

4th ICFA Mini-Workshop on Space Charge
November 4th – 6th , 2019
CERN (Geneva, Switzerland)

Minutes of Q & A: Tuesday, November 5th, 2019 - morning session

Reported by Foteini Asvesta

Frank showed some extra info on yesterday's talk concerning the question of the periodical condition.

The space charge tune spreads re-calculated with *sussix* after a bug fix were presented, while the results were not drastically affected.

Hideaki

Space Charge in JPARC synchrotrons

Q&A

Simon asked which would be the parameters considered for further optimizations in the longitudinal plane and **Hideaki** responded that the bunching factor would be the parameter to be checked and optimized.

William asked if the painting schemes and the tunes were changing pulse by pulse and **Hideaki** confirmed.

Giuliano started a discussion for the resonance observed, as **Hideaki** in his talk mentioned that it would be coherent however in the simulation it is not clear whether it would be coherent or incoherent. **Frank** reversed the question and **Giuliano** observed that there were 2 islands forming however the formation was quite fast. **Shinji** noted that the C factor in the presented work would be ~ 1 and in his opinion it looked more incoherent. **Hannes** further suggested that the stopband could be further studied. **Hideaki** mentioned it is still work in progress and all the remarks could be taken into account.

Hannes asked which would be the predicted beam loss level from simulations for the 2.5 MW, since the agreement to past measurements was quite good. **Hideaki** showed the corresponding figure that was predicting losses in the order of 10%.

Daniel

[Space charge effects in Linac4](#)

Q&A

Elias asked if it would be possible to compare results without the space charge compensation to check the agreement. **Daniel** said that such a comparison would not be possible as the effect is unavoidable.

He continued explaining that there are 2 contributions to the compensation and one of them is the source so this part cannot be avoided. **Elias** asked if by changing the position the effect could be avoided but **Daniel** noted that after the RFQ there are no issues.

Giuliano asked how well the mechanism is understood and if the compensation can be improved or better controlled. **Daniel** mentioned that some modifications in the beamline had a positive effect, however the reason is not yet understood and further studies are needed.

Malte asked about the PIC noise dependency on the grid and the number of macroparticles, and **Daniel** said that the only once the number of particles was sufficient {saturated} the grid size started to play a role.

Ji asked if the Δt^2 is the step size in the PIC simulations, which **Daniel** confirmed. **Ji** further noted that in their simulations the step size makes a difference so in every point it should be taken into account. **Daniel** said that he would have to check this for the presented simulations.

Kiersten

[Application of SNS beam test facility to halo formation in high-intensity linacs](#)

Q&A

William asked how depended the results are in the outlet of the test facility which has a U-shape.

Kiersten agreed that indeed it does not look like a true linac and the results would be much better in the purely straight case. Further studies on the dependency on the shape could be done.

Giuliano asked an estimate for the precision in the measurements and especially for the halo. **Kiersten** didn't have the numbers at hand however explained that they expect only small errors coming from the fact that the slits are not infinitely small but she wouldn't expect any errors from scattering. Some extra contributions from the interplane correlation could also be expected.

Jean-Baptiste Lagrange asked whether they have control over the permanent magnets and how confident they could be that they have sufficient knowledge of them. **Kiersten** mentioned that they do not have much control over them and **Jean-Baptiste Lagrange** mentioned that in some cases of other labs the permanent magnets could be controlled by getting dumped in water. In particular, they could get some control of the field by modifying the temperature of the water and thus of the magnets.

Kiersten said it would be worth checking since they have never done anything similar.

Dong-O noted that the extensive low energy tails could get cut off after the double bend due to the energy.

Stephen asked what is the beam dimension and how it compares to the length of the bends. **Kiersten** replied that the length would be smaller but comparable to the bend. Even considering a perfect arc, the beam would not take up all the space but it would be of comparable size so the dipole model could have a significant effect and should be checked.

Alessandra wondered why they do not model the actual field to which **Kiersten** noted that they do not have the field map yet. They have some specifications from the manufacturer concerning the integrated fields and there should be a spare that can be measured but it is not done yet.

Vera

[Working point and space charge simulation studies for SIS100](#)

Q&A

Shinji noted that even though the working point can be chosen for the cleanest transmission, the resonances and their sources should be studied and understood. The transmission seems to never be perfect and depends on the seeds, especially close to the resonances. The mechanisms that give this variation need to be understood and the source of the differences to be identified. **Vera** replied that the errors were rearranged and **Shinji** further wondered which resonances can be varied in this manner. **Yannis** noted that sorting the magnets could give further input and provided the example of the LHC where the sorting of the magnets was beneficial. **Giuliano** said that the resonance could be compensated and **Yannis** stressed that all this can be done after the magnets are sorted. **Vera** clarified that the errors set were always different and no rearranging of the locations was performed. **Adrian** said that the results still need to be understood. At this time, they are not at the level of understanding the dynamics of the system but they can be confident about their simulations. Further studies are needed to cross check with self-consistent simulations and then variations of the errors.

Frank noted that soon there will be a new release with some bug fixes in the MADX space charge, but he couldn't understand why the expected tune shift was larger than the simulated one. **Vera** said that the bunching factor was not the same in the estimation of the maximum tune shift and the simulation. Using the same parameters, the two should agree.

Malte asked which was the shape of the longitudinal distribution and **Vera** said that in all simulations it is taken Gaussian

Malte

[Study of the PS integer resonance](#)

Q&A

Eric commented on the two peak distribution for the frozen model and **Malte** noted that the distribution is not taken initially like this. It is taken Gaussian and then it evolves to this shape.

Ji noted that the dispersion and the beta functions are lattice parameters and from the sigma matrix the parameters taken should be for the beam. **Giuliano** added that the definition of those functions is in the linear single particle dynamics so what would it mean to get them in the Gaussian case. **Malte** noted that you get a distortion of the optics through space charge. **Giuliano** further stressed that they are global quantities and not single particle ones.

Vladimir wanted some extra info on the dispersion, in particular measurements, and the difference in the simulations with and without space charge since in all cases the dispersion was shown to have the major contribution to the beam size. **Malte** reported that the dispersion was measured in the experiment and the bare dispersion showed almost 1 meter error.

Adrian commented on the obscurity of the concept of dispersion as it could be viewed as a focusing function or in the orbit and one is actually the projection of the other.

Matthew

[Emittance blow-up studies at the transfer from the PSB to the PS](#)

Q&A

Giuliano asked the source of the oscillation of the dispersion and **Matthew** said that it was the injection oscillations. **Giuliano** asked if it was off-centered and **Matthew** replied that this was the case and stressed that it is hard to match. Within 30 turns it is expected to have filamented. **Adrian** added that is not only a betatron mismatch but also the dispersion one, which gives a coherent dispersive mode that is oscillating.

Hannes

[Studies on tune ripple](#)

Q&A

Jeffrey wondered whether the larger band of the half integer observed in the Booster at Fermilab could be connected to the modulation studies through the synchrotron period. **Hannes** said it could be and suggested it should be studied, however, he would expect it to be a small effect as it would be very slow but similar effects could be obtained from other sources such as a small mismatch etc. **Jeffrey** said it would be particularly interesting right after capture.

Adrian noted that the comparison of measurements and losses looks similar to the SIS18 case where the emittance is well reproduced but the losses are weaker in the simulations. He noted that according to **Ingo** the SIS18 had no change with a pic and he wondered what would be expected in the future to get better agreement in the losses. **Giuliano** noted that in the SIS18 case the modelling was not perfect as even if the resonance was not known, he had to implement a model which was the only one available. However, in the SPS where the model is better, the issue is still there. **Hannes** noted that the losses are always harder to reproduce since when losses occur the spread shrinks contributing to even more losses. **Giuliano** noted that the most important is the beam profile and the fact that they can be well reproduced should be enough for the time being. **Hannes** further added that the machine is always taken perfect in the simulations in the sense that no orbit is taken into account etc.

Giuliano and **Yannis** suggested a different experiment in different tune regimes that would affect the synchrotron tune and **Hannes** said that some data have already been taken and could be analyzed.