The ILC BDC Final Focus: 250 GeV option(s).

Dr. Larisa Malysheva

Oxford University

ILC BDS lattice status and changes

- Push-pull operation decks (A. Seryi)
- 3 version for different L*:
- L*=3.51m, L*=4.5m, L*=4.0m
- Optics was not tuned
- Beta_x=15mm, bet_y=40mm (500GeV) option
- Dipoles were not decimated.
- New IP parameters (see table on next slide)
- Operation for low energy (possibility of swithing part of final doublet)

The ILC new set of IP parameters)

Centre-of-mass energy E_{cm}		GeV	200	230	250	350	500
Beam energy	E_{beam}	GeV	100	115	125	175	250
Lorentz factor	γ		#######	#######	#######	#######	#######
Collision rate	f_{rep}	Hz	5	5	5	5	5
Electron linac rate	f_{linac}	Hz	10	10	10	5	5
Number of bunches	n_b		1312	1312	1312	1312	1312
Positron bunch population	N_+	$\times 10^{10}$	2.0	2.0	2.0	2.0	2.0
RMS bunch length	σ_z	mm	0.3	0.3	0.3	0.3	0.3
Electron RMS energy spread	$\Delta p/p$	%	0.206	0.194	0.190	0.158	0.125
Positron RMS energy spread	$\Delta p/p$	%	0.187	0.163	0.150	0.100	0.070
Horizontal emittance	$\gamma \varepsilon_x$	μm	10	10	10	10	10
Vertical emittance	$\gamma \varepsilon_y$	nm	35	35	35	35	35
IP horizontal beta function β_x^*		mm	16.0	14.0	13.0	16.0	11.0
IP vertical beta function (no TF)	β_y^*	mm	0.34	0.38	0.41	0.34	0.48
IP vertical beta function (TF)	β_y^*	mm	0.2	0.2	0.2	0.2	0.2
IP RMS horizontal beam size	σ_x^*	nm	904	789	729	684	474
IP RMS veritcal beam size (no TF)	σ_y^*	nm	7.8	7.7	7.7	5.9	5.9

Low energy (125 GeV) beam option.

- MAPCLASS code based on MAD-X PTC was chosen (R.Tomas)

- Use 2 version of optics: L*=3.51m and L*=4.05m

- Rematch the linear optics to the new IP parameters.

- Second and higher order aberrations tuning

- Decimate dipoles (keep space reserved)

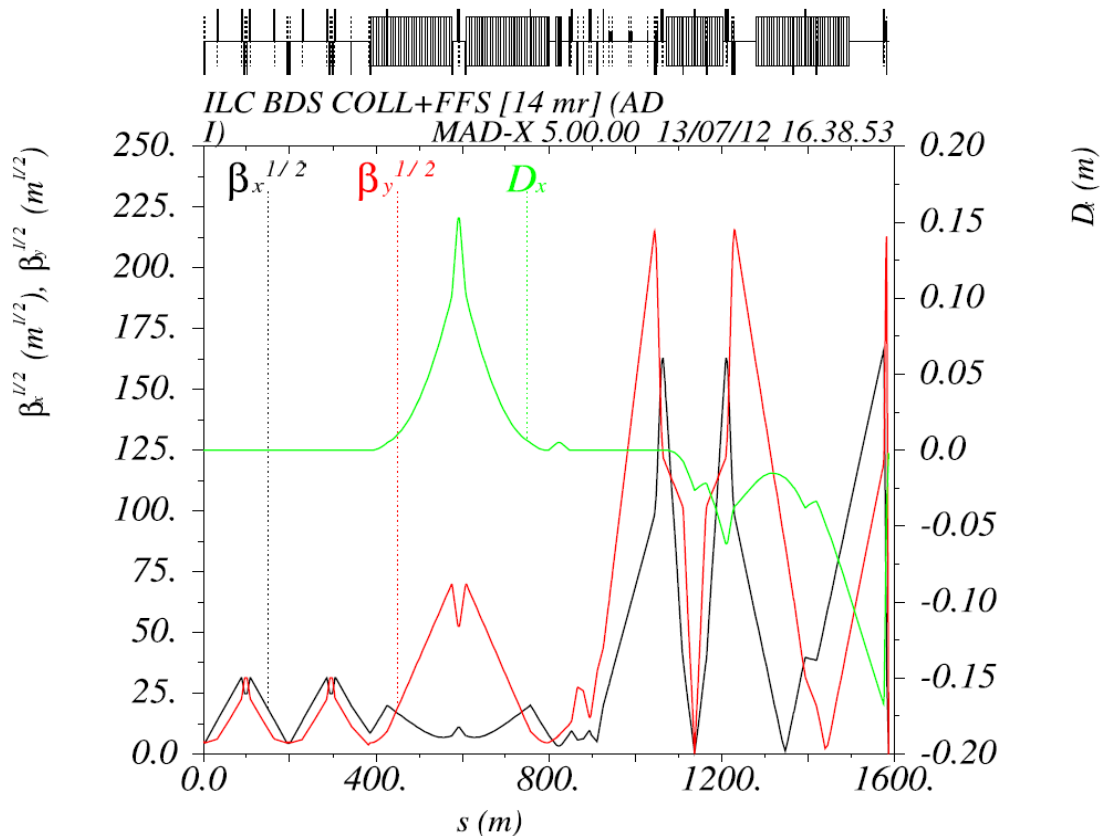- Check the possibility of Half QD0/QF1 operation

v.351LD0_135D1B (old version)

$\beta_x = 0.015$;
$\beta_y = 0.00040$;
Dx=-1.73528e-02

- Original plot (Dx=-1.735×10^{-3} !)

Corresponding beam sizes:

σ_x^1 =3.39e-06
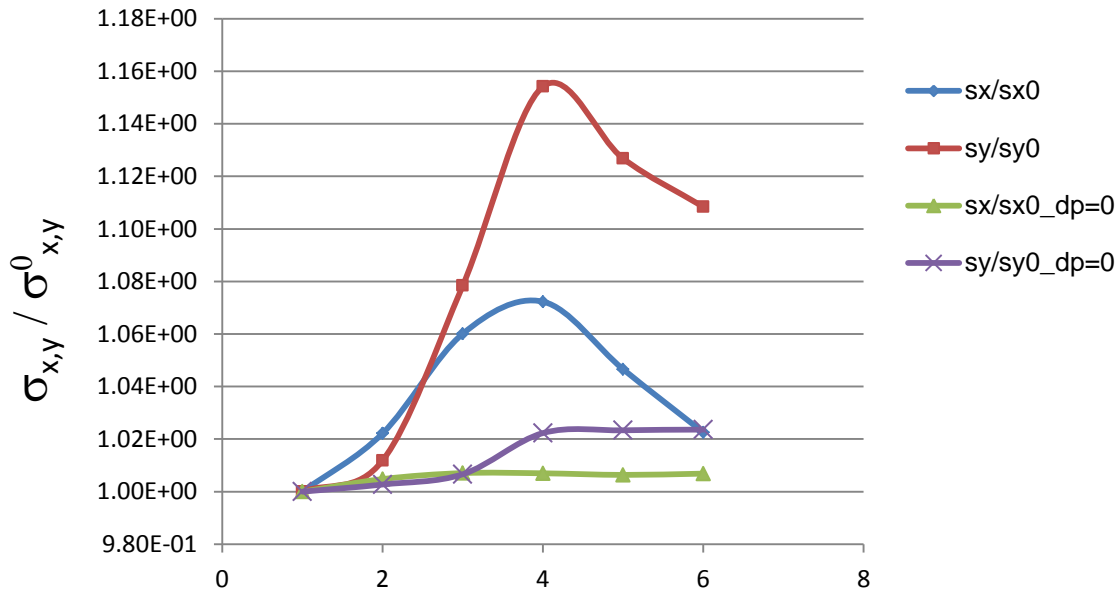σ_y^1 =7.57e-09

v.351LD0_135D1B (new IP parameters)

- Used QDO, Qf1, QD2A,Qf3, QD6,Qf5,QD4, QD2B + matching quads+ Sextupoles

$\beta_x = 0013$;
$\beta_y = 0.00041$;   Dx$=-6.25e-05;$
$\alpha_x = O(e-09)$;
$\alpha_y = O(e-09)$;

Beam size up to maximum order considered

Corresponding beam sizes:

$\sigma_x^1 = 7.36e-07$
$\sigma_y^1 = 7.66e-09$

$\sigma_x^2 = 7.55e-07$
$\sigma_y^2 = 7.75e-09$

$\sigma_x^3 = 7.83e-07$
$\sigma_y^3 = 8.26e-09$.

$\sigma_x^4 = 7.92e-07$
$\sigma_y^4 = 8.41e-09$

.
$\sigma_x^5 = 7.73e-07$ $\sigma_x^6 = 7.72e-07$
$\sigma_y^5 = 8.63e-09$ $\sigma_y^6 = 8.58e-09$

v.450LD0_205D1B –new optics

- Used QDO, Qf1, QD2A,Qf3, QD6,Qf5,QD4, QD2B + matching quads to rematch to new Twiss

- Used QDO, Qf1, QD2A,Qf3, QD6,Qf5,QD4, QD2B + sextupoles

β_x = 0.01300000001 ;
β_y =0.000410000219;
α_x = O(e-010); α_y =O(e-9)
D_x =O(e-6);0

Corresponding beam sizes:

σ_x^1 =7.29e-07
σ_y^1 =7.66e-09

σ_x^2 =7.41e-07
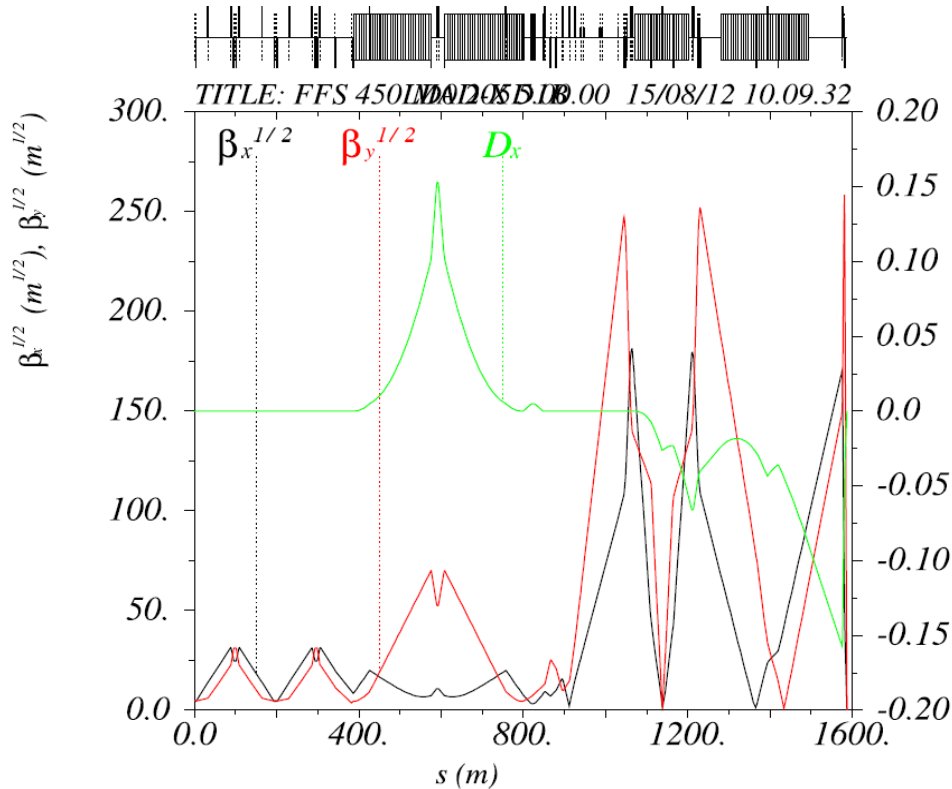σ_y^2 =7.78e-09

σ_x^3 =7.521e-0
σ_y^3 =8.01e-09 .

σ_x^4 =7.67e-07
σ_y^4 =8.72e-09
.
σ_x^5 =7.54e-07
σ_y^5 =8.52e-09

TITLE: FFS 450LD0.205D1B.00 15/08/12 10.09.32

v.450LD0_2055D1B-new optics

Beam size up to maximum order considered

Corresponding beam sizes:

$\sigma_x^1 =7.29e-07$
$\sigma_y^1 =7.66e-09$

$\sigma_x^2 =7.41e-07$
$\sigma_y^2 =7.78e-09$

$\sigma_x^3 =7.521e-0$
$\sigma_y^3 =8.01e-09$.

$\sigma_x^4 =7.67e-07$
$\sigma_y^4 =8.72e-09$
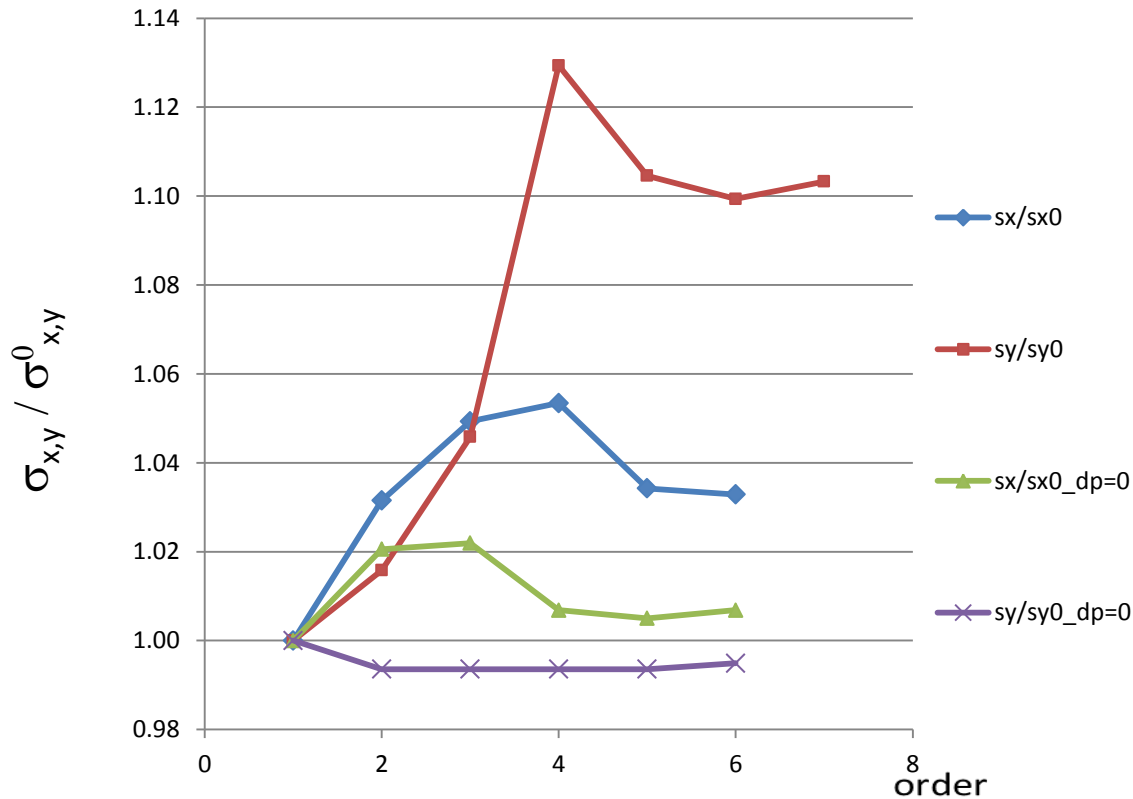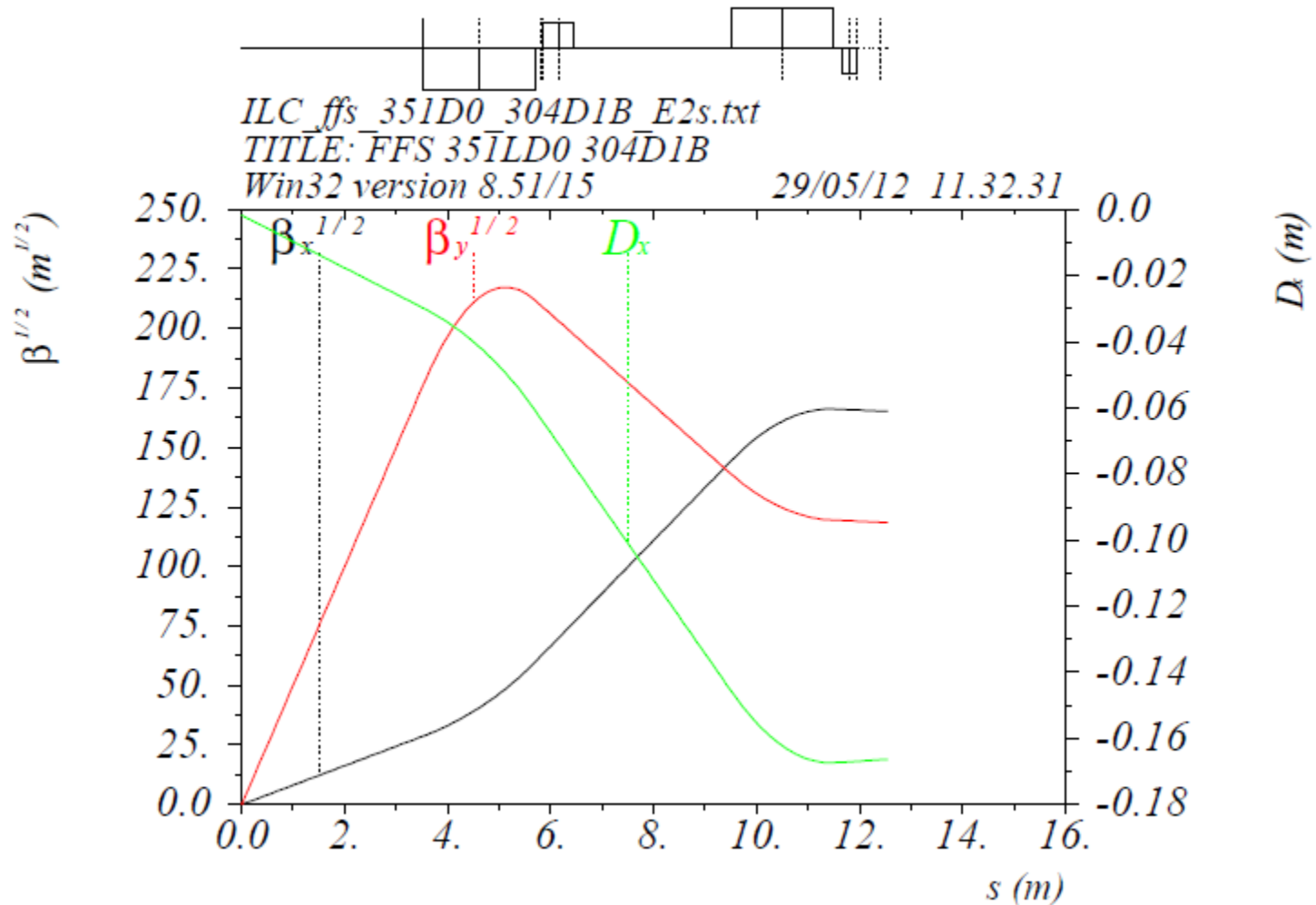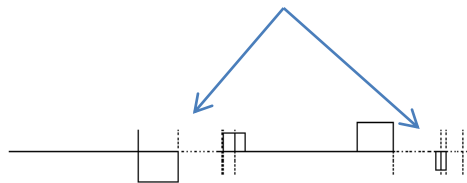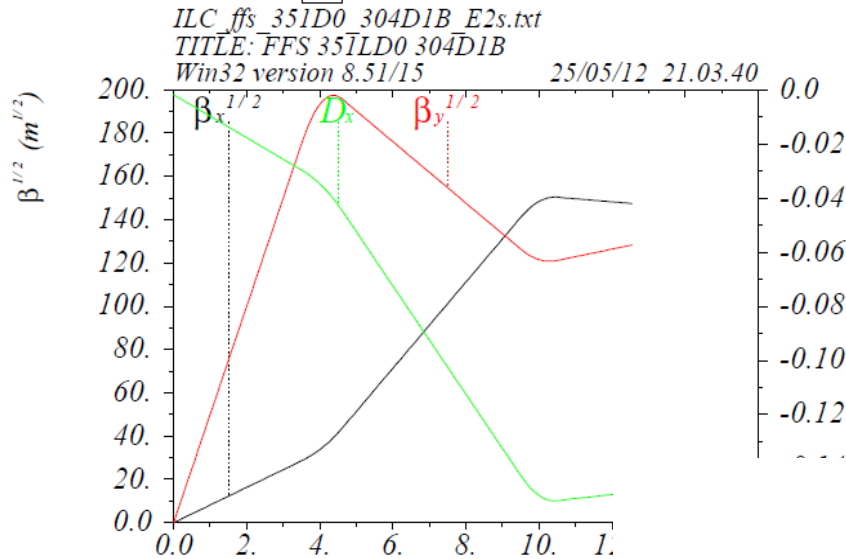.
$\sigma_x^5 =7.54e-07$
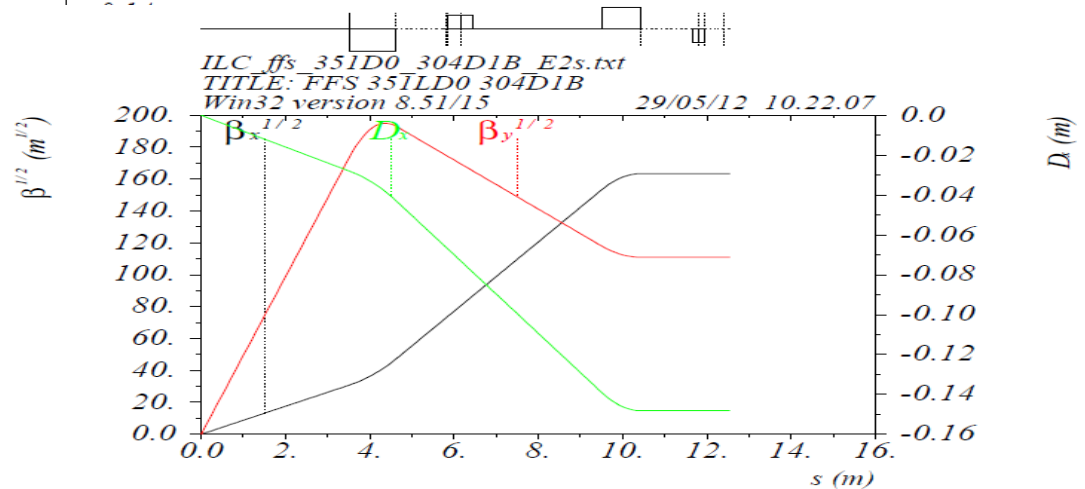$\sigma_y^5 =8.52e-09$

500 GeV CoM final doublet (orig.)

250 Gev CoM Half of FD is off

Replaced by drifts

Re-matched with
 slight variation of QD0 and QF1
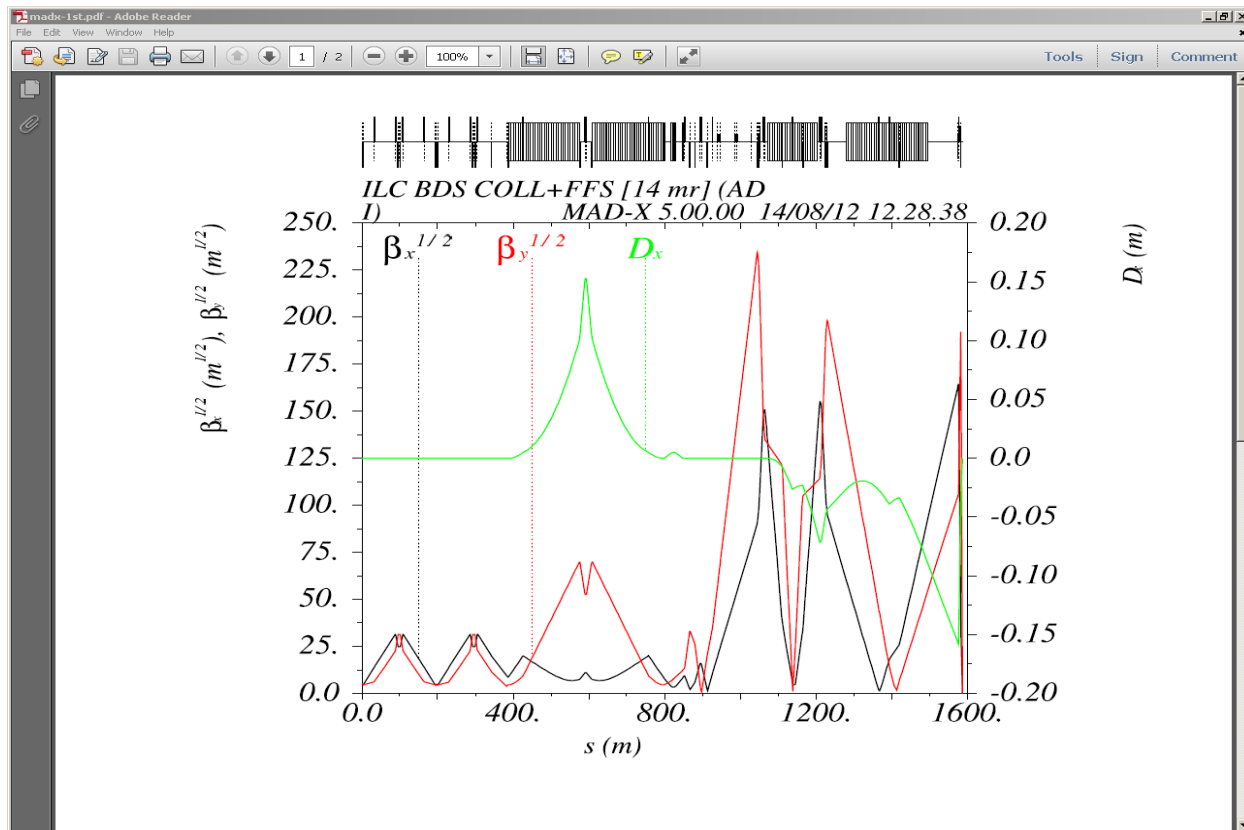KQD0:=-0.30059(was -0.3046)
KQF1:= 0.11861 (was 0.14470)

v.351LD0_135D1B (Half-quads)

- Used QDO, Qf1, QD2A, Qf3, QD6, Qf5, QD4, QD2B + QF7, QD8, QD10, QF9+matching quads+ sextupoles

$\beta_x = $ *0.013*;
$\beta_y =$ *0.0004100*; $\alpha_x = $ 4e-05;
$\alpha_y =$ -1.5e-09; $D_x =$ O(e-5);

Corresponding beam sizes:

$\sigma_x^1 = $7.30e-07
$\sigma_y^1 = $7.69e-09

$\sigma_x^2 = $7.67e-07
$\cdot\sigma_y^2 = $7.78e-09

$\sigma_x^3 = $7.86e-0
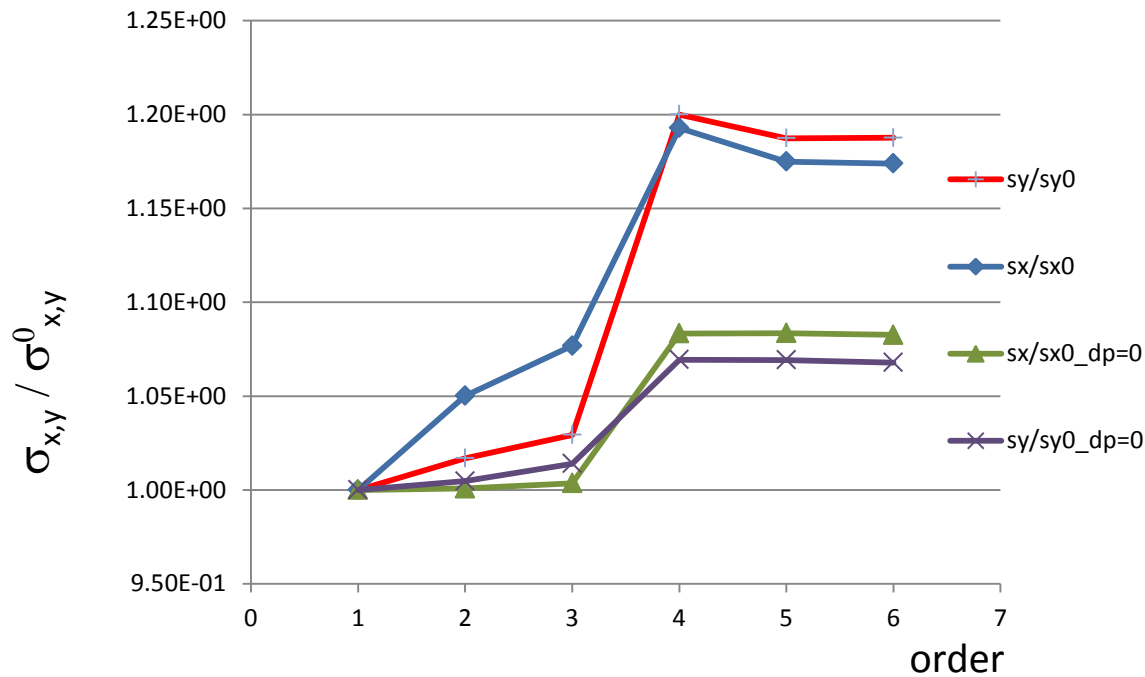$\cdot\sigma_y^3 = $7.88e-09 .

$\sigma_x^4 = $8.74e-07
$\cdot\sigma_y^4 = $9.19e-09
.

$\sigma_x^5 = $8.58e-07
$\cdot\sigma_y^5 = $9.09.e-09

v.351LD0_135D1B-new optics (Half FD Quads)

Used QDO, Qf1, QD2A,Qf3, QD6,Qf5,QD4,
QD2B + QF7,QD8,QD10, QF9+matching quads+
Sextupoles

Beam size up to maximum order considered

Corresponding beam sizes:

$\sigma_x^1 = 7.30e\text{-}07$
$\sigma_y^1 = 7.69e\text{-}09$

$\sigma_x^2 = 7.67e\text{-}07$
$\sigma_y^2 = 7.78e\text{-}09$

$\sigma_x^3 = 7.86e\text{-}0$
$\sigma_y^3 = 7.88e\text{-}09$.

$\sigma_x^4 = 8.74e\text{-}07$
$\sigma_y^4 = 9.19e\text{-}09$

.
$\sigma_x^5 = 8.58e\text{-}07$
$\sigma_y^5 = 9.09.e\text{-}09$

Decimation of dipoles

"So, for 250 GeV only two of these BS1 will be installed (i.e. one, 2.4 m long magnet) and other four 2.4 m long magnets will be installed in corresponding in ...SPACE at 500 GeV beam. The total angle at both 250 GeV and 500 GeV remains the same, so the footprint of the BDS does not change but dipoles are weaker at 500 GeV to keep the SR low."
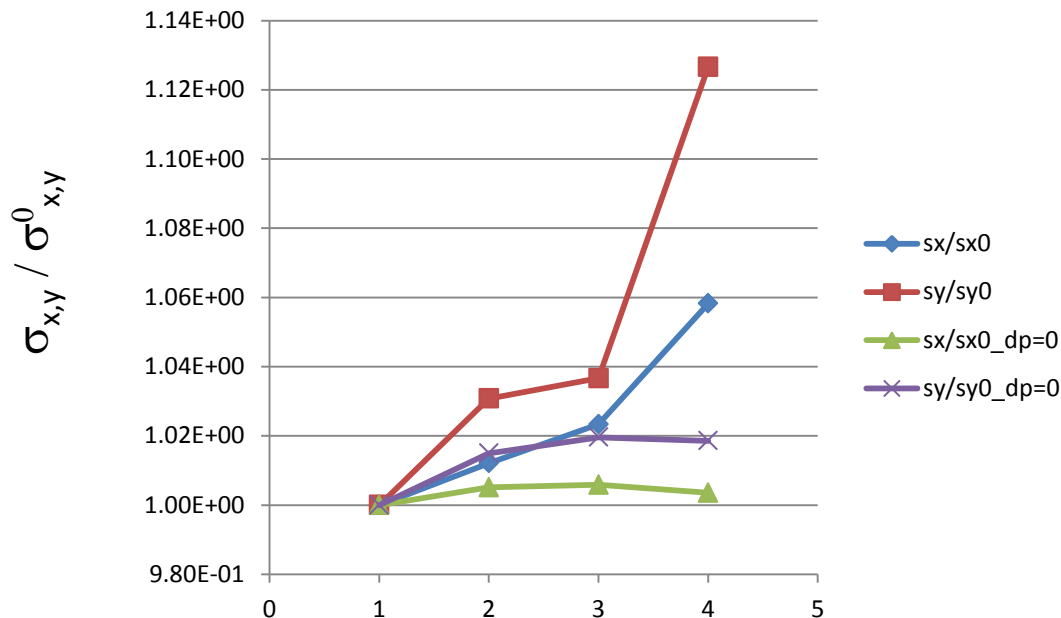 from D. Angal-Kalinin

Used   the replacement "anzatz" from B. List.

Replaced and checked that all the matching is still valid
 New version of beamlines available.
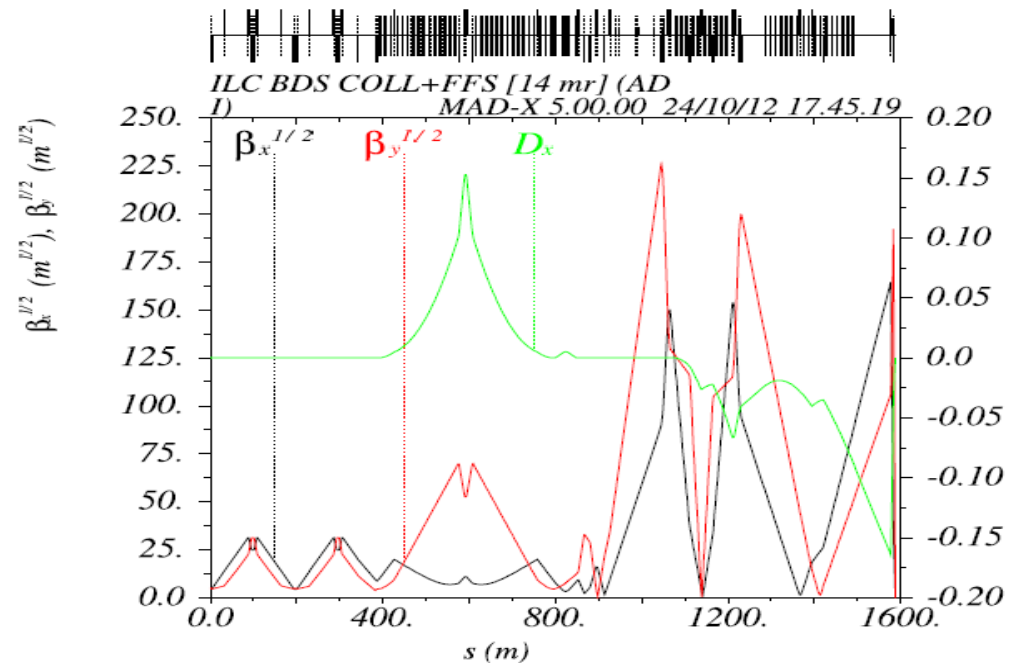
v.351LD0_135D1B-new optics (Half FD Quads)-1

Corresponding beam sizes:

$\sigma_x^1 = 7.30\text{e-}07$
$\sigma_y^1 = 7.66\text{e-}09$

$\sigma_x^2 = 7.39\text{e-}07$
$\sigma_y^2 = 7.90\text{e-}09$

$\sigma_x^3 = 7.48\text{e-}07$
$\sigma_y^3 = 7.93\text{e-}09$.

$\sigma_x^4 = 7.73\text{e-}07$
$\sigma_y^4 = 8.63\text{e-}09$

Chart legend:
- sx/sx0
- sy/sy0
- sx/sx0_dp=0
- sy/sy0_dp=0

Y-axis: $\sigma_{x,y} / \sigma^0_{x,y}$

Beam size up to maximum order considered

Conclusions/plans

- R. Tomas's code   was tasted for Linear collider
- 250 Gev CoM lattice v.351LD0_304D1B with new IP parameters, new bending section and with half QD0/QF1 is ready
- v. 450D0_205D1B with new IP parameters, new bending section is ready
- v. 450D0_205D1B with half of QD0/QF1 requires more tuning
- Tracking through lattices obtained (should be done