Minutes of the 90th WP2 Meeting held on 6/04/2017

Participants: S. Antipov, F. Antoniou, G. Arduini, R. De Maria, F. Carlier, M. Giovannozzi, P. Hermes, G. Iadarola, N. Karastathis, E. Maclean, E. Metral, Y. Papaphilippou, B. Salvant, G. Skripka, G. Sterbini, R. Tomas, A. Tsinganis, F. Van Der Veken.

General information

Minutes of the previous two meetings have been approved. Gianluigi reminded the following open actions:
- Vacuum team will look at possible optimization of the beam-screen to see if a better compromise between magnetic shielding and mechanical stability is possible.
- Operational scenarios are being updated (collimator settings to be included) and a note should be published
- The convention used for the field quality for the 11 T dipoles is being verified with Susana, reply is pending.
- Optimum TDIs opening to be found for the total heat load due to impedance and e-cloud.
- Gianluigi has contacted Vincent to have a status of the proposed coatings for the vacuum chambers in the insertion regions in IR1/2/5/8. The recommendation on the use of baffles for the new beam screen should be also discussed and presented at the HL-TCC.
- Possible orbit changes due to triplet vibrations should be studied also at positions of the primary collimators.

In the last TCC meeting there were presentations on new beam parameters, low impedance collimators (in the discussion emerged the possibility for additional measurements on the bench, if beam measurements are not conclusive).

Rogelio asked whether priority to test crystal collimators with Xenon should be given. Gianluigi expects that studies with lead ions in 2018 might be more important and tests could be done as an end of fill MD if a physics fill is agreed by the physics coordinators. Pascal reminded that the Xenon is interesting for luminosity reach compared to Pb ions.

During the crab cavity review, concerns on HOM damping design to sustain few KW emerged. This aspect is important to be tested in the SPS test. Also a test on detuning the few modes (one for one cavity and two for another one) could be carried out. Riccardo asked if we could verify how injection oscillations are handled since they are about 2 mm and Rama reported that 2 mm can be sustained for few ms only at injection (crab cavities operate at low voltage in counter phase). Action: Gianluigi to organize a meeting to review tolerances related to crab cavities and remaining impedance issues.

Optics update V1.3 (R. De Maria)

Riccardo presented an update of the optics repository HLLHCV1.3 available in AFS in the usual location. The layout and drawings from WP15 are checked and match. The main changes are half of crab cavities installed by defaults and MBH installed in Point 7. During the discussion it was mentioned that the present design of the TANB in IR8 should be included in the files in spite of that fact that it might not be the final design. **Action: Riccardo.** Optics files now contain orbit knobs (crossing, separation, offset,

angular offset) for IR1,2,5,8 and independent crab cavity alignment knobs in IR1/IR5. Crab cavities are now supported using crabcavity or rfmultipole elements in MAD-X. Riccardo highlighted that to build the new optics and use the last crab cavity models, one has to use the latest MAD-X production release expected in few days.

Riccardo presented two developments. Round optics at 15 cm is now available with improved phase advance MKD-TCT. A new ATS branch which allow to skip the defocusing sextupole families with odd number of sextupole is being prepared for tracking simulations. This branch has similar harmonic driving terms to the baseline, but without the installation of a MS in Q10 and with the disconnection of the focusing MS in Q14.

During the discussions the following action emerged:

- pass to the collimation team the new optics for validation: Action: Riccardo
- bring to the TCC the point of testing the Q7 in Point 1, 5 at least to 200 T/m. **Action: Gianluigi**
- complete the optics scenario for the round optics with good phase advance and without sextupole Q10 by the end of June for 20 and 15 cm b*. **Action: Riccardo**
- complete the optics scenarios for flat version with good phase MKD/TCT and without sextupole in Q10 by end of September . **Action: Riccardo**
- Complete the beam-beam models in MAD-X/SixTrack for 6D with crab crossing both for the weak and strong beam by end of June **Action: Yannis, Riccardo**

IR non-linear correction with beam-beam (N. Karastathis)

Studies of the impact of non-linear correction with beam-beam have been carried out for the baseline scenarios. Several points along a typical fill have been studied for which the precise relation between bunch population, and horizontal and vertical emittances have been used (fitting curves on luminosity evolution models). The models do not use additional source of emittance blow-up besides IBS. Cases with constant emittance have been studied too and are more representative to the scenarios in which there is additional emittance blow-up. The reported dynamic aperture has been normalized with the actual beam emittance. LHCb is simulated fully head-on with ±250 μrad external crossing angle (and "good" LHCb spectrometer polarity). The behaviour with the negative polarity should be verified. **Action: Nikos**. The reported crossing angle is the one for CMS. Beta* and half crossing angle values have been scanned in square grid from 15 cm to 1 m and from 120 μrad to 340 μrad.

Simulation shows that the present baseline offers some margin with small values of octupoles and chromaticity. During the discussion a question whether one should carry out scan the working point emerged.

When field imperfections and associated corrections are added in beam-beam simulations, results are similar to the minimum DA obtained by simulation with only beam-beam with reduction ranging from 0.5 to 1 σ. The beginning of levelling showed larger spread in the DA, hinting that with large bunch population one should keep more margins. **After the meeting the question was asked to specify what is the error table used for the simulations, v5 was used.**

A target of DA without inclusion of errors at 6.0 σ and with inclusion of error 5 σ is then accepted as criteria for comparing different scenarios. During the discussion the following actions emerged:

- study effect of imperfect correction (correction limited to low order) and the impact of each individual order of the field errors to guide the field quality specification
- introduce octupoles and chromaticity
- Conduct tune scans to verify the area of the tune diagram that is available for optimization taking into account that bunch-by-bunch tune shifts might occur as a result of beam-beam long range effects (in particular if LHCb would be operated at high luminosity) or other coherent effects

Action: Nikos

Update dynamic at injection (F. Van der Veken)

Frederik presented a new scan of DA at injection as a function of MO current with different chromaticities. Large drop of DA with large chromaticity for high values of the current of the octupoles is observed. **Action: scan working point for identifying better location: Frederik**

Action: add beam-beam effect to injection simulations: Nikos, Yannis

Reported by Gianluigi, Riccardo and Rogelio.