OSC simulation update

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1. IOTA OSC lattice

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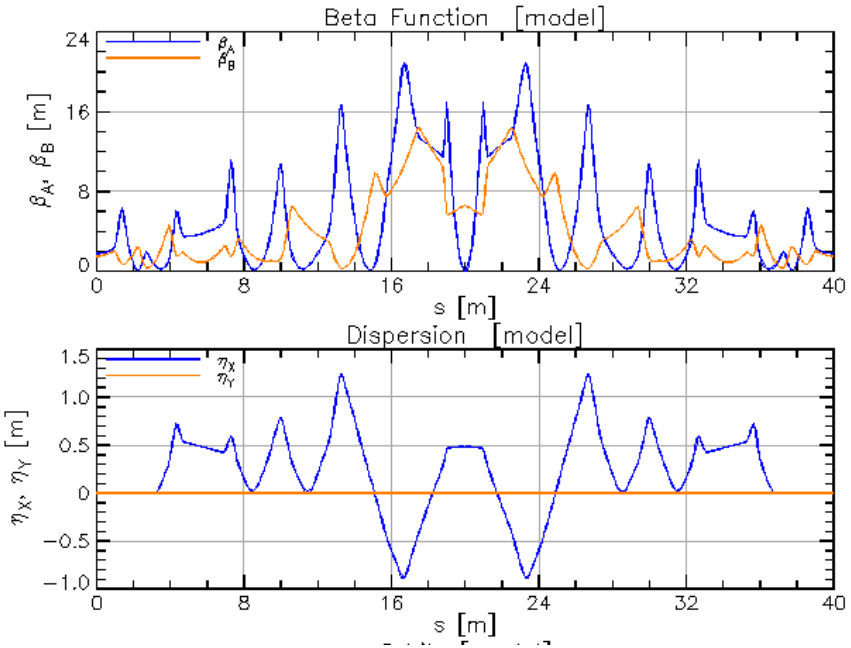
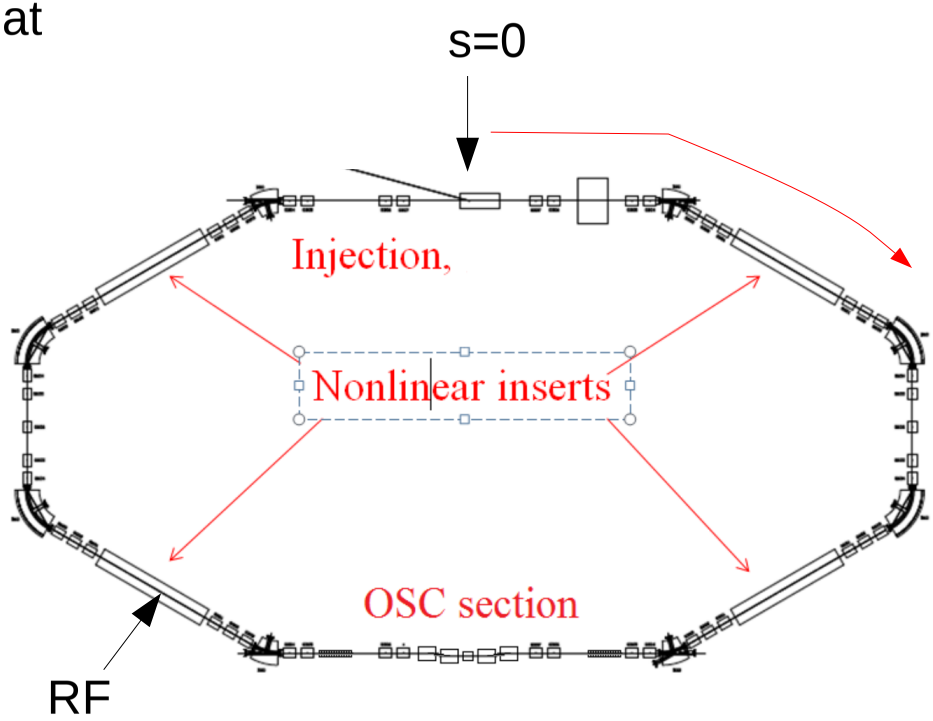
Use AML-UAP to translate IOTA lattice from MADX to BMAD (version 8/8/2016)

/home/sw565/sw565/osc/iota_lat/lat/iota_osc.lat





	X		Y		
	Model	Design	Model	Design	
Q	5.4636	5.4636	3.5271	3.5271	! Tune
Chrom	10.2753	10.2753	-1.3418	-1.3418	! dQ/(dE/E)
J_damp	1.1541	1.1541	0.9999	0.9999	! Damping Partition #
Emittance	3.835E-09	3.835E-09	5.191E-13	5.191E-13	! Meters
Alpha_damp	7.609E-08	7.609E-08	6.592E-08	6.592E-08	! Damping per turn

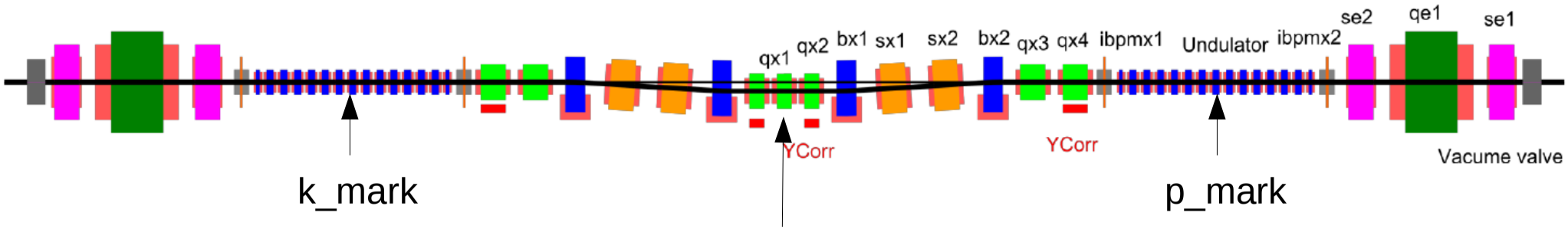
	Model	Design	
Z_tune:	0.0000	0.0000	! The design value is calculated with RF on
Sig_E/E:	1.063E-04	1.063E-04	
Sig_z:	2.050E-01	2.050E-01	! Only calculated when RF is on
Energy Loss:	1.325E+01	1.325E+01	! Energy_Loss (eV / Turn)
J_damp:	1.846E+00	1.846E+00	! Longitudinal Damping Partition #
Alpha_damp:	1.217E-07	1.217E-07	! Longitudinal Damping per turn
Alpha_p:	-1.747E-02	-1.747E-02	! Momentum Compaction

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

RF:
V_{rf}=30 V
Hamon=4
σ_{pmax}=1.0E-3
Q_z=5.457E-5

OSC bypass parameters

Δs=2 mm, N_u=7, B=0.1005 T, λ_u=0.111 m, λ=2.2 μm



η_x*=0.48 m, β_x*=0.072 m, β_y*=6.6 m

m51 = -2.0172E-04
m52 = -4.2945E-03
m56 = 3.9401E-03
m56_t = 1.6549E-03

$\varepsilon_{x\,max}$ = 4.5702E-07 $\sigma_{p\,max}$ = 5.0885E-04

n_x = 10.9, n_s = 4.8

λ_x/λ_s=1.38

p_mark:

β_x = 12.349, α_x = 0.77752, γ_x = 0.12993

η_x = 5.9647E-03, η_{px} = 0.53186, ϕ_x = 15.594

k_mark:

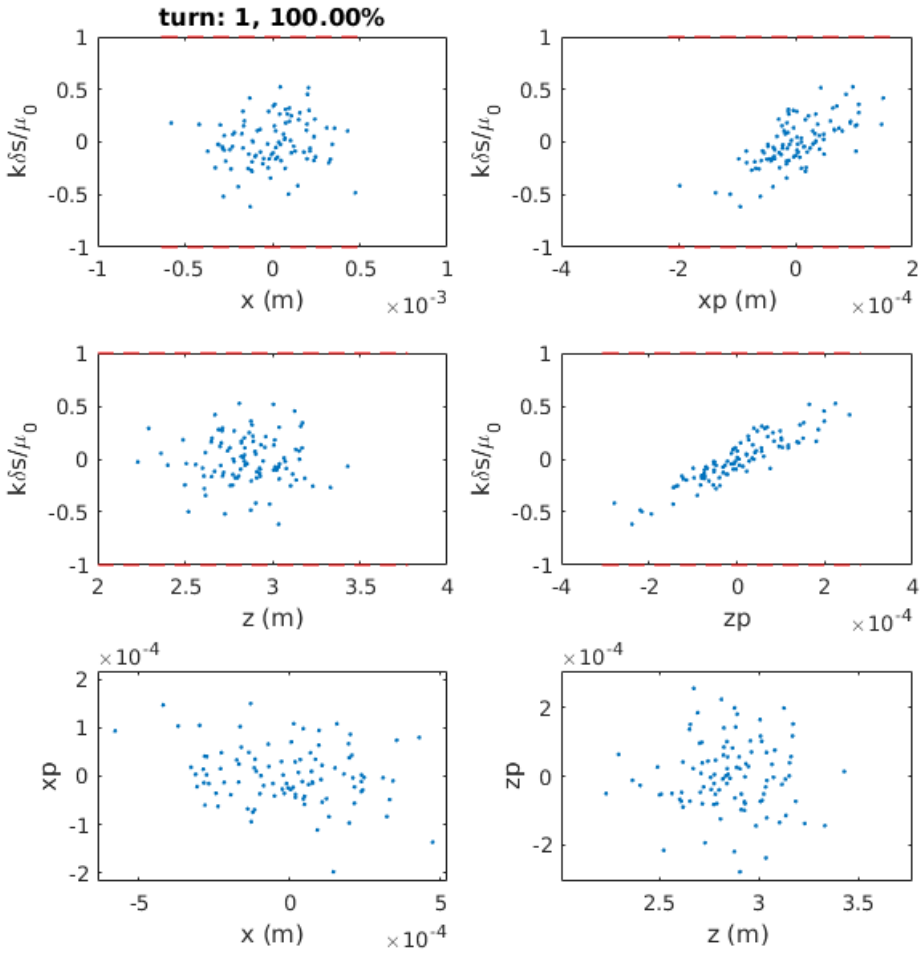
β_x = 12.350, α_x = -0.77789, γ_x = 1.2997E-01

η_x = 6.0831E-03, η_{px} = -0.53178, ϕ_x = 18.735

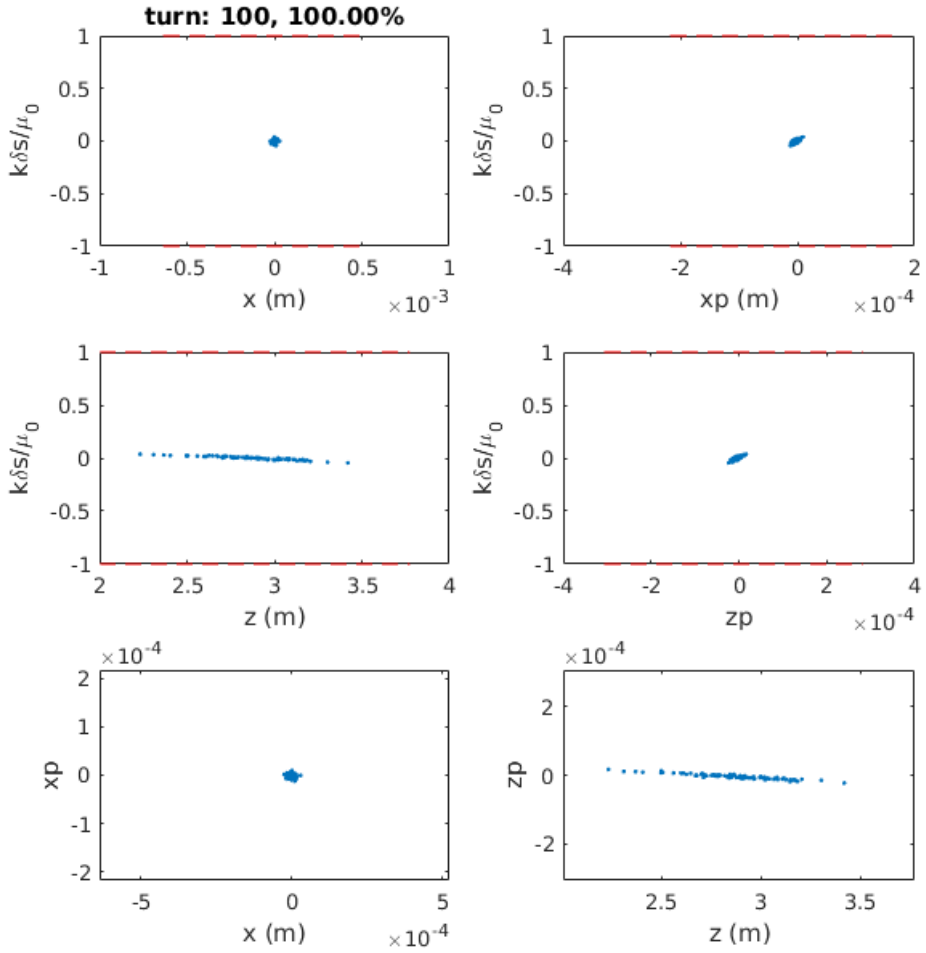
$\Delta\phi_x$=3.1404 ~ π, phase difference between p_mark and k_mark

Without incoherent kicks

Track 1000 particles for 1000 turns ξ=1E-6, λ=2.2 μm

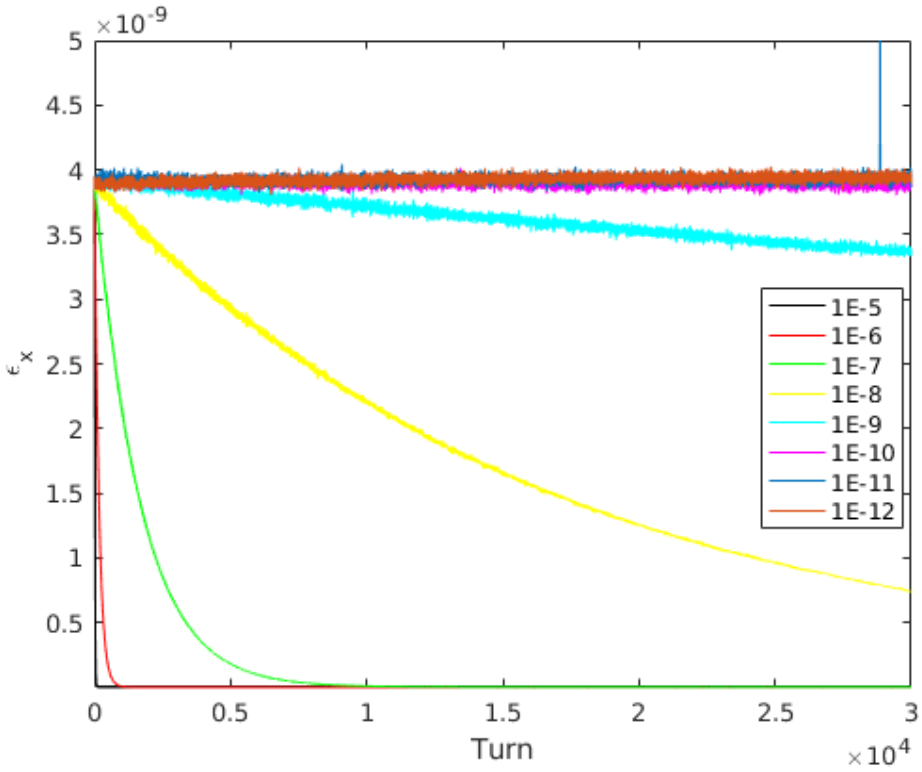


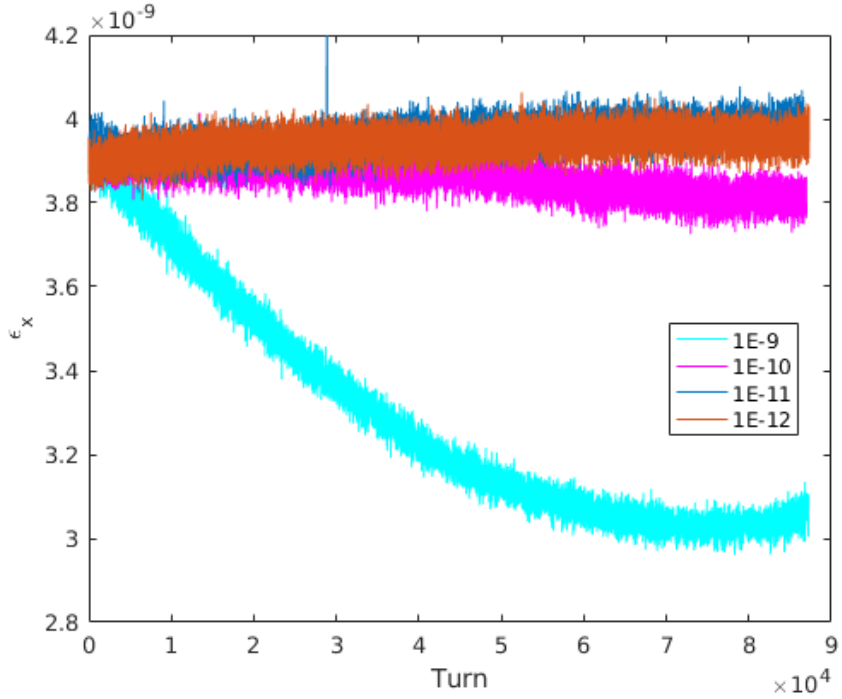
Turn 1



Turn 1000

Without incoherent kicks

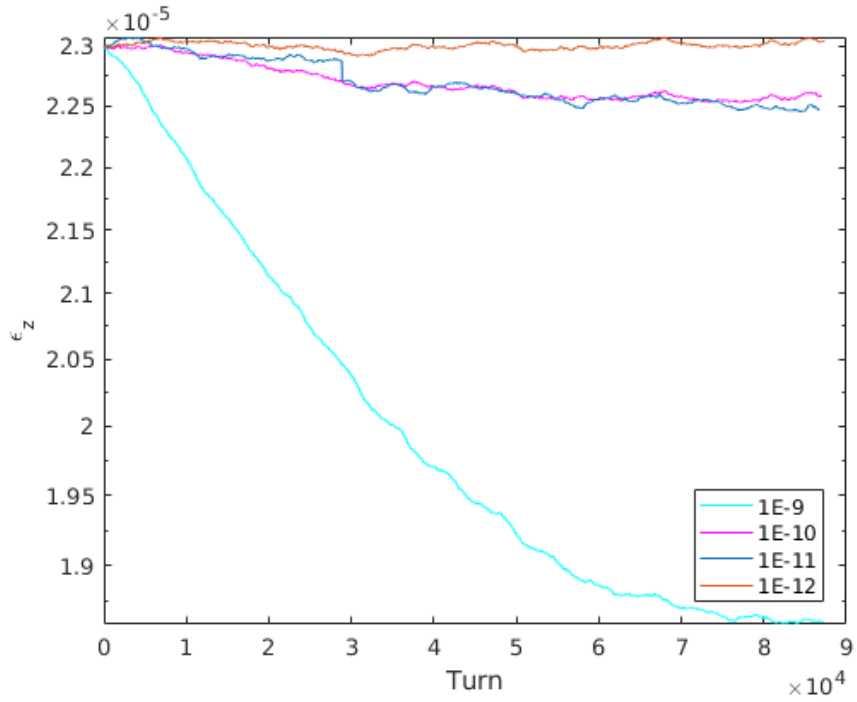




Track 1000 particles for 1E5 turns when varying ξ

Observe both horizontal and longitudinal cooling when ξ is between 1E-5 and 1E-10 within 1E5 turns

For IOTA ring, 1 turn = 1.33E-7 s
X damping time: 1.3317E7 turns ~ 1.8 s



Adding incoherent kicks

N_u=7, λ=2.2 μm, σ_z=0.205 m, N_particle=1E7

(For CESR 1E9, σ_{inco}=280.8)

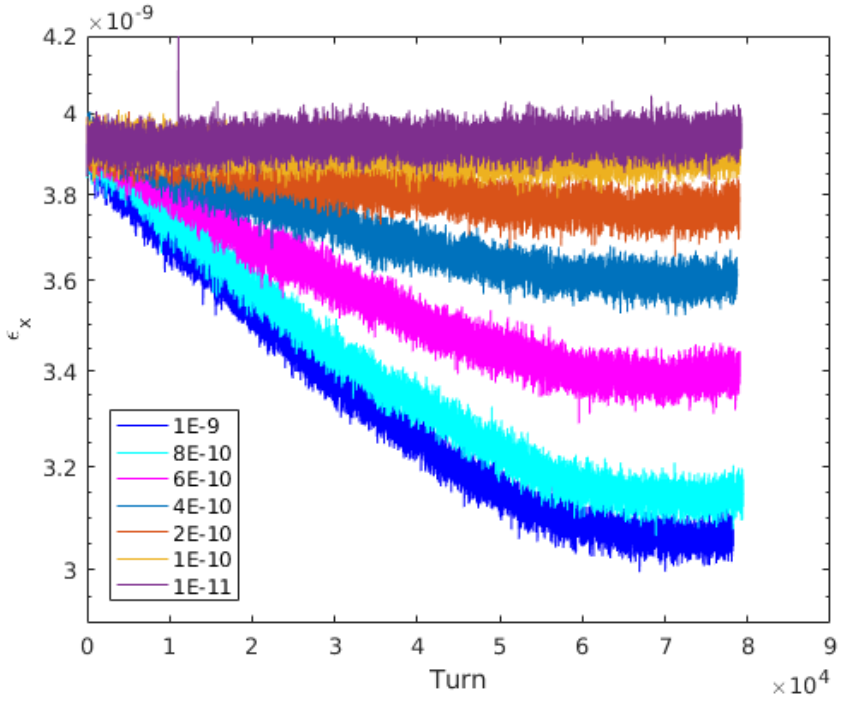
Within a slice [-$N_u\lambda/2$, $N_u\lambda/2$], the maximum number:

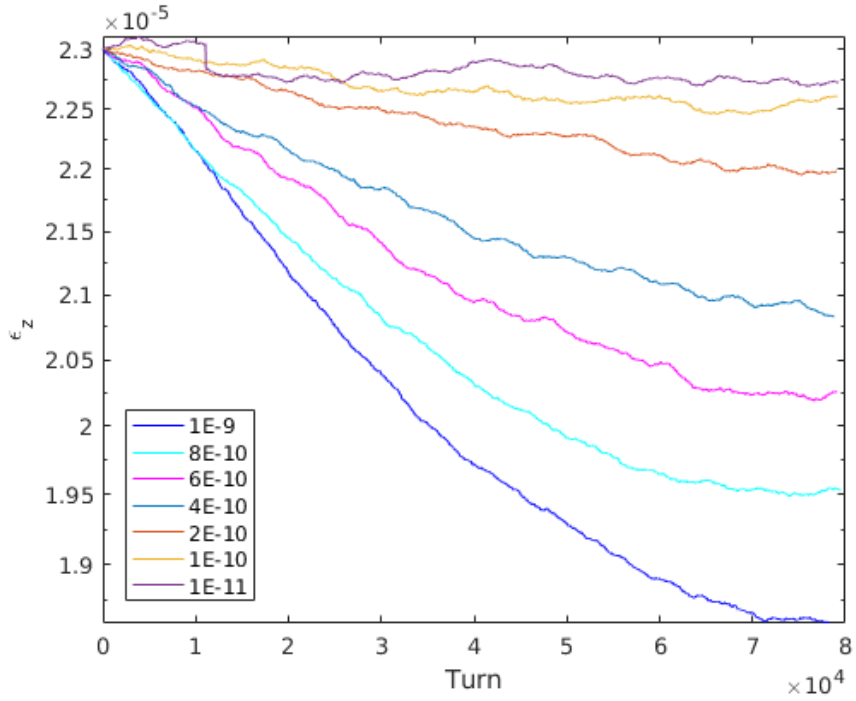
N_slice = N_particle*(P($N_u\lambda/2$)-P(-$N_u\lambda/2$)) = 299.69

$\Rightarrow$

σ_{inco}=12.2 for N=1E7

=122 for N=1E9





Observe heating when ξ > 1E-8 (not plotted) and cooling when ξ < 1E-8

The ξ=8.5E-10 in the first stage without amplifier may work for IOTA.

(M. Andorf et al, NPAC2016 paper)

Summary

- IOTA lattice format translated to BMAD
- Simulation with or without incoherent kicks
  - For IOTA ring with 1E7 particles in a bunch, the incoherent kick effect is negligible.