Minutes of the 105th WP2 Meeting held on 26/09/2017

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General Information (G. Arduini)

Minutes of 102nd, 103rd, and 104th have been circulated. Material wire is being followed up by Guido and Yannis. Clarifications for the validity of the wire model are being followed up, it does not seems this affect the LHC, and however a clearer statement from Andrei is missing. Actions to identify possible tests to validate impedance of crab cavities in the SPS.

Stefano asked about the assumption ramp and squeeze. Riccardo is working on trying to fit the entire squeeze up to 50 cm in the ramp, but the study is not final. Gianluigi decided that is better to fix a number and revise later. Riccardo proposed 70 cm we the option of stepping back in case problems will be identified.

During the last TCC there were the following presentations: ECR for HL collimation, change of position on galleries, possibility of a test of a-C coating on Q5 before LS2.Gianluigi noted that an additional Ti substrate below the a-C coating is foreseen. Benoit replied that he was aware of that and this has already been taken into account. The final design of the triplet BPMs has been presented too. Benoit will contact Thibaut to get the latest drawing to finalize the impedance and heating estimates.

Beta beating due to beam-beam effects for HL-LHC and possible correction (X. Buffat, L. Medina)

Xavier presented a study on the effect on beta-beating from beam-beam effects. The work is mostly based on the work of Patrick who left and optics team (L. Medina).

The effect of the beam-beam head-on interactions is about 5% beta-beating (with a beam-beam parameter of $\xi=0.01$) for the LHC and 10% for the HL-LHC ($\xi=0.02$).

Luis developed an effective correction strategy using quardrupoles for Head-on and sextupole for long-range.

A study on non-linear effect of the head-on interaction shows that the effective lattice functions are still well corrected by the linear approximation. At larger amplitudes (e.g. at the collimator) the effect is anyway smaller.

The AC dipole measurement could be used to measure the effect. An attempt showed that the order of magnitude was correct.

The impact of the beta-beam on the luminosity has been computed confirming that the effect is at few % level for the typical beam-beam parameters.

The effect of long-range is much more non-linear. The amplitude is in the % level for the core, but it is larger for larger amplitudes. For the LHC the effect is not worrying, however calculations need to be done for the HL-LHC to make sure that different phase advances will not change the picture.

In conclusion, the effect is not alarming. A possible strategy would be leave the effect uncorrected and recover the loss or gain of luminosity with separations.

Xavier comments that the effect could be reduced by optimizing the phase advances. Riccardo noted that phase advances are frozen for the MKD-TCT phase advances.

Yannis proposes to check if the effect to can explain the bunch-by-bunch imbalance in the present LHC luminosity models. Luis is planning to perform DA simulation with the correction to see if improvements are possible.

Action Xavier: give values of the effects for HL-LHC.

Impact of beta beating due to beam-beam effects on collimation and machine protection (S. Redaelli)

Stefano comments on the impact on collimation of the beam-beam effects. The possible issues concern the hierarchy violation, degradation of cleaning in multi-turn process, passive protection in case of fast failures, loss spikes in case of change of optics at amplitudes close to TCPs.

Present HL-LHC baseline use 2 sigma retraction for the collimators, however a 1 sigma target is kept in mind.

If the beta-beating is kept below 10% than the HL-LHC can use LHC settings. Rogelio comments that optics correction still cannot be guaranteed below 20% in the TCT. Rogelio proposed that 10% could be assumed in IR7.

Roderik noted that beam size measurements can absorb static errors (although it is time consuming), however dynamic beating (also coming from optics drifts) is the most dangerous.

Even with hollow e-lenses, it would probably be tricky to change the IR7 hierarchy in collision during the levelling.

Possible simulation work includes assessing amplitude-dependent beating for HL-LHC with tracking simulations and hierarchy violation calculations. Stefano proposed to split the tolerances between static and dynamic beating, to have a more precise accounting of the tolerances.

MD studies can be carried out in the machine in particular assess the beam-based hierarchy.

Riccardo asked if the amplitude dependent beam size have been computed with sextupole and octupole in the HL-LHC. Xavier commented that effects is small.

Protected aperture with optics 1.3 collimators (R. Bruce)

Roderik gave an update of the protected aperture in the HL-LHC.

The main limiting aspect is TCT-MKD phase advance that can expose the TCT to dumped beam. Phase-space integration (cuts propagated with linear optics) is used to estimate the impact. This method is fast but neglects secondary impacts. The TCDQ cannot be closed too much due to reliability in case of impact.

By comparing TCDQ damage limits as function of the phase advance, the minimum TCT settings are given. Riccardo asked if the 11.2 sigma can be assumed for the vertical TCT. With the present settings, including IP shift, 15 cm with 250 murad half crossing angle is within the aperture. The effect of IP shift is about 1 sigma in the triplets, which one can reduce after mechanical realignment.

Yannis comments that 250 murad are not sufficient to have 6 sigma dynamic aperture at 1.1 10^{11}. Comparing with the LHC that the impact of Q' and octupoles in HL-LHC is much stronger than in the HL-LHC. Gianluigi asked whether one can reduce the MO and Q' at 15 cm. Elias mentioned that is difficult to predict for instance due to the pop-corn instability. Gianluigi replied that chromaticity is more effective for that and that the pop-corn instability is seen only at low bunch populations when DA should be bigger due to the reduced effect of beam-beam. Elias agreed and mentioned that he had discussed with Yannis and agreed that reducing the octupoles and chromaticity should be feasible in collision but issues might be observed for the non-colliding bunches. The need for colliding bunches and, if needed, their parameters will be discussed in one of the forthcoming meeting of the EDQ-WG.

Simulation with SixTrack confirms the first analysis. Riccardo asked if one can reduce the margin between TCDQ and TCT. Roderik said that it is difficult to reduce. Presently 0.5 mm are assumed for TCT.

Reported by Dario, Gianluigi, Riccardo and Rogelio.