

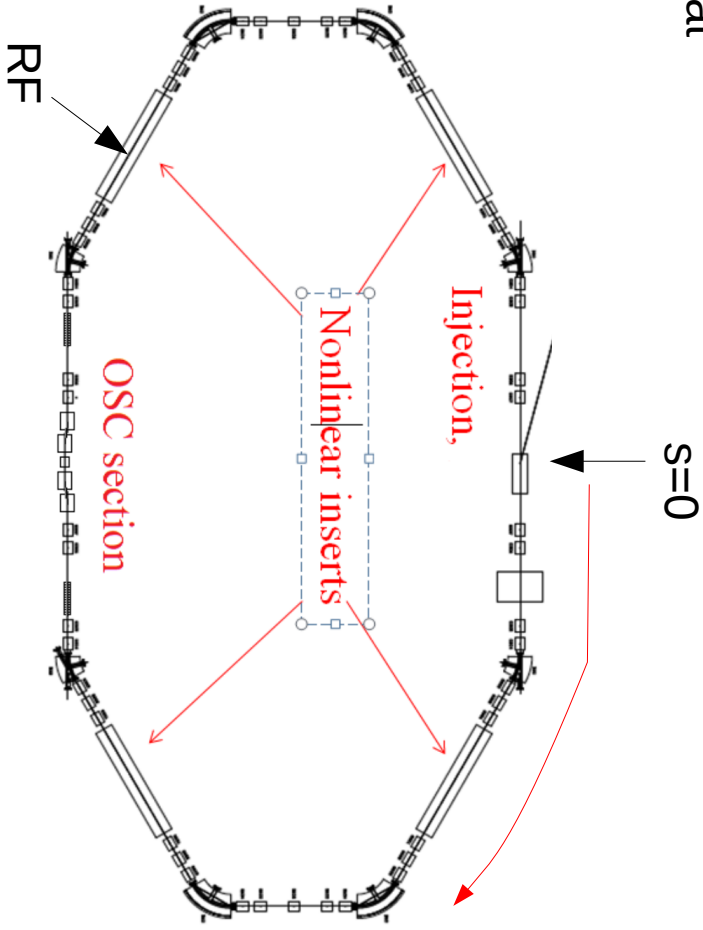
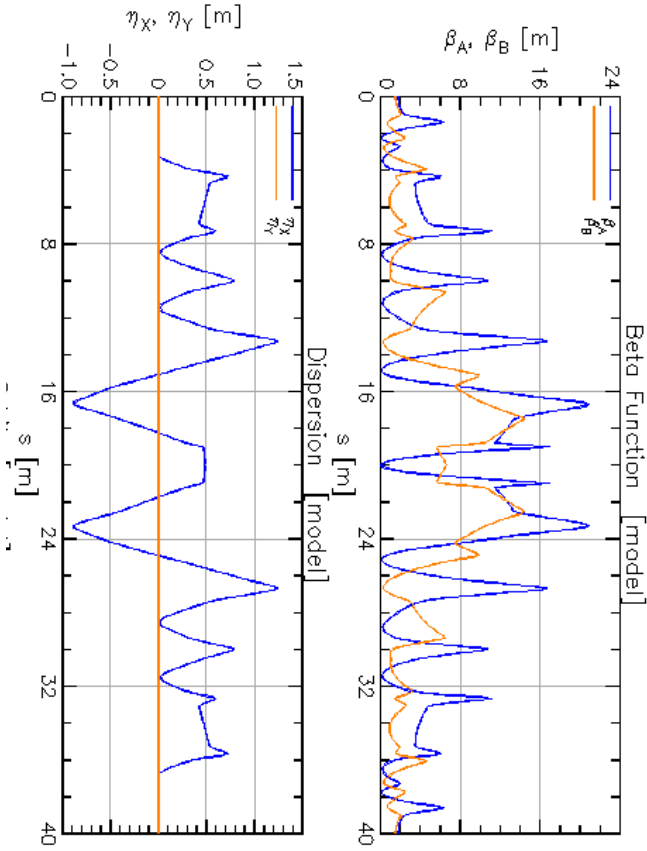
# OSC simulation update

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1. IOTA OSC lattice nonlinear effect
2. Gated camera sensitivity

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/home/sw5665/sw5665/osc/iota\_lat/lat/iota\_osc.lat



	Model	X	Design	Model	Y	Design
$Q$	5.4636		5.4636	3.5271		3.5271
Chrom	10.2753		10.2753	-1.3418		-1.3418
J_damp	1.1470		1.1470	0.9999		0.9999
Emittance	<b>4.371E-09</b>		4.371E-09	5.199E-13		5.199E-13
Alpha_damp	7.562E-08		7.562E-08	6.592E-08		6.592E-08

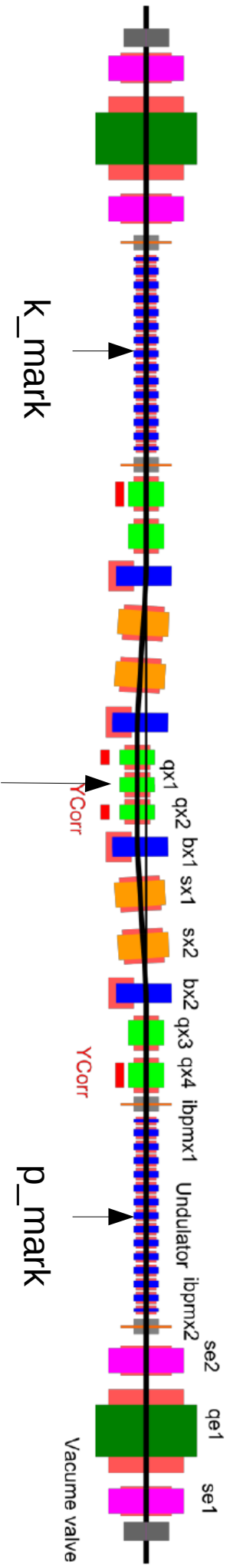
E=100.511 MeV  
 L=39.97 m  
 $f_{rev}=7.505\text{MHz}$

Z_tune:	0.00000	Model	Design		The design value is calculated with RF on
Sig_E/E:	<b>1.061E-04</b>		1.061E-04		
Sig_z:	<b>1.998E-01</b>		1.998E-01		! Only calculated when RF is on
Energy Loss:	<b>1.325E+01</b>		1.325E+01		! Energy Loss (eV / Turn)
J_damp:	1.853E+00		1.853E+00		! Longitudinal Damping Partition #
Alpha_damp:	1.222E-07		1.222E-07		! Longitudinal Damping per turn
Alpha_p:	<b>-1.666E-02</b>		-1.666E-02		! Momentum Compaction

RF:  
 $V_r=30\text{ V}$   
 Hamon=4  
 $\sigma_{pmax}=1.0E-3$   
 $Q_z=5.457E-5$

# OSC bypass parameters

$\Delta s = 2 \text{ mm}$ ,  $N_u = 7$ ,  $B = 0.1005 \text{ T}$ ,  $\lambda_u = 0.111 \text{ m}$ ,  $\lambda = 2.2 \text{ }\mu\text{m}$



$\eta_x^* = 0.48 \text{ m}$ ,  $\beta_x^* = 0.072 \text{ m}$ ,  $\beta_y^* = 6.6 \text{ m}$

m51 = -2.0172E-04  
 m52 = -4.2945E-03  
 m56 = 3.9401E-03  
 m56\_t = 1.6549E-03



$\epsilon_{x \text{ max}} = 4.5702E-07$      $\sigma_{p \text{ max}} = 5.0885E-04$   
 $\eta_x = 10.9$ ,     $\eta_s = 4.8$   
 $\lambda_x / \lambda_s = 1.38$

p\_mark:  
 $\beta_x = 12.349$ ,  $\alpha_x = 0.77752$ ,  $\gamma_x = 0.122993$   
 $\eta_x = 5.9647E-03$ ,  $\eta_{px} = 0.53186$ ,  $\phi_x = 15.594$

k\_mark:  
 $\beta_x = 12.350$ ,  $\alpha_x = -0.77789$ ,  $\gamma_x = 1.2997E-01$   
 $\eta_x = 6.0831E-03$ ,  $\eta_{px} = -0.53178$ ,  $\phi_x = 18.735$

$\Delta\phi_x = 3.1404 \sim \pi$ , phase difference between p\_mark and k\_mark

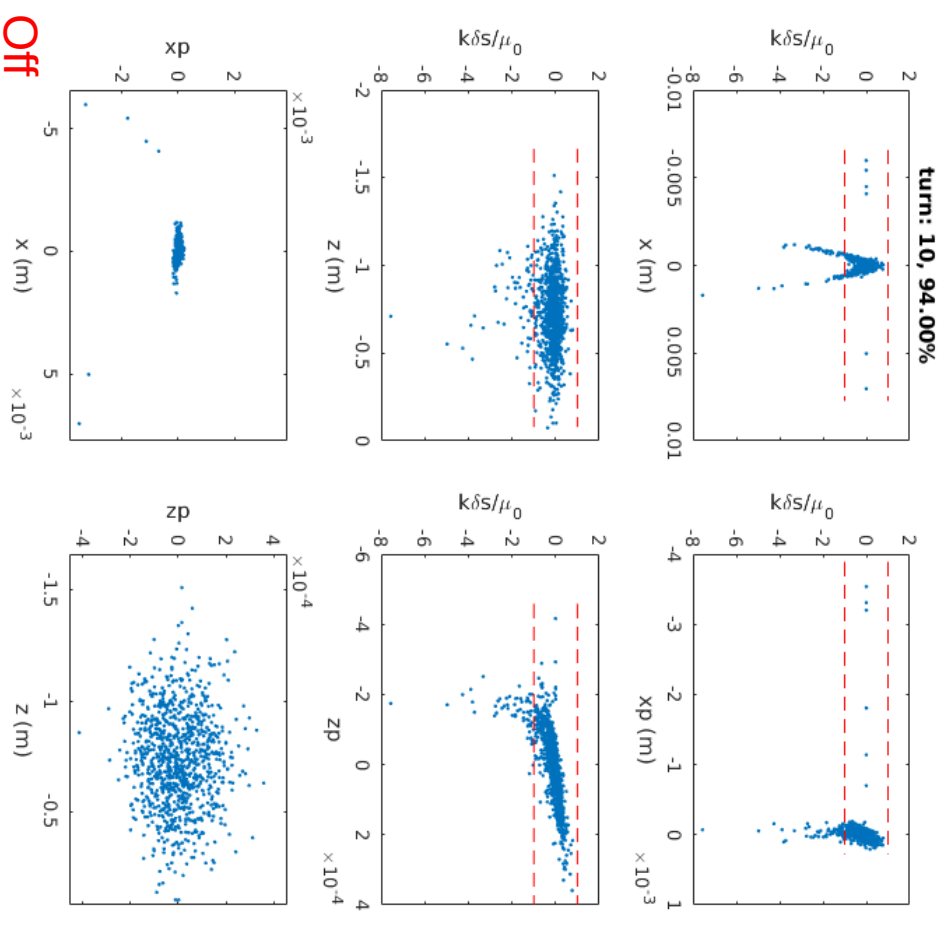
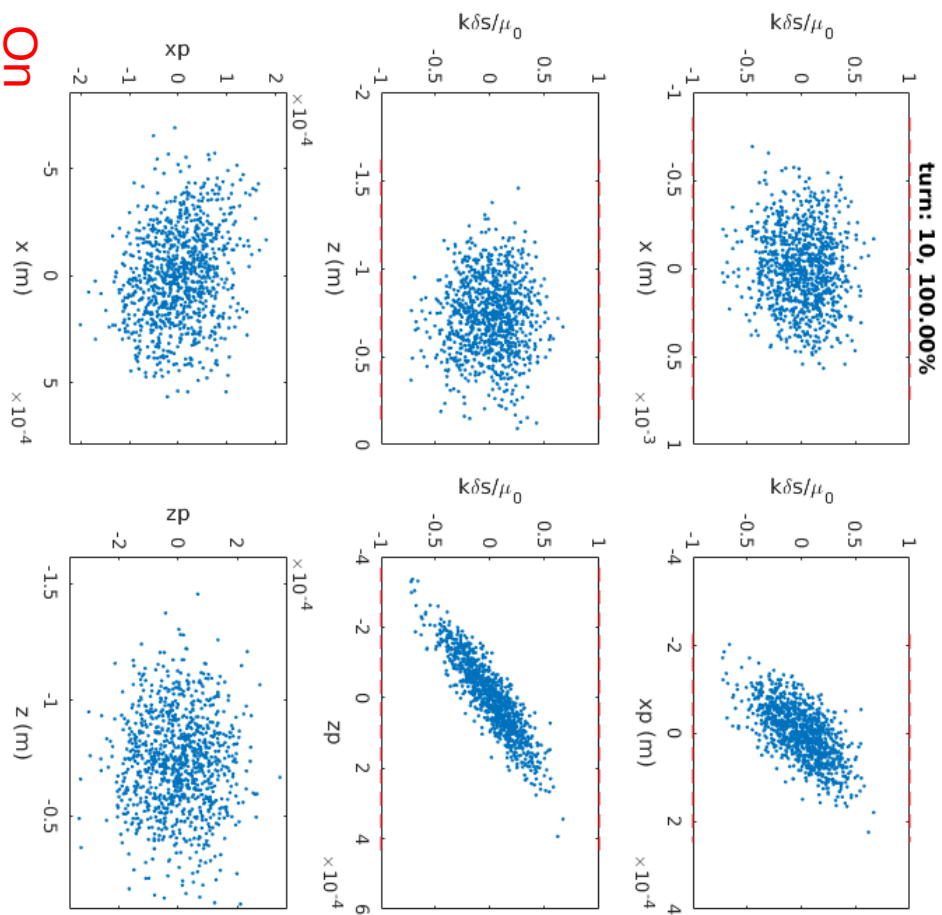
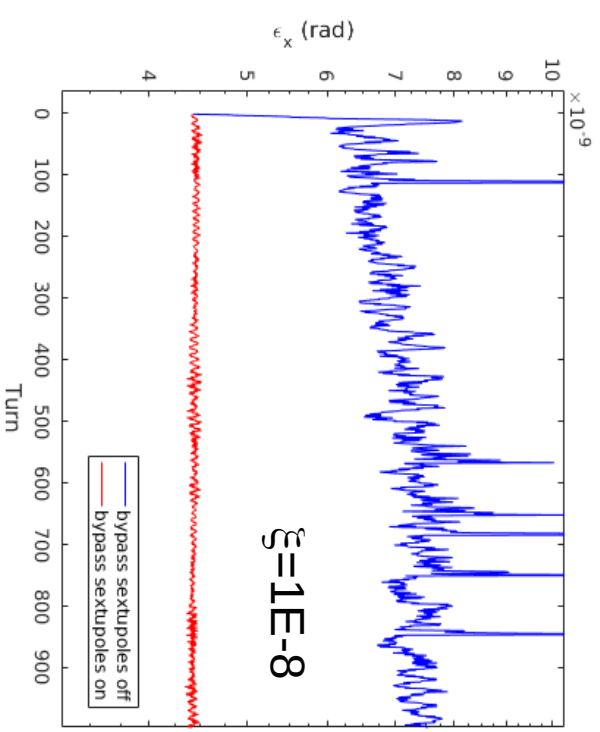
Turn off four sextupoles in the bypass

Chromaticity:  $\chi_h = -237.4860$ ,  $\chi_v = 90.1238$

Many particles outside the envelope due to nonlinear path lengthening

Results in horizontal emittance increase

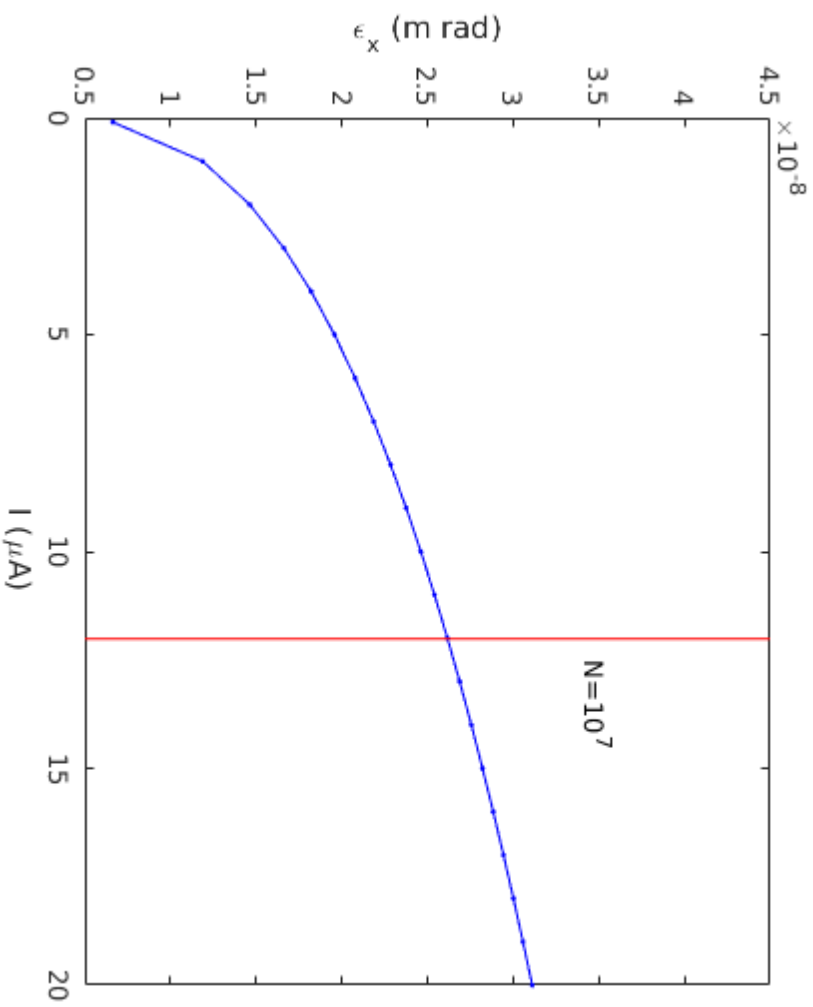
$\epsilon_x = 4.37$  nm rad, designed emittance



On

Off

# IBS effect

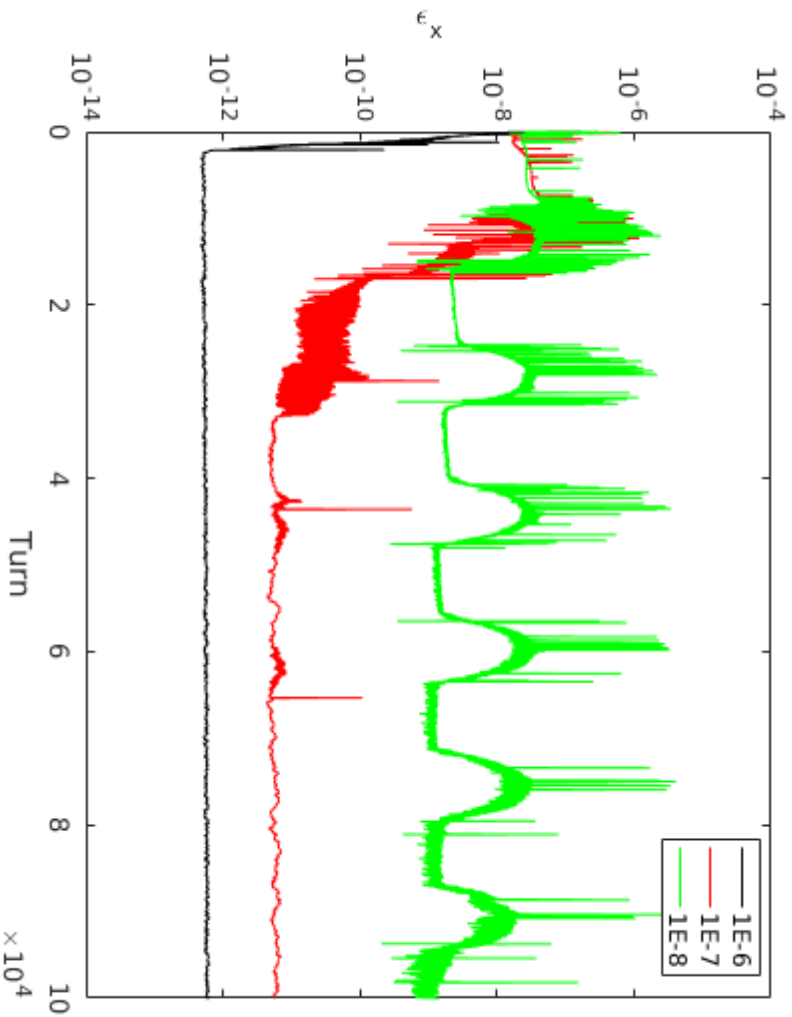


$\epsilon_x = 4.37$  nm rad @  $0 \mu\text{A}$

$\epsilon_x = 26.2$  nm rad @  $12 \mu\text{A}$  ( $N = 10^7$ )

$\eta_x = 4.18$

$\epsilon_x = 26.2$  nm rad



Track 1000 particles for 1E5 turns using map method

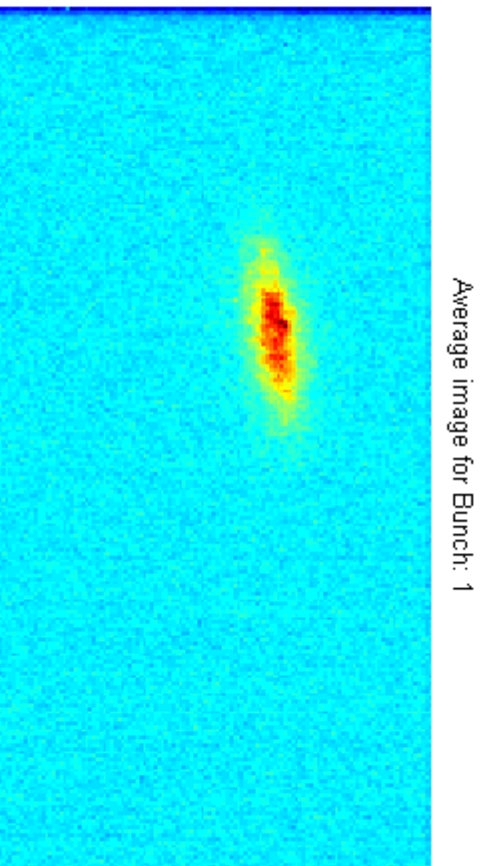
More particles lost with lower  $\xi$

$\xi$	Survived N
1E-6	882 (88.2%)
1E-7	118 (11.8%)
1E-8	11 (1.1%)
1E-9	49
1E-10	27
1E-11	34
1E-12	40
1E-13	33

The 1<sup>st</sup> order map may not represent the nonlinear effect from the rest rings.

Need higher order maps.

## Gated camera test for low light



Single electron bunch  $I=2.5$  mA

OD=3, 0.1% transmission

Equivalent to 2.5  $\mu$ A bunch

Gain=100, gate width=3 ns

Averaged 100 images which  
equivalent to  $2.56E-4$  s (100 turns)

## White beam power

Measured the visible white beam power with Thorlabs power meter  
at CHESS conditions (110 mA electrons)

$P=0.1\sim 0.2$  mW after a beam splitter,

Assume a 500nm light  $\rightarrow 5.03E14 \sim 1.0E15$  photons/s @ 110 mA

At 1  $\mu$ A,  $4.6E9 \sim 9.1E9$  photons/s

# Summary

- Strong nonlinear effect in the IOTA lattice
- Simulation with IBS-dominated emittance
- Gated camera sensitivity