

ILC BDS-FFS BASELINE LATTICE ($L^*=4M$)

E. Marin, G. White, SLAC.

Dec. 3, 2014

BDS Baseline Design ($E_{\text{CM}}=500$ GeV)

Assuming TDR parameters:

$$\begin{aligned}\beta_x^* &= 11 \text{ mm} \\ \beta_y^* &= 0.48 \text{ mm}\end{aligned}$$

$$\begin{aligned}\sigma_x^* &= 474 \text{ nm} \\ \sigma_y^* &= 5.9 \text{ nm}\end{aligned}$$

Considered initial lattice to work with: ILC2012b

- Remove 1.69 m of D2B to match the CFS length
- Split QF7 in 2 magnets (QF7B, QF7A) (0.5 m apart)
- Insert BPM in between the QF7s (*MIP*)

- Final Lattice has length = TDR length assumption for BDS
- QF1 in standard push-pull configuration location (9.5m from IP)

Following Usual Design Approach...

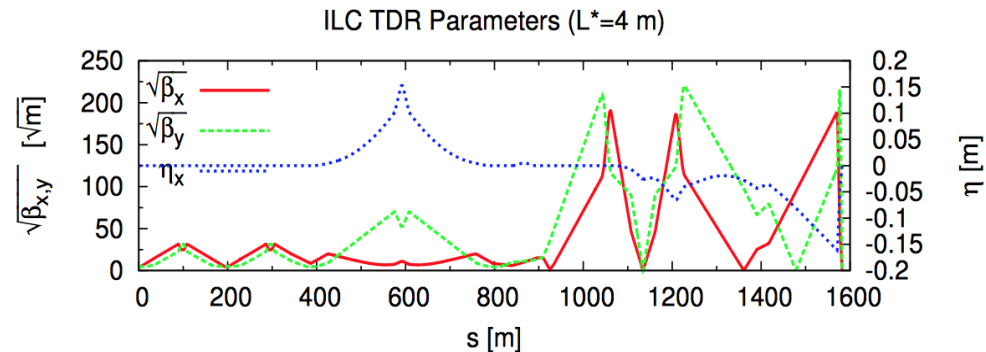
Following partially the recipe described at SLAC-PUB-9895

- adjust quadrupoles QF1 and QD0
 - to set $\alpha_{x,y}$ at exit of FD
- adjust quadrupoles from QD2 to QF7
 - to set $\alpha_{x,y}$ at image point (MIP) equal to 0
 - $\Delta\mu_{x,y} = n\frac{\pi}{2}$
 - $R_{ij}^{SF1-SF6} = 1$
 - $R_{ij}^{SD0-SD4} = -1$
- adjust matching quadrupoles
 - to match the incoming $\beta_{x,y}$ and $\alpha_{x,y}$
 - to set $\Delta\mu_{x,y}^{Coll-IP} = n\frac{\pi}{2}$

+2 additional quads in β COLL section
To help with phase matching

Matching with
MADX/MAPCLASS

L (inc.vert. waist shift)
 $1.78\text{E}34 \text{ cm}^{-2}\text{s}^{-1}$
(Lucretia Tracking)

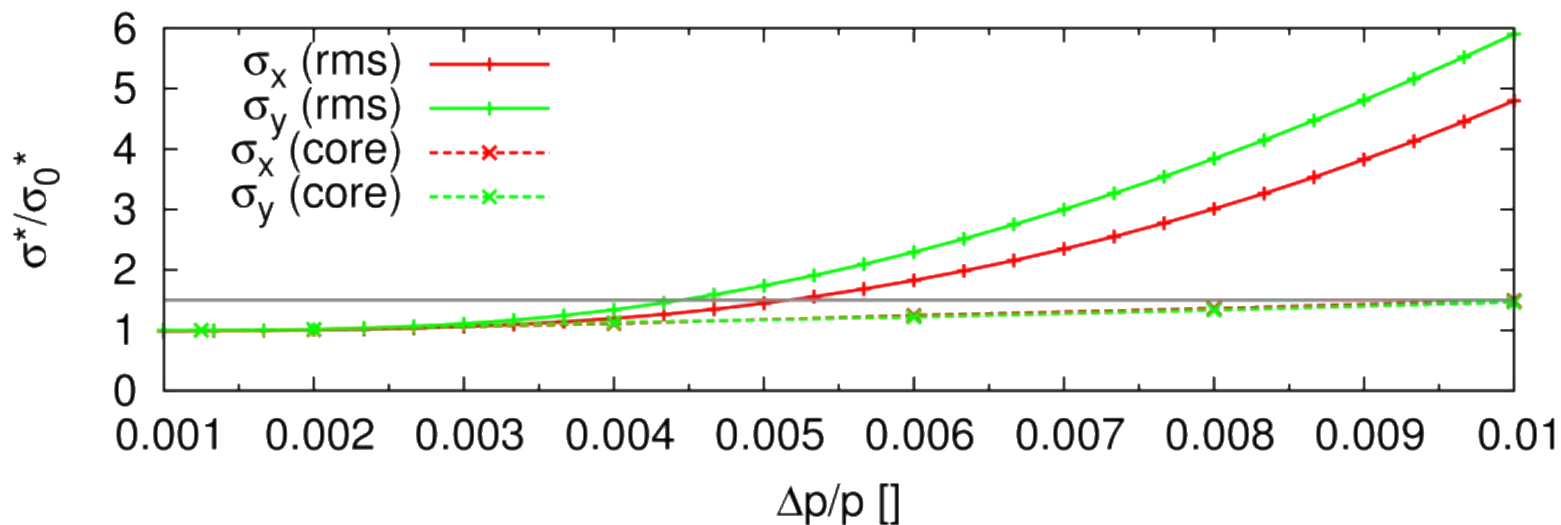
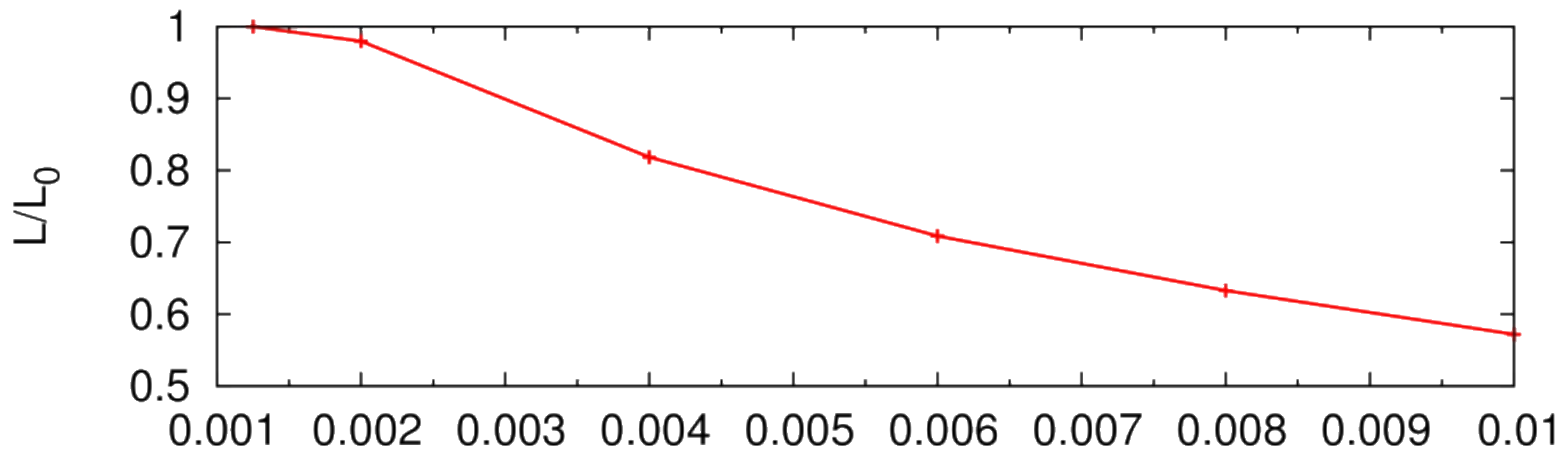


Phase advances between Collimation section and IP:

- from SPEX (E-collimation) to IP: $\Delta\mu_{x,y} = n\frac{\pi}{2}$
- from SP4 (β -collimation) to IP: $\Delta\mu_{x,y} = n\frac{\pi}{2}$
- from SP2 (β -collimation) to SP4: $\Delta\mu_{x,y} = n\frac{\pi}{2}$

- adjust SD0, SF1, SD4, SF5, SF6, OC10, OC1, OC0, DEC4L and DEC6L
 - $\sigma_x^* = 474 \text{ nm}$
 - $\sigma_y^* = 5.8 \text{ nm}$

Energy Bandwidth



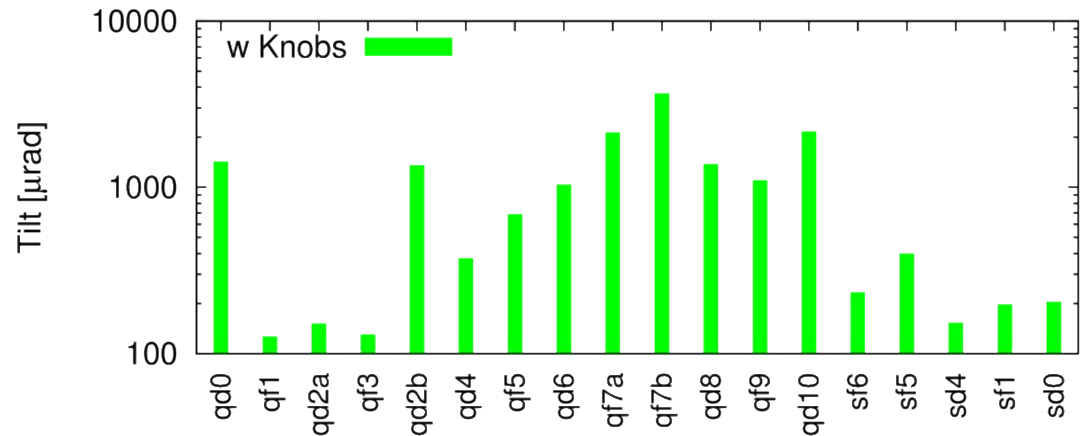
Tolerance Calculations

- Tolerance calculations show sensitivity to given error to produce 2% luminosity loss
 - $L=1/(\sigma_x^* \sigma_y^*)$
- Beam size calculations include removal of linear aberrations:
 - Shows tolerances including perfect operation of linear waist, dispersion and coupling sextupole multiknobs

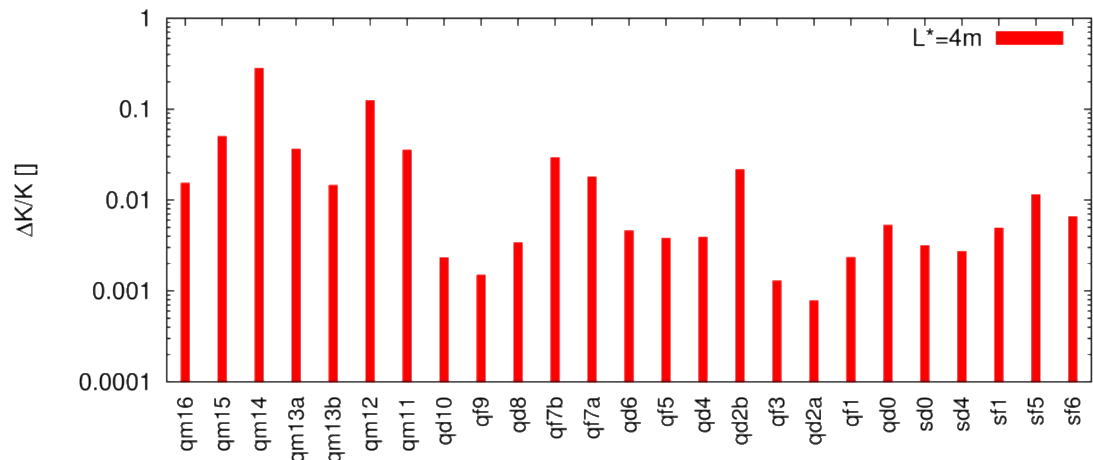
Tilt & Strength Tolerances

- These tolerances are all within assumed installation capabilities (just)
 - ~100 μ rad rms tilt alignment
 - $dK/K < 1E4$

Tilt Alignment Tolerance

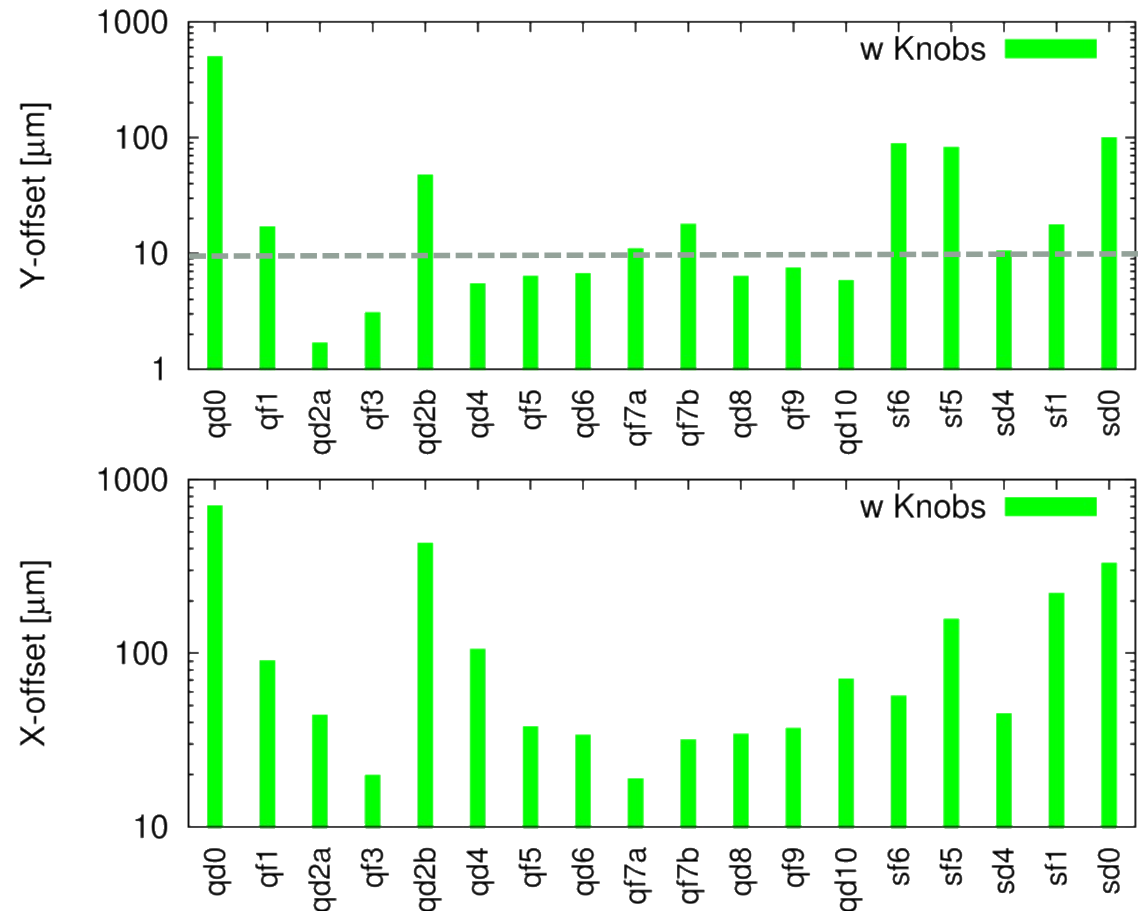


Strength Error Tolerance



Alignment Tolerances

- Several vertical offset tolerances $< 10\mu\text{m}$
- Good BBA critical here
- In principle $O(1\mu\text{m})$ possible with FFS&EXT cavity BPMs
- In practice, $< 10\mu\text{m}$ seems difficult...
- MC tuning simulations essential to judge lumi impact



Summary

- $L^*=4\text{m}$ lattice design work completed for $E_{\text{CM}} = 500 \text{ GeV}$
- Lattice designs for other TDR parameter sets in progress
- Lattice release schedule:
 - First release of entire, matched ILC lattice (source – dump) (XSIF format) to TDR specifications (3.5m & 4.5m FFS lattices) to DESY SVN repository by MDW, hopefully before year end (or first weeks of Jan).
 - After formal approval (if given) of single- L^* CR, look to submit CR for 4m lattice and associated changes:
 - New lattice configuration
 - Split QF7
 - Corrected E chicane length
 - Inclusion of skew-sextupoles in FFS lattice for non-linear knobs