Baseline Damping Ring Lattice Design Status

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LCWS11
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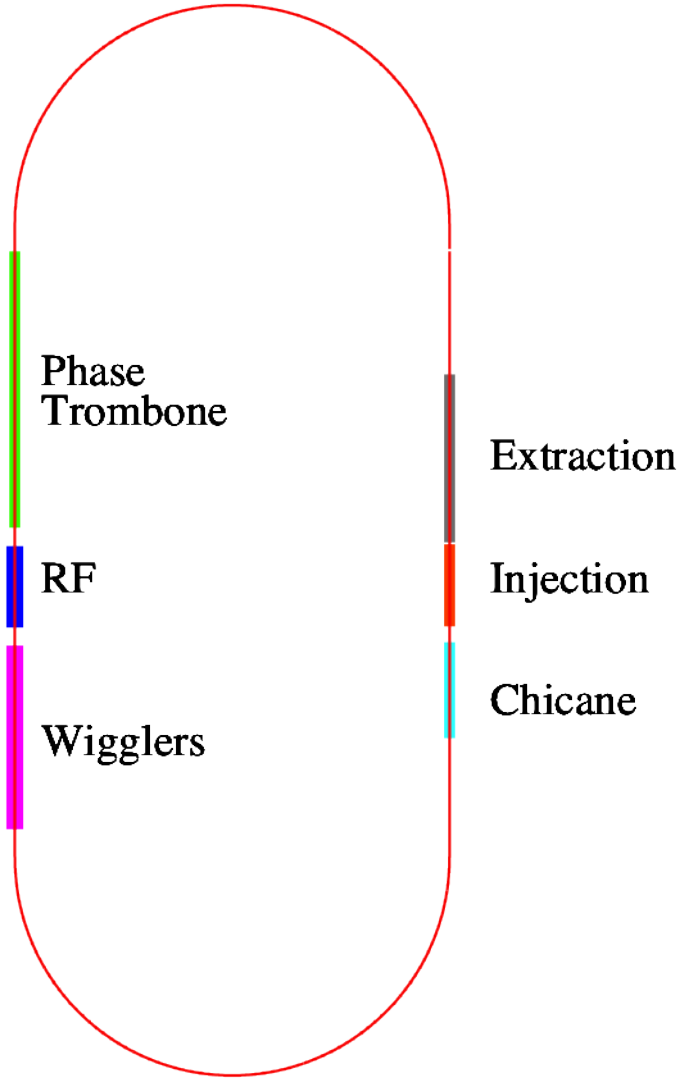
DTC02 Layout (D.L.Rubin)



Circumference = 3238.681 m

Harmonic number =7022

710-m straights

~ 6 phase trombone cells

Sixty 2.1-m long wigglers:

30-cm period, 14 poles

B_{max} = 2.16T

Space for 16 RF cavities

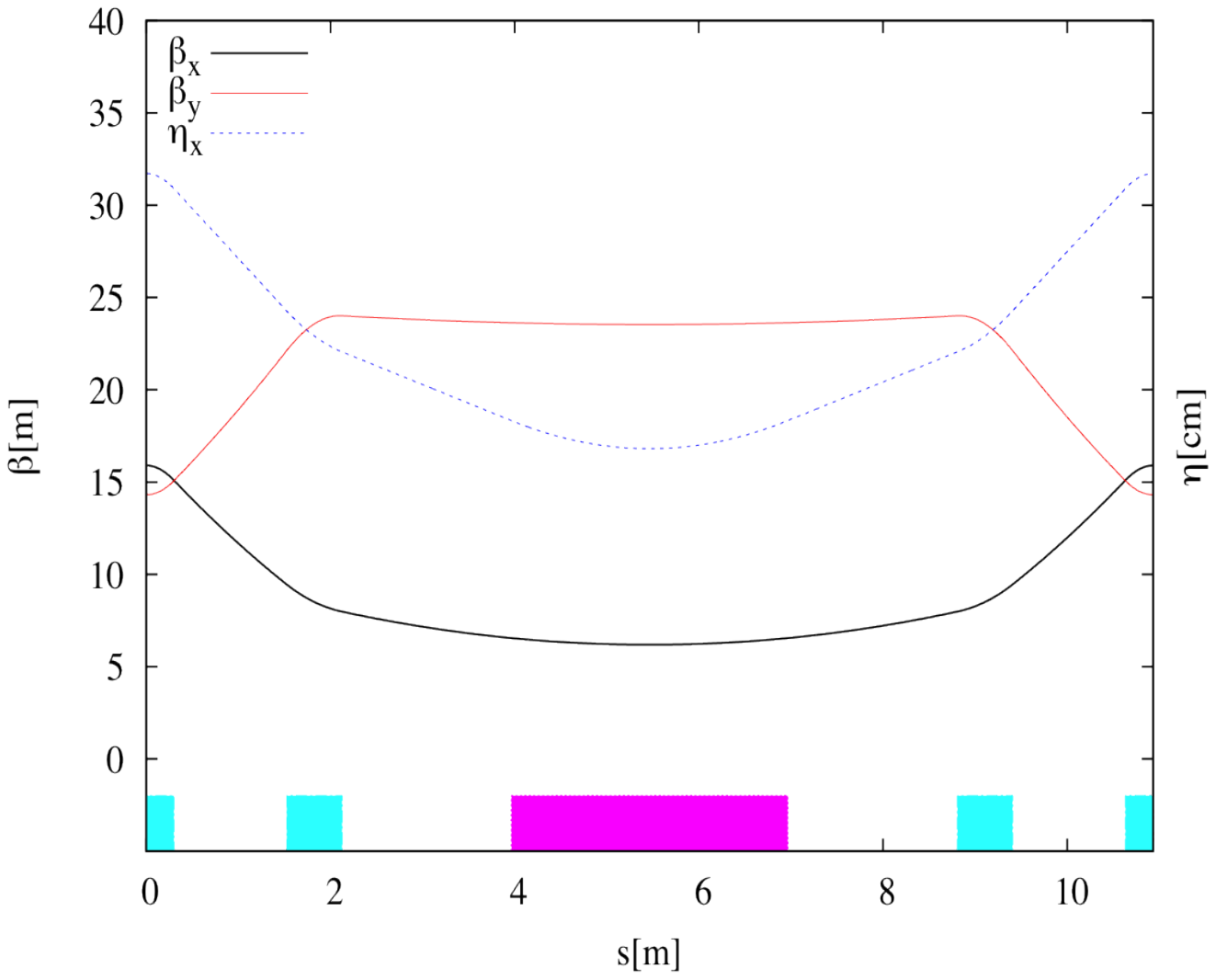
The cryostats for upper and lower positron rings are interleaved.

Arc Cell - FDBDF

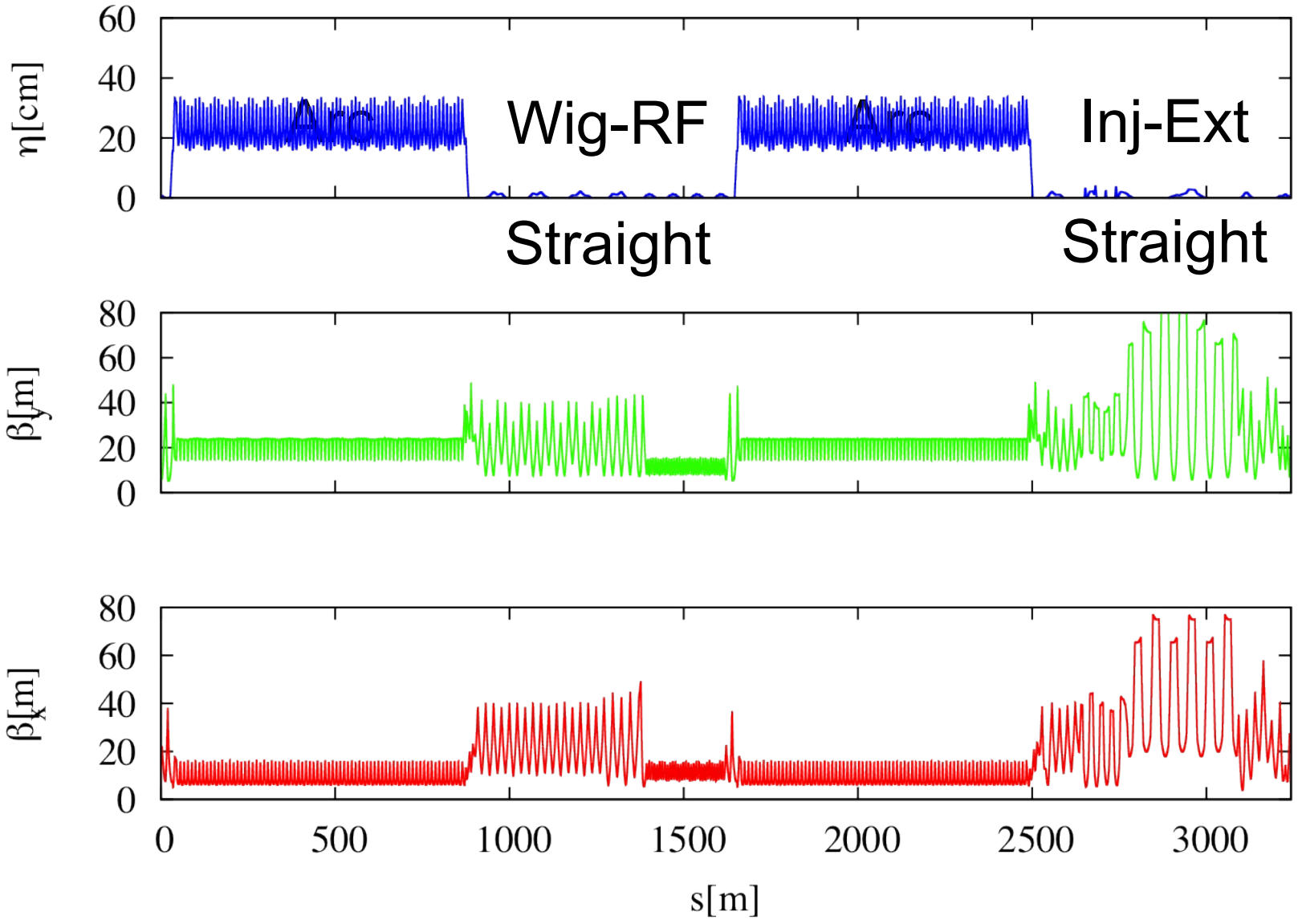
Cell length = 10.93m

Bend length = 3.0m

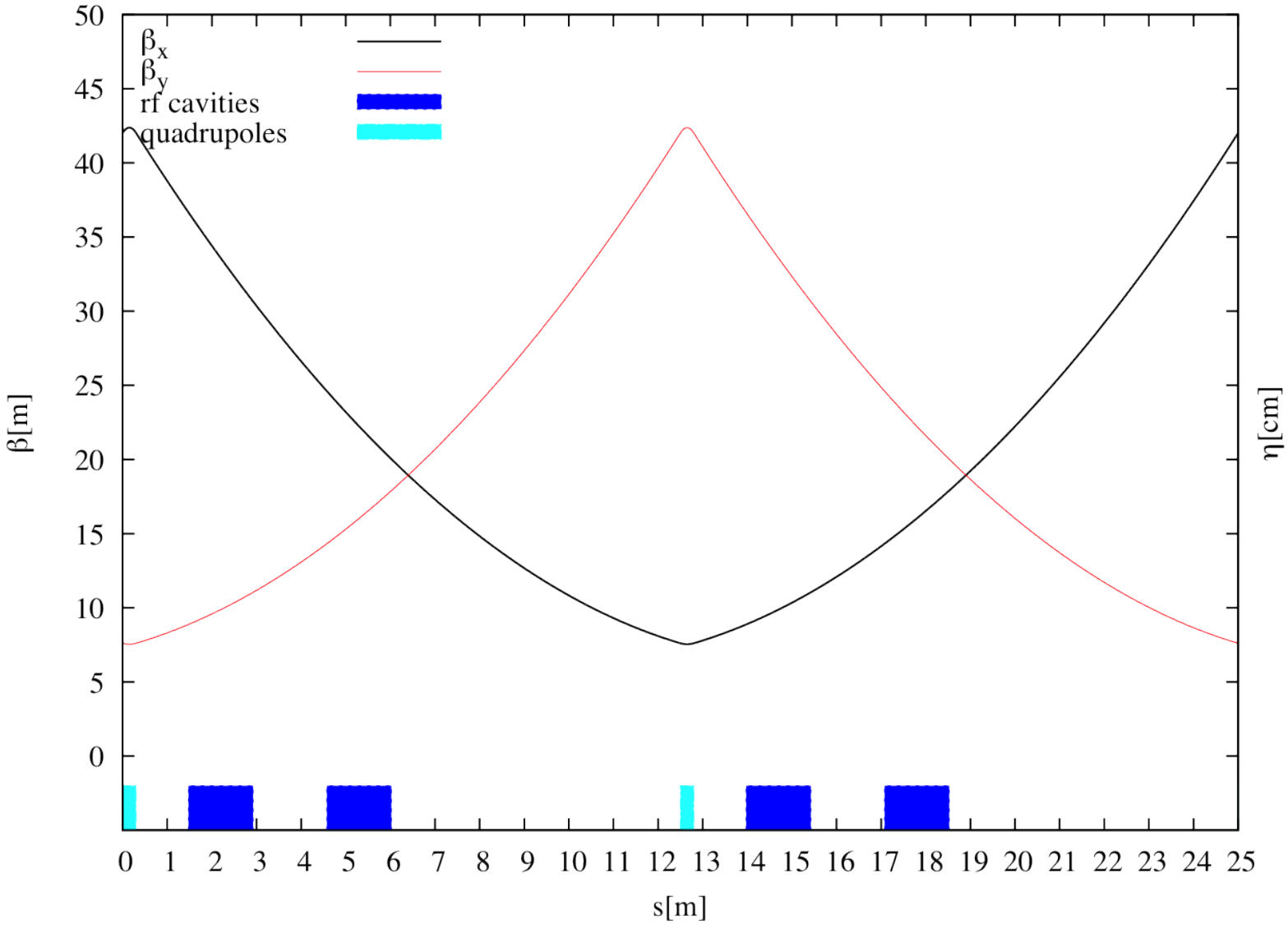
75 cells/arc



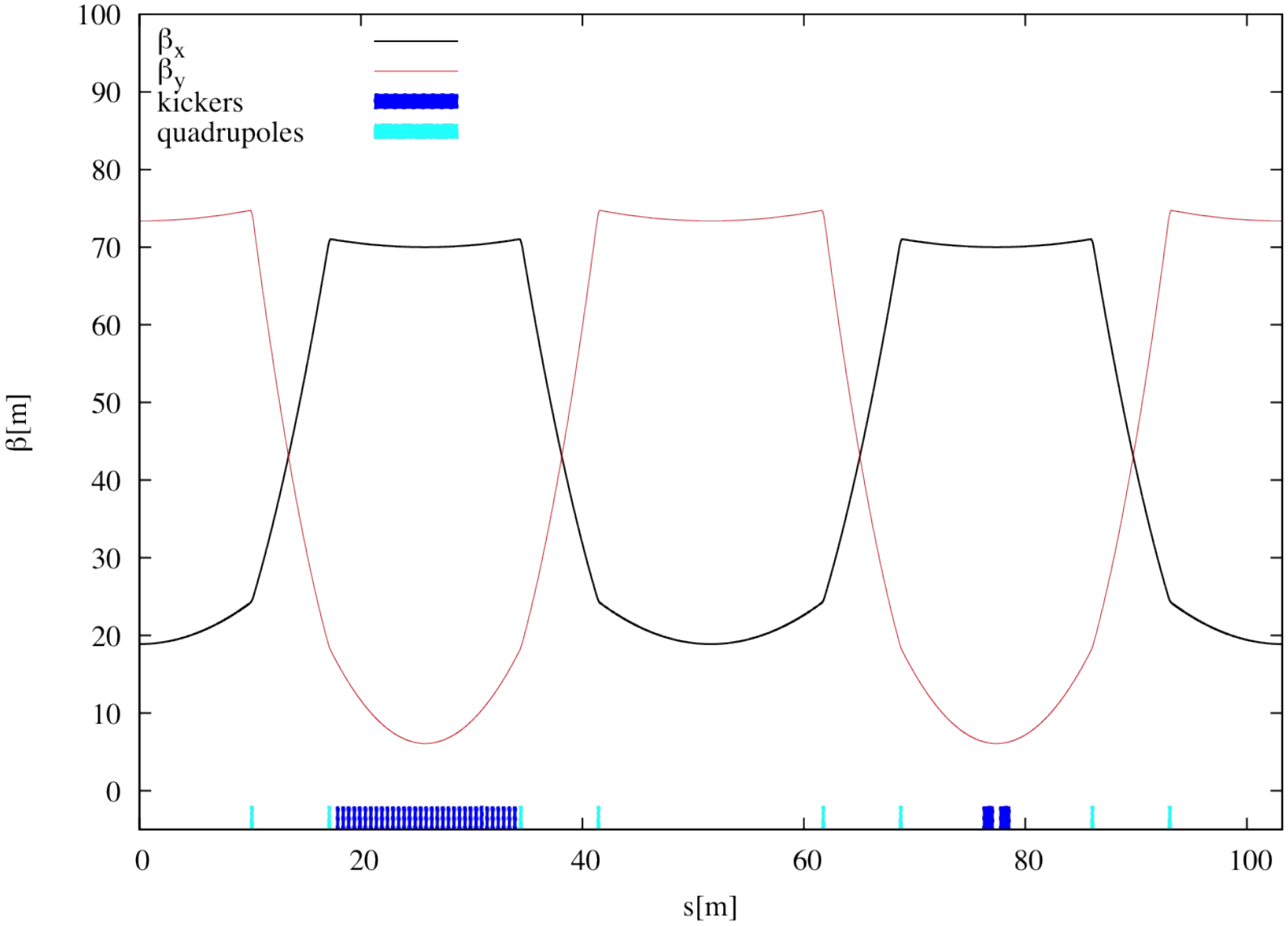
DTC02 Lattice Functions



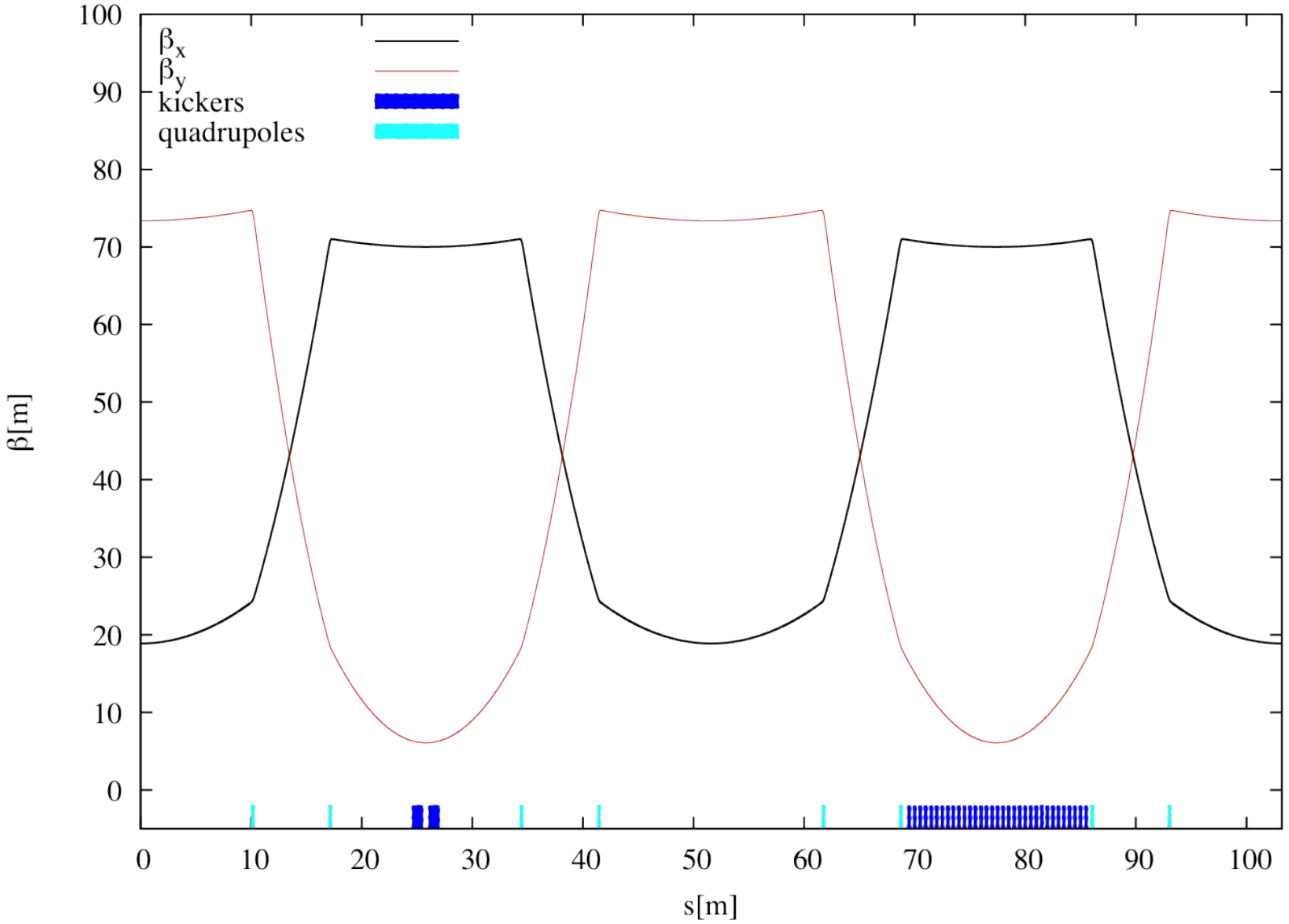
RF Cells


β_x
β_y
rf cavities
quadrupoles
β[m]
η[cm]
s[m]
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
0 5 10 15 20 25 30 35 40 45 50

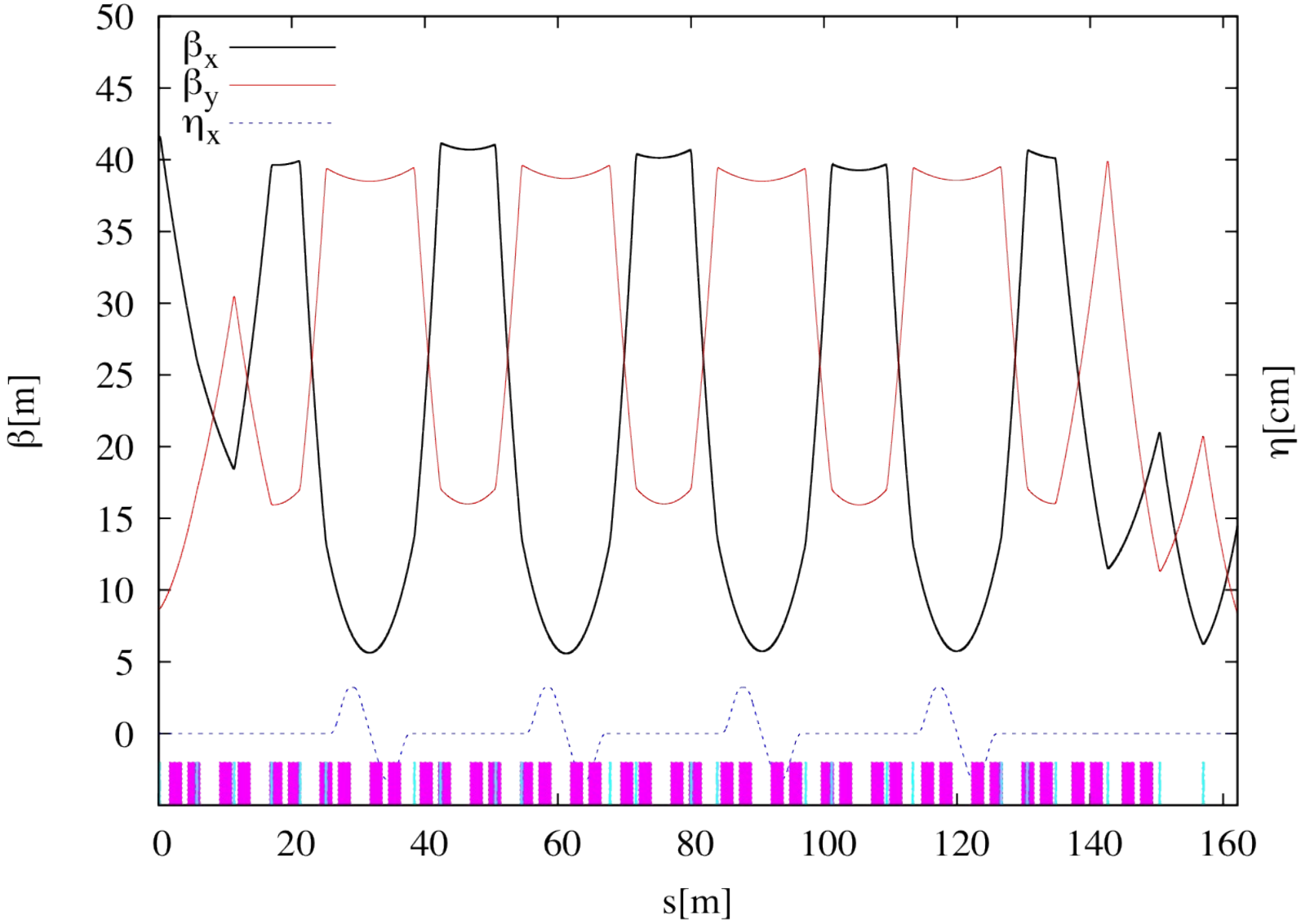
Extraction Straight



Injection Straight



Circumference-Changing Chicane



Wiggler Cells

Wiggler parameters

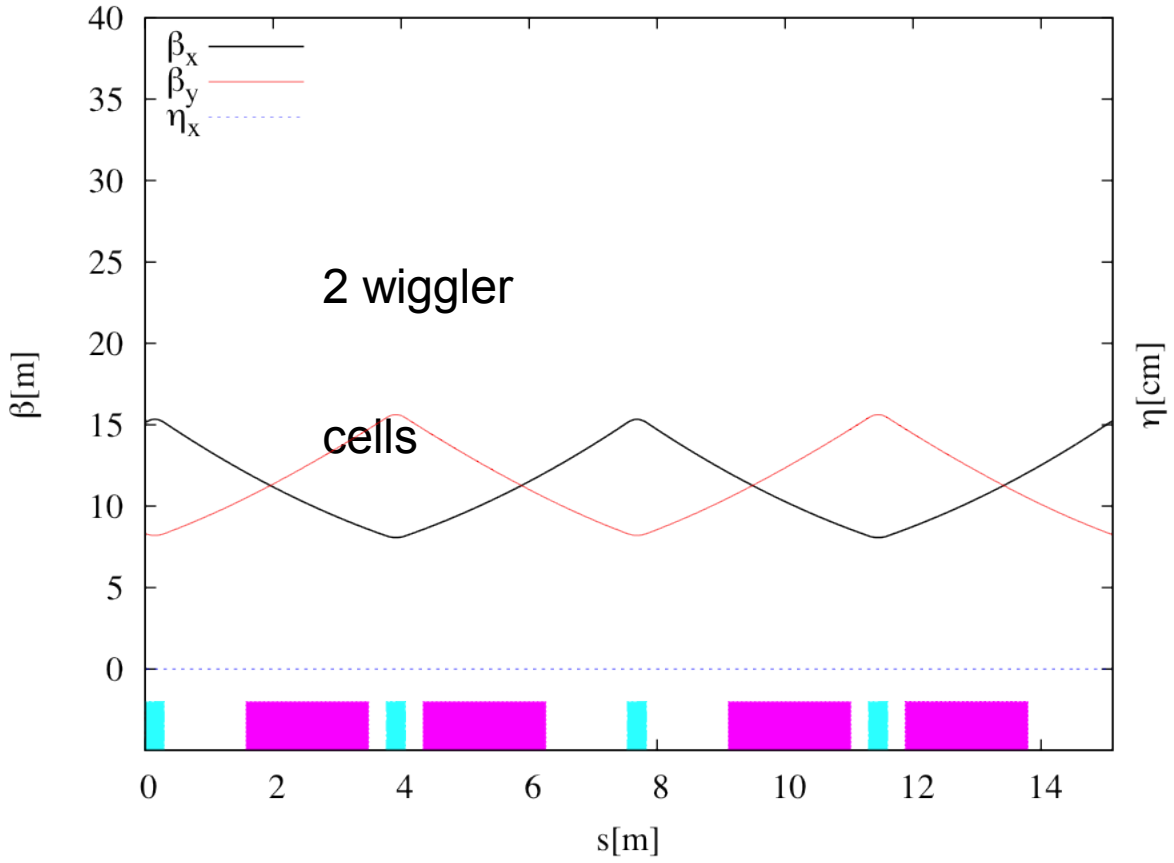
14 poles

30-cm period

Wiggler length = 2.1m

Cell length = 7.56 m

30 wiggler cells



DTC02 Parameters

	10 Hz(Low)	5 Hz (Low)	5 Hz (High)
Circumference [km]	3.23868	3.23868	3.23868
RF frequency [MHz]	650	650	650
τ_x/τ_y [ms]	13.5	24.1	24.1
τ_z [ms]	6.7	12.0	12.0
σ_z [mm]	6	6	6
σ_δ	0.134%	0.11%	0.11%
α_p	3.3×10^{-4}	3.3×10^{-4}	3.3×10^{-4}
$\gamma\varepsilon_x$ [μm]	4.6	5.4	5.4
RF [MV] (12 cavities) Total/cavity	19.7/1.64	14 /1.17	14/1.17
ξ_x/ξ_y	-50.9/-44.1	-51.3/-43.3	-51.3/-43.3
Wigglers: Ncells@B[T]	30@2.1	27@1.5	27@1.5
Energy loss/turn [MeV]	8.0	4.5	4.5
Sextupoles	3.34/-4.34	3.34/-4.23	3.34/-4.23
Power/RF coupler @400mA [kW]	267	150	300

RF Cavities

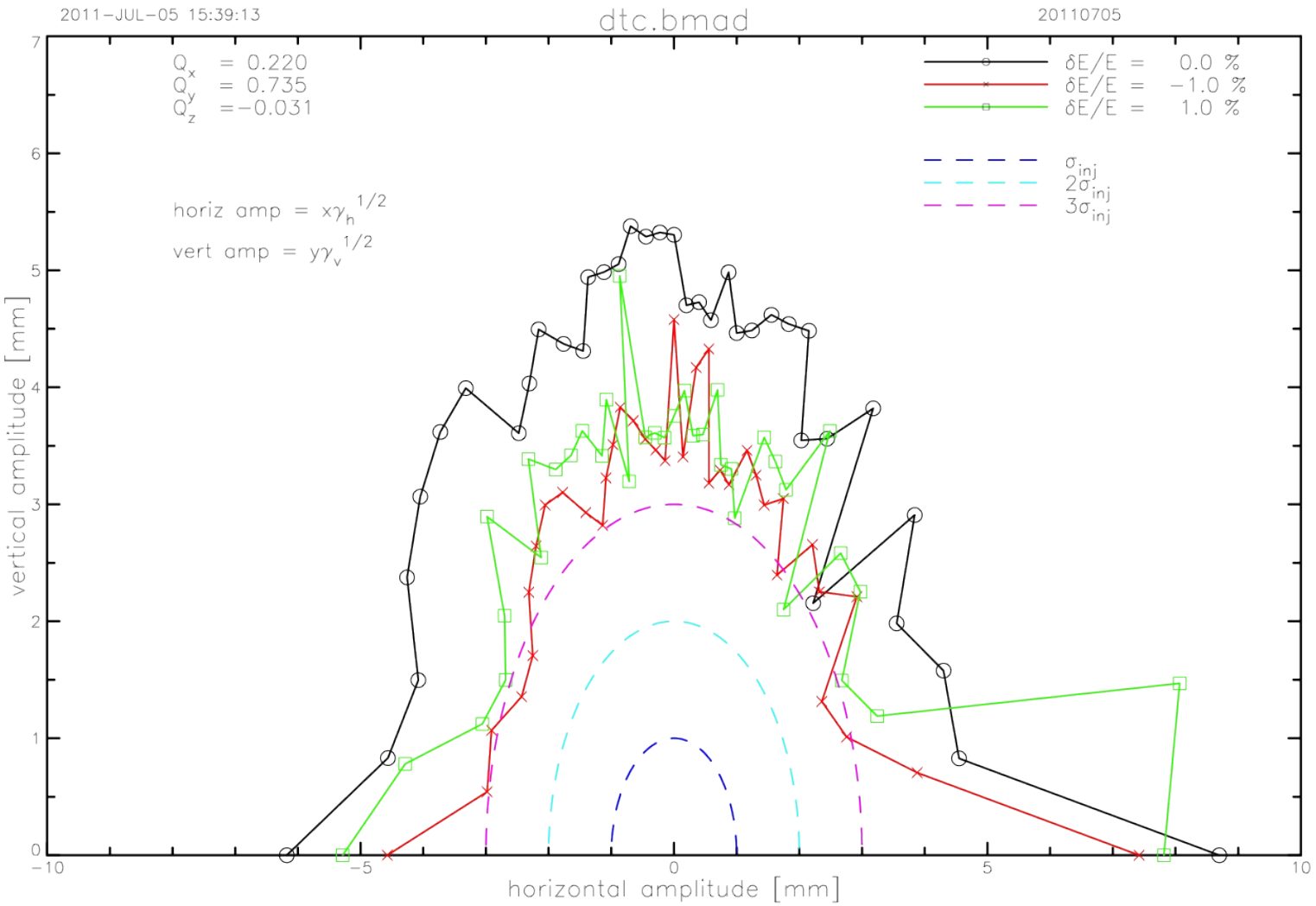
The lattice can accommodate 16 RF cavities

If we assume 12 cavities then:

Voltage/cavity in 10 Hz mode is 1.64 MV

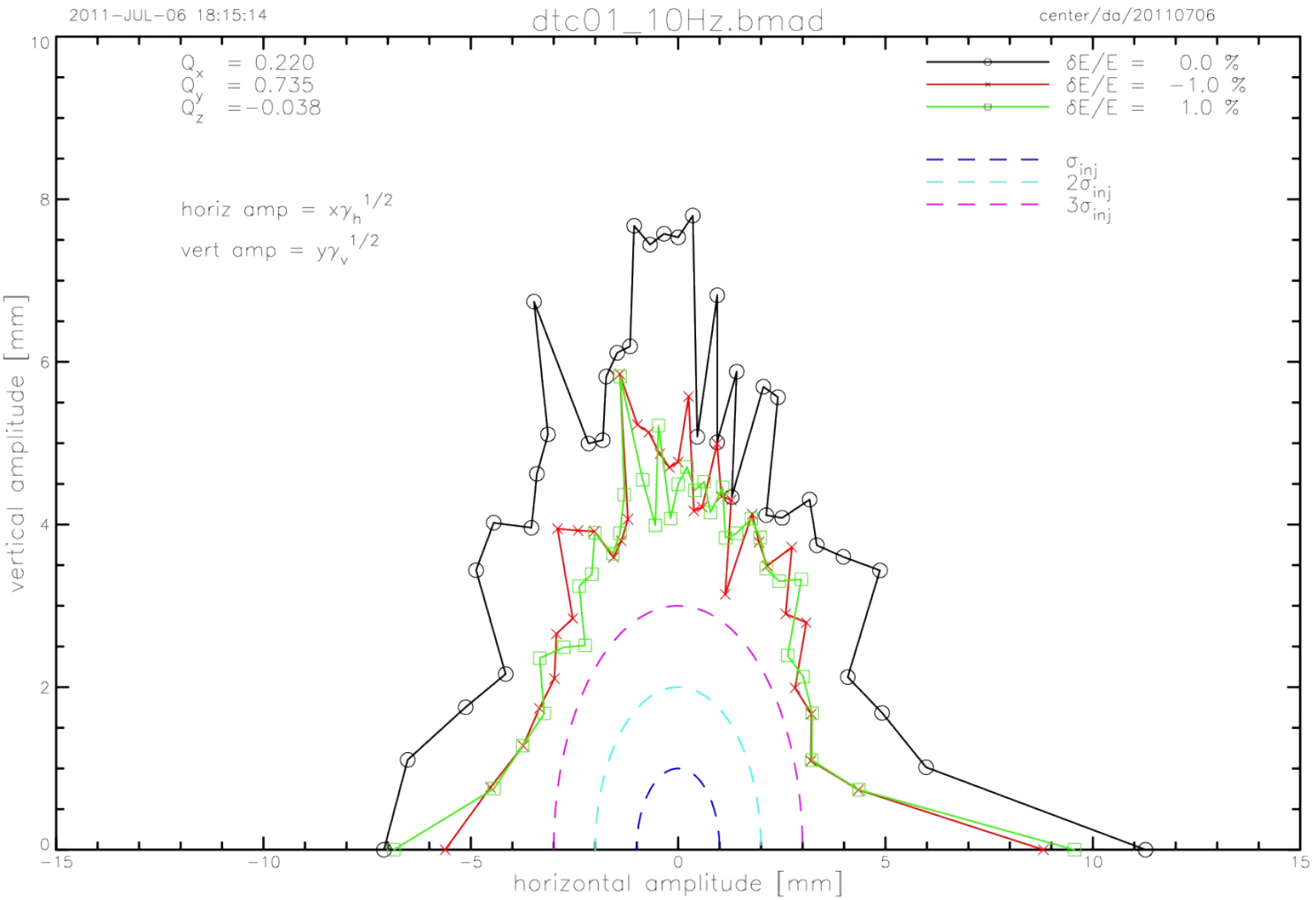
Power/coupler in 5 Hz, high power mode is 300 kW

Dynamic Aperture 5 Hz



Periodic type wiggler model, includes vertical focusing and cubic nonlinearity

Dynamic Aperture 10 Hz



Periodic type wiggler model, includes vertical focusing and cubic nonlinearity

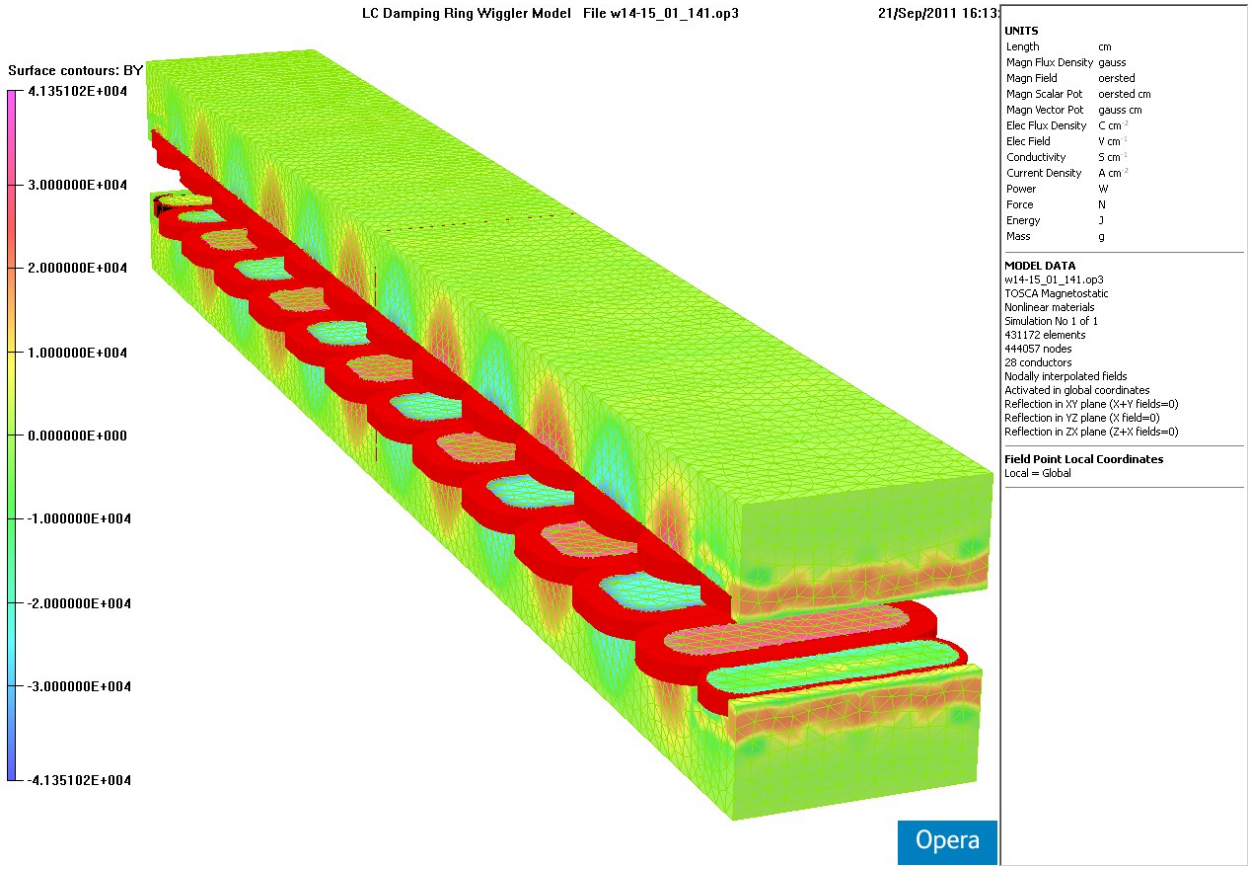
Magnet Count (Damping Ring)

	Length [m]	Strength	Number
Arc Dipoles	3	2.28 kG	150
Chicane dipoles	1	2.68 kG	28
Other dipoles	2	< 2.28 kG	4
Arc Quadrupoles	0.6	< 0.6 m^{-2}	450
Quadrupoles in dispersion suppressor and straights	0.3	< 0.55 m^{-2}	211
Sextupoles	0.3	< 4.34 m^{-3}	600
RF cavities	3	< 1.64 MV	12
Wigglers	2.1	2.16 T	60

Damping Wiggler Redesign

CESR-c Damping Ring Studies in the Context of the ILC Damping Ring Wigglers
PAC 2005
J.Urban and G.Dugan

Design Considerations and Modeling Results for ILC Damping Ring Wigglers Based on the CESR-c Superconducting Wiggler
PAC 2007
M.A.Palmer, J.A.Crittenden and J.Urban

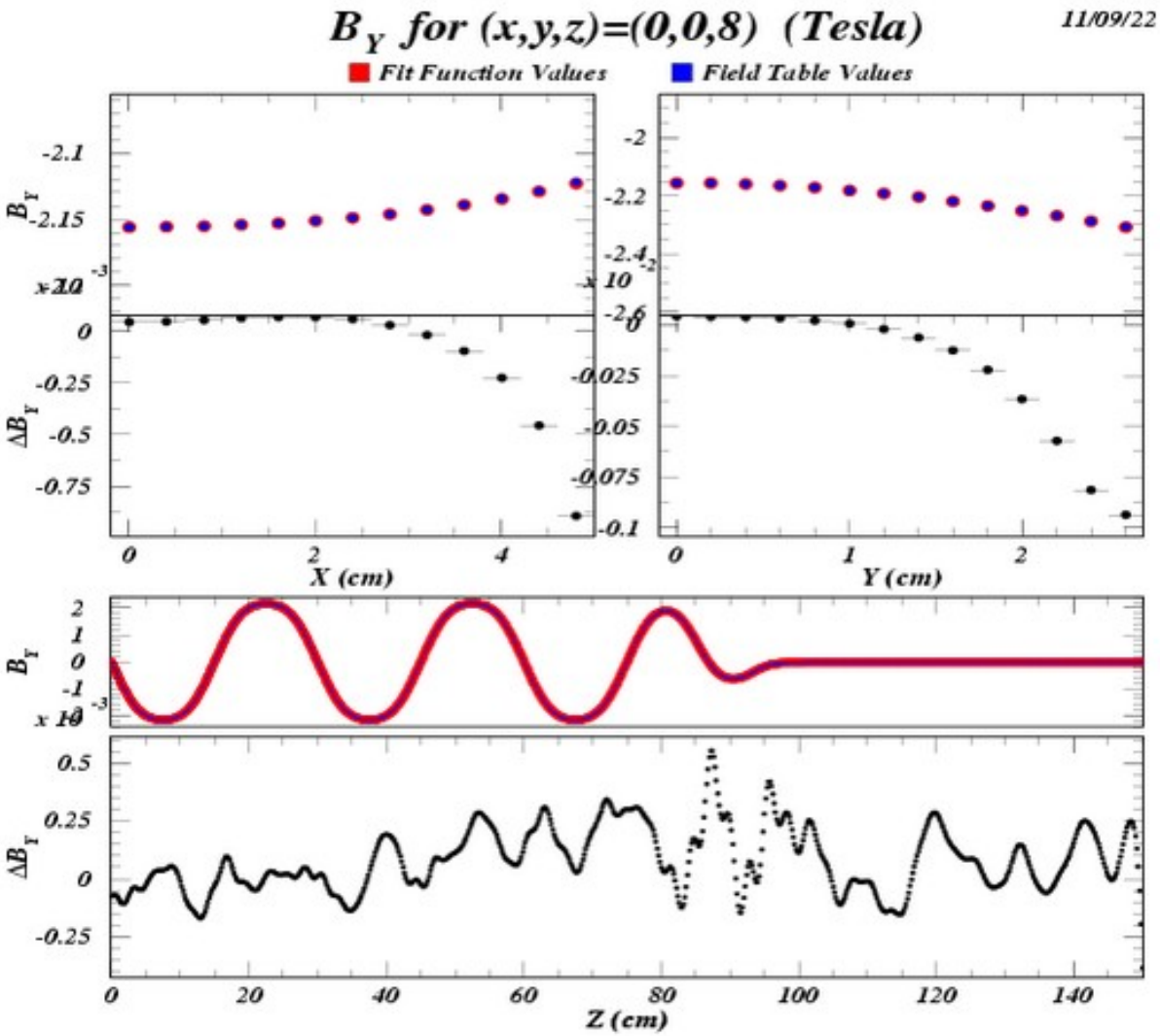


Period reduced from 32 to 30 cm and number of poles increased from 12 to 14.

Gap reduced from 8.64 cm to 7.62 cm. Peak field increased from 2.0 to 2.16 T.

Wiggler Field Analytic Form for Symplectic Tracking

A Magnetic Field Model for Wigglers and Undulators, , PAC 2003, D. Sagan, J.A. Crittenden, D.L. Rubin and E. Forest



The field map has been posted on the ILC/CesrTA wiki.

A conceptual design for costing purposes is in preparation.

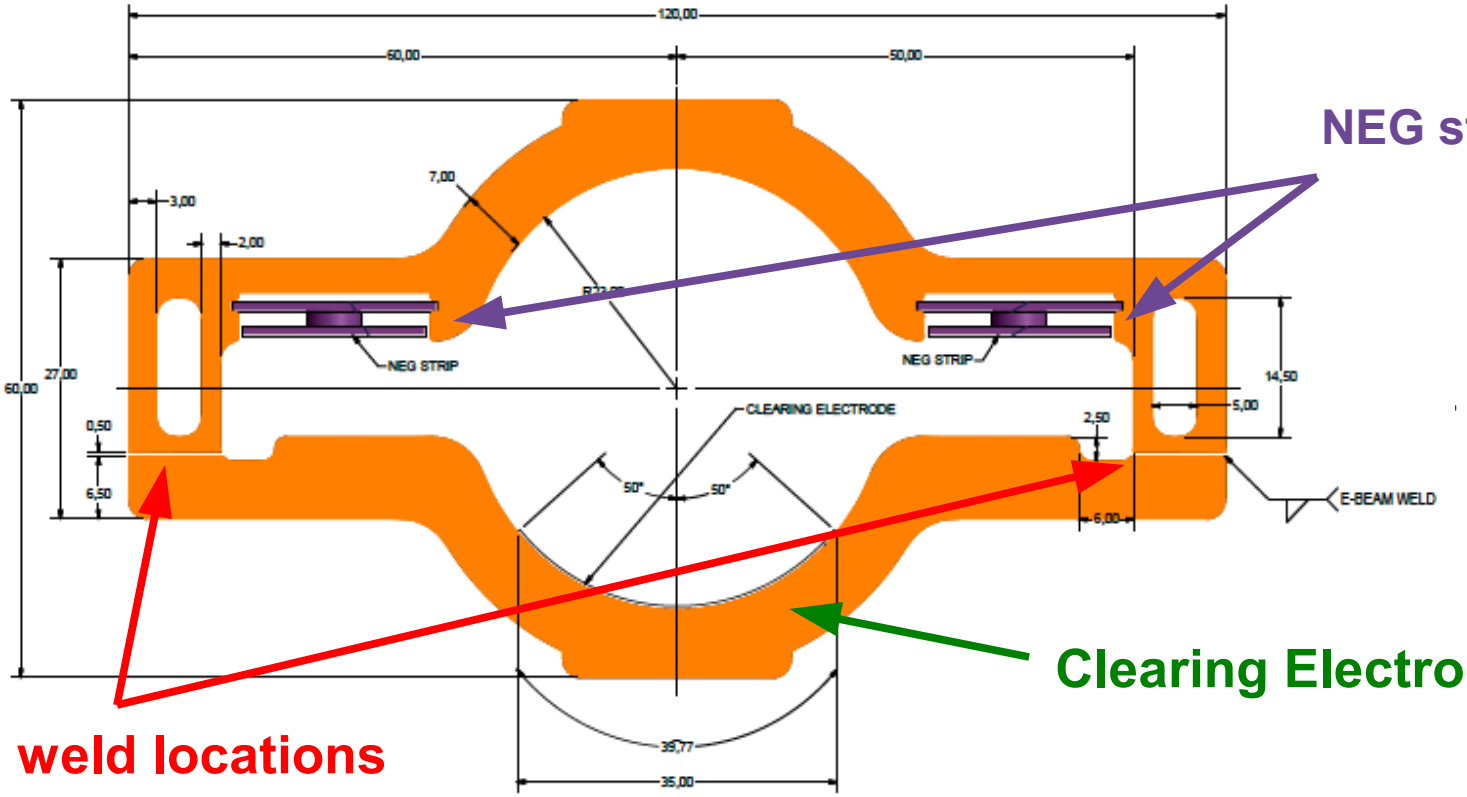
1200-term optimization underway.

Residuals presently at the level of a few gauss. The parameters have been posted on the wiki.

Vacuum System Design Effort

- Work at Cornell directed towards:
  - Implementation of mitigation recommendations into the vacuum chambers
  - Need chamber profiles for next round of physics simulations
  - Need chamber and system conceptual design for costing

Wiggler Chamber Concept I

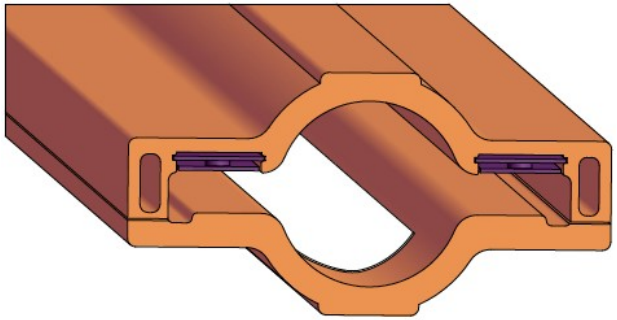


NEG strips

Clearing Electrode

E-beam weld locations

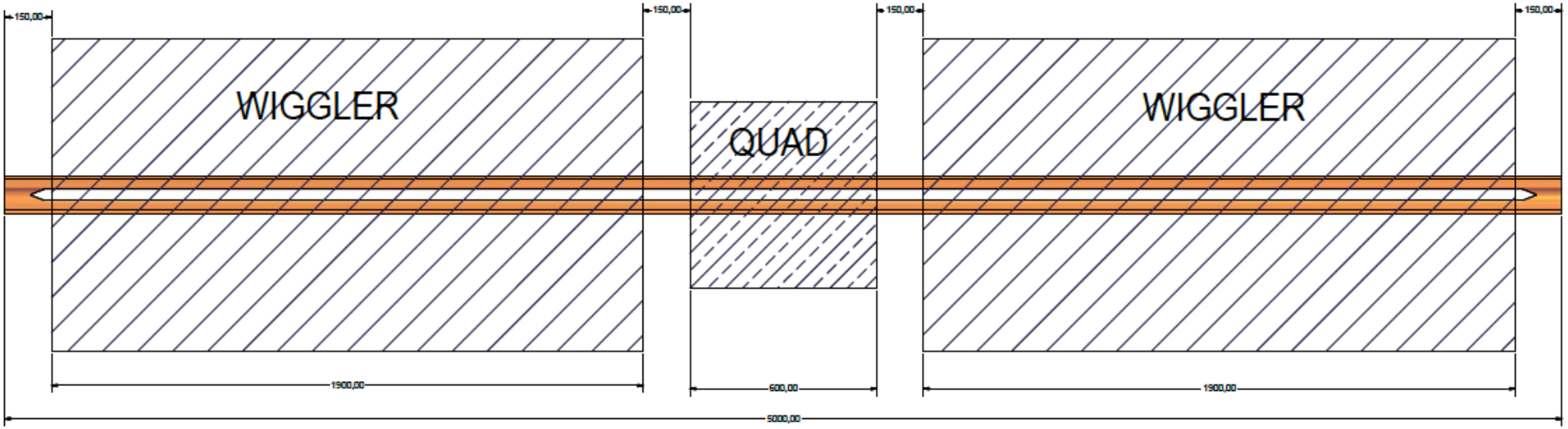
Copper Chamber



Wiggler Chamber Concept II

We are considering a scenario where 2 wigglers with a quad in center are assembled as a unit and then installed.

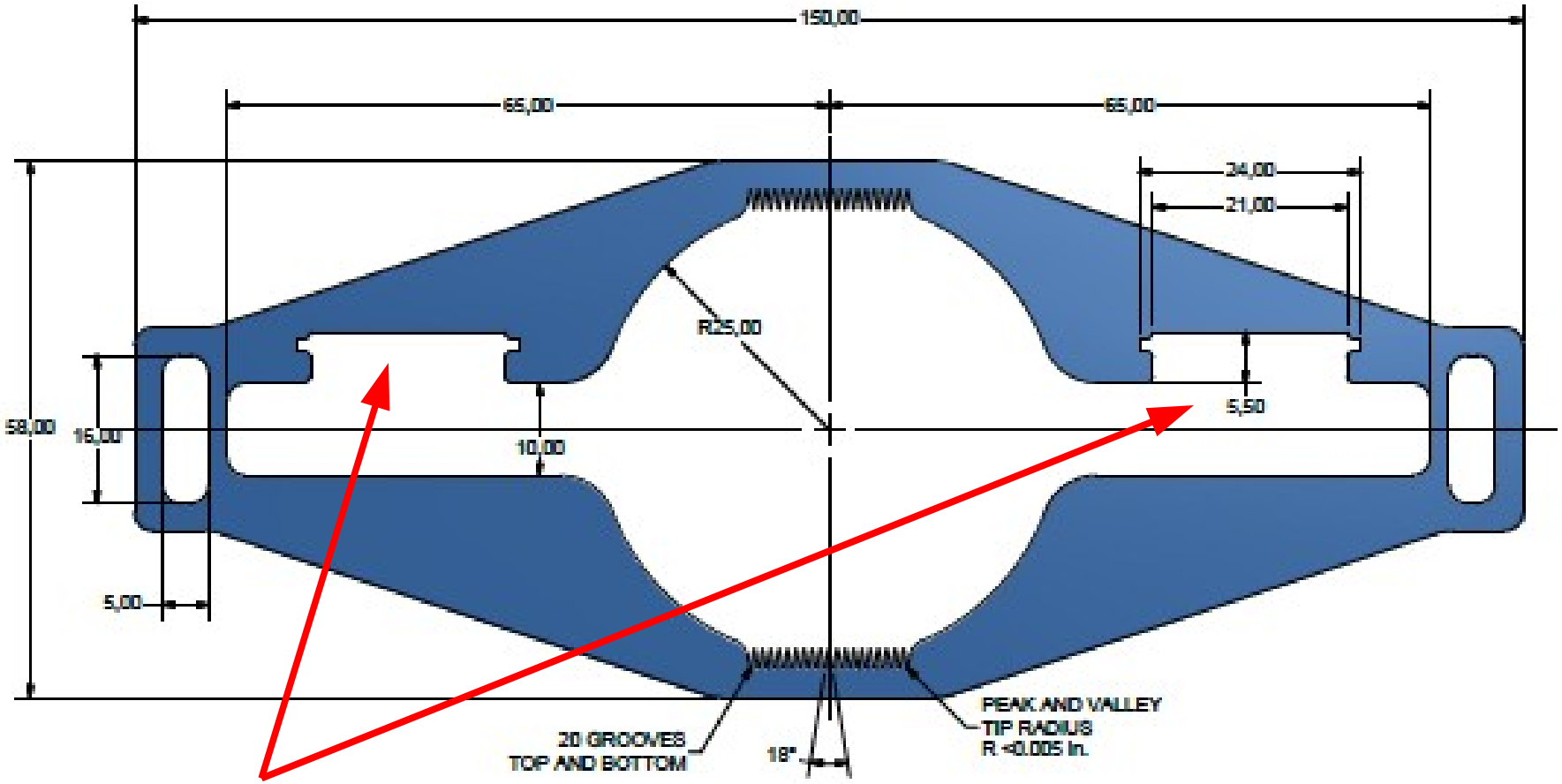
This would reduce the number of electrode chambers required.



Aluminum Dipole Chamber Concept

Radial inside of ring

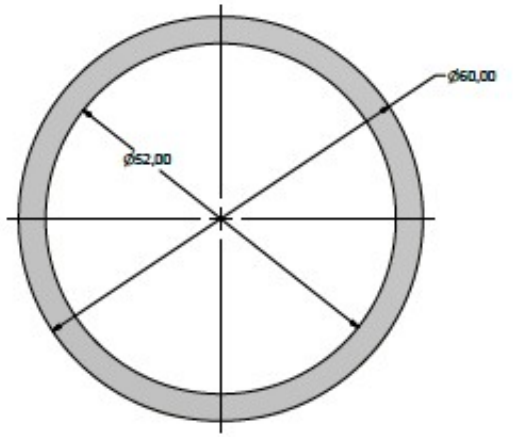
Radial outside of ring



Locations of NEG strips

Vacuum System Summary

- **Tasks underway**
  - Concepts for drift, quadrupole, sextupole chambers in arcs
  - Pumping requirements for straights
    - Will in-situ bakeout of chambers in the straights be required?
    - What are our options?
  - Full ring wall profile for EC simulations



DRIFT CHAMBER

- **Tasks to do**
  - Photon stop & masks conceptual design in wiggler region
  - Full system concept for costing