

Meeting Minutes of the 160th FCC-ee optics design meeting and 31st FCCIS WP2.2 meeting

Indico: <https://indico.cern.ch/event/1217166/>

When: 01.12.2022 15:00-16:00 CET

Agenda

Presenter	Title
J. Bauche	Magnet design with larger inter beam distance

1 General Information

F. Zimmermann opens the meeting. The minutes of the last meeting are approved, and it is reconfirmed that an azimuthal shift of the booster ring with respect to the collider, as well as a radial offset, pose no issue from the beam optics point of view.

F. Zimmermann mentions that a new tunnel layout is under study, with a slightly smaller circumference. This can be accomplished by either shortening the experimental insertions or the technical straights. The impact on the surface site placement is looked into to decide which option is preferred.

F. Zimmermann also comments that the following week, the FCCIS workshop will take place, and the program is briefly summarised.

2 Magnet design with larger inter beam distance

J. Bauche presents on proposed changes to the magnet design, resulting in an increase of the inter-beam distance. Recent studies as part of the arc cell mock-up WG have shown that in the current design, space between the cooling pipe and the busbar is insufficient. It is proposed to increase the inter-beam distance from the current 300 mm up to 350 mm. This increase would also have benefits for the quadrupole design, where the coupling between the two apertures leads to a strong sextupole components and a shift of the magnetic axis when increasing the gradient.

P. Raimondi asks if in the new quadrupole design, still only one coil is used. **J. Bauche** confirms. **P. Raimondi** asks if separate coils would bring any benefits. **J. Bauche** answer that in this case, aside from doubling the copper cost, the powering becomes less efficient.

J. Bauche continues that the increased inter-beam distance would also help with the sextupole design. Already in the current design, there is little space for the installation of the hardware for the vacuum bake-out. However, the increase of the sextupole aperture will lead to a higher pole tip field (larger iron saturation) and a significant increase in the power consumption (scaling with the 6th power of the radius). For example, scaling the bore radius from 38 mm to 42 mm would increase the power consumption by about 80 %.

F. Zimmermann comments that **T. Raubenheimer** proposed to decrease the beam-pipe aperture to 30 mm. **T. Raubenheimer** adds that this decrease in the sextupole aperture will require a taper and will increase

the resistive wall contribution. **T. Raubenheimer** and **J. Bauche** agree that the reduction in aperture can be less than 5 mm, but needs to be checked by different groups.

P. Raimondi comments that due to the relatively short length of the sextupoles, it could be considered to exclude this part from the bake-out. Implications on the vacuum conditioning should be investigated.

T. Raubenheimer comments that the radiation flux at the sextupoles should be quite low. He adds that one could consider reducing the winglet depth in the sextupoles. **J. Bauche** replies that the issue not only lies with the winglet hitting the coils, but also pole tip touching the beam-pipe, requiring a larger magnet aperture. It is agreed that this option should be looked into by the vacuum group.

T. Raubenheimer notes that an overall reduction of the beam-pipe aperture to 30 mm around the ring could also be looked into. **J. Bauche** adds that this option would also be beneficial for the quadrupoles, by reducing the power consumption.

F. Zimmermann asks if the inter-beam distance still needs to be increased if the aperture is reduced, or if the current distance could be kept then. **J. Bauche** replies that in this case, the size of the busbar in the dipole could be reduced, and then the cooling channel might fit.

P. Raimondi asks if the shift of the magnetic axis in the quadrupole goes in the same or opposite direction.

J. Bauche replies that it goes in the same direction. **F. Zimmermann** asks if horizontal movers could be used to counteract. **J. Bauche** replies that orbit correctors should be sufficient.

P. Raimondi asks about mechanical deformation of the quadrupoles. **J. Bauche** replies that a small change in the vertical separation could occur.

T. Raubenheimer notes that the increase of the inter-beam distance will require more material. **J. Bauche** agrees, but notes that the overall increase in cost should be small.

It is concluded that from the beam-dynamics point, the inter-beam distance can be increased, however it has to be accounted for in the crossing of the technical straight sections and the separator in the RF section.

Follow-up items

TASK

Determine minimum tolerable beam-pipe aperture in sextupoles

Study of vacuum conditioning without bake-out in the sextupoles

Study of a local decrease of the beam-pipe aperture in the sextupoles on impedance

37 Participants:

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