Study of CSR in the EEHG chicane with elegant and Genesis

Dmitrii Samoilenko Hamburg, 20.04.2022





Motivation

- last year for IPAC contribution we investigated how CSR in the EEHG chicane changes the energy profile of the beam with elegant simulations
- > would be more informative to see what is the effect on FEL output
- elegant doesn't do radiation. Genesis does
- I need to learn how to import elegant distribution into Genesis simulations.
- I got files from Naimeh with example of how shielding can be included in the calculation of CSR in the big EEHG chicane
- > didn't seem like a lot of work but had visible effect on the energy profile

I need to learn how to properly calculate CSR with shielding.

For this year's IPAC contribution I compare simulated FEL pulses with/without CSR and with/without shielding EHG chicane with elegant and Genesis | Dmitrii Samoilenko | Hamburg 20.04.2022



Progress: CSR shielding Compare CSR / no CSR





Progress: CSR shielding

Implementation of shielding

- > the regular method is to use elegant's element CSRCSBEND with CSR=1
- > elegant calculates CSR wakefields and applies them to the bunch
- > the regular method doesn't allow to include shielding
- > the alternative method is to calculate CSR impedance with an external program → import the impedance into elegant's element ZLONGIT → the impedance is converted into wakes which are applied to the bunch at the exit of each dipole
- > the alternative method allows to include shielding with 2 parallel plates
- > how much do the CSR wakes change because of the shielding?
- > consistency check: if the plates are far away from each other (1 m) shielding by the plates should be negligible → alternative method should converge to the regular one



Progress: CSR shielding

Compare shielding / no shielding



> the shielding seems to change the CSR effect on the energy profile significantly

> the two calculation methods seem to be consistent with each other

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Plans: CSR shielding

CSRZ and realistic chamber model

- > we are in contact with Demin Zhou, the creator of CSRZ
- > CSRZ allows to calculate CSR impedance with shielding by a rectangular chamber
- > the impedance data can be combined with elegant in the same way as above





Progress: elegant2genesis Procedure

- the idea is to take elegant particle distribution at the end of the seeding section and rewrite the file according to genesis format (slices) for particle distributions
- reformatting is done with a script by Mihai Pop
- the genesis particle distribution is imported to the FL1RAD simulation
- beam properties have to be conserved after converting from elegant format
- the bunching worried me the most



Progress: elegant2genesis

Bunching from genesis output files

One can:

- have slice length of 300nm and track 75th harmonic
- have slice length of 4nm and track 1st harmonic
- resample distribution in Genesis to switch from 300nm slices to 4nm slices



Could be because of bad statistics, could be a problem with the distribution itself





Progress: elegant2genesis

Bunching from particle distributions

- if we calculate bunching from the particle files, we have control over statistics
- > Fabian shared a script to do that
- > bunching is conserved





Progress: genesis Gain curves

- without resampling, simulations are consistent with each other
- Fabian simulates both the seeding section and FL1RAD with genesis
- elegant + genesis is also consistent with Fabian, if CSR is off







elegant

compare CSRDRIFT/DRIFT >

Genesis:

- compare gain curves with/without CSR >
- compare spectral properties with/without shielding >
- > add finite laser profiles





Thank you!

Contact

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