Science & Technology Facilities Council

Notes on Simulation Plan

KURRI FFAG Collaboration Meeting

S. L. Sheehy, ASTeC IB Group

23/10/14

Motivation

- For some measurements our simulations and experiments don’t match - or perhaps we lack some understanding
- It is useful to have a number of different simulations to check we really understand what is happening, and if the simulations agree
- At FFAG’14 people were really interested in this topic and in working out these discrepancies
- There is also a lot of general interest in simulating FFAGs with space charge, particularly from attendees of the ZGOUBI/ OPAL mini-workshop
- … a lot of common interests. Let’s try to co-ordinate a bit!

Simulation plan (draft)

Main objectives:
Obtain a better understanding of the KURRI FFAG by comparing models with measurements. Use the model to:

- Benchmark ZGOUBI & OPAL basic dynamics (transverse & longitudinal)
- Increase the performance of the existing machine
- Guide modifications
- Investigate intensity limits

This was put together at ZGOUBI/OPAL mini workshop, with:
S. Sheehy, S. Machida (RAL)
A. Adelmann (PSI)
S. Tygier (Manchester)
F. Meot, M. Tahar (BNL)
D. Bruton, R. Barlow (Huddersfield)

Areas of study: without SC

- Write down the "golden table" of KURRI FFAG parameters
- Closed Orbit Distortion correction and modeling the influence of the RF cavity interaction with the magnetic field in the straight sections (in ZGOUBI)
- Dispersion matching from linac through injection line to the ring (in ZGOUBI – Malek has done most of this already?)
- Understand the COD and its effects on other measurements including tune, dispersion etc
- Single particle accelerated orbit (no foil, with ZGOUGI & OPAL). Optimize injected orbit (min. phase oscillation)
- Understand emittance growth and energy loss due to the foil. (Geant 4 done by Chris R, compare to models in OPAL)
- Understand the rf capture process and beam survival when long bunch (> 1 turn) is injected

Areas of study: with SC

- Can we observe the emittance growth from space charge in this machine? Chris R has studied the foil scattering & foil emittance growth in GEANT 4 but eventually we need to compare to space charge emittance growth as well.

- RF capture and losses through the acceleration cycle - T. Uesugi has already studied this to identify ideal phase and done a lot of work on RF capture with simulation, you can read the results on the hadron.kek server. (can we confirm against existing results and then extend it to include space charge)

- Study whether we need to add additional collimation etc. to avoid machine activation when intensity is increased?

- What is the influence of the vacuum chamber shape? (i.e. we are close to one side of the chamber at injection where space charge is strongest). So we need to include boundary conditions on the simulation.

- other items?

Progress

- There is a git repository of an OPAL version of the lattice (thanks to Chris R)
- Should add a ZGOUBI version too (Malek has a field map version, David has an analytical version?)

https://sites.google.com/site/kurriffag/scripts

Discussion

- Some people are interested in ‘general’ code or space charge studies rather than ADSR-FFAG itself (eg. for compact isotope machines), but the work can be complementary

- It can also build on and benchmark against previous simulation work by KURRI group - (which items need to be prioritised?)

- We would like to add an agenda item to every other KURRI-FFAG meeting for any progress updates and to keep everyone in the loop, is this OK?

- Thoughts/ideas?