FCC collimation design meeting #11

Notes from the meeting held on 5th May 2017

Participants:
R. Bruce [chair], A. Langner [scientific secretary], M.I. Besana, F. Burkart, F. Cerutti, A. Krainer, A. Mereghetti⁕, D. Mirarchi, J. Molson⁕, E. Renner, D. Schulte, S. Redaelli, Y. Zou
⁕ via Vidyo

FCC aperture calculations (A. Langner)

Summary:
- A status of the n1 calculations has been presented for each straight insertion and the arc, and elements with missing aperture definitions were listed.
- An alignment tolerance for the beam screen has been added, which was not considered in the past and which reduces the already critical n1 in the arc by 2 sigmas.
- Furthermore, since the dipole magnets are straight, the resulting beam offset inside the magnet would consume another 5 sigmas of the n1 in the arcs, which would result to a value of 6.4 sigmas.
- To mitigate this, it was proposed to reduce the closed orbit (CO) tolerance from 4 mm to 2 mm, and to start with a beam offset at the beginning of the dipoles to reduce the maximum offset inside the magnet.

Discussion:
- R. Bruce comments that a 2 mm CO tolerance should be possible as it is the same for HL-LHC.
- S. Redaelli adds that the 4 mm include injection oscillations and it is not clear by how much it can be reduced.
- R. Bruce adds that a separate study should be done to asses the aperture criterion for FCC at injection energy, as it was done for HL-LHC. This could be done as for HL-LHC, with three different components: standard collimation cleaning, asynchronous beam dumps, and injection failures (including injection oscillations). The latter two require collaboration with the injection and dump teams.

Studies of dispersion suppressor losses (A. Krainer)

Summary:
- Loss maps have been computed with an updated lattice and optics using Merlin. In the dispersion suppressor (DS), the losses deviate by a factor 2 to Sixtrack, however this is also a factor 5 reduction to simulations with the previous lattice version.
- Three cases were studied to mitigate the losses in the DS: one 1 m collimator, two 1 m collimators, and two 1 m collimator together with a 0.5 m mask.
- Two collimators + the mask are sufficient to mitigate the losses even if the losses are significantly underestimated.
- This system can also mitigate losses in the DS in the experimental insertions.
- It needs to be checked if the assumed DS collimator setting violates the energy collimation hierarchy.

Discussion:
- R. Bruce comments that a factor 5 difference for the losses is high. J. Molson adds that there were only minor code modifications, and a reason for this could be the addition of energy collimation and TCTs which were not included before. R. Bruce adds that one could try to open these collimators to see if it goes back to a factor 2.
- F. Cerutti asks how the limit for the energy deposition is defined. A. Krainer replies that it is defined by the quench limit.

- R. Bruce adds that with imperfections, the losses will go up in the DS, and asks what safety factor was used.
- F. Cerutti replies that the safety factor should be 3, however since the 12 min beam lifetime is not a regular scenario one could question this factor.
- D. Schulte adds that the used numbers might already include the safety factor as they were provided by E. Todesco to be used in this study.
- R. Bruce concludes that it needs to be checked if the safety factor of 3 has been included or not.
- R. Bruce asks if a similar impact parameter was used as by M. Fiascaris studies.
- A. Krainer replies the impact parameter was 1μm and S. Redaelli comments that it seems to be similar to what M. Fiascaris used.

Update on loss maps for input to energy deposition studies (D. Mirarchi)

Summary:

- Loss maps have been computed for different scenarios to be used as an input for energy deposition studies. Without the TCLD collimators, the simulations of M. Fiascaris could be reproduced well. Adding the TCLD collimators mitigate the cold losses as expected.
- A second scenario assumes with a length of 30 cm a half as long primary collimator (TCP). In this case the losses at the horizontal and vertical TCP are reduced by about 10 %, and increased by around 50 % for the other collimators. The cleaning inefficiency changes only by a few percent. It is hoped that in this scenario, the achieved power load on the primary collimators could be less critical than in the standard configuration.

Discussion:

- R. Bruce concludes to set the highest priority to study the energy deposition for the scenario with a vertical TCP of 60 cm, which is the most critical case and which does not require to change the collimator geometry.
- F. Cerutti asks about the effect of the longer tapering for the case with 30 cm TCPs. S. Redaelli and A. Mereghetti explain that the tapering is the same and just shifted in position, the collimator has been shortened by removing a part in the middle.

FCC loss maps studies with different scattering routines for latest lattice (J. Molson)

Summary:

- A brief summary has been presented of the IPAC talk from J. Molson. The losses around the ring and in the betatron and energy collimation section have been simulated with different codes (K2, Merlin, Geant4 QGSP and FTFP, and FLUKA) and were compared to each other. Furthermore the run time of the different codes was evaluated.

Discussion:

- R. Bruce comments that it is nice to see a good agreement among the different codes, except for one Geant4 simulation which shows fewer losses.
- S. Redaelli asks which code would be preferred to use. J. Molson replies that for FCC, the old K2 might not be a good choice, and FLUKA might be the best, especially since it is the fastest.