SRW simulations at 1 GeV with a helical undulator

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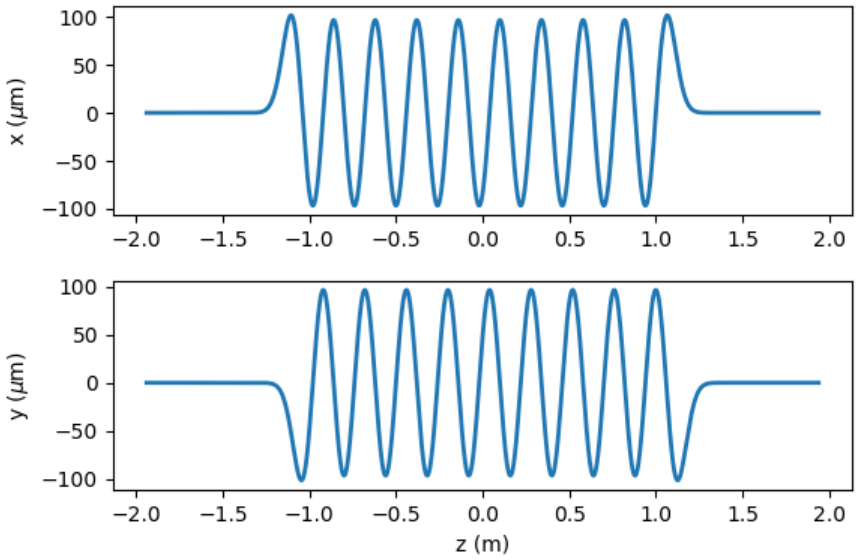
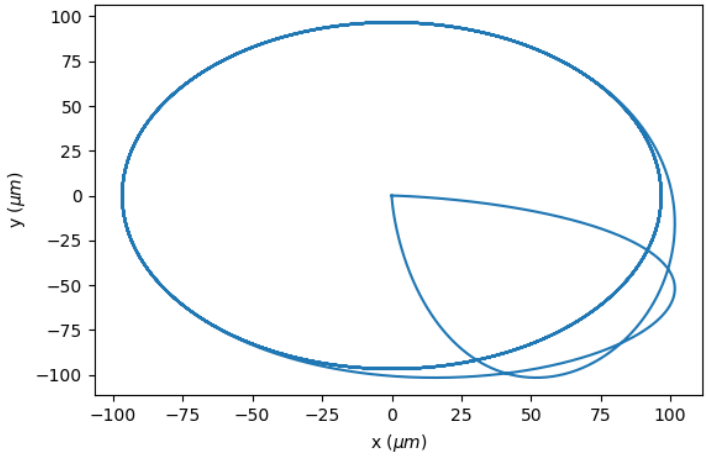
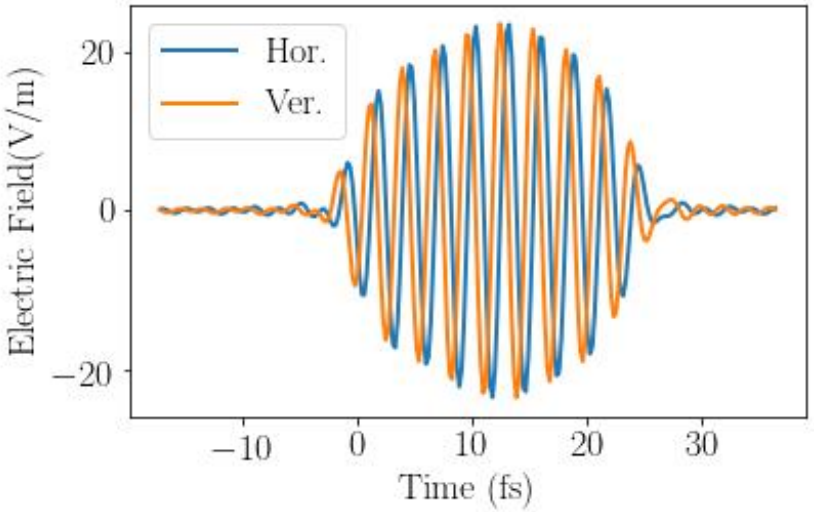




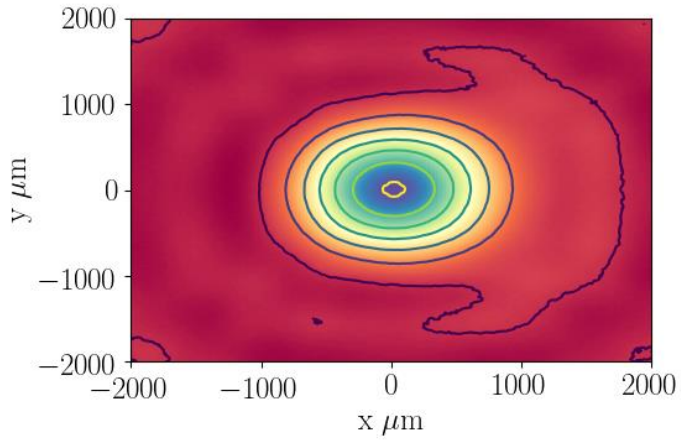
Parameter	Value
Length (m)	2.4
Period (cm)	24
K	4.95
X-Y phase	π/2
γ	1957

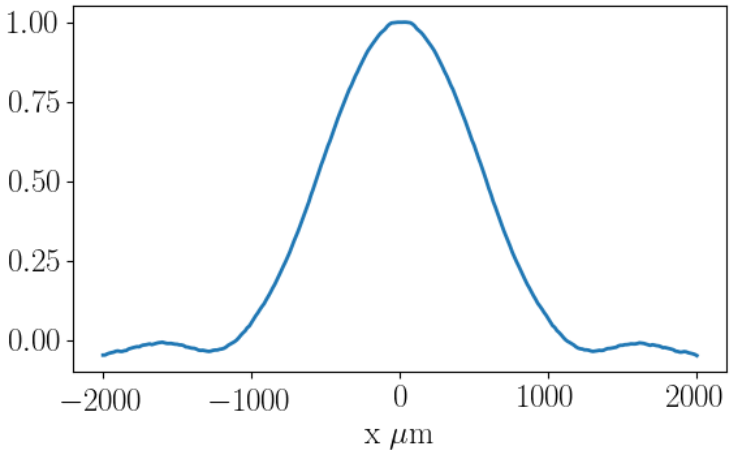
Field in the kicker center

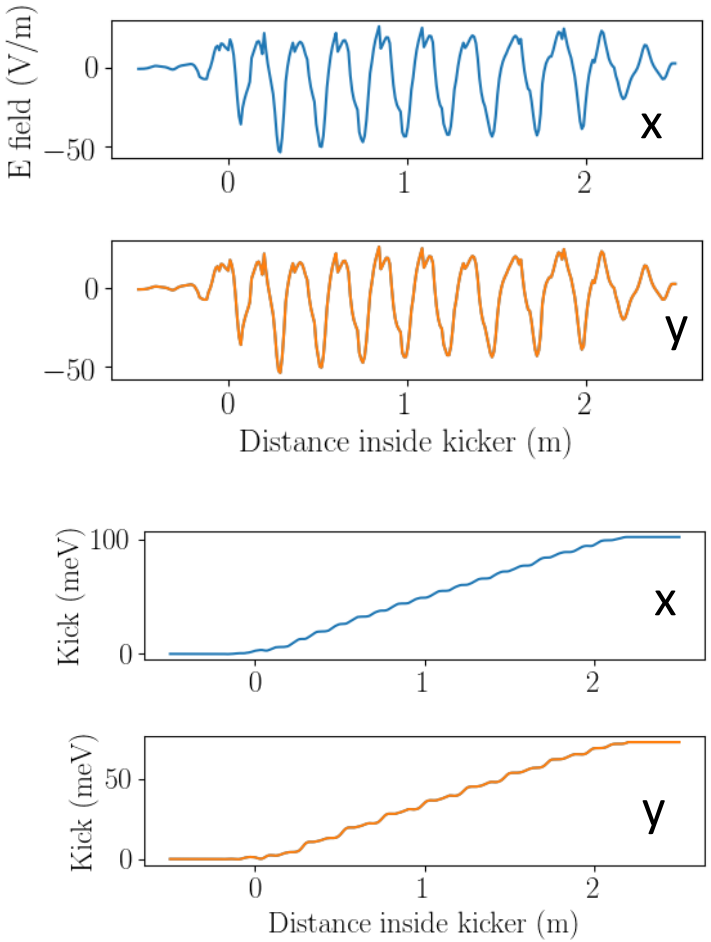


Wave-packet has two polarizations
90 degrees out of phase.

Particle rotates ~100 µm off axis. Field reduces <1%.



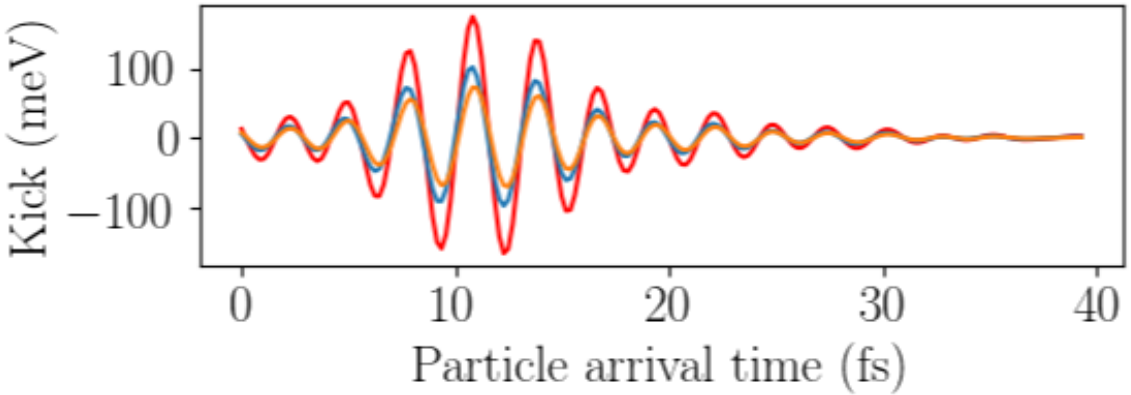




$$\Delta\mathcal{E} = \frac{q}{c}\int \boldsymbol{E}(z,x,y)\cdot\boldsymbol{v}(z)dz$$

$$v_x = \frac{c}{K\gamma}\sin(k_p z)$$

$$v_y = \frac{c}{K\gamma}\cos(k_p z)$$



Notice initial arrival time between pulse and particle needs to be ~20 fs before any effect on the beam will be observed.

Chicane delay of 2 mm=7 ps. This corresponds to an initial accuracy of ~0.3%.

Fine tuning of timing done with light optics.

$$\lambda_p + \lambda_x = \frac{k_o M_{56}}{2\tau_s}\frac{\Delta\mathcal{E}}{U_s}$$

$$a_p = k\left(M_{51}D + M_{52}D' + M_{56}\right)\left(\frac{\Delta p}{p}\right)$$

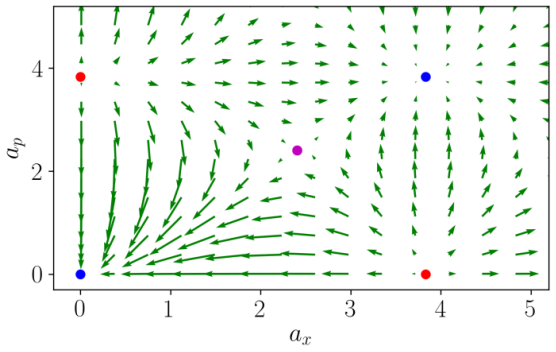
$$a_x = k_0\sqrt{\tilde{\varepsilon}\left(\beta {M_{51}}^2 - 2\alpha M_{51}M_{52} + \left(1+\alpha^2\right){M_{52}}^2/\beta\right)}$$

$$n_{\sigma s} \approx \frac{\mu_{01}}{\left(2\Delta s - \Phi D^* h\right)k_0\sigma_p} \qquad n_{\sigma x} \approx \frac{\mu_{01}}{2k_0 h\Phi\sqrt{\varepsilon\beta^*}}$$

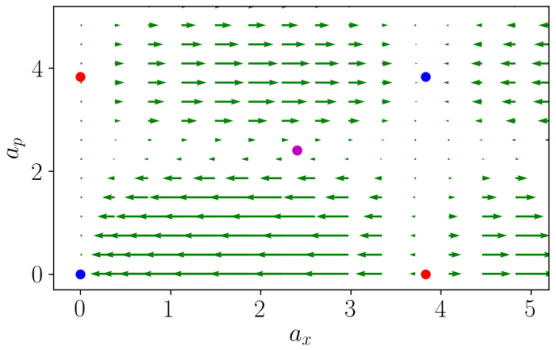
For pure horizontal cooling use μ_{o1}=2.40.

For pure longitudinal cooling if M_{51} and M_{52} can be made zero, μ_{o1} can be replaced with μ_{11}=3.83.

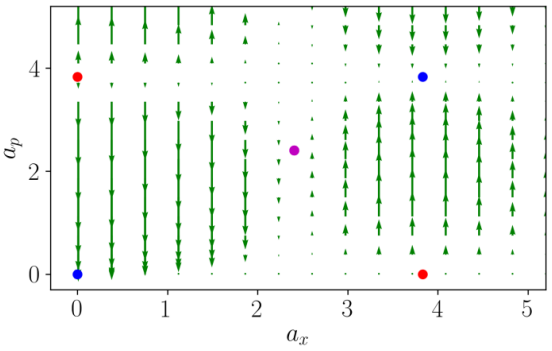
Questions: When we cool the beam IBS will increase as the beam density increases. Are IBS contributions coming equally from all three planes? If we damp in only one plane will we cause growth in the other plane?



Cooling in both planes



Cooling transversely



Cooling longitudinally