# “Improvement” of Scott’s FFAG lattice

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15 December, 2008
http://www.astec.ac.uk/intbeams/users/machida/doc/nufact/ffag/machida_20081215.pdf & ppt

# Background (1)

*possible area to be improved*

- Chromaticity correction reduces the phase slip problems due to transverse large amplitude.

- Longer straight section (presumably with insertion) provides enough space for moderate strength kickers and septa.

# Background (2)
*strategy*

- Introduce nonlinear components in the main magnets to correct chromaticity.

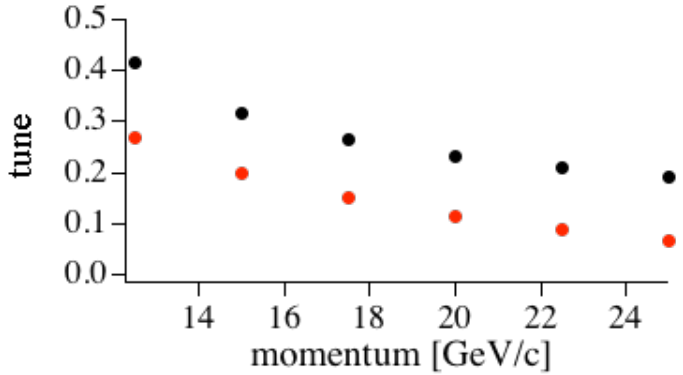
- Make sure the dynamic aperture is large enough with those nonlinearities.

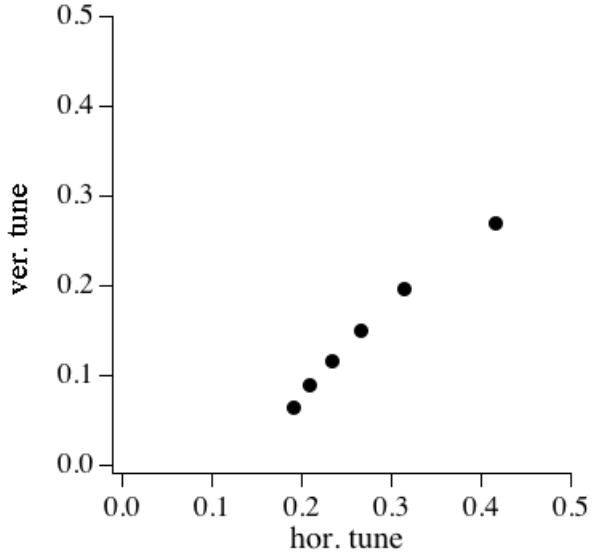
- Design insertion for the chromaticity corrected lattice.
  - Matching should be easier for the chromaticity corrected lattice.
  - Grahame Rees' "Pumplet lattice" successfully introduced the insertion with constant phase advance.

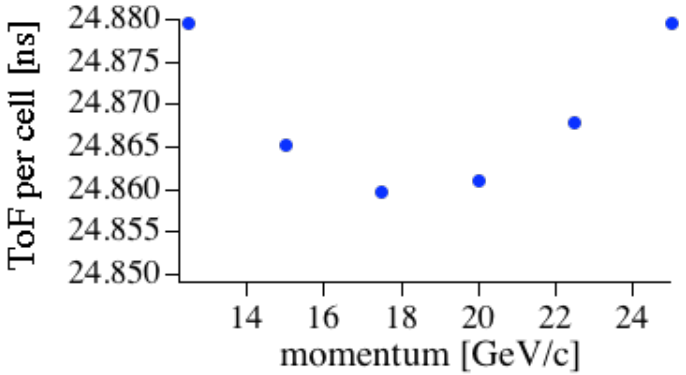
# Chromaticity correction (1)

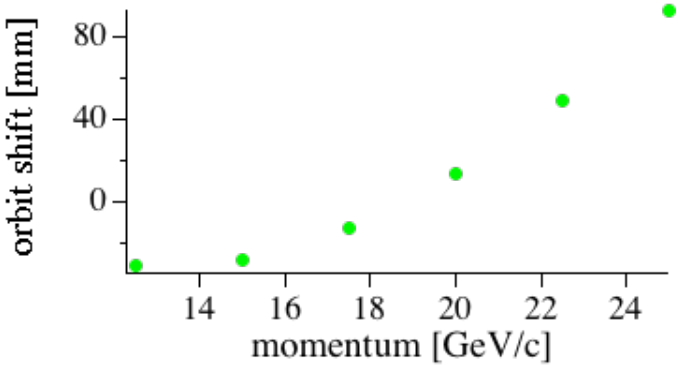
*original behavior*

- Scott's 080221a FODO



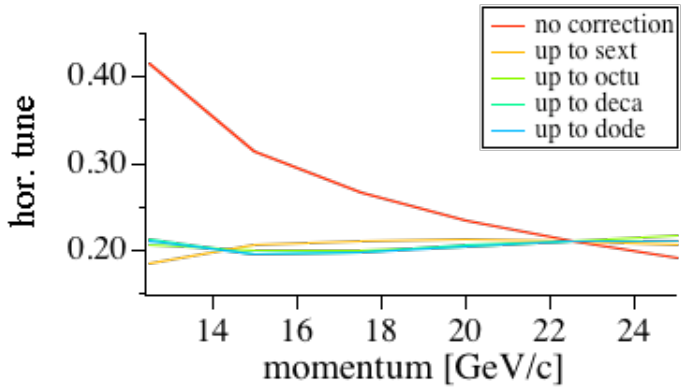



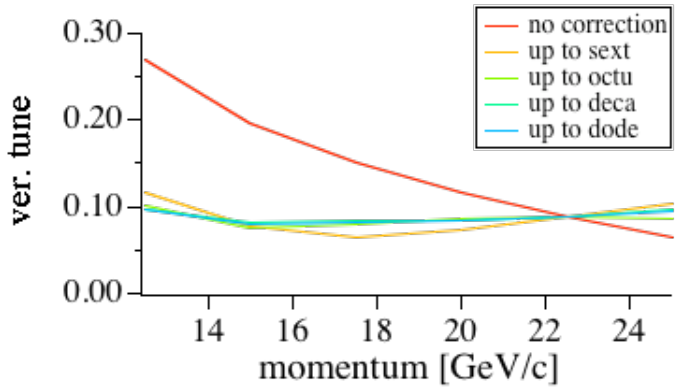



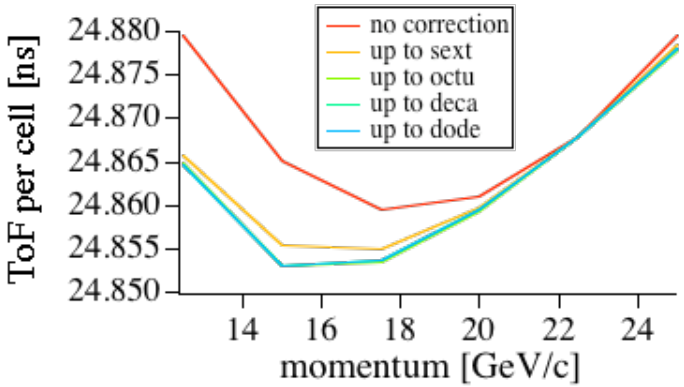
# Chromaticity correction (2)

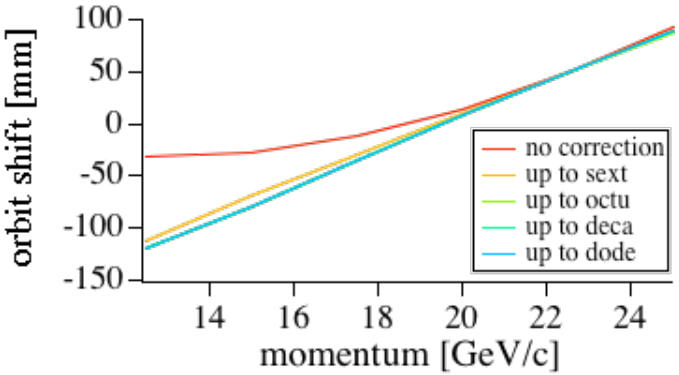
*with multipoles*

- Sextupole only gives sufficient correction.



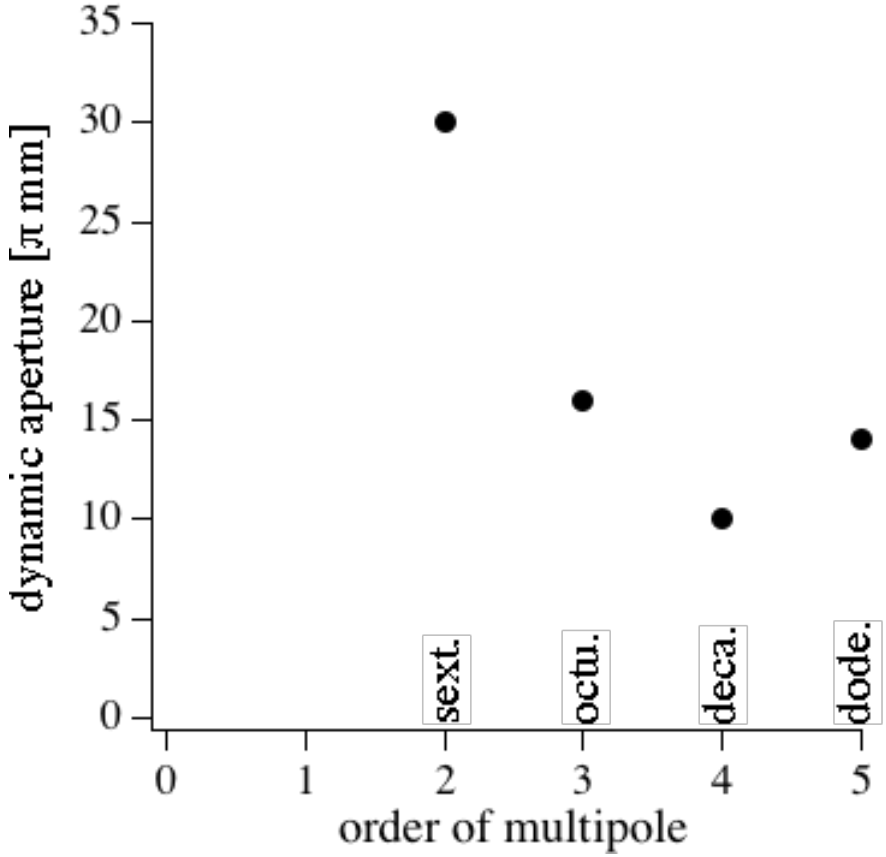



# Chromaticity correction (3)

*dynamic aperture*

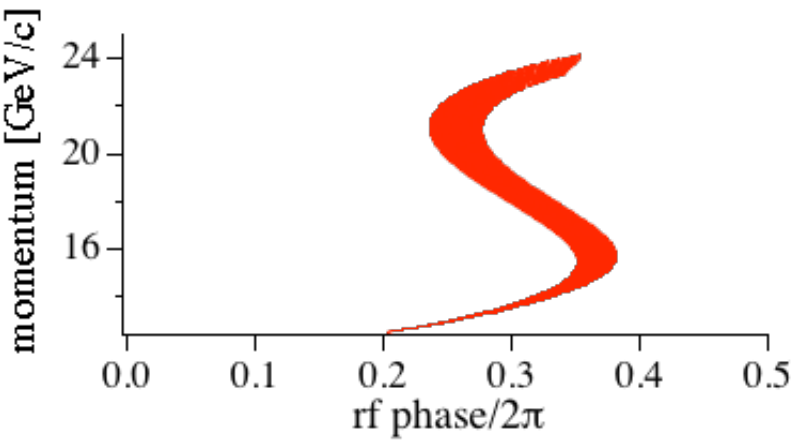
- Constant energy gain: 20 MV per cell
- Every cell has cavity: 62 cells
- Total 10 turns: 20 x 62 x 10 = 12.4 GeV



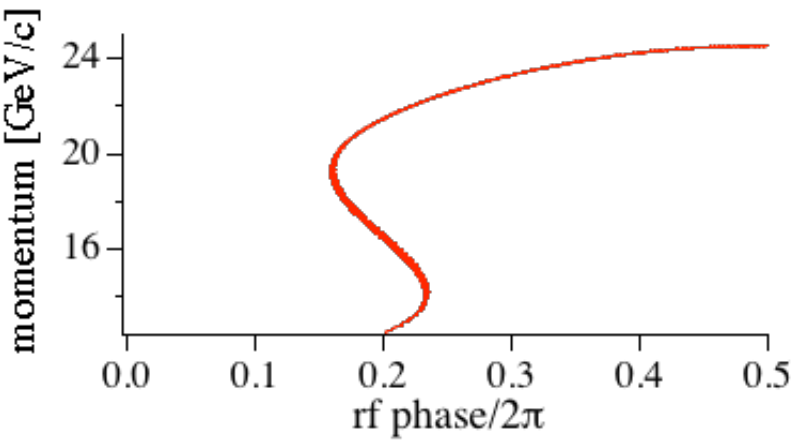
# Chromaticity correction (4)
*phase slip problem*

- With chromaticity correction (sextupole only), phase slip problem almost disappear.

without chromaticity correction




with chromaticity correction

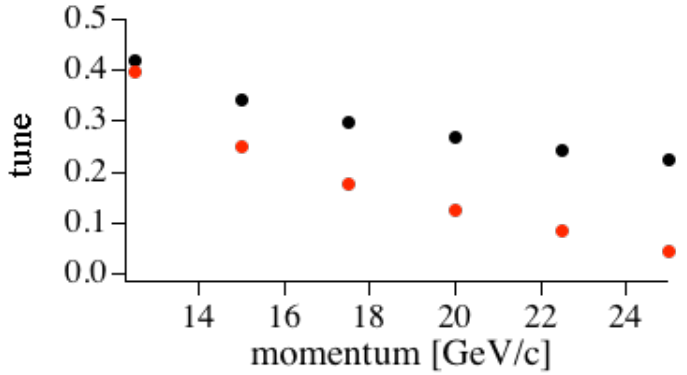


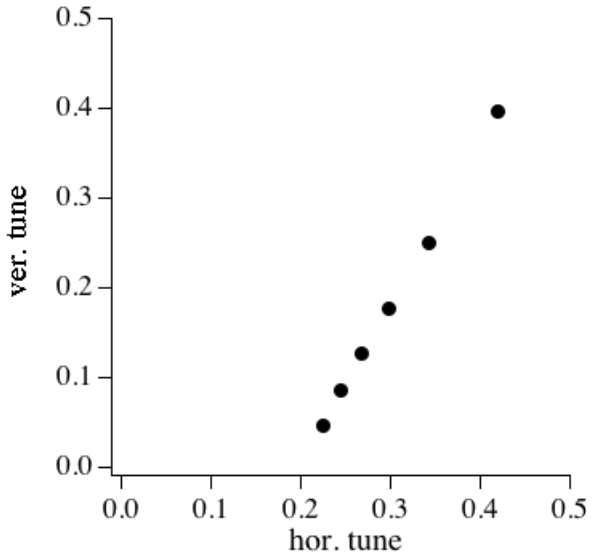

- Price we have to pay
  - Higher voltage: 35 MV/cell instead of 29 MV/cell
  - Wider aperture: 22 cm instead of 13 cm

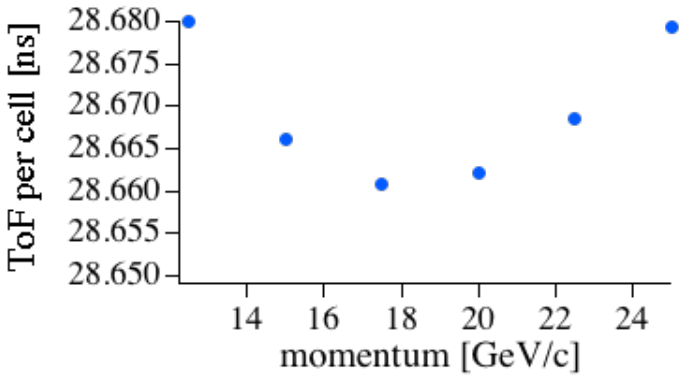
# Chromaticity correction (5)

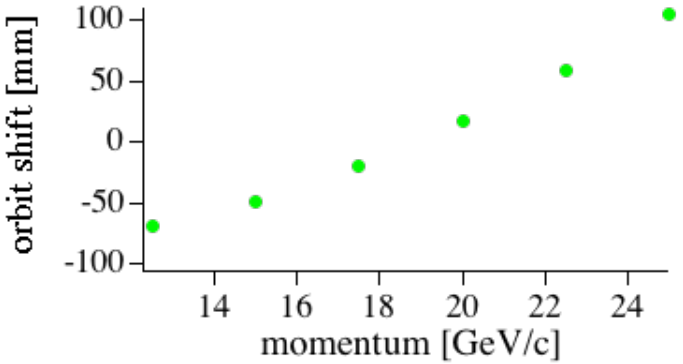
*same exercise for triplet: original behavior*

- Scott's 080812b Triplet



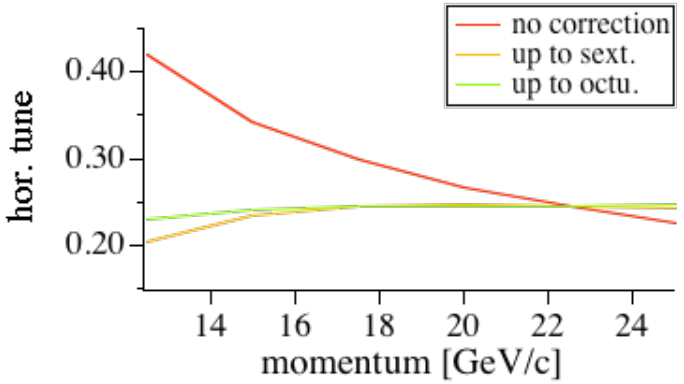



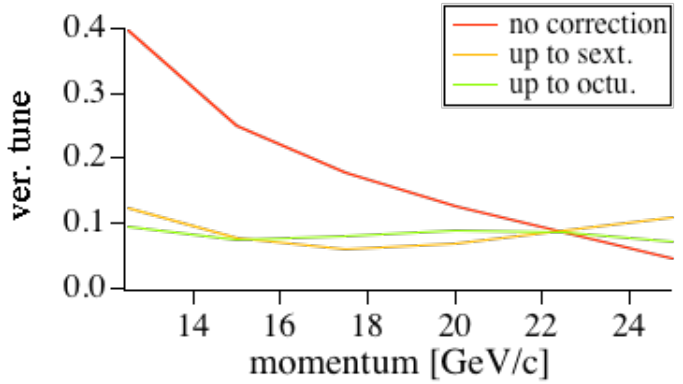



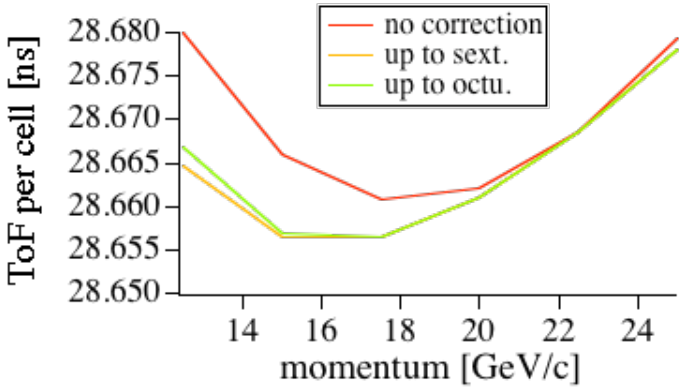



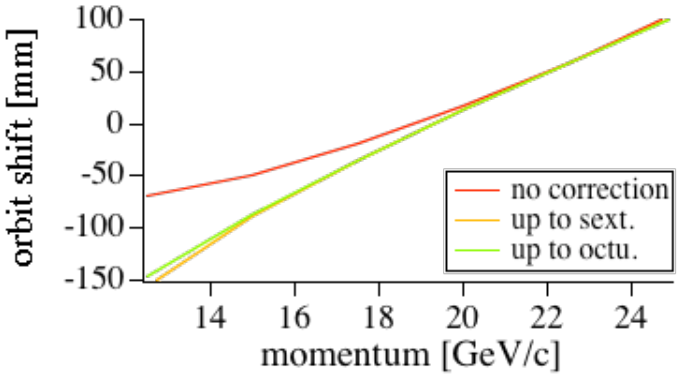
# Chromaticity correction (6)
*with multipoles*

- Sextupole only gives sufficient correction also in Triplet.



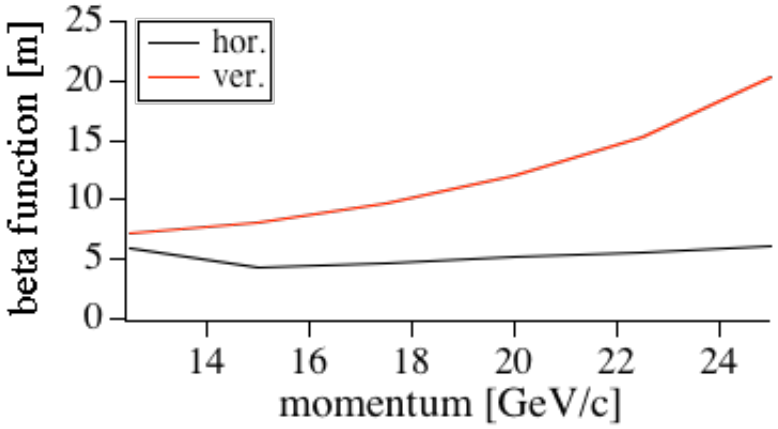



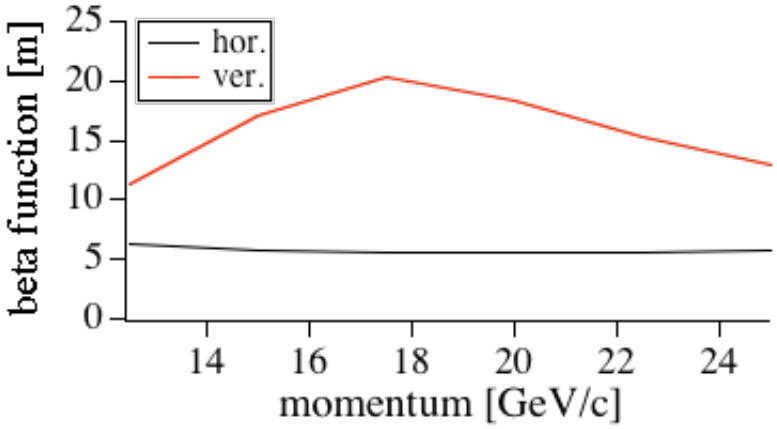
# Insertion (1)
*beta function*

- With chromaticity correction (sextupole only), vertical beta function still changes a lot.

without chromaticity correction




with chromaticity correction

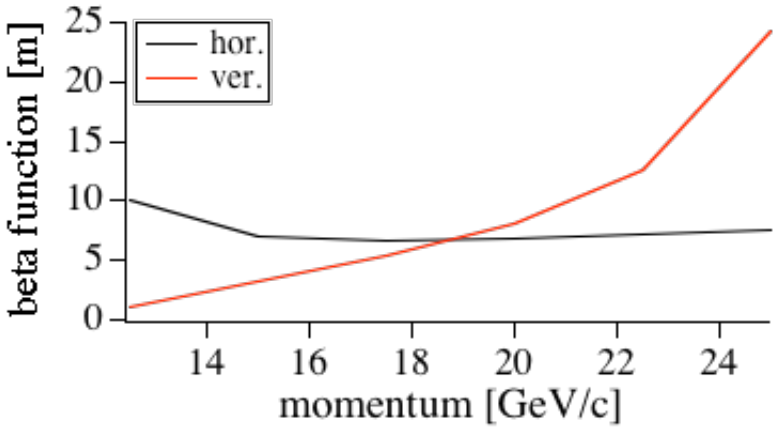


# Insertion (2)

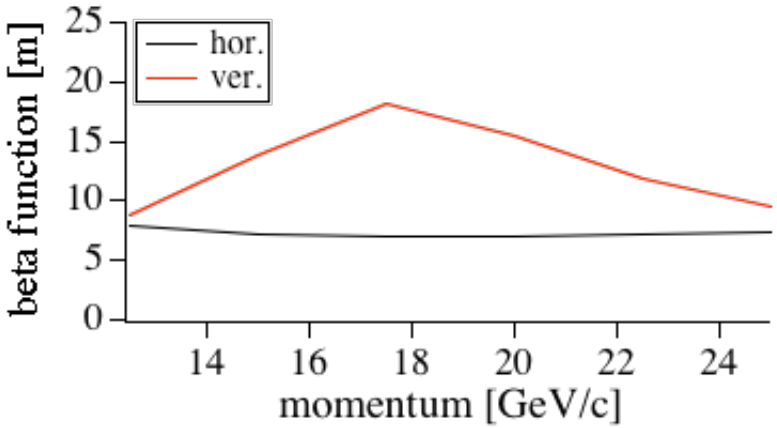
*beta function in triplet*

- With chromaticity correction (sextupole only), vertical beta function still changes a lot. Unfortunately same for triple.

without chromaticity correction




with chromaticity correction



# Summary

- Sextupole only makes tune fairly flat.
- Dynamic aperture is still large enough.
- Phase slip problem disappear with the correction.

- Until Inj/Ext scheme becomes feasible, insertion idea should be investigated.