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FFAG dynamic aperture study at 11, 20 and 50 MeV with Zgoubi and Scode

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Lattice with fieldmap
at 11 MeV

Zgoubi

Lattice with fieldmap at 11MeV

Verti amplitude (mm.mrad)	Verti amplitude (cm)	Cell tune	Ring tune	Hori aperture (mm.mrad,norm)
0	0	0.3063 0.1114	3.6756 1.3368	628
1	0.51	Same	Same	605
2	0.73	Same	Same	605
3	0.89	Same	Same	605

βγ = 0.1535
βx = 0.739 m
βy = 4.095m

At injection energy for 10 000 turns.

Same results with 2D and 3D fieldmaps.

Scode

Lattice with fieldmap
at 11 MeV

Vertical amplitude is restricted by field map (+/- 10 mm). It cannot go beyond 3 pi mm mrad (normalised).

vert amplitude [pi mm mrad]	cell tune	ring tune	hori aperture [pi mm mrad]
0	0.3066 / 0.1112	3.6791 / 1.3348	600
1	same above	same above	550
2	same above	same above	550
3	same above	same above	550

At injection energy for 10,000 turns.

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Lattice with fieldmap
at 20 MeV

Zgoubi

Lattice with fieldmap at 20 MeV

Verti amplitude (mm.mrad)	Verti amplitude (cm)	Cell tune	Ring tune	Hori aperture (mm.mrad, norm)
0	0	0.3130 0.1138	3.7564 1.3664	384
1	0.51	Same	Same	384
2	0.73	Same	Same	364
3	0.89	Same	Same	364

βγ = 0.2075
βx = 0.745 m
βy = 4.082m

Same results with 2D and 3D fieldmaps.

Scode

Lattice with fieldmap
at 20 MeV

Vertical amplitude is restricted by field map (+/- 10 mm). It cannot go beyond 3 pi mm mrad (normalised).

vert amplitude [pi mm mrad]	cell tune	ring tune	hori aperture [pi mm mrad]
0	0.3128 / 0.1137	3.7536 / 1.3640	400
1	same above	same above	400
2	same above	same above	350
3	same above	same above	350

At injection energy for 10,000 turns.

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Lattice with fieldmap
at 50 MeV

Zgoubi

Lattice with fieldmap at 50 MeV

Verti amplitude (mm.mrad)	Verti amplitude (cm)	Cell tune	Ring tune	Hori aperture (mm.mrad,norm)
0	0	0.3169 0.1156	3.8034 1.3876	407
1	0.51	Same	Same	407
2	0.73	Same	Same	407
3	0.89	Same	Same	407

βγ = 0.3308
βx = 0.780 m
βy = 4.168m

Same results with 2D and 3D fieldmaps.

Scode

Lattice with fieldmap
at 50 MeV

Vertical amplitude is restricted by field map (+/- 10 mm). It cannot go beyond 3 pi mm mrad (normalised).

vert amplitude [pi mm mrad]	cell tune	ring tune	hori aperture [pi mm mrad]
0	0.3165 / 0.1156	3.7986 / 1.3876	400
1	same above	same above	400
2	same above	same above	400
3	same above	same above	400

At injection energy for 10,000 turns.

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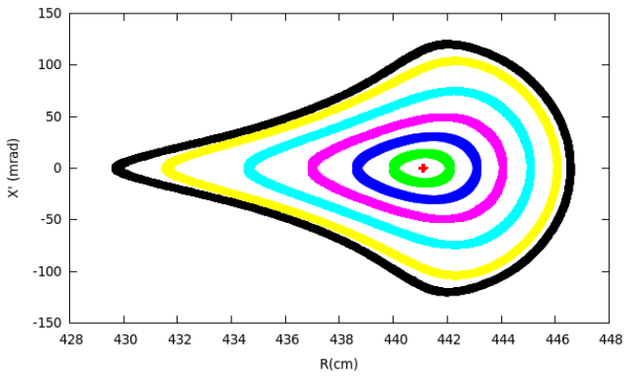
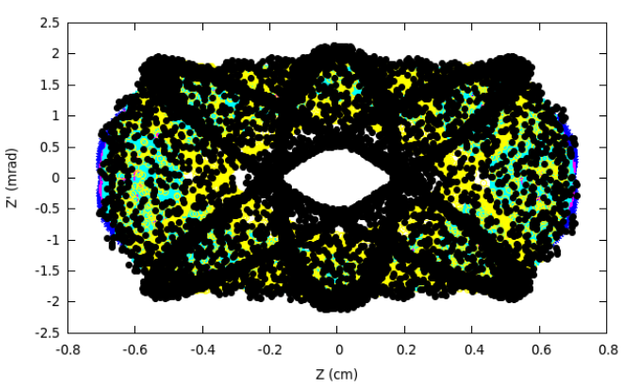
Phase space at injection
at 11 MeV

Phase space at injection



Horizontal

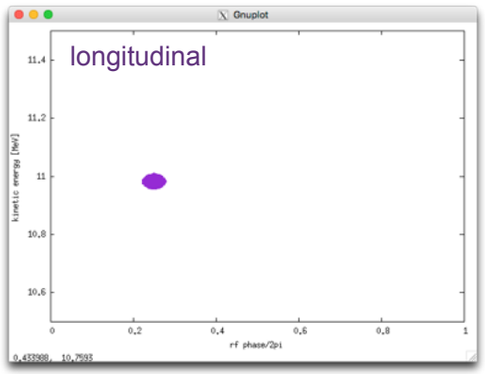


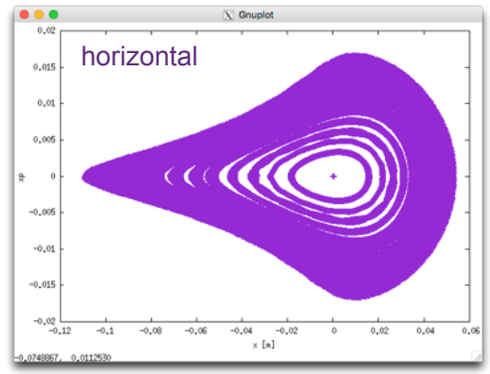
Vertical

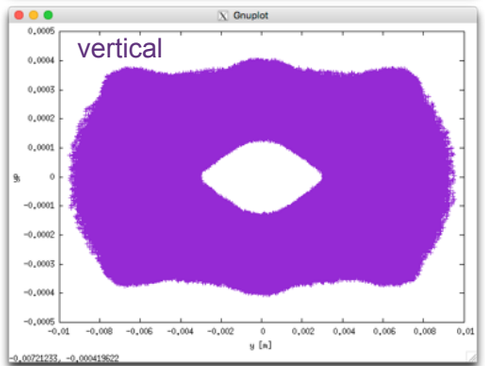
Phase space at injection energy when vertical amplitude is 2 mm.mrad.

Phase space

When vertical amplitude is 3 pi mm mrad (fixed) and search horizontal aperture until a particle is lost.







- Horizontal aperture is limited by 3qx=1.
- There is not much dependence of vertical amplitude.

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Summary

- Zgoubi and scode fairly agree on dynamics aperture.
- It is about a few 100 pi mm mrad (normalised).

- Would like to invite OPAL and Earlietime developers/users to join the benchmark efforts.
    - With fixed vertical amplitude (0, 1, 2, 3 pi mm mrad), search maximum horizontal aperture.
    - In longitudinal space, either at the centre of the bucket or no longitudinal dimension.
    - 10,000 turns at fixed energy.

- Outstanding issue: Calculation of finer field map data?
    - One of Mori-san's student?