FCC-ee interaction region

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Seventh TLEP workshop
CERN
19th-21st June 2014

Parameters for crab waist

	Z	W	H	tt
Energy [GeV]	45	80	120	175
Perimeter [km]	100			
Crossing angle [mrad]	30			
Particles per bunch [10^{11}]	1	4	4.7	4
Number of bunches	29791	739	127	33
Energy spread [10^{-3}]	1.1	2.1	2.4	2.6
Emittance hor. [nm]	0.14	0.44	1	2.1
Emittance ver. [pm]	1	2	2	4.3
β_x^*/β_y^* [m]	0.5 / 0.001			
Luminosity / IP [$10^{34}\ cm^{-2}s^{-1}$]	212	36	9	1.3
Energy loss / turn [GeV]	0.03	0.3	1.7	7.7

Choice of L* https://indico.cern.ch/event/286658/

Final focus quadrupole strength

$$(-K_1 L)_{QD0} = \frac{2}{L^*}$$

Beta maximum

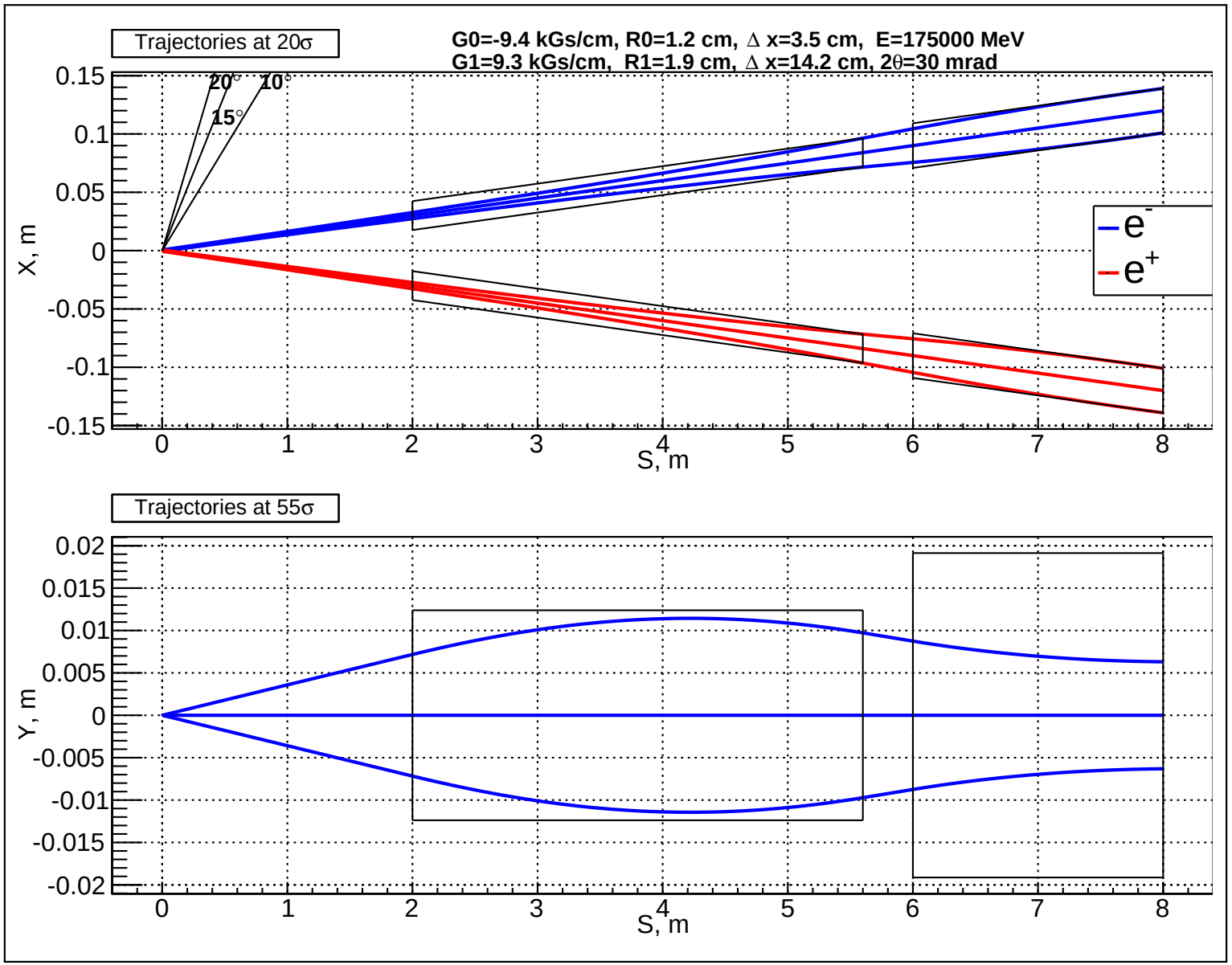
$$\beta_{max} \approx \frac{L^{*2}}{\beta^*}$$

Chromaticity

$$\mu'_y \approx -\frac{L^*}{\beta^*} + \frac{1}{2} K_2 L_s \beta_s \eta_s$$

Dynamic aperture decreases nonlinear with sextupole strength increase.

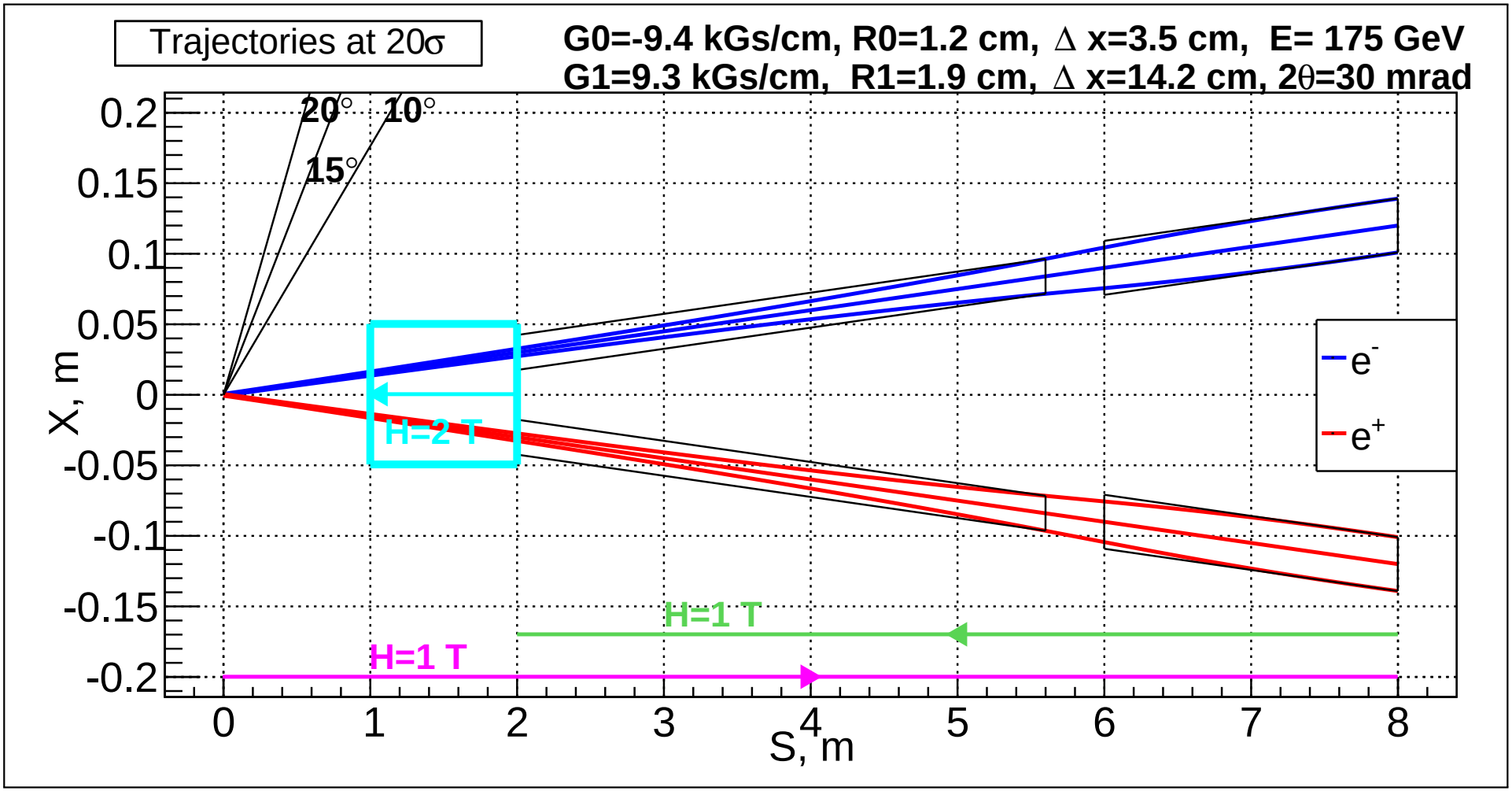
Final Focus layout



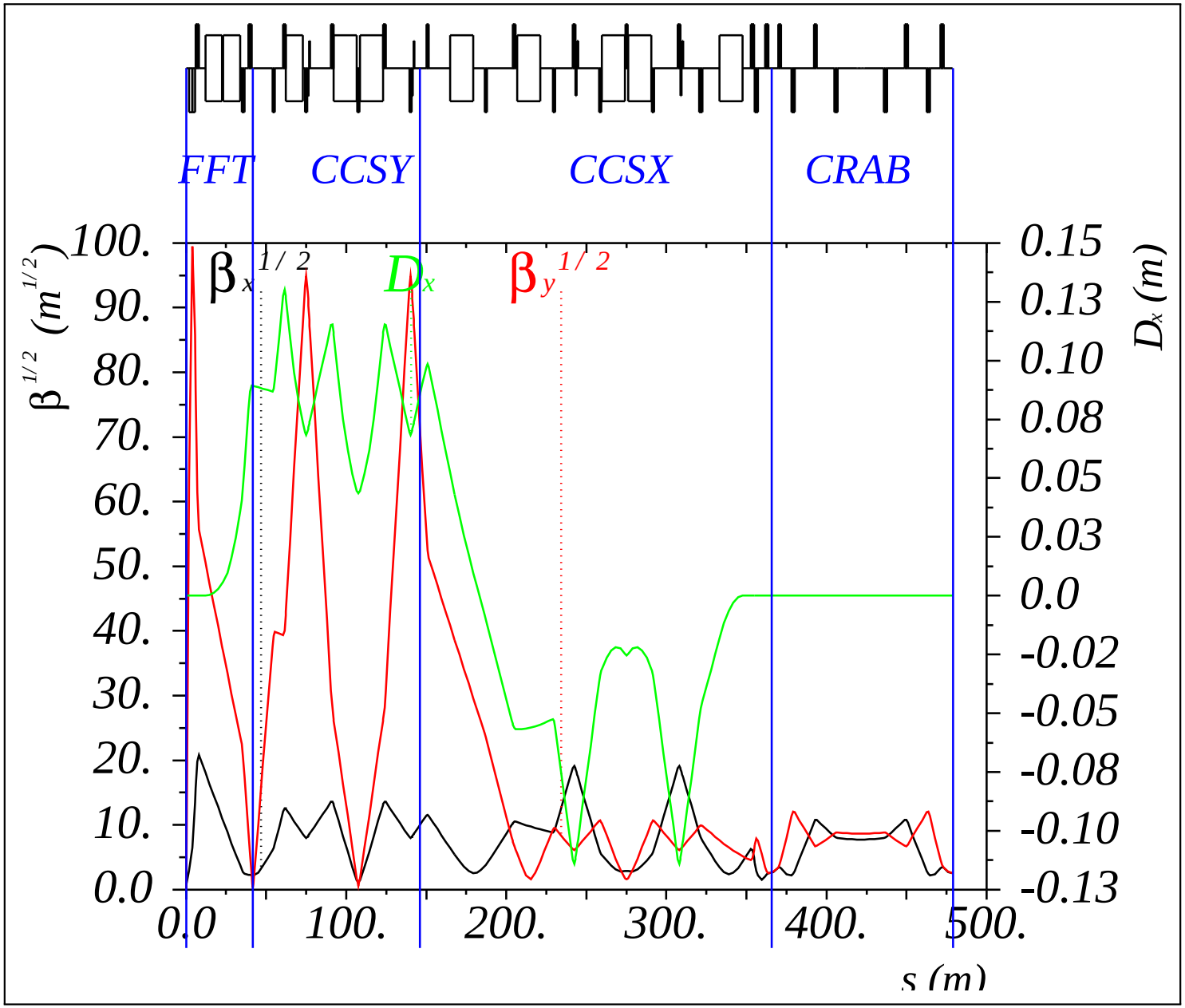
Rectangles represent bare apertures.

	L [m]
Q0	3.6
Q1	2

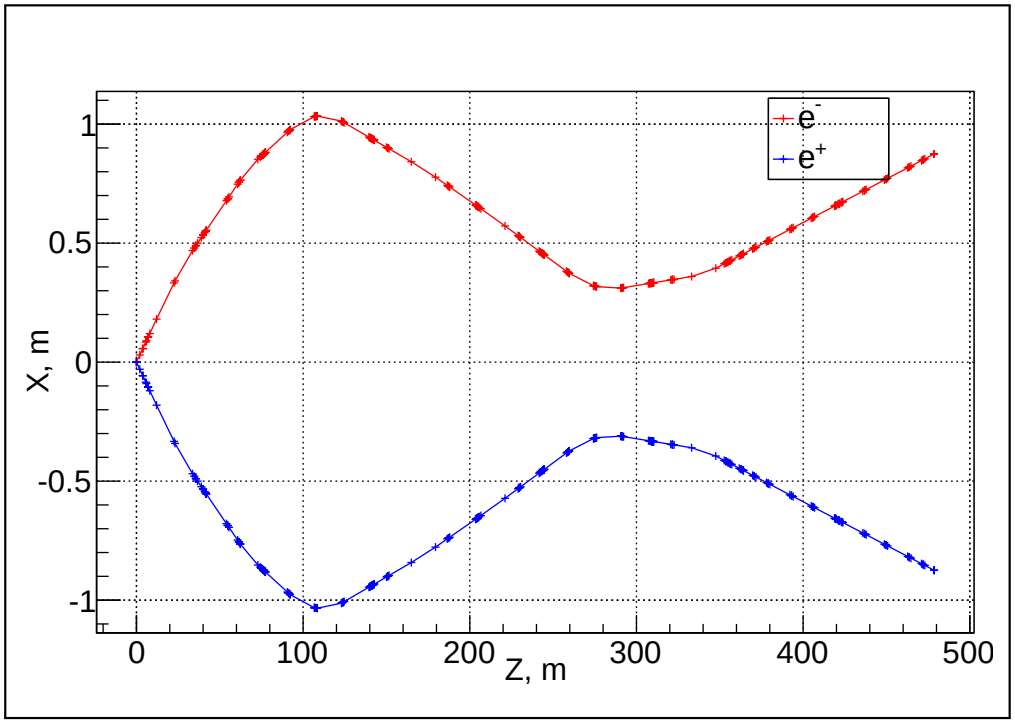
Final Focus layout: sketch of solenoids



Interaction Region optical functions



Interaction Region layout

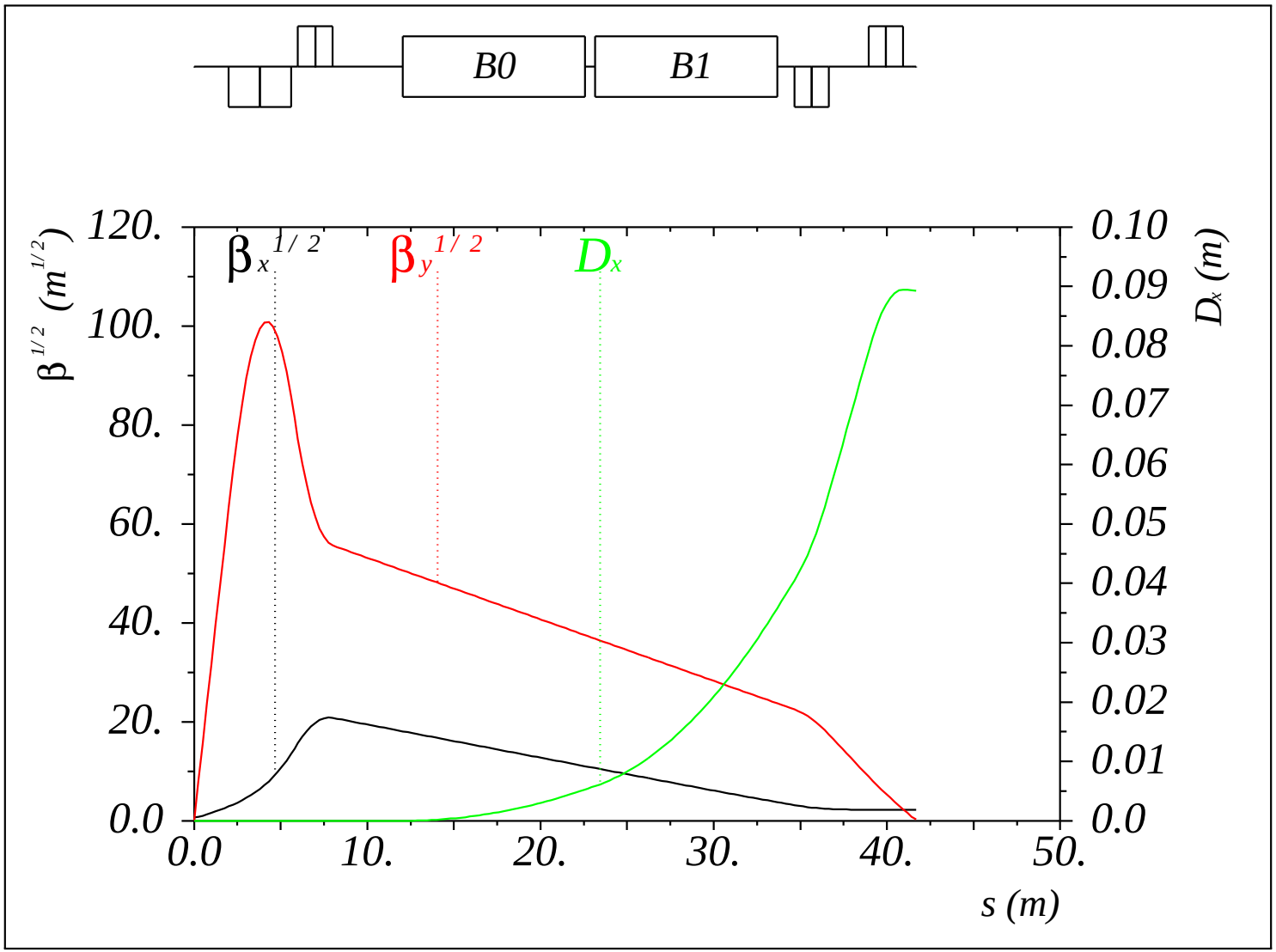


Divergence of the beam lines is 7.3 mrad.

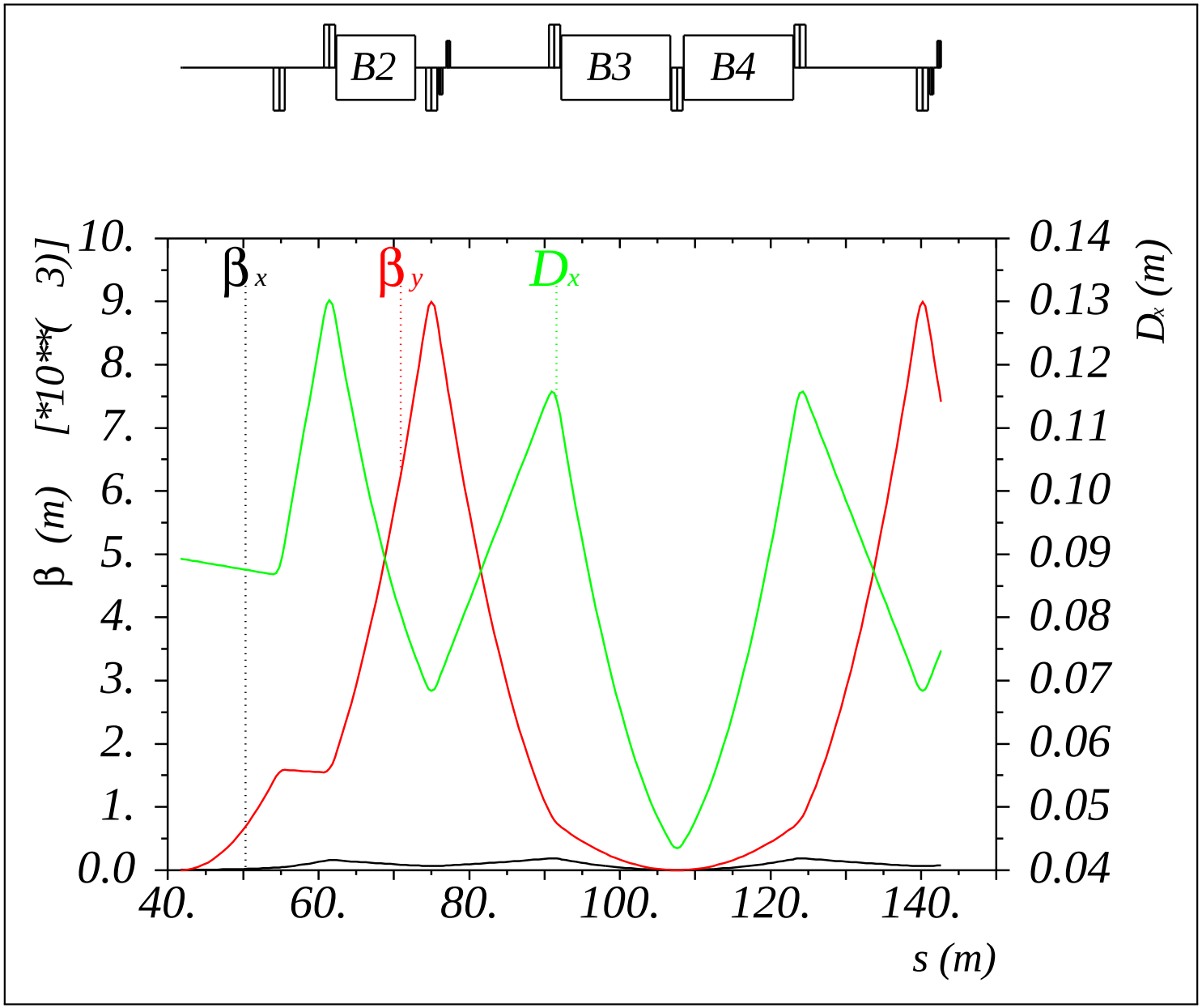
Energy loss is 0.11 GeV at $E = 175$ GeV.

	L [m]	B [T]	ϕ [mrad]
SEB0	10.5	0.06	1
SEB1	10.5	0.216	3.7
SEB2	10.5	0.22	3.9
SEB3	14.5	0.21	5.2
SEB4	14.5	0.21	5.2
SEB5	14.5	0.03	0.8
SEB6	14.5	0.01	0.3
SEB7	14.5	-0.13	-3.2
SEB8	14.5	-0.13	-3.2
SEB9	14.5	-0.10	-2.5
Total			11

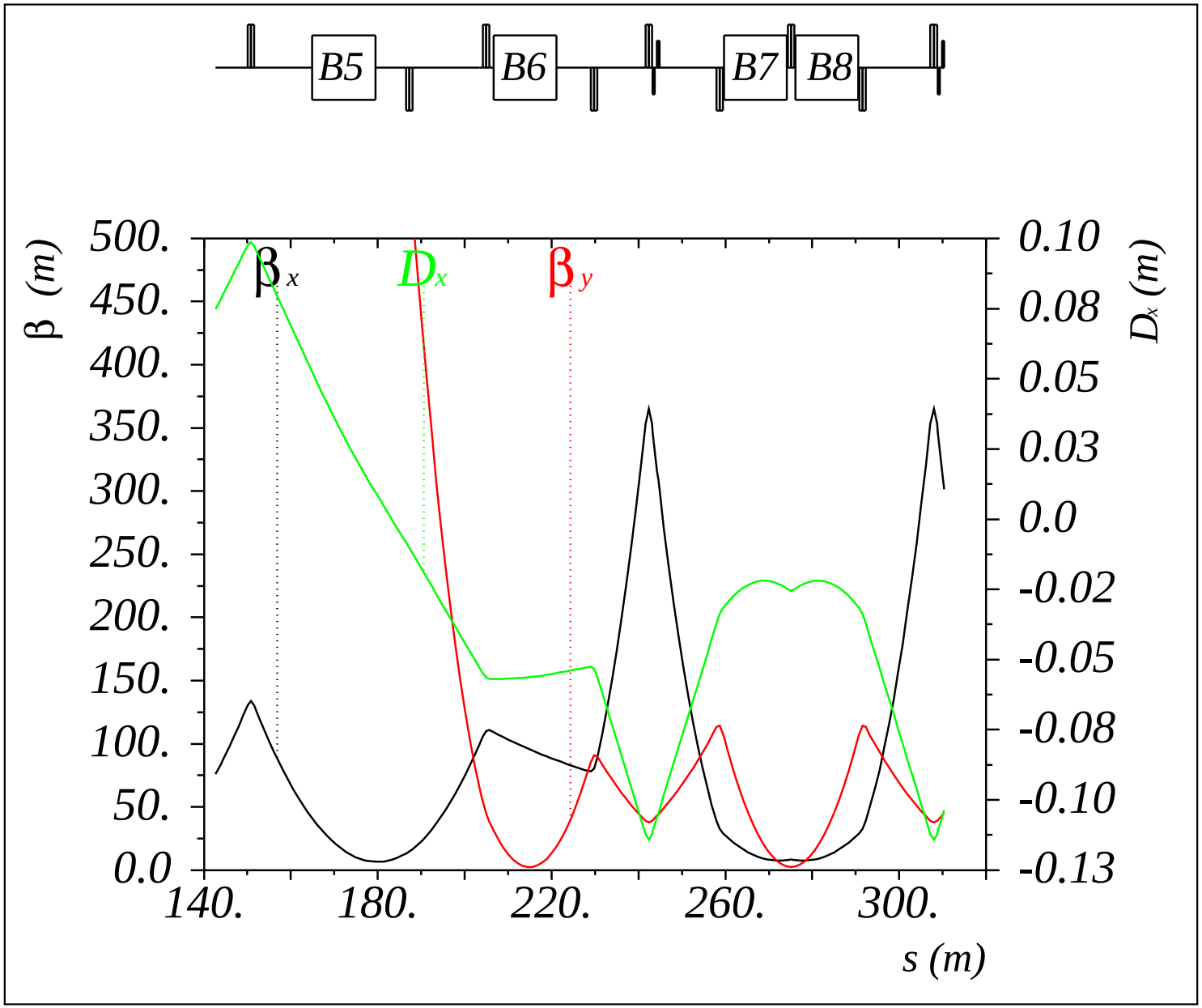
Final Focus Telescope



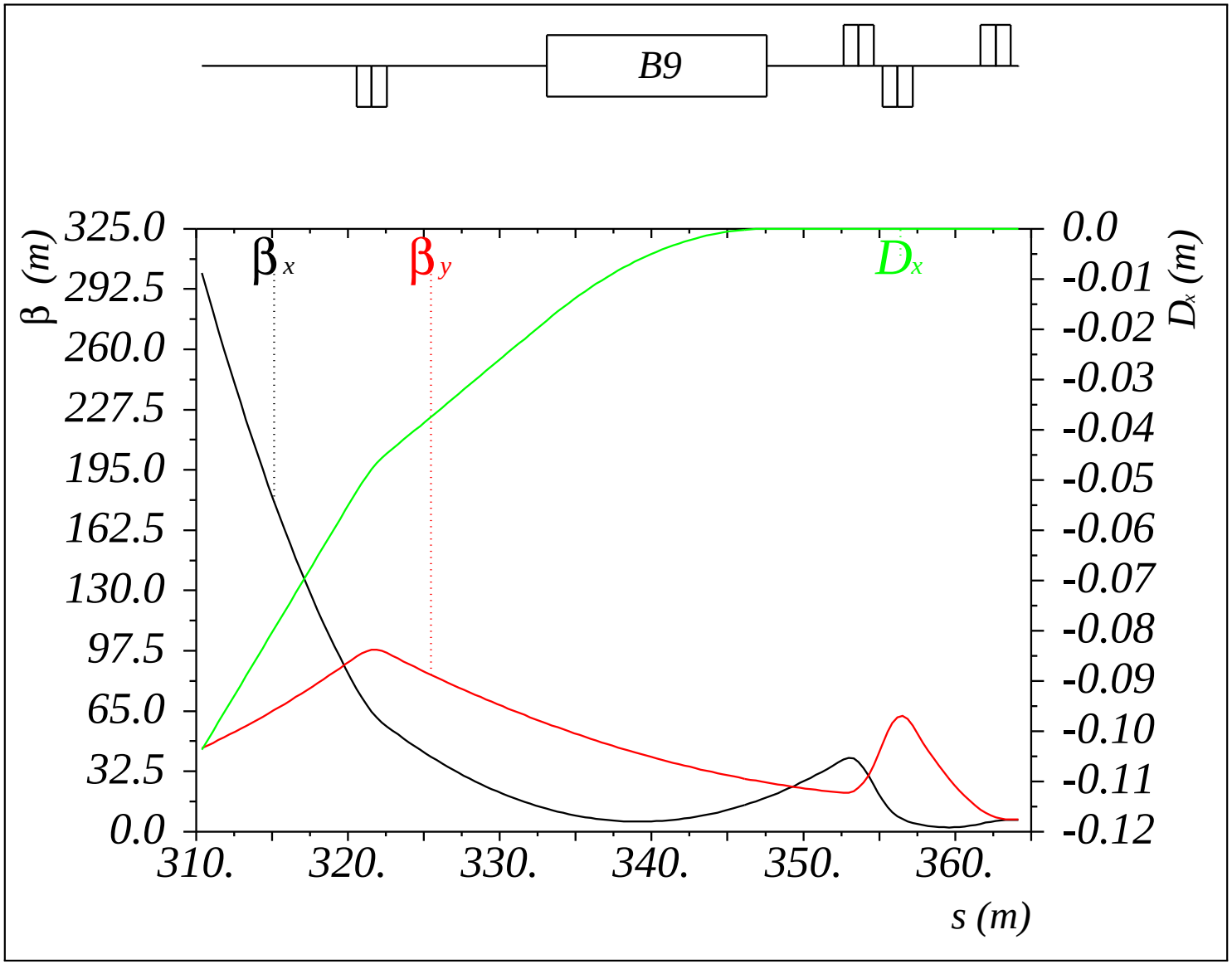
Y Chromaticity Correction Section



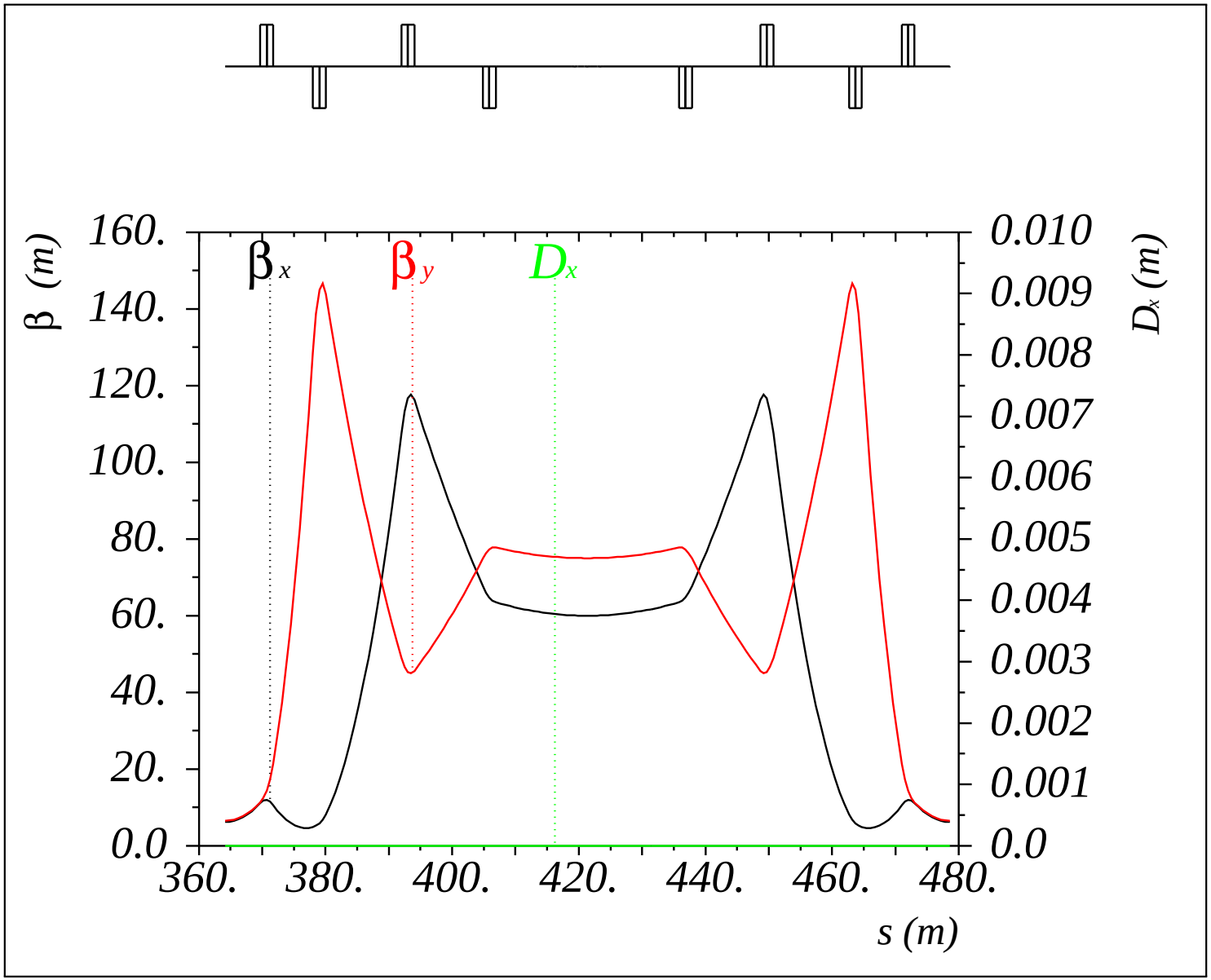
X Chromaticity Correction Section



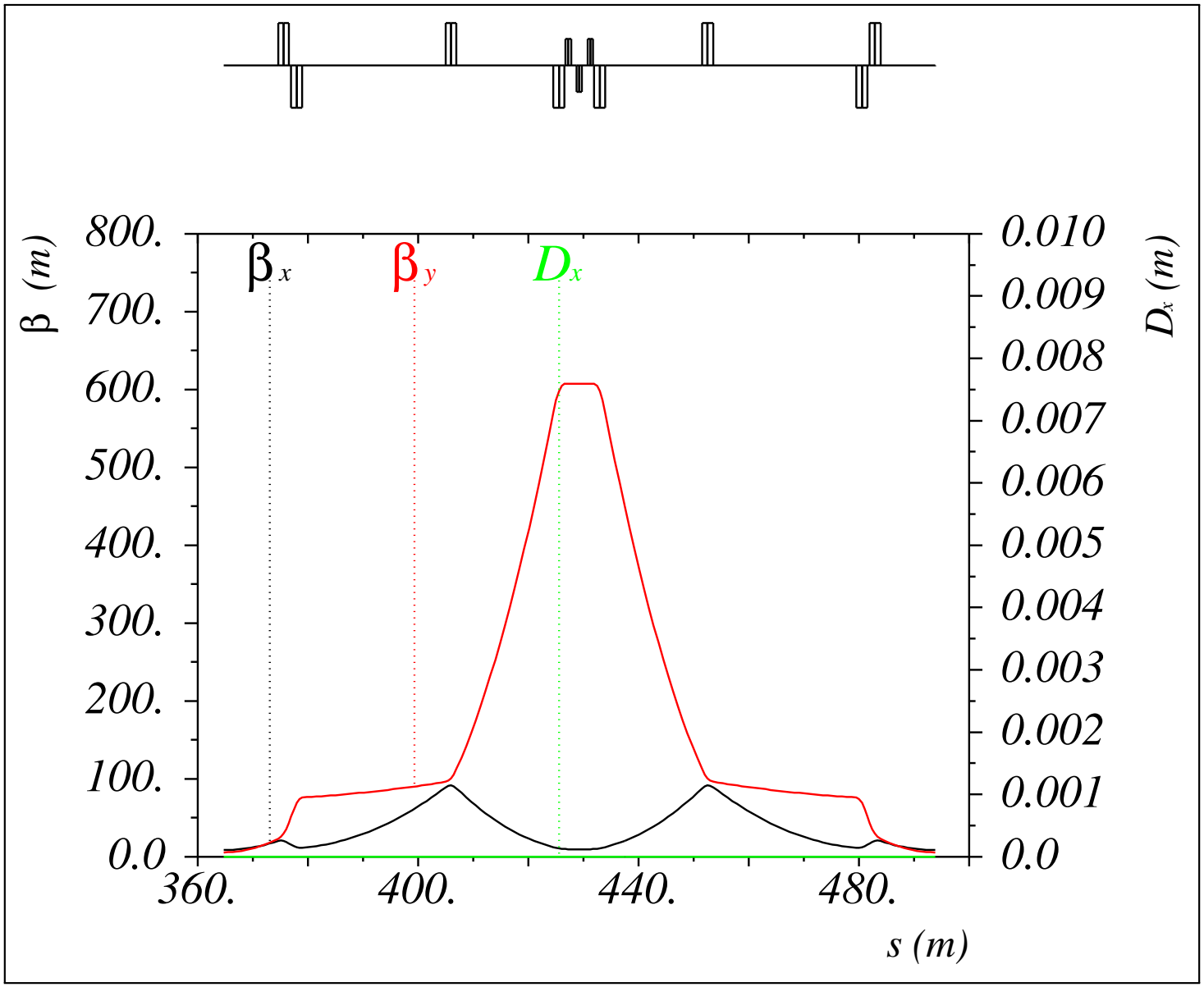
Chromaticity Correction Telescope



CRAB section 1



CRAB section 2



Instead of conclusion

1. A version of interaction region with crab waist is ready.
2. Synchrotron radiation is low.
3. Beam lines are symmetrical, making tunnel straight.
4. Detector field?
5. Design of anti-solenoids, screening solenoids, FF quadrupoles, cryostats ...
6. Calculations of synchrotron radiation backgrounds for detector, adjustment of IR.
7. Connecting with the arcs and closing the ring.