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FFAG simulation update

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Where we stand?

- KURRI FFAG Simulation plan second draft wad released on 18 December 2014.

http://hadron.kek.jp/FFAG/colabo/meetings/KURRIFFAGSimulationPlanv4.pdf

- Results after a few months was published at IPAC'15 and Suzie presented its summary on 14 May 2015.

http://hadron.kek.jp/FFAG/colabo/meetings/sheehy-20150514.pdf

Last slide of Suzie's presentation

Next steps

- Need to upload these results/input files to simulation page & make sure correct files in github
- Other codes (OPAL in particular) to benchmark longitudinal studies.
- We should continue according to simulation plan (on hadron.kek server in 18th December meeting)
- Look forward to seeing matched distributions & high intensity studies.

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A couple of questions

Do we keep using the same TOSCA file from now on?

- I think the answer is YES for code benchmarking for generic FFAG (ideal 12 hold symmetry KURRI FFAG).
- For simulation of KURRI specific, e.g., COD effect, influence of "patch", etc, TOSCA field map should be updated. Some one has to keep track of various files (Uesugi-san?).

Do we keep using the same rf voltage and frequency file from now on?

- As long as the same TOSCA file is used, no need to change.

Benchmark step 0
single particle tracking

Without rf

- Transverse tune and revolution time or frequency vs momentum.
- Explore transverse phase space trajectory to observe DA.
- Amplitude dependent tune shift

With rf but no acceleration

- Direct comparison of longitudinal phase space trajectory.
- Synchrotron tune vs longitudinal amplitude.

With rf and acceleration

- Direct comparison of longitudinal phase space trajectory.
- transverse and longitudinal tune vs momentum.

Benchmark step 1

multi particle tracking without space charge

With rf but no acceleration

- If the initial distribution is matched, there should be no emittance growth.
- This is a check that we can find matched distribution at least when there is no space charge.
- Emittance growth of transverse and longitudinal due to foil scattering.

With rf and acceleration

- Adiabatic damping should be observed. Physical beam size calculation has to include the change of beta function.

Benchmark step 2
intensity effects

With rf but no acceleration

- Find out matched beam with space charge.
- Emittance growth vs intensity (Malek on 11 June 2015).
- Emittance growth with space charge and foil scattering together.

With rf and acceleration

- As energy increases, space charge force becomes weaker.
- As energy increases, a beam escape from the foil.

KURRI specific benchmark step 1

without space charge

Without rf

- Modelling of COD by influence of rf cavity
  - thin lens or 3D field map, does they make difference?
  - Including correction element on both side.
- Modelling of injection line.
- Understand the effects of COD on other measurement including tune, dispersion.
- Calculate tune with more detailed TOSCA field map.

With rf

- Understand capture process and beam survival when the beam injection for many turns.

KURRI specific benchmark step 1

coupling in transfer planes

- Simulate coupling effects due to
  - tilt of main magnets.
  - finite vertical COD.
- This can be done either by looking at single particle motion or transverse emittance exchange.

KURRI specific benchmark step 2

with space charge

With acceleration

- With foil scattering model and space charge in the realistic lattice, estimate emittance growth we should observe experimentally.
- Detailed simulation of injection and capture process with space charge and foil scattering.
- Study of collimator, whether it help or not.
- Study of image charge/current.

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Any other suggestion?