Meeting Minutes of the
201st FCC-ee Accelerator Design Meeting & 72nd FCCIS WP2.2 Meeting

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When: 28.01.2025, 15:00-17:00 GVA time

Agenda

Presenter	Title
F. Zimmermann	**General Information & highlights from the 28th (Super)KEKB Accelerator Review meeting**
I. Karpov	**Updates of the RPO / cavity voltage studies for the FCC-ee booster**
S. G. Zadeh	**800 MHz cavity design options**

1 General Information & highlights from the 28th (Super)KEKB Accelerator Review meeting

F. Zimmermann presents the status of FSR report. He mentions that there is a lot of material already for the report. Then he shows the members of the SuperKEKB review committee which took place from 14-16 January 2025. He then shows some highlights from the SuperKEKB 2024 operation. They tried various values for betastar y and tried to increase the beam current. They reduced LER betastar x which helped reach a new record luminosity. He shows the parameter table of SuperKEKB comparing the old KEKB and the different SuperKEKB designs, including the newest one with the reduced betastar x. He mentions that still the beam current is still half of the design value. The beam-beam tune shift is very low, about half of design. The vertical emittance is still 10 times worse. The specific luminoisty is a factor 4 less than the design. He mentions that 10 years ago **D. Zhou** showed that space charge affects luminosity but no followup was made. Next, he shows another table with the SuperKEKB target plans, by reducing vertical betastar. He shows a slide on beam aborts, which highlight that the number of sudden beam losses did not go down after modifications in the ceramic beam chambers. There are lot of aborts coming from injection. He then presents some plots of beam loss instances. All of them show a vertical emittance blowup. At SuperKEKB they see a voltage on some of the clearing electrodes right before the beam abort. After modifications in the ceramic beam chambers the next candidate is the vacuum chamber called "vacseal" for causing the sudden beam loss. During vacuum conditioning the vertical emittance suddenly became large and very strong resonances were observed in an operation without collisions, with a single beam. It remains unclear why. The cleaned the vacuum chamber and it reduced the frequency of sudden beam loss. He shows list of priority items for SuperKEKB. These include to reconnect BPMs which were isolated in 2024 to the quadrupoles and stabilize quad position by mechanical means, the usage clam shell and placing more diagnostics around the ring.

C. Carli asks if the section injection after abort is needed? We should refer to parameters of the polarization wiggler if it is described somewhere.

K. Oide comments that with nonlocal solenoid compensation there is no polarization.

F. Zimmermann comments that we need polarization.

K. Oide adds that polarization tuning is needed.

F. Zimmermann comments that we might need to simulate polarization in `Xsuite`.

M. Koratzinos asks what is the baseline?

K. Oide answers that the baseline is not clear.

F. Zimmermann comments that polarized pilot bunch is likely to be prepared in the injector.

K. Oide comments that every 20 minutes we can inject a new pilot and the depolarization lifetime is 20 minutes, considering only the bare lattice.

T. Pieloni comments that Yi and Georg are working on simulating polarization with bumps.

M. Boscolo raises hand and comments baseline scheme is local and polarization is under investigation.

M. Koratzinos points out that the dominant factor is not the sudden beam loss. He asks what is the majority?

F. Zimmermann comments the maybe the experiment triggers some beam loss and mentions that loss could also be from electron cloud or it could be some plasma type instability but we need people to do the corresponding simulations.

2 Updates of the RPO / cavity voltage studies for the FCC-ee booster

I. Karpov presents the latest updates on the reverse phase operation mode studies for the booster. It seems feasible for the high-energy booster to avoid hardware modifications for Z, W, and ZH modes. He mentions that beam instabilities, especially the coupled bunch instability, due to fundamental mode require strong feedback but the RF feedback leads to large power transient at injection, which can be cured if additional stability margin is available. He shows that the detuning builds up over time. The filling scheme has to be modulated according to this in the booster.

M. Koratzinos asks what is the cost in electricity of this operation mode?

I. Karpov answers that it is 50 MW anyway, it is already optimized, with rephasing you can choose Q_{loading} optimally.

M. Koratzinos asks how long are the cavities?

S. Zadeh answers that the 6 cell cavities are 9-10 meters long.

F. Zimmermann asks what filling scheme does this study assume?

I. Karpov responds that this study assumes a uniform ring without particular filling scheme.

I. Karpov comments that wigglers are not yet included in the current study. The voltage would have to be recomputed, but it would still be acceptable.

F. Zimmermann comments that the contribution should be less at high energy due to inverse relation with momentum in the synchrotron radiation integrals.

A. Chance further comments that with wigglers he is not sure if there is an update on studies of the microwave instability.

A. Ghribi comments too that there is no update. No wigglers were included in the collective effect studies. He adds that wigglers are not necessary to avoid microwave instability.

F. Zimmermann adds that the wiggler gets weaker the higher the energy of the beam.

A. Chance points out that at Z the ratio of the synchrotron radiation integrals is important. The effect of wiggler is not negligible .

I. Karpov mentions that the momentum spread of colliding bunches is much larger than non-colliding bunches. There is some margin there. The current for W is just a little lower than Z so its the same problem there unless we change the current.

F. Zimmermann asks whether we detune the cavities mechanically?

I. Karpov answers that it is under investigation. There are 2 ways of doing it, one mechanical and one not mechanical.

F. Zimmermann asks how we do it in the LHC?

I. Karpov answers that we do mechanical tuning in the LHC.

3 800 MHz cavity design options

S. Gorgi Zadeh presents the updates on the 800 MHz cavity design options studies. He mentions that we might be able to save 80 m length in the beamline per module by removing the inner coaxial couplers. The reduction can potentially be more with optimized tapering and BLA connections. He discusses that the available vacuum gate valve diameter must be determined for further improvements. The lower beam impedance limit at injection energy in RPO addressed by having an asymmetrical end-cell shape for better higher order mode (HOM) damping. In addition, larger coupler dimensions allow for better mechanical robustness and inner cooling. Cell-sorting during manufacturing allows to minimize trapped HOMs. In conclusion the stability can be achieved with limited margin. He mentions that with the 6-cell cavity shape, port positions, and distances now fixed, one should study how to improve HOM coupler designs for better HOM damping and reduced multipacting and beam tracking in the booster cavities to better understand the beam stability limits.

F. Zimmermann asks if it is always the fundamental mode that is the highest?

S. Gorgi Zadeh answers that for multicell cavities it is. We should focus on higher order modes that are problematic.

F. Zimmermann asks if one can just remove the inner coaixal cable without harmful consequences?

S. Gorgi Zadeh answers that yes one can do that.

K. Oide asks what about 7 cell cavities?

S. Gorgi Zadeh responds that already with the 6 cell we are close to the limit. The 7 cell cavity design would not work.

F. Zimmermann asks whether the results agree with XFEL measurements?

S. Gorgi Zadeh answers that they are not very far from each other.

M. Koratzinos asks what is the length of the cryomodule now with the shortened ring?

S. Gorgi Zadeh answers that it is around 8 m.

F. Zimmermann asks if in the FSR this is the baseline?

S. Gorgi Zadeh tells that it is 6 cell cavity but an older one.

F. Zimmermann mentions that we should deliver FSR by next week Monday. He hopes that we can still edit for 2 weeks.

38 Participants:

M. Ady, A. Apyan, M. Boland, M. Boscolo, G. Broggi, Q. Bruant, O. Brunner, X. Buffat, H. Burkhardt, C. Carli, A. Chance, B. Dalena, H. Damerau, L. Deniau, V. Gawas, A. Ghribi, D. Gibellieri, S. Gorgi Zadeh, S. Jagabathuni, I. Karpov, P. Kicsiny, R. Kieffer, M. Koratzinos, A. Korsun, T. Mori, G. Nigrelli, K. Oide, T. Pieloni, L. Rivkin, G. Roy, L. Sabato, J. Salvesen, K. Skoufaris, F. Valchkova-Georgieva, L. Valle, R. Wanzenberg, F. Zimmermann, and M. Zobov