Meeting Minutes of the
200th FCC-ee Accelerator Design Meeting & 71st FCCIS WP2.2 Meeting

Indico: https://indico.cern.ch/event/1497833/
When: 16.01.2025, 15:00-17:00 GVA time

Agenda

Presenter	Title
F. Zimmermann	**General information**
J. Salvesen	**Update from December 2024 EAJADE Secondment**
K. Skoufaris	**Beam dynamics in FCC-ee with reduced sextupole strength**

1 General information

F. Zimmermann presents the preliminary timetable of the FCC Week 2025. Then he shows the schedule for the feasibility report volume 2 which has its deadline on 2nd of February 2025. Then he mentions that there is an open question regarding the RF operation of the FCC-ee booster, namely whether to operate the RF of the booster also in reverse phase mode, if the main rings need to be operated in this mode. Then he mentions that the SuperKEKB advisory committee had a discussion on future collaborations for FCC. There is a high request for exchanges in beam-beam studies. They proposed dedicated beam-beam meetings once per month, starting after the eeFACT workshop. They mentioned also that the interplay of space charge and beam-beam could be studied. In addition another study with beam-beam and residual coupling could be done to see the specific luminosity.

He also mentions that due to a company event, most hotels are overbooked in Tsukuba on the night of March 5. The eeFACT organizers are working on solutions. One possibility can be to sleep at the KEK guest house for that night.

2 Update from December 2024 EAJADE Secondment

J. Salvesen starts by reminding of the goal of his exchanges at KEK. He aims to have a self-consistent model of the FCC IP feedback. He mentions that he aims for first tests in the SuperKEKB context, where real data is available for benchmarking the simulation model. Afterwards he describes the SuperKEKB feedback system. He then presents a current scan measurement done during his earlier exchange in May/June, for which the analysis has been done since then. There it was found that there is a linear trend between the current and the vertical offset target. Then he gives a clarification of what the feedback target is: from 4 beam position monitor (BPM) signals (2 per beam) an IP offset is calculated. The target is a free parameter in the equation for the optimization of luminosity. This offset target is the parameter that we have to optimize for. It accounts for errors in the BPM measurements. We look at the specific luminosity over time

and perform a fit on the luminosity over time. A presentation by **Y. Funakoshi** that discusses the maths behind the target can be found here. There are a number of other parameters that were checked from the same MD where the current scan was performed. He wanted to find out if BPMs work better at higher currents or is there a heat effect?

He then reports on a constant current study performed at SuperKEKB. He mentions that no drift in the target has been observed. A reproducibility test of the scan was also performed. He shows then that if the target offset fluctuates the specific luminosity is not too much degraded and the change is within the error bars.

He then moves on to discuss the status of the optics model of SuperKEKB in Xsuite. He mentions that many people are doing FCC related studies on SuperKEKB and KEK has now a SuperKEKB beam-beam working group. He then reports on the most recent developments related to the SuperKEKB model. This includes the solenoid in the lattice, tests with the synchrotron radiation and emittance. the DA is smaller than in the equivalent SAD simulation. There are initial tests ongoing with beam-beam included. He notes that the SuperKEKB model is supported as of v.0.72.0 of xtrack.

G. Roy asks that if you refill the beam does it get refilled onto the same orbit?

T. Mori responds that the feedback system is restarted at refill and its not hard to find the optimum orbit.

F. Zimmermann asks if in the SuperKEKB model there is coupling at the IP? Finding right coupling would be interesting.

J. Salvesen replies that in the model currently there is residual coupling but he forces the coupling to be 0 because it is easier to match the optics like that. He comments that the lattice with collimator optics also works. He is currently working to implement the correct coupling.

C. Carli asks how fast does the beam-beam offset feedback react?

J. Salvesen responds that it runs on an FPGA and it has a 32 KHz logging frequency, which translates into about one log every 3 turns for all bunches. It is not turn-by-turn.

C. Carli comments that the feedback system meant for FCC would also be similar, i.e. not turn-by-turn feedback but once every couple of turns.

3 Beam dynamics in FCC-ee with reduced sextupole strength

K. Skoufaris presents that he has been performing studies with 3 lattices were using xsuite:

K. Oide's relaxed optics, his ballistic optics and **P. Raimondi**'s LCC optics. The studies he presents are performed with synchrotron radiation but no beam-beam. He the shows plots of the simulated dynamic aperture (DA) for these lattices. By default with nominal sextupole settings (for reference) all lattices have a good DA and 0 particle losses. He then did a study where he reduces sextupole strengths to half of their original value. For the relaxed optics lattice and the ballistic optics lattice he observed a significant reduction of the beam lifetime, as well as a vertical emittance blowup. The lifetime and blowup with the ballistic little are a bit better than with the relaxed betastar lattice. The LCC optics has still a quite good lifetime ($\sim$50% of intensity after 2500 turns), and less vertical emit blowup than the other two lattices. In terms of DA, all lattices have a smaller momentum acceptance (MA), but the transverse DA is still ok but a bit reduced compared to the reference study. He argues that the reduced MA comes mainly from the arc sextupoles.

G. Roy asks whether we have sextupoles in the interaction region (IR)?

C. Carli comments that they are not used in the relaxed optics only in the nominal optics. In the relaxed optics the betastar is an order of magnitude larger.

K. Skoufaris adds that it is important to try to understand the MA degradation. Chromaticity is quite large and coupling could be source of problem. Possible future studies are to include higher order contributions or changing the synchrotron phase or optimizing the strength of the sextupoles.

G. Roy asks what is the mechanism for the loss? Are the particles lost in the longitudinal or transverse aperture?

K. Skoufaris answers that the loss is mostly on the longitudinal and later on the transverse aperture.

G. Roy asks why is it necessary to reduce sextupole strengths?

K. Skoufaris responds that it is important for commissioning.

G. Iadarola asks why does the relaxed optics ease commissioning?

G. Roy answers that because there are less high order effects with the relaxed betastar.

R. Tomás comments that the use of ballistic optics is to be able to put a beam with large transverse errors for commissioning. This was not possible with nominal GHC optics.

J. Salvesen asks if the ballistic optics is only needed for Z or do we need a ballistic optics for all energies?

C. Carli answers that for all energies we need it. He further comments that we need to extend the study to a machine with alignment errors. It is expected that the machine with lower sextupole strengths is less sensitive to alignment errors.

F. Zimmermann comments that the Chamonix workshop takes place at the same time as the planned next optics meeting. Also in 3 weeks the FCC feasibility report needs to be ready.

G. Roy suggests to discuss the work plan for all topics for this year at the next optics meeting.

34 Participants:
M. Ady, K. André, A. Apyan, G. Broggi, Q. Bruant, X. Buffat, C. Carli, A. Chancé, B. Dalena, L. Deniau, D. Domange, Y. Dutheil, C. Garcia, V. Gawas, A. Ghribi, C. Goffing, G. Iadarola, P. Kicsiny, R. Kieffer, A. Korsun, S. Kostoglou, T. Mori, V. Musat, G. Nigrelli, G. Pérez, G. Roy, L. Sabato, J. Salvesen, K. Skoufaris, R. Soos, R. Tomás, L. van Riesen-Haupt, F. Zimmermann, and M. Zobov