# Lattices for Bunch Coalescing

Alex Bogacz

- Requirements for bunch coalescing:

Energy = 20 GeV

Total Length = 504 m

Bunch energy offset = 4 MeV $\Delta p/p = 2\times10^{-4}$

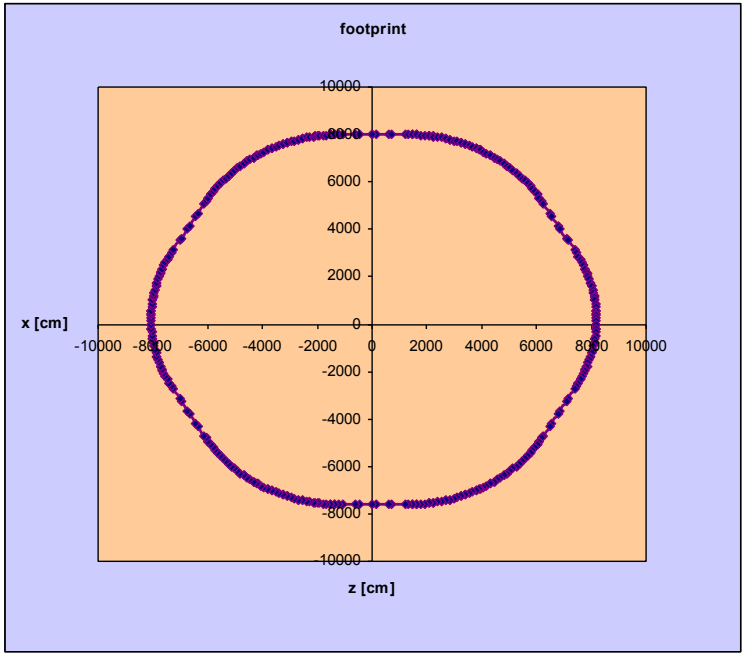
Pathlength diff. in one turn =2 mm (7 psec)

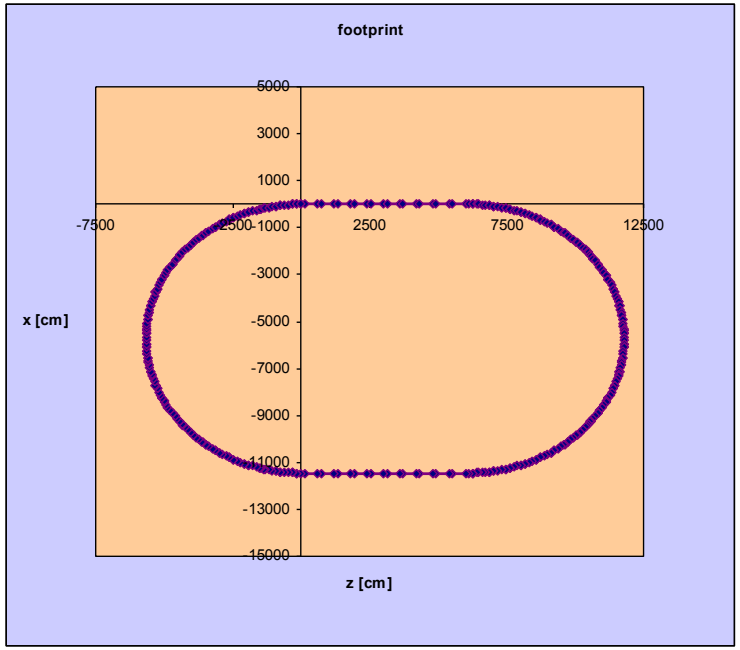
Momentum compaction $\alpha$ = 0.032 ($M_{56}$ = -16 m)

$\gamma_t$ = 5.6 ($\gamma_t = \alpha^{-1/2}$)

- May be implemented in two configurations:
  - 'Ring' (distributed rf – useful for 'slip' stacking)
  - 'Racetrack' (rf in two long straights - beneficial for bunch rotation)

# Coalescing Ring or Racetrack at 20 GeV – Layout




## Arc dipoles

$Lb=150; => 150 cm

$Ndip=(6*5)*6; => 180

$ang=360/$Ndip; => 2 deg

$E=20000; => 20000 MeV

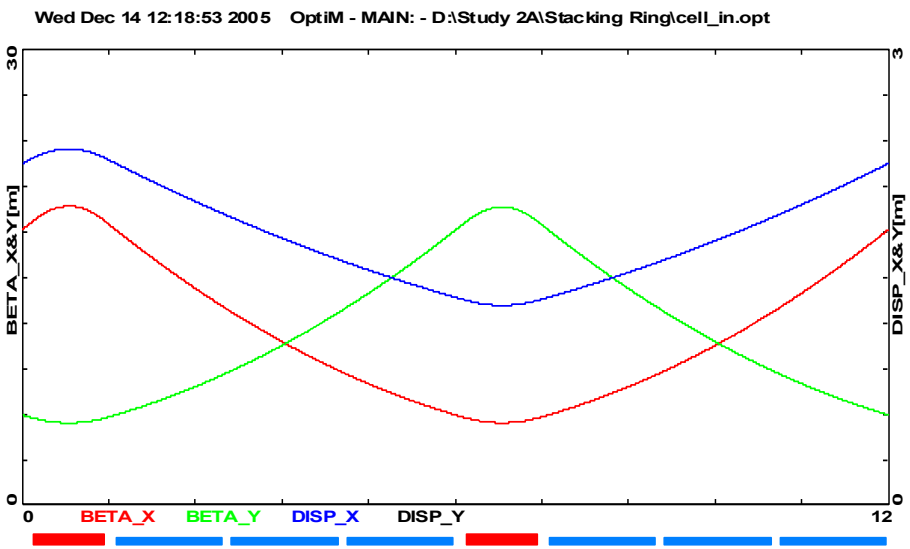
$B=$PI*$Hr*$ang/(180*$Lb); => 15.6 kGauss

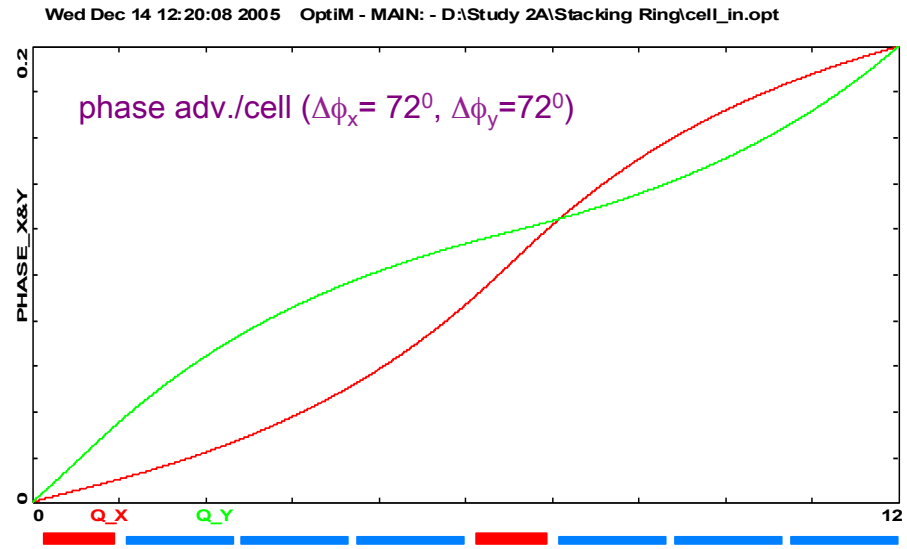
$Rdip=$Lb/($PI*$ang/180); => 43 m

$Lring=504 m

# Periodic FODO cell – 72 deg. phase advance

'inward cell' at 20 GeV

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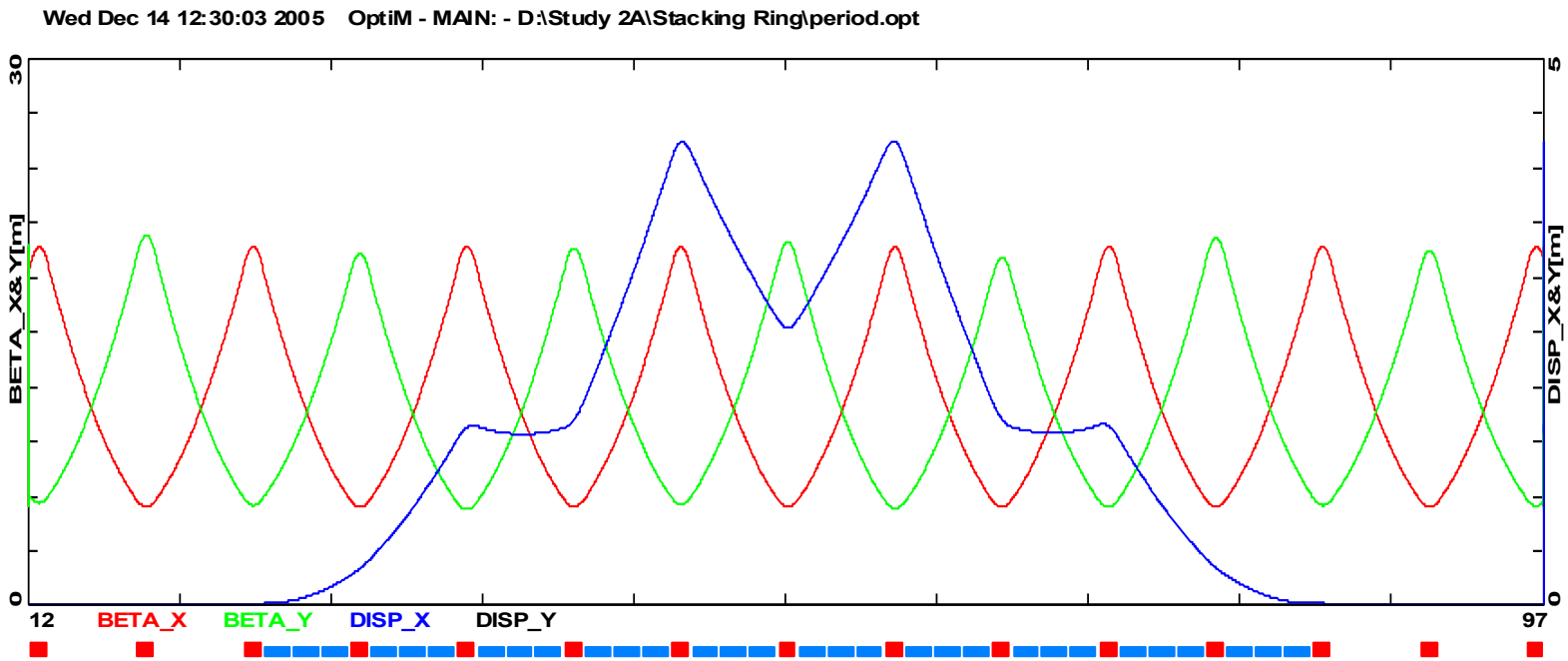
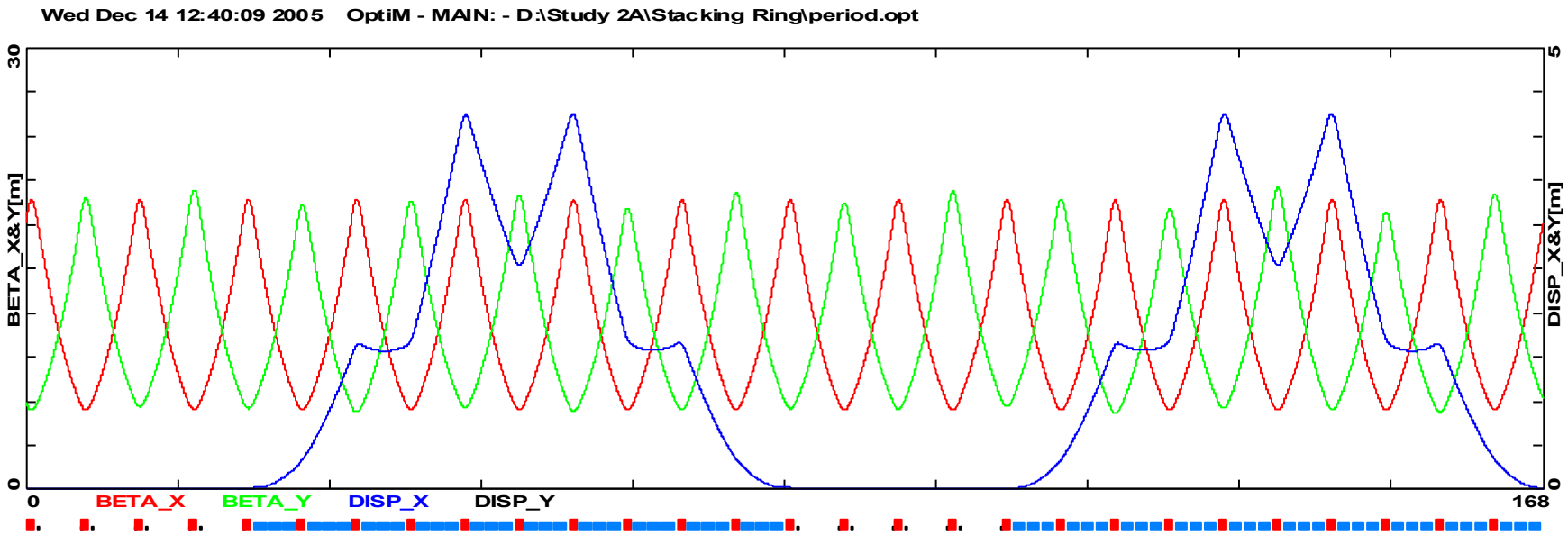
quadrupoles:

| L[cm] | G[kG/cm] |
|---|---|
| 100 | 1.388 |
| 100 | -1.375 |

# Quasi-periodic Arc – Dispersion pattern



# Momentum compaction




Dispersion free straight

Quasi-periodic dispersion in the Arc

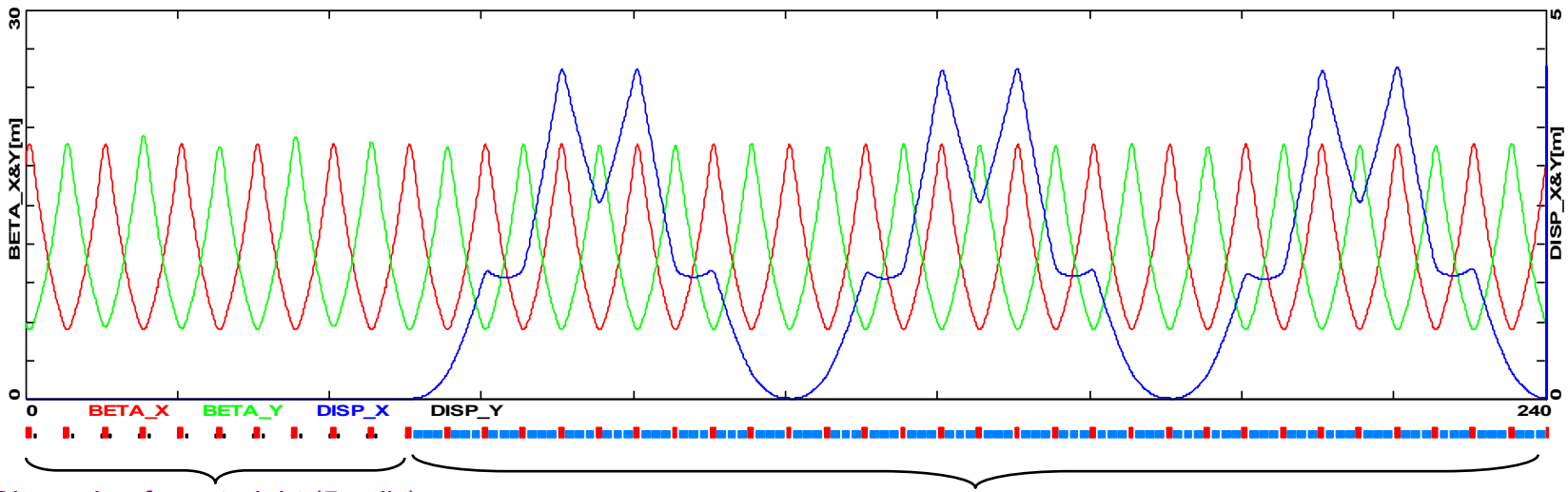
$$M_{56} = -\int \frac{D_x}{\rho}\, ds = -D_x^{dip} \int d\left(\frac{s}{\rho}\right) = -D_x^{dip} \int d\theta_{rad} = -D_x^{dip} \times \theta_{rad}^{tot}$$

$$M_{56} = -2\pi \times 2.6\ m = -16.3\ m$$

# Racetrack - Lattice

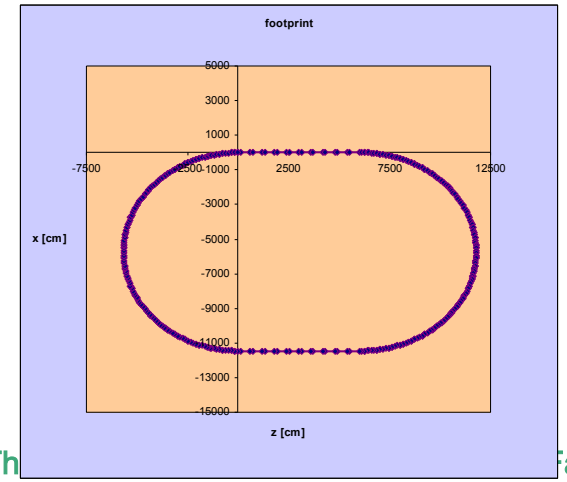
$$M_{56} = -2\pi \times 2.6\ m = -16.3\ m$$

2 x



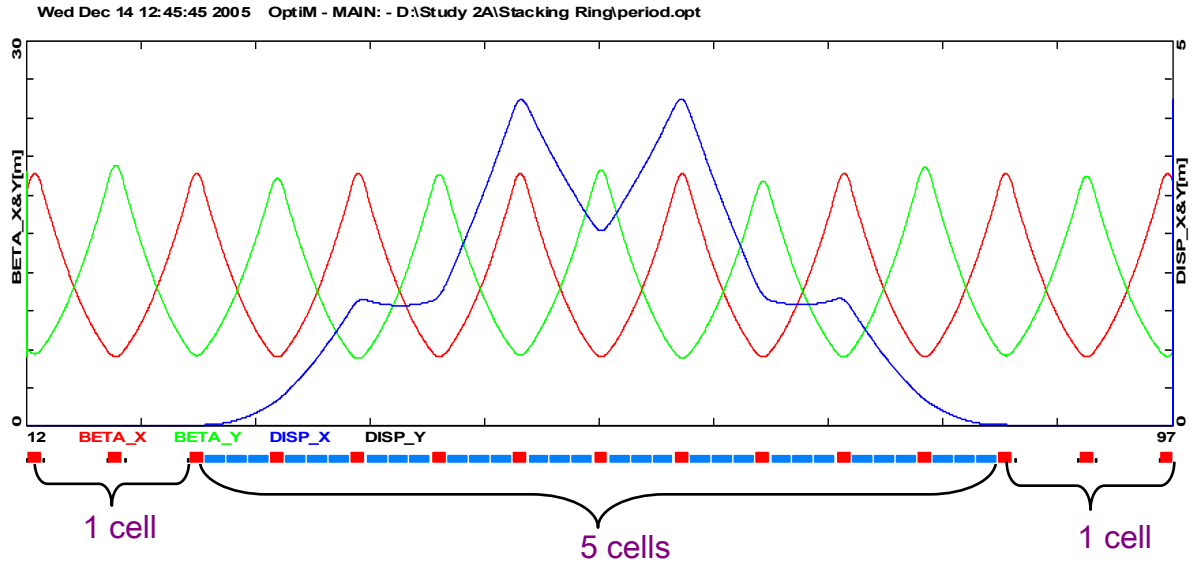

Dispersion free straight (5 cells)

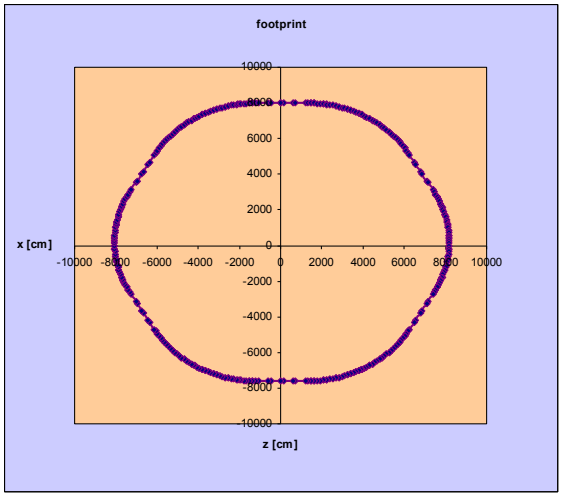
Quasi-periodic Arc (3×5 cells)



# Ring - Lattice

6 x




Energy = 20 GeV

Total Length = 504 m

Tunes: Qx = 8.392 Qy = 8.348

Chromaticity: nuxp = -9.137 nuyp = -9.271

Momentum compaction = 0.032 M56 = -16 m

gamma_t = 5.6

# Summary

- FODO based lattice (72deg/cell) for bunch Coalescing Ring - Linear Optics
  - Uniform focusing periodicity
  - Minimized betas
  - Maximized $M_{56}$
  - Ring/Racetrack configurations
  - Optimized lattice parameters