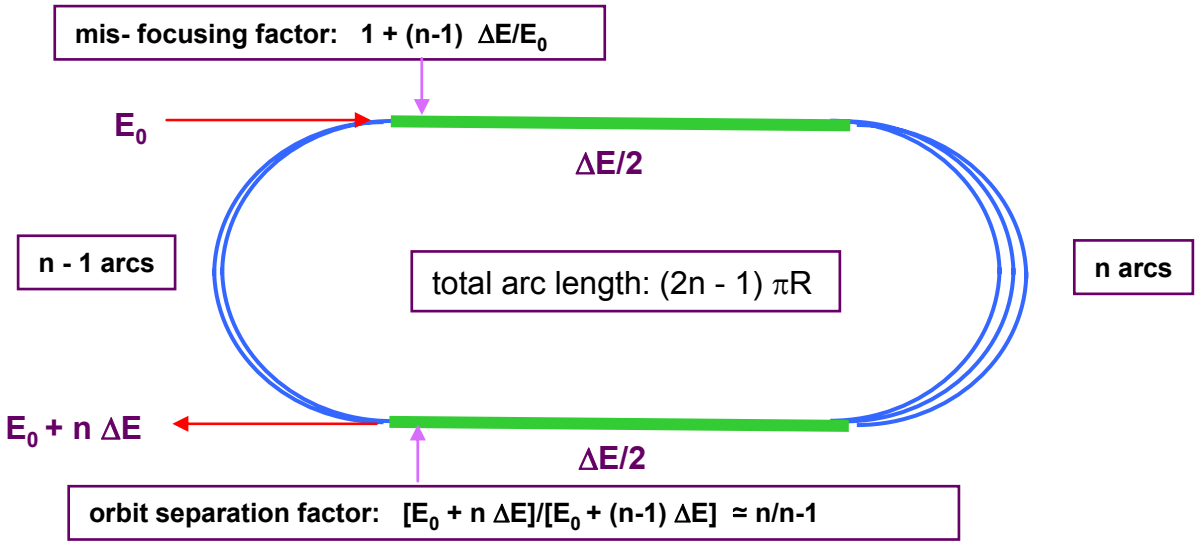
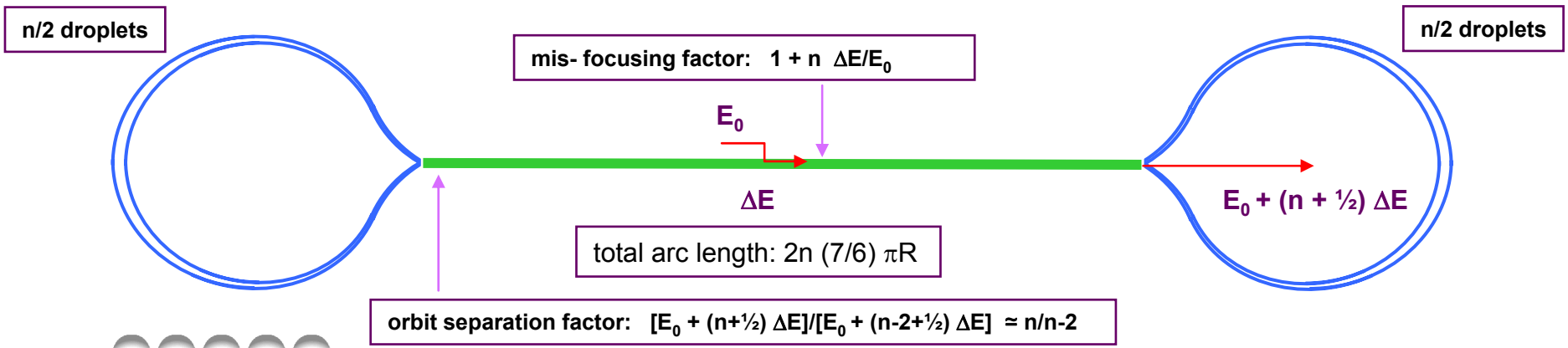
Acceleration in RLAs – Design Choices

Alex Bogacz

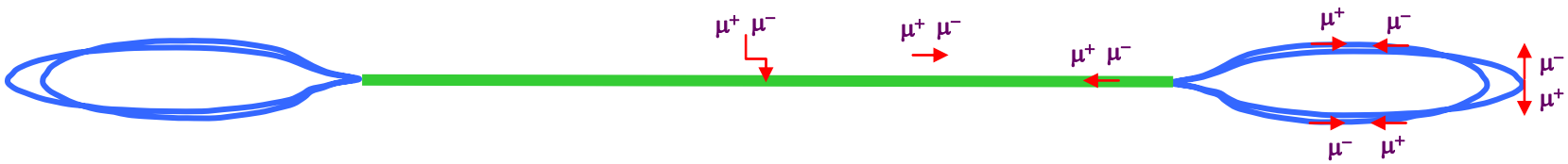
- 'Racetrack' vs 'Dogbone' configuration
  - multi-pass linacs focusing
  - orbit separation
  - simultaneous acceleration of both μ^+ μ^- species
- **10 GeV Two-step-Dogbone RLA**
- Quadrupole focusing scheme – Triplet vs FODO lattices
  - multi-pass linac
  - matching to the Arcs
  - vertical injection double-chicane

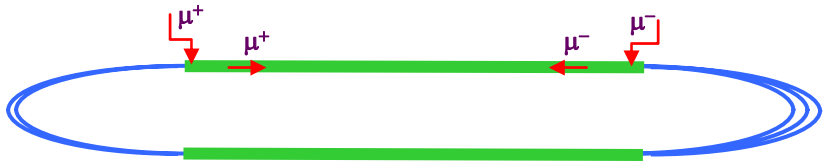
'Racetrack' vs 'Dogbone' RLA (n-pass)



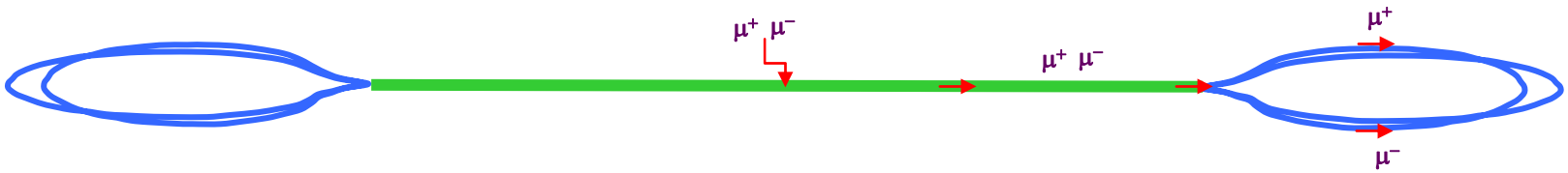


‘Racetrack’ vs ‘Dogbone’ RLA (both μ^+ and μ^- species)





‘Racetrack’ vs ‘Dogbone’ RLA (both μ^+ and μ^- species)



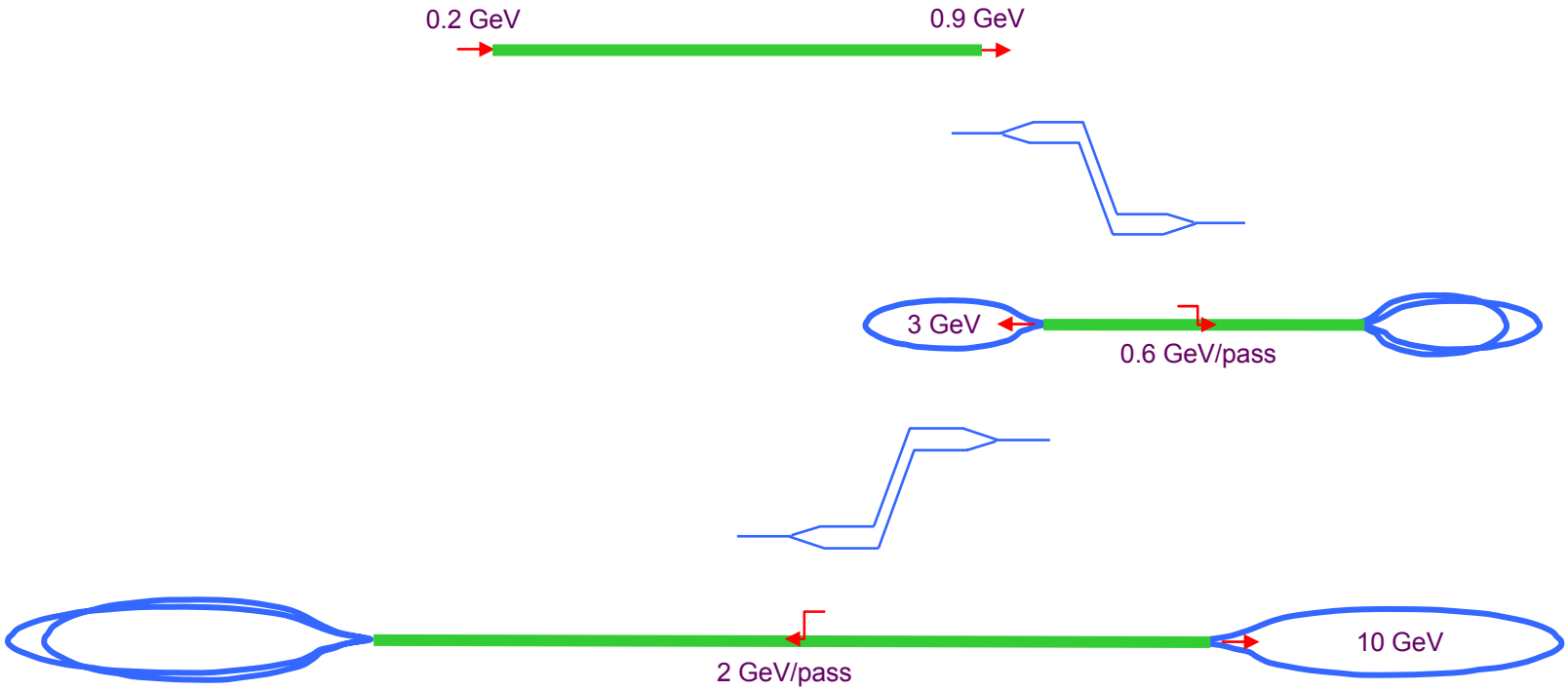
10 GeV Two-step-Dogbone RLA

0.9 GeV to 3.0 GeV

3.33… ext/inj energy ratio

3.0 GeV to 10 GeV

1.5 GeV to 5.0 GeV



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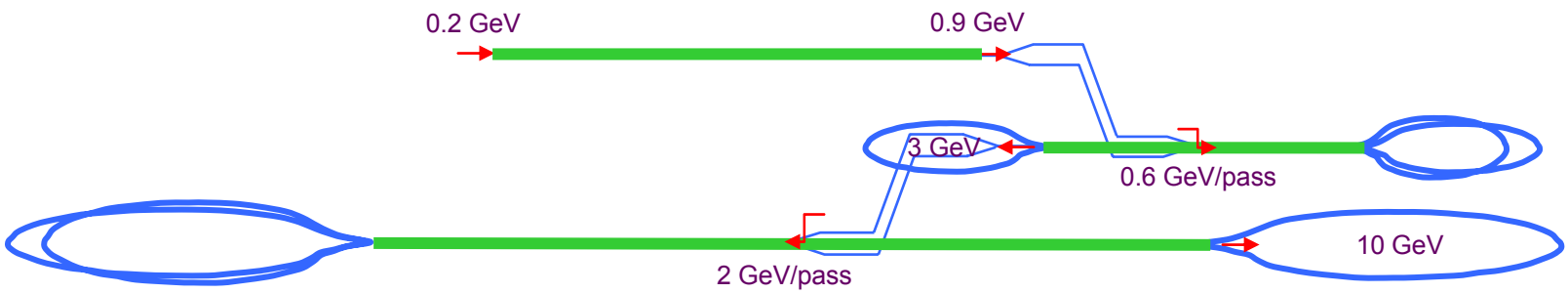
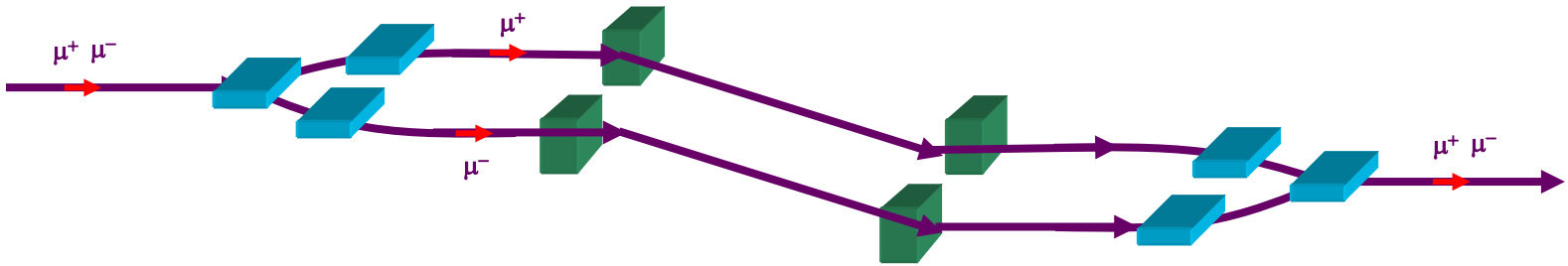
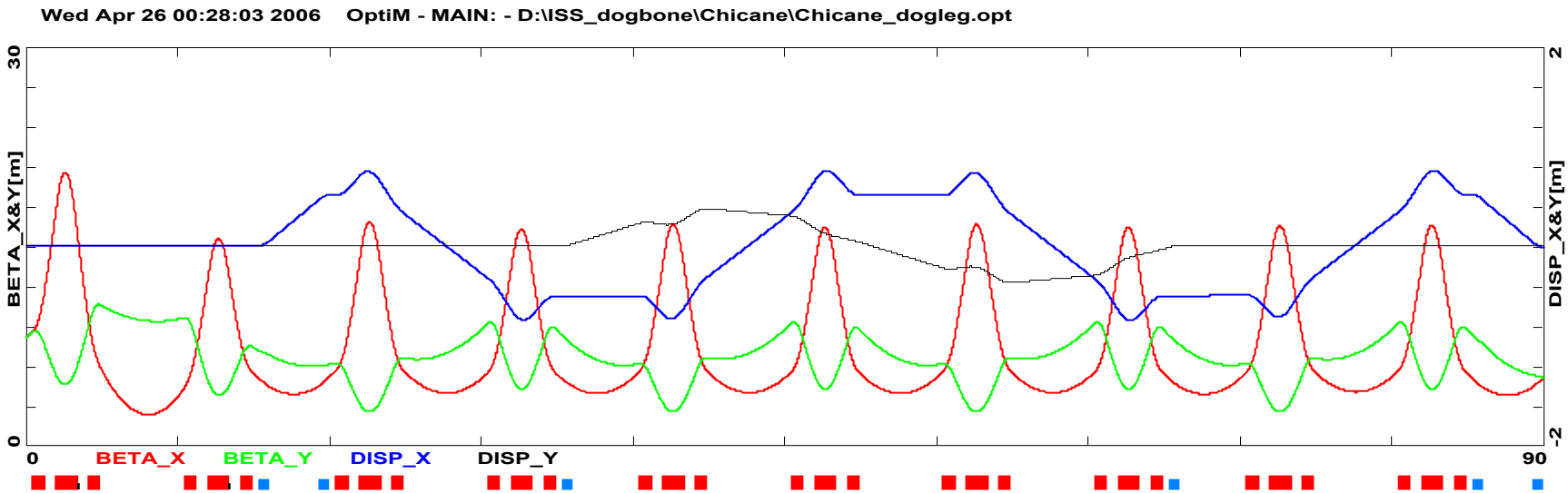


Injection double-chicane

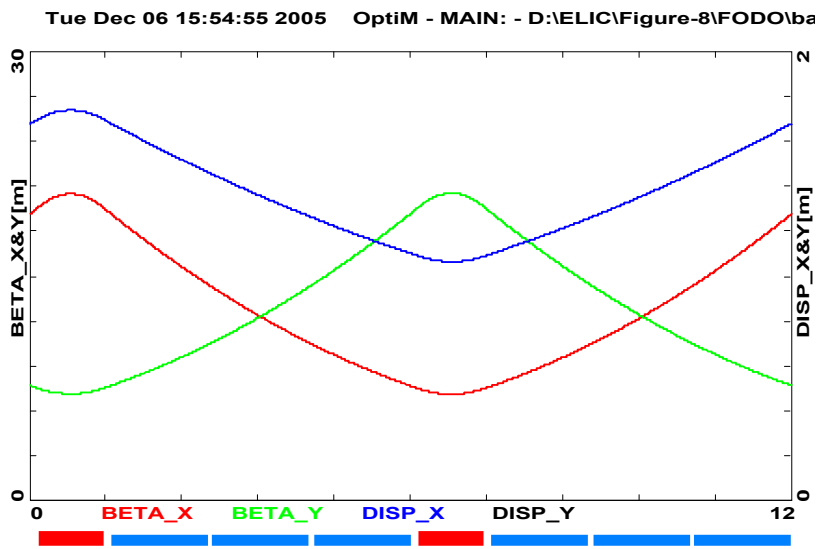




FODO vs Triplet focusing structure

- The same length
- The same phase advance per cell ($\Delta\phi_x = 90^0 = \Delta\phi_y$)

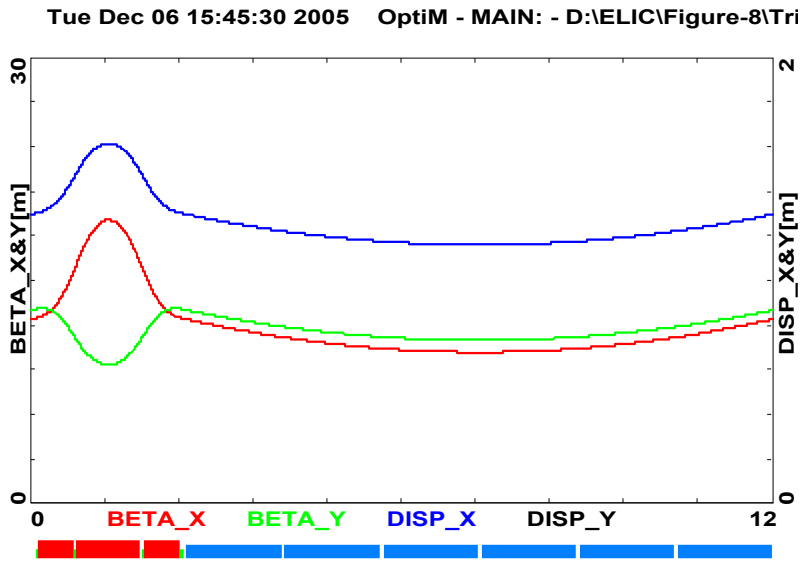
FODO



Advantages:

- much weaker quads (~3 times)
- shorter quads (total)
- easier chromaticity correction

Triplet

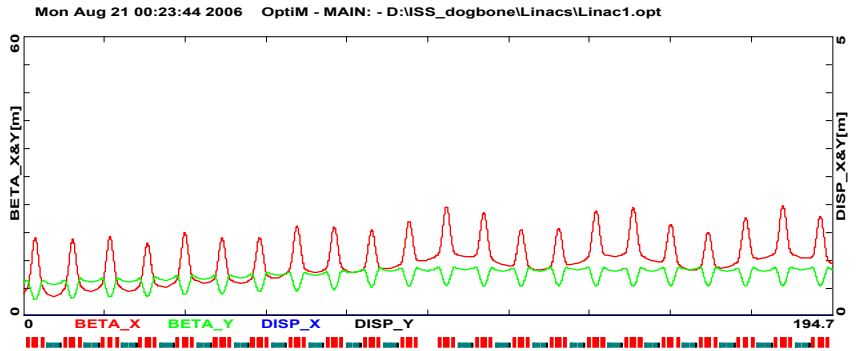


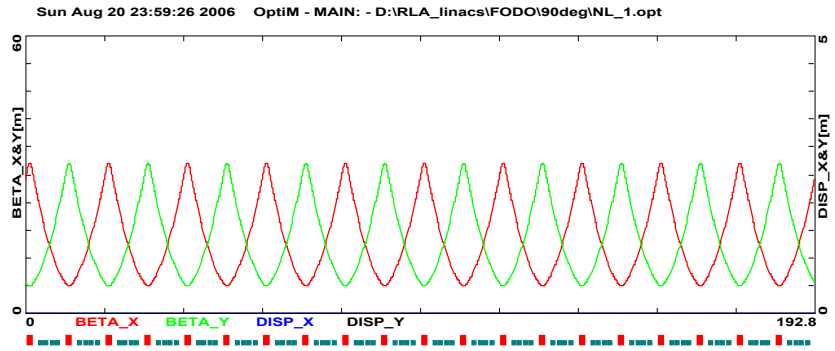
Advantages:

- longer straight sections
- smaller vertical beta-function
- uniform variation of betas and dispersion

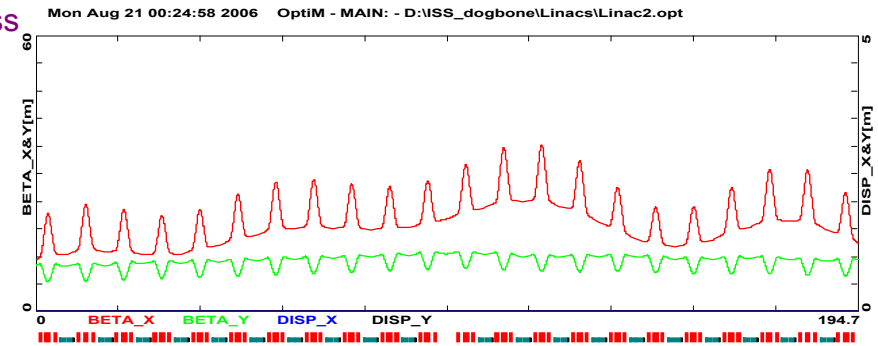
Multipass linac - Triplet vs FODO focusing (90^0 phase adv/cell)

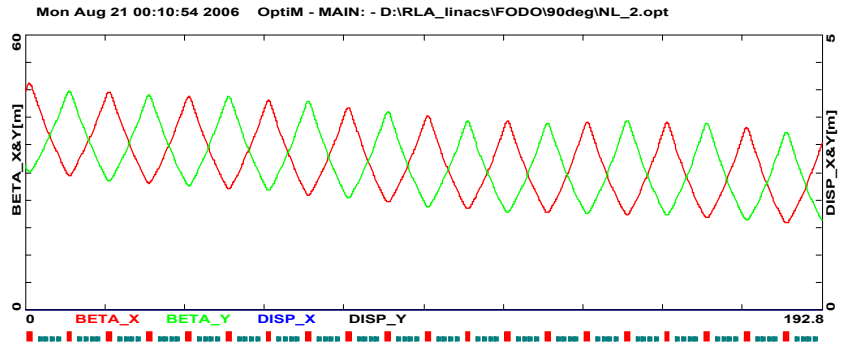
1-pass



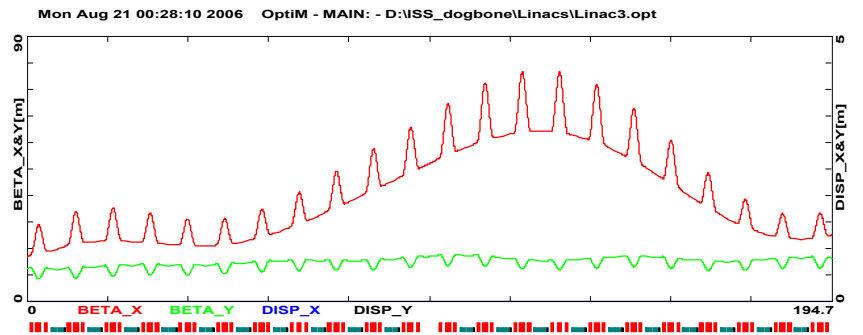


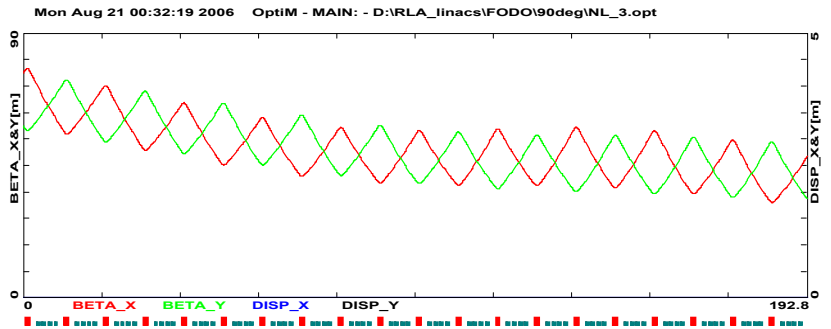
2-pass





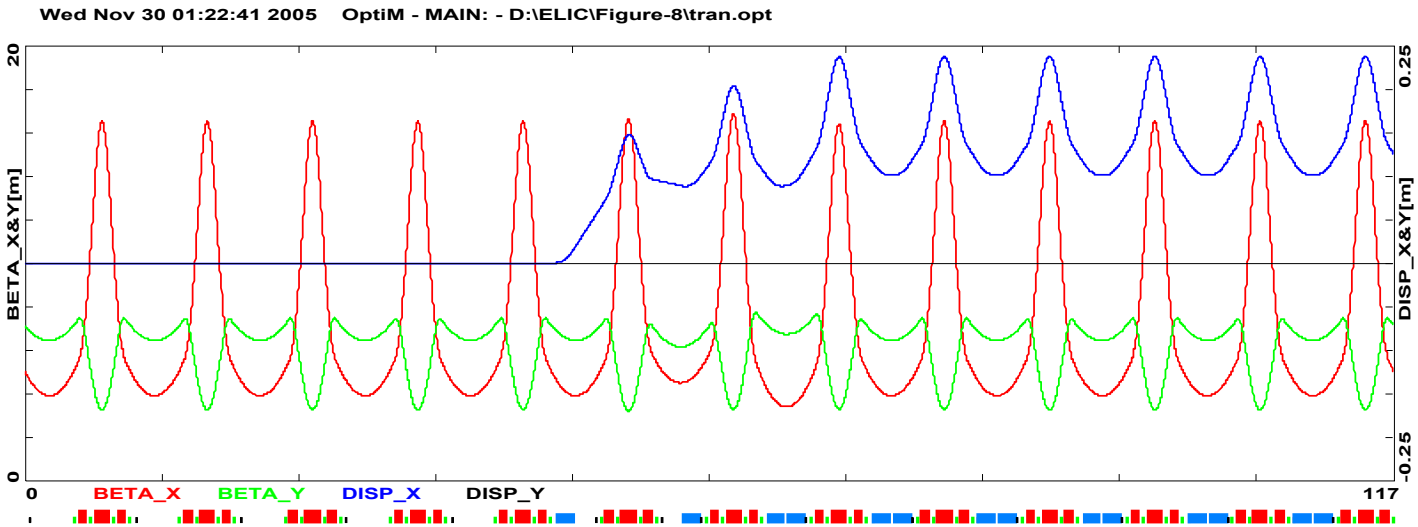
3-pass



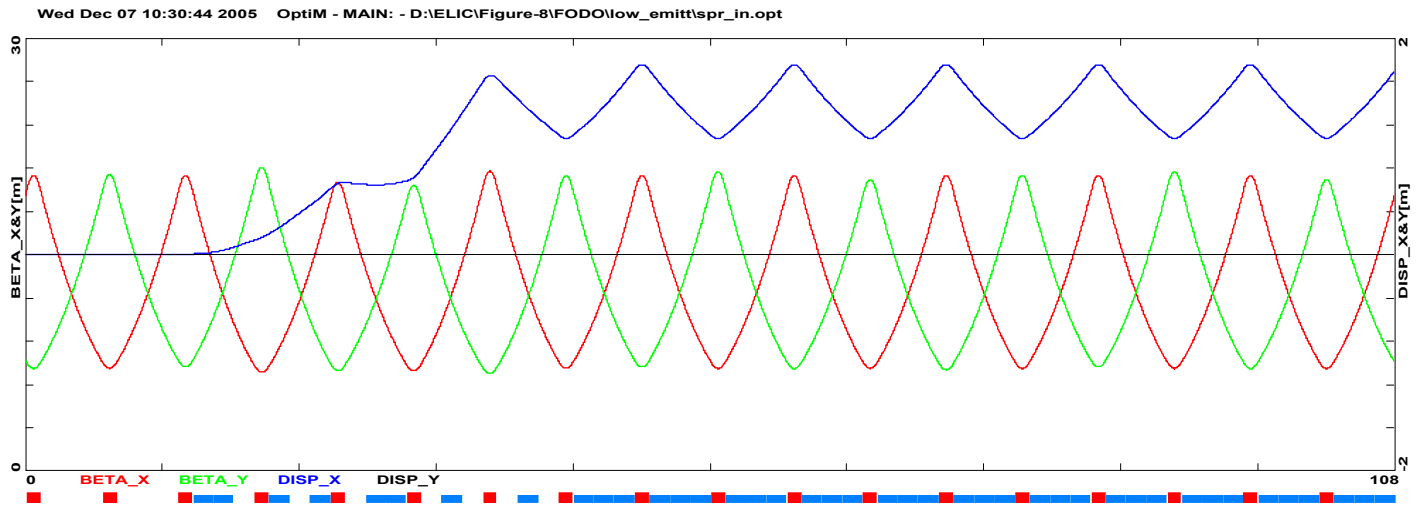


Straight-Arc – Periodic transition

Triplet



FODO



Summary

- **'Dogbone'** RLA – preferred configuration (compared to the 'Racetrack')
  - better orbir separation for higher passes
  - more efficient use of the rf (extra half-pass)
  - offers symmetric solution for simultaneous acceleration of μ^+ and μ^-
- **FODO** lattice more favorable (compared to the triplet) to accommodate large number of passes
  - uniform phase advance decrease in both planes
  - smaller variation of Twiss function – easier match to the Arcs
  - allows to maintain 90^0 phase advance per cell for lowest passes
- Proposed **10 GeV two-step-dogbone RLA** (30 mm rad acceptance)
  - 3.0-10GeV 'dogbone' with 400MHz SRF?
  - Needed: front-to-end simulation, magnet error/misalignment sensitivities etc.