Meeting Minutes of the
61^{st} FCC-ee MDI meeting

Indico: `https://indico.cern.ch/event/1483308/`
When: 02.12.2024 16:00-18:00 CET

Agenda

Presenter	Title
M. Boscolo and F. Palla	**General Information, News**
A. Frasca	**Update on Radiative Bhabha impact on FFQs**
K. Oide	**Polarization with local solenoid compensation**
V. Gawas	**Update on luminosity optimization for FCC-ee**

1 F. Palla and M. Boscolo - General Information, News

F. Palla 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 tentatively scheduled for the 16th of December.

The FCC Feasibility Study report is currently in preparation. For the PED volume, a first draft was submitted for internal review on December 1st. Regarding the Accelerator volume, the first draft is expected to be completed by the end of the year, with the goal of submitting it for final editing by February 3rd.

Additionally, a more detailed MDI note is being prepared. Final contributions are due by mid-February to allow for final polishing thereafter.

Upcoming events:

- FCC Physics week at CERN, 13-16 January 2025.
- FCC week 2025 in Vienna, 19-23 May.
- ESPPU general meeting in Venice, 23-27 June.

2 A. Frasca - Update on Radiative Bhabha impact on FFQs

A. Frasca presents an update on the study of power deposition by radiative Bhabha electrons on the final focus quadrupoles (FFQs). Preliminary results on incoherent pair creation (IPC) are also discussed.

The main updates concern results obtained using a more refined IR geometry. The refinements include the implementation of a water-cooled stainless steel beam pipe and a more detailed magnet model consisting of layered aluminum and coils (composed of a mixture of NbTi, Al, and Cu).

The conclusions are as follows:

- A more sophisticated model of the FFQs has been implemented in FLUKA.
- The updated simulations confirm the order of magnitude of the peak values of power deposition and TID in the coils: 26mW/cm^3 and 51MGy/year in QC1R3.
- The need for shielding (2.5–5 mm of W) is confirmed.
- A FLUKA routine has been set up to sample IPC pairs generated by `GuineaPig++`.
- Preliminary evaluations of radiation levels in the IR have been performed.
- Initial IPC studies indicate that the first layer of the inner vertex detector is the most exposed component.

F. Palla asks **A. Frasca** to elaborate on slide 6, particularly why the TID is much higher with the former FFQ model. **A. Frasca** explains that the higher TID is due to the use of a denser equivalent material for the coils in the new model.

M.Boscolo inquires about reducing the shielding thickness below 2.5mm, potentially using a tapered, non-uniform thickness along the FFQ length, as some sections seem more problematic. **A. Lechner** responds that this is unlikely due to the estimated power deposition values.

G. Lerner adds that shielding is necessary even in areas with lower power deposition. He suggests studying scenarios with partial shielding where most needed, to save space and provide design flexibility.

A. Lechner cautions against over-optimizing the shielding design, emphasizing the difficulty of making changes later if power deposition exceeds expectations. He recommends including a reasonable safety margin.

B. Parker concurs that shielding is essential and agrees on maintaining a safety margin. He notes that the power deposition values presented by **A. Frasca** are based on equivalent materials, but real materials' inhomogeneities could increase local power density. He also mentions that the use of HTS could change the picture, though further study is needed.

A. Novokhatski highlights that replacing copper with stainless steel in the new model doubles resistive wall losses due to lower conductivity. He suggests verifying the cooling requirements for the new model but notes that adding a thin copper coating could mitigate this issue.

B. Parker confirms that copper coating is always foreseen.

K. Oide comments on the power deposition distribution in Slide 7, noting that it is concentrated on one side without coils (except for the shielding solenoid region). He believes this may not cause quench issues in the FFQ but could affect the shielding solenoid.

B. Parker clarifies that this is inaccurate, as the double-helical pattern means these quadrupoles have superconductors throughout.

K. Oide asks if space could be created at the power deposition hotspot to avoid quench issues. **B. Parker** responds that this would require reverting to a classical magnet design, which has drawbacks like less effective field cancellation. While worth considering in the long term, he advises caution against over-optimism.

G. Broggi asks if the tungsten shielding will reduce FFQ apertures. **B. Parker** confirms that it will not.

3 K. Oide - Polarization with local solenoid compensation

K. Oide presents the results of his studies on polarization with the local solenoid compensation scheme.

K. Oide has included the solenoid field from M. Koratzinos in the HFD lattice for the Z operation mode. With doing this, he observed that the coupling compensation is not perfect, with small leakage of the x-y coiupling towards the outside of the solenoid. the consequence is that the resulting vertical emittance is higher than expected (0.56 pm vs. 0.43 pm).

The estimated polarization for the local scheme is significantly higher that in the non-local scheme (56% vs. 0.47%). Therefore, a bump tuning for the non-local scheme is needed.

The depolarization time in the non-local scheme is estimated to be 5000 s. **K. Oide** points out that the polarization time of positrons should be faster than this if a polarization ring is used.

J. Wenninger comments that he did some quick estimates, and these agrees with the values reported by **K. Oide**.

4 V. Gawas - Update on luminosity optimization for FCC-ee

V. Gawas presents an update on luminosity optimization studies for the FCC-ee.

The main conclusions are that:

- A forward waist-shift in the FCC-ee (Z) shows increased luminosity, with the effect being opposite in the *ttbar* mode.
- A reduction in luminosity is observed if spurious vertical dispersion (either positive or negative) is present at the IP. The recommendation is therefore to contain the vertical dispersion at the IP within 50 micron.
- Luminosity drops drastically in the presence of coupling, with this effect becoming more pronounced in the *ttbar* mode.
- IP tolerances increase BS power, leading to a direct decrease in luminosity and an increase in machine backgrounds.
- A ML framework is being developed to perform luminosity optimization studies.
- Effort is ongoing to track pairs (CP and ICP). The goal is to add this feature in `Xsuite`.

A. Frasca asks for clarification about the number of IPC, as this appears inconsistent with the number used in his studies, which were provided by **A. Ciarma** using the same software (`GuineaPig++`) that **V. Gawas** is using.

An agreement on the number has not been reached. Therefore, **V. Gawas**, **A. Frasca**, and **A. Ciarma** propose to discuss this in more detail offline and report later on the outcome.

28 Participants:
K. André, M. Boscolo, G. Broggi, L. Brunetti, H. Burkhardt, C. Carli, A. Ciarma, M. Dam, A. Faus-Golfe, F. Fransesini, B. Francois, A. Frasca, P. Janot, R. Kieffer, M. Koratzinos, A. Lechner, G. Lerner, M. Marchand, G. Nigrelli, A. Novokhatski, K. Oide, F. Palla, F. Poirier, G. Roy, J. Salvesen, V. Schwan, J. Seeman, and L. Watrelot

Minutes prepared by **G. Broggi**