Minutes of the 89th WP2 Meeting held on 28/03/2017

Participants: A. Alekou, S. Antipov, G. Arduini, R. De Maria, D. Gamba, M. Giovannozzi, P. Hermes, G. Iadarola, N. Karastathis, K. Li, E. Metral, D. Pellegrini, G. Skripka R. Tomas.

Update on e-cloud build-up in the triplets and in the TDIS for HL-LHC (G. Skripka)

The e-cloud is simulated in the triplet/D1 area considering quadrupoles, dipole and correctors (dipolar and multipolar), two cases are considered:

- the beam screen is assumed coated apart from the drifts
- the beam screen is coated including the drifts

The beam parameters used are the ones for the start of fill. The optics is v1.2; the two counter-rotating beams are simulated.

The heat load along the triplet area is shown and compared between the two cases explained above. The heating in the coated case is less by one order of magnitude. The heating spikes are at the spots in between the long range encounters. Gianluigi asks if multipoles are included. Gianni replies they have been recently implemented and that for the time being only the dipole fields are considered, while multipoles are considered as (coated) drifts. Gianni asks about the field for the multipoles, Riccardo points out that the settings depend on the misalignments, 2 Tm can be considered as maximum value for the integrated field (i.e. between 1 and 2 T in dipole field). Gianni explains that the threshold field below which they behave as drift is 0.1 T. There is no big difference between IP1 and IP5. The beam offset is not relevant. Coated strong multipoles are expected to behave better than uncoated drifts.

The uncoated drifts cost about 150 W in terms of heat-load. Electron distributions are shown; asymmetries are due to the beam offset in the pipe.

The TDIS shows the stronger heat load in between the LR encounters. When the TDIS is closed below 20mm the e-cloud disappears. Gianluigi asks about the current settings at injection, after the meeting it is clarified that the typical setting at injection is 7.6 mm (full gap) while the maximum opening is 110 mm (full gap). The e-cloud heats mostly the flat parts of the TDIS, e.g. the jaws. Gianluigi suggests including the collimator settings for the various phases of the cycle in the operational scenario. **Action: Elias.**

When the TDIS is closed the impedance effect is worse for the resistive wall, need to check what HOMs do. Gianluigi wonders if there is an optimum for e-cloud and impedance together. **Action: Elias**

Gianni points out that opening the TDI causes outgassing which is surely connected to e-cloud. Erratic spikes were observed on top of that, whose origin is not clear and hardly attributable to e-cloud. The spikes were present also for not fully opened TDI.

Gianluigi asks to check the electron cloud heat load and densities at the TAXS. The updated inner diameter is 60mm. He points out that it is interesting to know the heat load there, as additional heating will also come from the debris. Massimo points out that the solenoid stray fields from the CMS magnet

should also be considered for the TAS area as it can a have significant impact on e-cloud. It is not yet clear which coating will be used for the TAXS: NEG or a-C. Gianni reports that NEG can possibly go down to an SEY of 1.1, but it needs to be activated. **Action: Gianluigi to clarify with Vincent.**

AOB: Impact of triplet misalignment (D. Gamba)

Davide reports a study that he performed and that was presented by Paolo Fessia at Chamonix 2017. The maximum amplification between ground motion and magnet motion measured for a LHC triplet magnet is observed for two modes (8 Hz and 12 Hz) and is up to a factor 100. The noise spectrum is composed by a micro-seismic background with some cultural noise on top of it; the latter depends on the location of the measure (its limits are shown by the dashed lines). Davide expects that the present LHC orbit feedback could act on frequencies below 1 Hz. The orbit feedback does not use the MCBX correctors, but normally the BPM in the IR are not masked, Riccardo says that some could be. Rogelio clarifies that one cannot rely on the orbit feedback to maintain collision. Gianluigi suggests marking the frequencies of the two modes on the spectrum plot.

A plot shows how much the misalignment of particular elements, results in separation at the four IPs. The impact of misalignment of the triplet is considered for different correlations of the magnet motion. The amplification of the separation at the IPs for four different correlation cases is shown. Gianluigi suggests normalising the plot to beam sigma and to show the corresponding luminosity reduction.

The studies have also been repeated for the LHC 2016 collision optics. The results are very similar to the ones for the HL-LHC. No significant impact on luminosity from ground motion has been observed.

Rogelio suggests verifying the impact on luminosity. Riccardo and Dario point out that the major impact will probably be on diffusion and emittance blow-up, studies are on-going.

Gianluigi suggests trying to use measurements with the DOROS and the measurements of the ground motion at the triplets in order to infer the amplification factors and/or typical patterns in the movement of the triplets.

Gianluigi suggests checking the induced movements of the beam also at the positions of collimators as a large movement there can lead to loss spikes and beam dump. Rogelio confirms as the much larger beta at the collimator can give large movements, he adds that a limit is 200 µm, but smaller movements led to beam dumps in 2012 **Action: Davide and Roberto**

Reported by Dario, Gianluigi, Riccardo and Rogelio.