　- One of the possible ways to reduce the impedance of LHC secondary collimators is to reduce the tapering angle.

　　- Present LHC secondary collimator design consists of 2 tapers at different angles, separated by a longitudinal gap, and at different distance from the beam axis; the closest to the beam contributes the most to the overall impedance.

　　- It has been shown that the best analytical approximation to the tapers' geometry is the Stupakov formula for flat taper [O. Frasciello et al., IPAC '14].

　　- Writing the impedance of the 2 tapers as a function of the first (the closest to the beam) taper angle and length, it is possible to find local minima and a best set of tapers' angles and lengths => The impedance can be reduced by some factor.

　　- The new (small) angles' set collimator design can, in principle, be affected by a stronger RW contribution to the impedance, wrt the old

one, especially for small half gaps values. In order to estimate this contribution, again we carried out kick factors comparison for the 2 geometries, performing simulations for two flat tapers, using the new GdfidL version with implemented IBCs (Impedance Boundary Conditions).

- Finally, OscarF discussed another study he performed on the new TDI design

- The new TDI design features where analyzed in detail. Even though a careful optimization of its geometrical and, consequently, RW impedance contribution was carried out, it resulted no significant advantage of the new design wrt the present installed in LHC. The new design performances, from the impedance point of view, are indeed worse then the present collimator.

- Next steps

1) More detail for TCTP mode => Need simplified model (under discussion with BenoitS).

2) With old TCTP => Wakefield simulations with very short bunch length.

3) TDI => Plan under discussion with BenoitS and AlexejG.

=> In the future, this detailed impedance work could/should be followed up within the impedance working group to be able to discuss with all the impedance experts.

3) Next meeting

- The next (18th) VIDYO meeting will take place on Wednesday 10/12/2014 from 11:00 to 12:30 in the room 6/R-018 for the CERN people. The agenda is

1) General information (EliasM)

2) Follow-up of the impedance of the crab cavities (NicoloB, BenoitS and KevinL)

3) AOB (EliasM)

Minutes by EliasM, 04/01/2015.