Decay Ring Options for VLENF

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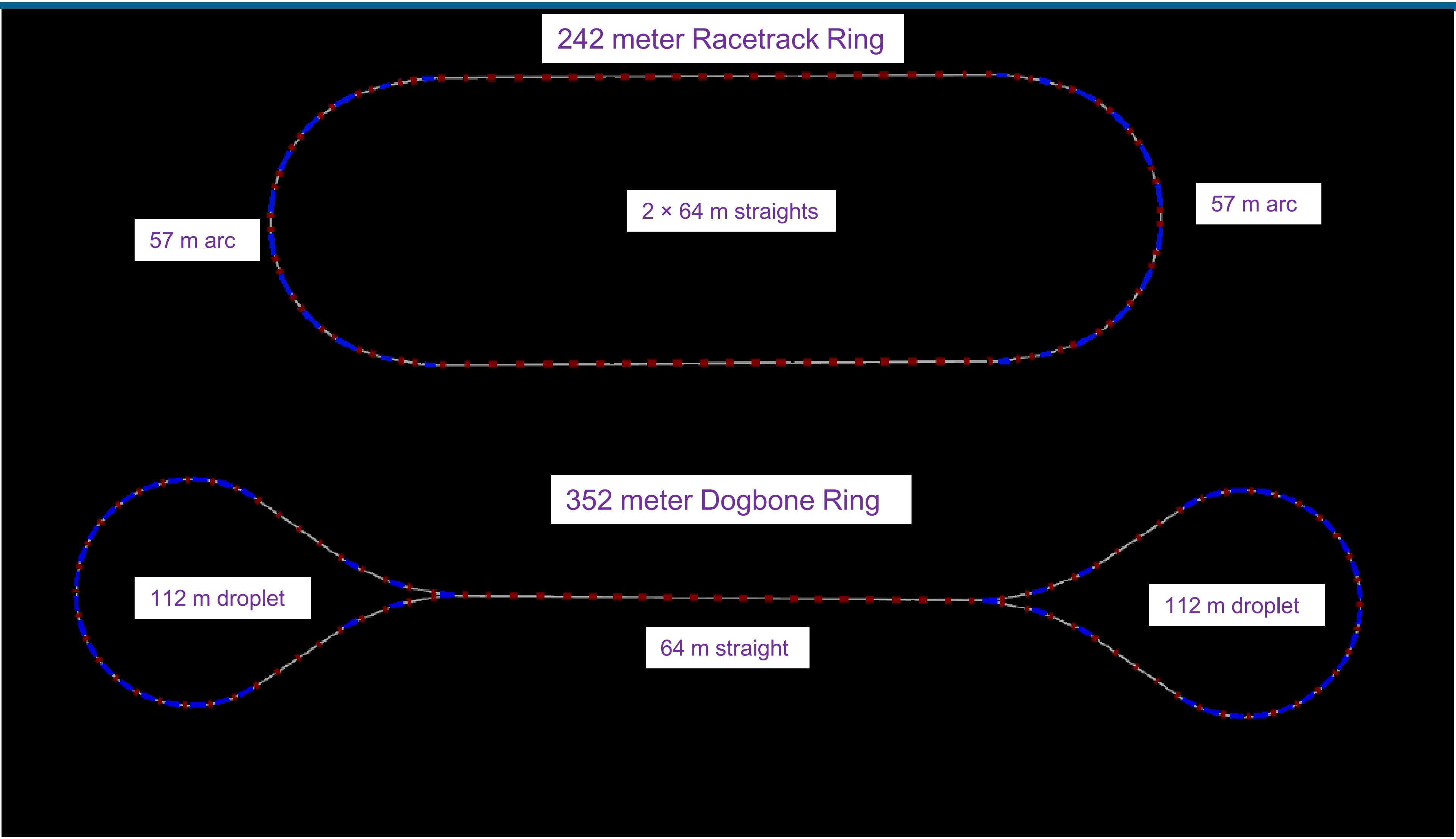
Overview

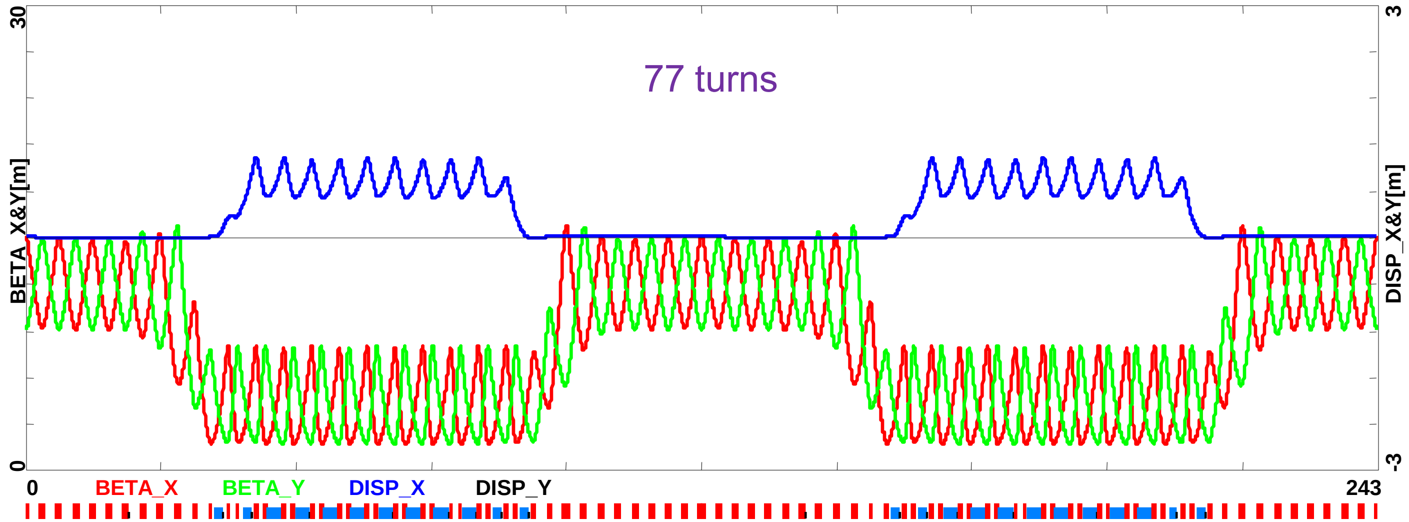
- Conventional Decay Ring (3 GeV)
  - Dipoles 1.2 Tesla
  - Quads
- Racetrack vs Dogbone Ring
- Acceptance studies (OptiM and MAD-X tracking)
- Combined function magnet Ring
- Solenoid Ring
  - Axially symmetric focusing - Solenoids
  - Dipole bends
- Acceptance studies (OptiM tracking)

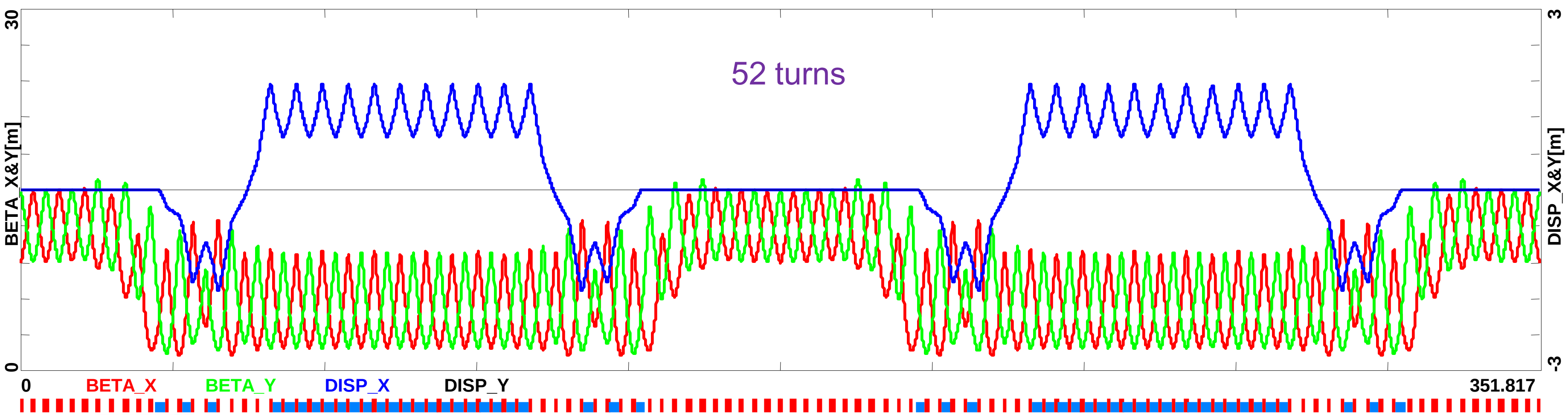
Racetrack vs Dogbone Decay Ring



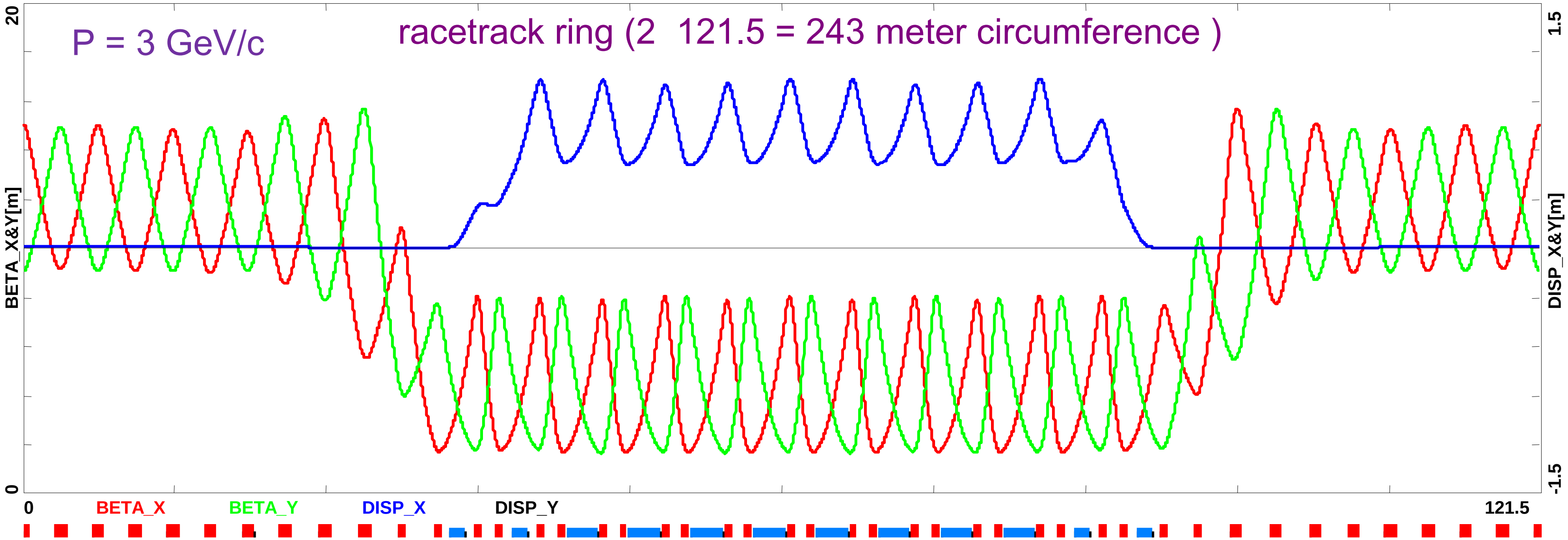
Racetrack vs Dogbone Ring - Optics

Muon decay at 3 GeV (e-folding)





Ring Optics (90^0 doublets + 30^0 FODO)



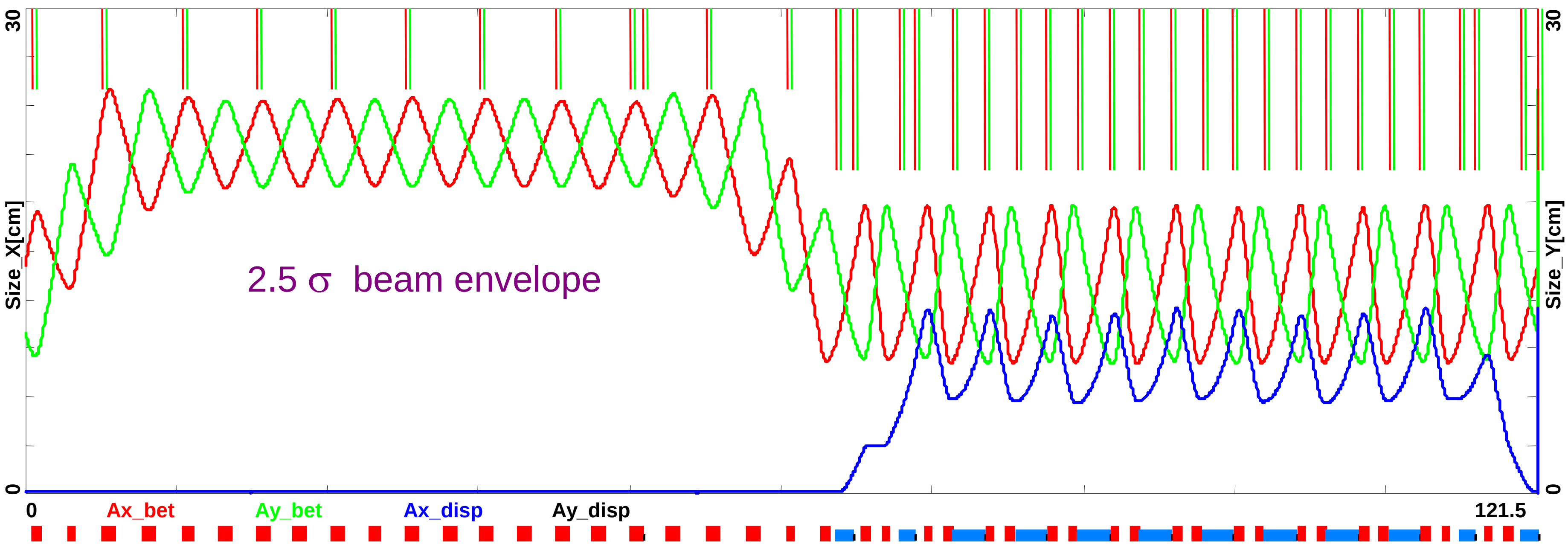
qFL	L[cm]=100	G[kG/cm]=0.2
qDL	L[cm]=100	G[kG/cm]=-0.2

bend	L[cm]=250	B[kG]=12.575
qF	L[cm]=60	G[kG/cm]=1.12
qD	L[cm]=60	G[kG/cm]=-1.09

qFL	L[cm]=100	G[kG/cm]=0.2
qDL	L[cm]=100	G[kG/cm]=-0.2

Ring (half) – Beam Envelope

P = 3 GeV/c



aperture radius L[cm]=25

aperture radius L[cm]=20

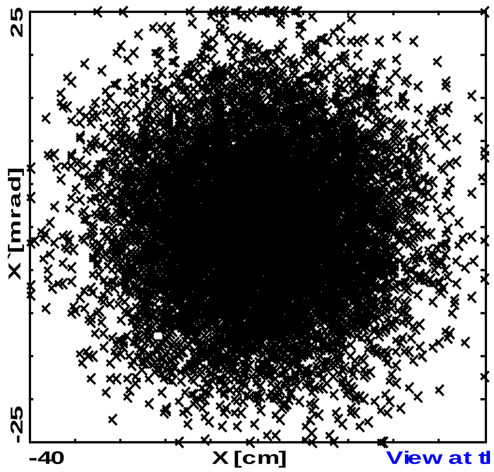
$\varepsilon_N = 30$ mm rad

$\sqrt{\beta\varepsilon}$

$\sigma_{\Delta p/p} = 0.05$

$D_x \sigma_{\Delta p/p}$

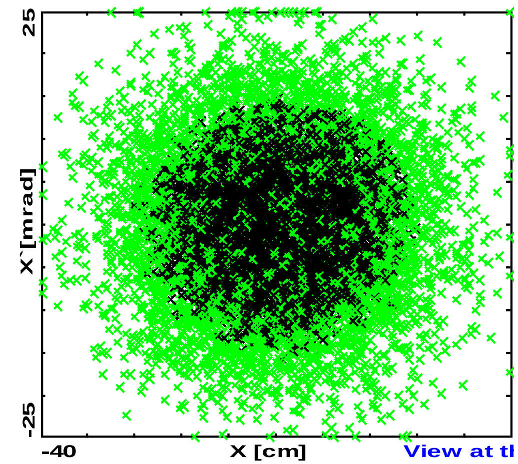
initial 1.000000



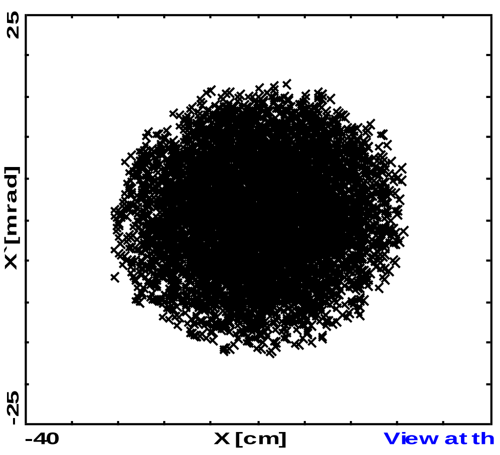
$MuDecay=2.2e-6; => 2.2e-06
$C=12150*2; => 24300
$NTurn=$gamma*$MuDecay*$beta*$c/$C; => 77

ε_N = 30 mm rad $\qquad \sqrt{\beta\varepsilon}$

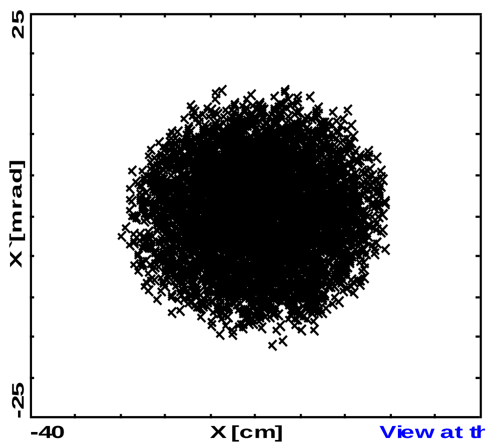
$\sigma_{\Delta p/p}$ = 0.05 $\qquad D_x \sigma_{\Delta p/p}$



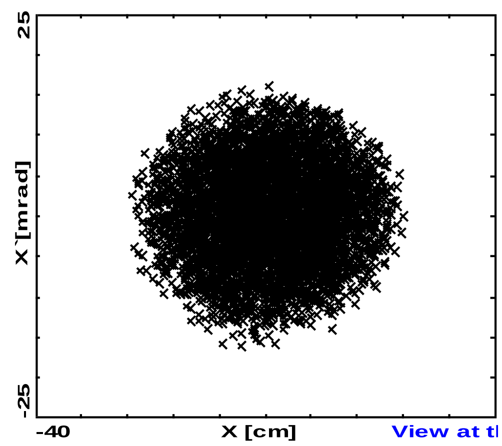
turn 1 0.720300



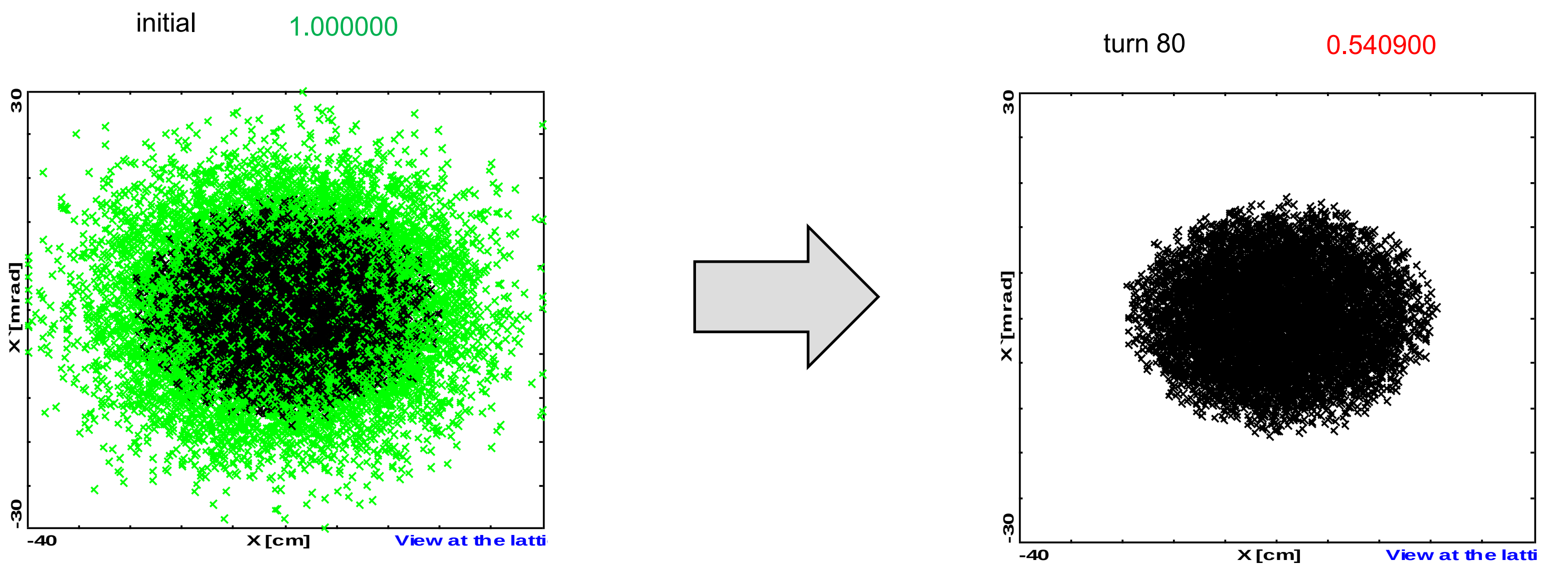
turn 30 0.569300



turn 80 0.540900



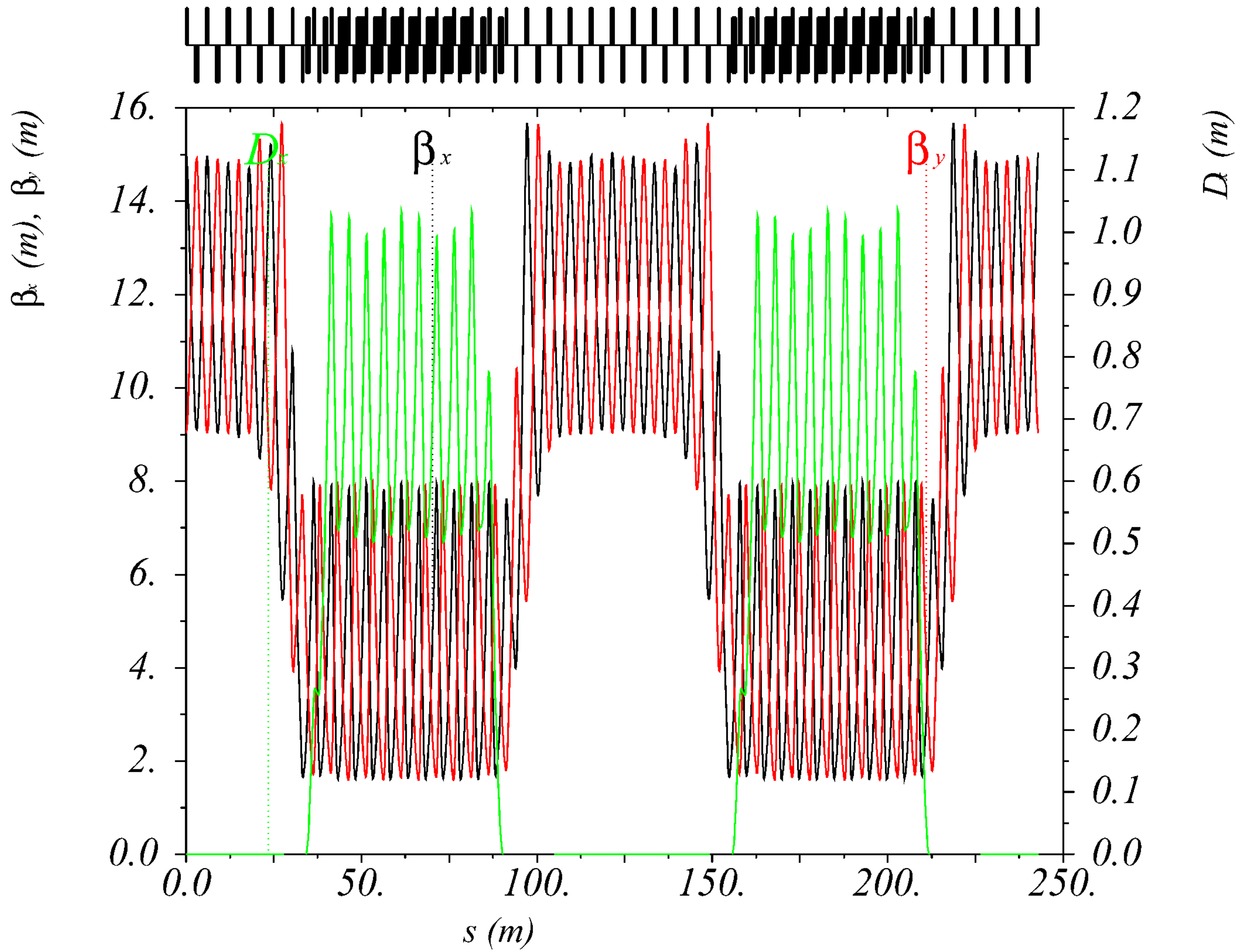
Transverse Acceptance – 80 turns



ε_N = 30 mm rad $\sqrt{\beta\varepsilon}$

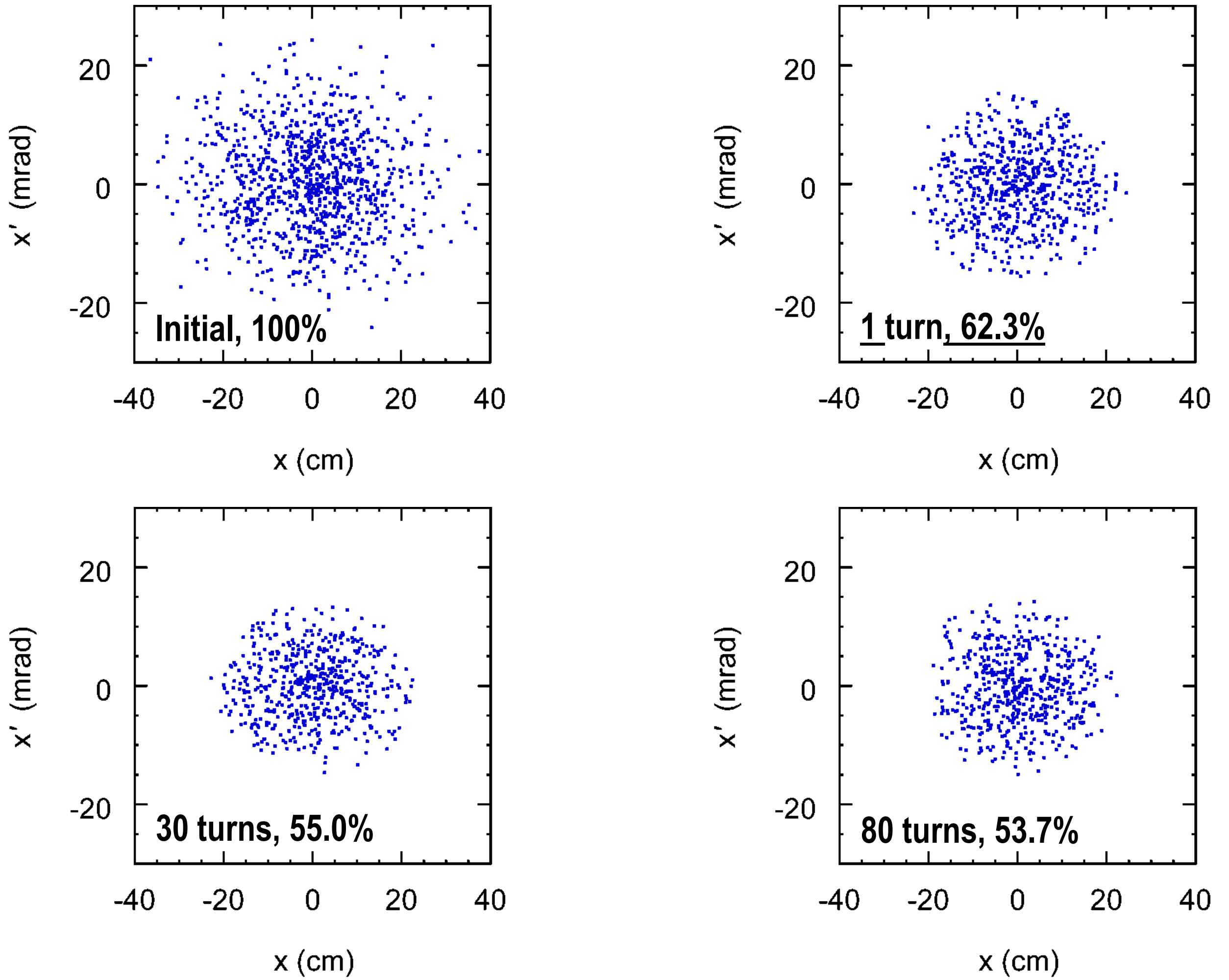
$\sigma_{\Delta p/p}$ = 0.05 $D_x \sigma_{\Delta p/p}$

Racetrack Lattice in MAD-X



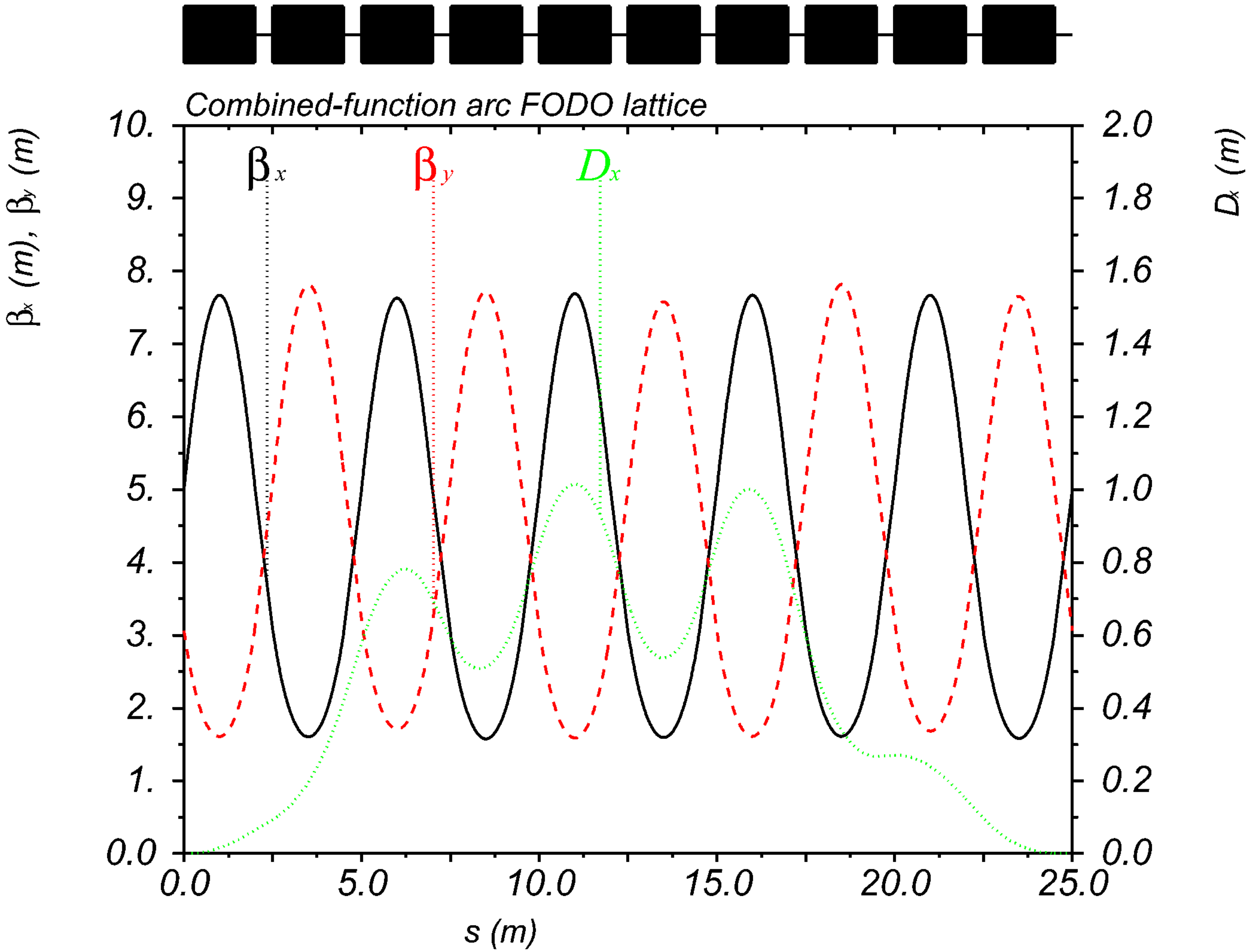
Tracking in MAD-X

- **1000 particles, ε_{xN} = 30 mm·rad, ε_{yN} = 30 mm·rad, $\sigma_{\Delta p/p}$ = 0.05, same collimation as Alex**
- **Limitations due to physical apertures $\Rightarrow$ Stronger focusing needed to improve acceptance**



Combined-Function FODO Lattice

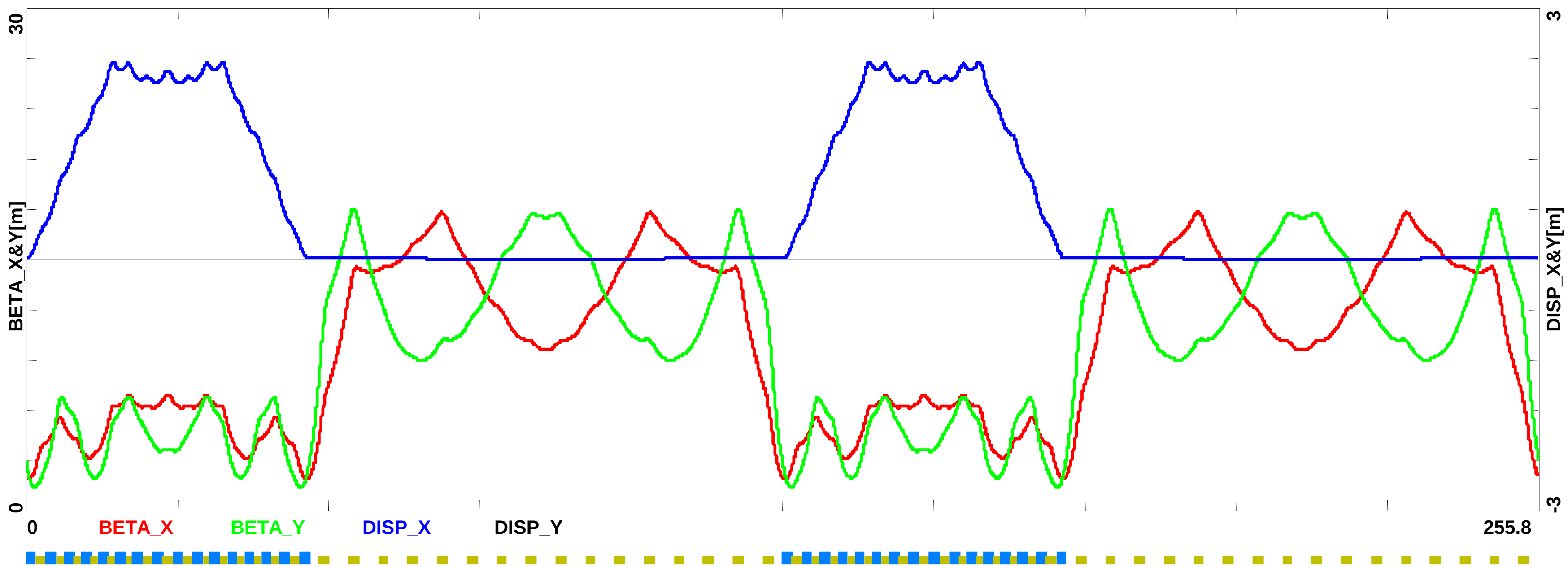
- **Focusing strength is the same as of the same-length separate-function lattice**



Solenoid Ring

P = 3 GeV/c

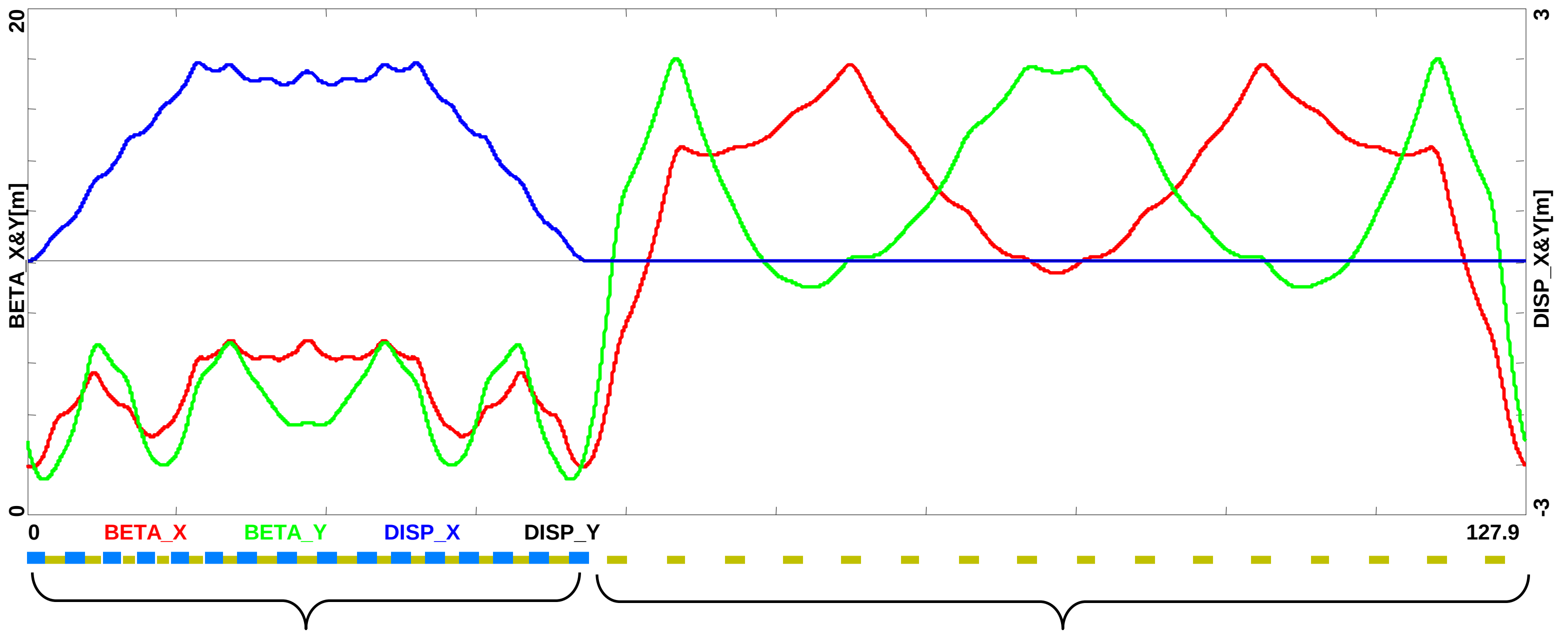
racetrack ring (256 meter circumference)



Solenoid Ring (Half)

P = 3 GeV/c

racetrack ring (256 meter circumference)



16 × bends + 15 × solenoids

16 × solenoids

bend L[cm]=150 B[kG]=12.

solenoid L[cm]=100 B[kG]=22-78 r[cm]=30

solenoid L[cm]=100 B[kG]=47-103 r[cm]=25

Dynamic Aperture – 70 turns

```
$MuDecay=2.2e-6;  =>     2.2e-06
$C=25600;  =>       25600
$NTurn=$gamma*$MuDecay*$beta*$c/$C;  =>  73.
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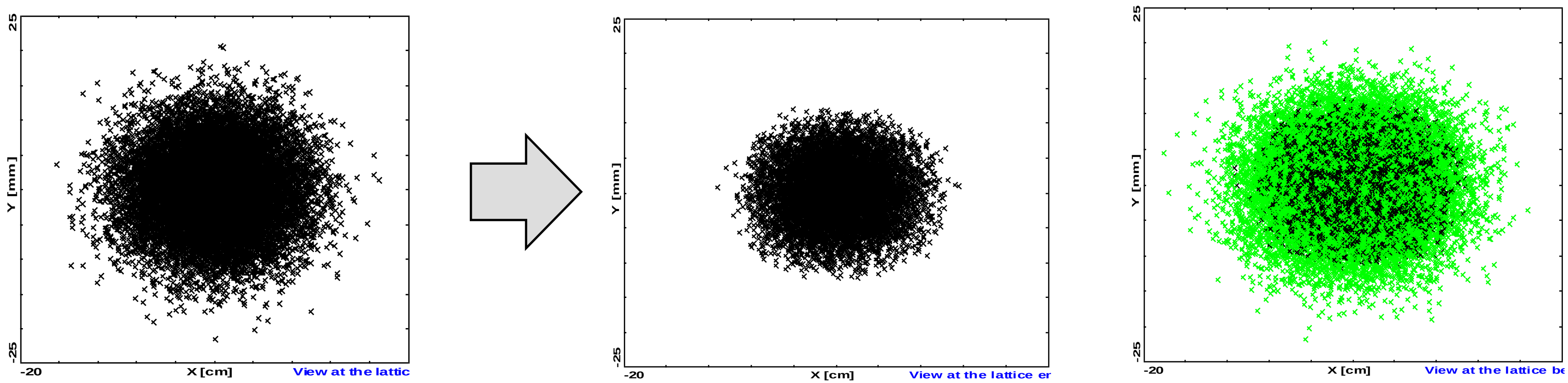
ε_N = 30 mm rad $\sqrt{\beta\varepsilon}$

$\sigma_{\Delta p/p}$ = 0.05 $D_x\sigma_{\Delta p/p}$

initial 1.000000

turn 73 0.499000



Summary – Conventional Ring

- Decay Ring (3 GeV Racetrack of 243 meter circumference)
  - 7 m betas, 90 cm hor. dispersion in the Arcs
  - 15 m betas in the Straight
- Acceptance - Dynamic Aperture Study
  - transverse: ε_N = 30 mm rad
  - momentum: $\sigma_{\Delta p/p}$ = 0.05
  - Physical aperture: r = 20 cm (Arc) and r = 25 cm (Straight)
  - 46% dynamic lost after 80 turns
- Compact Ring Optics – Linear lattice
  - Dipole bends (2.5 m long, 12.6 kGauss) × 20
  - Doublet focusing - Quads (0.6 m long, 1.1 kGaus/cm) × 44
  - FODO focusing - Quads (1 m long, 0.2 kGaus/cm) × 38

Summary – Solenoid Ring

- Decay Ring (3 GeV Racetrack of 256 meter circumference)
  - ~250 cm hor. dispersion in the Arcs
  - ~8 m Beta functions Arc
  - ~15 m Beta functions straight
- Acceptance:
  - transverse: $\varepsilon_N = 30$ mm rad
  - momentum: $\sigma_{\Delta p/p} = 0.05$
  - Physical acceptance: r = 25/30 cm
- Compact Ring Optics – Linear lattice
  - Axially symmetric focusing - Solenoids (4-10 Tesla)
  - Dipole bends (1.2 Tesla)