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Memo for Monday weekly ILC meeting

Combined effect of IBS and misalignments

The $\mathcal{H}_y$ in CesrTF is about an order of magnitude too small to make the direct contribution of IBS to the vertical plane significant compared to the coupling contribution. This means that the vertical IBS factor can be set to one in the equilibrium equations.

$$\epsilon_y = [(1 - r_e)\frac{T_y}{T_y - \tau_y} + r_e\frac{T_x}{T_x - \tau_x}]\epsilon_{y0} \tag{1}$$

becomes,

$$\epsilon_y = [(1 - r_e) + r_e\frac{T_x}{T_x - \tau_x}]\epsilon_{y0}. \tag{2}$$

Since $r_e = \epsilon_{y0,\kappa}/\epsilon_{y0}$ and $\epsilon_{y0} = \epsilon_{y0,\eta} + \epsilon_{y0,\kappa}$, the equation further simplifies to,

$$\epsilon_y = \epsilon_{y0,\eta} + \epsilon_{y0,\kappa}\frac{T_x(..., \epsilon_y, ...)}{T_x(..., \epsilon_y, ...) - \tau_x}, \tag{3}$$

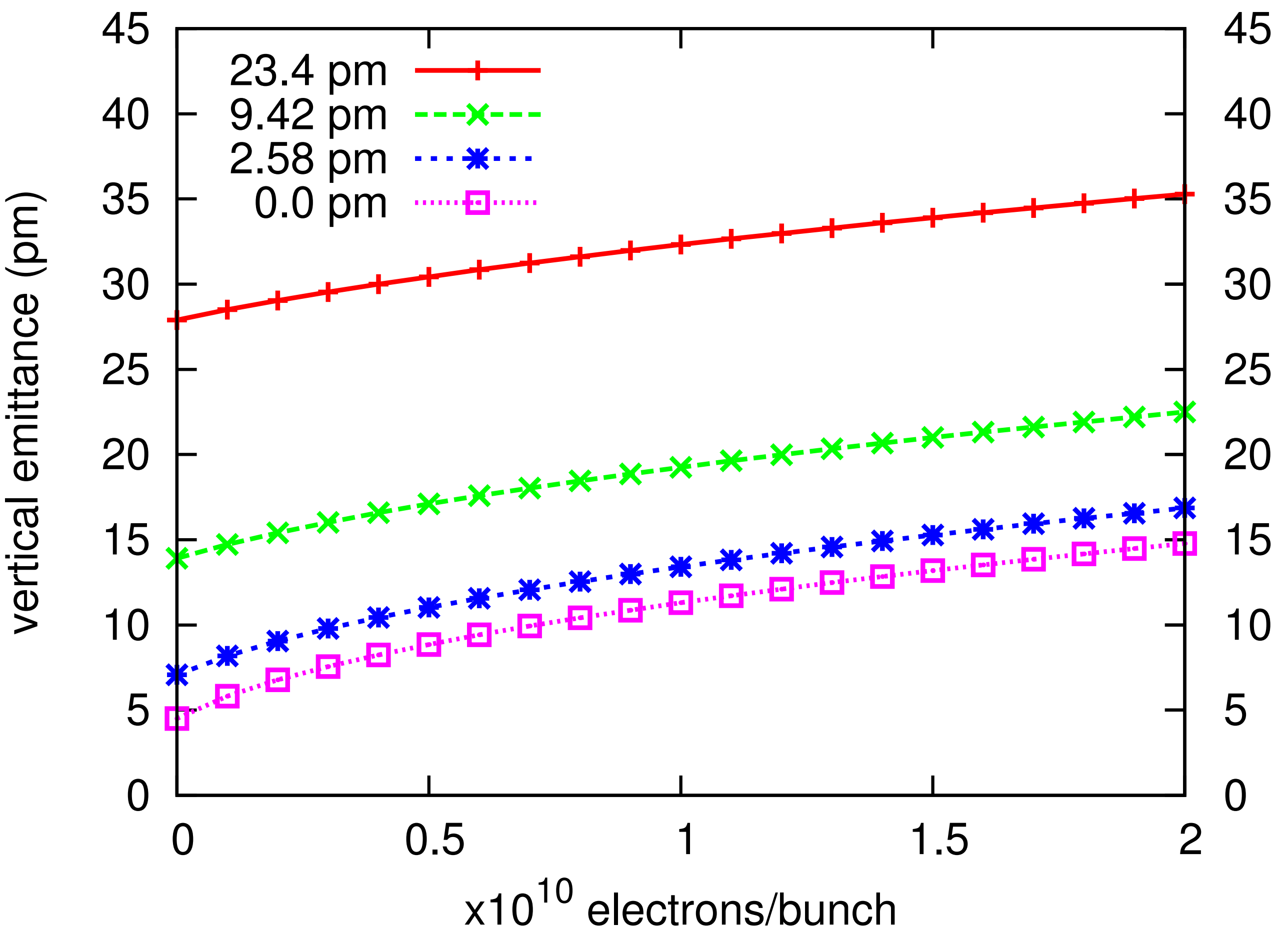
where it has been highlighted that the horizontal IBS rate T_x is a function of vertical emittance. But we find,

$$\frac{\partial T_x}{\partial \epsilon_y} = small. \tag{4}$$

Ultimately this means,

$$\epsilon_{v,ibs,\kappa\&\eta} \approx \epsilon_{v0,\eta} + \epsilon_{v,ibs,\kappa}.$$

That is, to find the equilibrium emittance after IBS effects taking coupling and vertical dispersion into account, we can simply find the equilibrium emittance of an ideal lattice (no misalignments) and add to it the vertical emittance due to misalignments.



This plot shows the equilibrium vertical emittance as a function of particles per bunch. The 0.0 pm data represents vertical emittance assuming a perfectly flat lattice, but with .25% emittance coupling.

Plot	N part/bunch	Coupling	$\epsilon_{y0,\eta}$ (pm)	$\langle \mathcal{H}_y \rangle$ (μm)
0.0 pm	2E10	.25%	0.0	0.0
2.58 pm			2.58	1.95
9.42 pm			9.42	7.12
23.4 pm			23.4	18.8