OSC simulation update

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1. Evaluate MPE's recent IOTA bypass

4/3/2018

MPE bypass 4: /home/sw565/sw565/osc/lattice/mpe_5mm_500mev/iota/bmad.lat

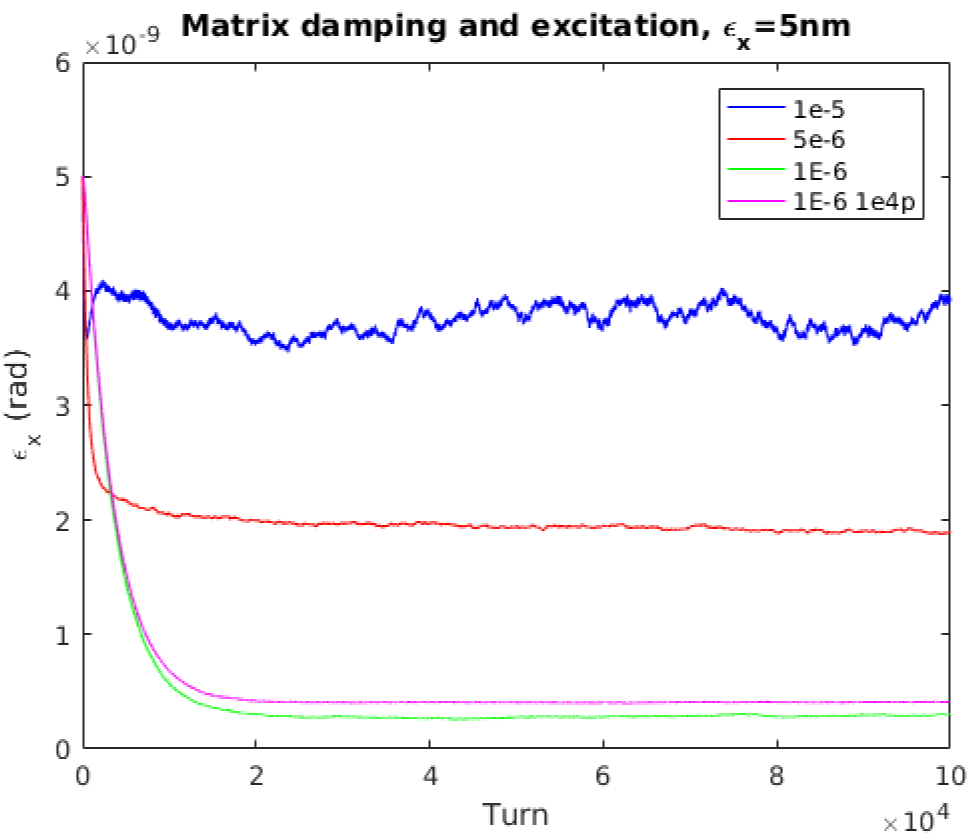
1. Matched to CHESS-U lattice
2. CCU standard Bmad wiggler model (0.95T)

Basic parameters:
ε_x=32 nm, α_{damp}=2.25E-6 (~1s), x_h (x_v)=1
σ_E/E=2.92E-4

Emittance acceptance:
E_{xmax}=69.6 nm, σ_{pmax}=2.38E-4

Colling rates:
λx=1.04E-3, λs=3.0E-2 @ ξ_0=1E-6

m56=9.8917E-03
m56_t=9.5595E-03



Without incoherent kicks

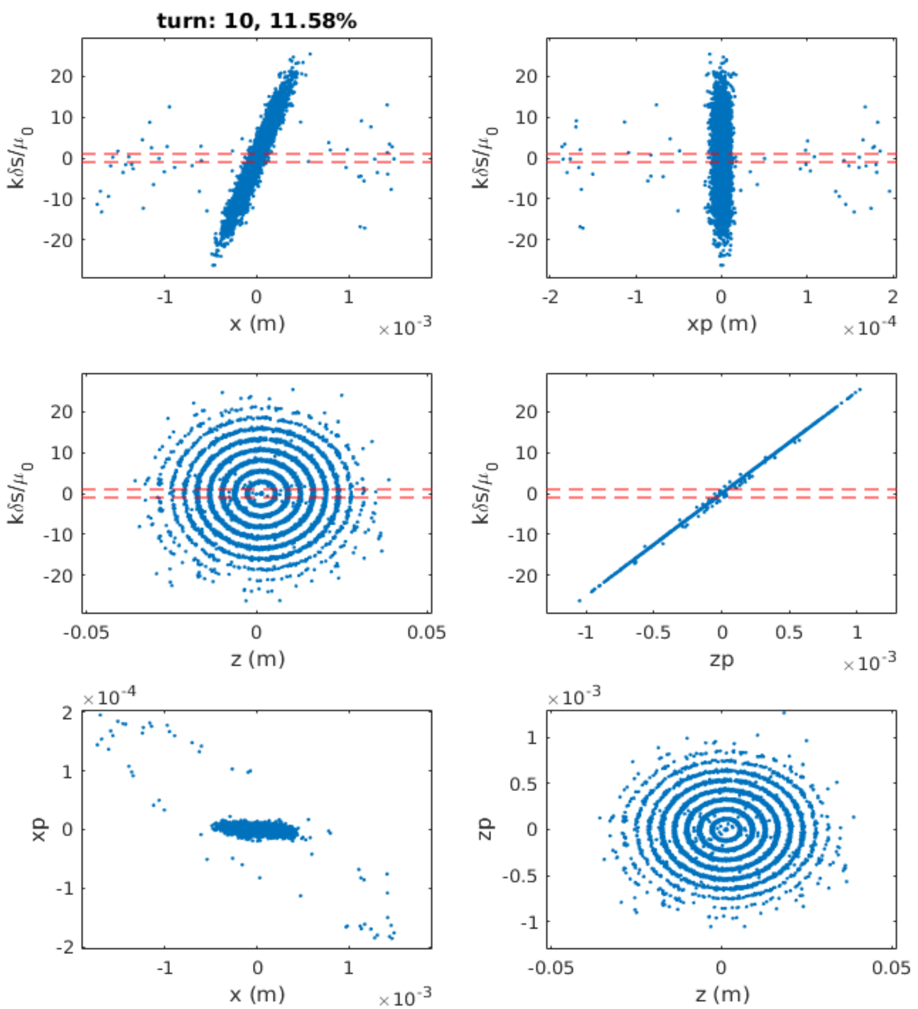
Sample lengthening mainly due to synchrotron motion

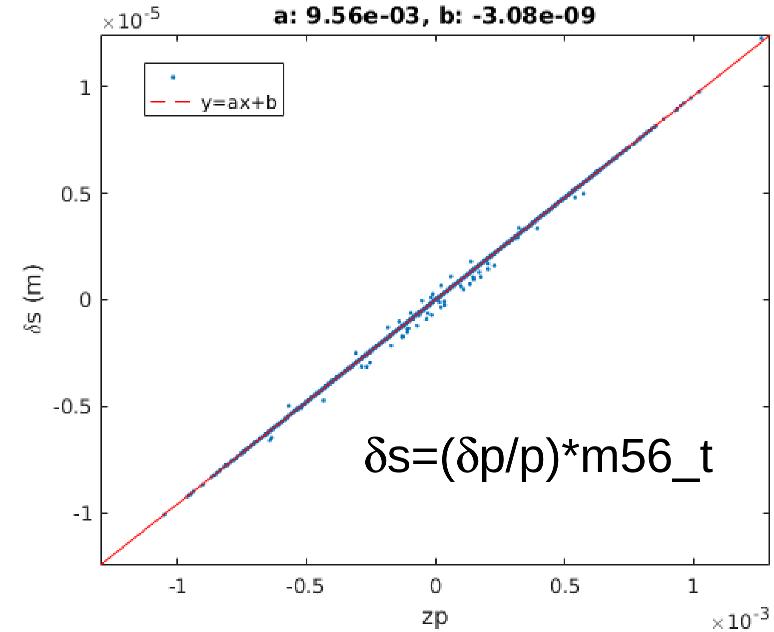
OSC process on, ε_x=5nm

Matrix tracking

1E4 particles, 1E5 turns, ξ=1E-6

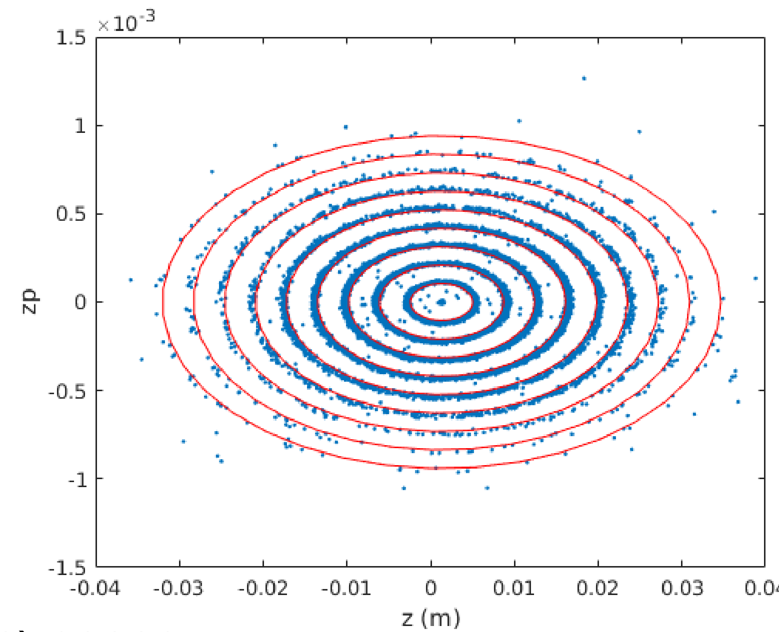
Without incoherent kicks





Cooling to fixed attraction points

Red lines: σ_p=n2π/(k*m56_t), n=0, 1,...



Consistent with Zholents' prediction, PRSTAB 15 (2012) 032801

Cooling requirement for m56_6:

Cool particles with initial σ_p <= $n\sigma_E$ to zero fixed points

=> m56_t <= $1.2\pi/(nk\sigma_E)$

λ=800nm, $k=2\pi/\lambda$, σ_E=2.9E-4, n=4

m56_t <= 4.1E-4

Energy acceptance: $(\delta p/p)_{max} = \mu_0/(k*m56\_t)$

=> $m56\_t = \mu_0/(k*(\delta p/p)_{max}) = \mu_0/(k*n\sigma_E)$

m56_t <= 2.6E-4

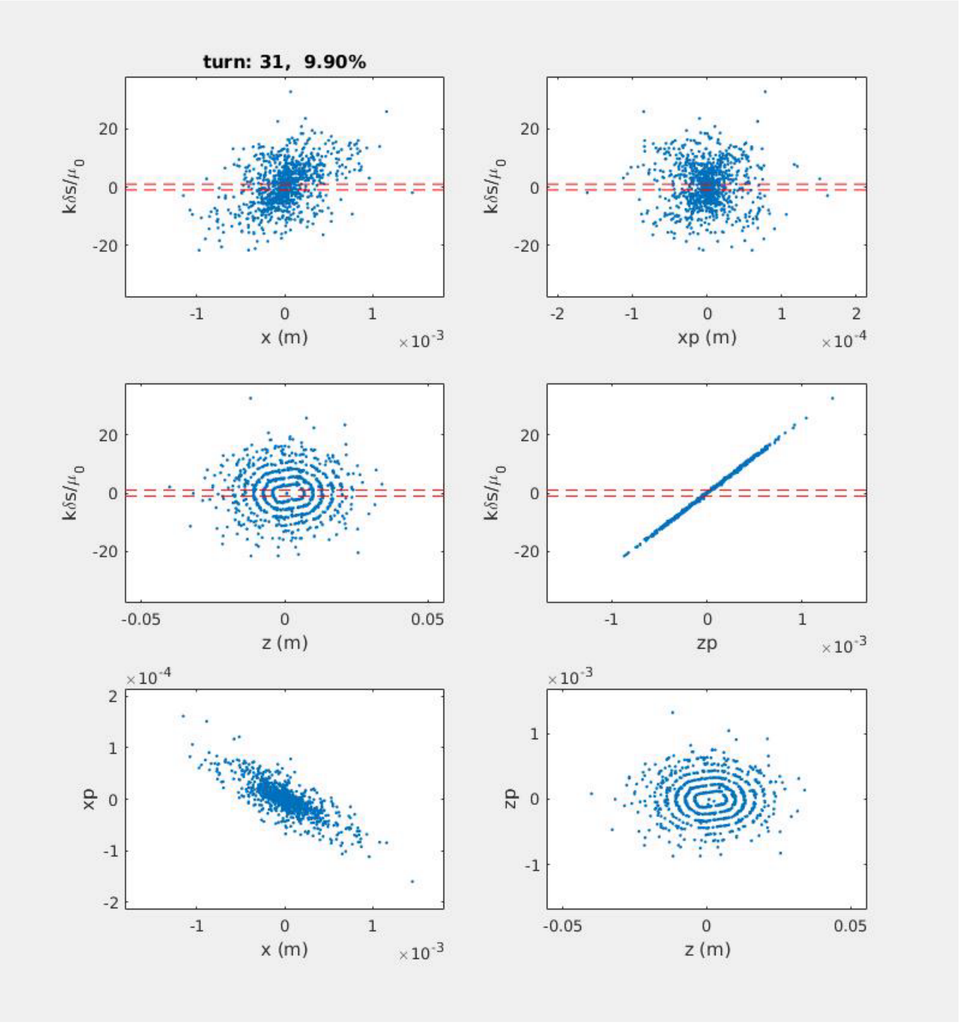
General case isosurfaces:

$\Delta s = m_{51}x + m_{52}x' + m56*(\delta p/p)$

Fixed attraction surfaces: $k\Delta s = 2n\pi$, n=0,1,2...

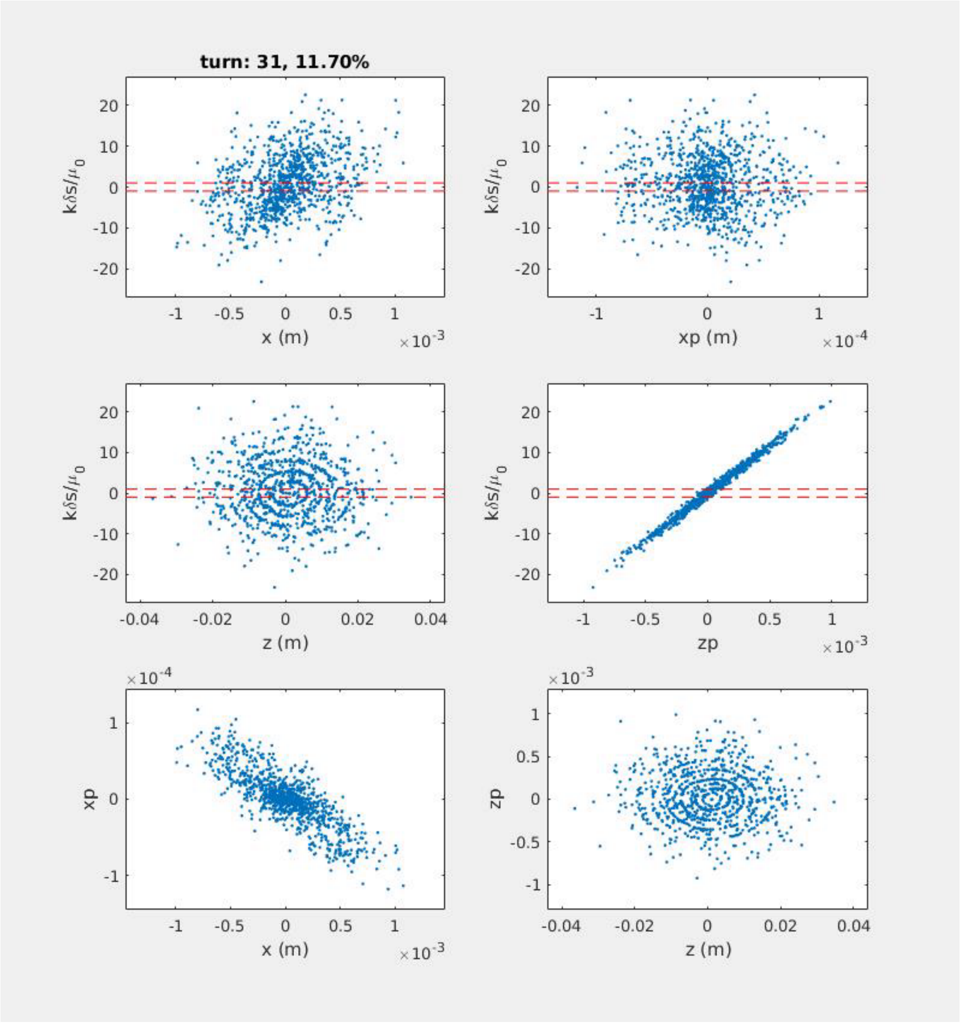
Q49 = -0.05 m^{-2}

ε_x=32 pm, ε_{xmax}=69.6 nm, σ_{pmax}=2.38E-4
m51=-7.4773E-04, m52=-5.8124E-03
m56=9.8917E-03, m56_t=9.5595E-03



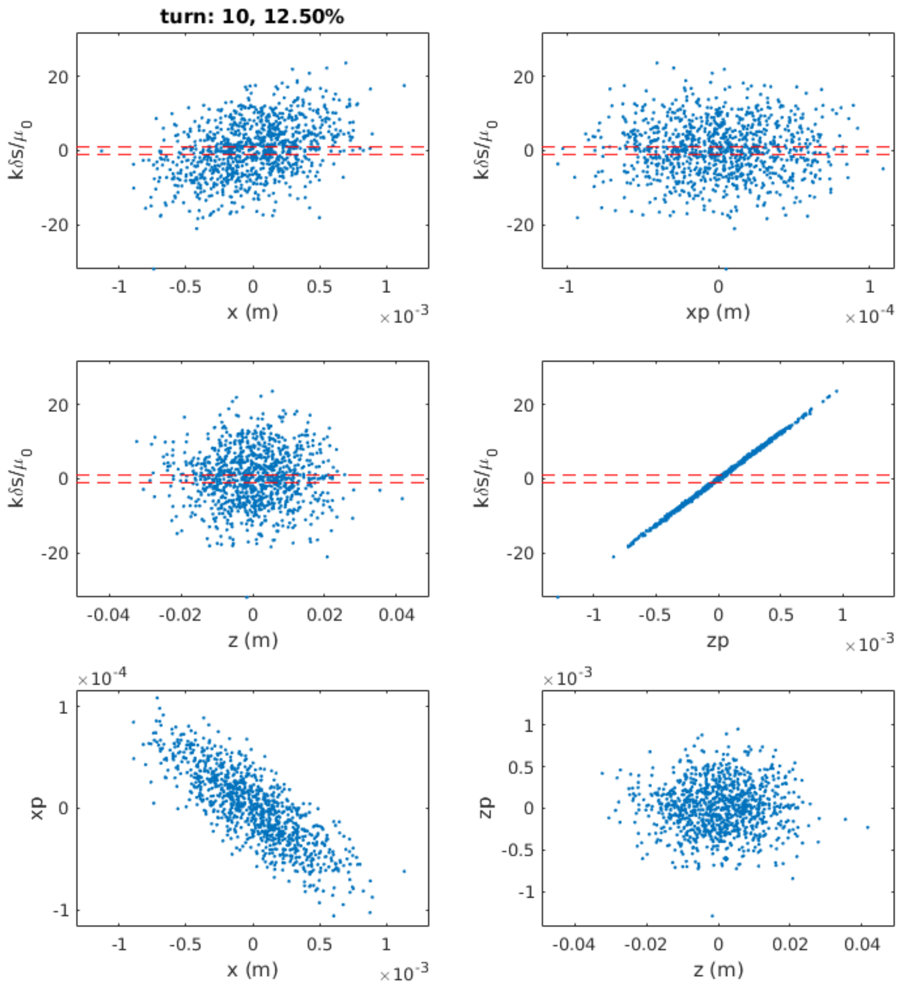
Q49 = -0.1 m^{-2}

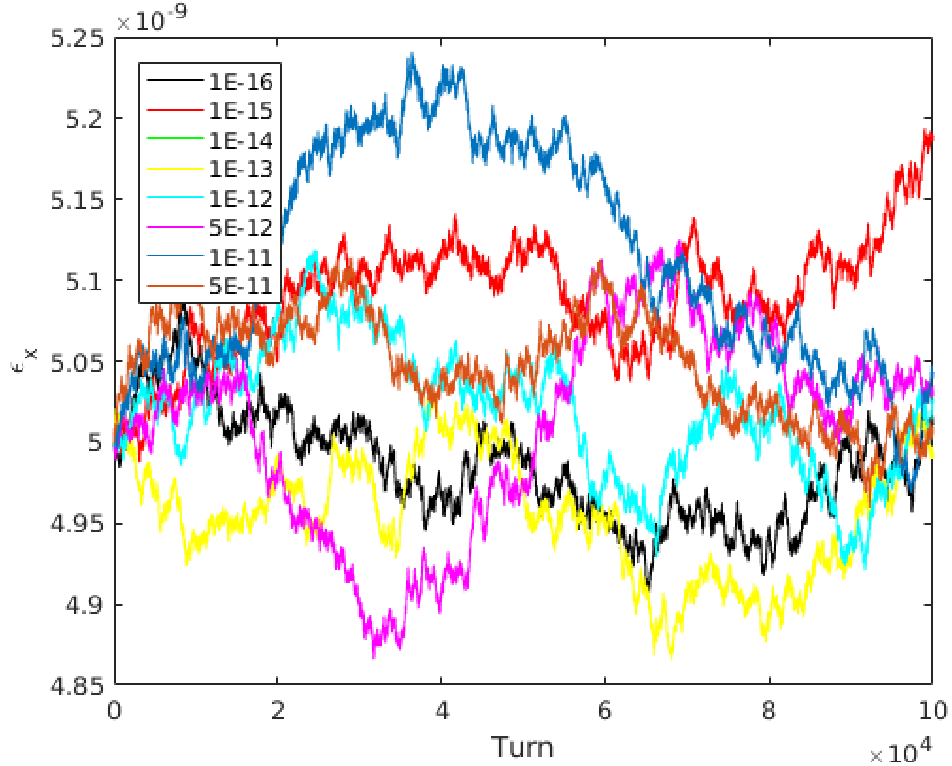
ε_x=34 pm, ε_{xmax}=11.2 nm, σ_{pmax}=4.29E-5
m51=-1.8184E-03, m52=-1.4135E-02
m56=9.7299E-03, m56_t=8.9241E-03

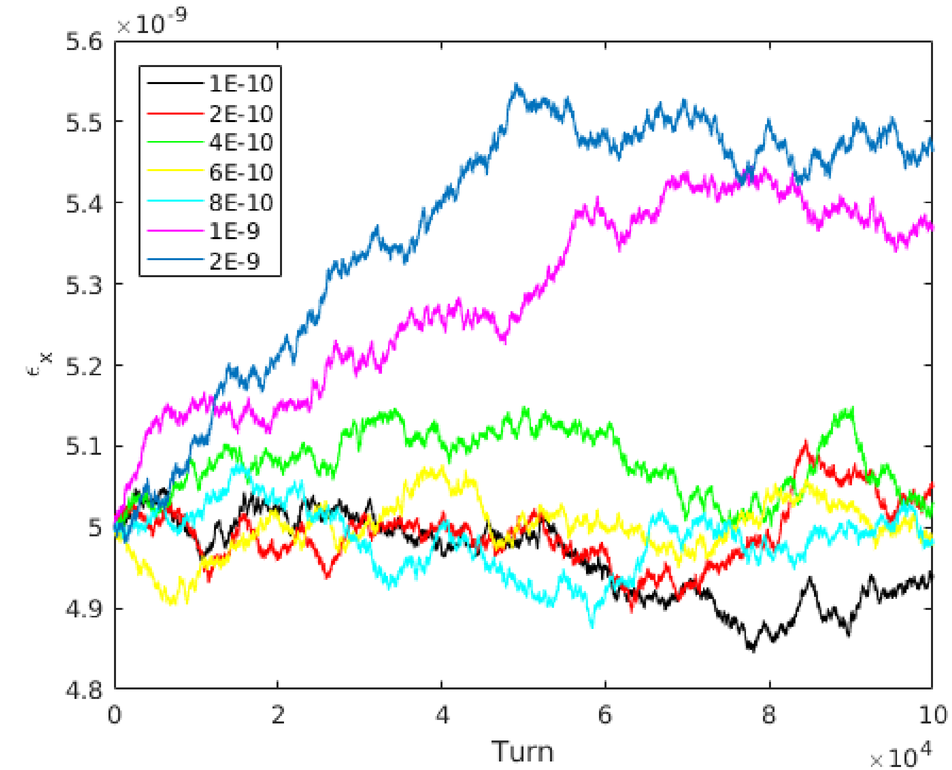


Track 1000 particles for 1000 turns, ξ=1E-5

Add incoherent kicks



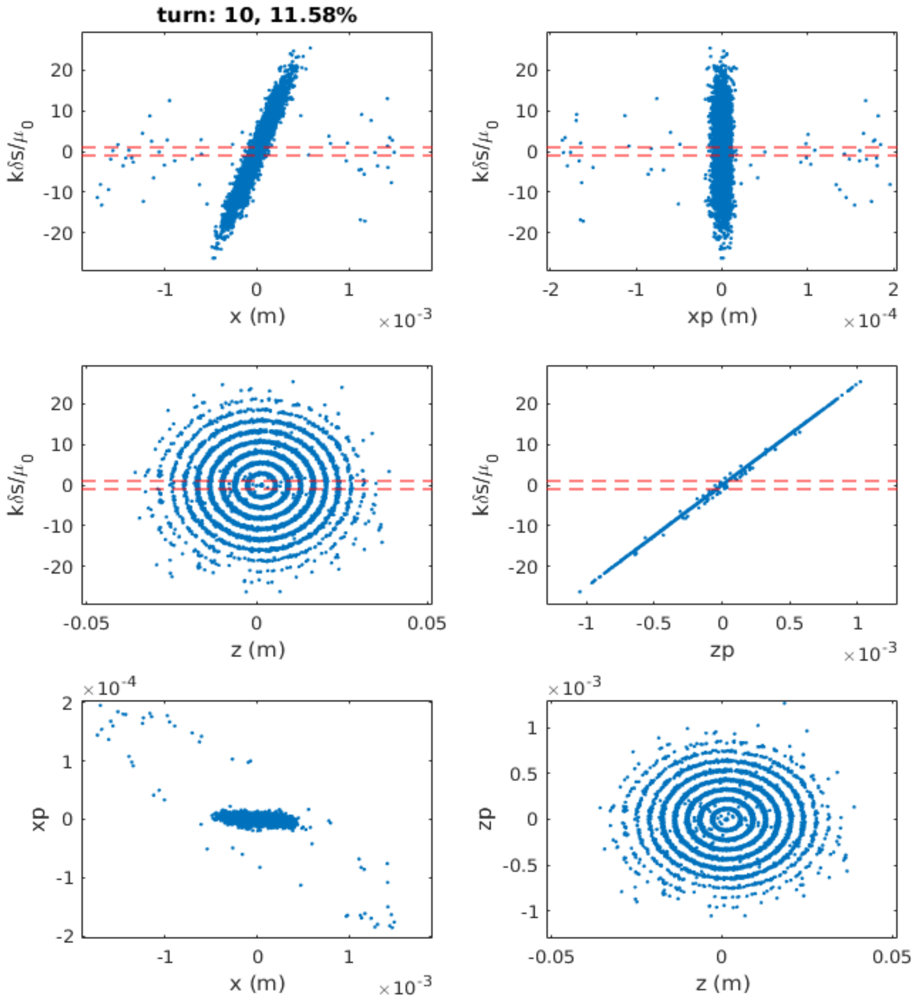


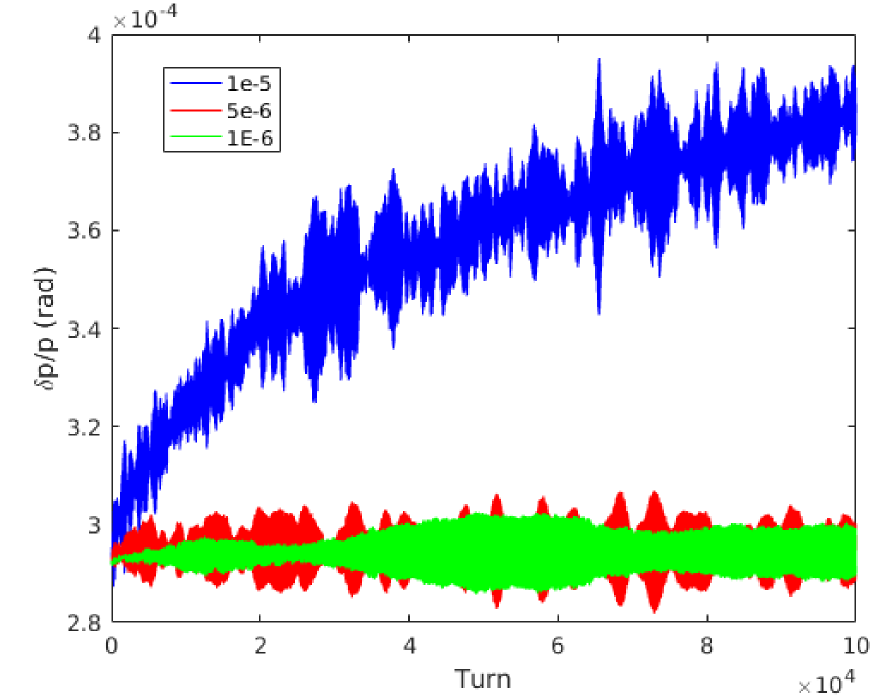


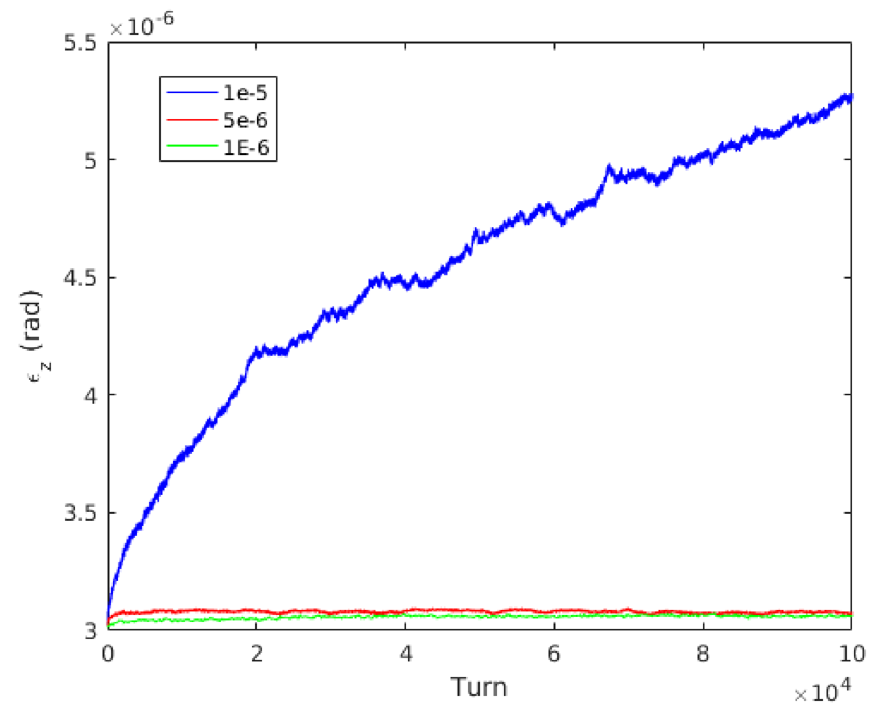
No cooling observed, probably due to incorrect model of incoherent kicks when having longitudinal structures (micro-bunching).

Microbunching

Track 1E4 particles for 1E6 turns
ξ=1E-6



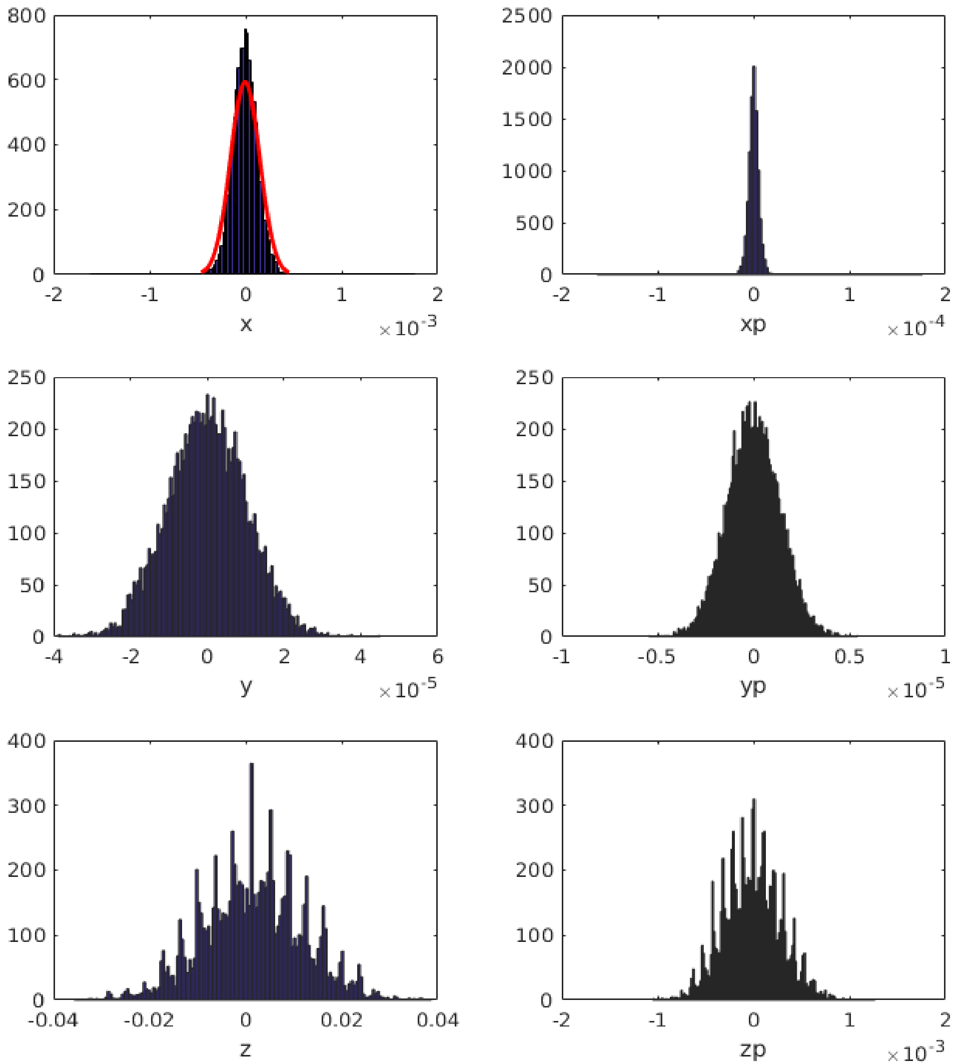


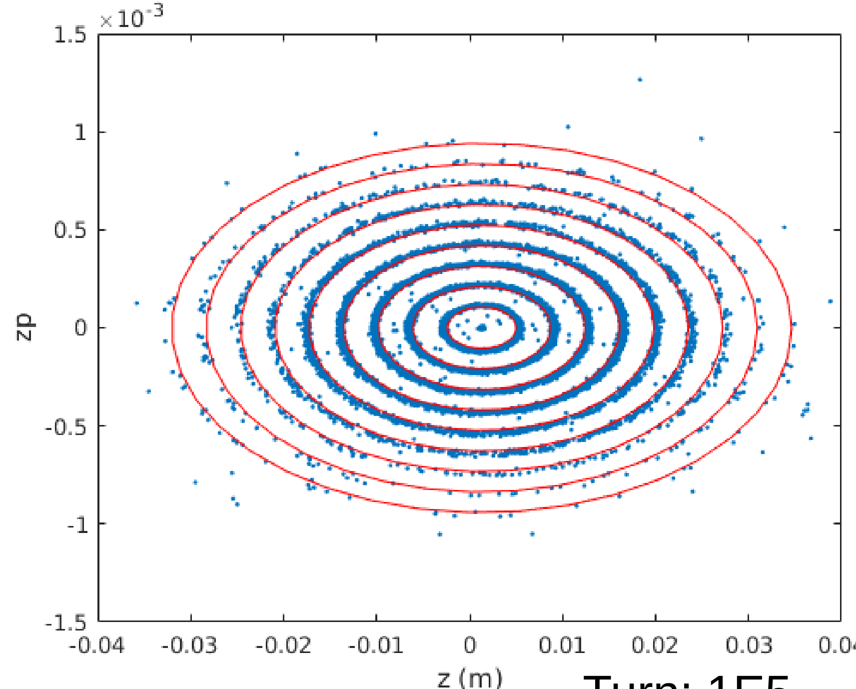


Microbunching

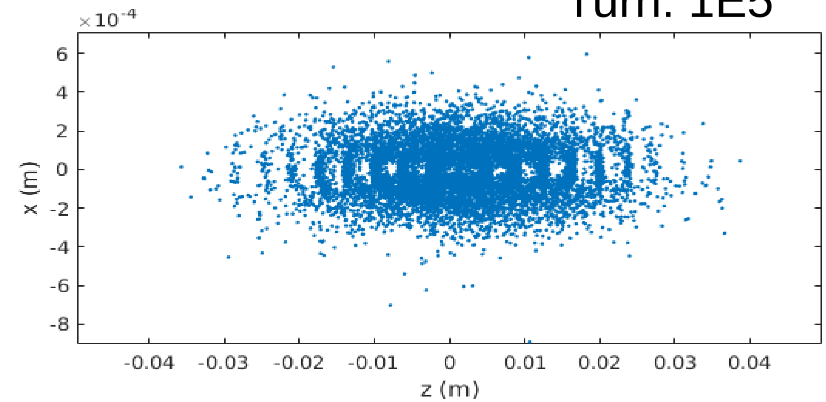
Track 1E4 particles for 1E5 turns, ξ=1E-6

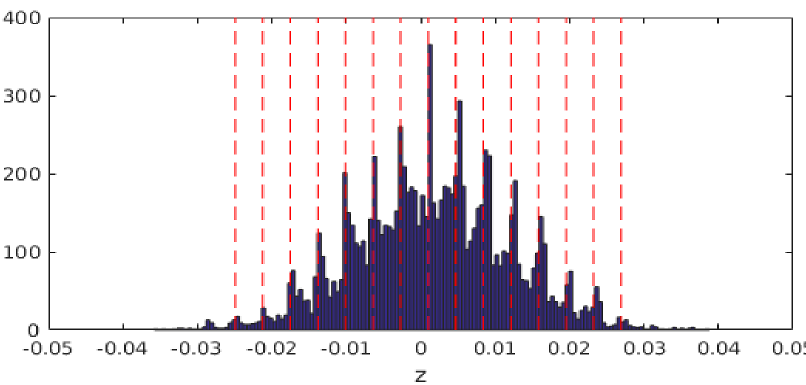
Turn: 1E5





Turn: 1E5



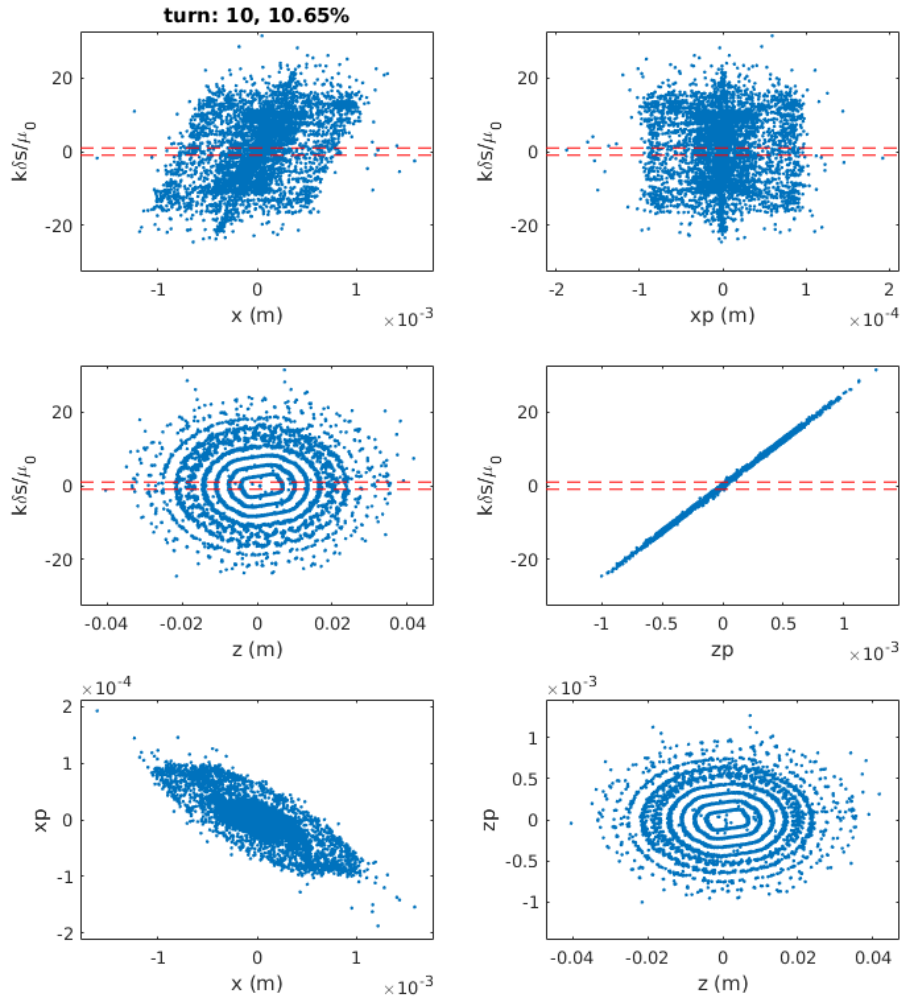


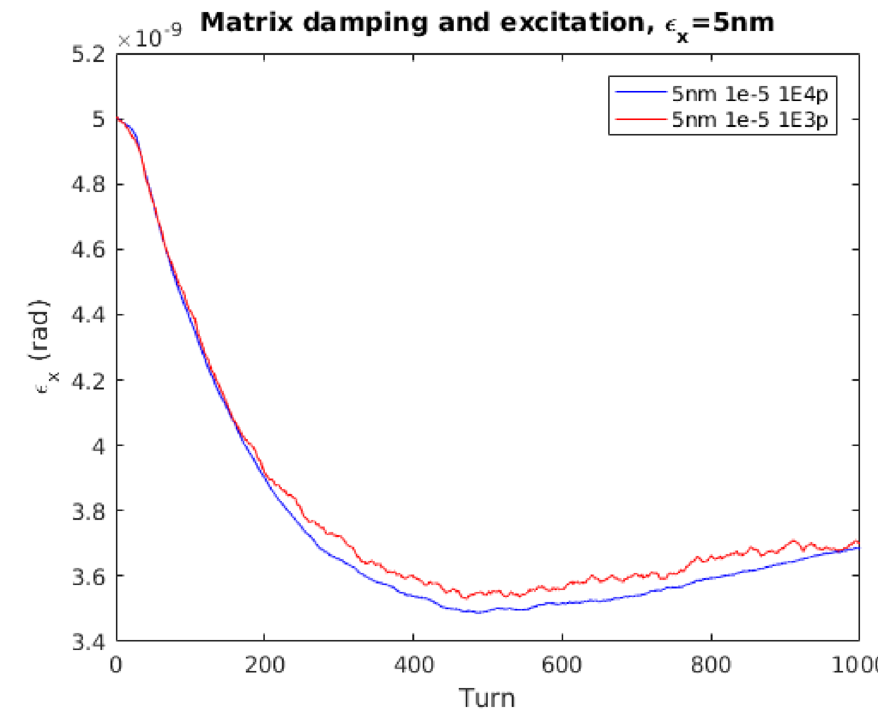
Red lines: $z_i=2i\pi/(k*m56\_t)*\sigma_z/\sigma_E$

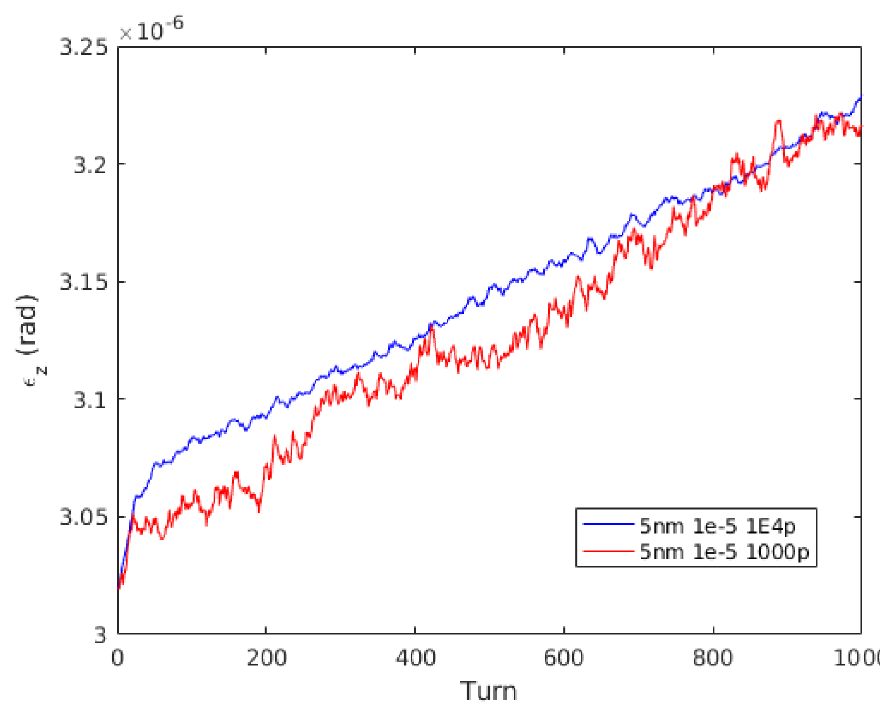
Δz=3.7mm

Microbunching

Track 1E4 particles for 1000 turns
ξ=1E-5



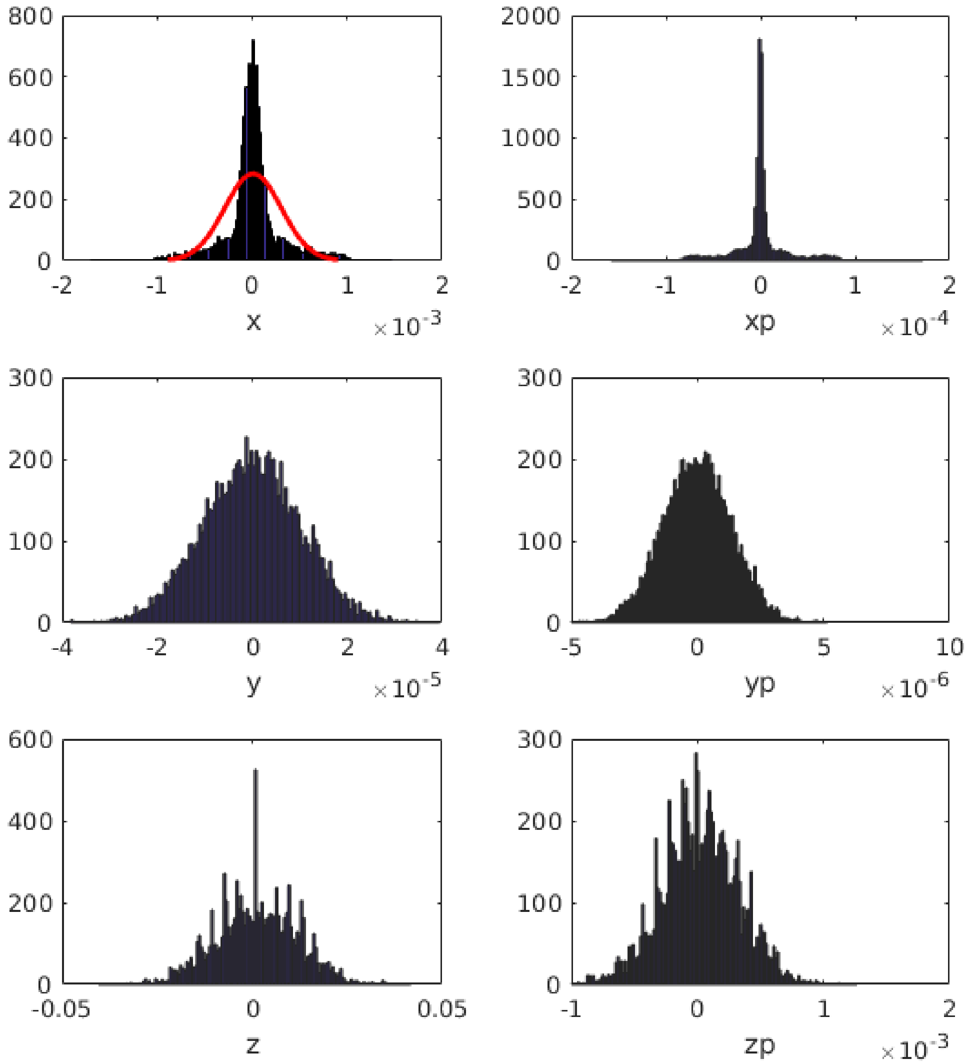


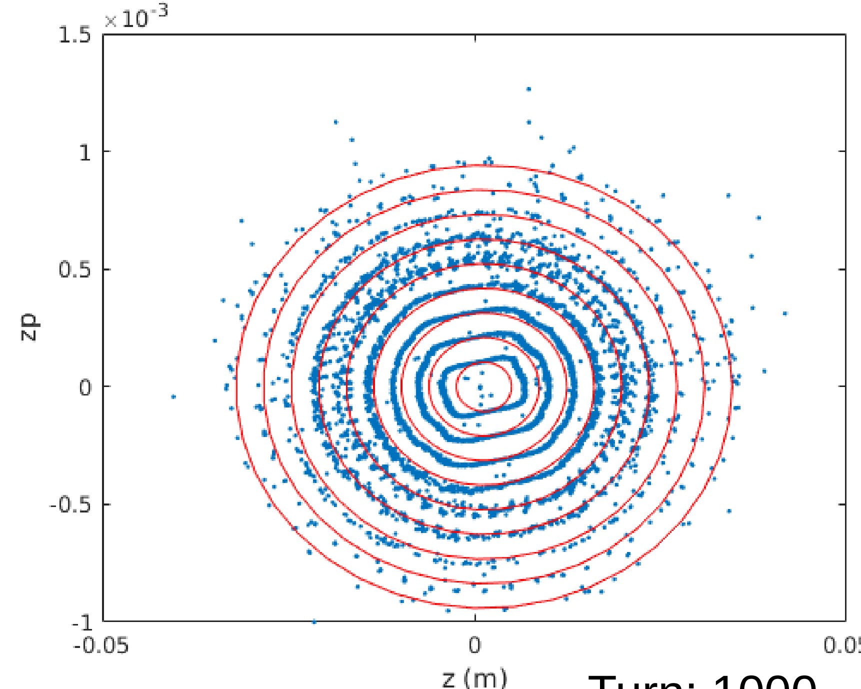


Microbunching

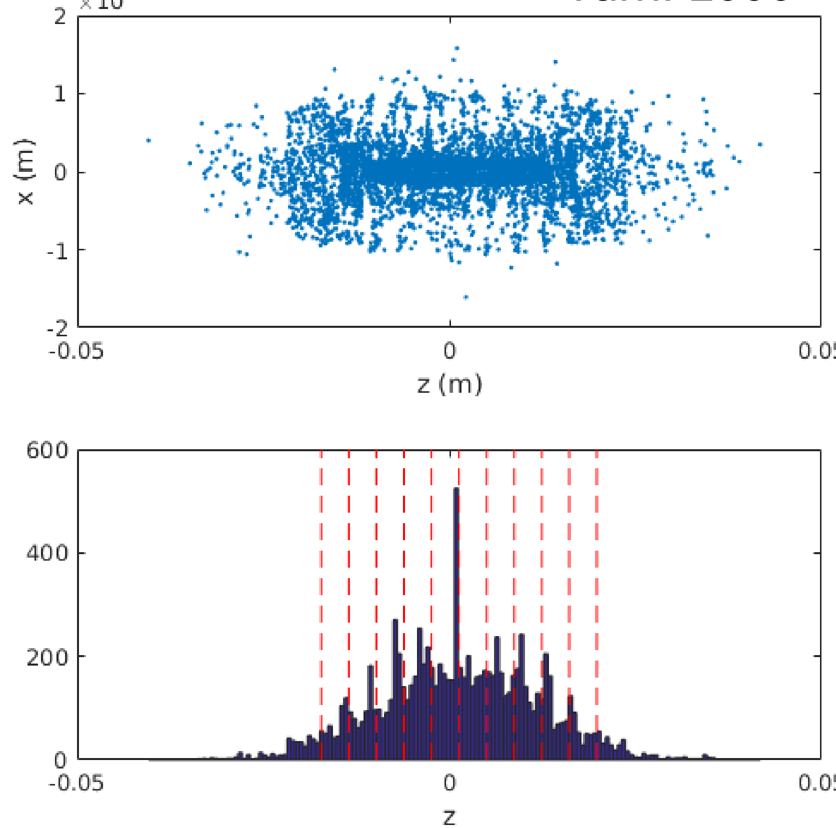
Track 1E4 particles for 1000 turns, ξ=1E-5

Turn: 1000





Turn: 1000



Red lines: $z_i = 2i\pi/(k*m56\_t)*\sigma_z/\sigma_E$

Conclusion

- Observe cooling fixed points without incoherent kicks
- Observe “micro-bunching”
- Model incoherent kicks with microbunching or use large number of particles for tracking