OSC simulation update

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Add incoherent kick

$$\delta_{ic} = \delta_i + G\,\sin(\Delta\phi_i) + G\sum_{k\neq i}^{N_s}\sin(\Delta\phi_i + \psi_{ik})\ .$$

$\Delta\varphi_i = k\,\Delta s$

Incoherent kick

Here, δ_{ic} is the relative momentum of the ith particle after the longitudinal kick, $\psi_{ik} = \phi_i - \phi_k$ and

$$G = g\frac{q\,E_0\,M\,\lambda_u\,K}{2c\,\gamma\,P}\ . \qquad (4)$$

EM wave radiated by the *i* electron: $E_i = E_0\sin(kz - \omega t + \phi_i)$

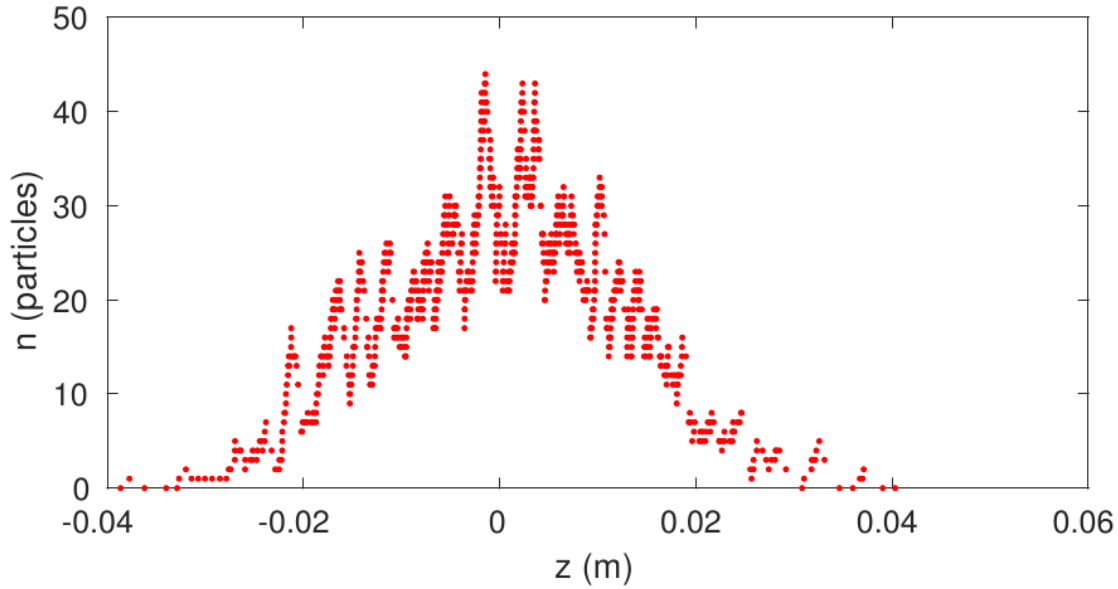
Ns: number of EM waves emitted by other electrons moving behind the I electron within a distance <= $N_{und}\,\lambda$,

N_{und} : the number of undulator periods ~3

λ : undulator light wavelength ~ 1μm

Simulation

For each particle *i*,
Find the particles behind it within a distance < z_slice (z_slice = 1E-3 m)



1000 particles

Find the phase difference of their EM waves radiated at pick undulator relative to *i* particle

$\Delta\psi = k\delta z = 2\pi\delta z/\lambda \longrightarrow \Delta\psi = \psi_i - \psi_k = 2\pi\, N_{und}(\delta z)/z\_slice$

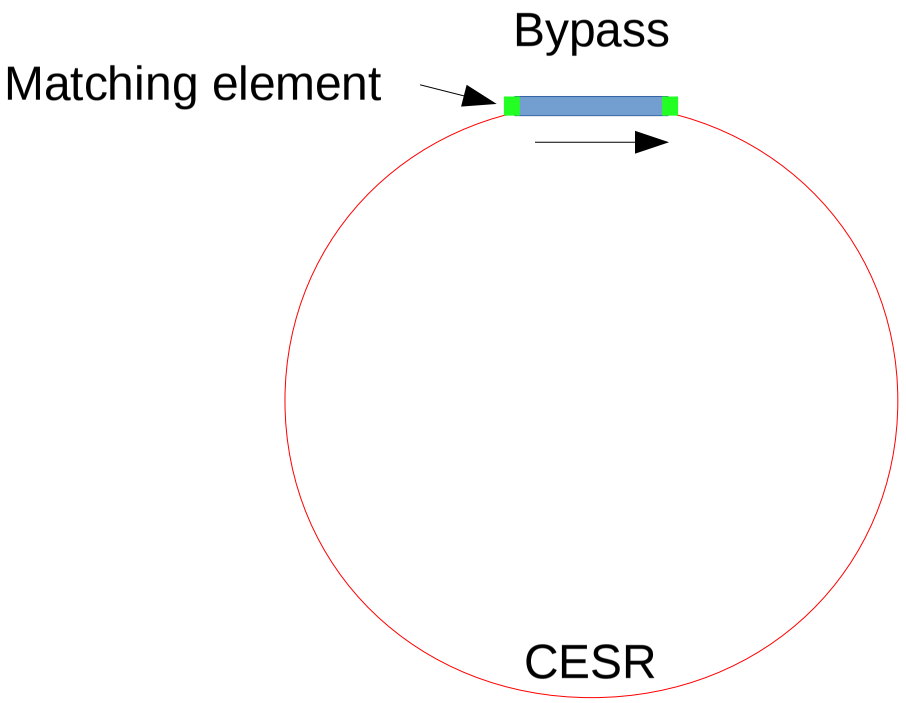
Initial studies show

1. Dependence on the number of macro particles (statistics) Needs ~10E6 macroparticles
2. Dependence on ξ

   At the same ξ (10E-6), heating instead of cooling after adding incohere kick

   Lower ξ (10E-8), cooling observed

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

1. Tested it without radiation damping and excitation kicks.
   Super fast and show similar result as tracking through a whole ring

2. Added exciation kicks

$$\Delta y'_e = \sigma_{p_y} R = 2R\sqrt{\frac{\Delta\epsilon_y \tau_y}{\beta_{y_0}}}$$

3. Need to add radiation damping kicks or generate the transfer map with radiation