



6th FCC-hh design meeting

Wednesday 13th December 2023, 11:00 – 12:10

Chair: Massimo Giovannozzi

Speakers: Massimo Giovannozzi

Participants: Wolfgang Bartmann, Roderik Bruce, Sergio Calatroni, Davide Di Croce, Massimo Giovannozzi, Michael Hofer, Patrick Krkotic, Anton Lechner, Nicolas Mounet, Gustavo Pérez Segurana

Apologies:

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PROPOSAL OF A NEW CONFIGURATION FOR PB (MASSIMO GIOVANNOZZI)

The current layout of the FCC-hh ring consists of four experimental insertions: PA, PD, PG and PJ; two collimation insertions: betatron cleaning in PF and momentum cleaning in PH. The two remaining insertions are PB, with dump system for both beams and injection of the clockwise beam, and PL with the RF for both beams and injection of the anti-clockwise beam. However, the design of PB combining injection of Beam 1 and the dump for both beams has proven problematic from a machine protection standpoint.

An alternative arrangement of the insertions is proposed to solve the machine protection challenge. This would entail moving the betatron cleaning to PH, the extraction of both beams to PF and rework PB to accommodate momentum collimation and injection of the clockwise beam. In principle, one could also merge betatron and momentum collimation, but this is challenging in term of optics design.

A possible configuration of PB with both injection and collimation systems could be as follows (moving along the direction of the clockwise beam): an injection section sharing the hardware parameters used in PL with possible length optimizations, a transition region to match optics between both systems and to allow for shielding for the kickers and the momentum collimation section. In the CDR, the momentum cleaning insertion was in a short straight section, 1.4 km long.

BRAINSTORMING ON PROPOSAL OF A NEW CONFIGURATION FOR PB (ROUND TABLE DISCUSSION)

Roderik asks what is the length that can be allocated for each of the sections in PB, and if the 1.4 km version of the momentum collimation from the CDR would have to be shortened further. **Wolfgang** recalls the injection section in the CDR was closer to 450 m instead of the current ~600 m in PL. **Massimo** suggests that the configuration of the injection system used in the CDR should be reviewed to see if it can be reimplemented and if it can work with the updated geometry of the transfer lines.

Anton comments from the side of civil engineering that for FCC-ee, the dump is planned for PB, and this has an impact on the tunnel design. **Massimo** agrees that there was an initial preference for the dump systems in PB, but now that machine protection is an issue, this should be reviewed and moving the dump to PF is not a showstopper for civil engineering. **Michael** also comments that it is viable to move the dump insertion in FCC-ee to PF from an optics standpoint if dedicating the same insertion for both colliders were beneficial. On the other hand, **Massimo** comments that the wider cavern required for the FCC-ee dump insertion could be used in FCC-hh to minimize the radiation impact from proposed momentum collimation system onto the injection hardware. In this regard, **Wolfgang** highlights that the elements in the injection system that would be most impacted from radiation are the electronics, and then the activation of equipment that would impede required access to the area.

Going back to the optics design of the new proposal for PB, **Michael** points out that the injection should be made with zero horizontal dispersion, whereas the momentum collimation necessitates high dispersion. **Wolfgang** comments that some horizontal dispersion should be tolerable, since the injection is in the vertical plane, but the magnitude of this tolerance should be studied, in particular the impact on the required beam aperture.

Massimo moves the discussion to the requirements of the transition region. Anton points out that most of the particle debris generated from the momentum cleaning of the counterclockwise beam towards the injection hardware will travel through the vacuum system, so additional shielding cannot block this. **Roderik** and **Massimo** answer that losses in particularly sensitive elements can be minimized by controlling the single pass dispersion and optics of the counterclockwise beam since it does not have to satisfy the additional constraints for the injection.

Anton queries about losses from the transfer lines and how they impact the superconducting machine. **Wolfgang** replies that since the transfer lines in the ring tunnel consist of permanent magnets, all collimators are pushed back in the transfer lines before reaching the ring tunnel and so no significant losses are expected in the transfer lines that would impact the FCC-hh ring.

Minutes reported by Gustavo Pérez Segurana