Argonne NATIONAL LABORATORY

… for a brighter future

U.S. Department of Energy

UChicago ▶ Argonne LLC

Office of Science U.S. DEPARTMENT OF ENERGY

A U.S. Department of Energy laboratory managed by UChicago Argonne, LLC

ILC Damping Ring RDR Lattice – status report

Aimin Xiao and Louis Emery

APS-OAG (ANL)

Presented at ALCPG07/ILCGDE meeting

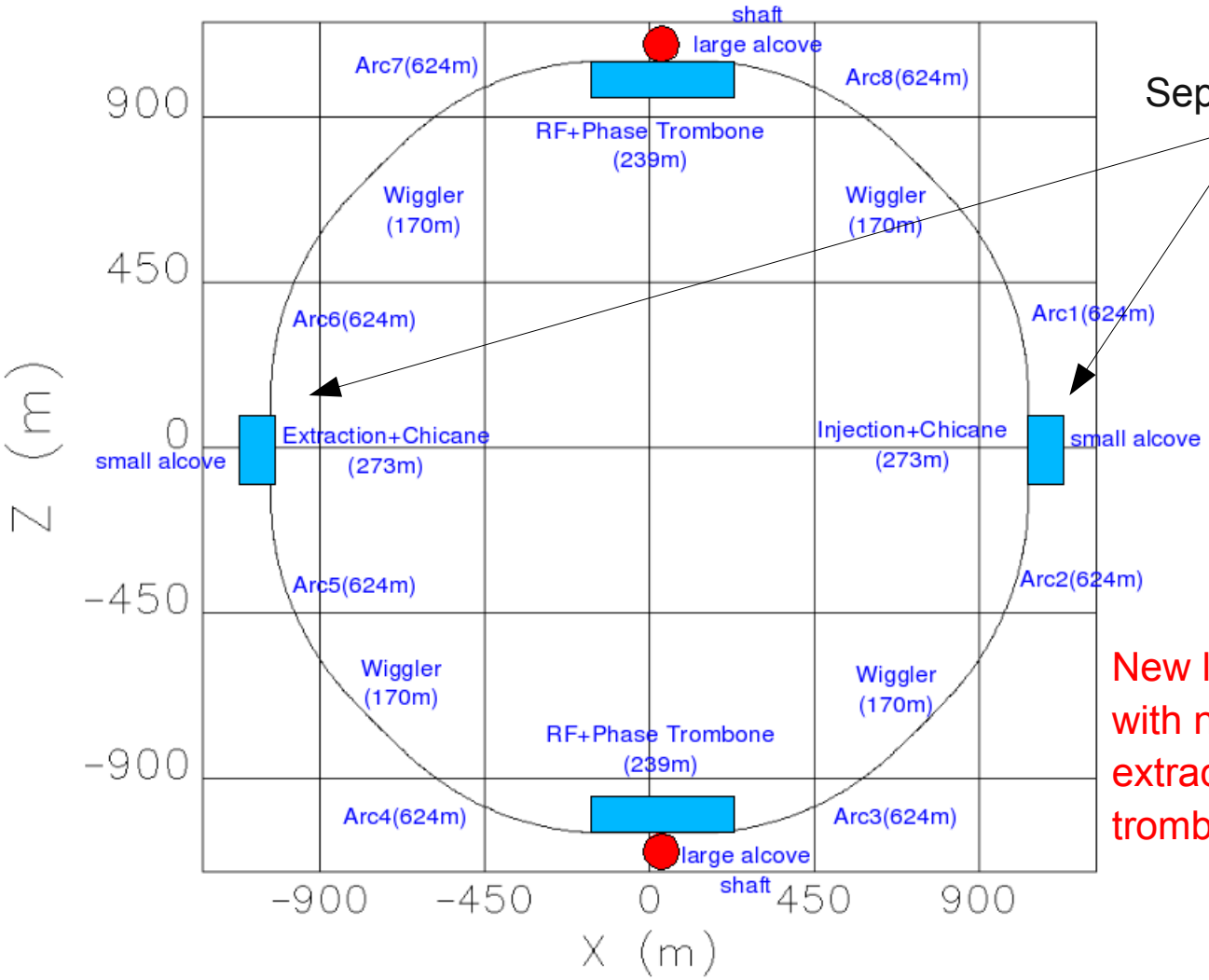
Oct. 23, 2007

Outline

Many changes had been made with OCS6 (baseline design lattice) based on requirement from other system:

- Separated injection/extraction line
- Lumped injection/extraction kickers
- RF sections adjusted to accommodate SC rf cavities
- Phase trombone
- Circumference adjustment chicane
- Dynamic Aperture
- Summary

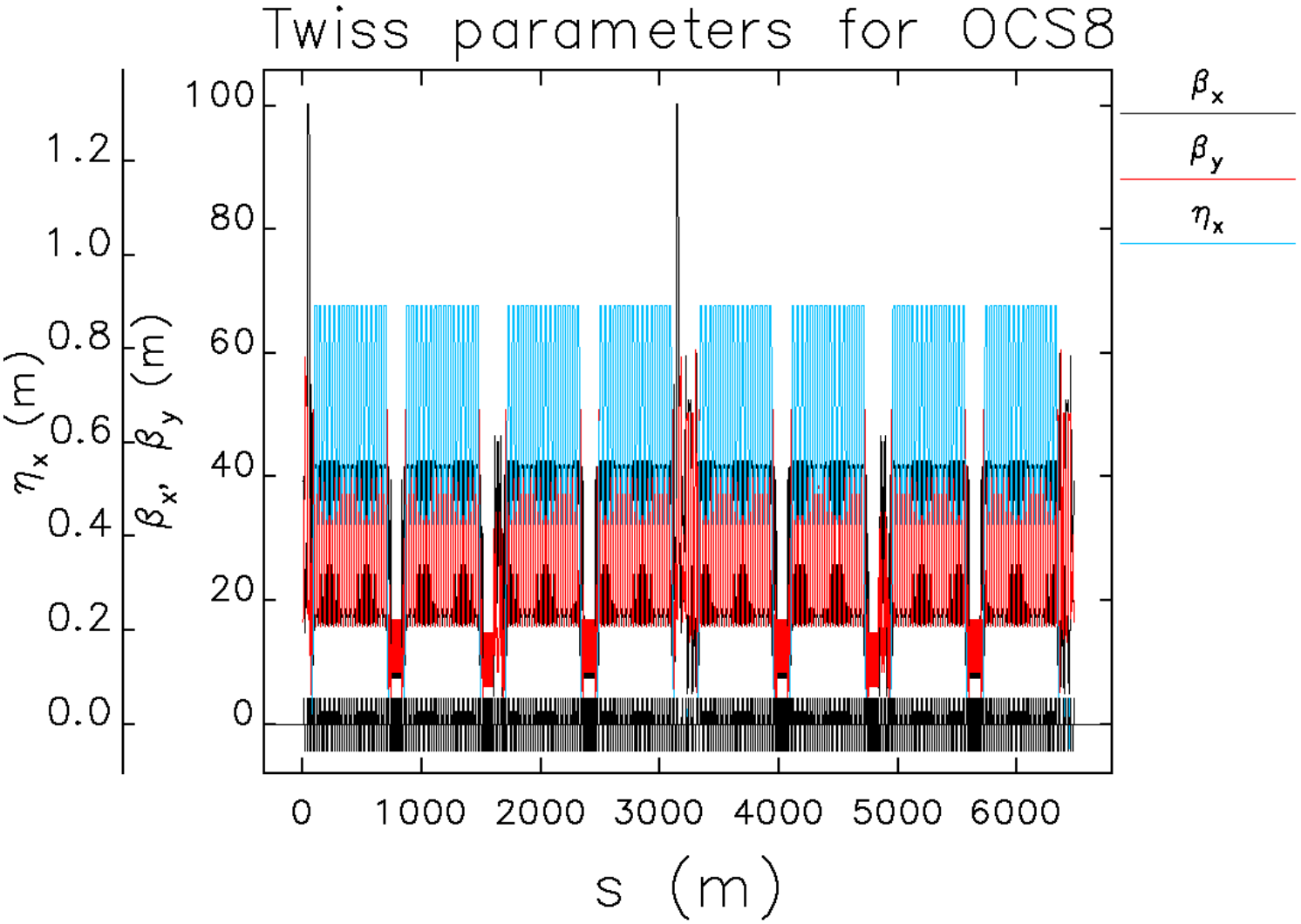
ILC Damping Ring RDR Lattice (OCS8) – Ring's Layout



Separated Injection/Extraction

New lattice has 8 symmetries, with new rf; chicane; injection; extraction; and phase adjustment trombone.

Optical Functions

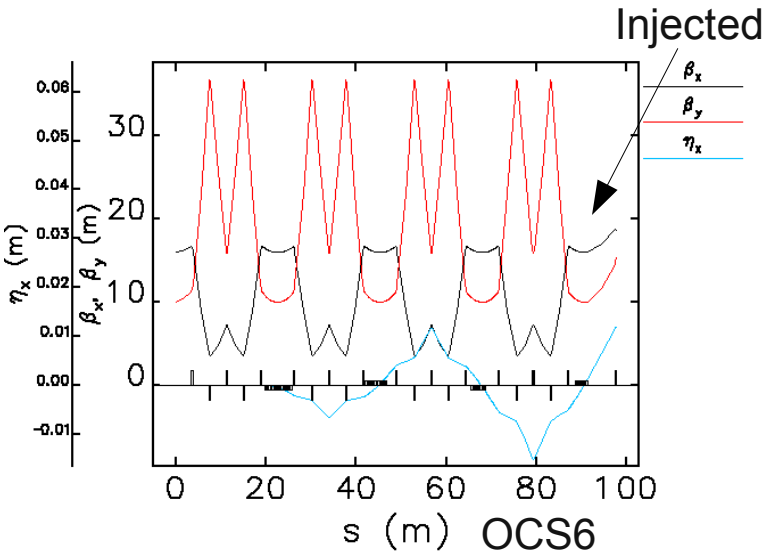


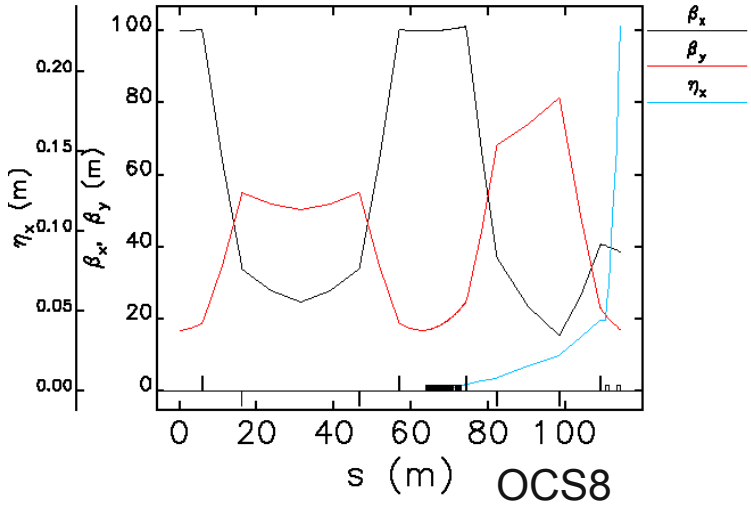
Main Parameters

Table 1: OCS8 Principal Lattice Parameters

Energy	E	5 GeV
Circumference	C	6476.4395 m
Betatron tunes	ν_x, ν_y	49.23, 53.34
Chromaticity	ξ_x, ξ_y	-63.7, -63.3
Momentum compaction	α	3.96×10^{-4}
Natural emittance	$\gamma\epsilon_x$	$4.95\mu m$
Damping time	$\tau_{x(y)}$	25 ms
RF voltage	V_{rf}	21.2 MeV
Energy loss per turn	U_0	8.7 MeV
Momentum acceptance	ϵ_{rf}	1.48%
Synchrotron tune	ν_s	0.06
Equilibrium bunch length	σ_z	9mm
Equilibrium energy spread	σ_δ	0.128%

Lumped Injection/Extraction Line





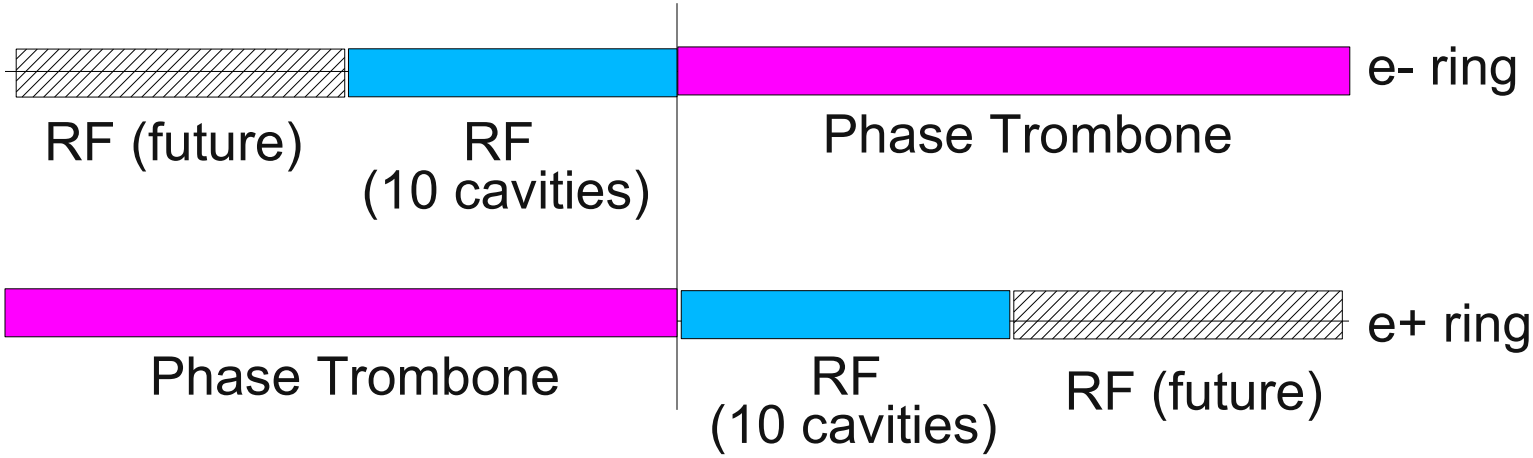
Design of Injection/Extraction

- Strength of fast strip-line kicker is very weak.
- Need 42 strip-lines in total (30 mm gap, 10 kV pulser).
- They have to be put into separated groups with 180^0 phase advance.
- Extraction line is slightly different from injection line due to damped beam size.

- With 70 mm gap and double the pulser voltage, 23 strip-lines are needed, and can be put into one straight section.
- Extraction line is the same as injection line except using less strip-line kickers.

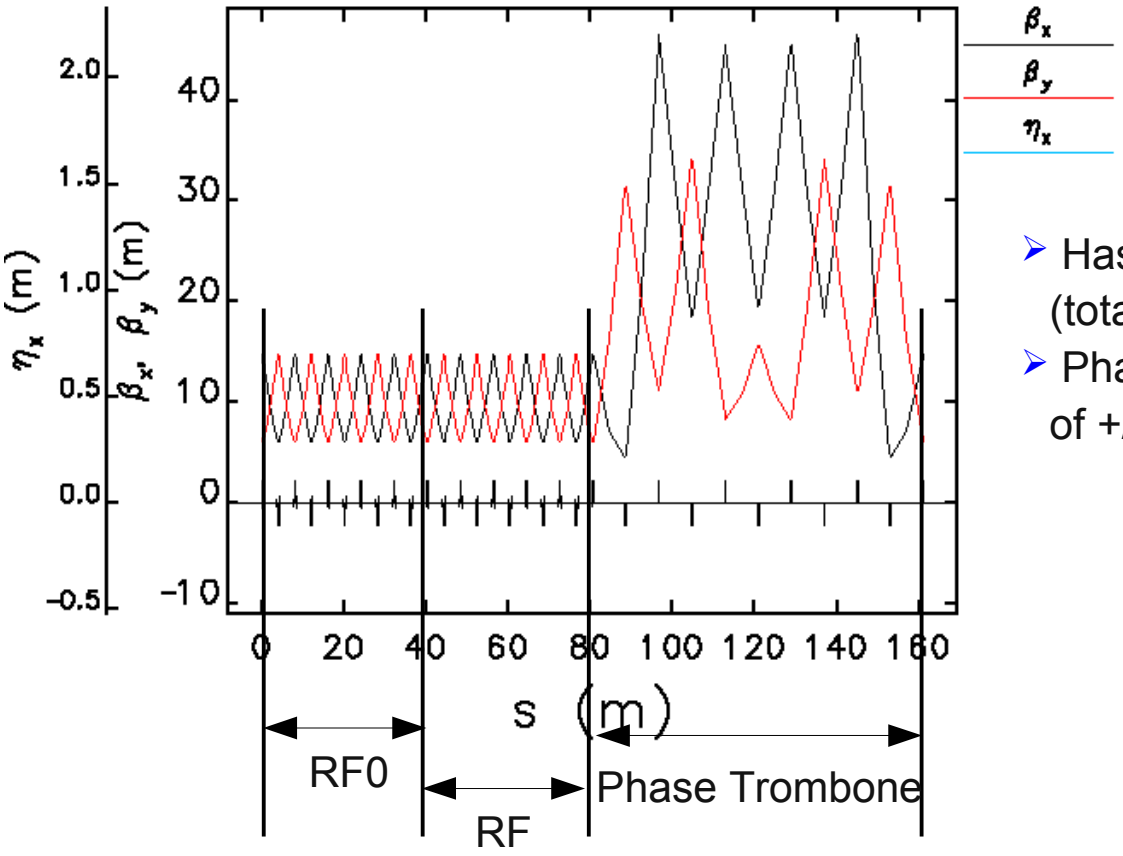
RF Section + Phase Adjustment Trombone

- The designed SC rf cavity has much bigger size than the space left for them in OCS6.
- We learned that they can not be stacked onto each other.
- The needs on preserving free space for future 6mm bunch length operation.
- The required rf section length is about 4 times of previous design and is suitable for occupying a stand alone straight section.



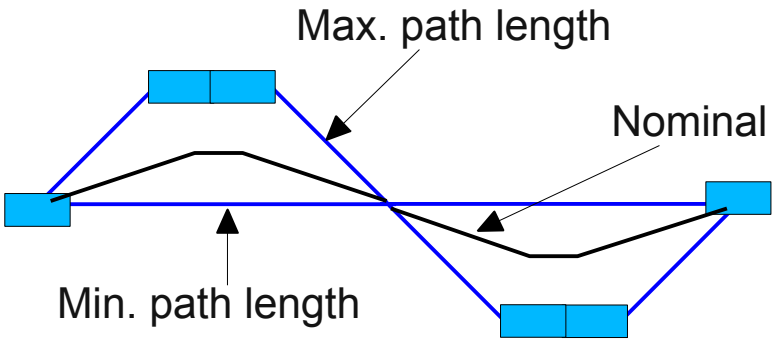
- All sections have same lattice configuration. So, magnets stand up on each other.
- Two sectors in the ring

RF Section + Phase Adjustment Trombone

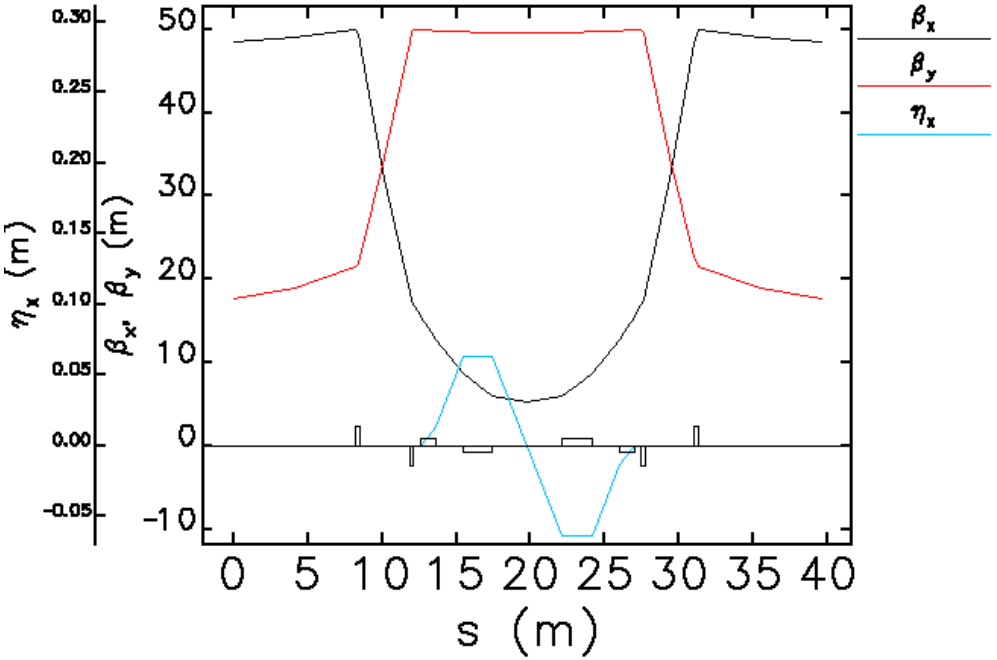


- Has ability to install 10 + 10 rf cavities (total 20 + 20)
- Phase trombone has adjustment ability of +/- 0.25 (total +/- 0.5)

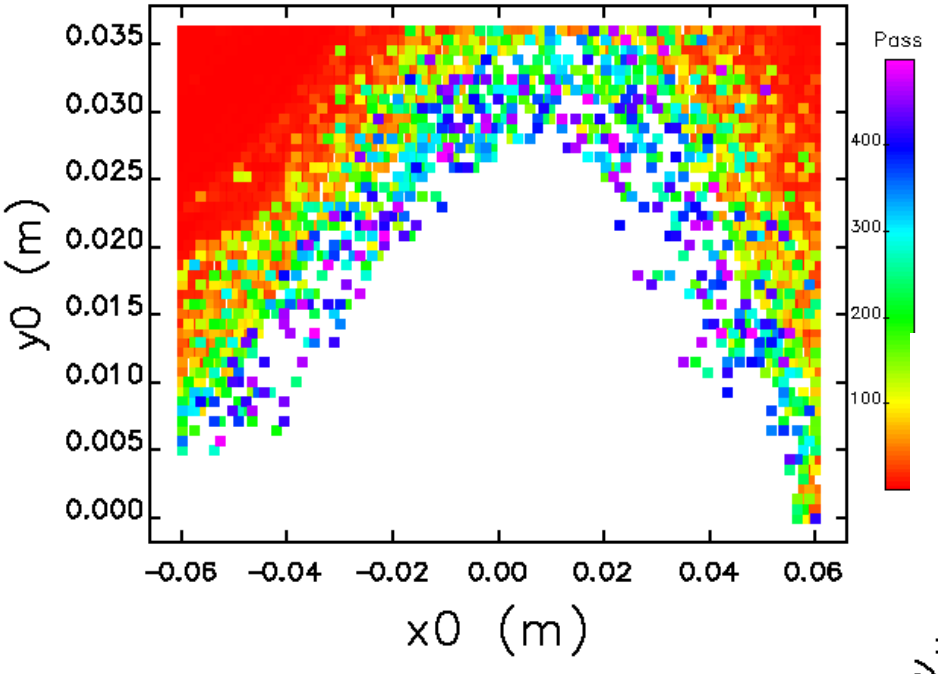
Circumference Adjustment Chicane



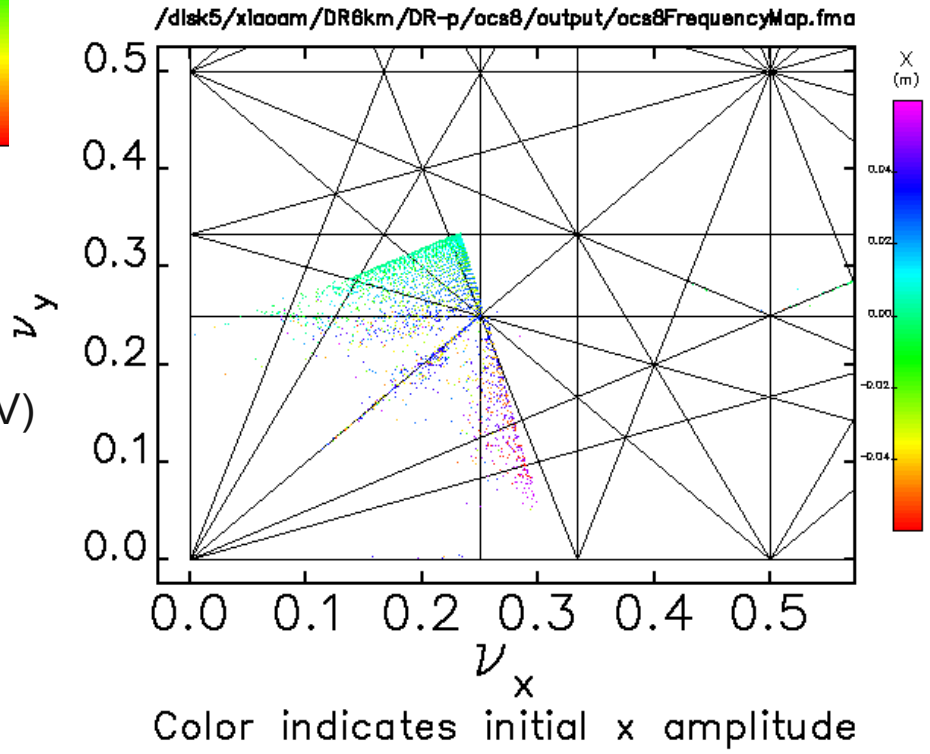
- Adjustment ability: ±7.5 mm
- Emittance dilution: ~15%
- Total 4 cells



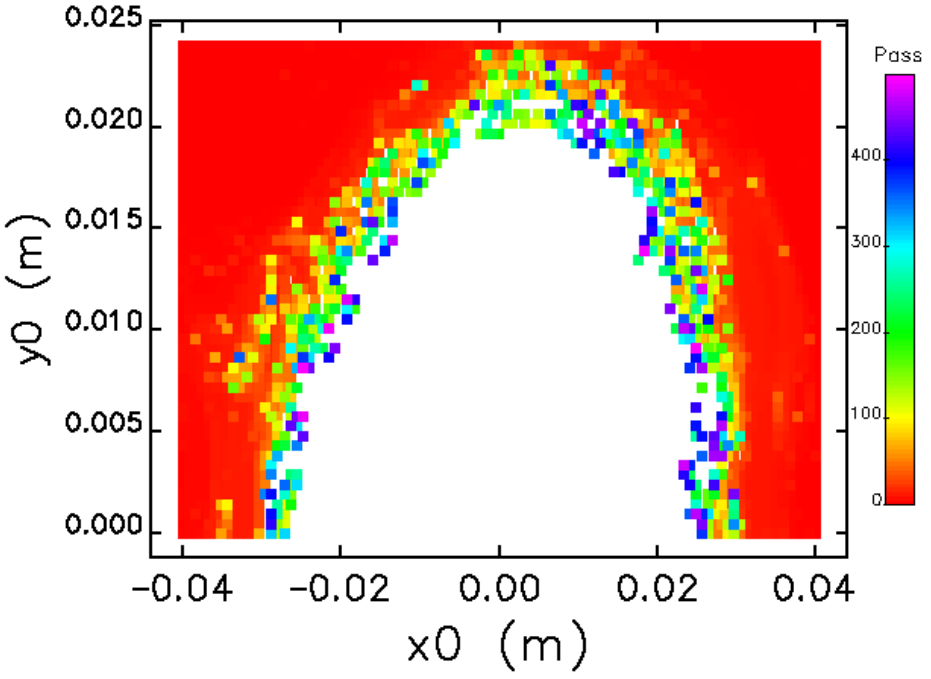
Dynamic Aperture – without multipole errors



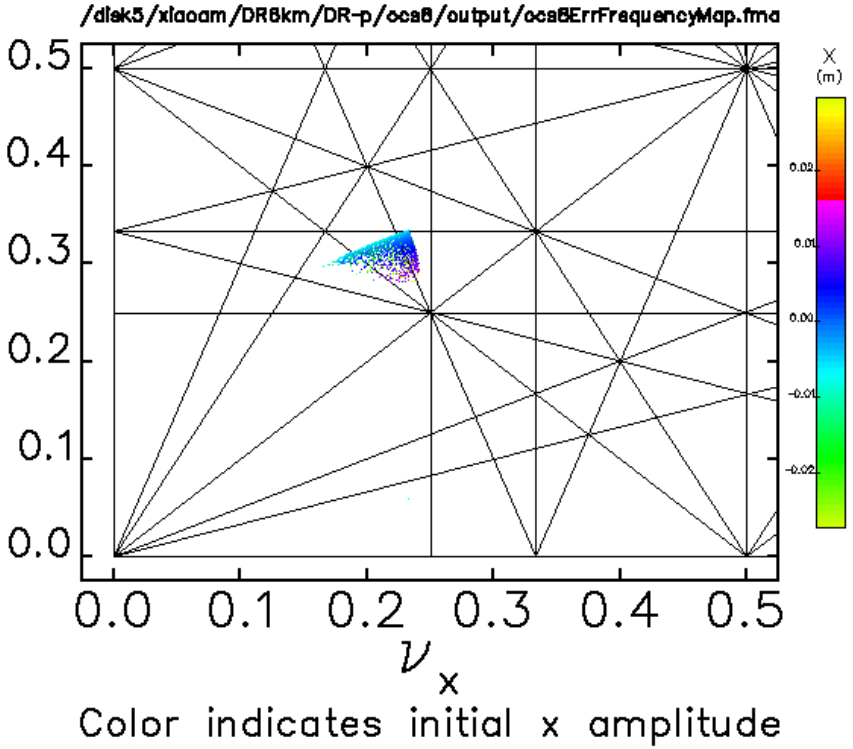
Injection beam size: 20 mm (H) x 12 mm (V)



Dynamic Aperture – with Multipole Errors



Injection beam size: 20 mm (H) x 12 mm (V)



Color indicates initial x amplitude

[Error specified by Y. Cai (SLAC).]

- The original data is for bore radius of 50mm.
- We scaled the data to bore radius of 30mm.
- Larger magnet size (= weak multipole error strength) gives larger dynamic aperture.

Summary

- Lattice had been updated for new injection/extraction configuration.
- The circumference was adjusted to suit the new rf harmonic number.
- New rf region for accommodating large SC rf cavity.
- Added phase trombone (may not be needed) and chicane.
- The dynamic aperture had been checked with and without error.
- More changes will be done as we know more details in both technology and physics development.