Prototype Lattice for PIC/REMEX Channels

Alex Bogacz

Lattice Requirements/Implementation

- Lattice requirements:
  - Integer/Half-integer betatron phase advance per cell
  - One dispersion period per cell

Momentum = 300 MeV/c

Dispersion at the absorber = ±22 cm

Minimum betas at the absorber (h/v) = 1/1 cm

Maximum dispersion = 80 cm

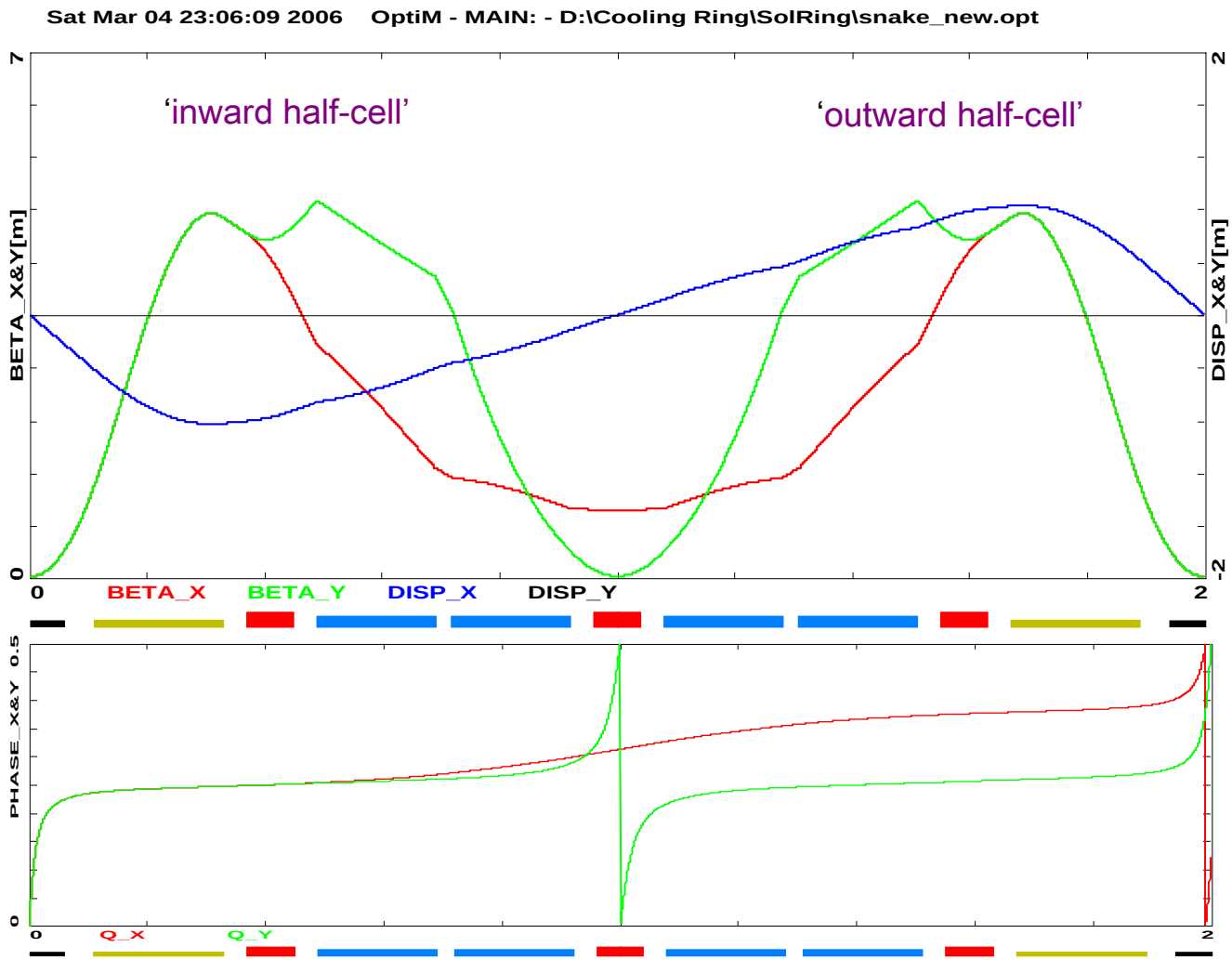
Maximum betas (h/v) = 5/5 m

Periodic cell length = 2 m

Betatron phase adv/cell (h/v) = $\pi/2\pi$

- Lattice implementation:
  - Solenoid focusing around the absorber – axially symmetric β^* region
  - Two pairs of dipoles with opposing bends – 'dispersion flip'
  - Quadrupole compensation for the dipole edge focusing – balanced betas

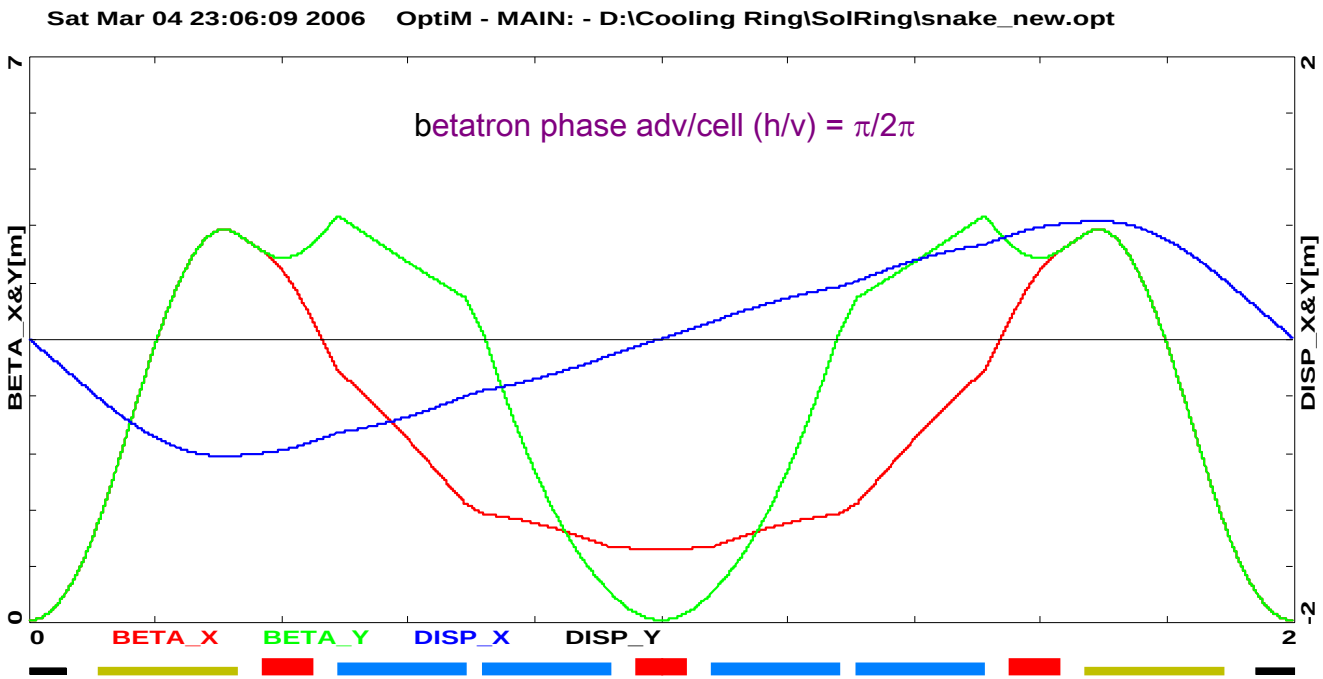
Periodic Cell – Optics



betatron phase adv/cell (h/v) = $\pi/2\pi$

Periodic Cell – Magnets

'inward half-cell' 'outward half-cell'



solenoids:

L[cm]	B[kG]
22	105
22	105

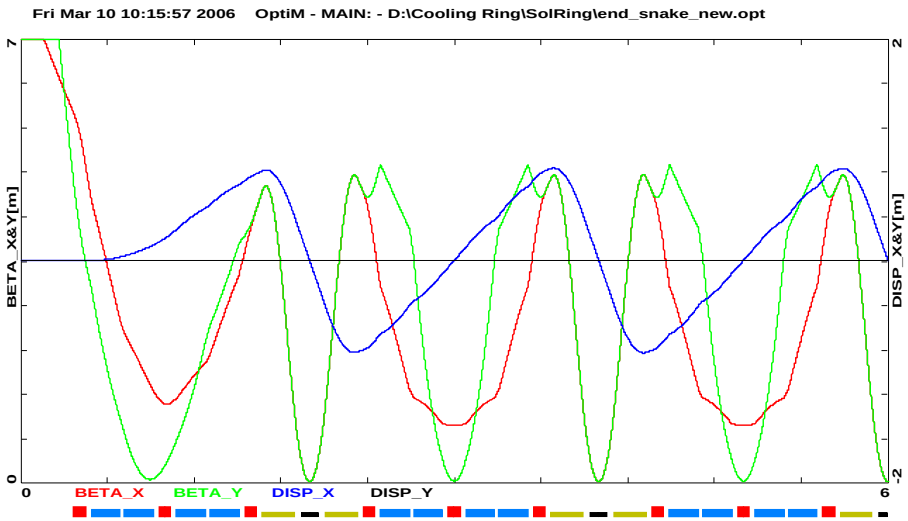
quadrupoles:

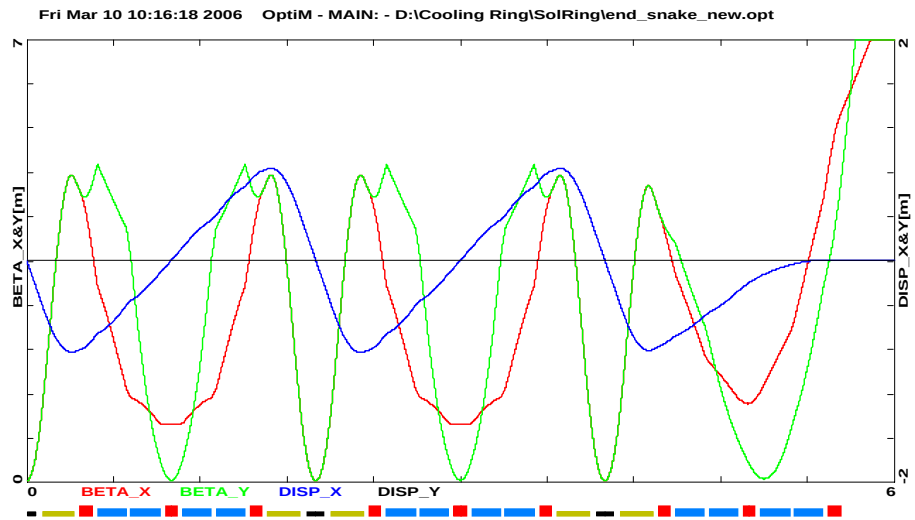
L[cm]	G[kG/cm]
8	1.79754
8	-0.3325
8	1.79754

dipoles:

$L=20; => 20 cm
$B= 25; => 25 kGauss
$Ang=$L*$B/$Hr; => 0.4996 rad
$ang=$Ang*180/$PI; => 28.628 deg

Entr/Exit into the Snake channel – Dispersion suppression



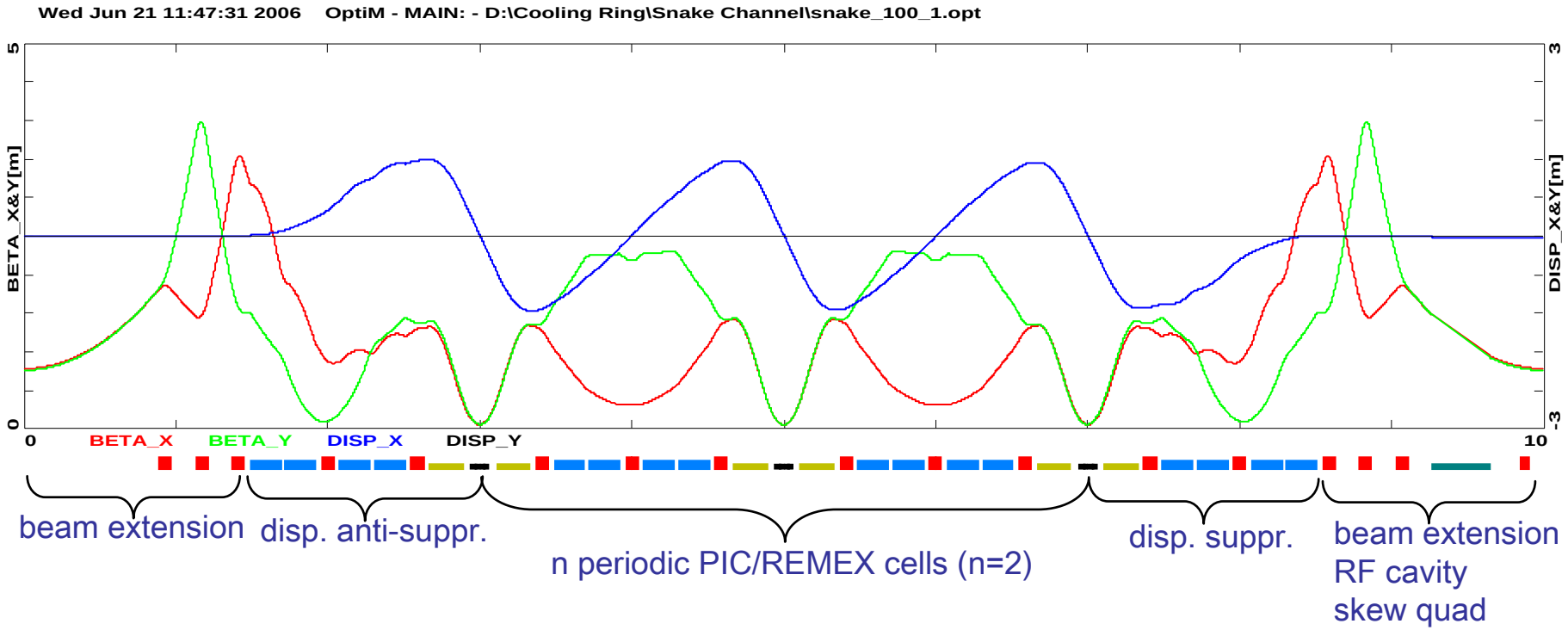


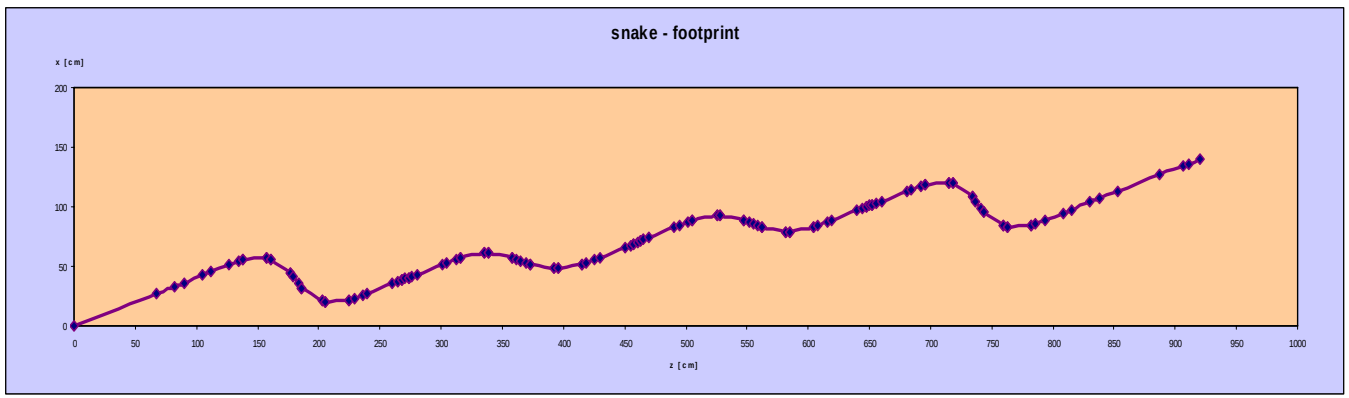
entrance cell

periodic cells

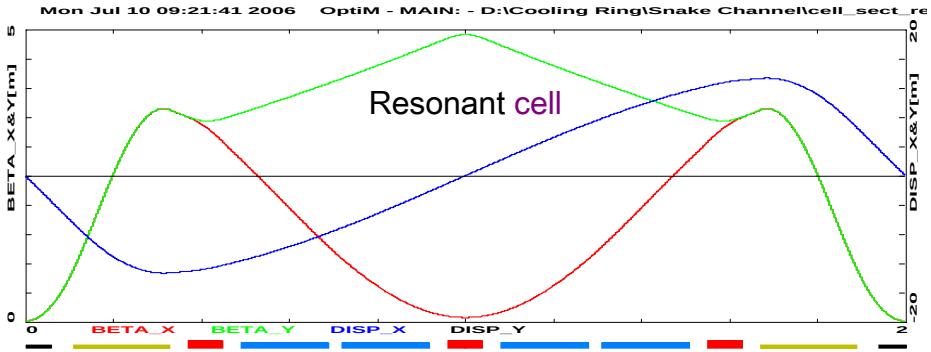
exit cell

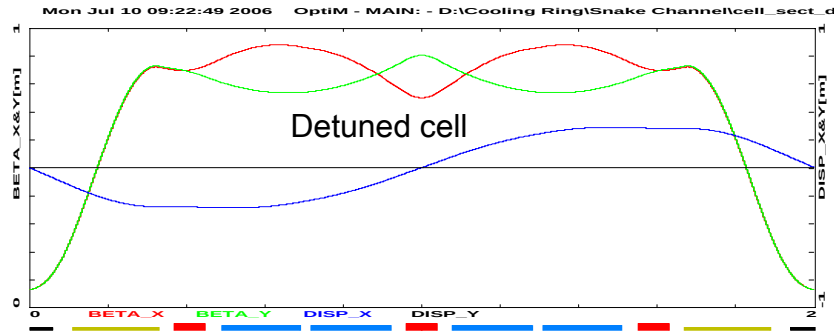
PIC/REMEX Channel – Optics

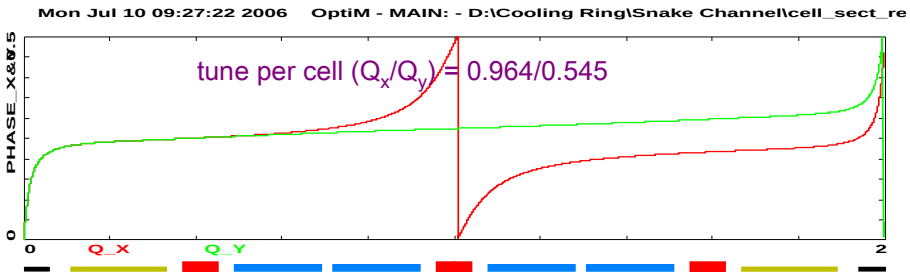


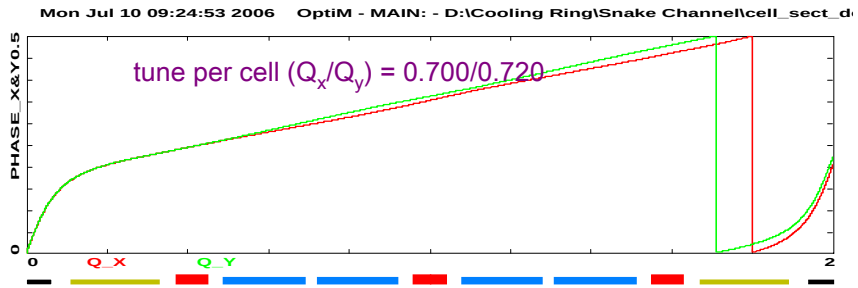


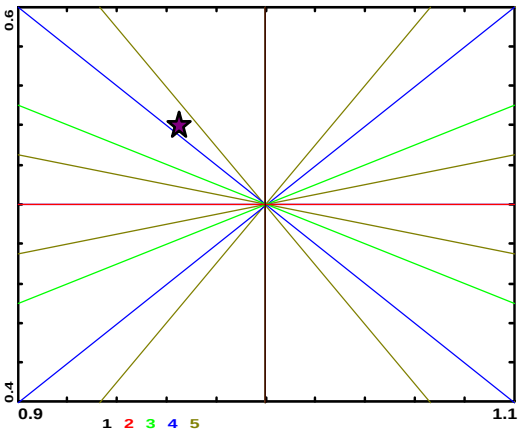
Resonant vs Detuned Cell – Optics

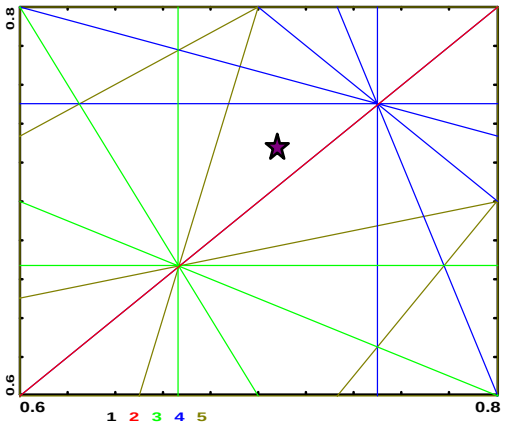












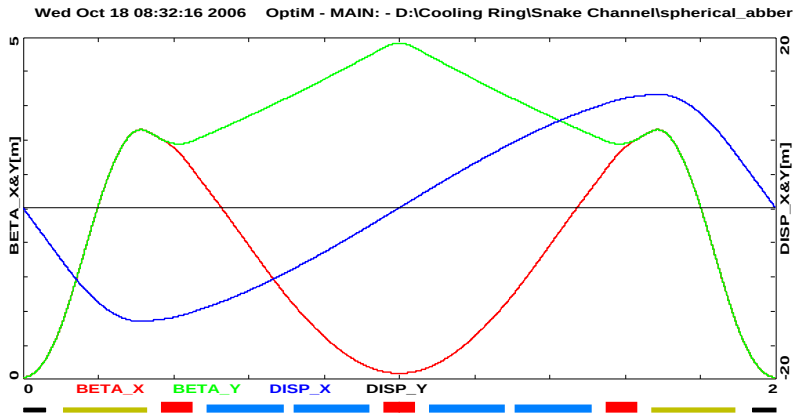
‘Snake’ vs. ‘Chicane’ channel – Spherical aberrations

Follow up on Richard Sah’s idea of geometric suppression of T_{122} spherical aberration

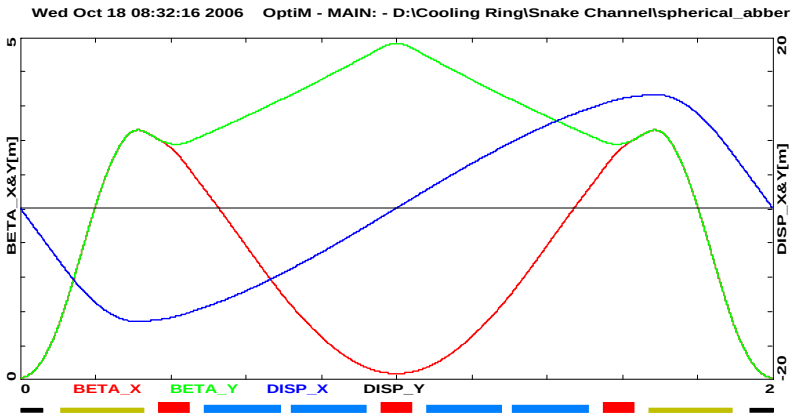
$$x^f_i = T_{ijk}\, x_j\, x_k$$

$$x^f = T_{122}\, x'\, x'$$

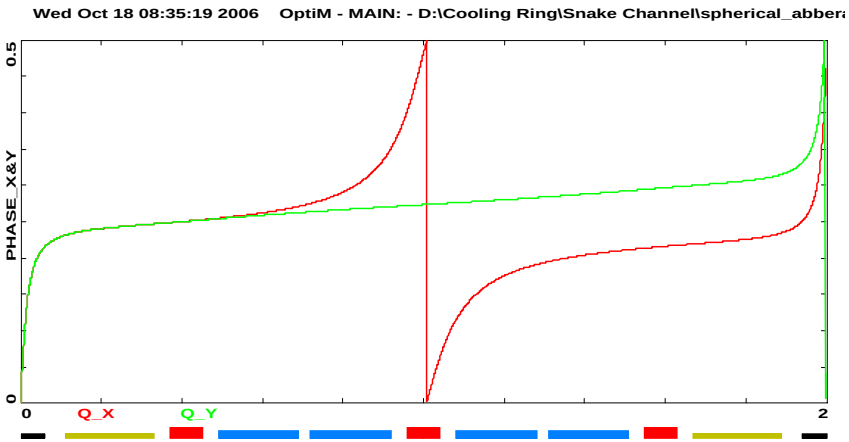
Cooling Cell – Mirror Symmetry/Degeneracy



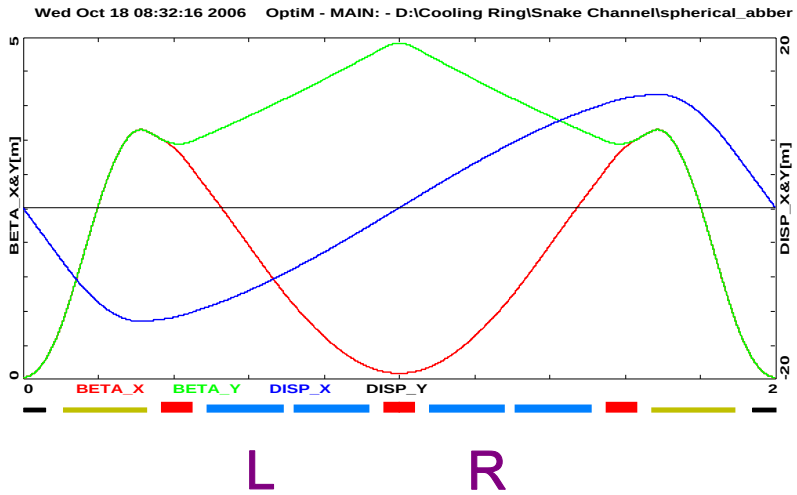
L R

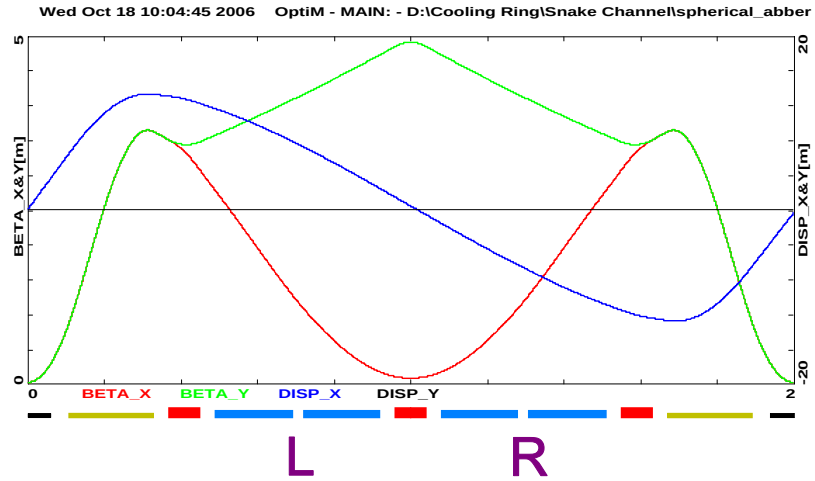


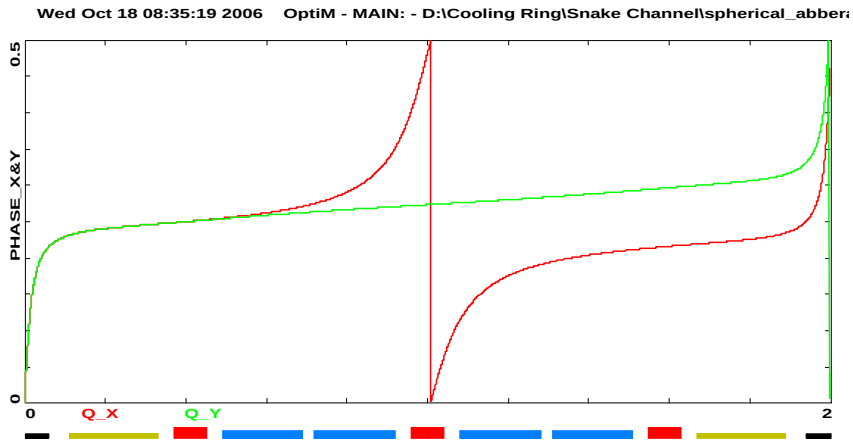
R L



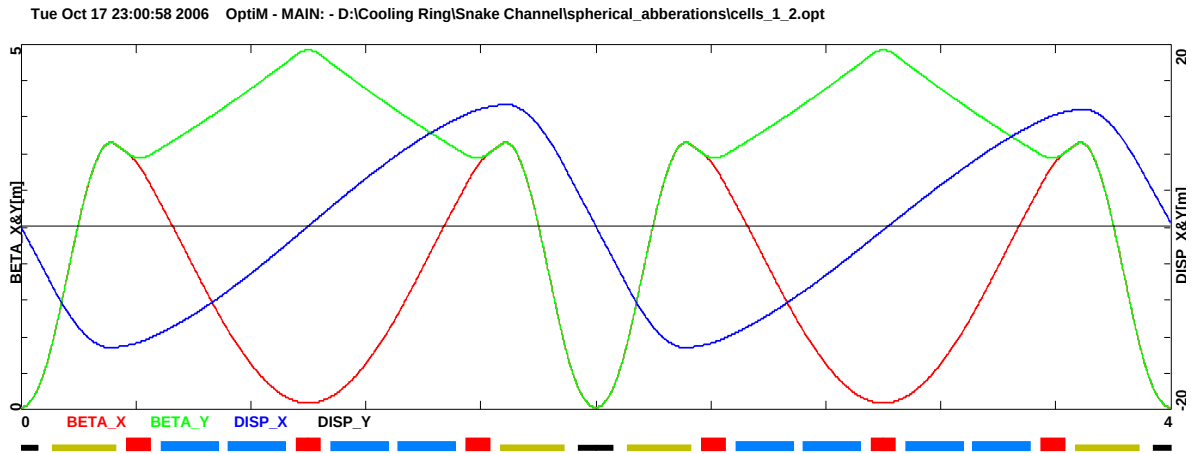
Periodic Cell – Degenerate Optics





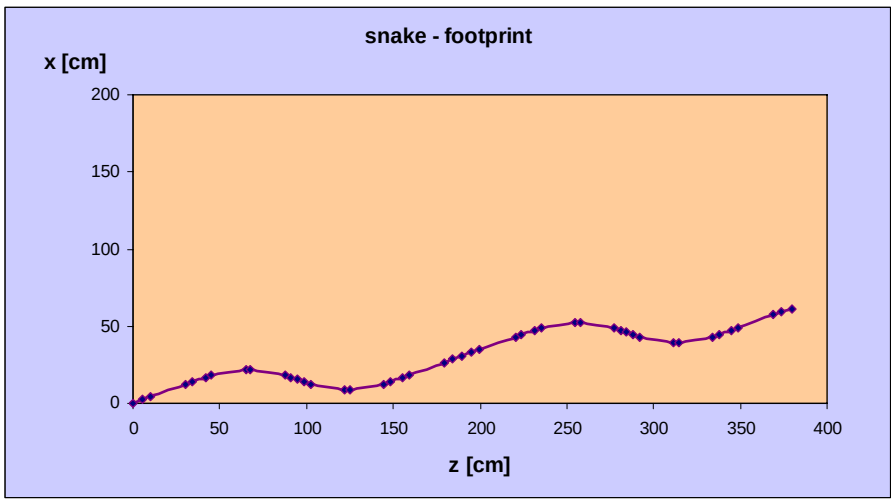


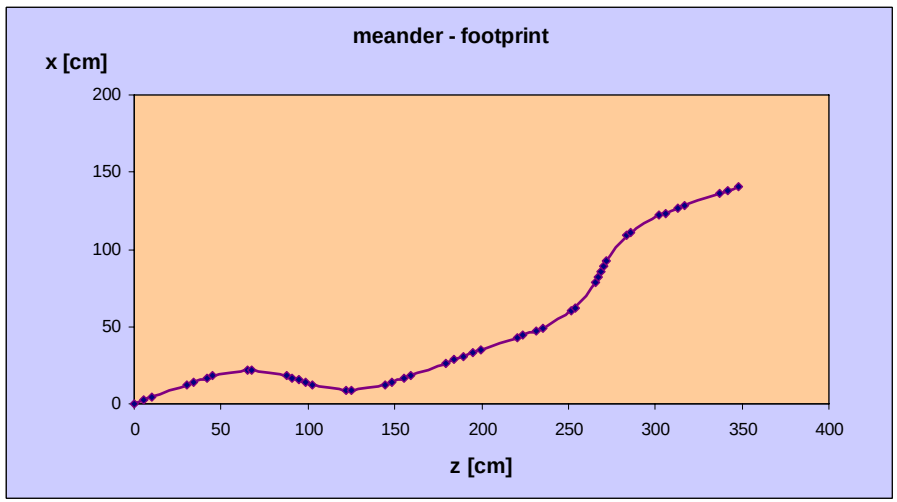
‘Snake’ vs. ‘Chicane’ Layout



‘snake’ L R L R

‘chicane’ L R R L





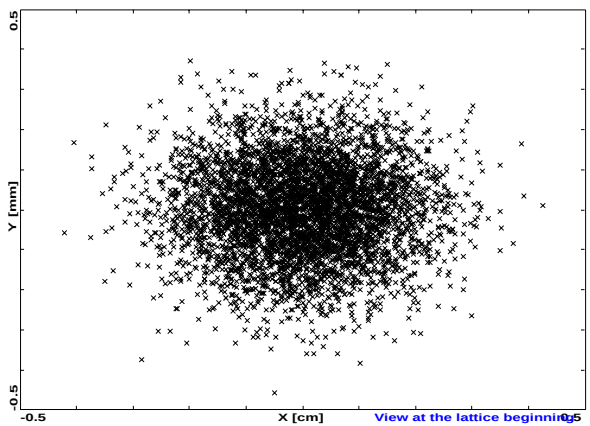
Initial Transverse Phase-space

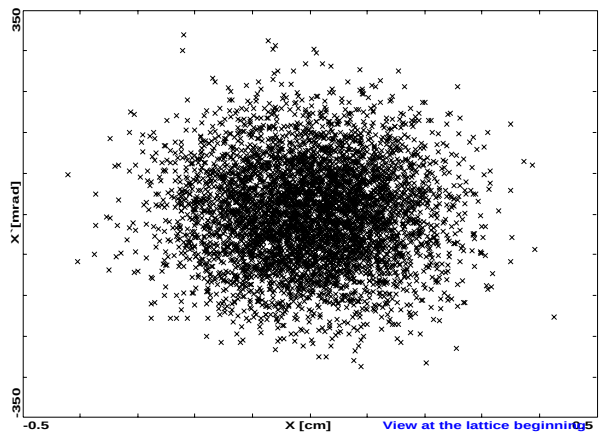
$\varepsilon_{x,y}$ = 100 mm mrad geometric emittance at p =100 MeV/c

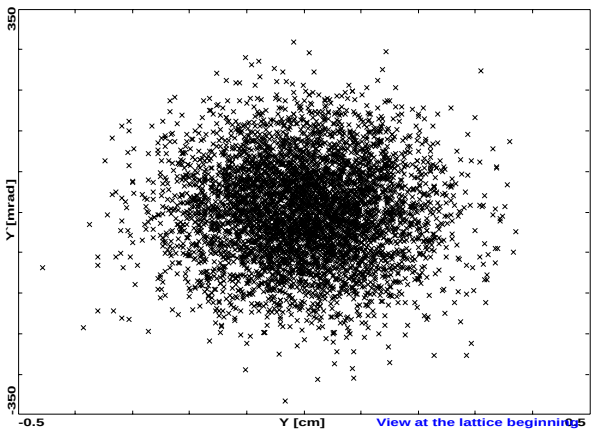
Initial phase-space

BunchLength[cm]=1.0 dP/P=0.000001

Beta_X_1[cm]=1.36483	Beta_X_2[cm]=0.
Alfa_X_1=0.0	Alfa_X_2=0.
Beta_Y_1[cm]=0.	Beta_Y_2[cm]=1.36448
Emit1[cm]=1.e-2	Emit2[cm]=1.e-2
DispX[cm]=0.	DispY[cm]=0
DispXpr[cm]=-59.8339	DispYpr[cm]=0

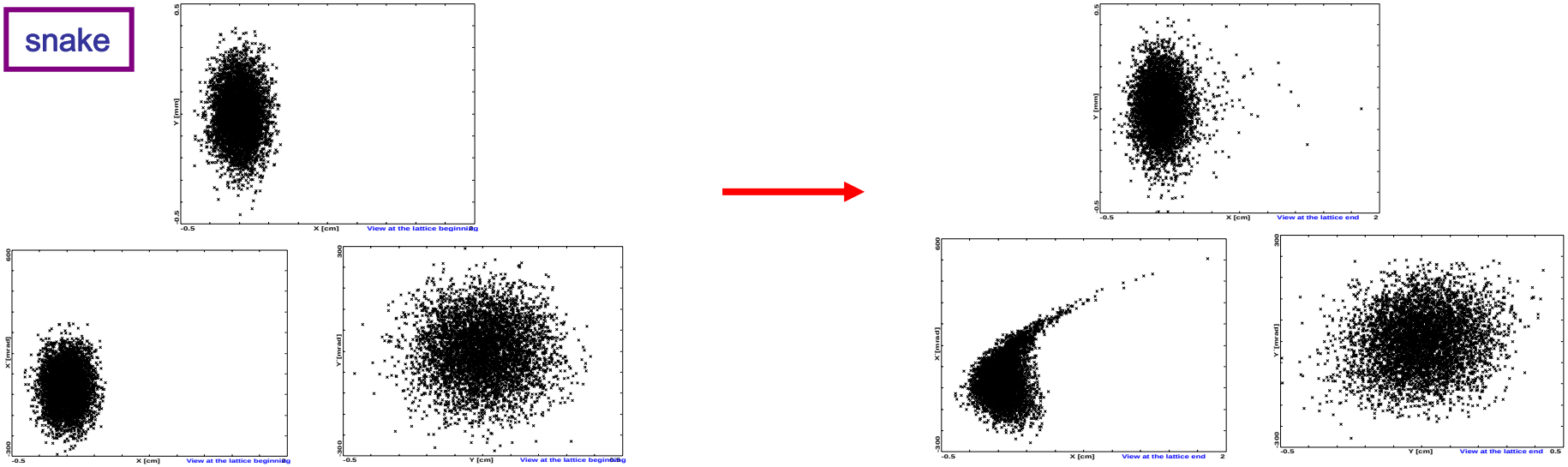




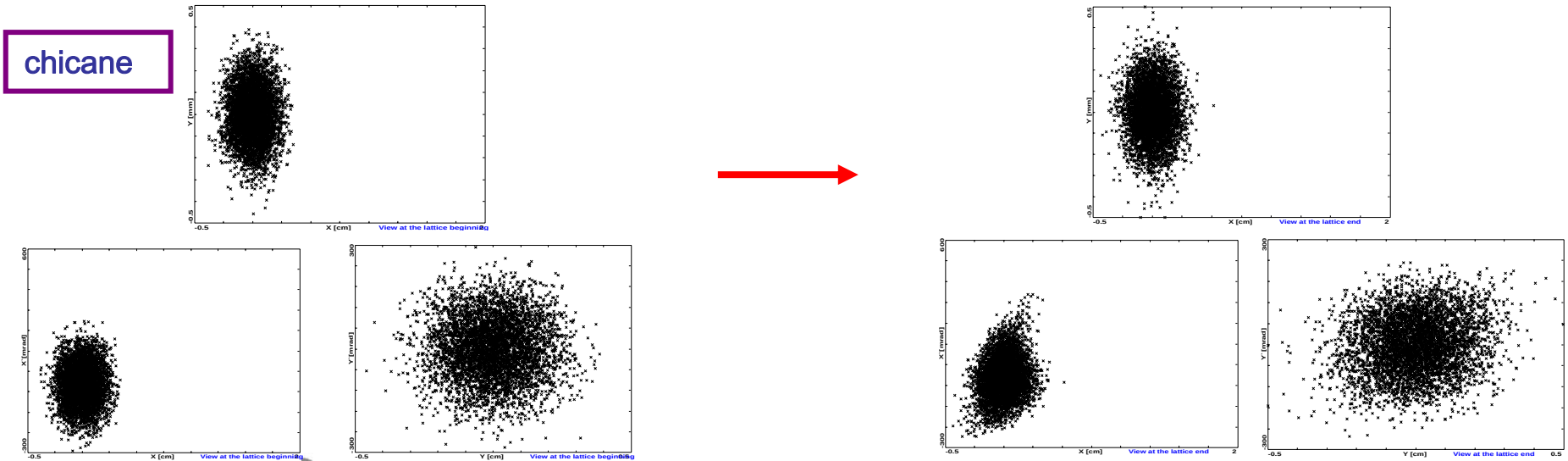


‘Snake’ vs. ‘Chicane’ – Tracking

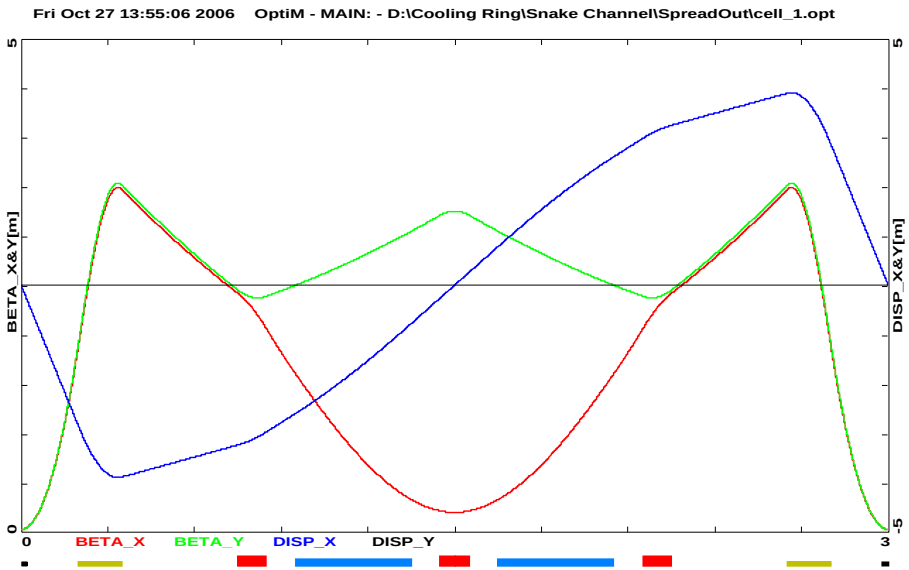
snake

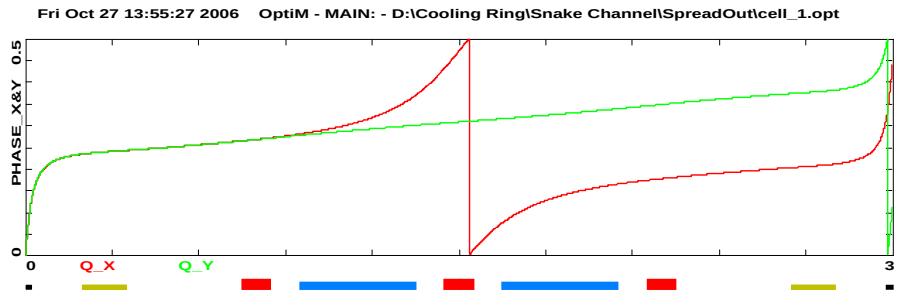


chicane



Spread-out Cell – Optics





betatron phase adv/cell (h/v) = $\pi/2\pi$