OSC simulation update

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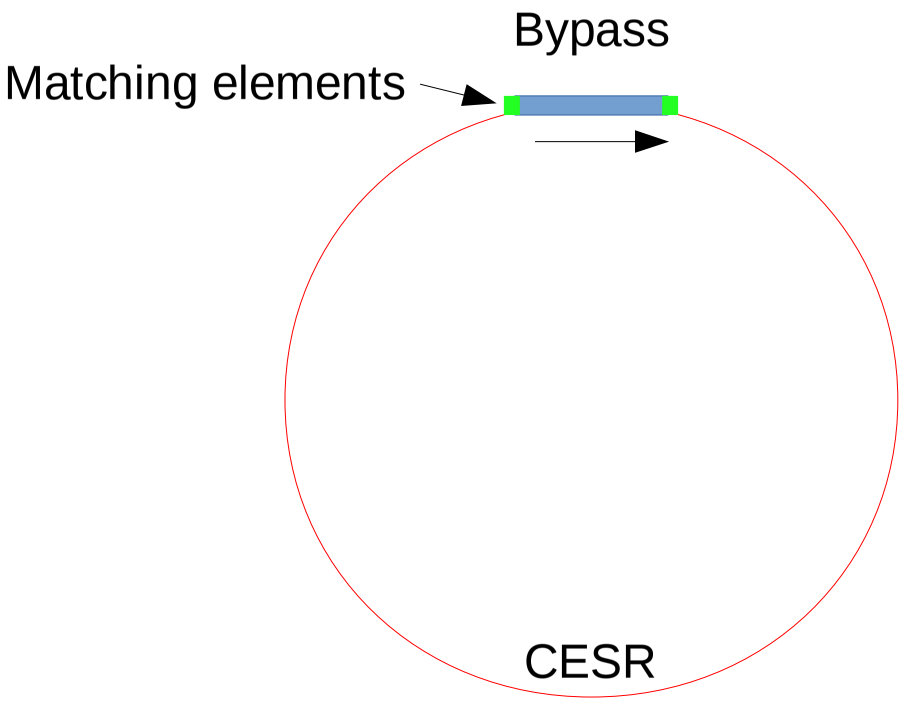
12/19/2017

Tracking with CESR transfer matrix



Track through bypass line
Track the match element and CESR with their transfer matrix

Apply radiation damping and excitation kicks at the end of matching element with zero dispersions ($\eta_x=0$, $\eta_x'=0$).

Radiation kicks: $\Delta p_x=-k_R p_x$, $\Delta p_y=-k_R p_y$, $\Delta p_z=-k_R(1+p_z)^2$, $k_R=U_0/E_0$

Excitation kicks: $\Delta p_{x,y,z}=2R\,\mathrm{sqrt}(\varepsilon_{x,y,z}\alpha_{x,y,z}/\beta_{x,y,z})$

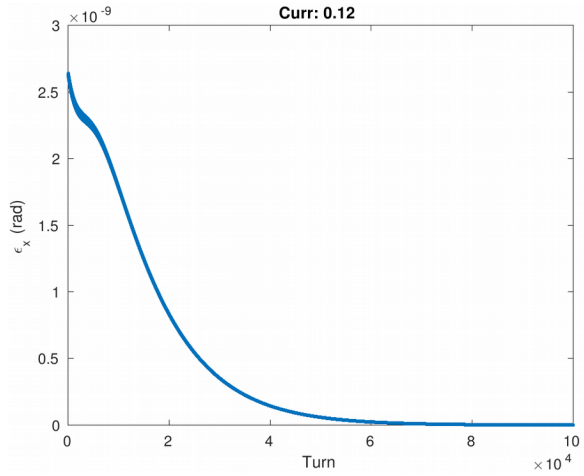
U_0 is the energy loss per turn.
R is a Gaussian distributed random number with unit sigma and zero mean.
$\alpha_{x,y,z}$ are the damping coefficients in x,y,z plane, respectively.

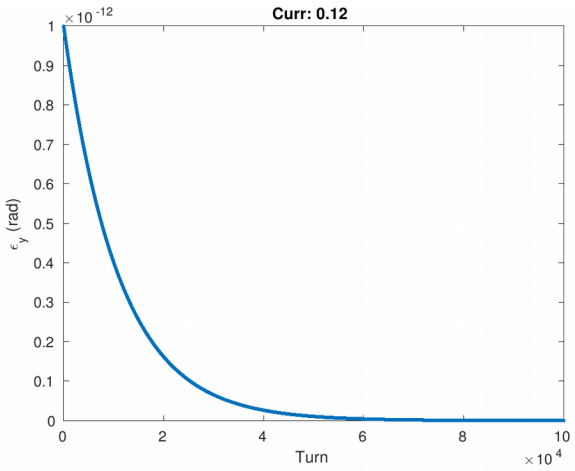
Radiation damping only

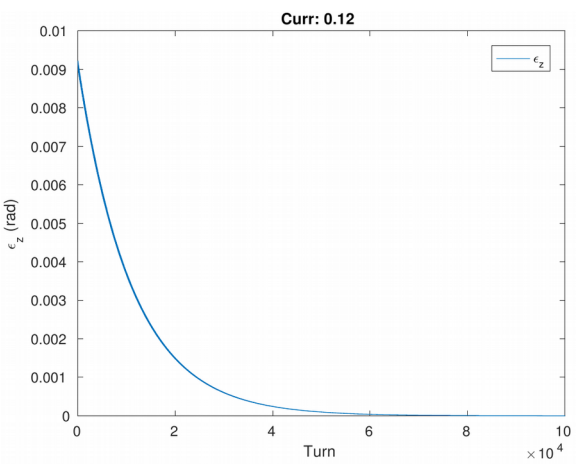
CTA lattice: cta_2085_xr40mc_und_20160328.lat

Track 100 particles for 1E5 turns

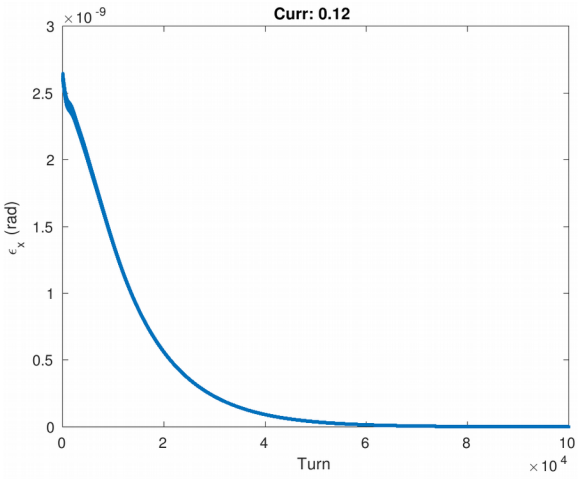
Matrix method

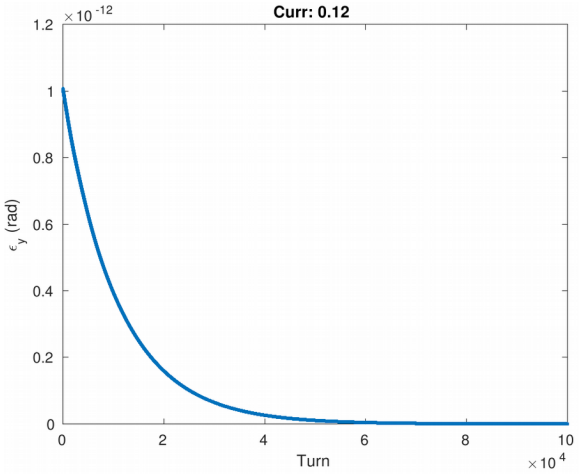


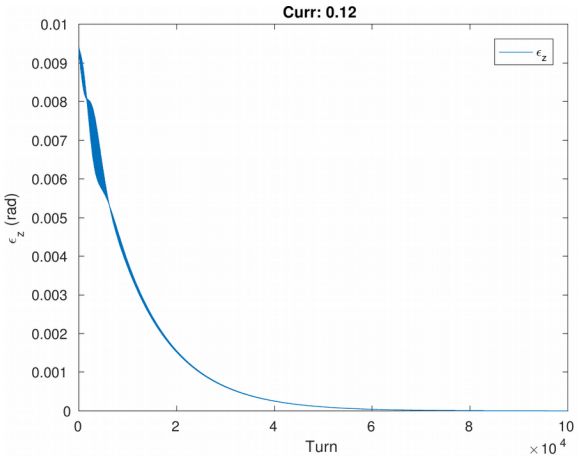




BMAD ring

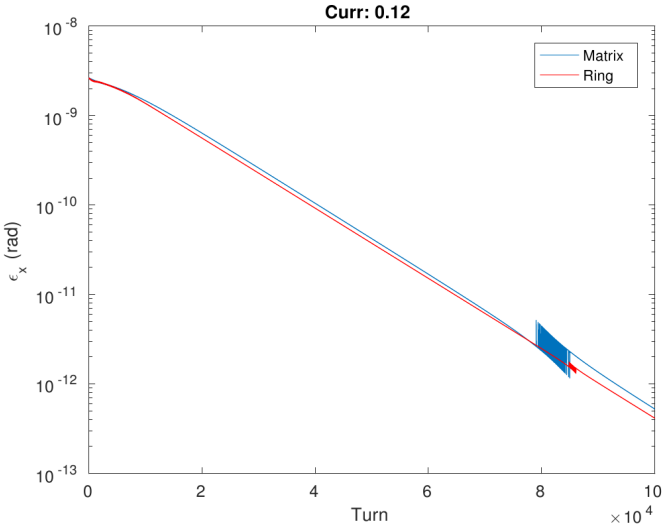


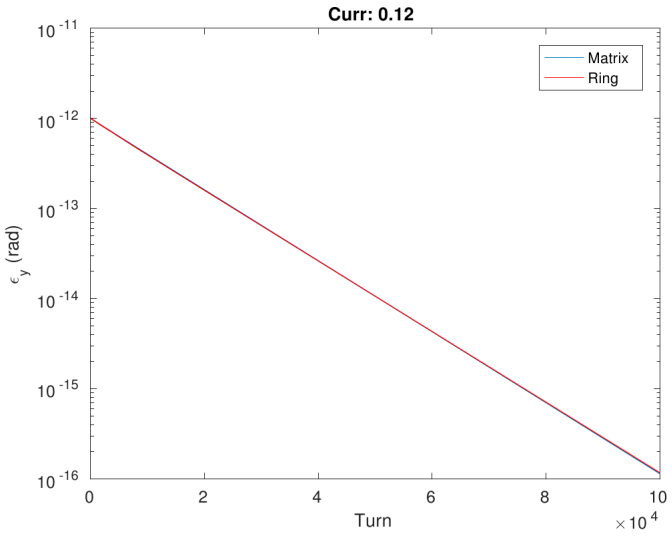


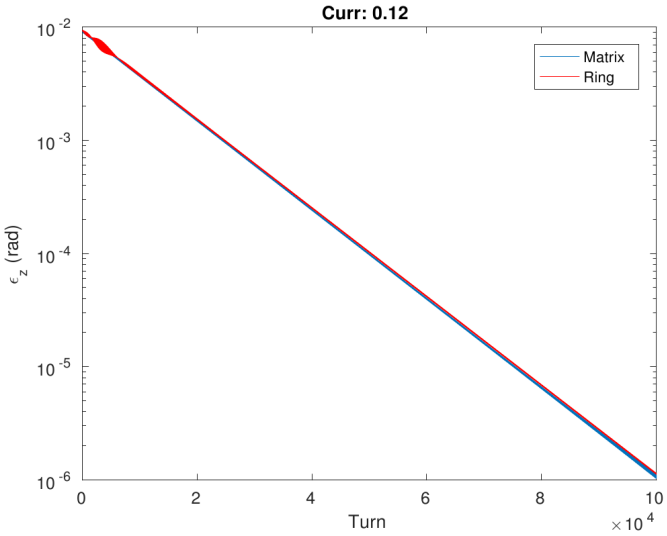


Radiation damping only

Track 100 particles for 1E5 turns

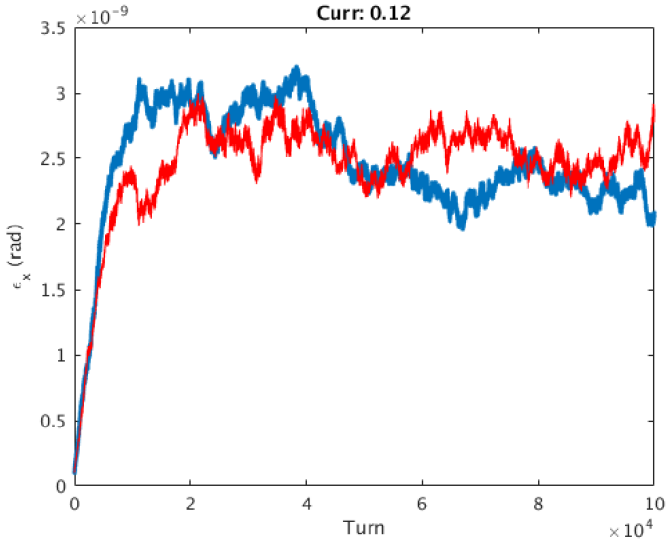


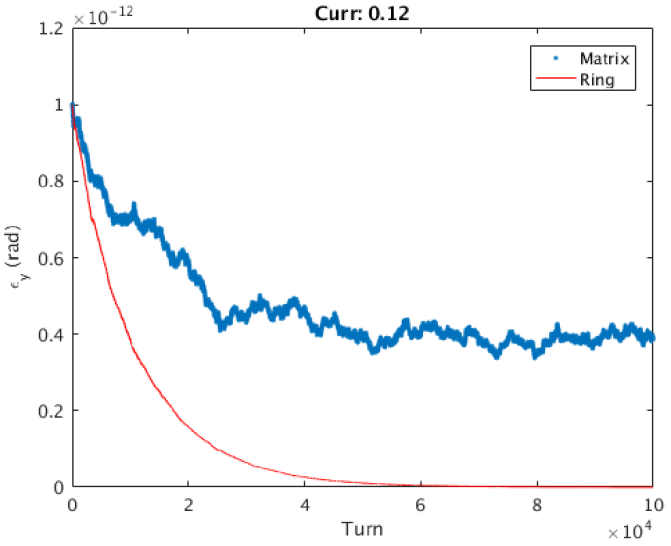


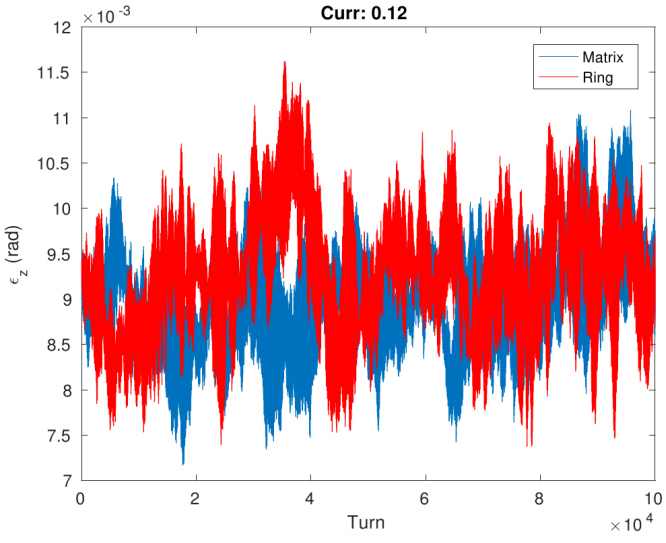


	α_x	α_y	α_z	Time
Matrix	4.518E-5	4.539E-5	9.052E-5	~6 mins
Ring	4.531E-5	4.539E-5	9.076E-5	~4.8 hours

Damping and excitation





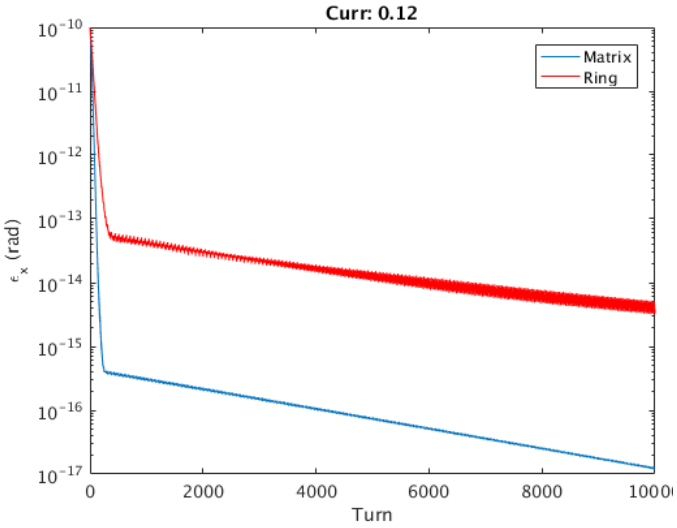


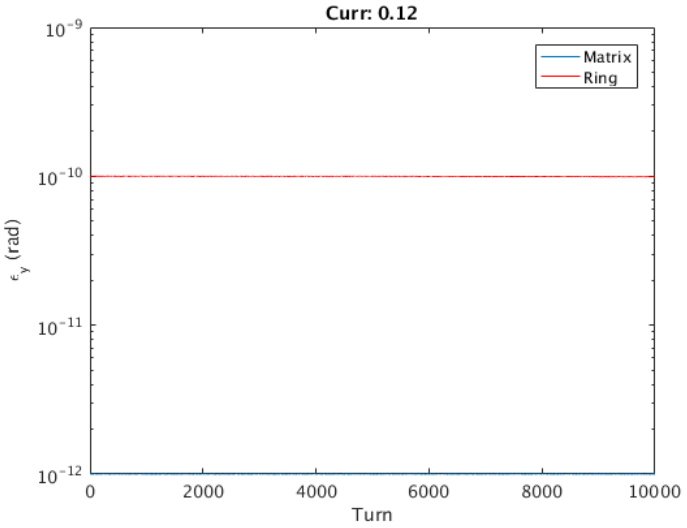
Matched bypass lattice

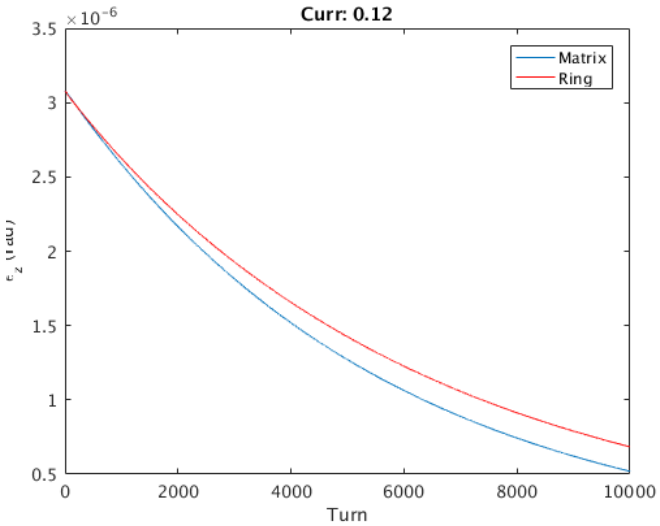
Track 500 particles for 1E4 turns, g=1E-6, coherent kick only

/home/sw565/sw565/lat_des/cta_zero_eta/osc_bypass/new_bmad_input_20171008_ring

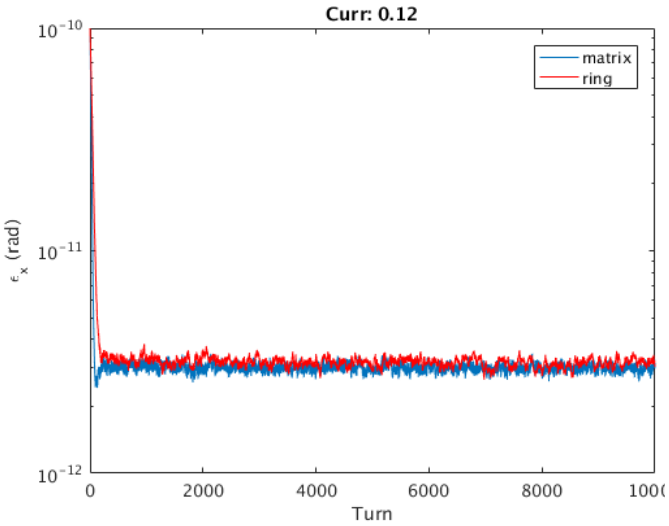
Damping and excitation off

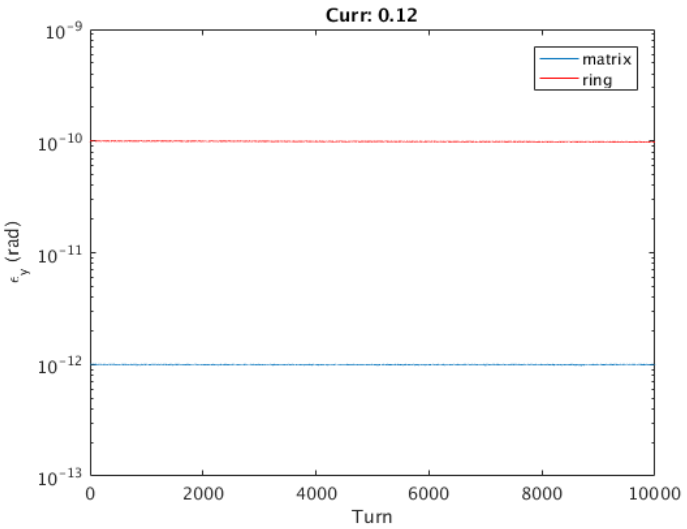


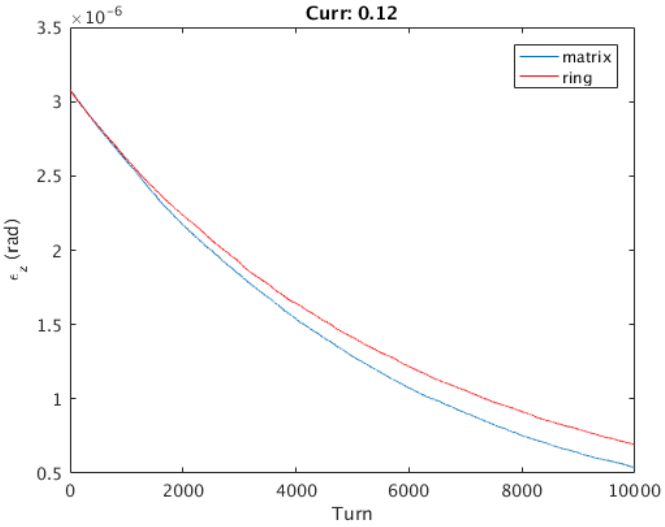




Damping and excitation on

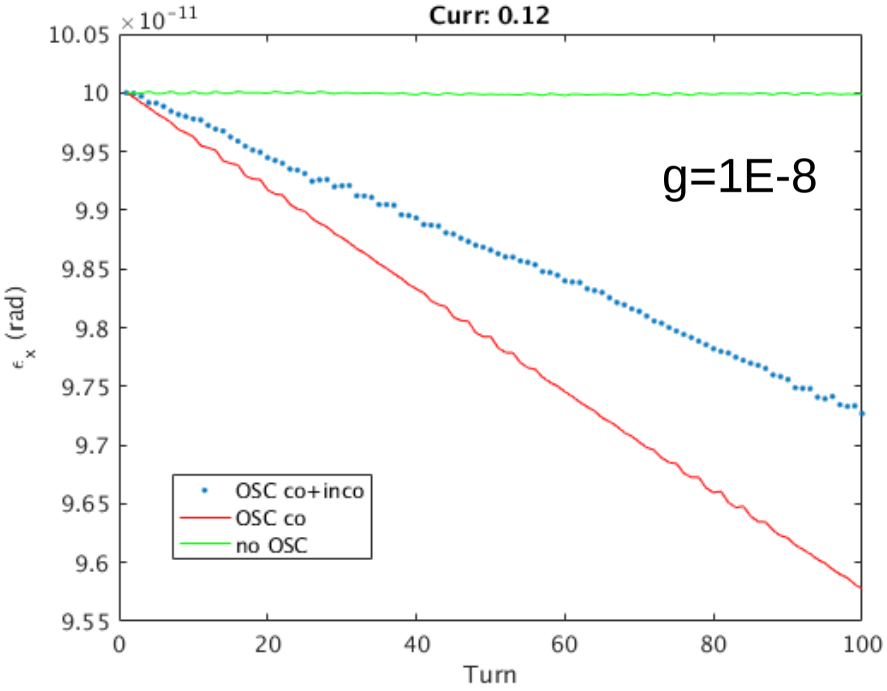


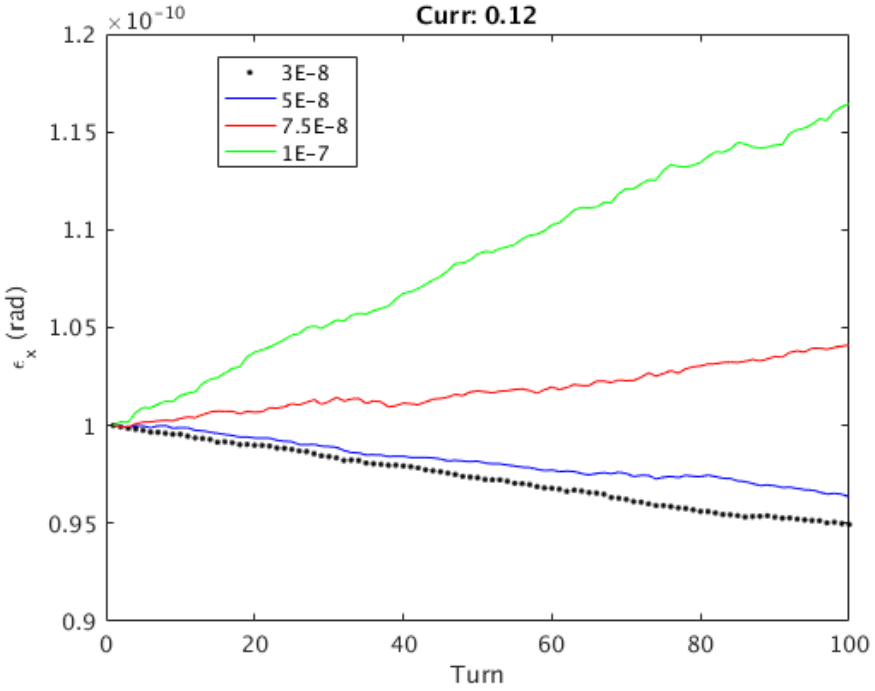




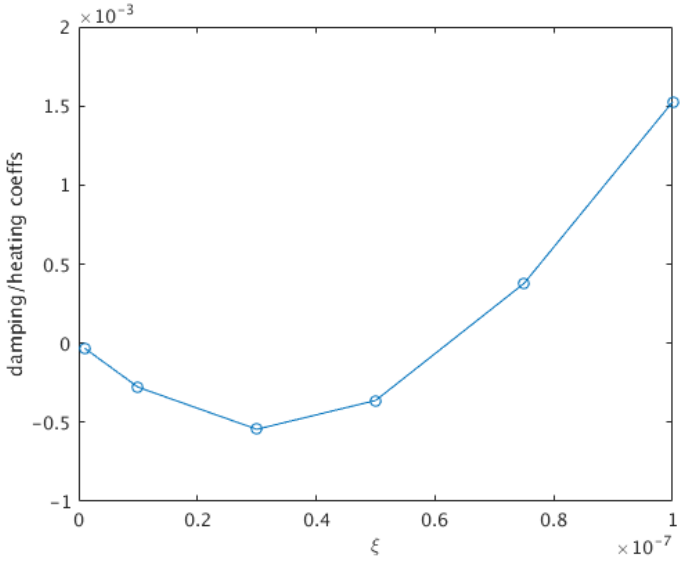
Include the incoherent kicks

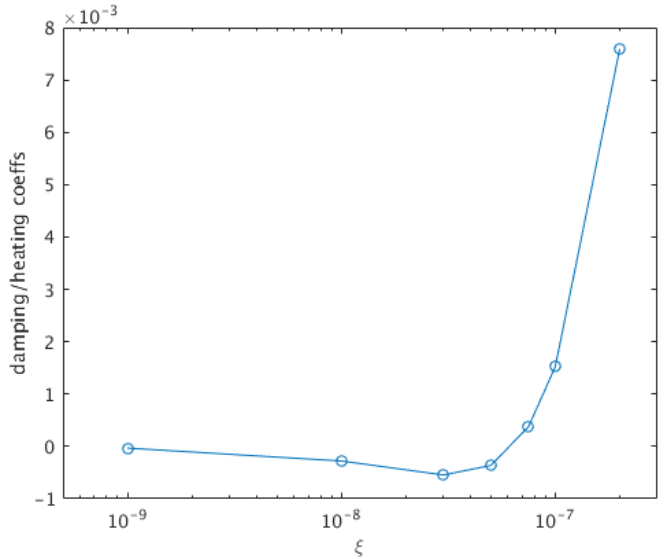
Track 1E4 particles for 1E2 turns





Add incoherent kicks, require lowering the OPA's gain in order to cool





$\varepsilon=\varepsilon_0 \exp(\alpha\varepsilon)$

α: damp/heat coeff

α_0 = 5.4E-4 @ 1E4 p

5.4E-9 @ 1E9 p

<< α_x=6.0E-7 (ring)

Conclusions

1. Fast tracking with matrix method is implemented.

2. Incoherent kicks set a limit for the gain of optical amplifier.
   Will compare to the theory values later.

3. Need to optimize the tracking codes to include more particles.