Meeting Minutes of the
57^{th} FCC-ee MDI meeting

Indico: `https://indico.cern.ch/event/1441295/`
When: 23.09.2024 16:00-18:00 CET

Agenda

Presenter	Title
M. Boscolo	**General Information, News**
A. Frasca	**Fluka IR Model update**
K. Oide	**Non-local solenoid compensation**
K. Andre	**Update on SR studies including X-ray reflection**
G. Broggi	**Update on beam losses simulations**

1 M. Boscolo - General Information, News

M. Boscolo presents general information and news. The minutes of the previous meeting are approved and are available on the Indico page. The next MDI meeting is scheduled for Monday October 14th.

M. Boscolo announces that until the end of 2024 the FCC-ee MDI meetings will take place every two weeks.

Upcoming events:

- 2nd FCC Italy and France workshop in Venice in November 4-6
- 3rd ECFA workshop on e+e- Higgs/EW/Top Factories, Paris, 9-11 October 2024
- FCC Physics week at CERN mid January 2025.

2 A. Frasca - Update on FLUKA IR model

A. Frasca presents an update on the FLUKA studies for the FCC-ee IR, in particular, on the impact of radiative Bhabha scattered electrons on the final focus quadrupoles (FFQs).

The FLUKA model for the FCC-ee IR has been updated according to the latest available optics version (GHC v24). With such updated model, the power deposition by radiative Bhabha scattered electrons on the FFQs has been simulated and the results have been compared with similar studies performed with the previous model available (based on GHC optics v22). The comparison shows that:

- The loss pattern changed, especially for the QC2 FFQ.

- A 40% reduction in the power deposition on QC1 is observed in the results based on GHC optics v24.
- A factor of more than two reduction in the peak power deposition is observed in the results based on GHC optics v24. Nevertheless, the registered values cannot yet be considered safe for operation.

As a possible mitigation strategy for reducing the power deposition in the FFQs, a tungsten shielding layer with thickness 2.5–5 mm is proposed.

Concerning future work, additional contribution to the power deposition on FFQs that have not been studied yet will be studied, e.g., incoherent pair production, Z->qq decay, local beam-gas scattering.

M. Boscolo asks what could be done from the optics point of view to further reduce the power deposition, with an optimization of the main parameters that play a role.

A. Frasca answers that reducing the gradient of the FFQs will help reducing the power deposition in the FFQs.

C. Carli asks if this type of studies have been performed also for the FCC-ee LCC optics. **A. Frasca** answers that this is not the case. **A. Lechner** comments that among the future developments there could be the possibility to study the LCC lattice, if this has higher priority compared to other possible studies.

3 K. Oide - Non-local solenoid compensation

K. Oide presents an update on the non-local solenoid compensation scheme studies with SAD. In these studies, a non-local solenoid compensation scheme with $l_{sol} = 1.7$ m has been tried. The implementation of the non-local compensation scheme with SAD differs from the one of A. Ciarma et al. with MAD-X (as presented in IPAC24-TUPC68).

The main conclusions are that:

- Unlike in the case with $l_{sol} = 1$ m, beam-beam seems to give issues in terms of beam lifetime and emittance blow-up.
- For the studied case with $l_{sol} = 1.7$ m, spin depolarization might be an issue. Nevertheless, the same issue might persist with $l_{sol} = 1$ m.
- Polarization tuning will be crucial.

M. Dam suggests that the shielding solenoid might be placed at 1.2 m from the IP instead of 1.7 m. In this way, one can gain 0.5 m and l_{sol} will become 1.5 m. **K. Oide** answers that he can try this solution.

J. Wenninger reports that he tried to look at the method that was used in LEP to restore polarization. However, since the number of dipoles per cell in the FCC-ee is not the same as for LEP, the method cannot be directly implemented, but some optimization work needs to be done. Despite this, it should be feasible to implement such method in the FCC-ee.

H. Burkhardt reports that he is working together with **A. Ciarma** on emittance estimates using a different approach compared to the one used by **K. Oide**. In these studies, no emittance blow-up as the one shown by **K. Oide** has been observed. **H. Burkhardt** says that he can present these results at the next MDI meeting.

A. Ciarma comments on the position of the solenoid, remembering that fringe fields from the solenoid should be avoided in the LumiCal region.

4 K. Andre - Update on SR studies including X-ray reflection

K. Andre presents an update on SR background studies including X-ray reflection. The studies have been carried out using BDSIM (exploting the X-ray reflection model implemented in Geant4) assuming different roughness values for the vacuum chamber 0 nm, 5 nm, 50 nm, 100 nm and 500 nm, and considering different beam distributions as input (beam core, beam tail/halo, injected beam).

The main conclusions are that:

- First SR studies including X-ray reflection have been carried out, demonstrating their feasibility.
- 100 nm roughness seems to be the more realistic value (same value considered by the vacuum team).
- The higher the roughness the more SR photons are absorbed in the beam pipe leading to less power deposited in the SR collimators.

As next steps, the effect of x-ray reflection from beam tail/halo and non-zero closed orbit beam core from Z to ttbar operation modes will be studied, and SR photons will be propagated in the detector model with and without considering X-ray reflection.

H. Burkhardt clarifies that the Geant4 model also includes Rayleigh scattering and Compton scattering of X-rays, not only specular reflection.

F. Palla suggest to filter out SR photons that will go straight and will not hit the vacuum chamber in the detector region when providing input files to the detector study group, as this will allow to save computation time and storage space.

5 G. Broggi - Update on beam losses simulations

G. Broggi presents an update on beam losses simulations. Beam losses simulations are being carried out in the frame of FCC-ee detector background evaluation and FCC-ee halo collimation system design. The current focus is on the Z operation mode, being the most challenging for stored beam energy.

Updated results for different beam loss scenarios (generic beam halo losses, beam losses from long-range beam-gas interaction, spent beam losses) are presented.

The main conclusions are that:

- No criticalities have been identified for the generic beam halo and beam-gas beam loss scenarios.
- The estimated beam-gas lifetime (dominated by beam-gas bremsstrahlung interactions) from simulations is of about 5 h. This represents a pessimistic scenario after only 1 h of beam conditioning at full nominal current. The beam-gas lifetime is expected to increase of a factor up to two orders of magnitude with increasing beam conditioning time.
- The spent beam beam loss scenario is the only one showing sizeable beam losses in the detector region (order of 100 macroparticles over 10 millions).
- An unexpected vertical emittance blow-up due to the interplay between beam-beam effects and the inclusion of the collimation insertion optics in the lattice is observed. This, together with the worsening of the MA with the inclusion of the collimation insertion optics, is most likely the cause of a rather high beam loss rate observed in simulations.

The importance of optimizing DA and MA with collimation insertion optics and full aperture and collimator model is remarked.

F. Palla asks if the spent beam losses ending up in the detector region can be provided to the detector study group to asses the impact on background.

G. Broggi answers that this is possible, but some checks are needed to clarify if the observed losses are driven by the unexpected vertical emittance blow-up or are really caused by beam-beam interactions themselves.

G. Broggi asks if, for this purpose, it is correct to consider as pure detector region the region +- 1.5 m from each of the interaction points.

F. Palla answers that +- 1.5 m from each of the interaction points should be the correct region to consider.

33 Participants:
K. André, P. Azzi, N. Bacchetta, M. Boscolo, G. Broggi, R. Bruce, H. Burkhardt, C. Carli, A. Ciarma, M. Dam, C. Eriksson, F. Fransesini, B. Francois, A. Frasca, A. Gaddi, V. Gawas, A. Ilg, A. Lechner, G. Lerner, M. Marchand, G. Nigrelli, A. Novokhatski, K. Oide, F. Palla, B. Parker, G. Roy, J. Salvesen, V. Schwan, J. Seeman, M. Selvaggi, L. Watrelot, J. Wenninger, and F. Zimmermann

Minutes prepared by **G. Broggi**