LEPIII FFS considerations

R. Tomás and F. Zimmermann

Thanks to R. de Maria and H. Garcia

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LEPIII and some machines

Machine	L* [m]	β_y^* [mm]	β_x^* [mm]	L*$/\beta_y^*$ [10^3]	dp/p accept. [%]
LEP III	4	1	200	4	4
SuperB	0.4	0.2	20	2	1.5
SuperKEKB	0.7	3	200	0.23	1.8
LHC-ATS	23	150	150	0.15	0.5-1
Light sources					3-4

LEPIII IR challenges

- ⋆ Largest chromaticity than any other circular collider
- ⋆ Largest momentum acceptance than any other circular collider (similar to light sources)

Frank's suggestion

Would the future linear collider FFS suit LEPIII?

Parameter [Units]	**CLIC500**	**ILC500**
FFS length/side [m]	553.1	735.4
Energy/beam [TeV]	0.25	0.25
L* [m]	4.30	3.51/4.50
Crossing angle at IP [mrad]	18.6	14.0
Beam size at IP, $\sigma^*, x/y$ [nm]	202/2.3	474/5.9
β-function at IP, $\beta^*, x/y$ [mm]	8/0.1	11/0.48
Bunch length, σ_z [μm]	72	300

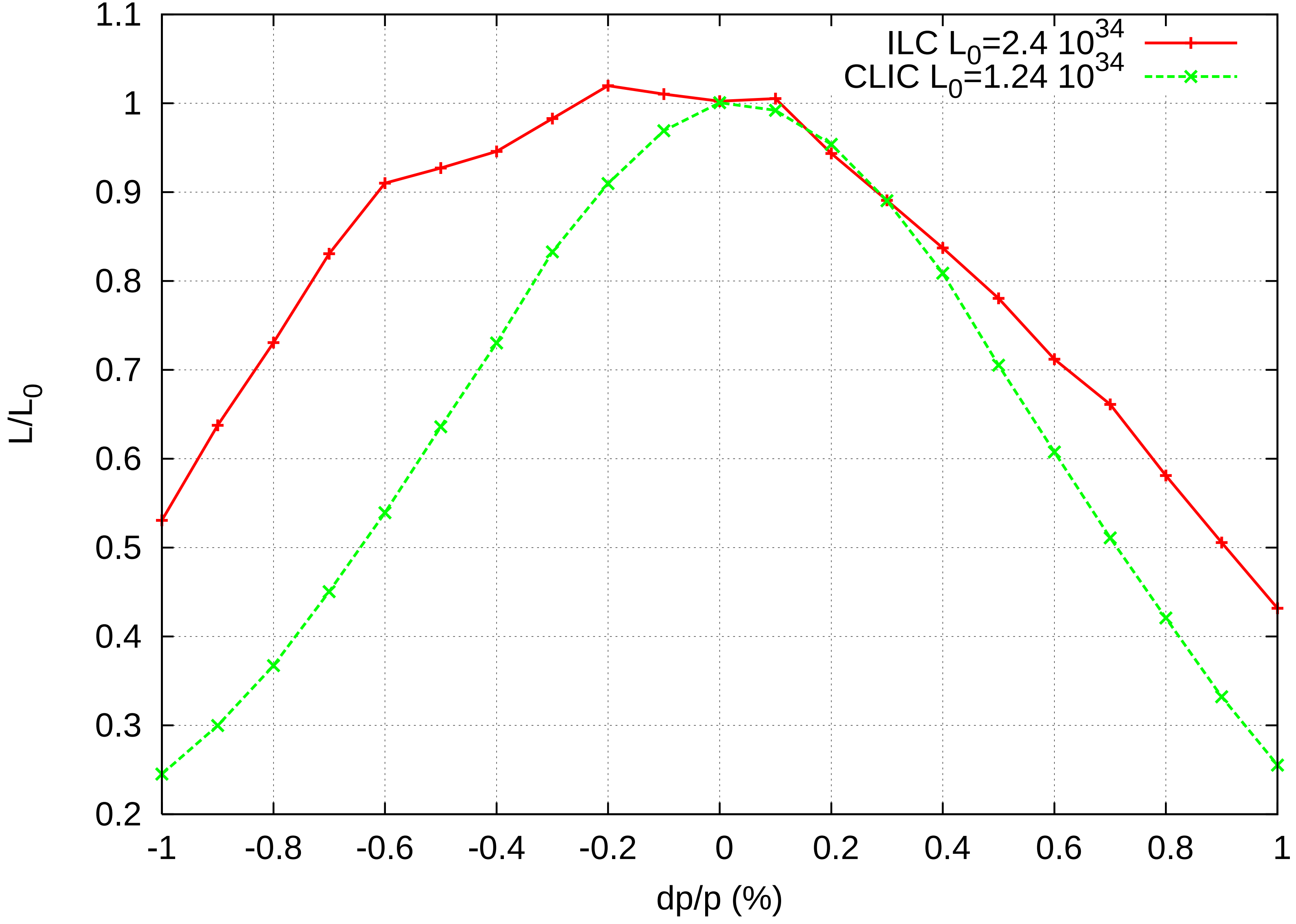
MAPCLASS

- Both ILC and CLIC FFSs are currently optimized with MAPCLASS
- MAPCLASS minimizes σ_x^* and σ_y^* by varying all available FFS optics parameters.

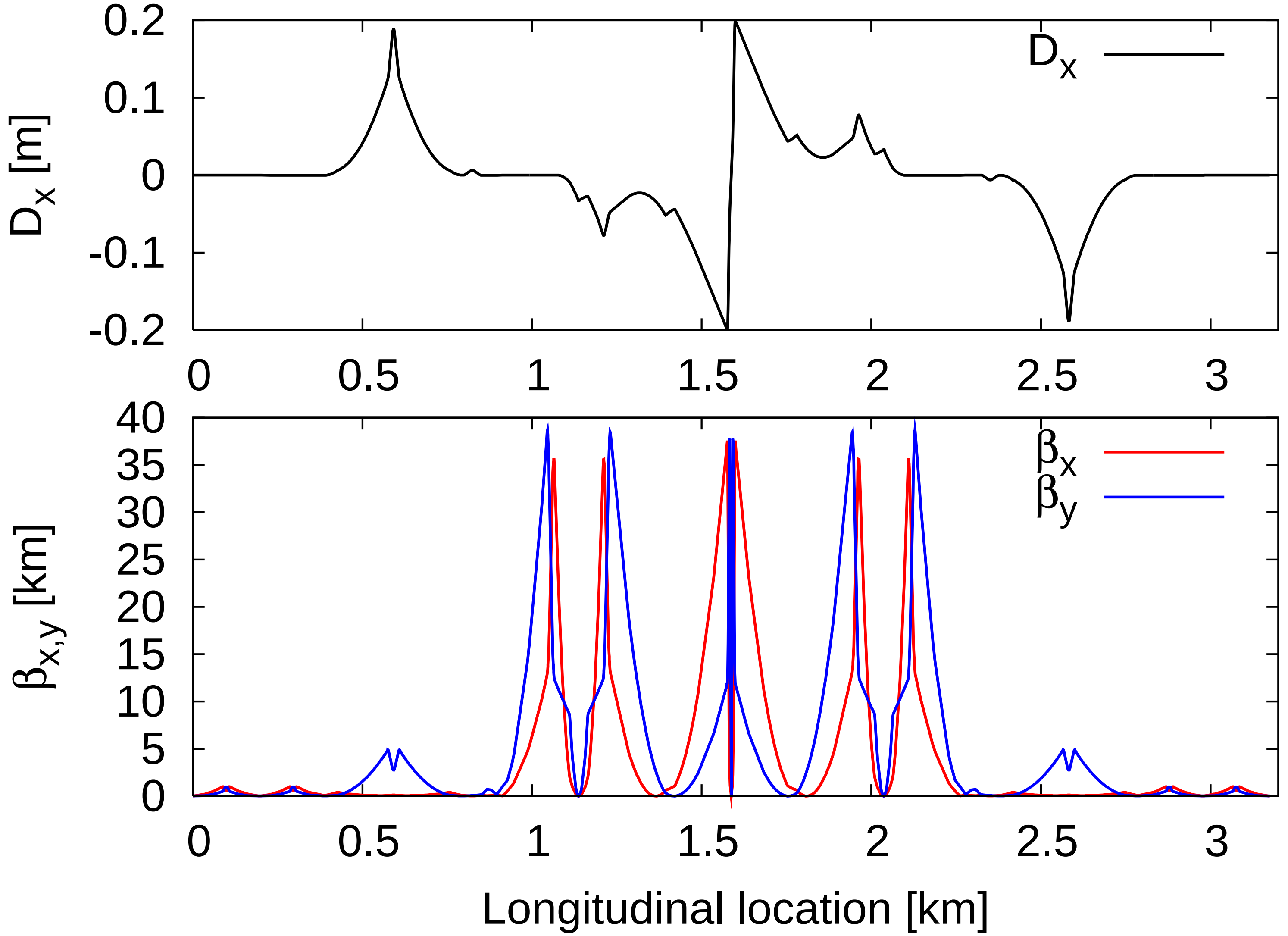
$$
\begin{aligned}
{\sigma_x^*}^2 \quad = \quad & \sum_{jklmn} X^2_{jklmn} \Gamma\left(\frac{1+2j}{2}\right) \Gamma\left(\frac{1+2k}{2}\right) \Gamma\left(\frac{1+2l}{2}\right) \Gamma\left(\frac{1+2m}{2}\right) \\
& \times \frac{2^{j+k+l+m-2n}}{(2n+1)\pi^2} \sigma_x^{2j} \sigma_{p_x}^{2k} \sigma_y^{2l} \sigma_{p_y}^{2m} \Delta_\delta^{2n} + \ldots
\end{aligned}
$$

- where X_{jklmn} are the transfer map coefficients given by PTC
- Note that currently σ_{px}^* and σ_{py}^* are not optimized

ILC & CLIC energy bandwidths

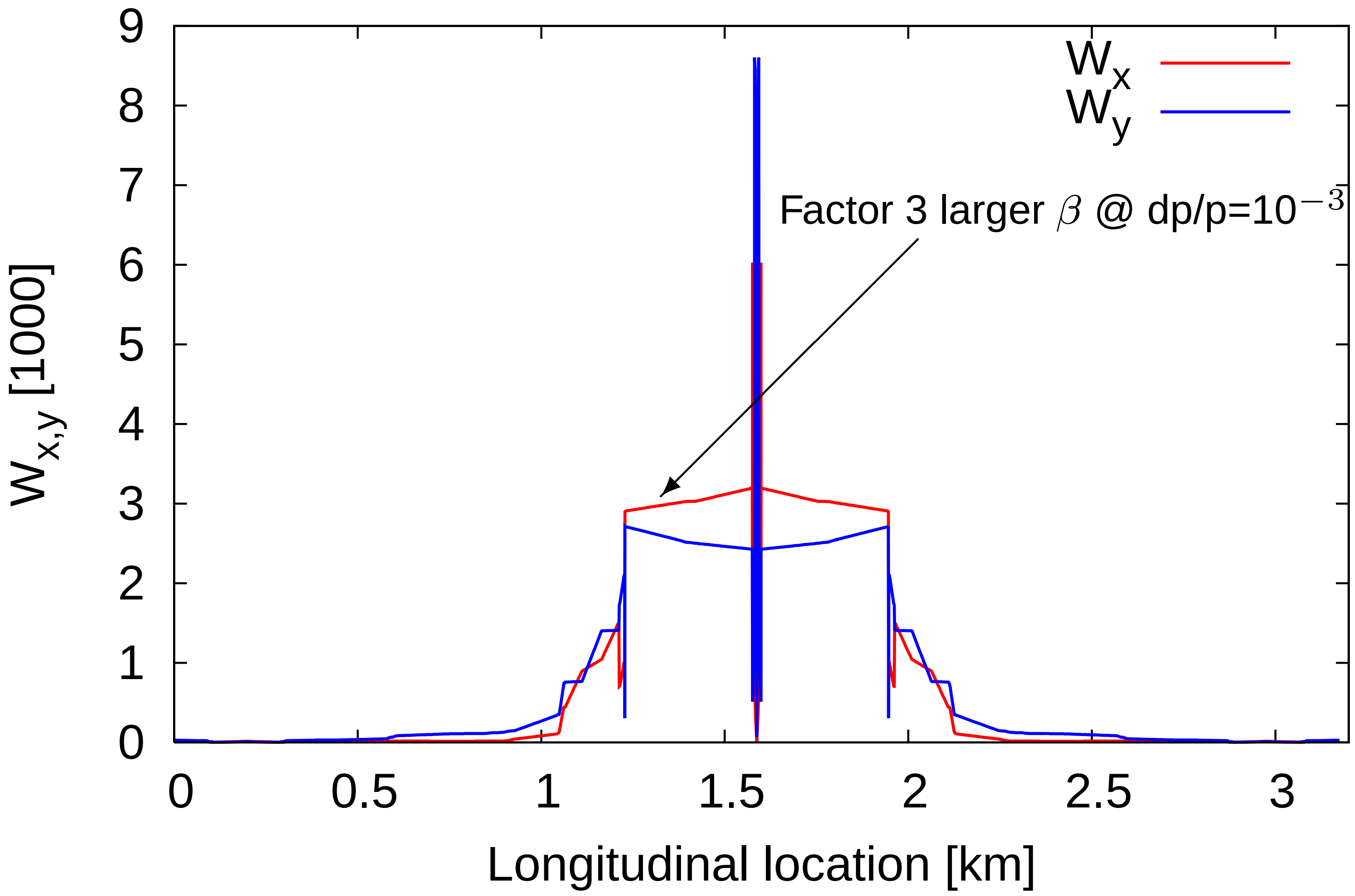


ILC-based LEPIII IR - Optics



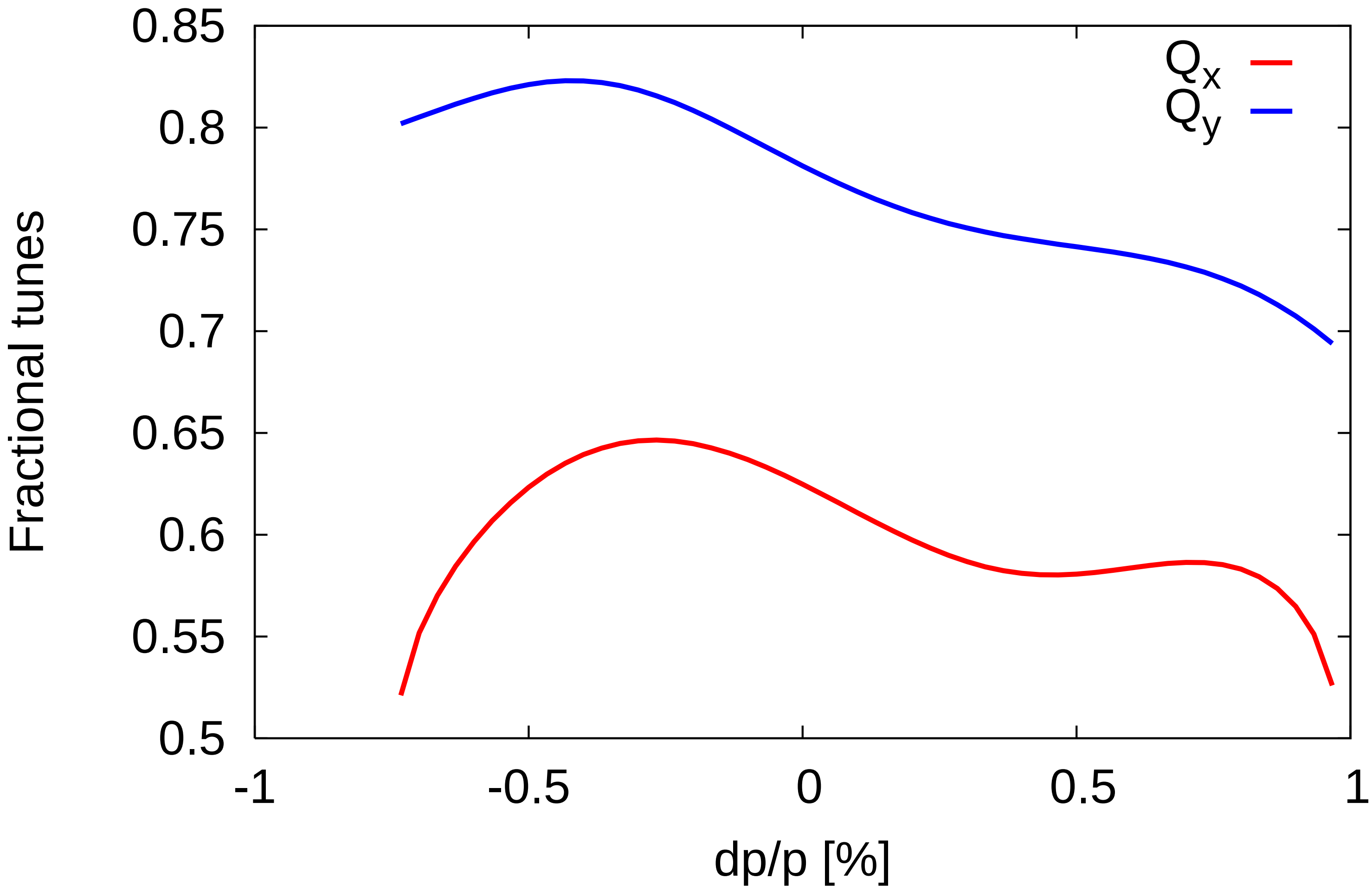
Antisymmetric dipoles and sexts on both IP sides

ILC-based LEPIII IR - Chromatic functions



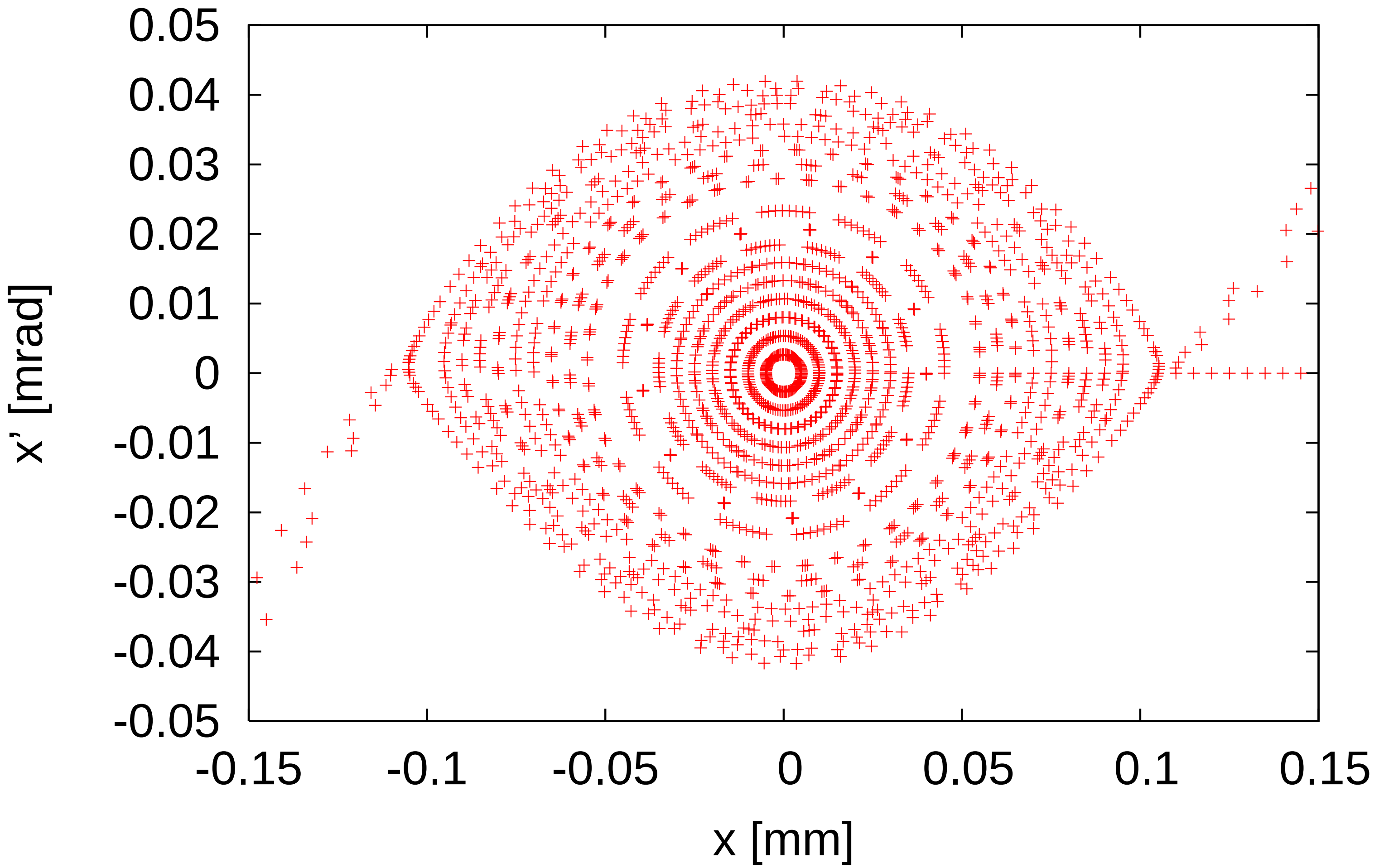
A good fraction is locally corrected as expected.

ILC-based LEPIII IR - dp/p acceptance



... not even the 1%

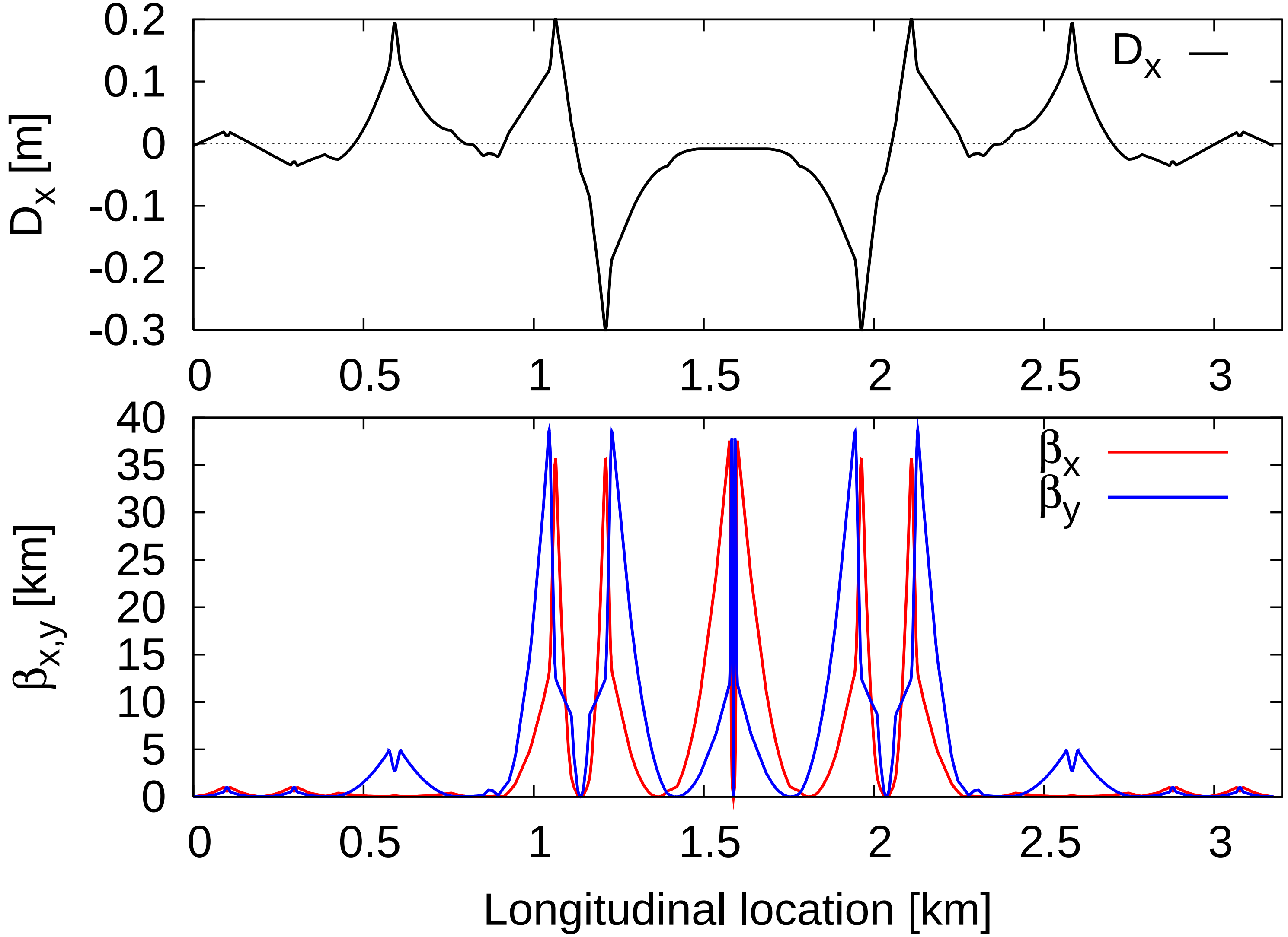
ILC-based LEPIII IR - DA



β_x= 20 m, dp/p=0.95%, $\epsilon_x = 20$ nm, DA=0.15σ_x

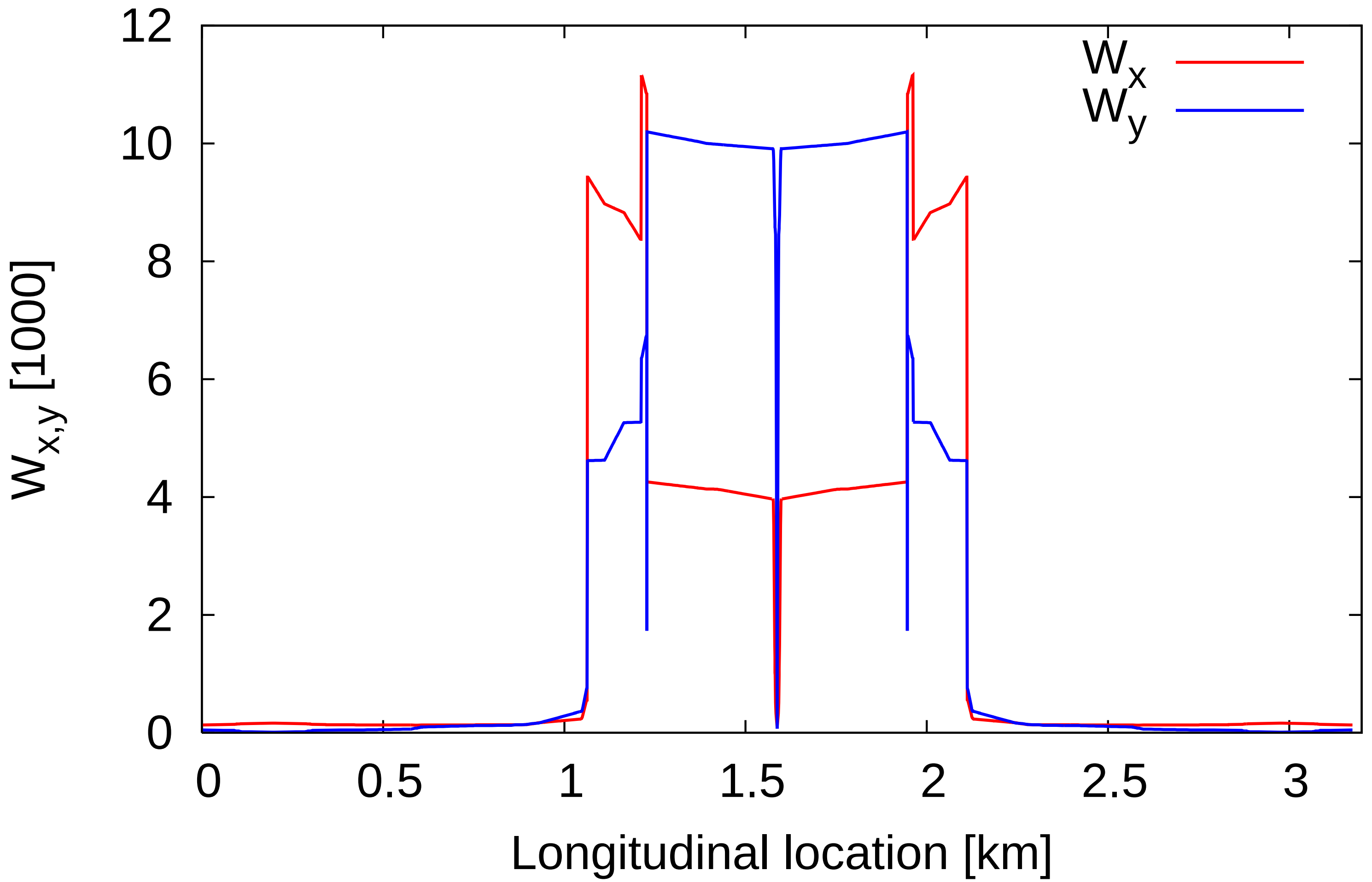
particle is lost in few turns.

ILC-based LEPIII IR - 2^{nd} attempt



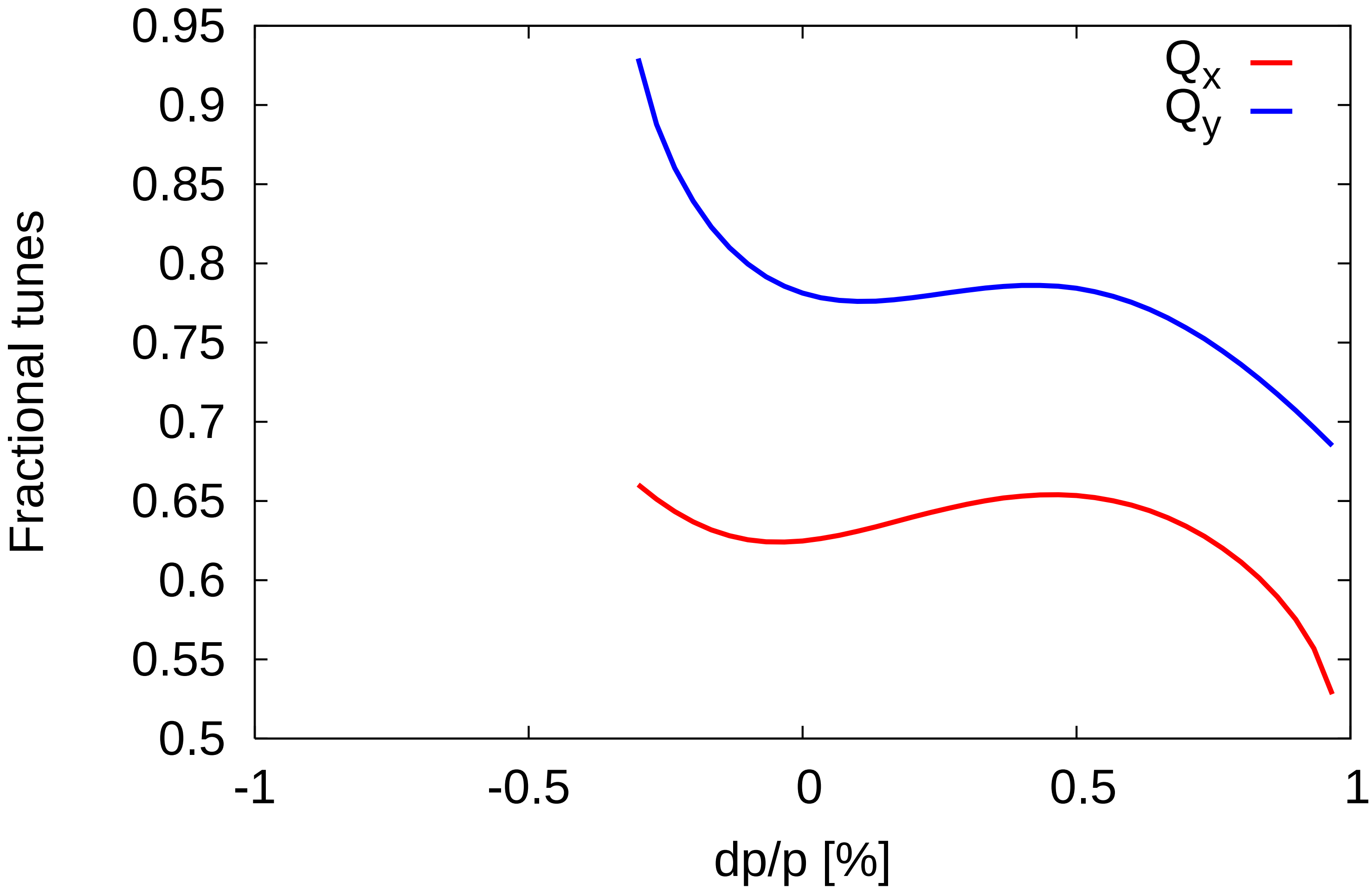
Symmetric dipoles and sexts on both IP sides.

ILC-based LEPIII IR - 2$^{\rm nd}$ attempt



No trace of local correction.

ILC-based LEPIII IR - 2$^{\rm nd}$ attempt



slightly worse than first attempt...

Summary

- ⋆ Challenging IR design and momentum acceptance
- ⋆ First and bold attempts with ILC FFS not satisfactory
- ⋆ Reducing L* might help but 4% acceptance still looks difficult
- ⋆ Need to try other concepts for the IR design.