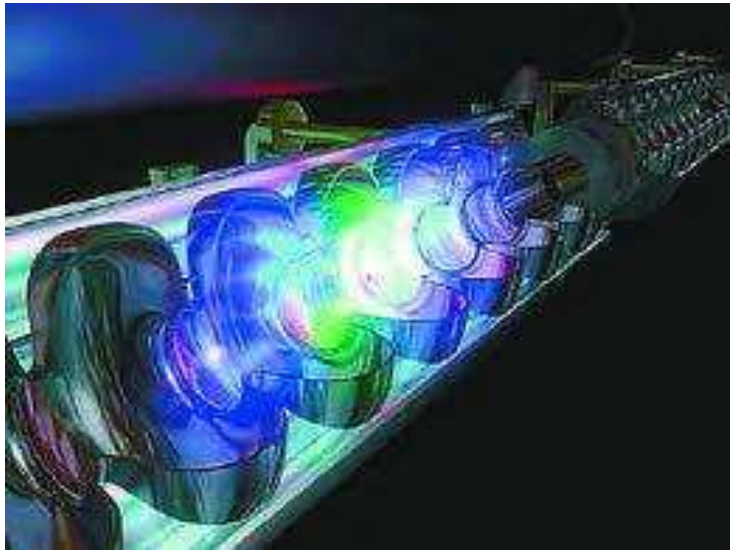
Tools Development for HGHG and EEGH

FLASH2 Simulations



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S2E Meeting

DESY
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HELMHOLTZ GEMEINSCHAFT

DESY

ASTRA

- modulator and chicane simulations with all collective effects, no radiation fields
- how to model an undulator (set of dipoles or field map)?
- how to model an external laser field?
- a vacuum chamber can be described through wakefields
- how good is the used model of collective uniform motion (Poisson solver)?
- requires additional programming (3-9 monthes)

CSRtrack

- modulator and chicane simulations with CSR, but space charge model is not full, radiation fields not full
- external laser needs programming
- a vacuum chamber can be described only as perfectly conducting planes
- a large memory demand (~400 bytes for one particle), it can be reduced for the simple projected model of CSR
- requires recompiling to increase the number of mesh points (short time scale)
- needs completely new programming to reduce memory demands and to increase the number of mesh points (a year)

Elegant

- modulator and chicane simulations with CSR, but space charge model is not full, no radiation fields
- simplified model for self effects, no transverse space charge, not quite correct simulation of CSR in bunch compressors (a set of several dipoles)
- no experience how to use it for HGHG or EEHG simulations
- no at home possibility to extend it

QField with tracker

- QField is a space charge solver in Matlab
- self written tracker with Qfield, external fields and wakes can be developed (3-9 monthes)
- the mathemetical model is the same as in ASTRA but could be easier to extend and to control

Genesis 1.3

- modulator and radiator simulations are possible
- no CSR and space charge (the longitudinal space charge can be included through energy loss parameter)
- particles are caught in the slice, the problem should be solved in the next release
- not really clear how correct are simulations for energy chirped beams or for EEHG where the longitudinal phase space is quite complicated
- source code is open, widely used

ALICE

- the mathematical model is the same as in Genesis, the numerical methods are different
- correct simulation of drifts
- correct simulation of open boundary conditions
- no harmonics so far
- particles are caught in the slice, the problem could be solved (several months)
- not really clear how correct are simulations for energy chirped beams or for EEHG where the longitudinal phase space is quite complicated
- source code is in C and open for DESY

PIC code

- full physics
- 1D code can be developed fast (weeks)
- 2D or 3D code requires long time
- usage of such codes will help to confirm and to understand the limits of other approximate models used in CSRtrack, ASTRA, Genesis 1.3, ALICE, Elegant

Hierarchie from PIC code to FEL code

- in FEL code several approximations are done and we can think about several models between PIC model and FEL model
- full electron motion, full EM field (PIC)
- full electron motion, general (non-resonant) paraxial approximation
- full electron motion, resonant paraxial approximation (as used in the FEL codes)
- averaged electron motion, resonance parabolic equation (FEL codes like Ginesis 1.3 and ALICE)