Minutes of the 48th WP2 Task Leader Meeting held on 24/04/2015

Participants: G. Arduini, R. De Maria, J. Jowett, E. Métral, G. Rumolo.

Minutes, Follow-up of Actions, General Information (Gianluigi)

Gianluigi apologized as he did not managed to go through the minutes of the previous meeting. No PLC or TC meeting has taken place during the last week.

Progress on e-cloud studies for the HL-LHC (G. Rumolo)

PyHeadtail includes now all the models and features available in PyEcloud allowing to use the same tools to simulate both electron cloud build-up and beam dynamics in dipoles, quadrupoles and other magnetic field configurations.

PyHeadtail has been benchmarked with Headtail showing very similar results for SPS and LHC as presented at the electron cloud meetings.

In the LHC arc dipole the vertical instability threshold is 1.15 10^{12} e^-/m^{-3} for 1.3 10^{11} ppb and 1.10 10^{12} e^-/m^{-3} for 2.3 10^{11} ppb. In the horizontal plane we expect mostly coupled bunch instabilities for which the multi-bunch version of PyHeadtail needs to be yet developed.

In the LHC quadrupoles, the horizontal/vertical instability threshold is 9 10^{12} e^-/m^{-3} for both 1.3 10^{11} ppb and 2.3 10^{11} ppb.

The build-up simulation shows that in the dipoles the SEY threshold for the onset of the heat load is lower than that for the onset of significant central electron cloud density because the stripes build up for lower SEY values than the electron cloud at the center of the chamber. The simulations indicate that for bunch populations of 1.3 10^{11} ppb no instability should occur in main dipoles and main quadrupoles for SEY<1.6. For 2.3 10^{11} ppb the main quadrupole threshold is much higher. For those estimates an average beta function value has been assumed.

Incoherent effects have also been studied. A frozen electron distribution is estimated taking into account of the pinch effect due to the bunch passage starting from a uniform electron distribution with density corresponding to that estimated for a given configuration (bunch population, SEY, magnetic field). The distribution is refreshed only when important emittance variations are observed. The synchrotron motion is frozen for the footprint exercise. Tune spreads are shown for dipoles and quadrupoles close to the instability thresholds. The tune spread in dipoles in the vertical plane is important. Elias highlighted that the plots show the distributions of the tunes without the averaging effects of the synchrotron motion. Giovanni replied that he believes this should be the procedure to establish instantaneous tune spreads and identify possible resonance trapping of individual particles over some turns. For the quadrupoles the shape has a diamond type. The simulated tune footprints are smaller when a realistic initial distribution is used as a starting point for evaluating the electron distribution resulting from the pinch due to the bunch passage. For that reason it is important in the future to use realistic distributions for the estimation of the tune footprints. This is particularly important for complex geometries like the triplet. Among the additional elements that will be included for future simulations are realistic beta function evolution.

For the triplets slicing with beta function variation, self-consistent distributions with enough macro-electrons in the centre for each slice, weak-strong two-bunch pinch in LR points, off-axis beam with changing orbit, are required. All these elements are now only partially available, so need to be fully developed, tested and finally combined.

A very preliminary analysis of the electron cloud build-up in the presence of pumping holes and baffles just behind the holes seems to indicate that the baffles should be coated as well but further simulations with more realistic geometries will be implemented now that PyEcloud has been developed to handle non-convex geometries of the boundary.

Giovanni warmly acknowledged Gianni, Annalisa, Aron for their important work in producing the results presented.

Report from Task Leaders:

Task 2.4 (Elias): Nicolo` Biancacci has updated LHC impedance repository with all HL-LHC collimators and a more realistic model of crab cavities including the spread of the HOM modes is being developed in preparation of the US-LARP meeting. Claudia Tambasco has made further progress on the stability diagram for HL-LHC. Olga is working on the VELO impedance model.

Reported by Riccardo and Gianluigi