Updates BI-TL MADX Optics Studies

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Next Steps from last meeting

- **Start @ BHZ40**
- Define how to take into account SC
- Check “s” coordinates (close bump towards DIS)
- Optics for TL to 4 rings
- Check other optics for all rings (0 dispersion, large and small beta + -1.4 m dispersion, nominal, large, small beta)

Optics

- Lattice manually derived from “Path” output
- “s” coordinates not rechecked wrt existing TL
- Quads strengths and initial conditions (start of **BHZ40**, beginning of BI line)

	L [m]	B [T/m]	B [T/m]	B [T/m]
		~~Large~~ Nom.	~~Nominal~~ Small	~~Small~~ Large
QFN50	0.255	-1.1909	-1.1909	-1.1909
QDN55	0.255	1.3859	1.3859	1.3859
QFN60	0.255	-1.82279	-1.82279	-1.82279
QDN65	0.255	1.15105	1.15105	1.15105
QFW70	0.467	0.401532	0.401532	0.401532
QDN75	0.255	-1.46635	-1.46635	-1.46635
QFN10	0.255	1.0816	1.0816	1.0816
QDN20	0.255	-0.40911	-0.40911	-0.40911
QFW30	0.461	-1.40927	-1.40927	-1.40927
QDW40	0.461	1.65575	1.65575	1.65575
QFW50	0.461	-1.33639	-1.33639	-1.33639
QDW60	0.461	1.06024	1.06024	1.06024
BI.QN10	0.462	-1.04465	-1.28068	-1.04465
BI.QN20	0.462	1.01876	1.22486	1.01876
BI.QN30	0.462	-0.96627	-0.82535	-1.02548
BI-QN40	0.462	0.972508	0.914672	0.99931
BI-QN50	0.466	-1.84028	-2.13851	-1.6121
BI-QN60	0.466	2.015537	2.359182	1.781536

(X,BGX') 100%-Emittance [m.rad]	**1.62E-05**
(X,BGX') 90%-Emittance [m.rad]	1.30E-06
(X,BGX') RMS-Emittance [m.rad]	3.11E-07
(Y,BGY') 100%-Emittance [m.rad]	1.54E-05
(Y,BGY') 90%-Emittance [m.rad]	1.45E-06
(Y,BGY') RMS-Emittance [m.rad]	3.34E-07
(PHI,dE) 100%-Emittance [deg.MeV]	7.58E+01
(PHI,dE) 90%-Emittance [deg.MeV]	1.09E+00
(PHI,dE) RMS-Emittance [deg.MeV]	3.13E-01
(X,X') Alpha [1]	**9.89E-01**
(X,X') Beta [m/rad]	**9.02E+00**
(Y,Y') Alpha [1]	**1.34E+00**
(Y,Y') Beta [m/rad]	**4.53E+01**
(PHI,dE) Alpha [1]	1.09E+01
(PHI,dE) Beta [deg/MeV]	4.09E+03
dx [m]	*? – 0*
dyp	*? – 0*
dy [m]	*? – 0*
dxp	*? – 0*

Change sign in MADX (H^-)

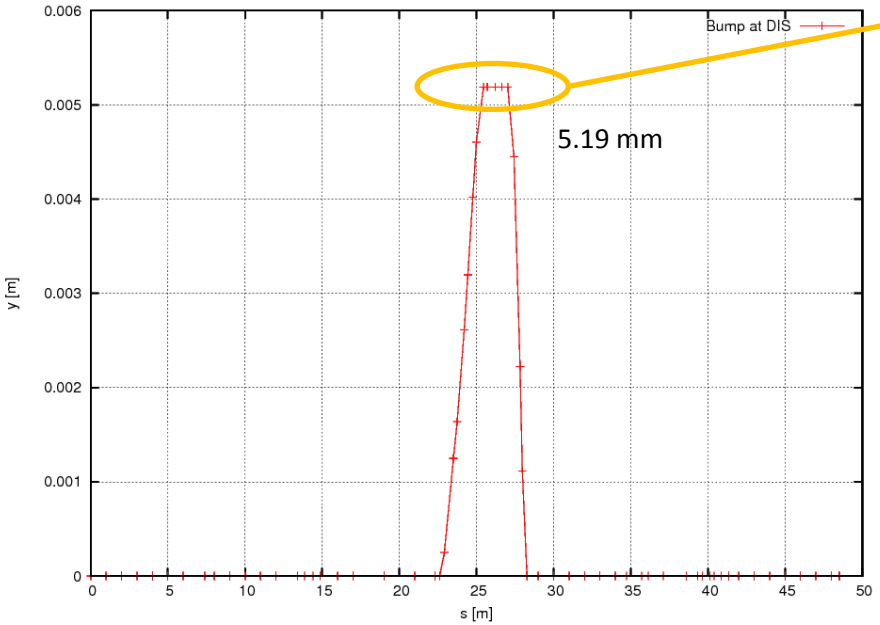
Positions

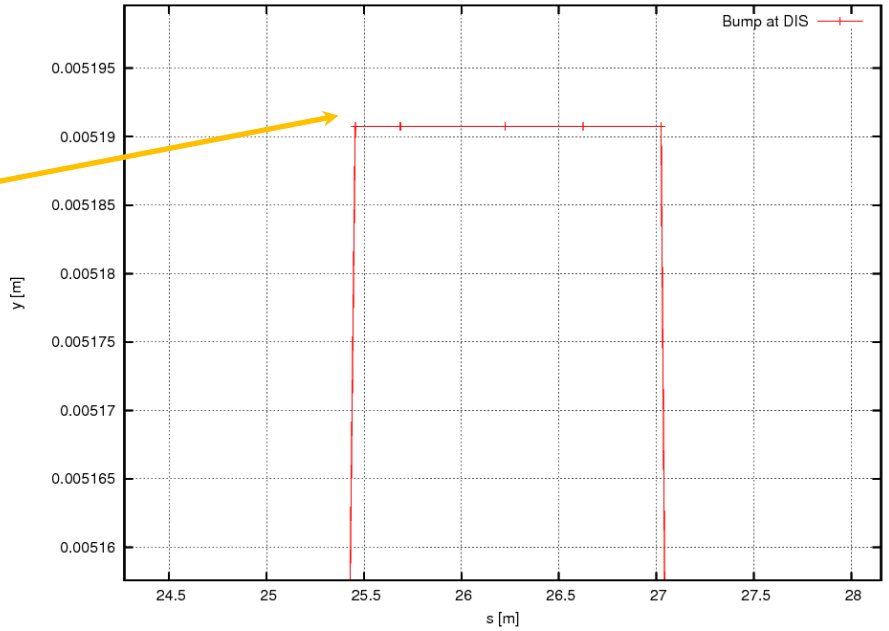
Compared magnets position with 2014 Linac2 layout.

	Actual position [m]	Path position [m]	Difference [m]
BHZ40	0.45	0.45	0
BI.QNO10	13.624	13.636	-0.012
BI.QNO20	14.624	14.636	-0.012
BI.DVT30	22.766	22.532	0.234
BI.QNO30	23.9747	23.952	0.022697
BI.QNO40	25.22415	25.252	-0.02785
BI3.DIS1	26.42415	26.383	0.041154
BI3.DIS2	26.82415	26.783	0.041154
BI3.DIS3	27.22415	27.183	0.041154
BI3.DIS4	27.62415	27.583	0.041154
BI3.DVT40	28.12415	28.083	0.041154
BI3.SMV	35.22415	35.283	-0.05885
BI3.SMV	36.62415	36.603	0.021154
BI3.QNO50	39.87602	39.896	-0.01998
BI3.QNO60	40.62602	40.646	-0.01998
BI3.INJPT	48.50322	48.50322	0

Bump to DIS

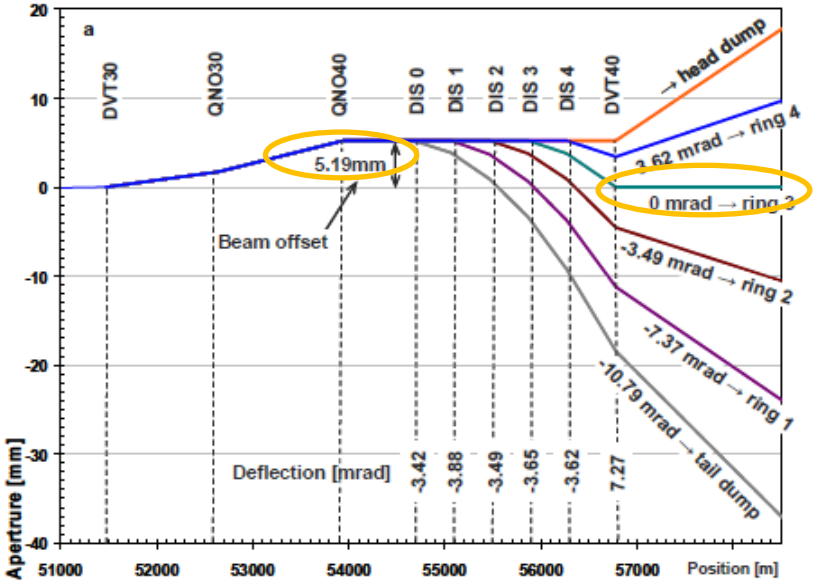
- QN30 and QN40 (off-centred ➔ SBENDS)



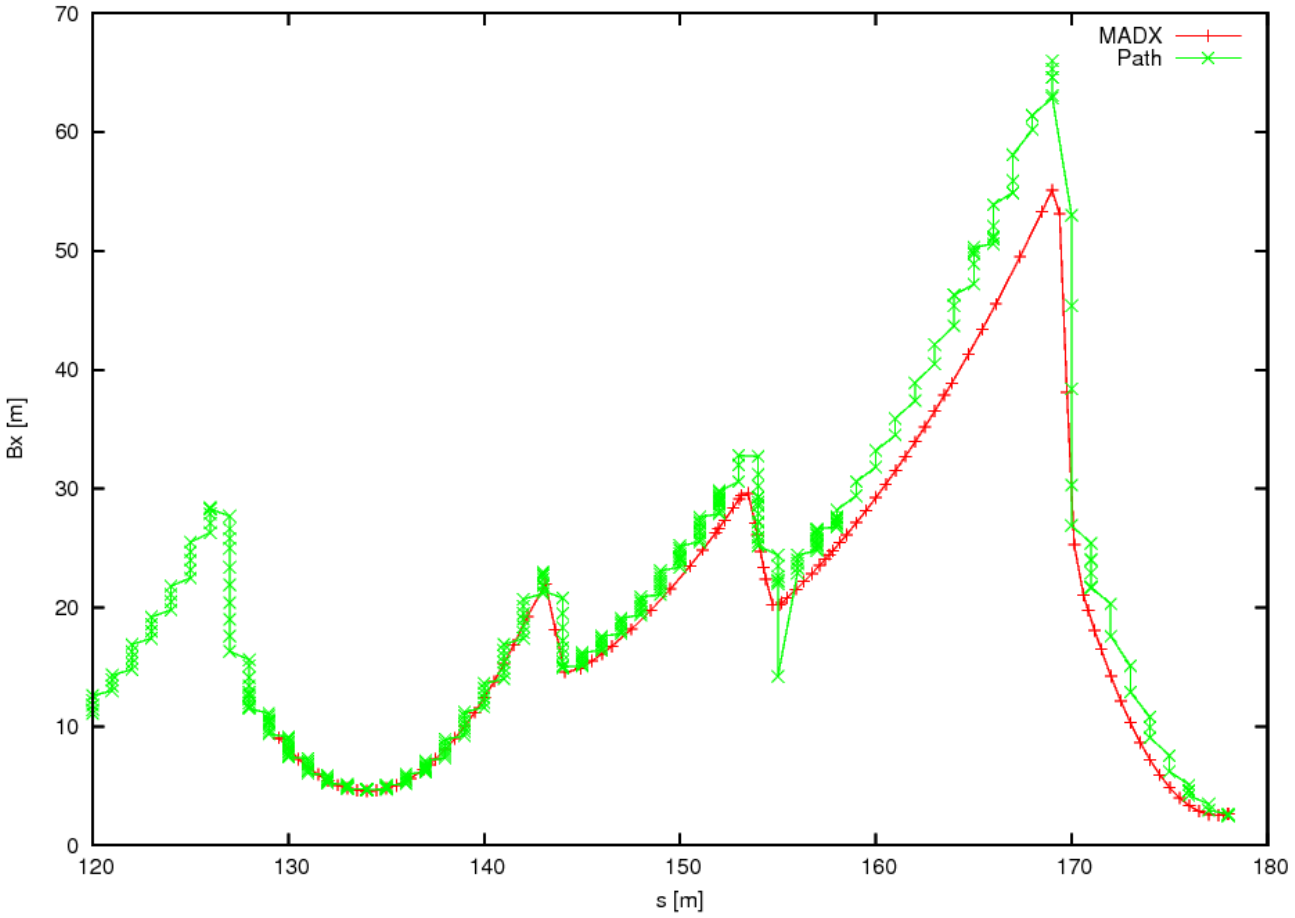


Kept Q30 and Q40 ➔ calculate DVT30

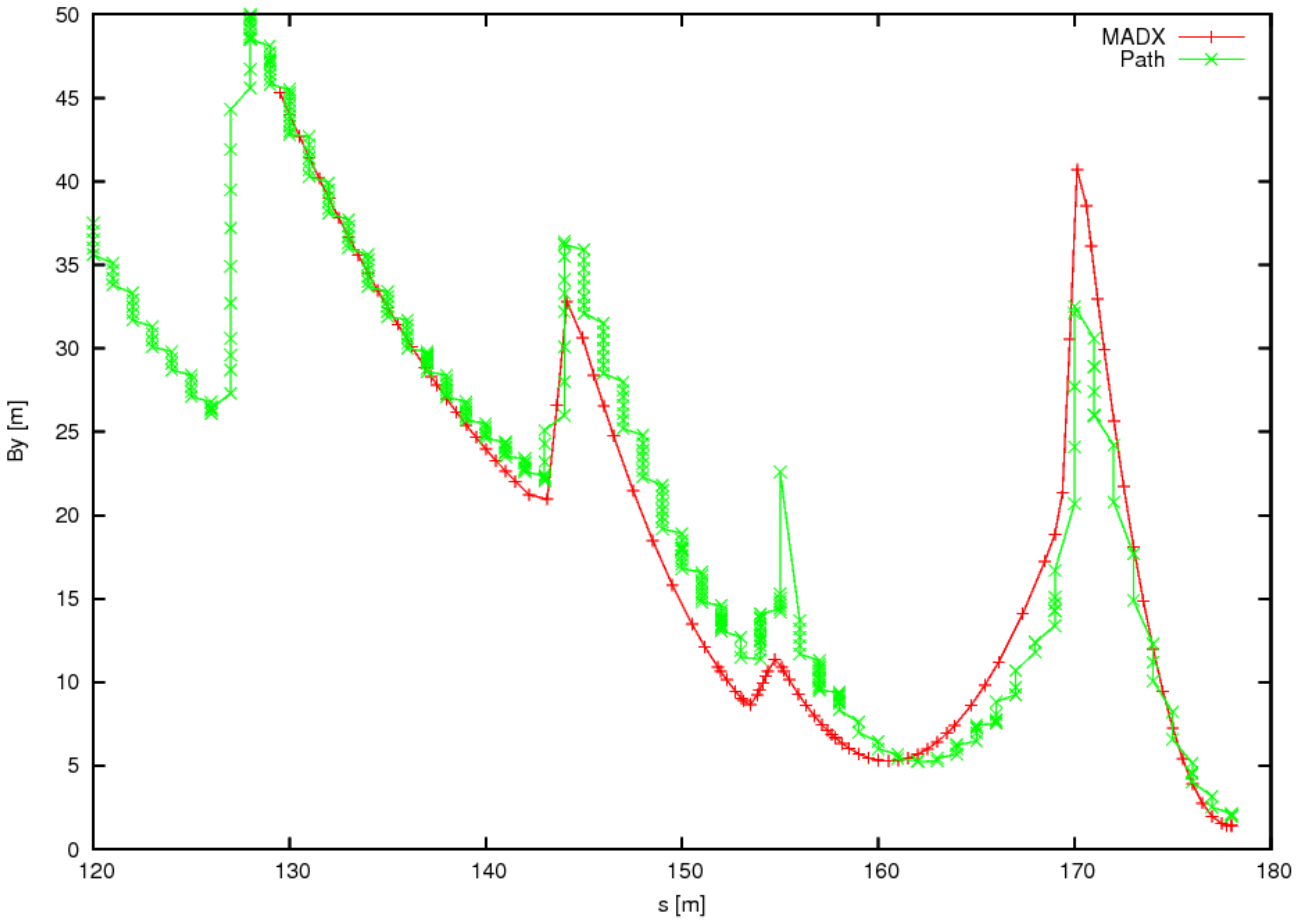
kdvt30 := 0.001676;
kbiqn1_30 := 0.82535/brho ;
kbiqn1_40 := -0.914672/brho ;
kbiqn1_s30 := -0.000857;
kbiqn1_s40 := 0.002533;
kdis3 := 0.003710;
kdis4 := 0.003702;
kdvt3 := 0.007412;



Small Betax- Zero Dispersion- Ring3



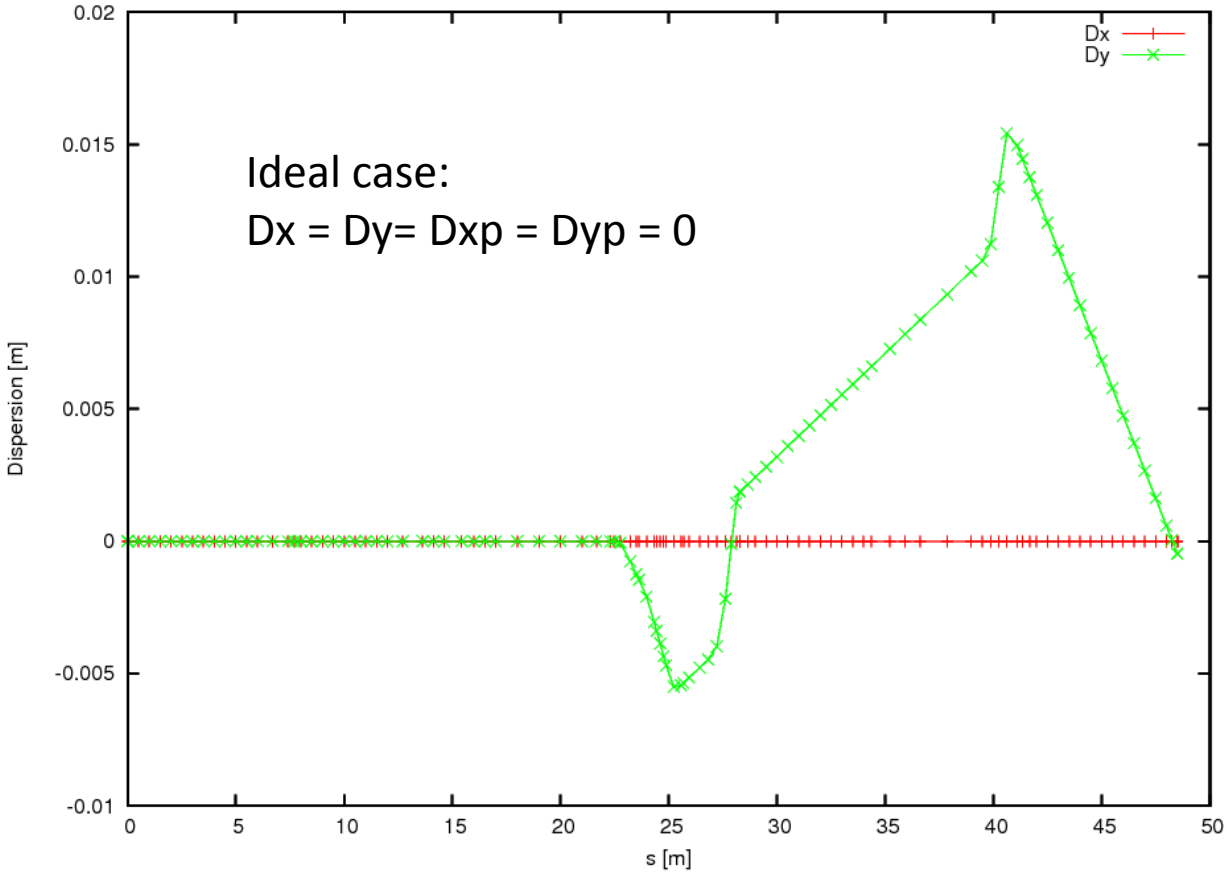
Small Betay- Zero Dispersion- Ring3



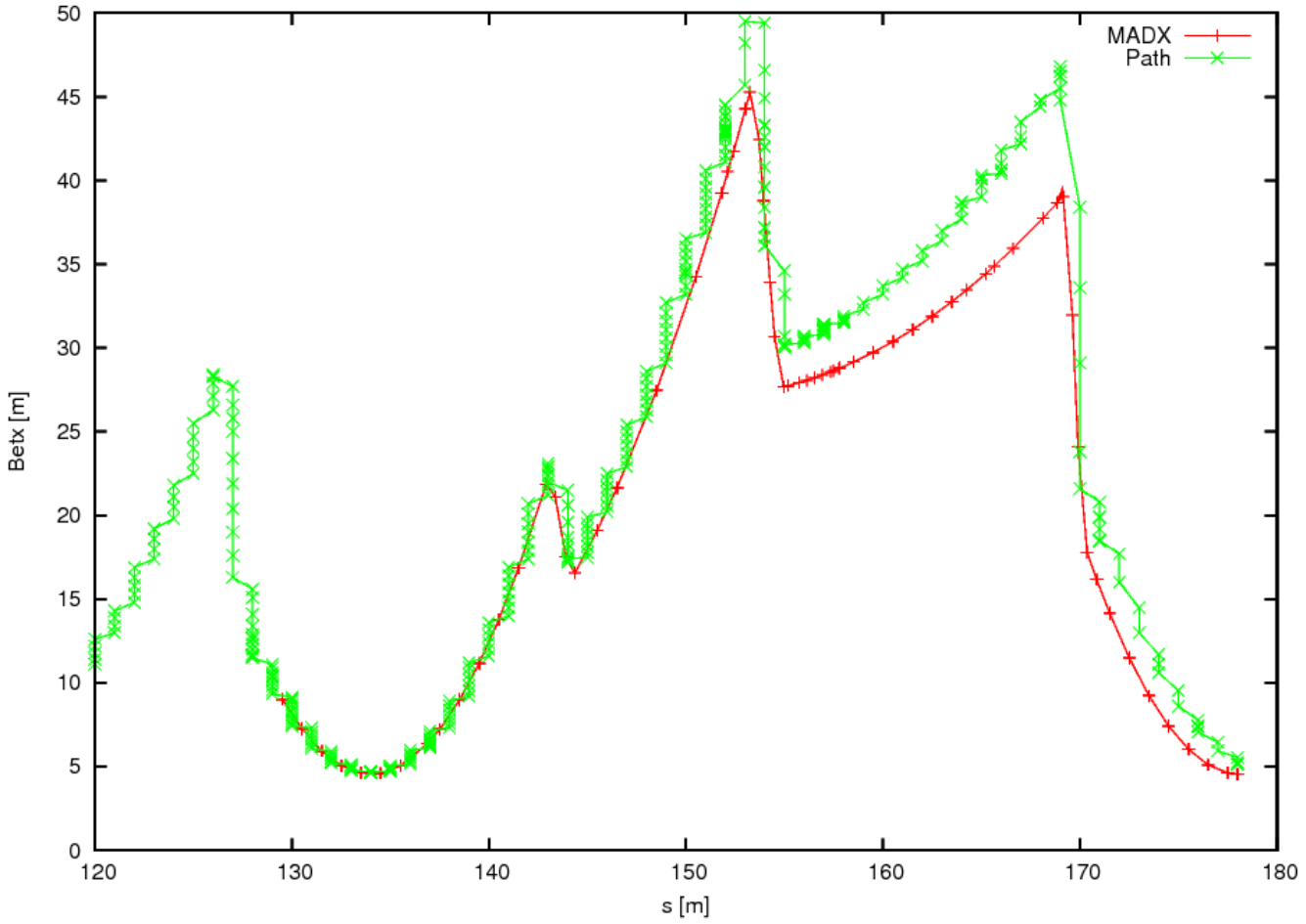
Dispersion

Case 1 : dispersion zero.

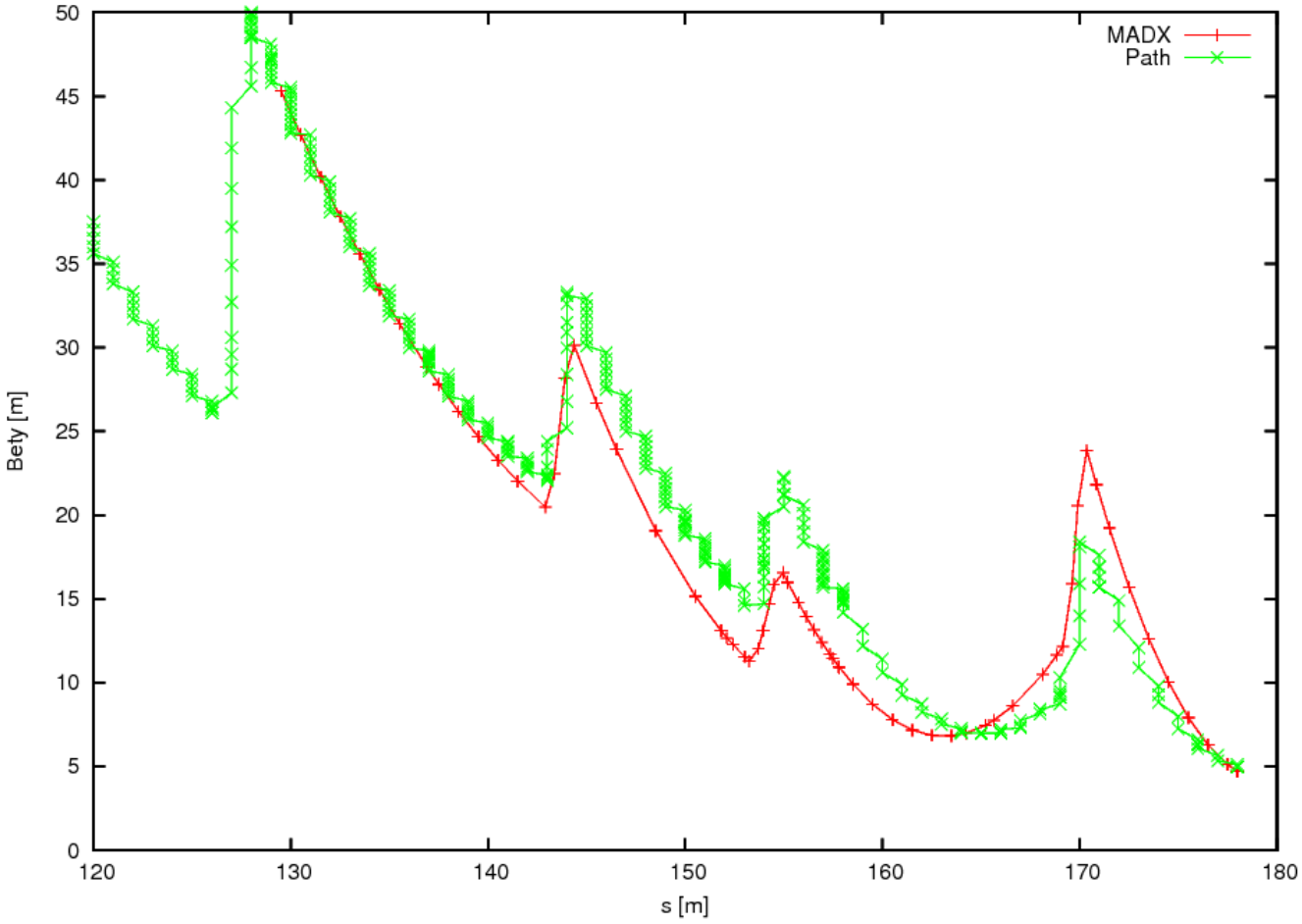
The cases where the dispersion is nullified are somehow simpler as the matching of the dispersion and the matching of the beta function is completely decoupled. In particular the dispersion and its derivative are matched to zero after BHZ30 and then they stay zero until the foil. The quadrupoles of the BI line are used to obtain the big/medium/small beta function.



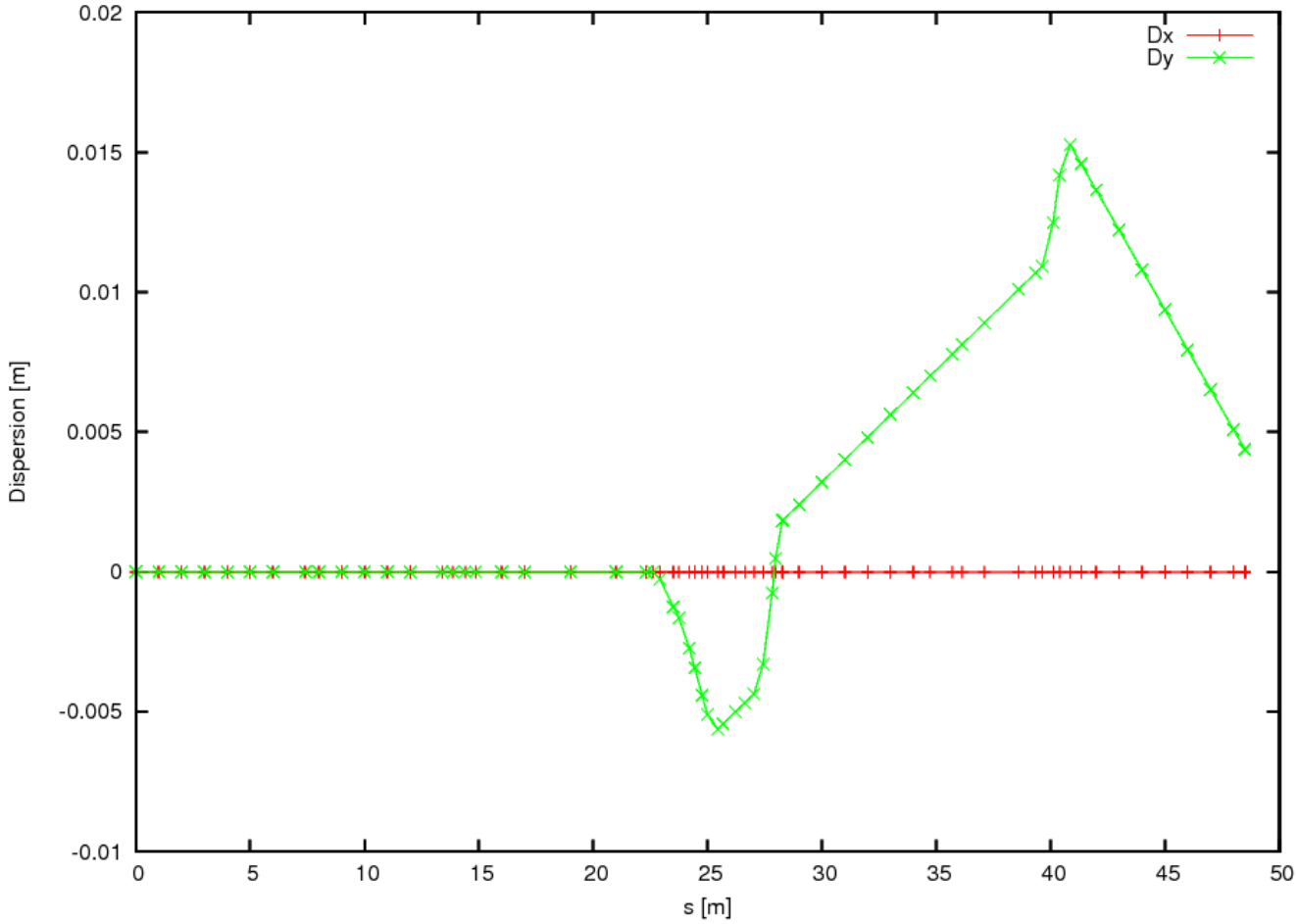
Nominal Betax – Ring3



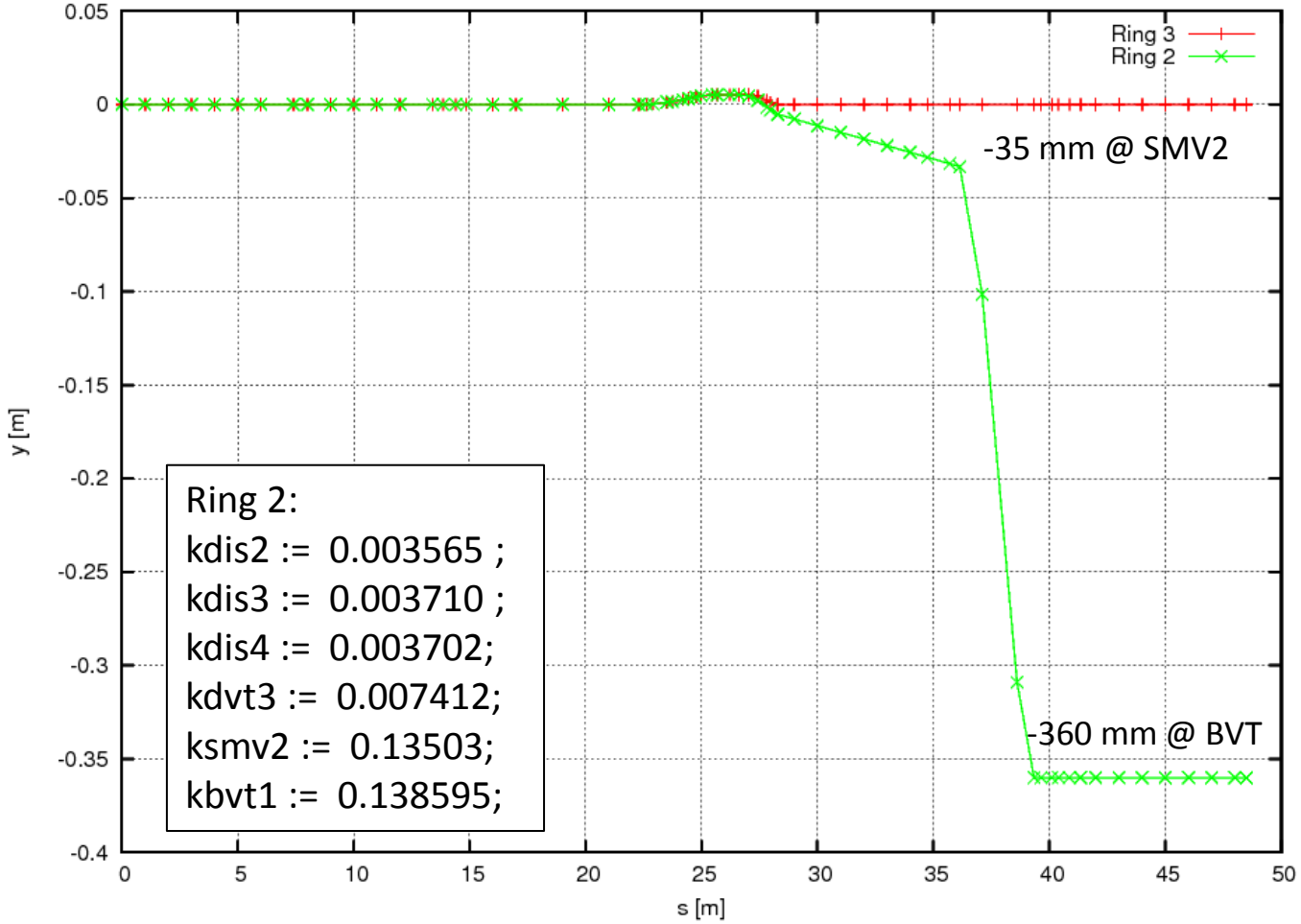
Nominal Betay – Ring3



Dispersion

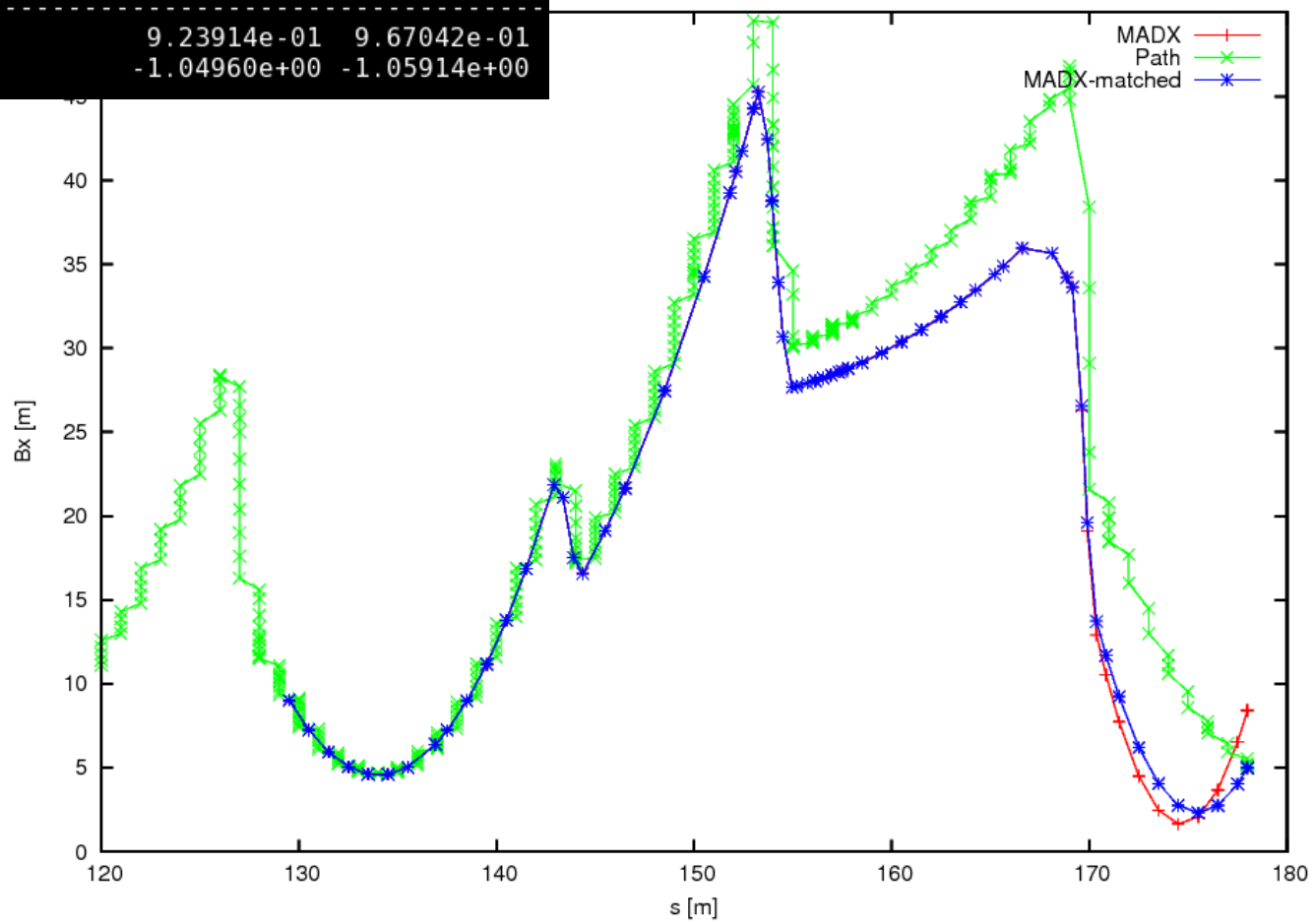

Dx
Dy
Dispersion [m]
s [m]
0.02
0.015
0.01
0.005
0
-0.005
-0.01
0
5
10
15
20
25
30
35
40
45
50

Ring 2 - 3


Ring 3
Ring 2
-35 mm @ SMV2
-360 mm @ BVT
Ring 2:
kdis2 := 0.003565 ;
kdis3 := 0.003710 ;
kdis4 := 0.003702;
kdvt3 := 0.007412;
ksmv2 := 0.13503;
kbvt1 := 0.138595;
y [m]
s [m]
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
0
5
10
15
20
25
30
35
40
45
50

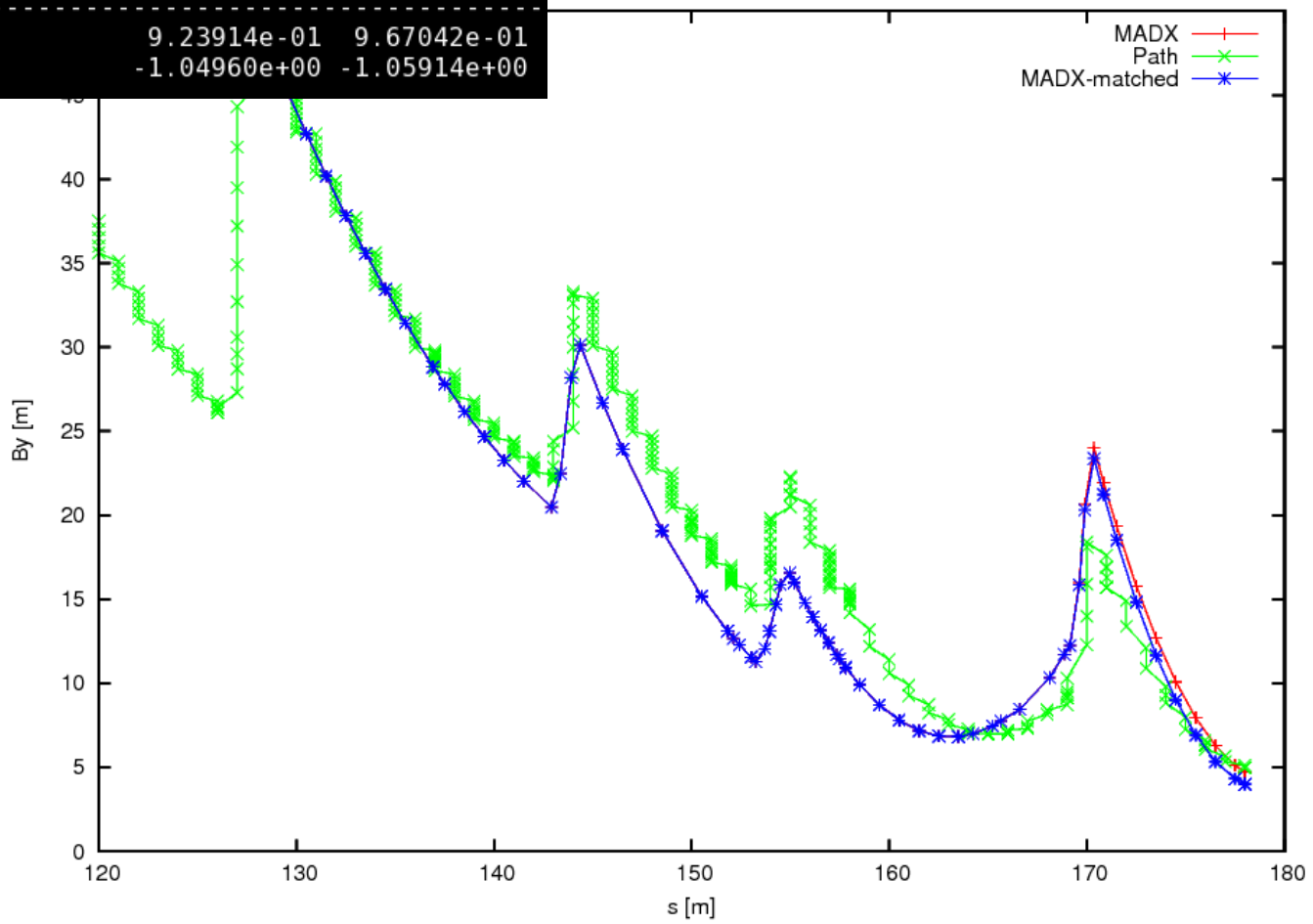
Ring2 – Nominal Betax

Variable	Final Value	Initial Value
kbiqn2_1	9.23914e-01	9.67042e-01
kbiqn2_2	-1.04960e+00	-1.05914e+00

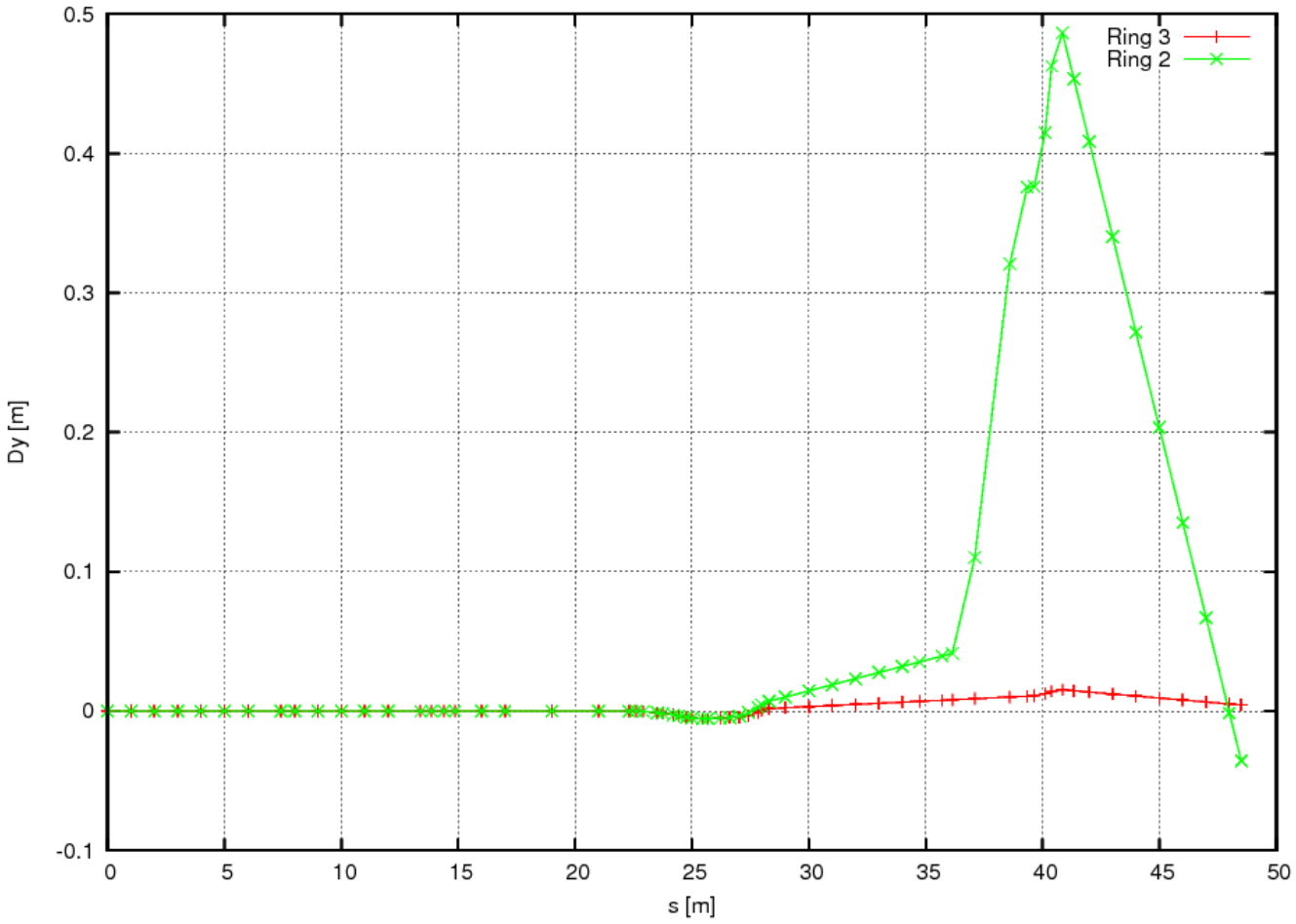


Ring2 – Nominal Betay

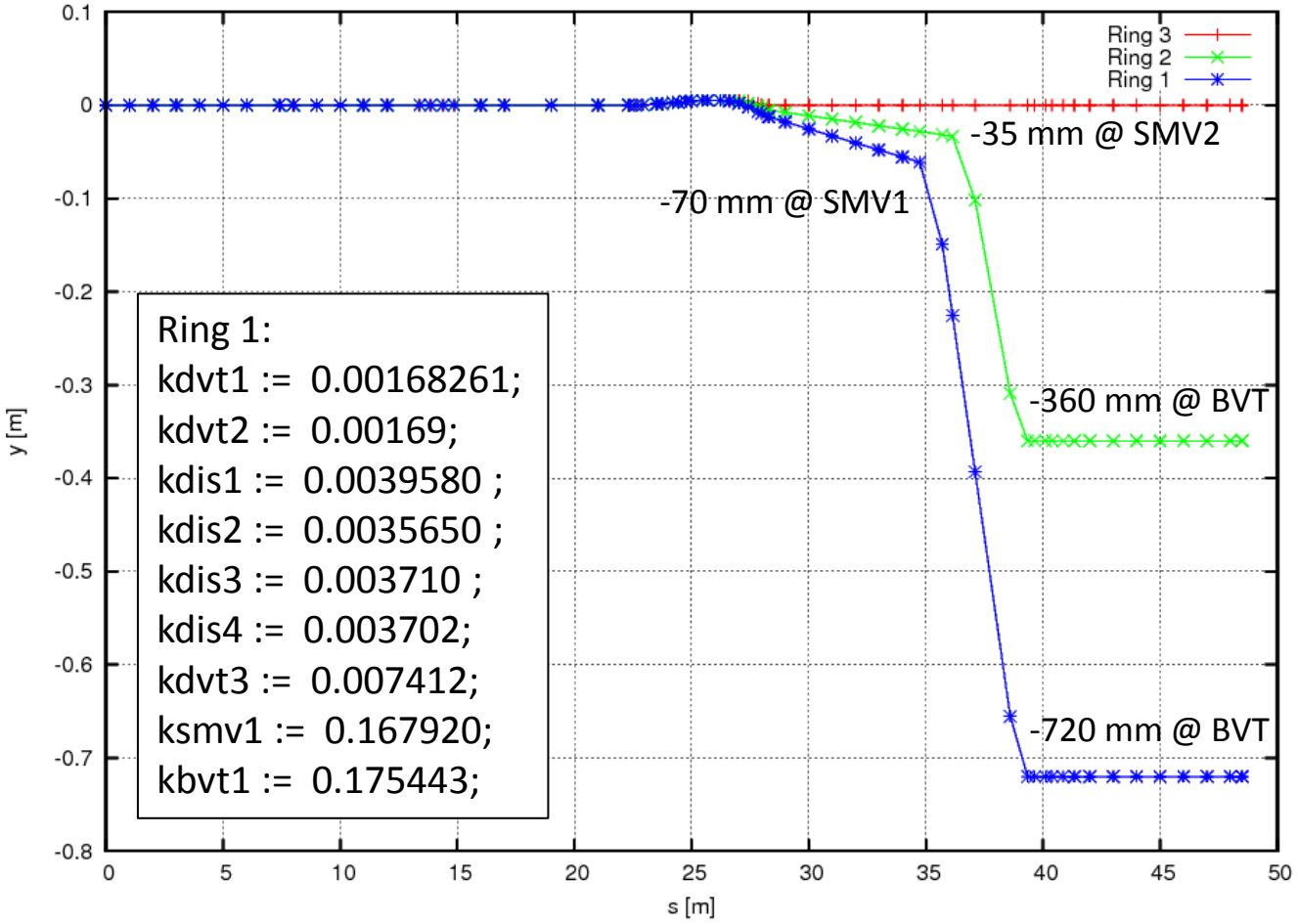
Variable	Final Value	Initial Value
kbiqn2_1	9.23914e-01	9.67042e-01
kbiqn2_2	-1.04960e+00	-1.05914e+00



Vertical Dispersion

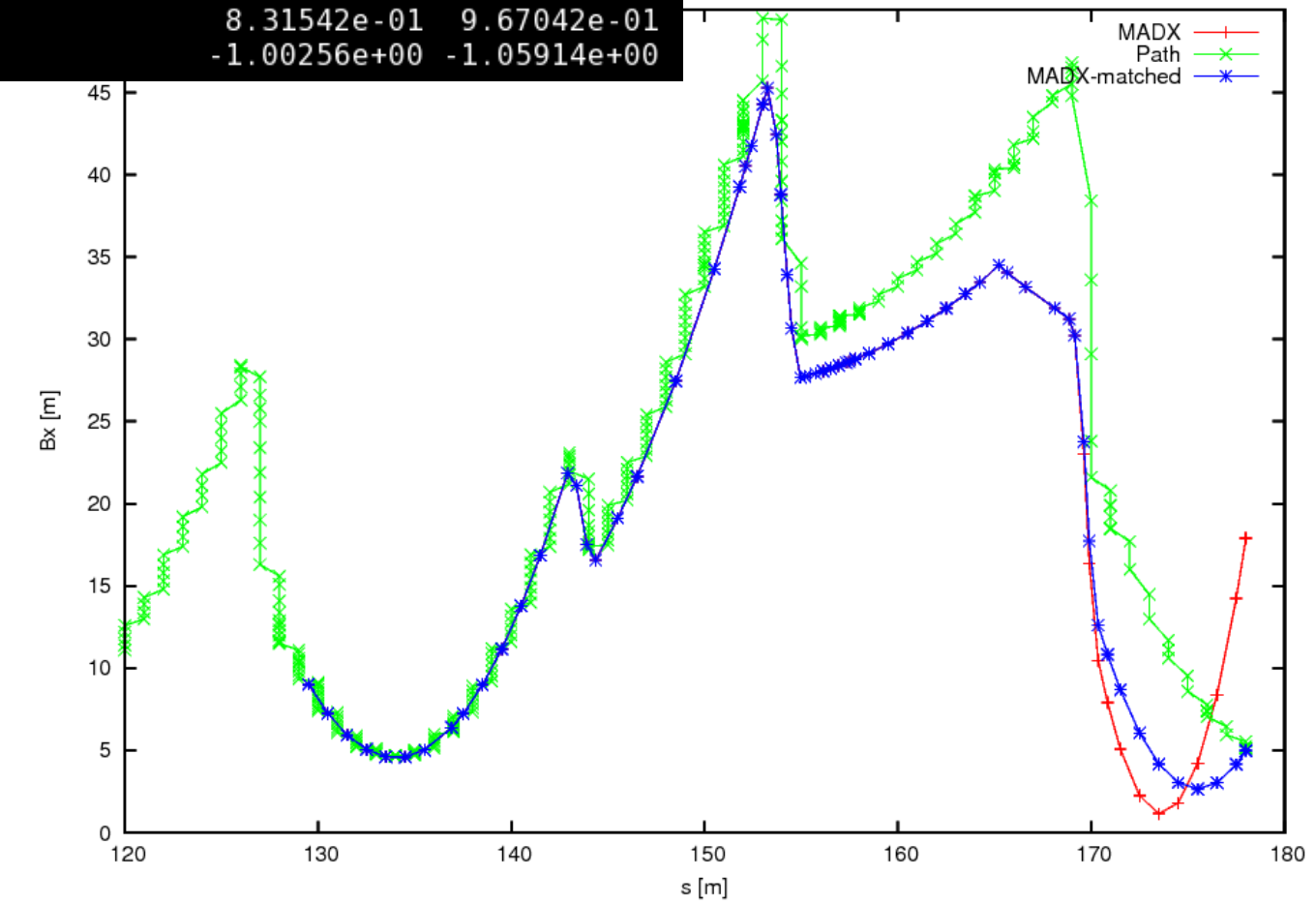


Ring 1 - 2 - 3


Ring 3
Ring 2
Ring 1
-35 mm @ SMV2
-70 mm @ SMV1
-360 mm @ BVT
-720 mm @ BVT
Ring 1:
kdvt1 := 0.00168261;
kdvt2 := 0.00169;
kdis1 := 0.0039580 ;
kdis2 := 0.0035650 ;
kdis3 := 0.003710 ;
kdis4 := 0.003702;
kdvt3 := 0.007412;
ksmv1 := 0.167920;
kbvt1 := 0.175443;
y [m]
s [m]
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
0
5
10
15
20
25
30
35
40
45
50

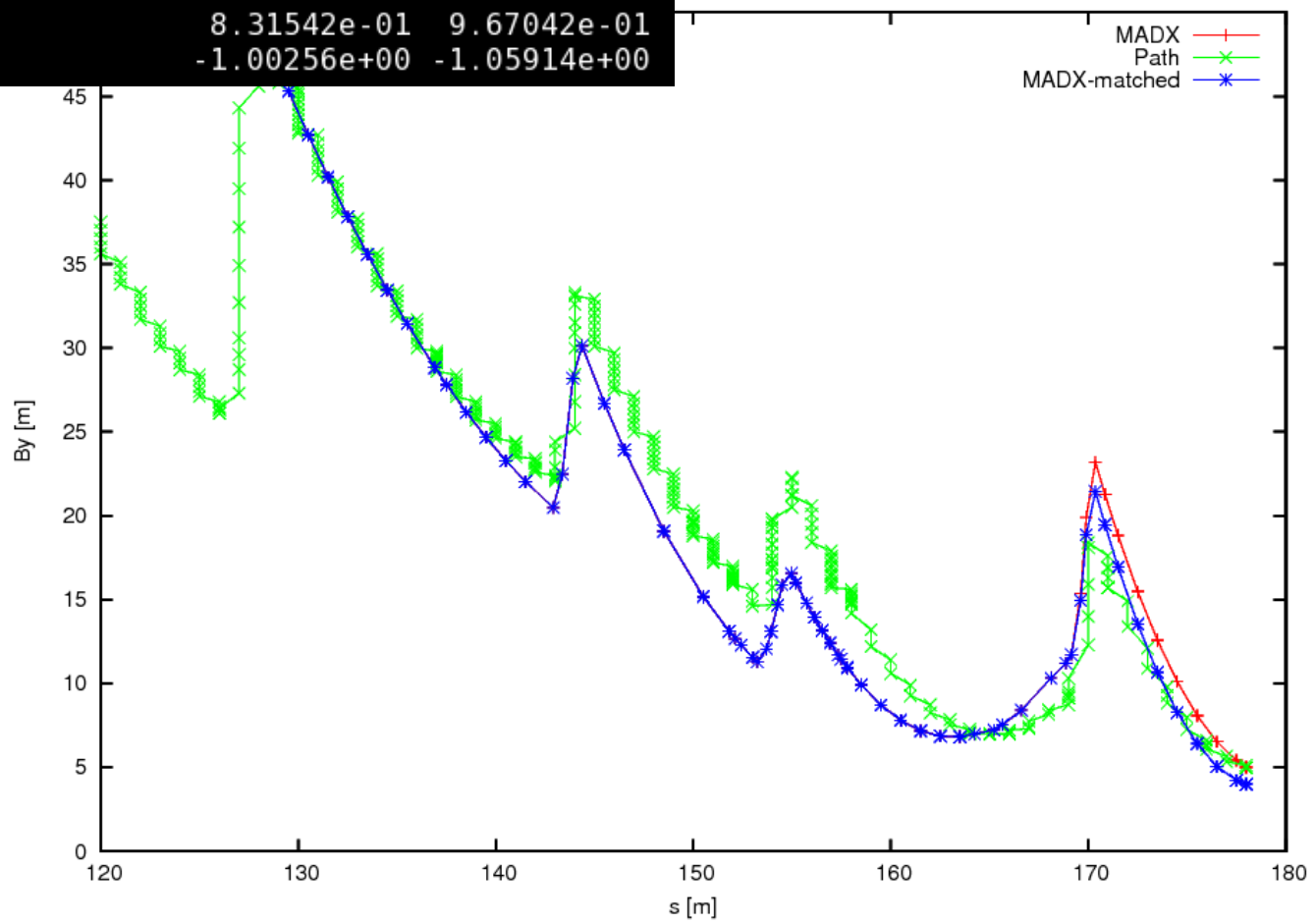
Ring1 – Nominal Betax

Variable	Final Value	Initial Value
kbiqn2_1	8.31542e-01	9.67042e-01
kbiqn2_2	-1.00256e+00	-1.05914e+00

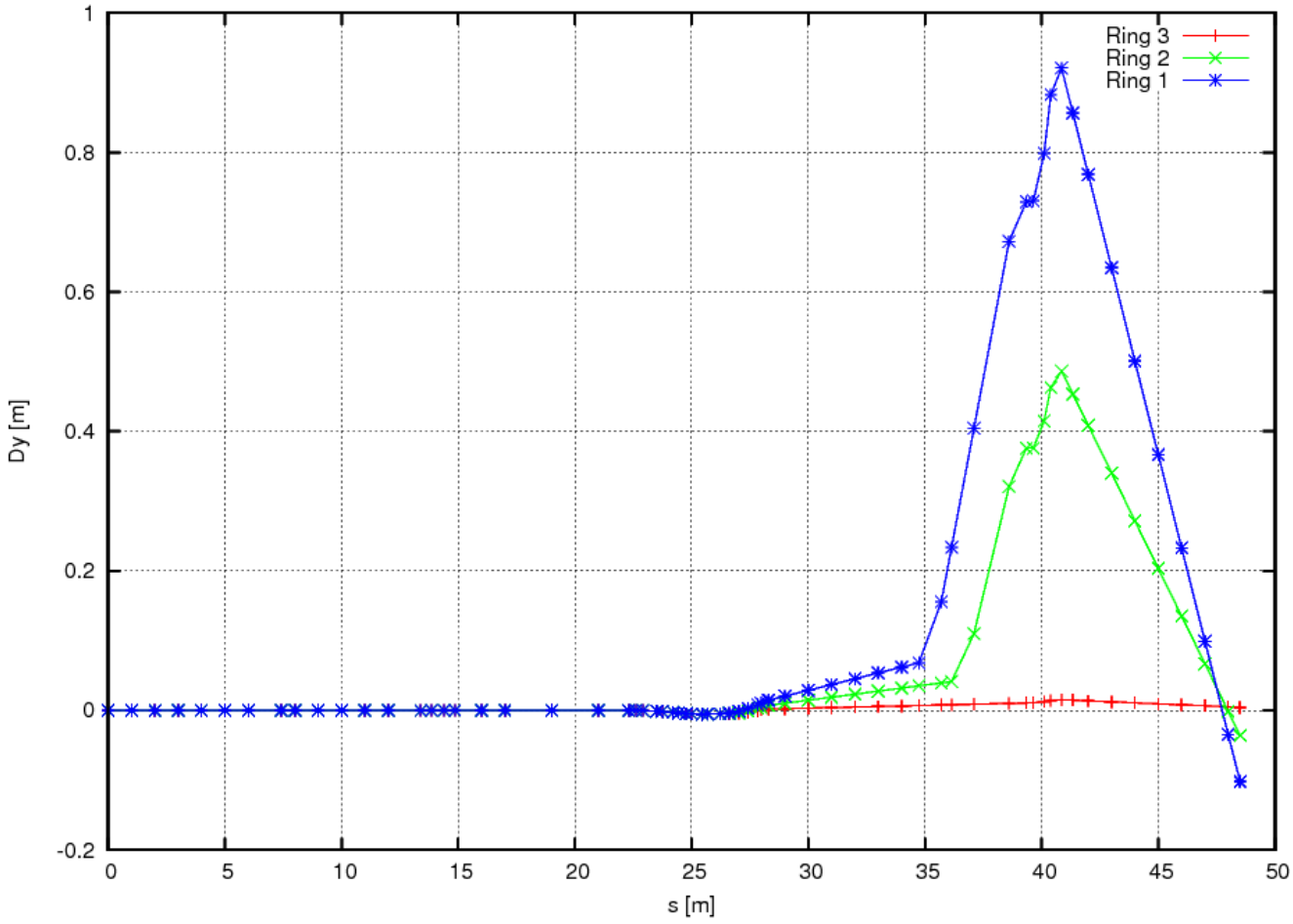


Ring1 – Nominal Betay

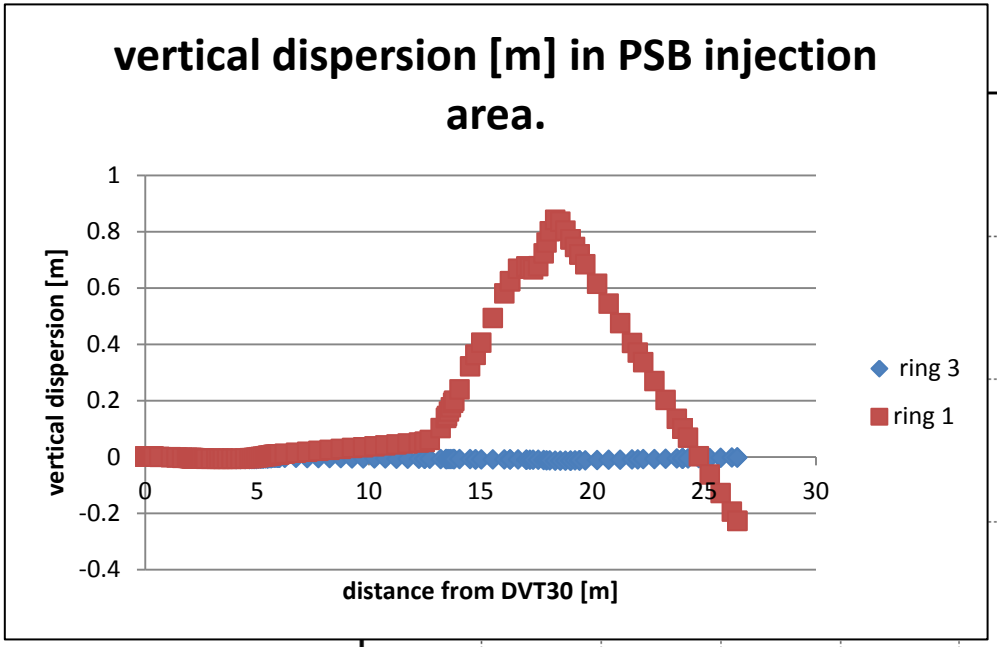
Variable	Final Value	Initial Value
kbiqn2_1	8.31542e-01	9.67042e-01
kbiqn2_2	-1.00256e+00	-1.05914e+00



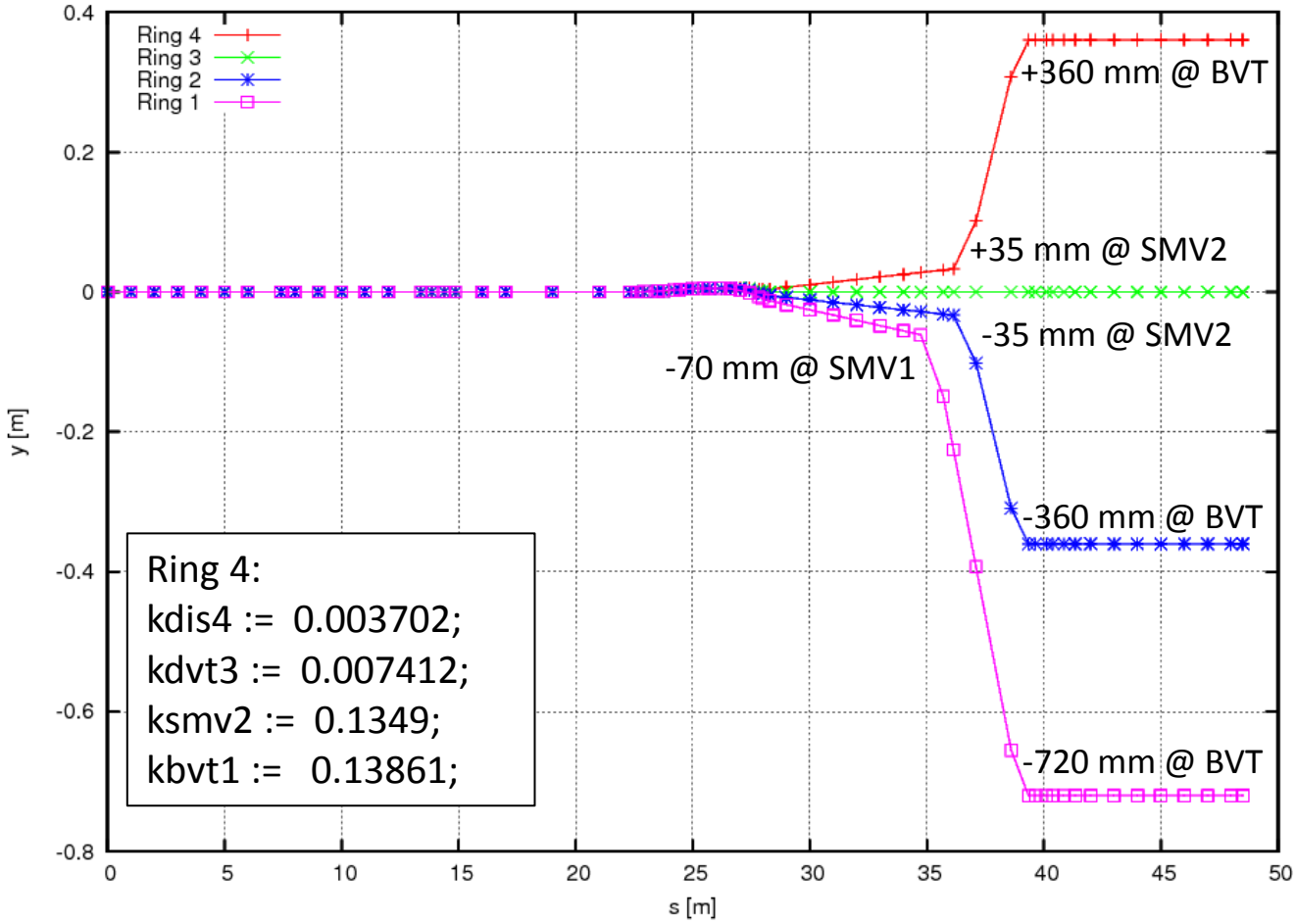
Vertical Dispersion



Vertical Dispersion

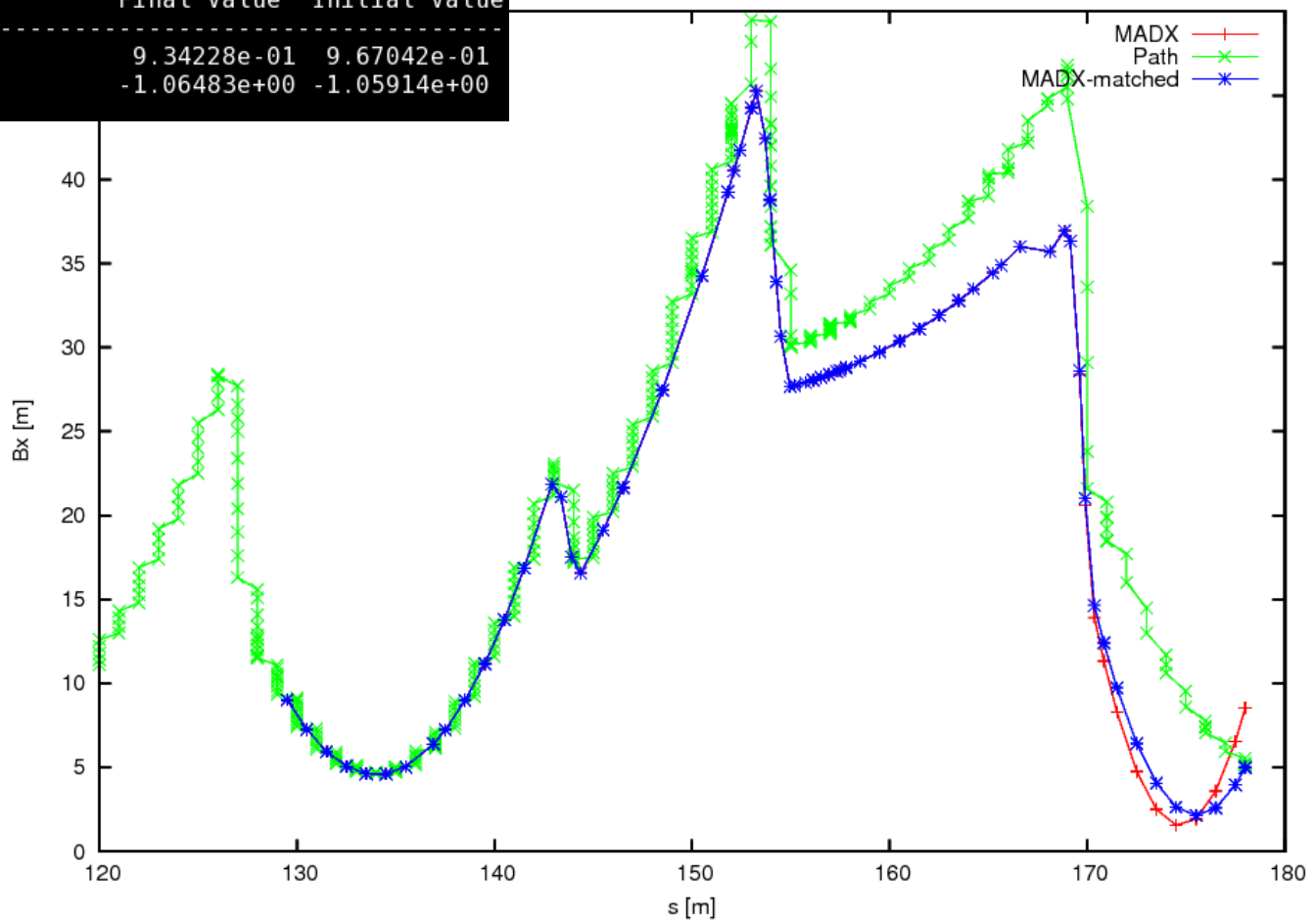


Ring 1 - 2 - 3 - 4


Ring 4
Ring 3
Ring 2
Ring 1
+360 mm @ BVT
+35 mm @ SMV2
-35 mm @ SMV2
-70 mm @ SMV1
-360 mm @ BVT
-720 mm @ BVT
Ring 4:
kdis4 := 0.003702;
kdvt3 := 0.007412;
ksmv2 := 0.1349;
kbvt1 := 0.13861;
y [m]
s [m]
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
5
10
15
20
25
30
35
40
45
50

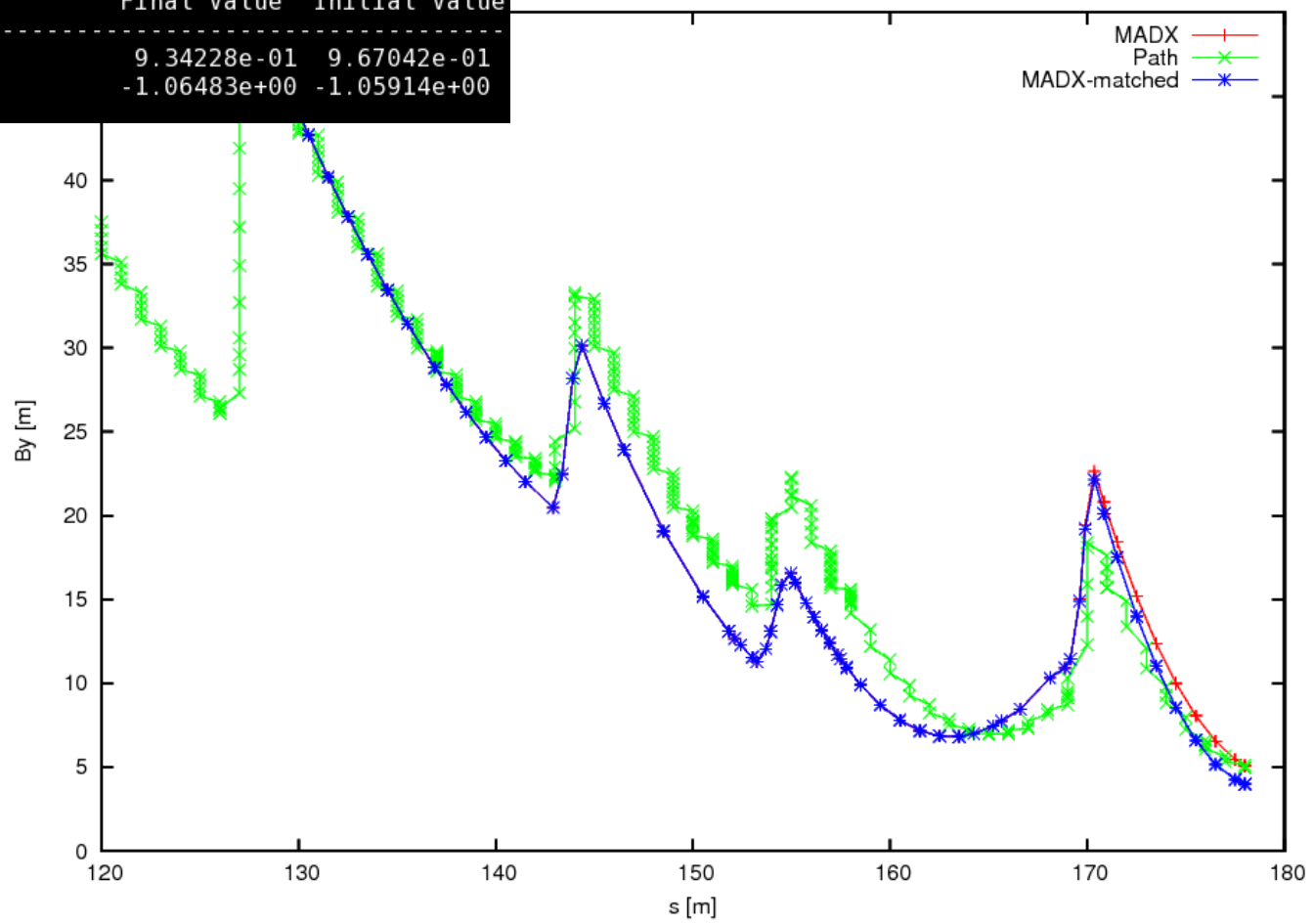
Ring4 – Nominal Betax

Variable	Final Value	Initial Value
kbiqn2_1	9.34228e-01	9.67042e-01
kbiqn2_2	-1.06483e+00	-1.05914e+00

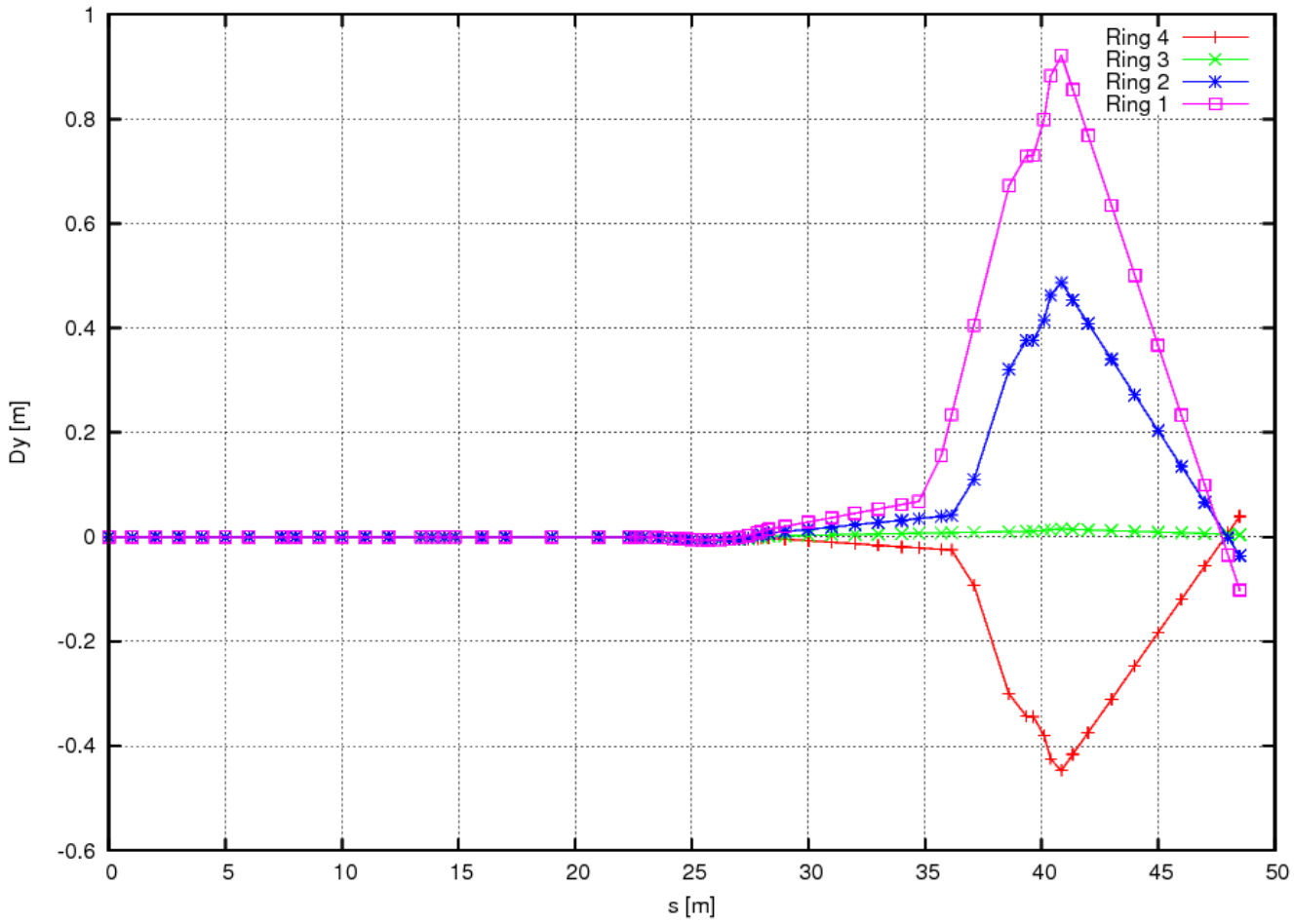


Ring4 – Nominal Betay

Variable	Final Value	Initial Value
kbiqn2_1	9.34228e-01	9.67042e-01
kbiqn2_2	-1.06483e+00	-1.05914e+00

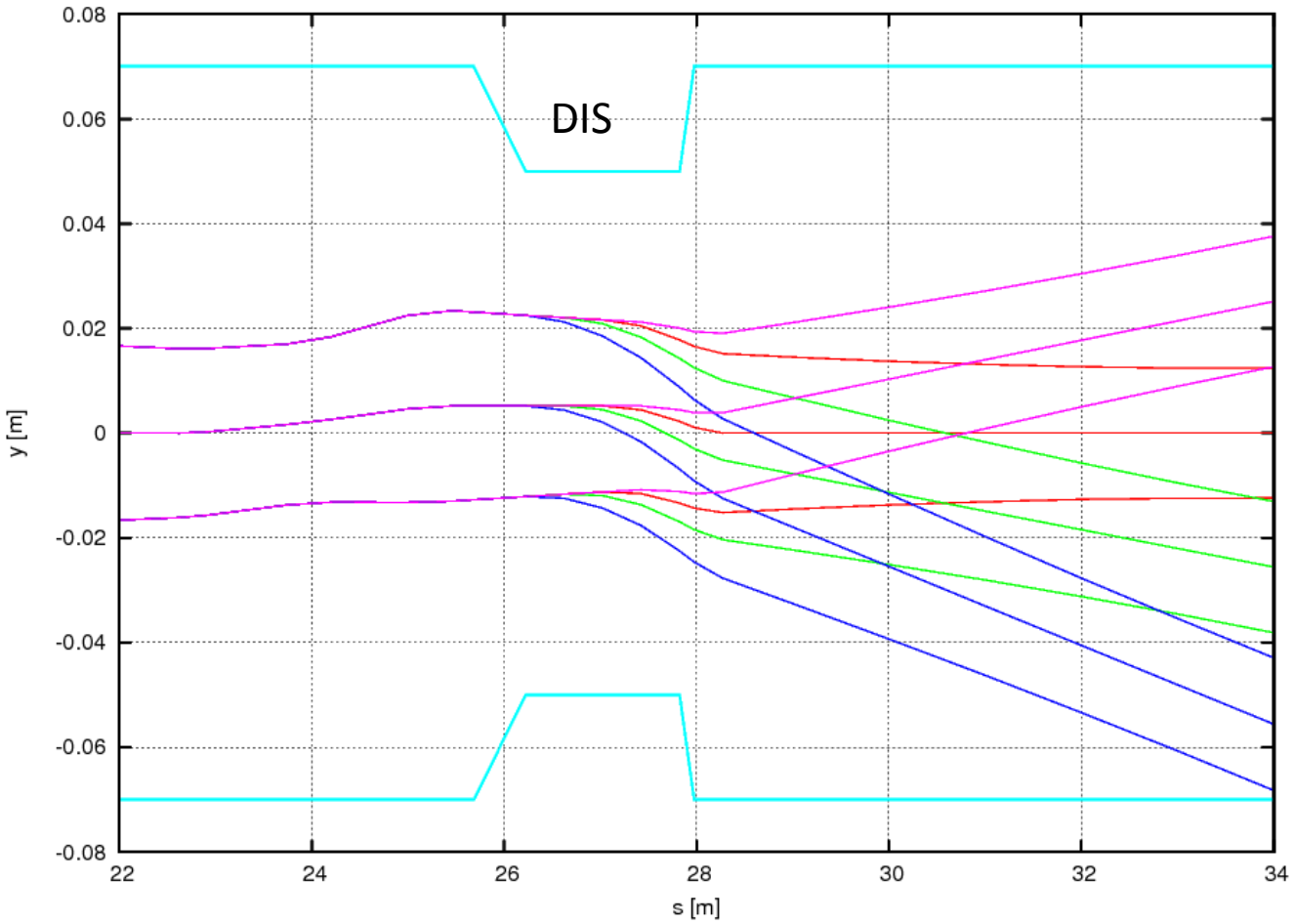


Vertical Dispersion

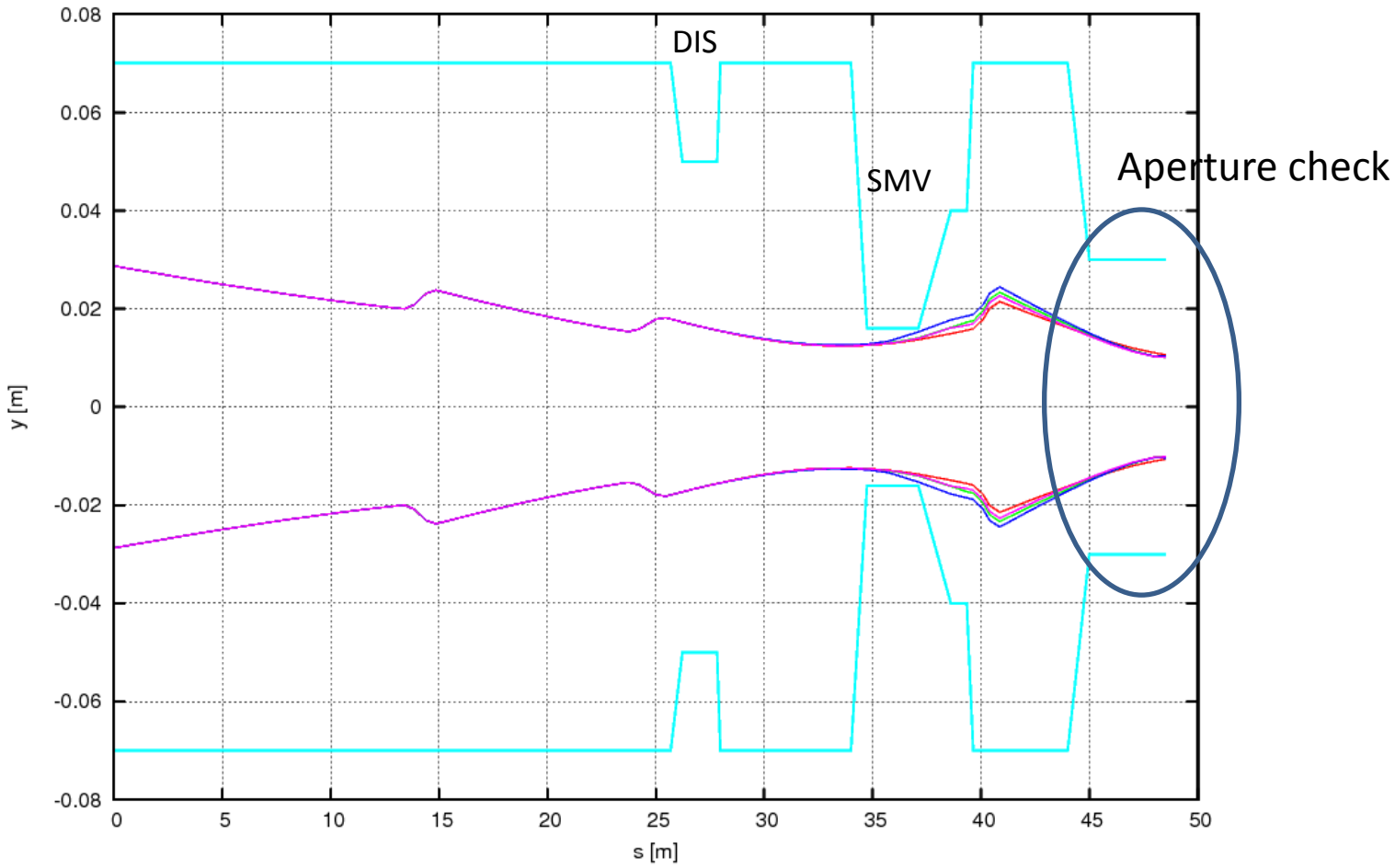


Vertical Envelope @ DIS

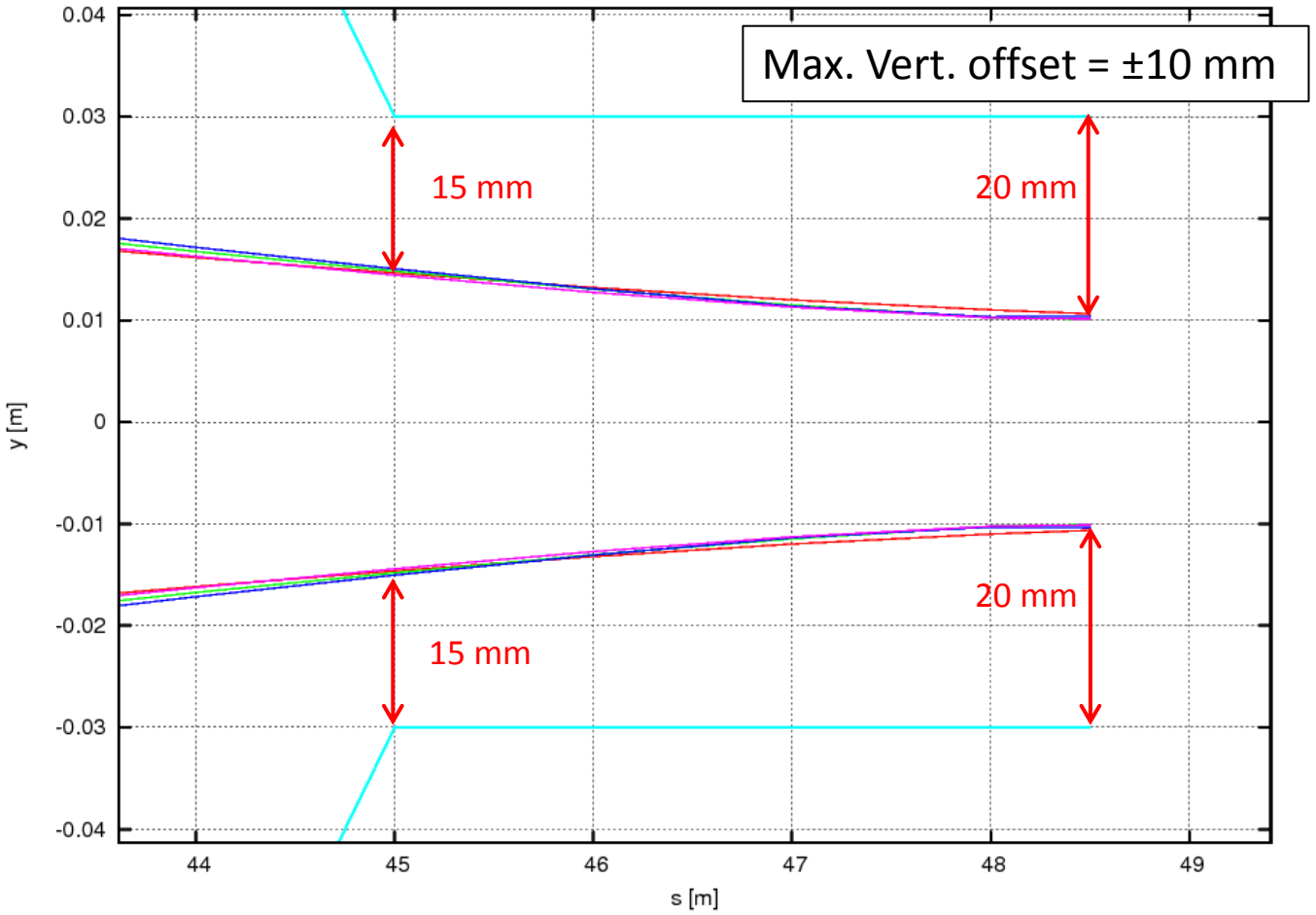
4 $\sigma_{\beta(+20\%)}$ + Dy*Δp/p + Orbit
(normalized r.m.s. ε_y =0.5 mm mrad)
Dp/p = 0.0044
Orbit = ±2 mm



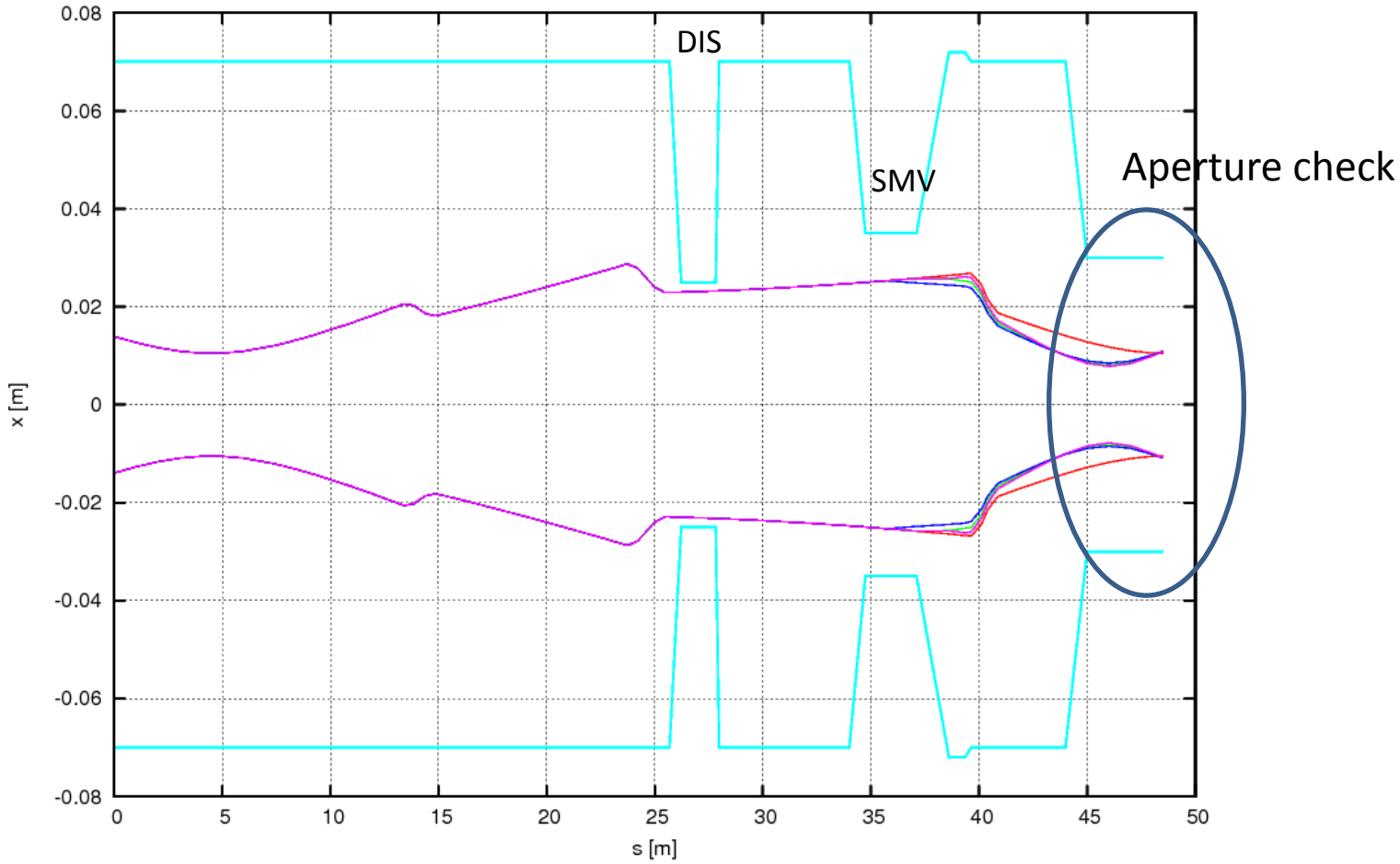
Vertical Envelope



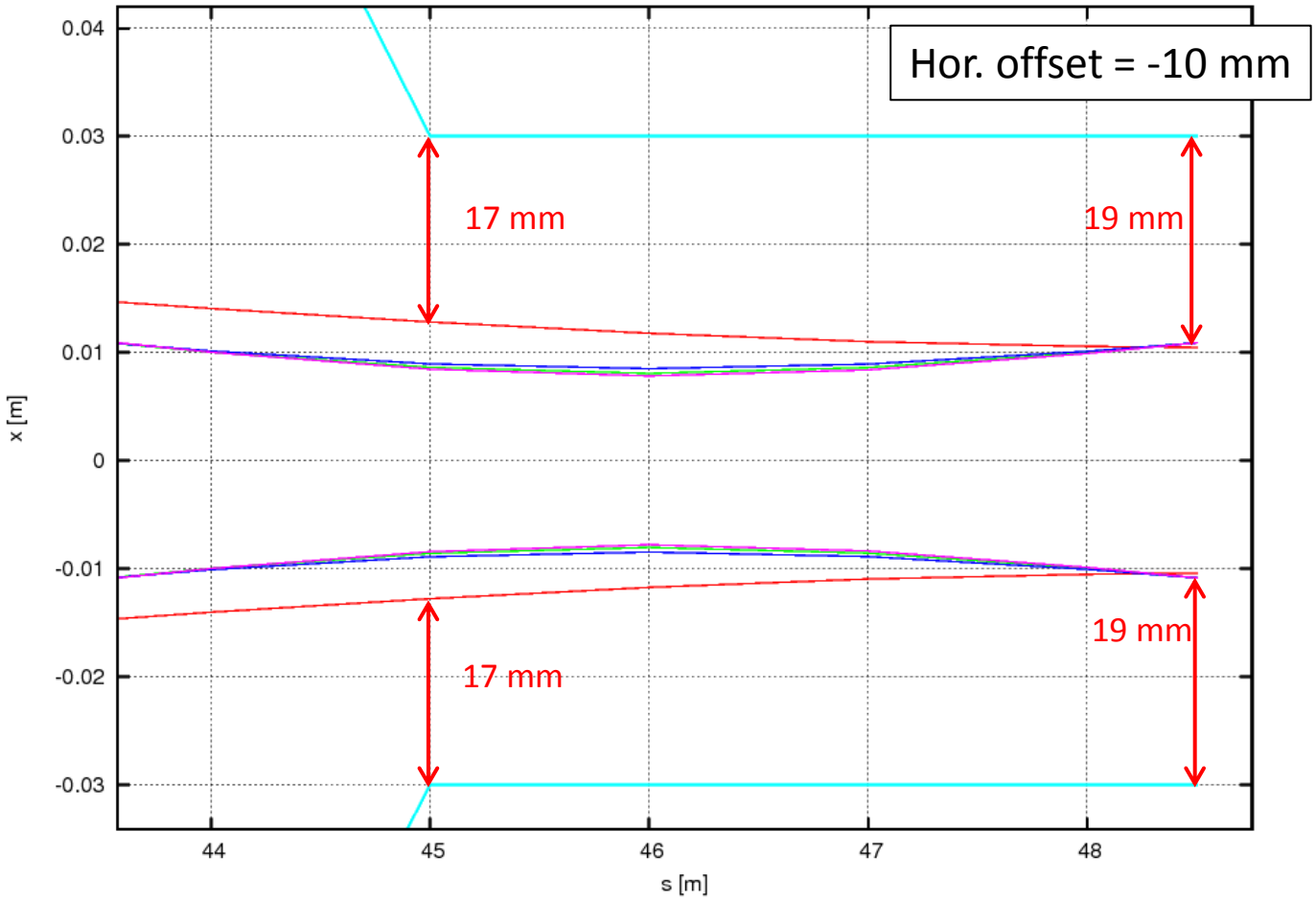
Zoom Vertical Envelope



Horizontal Envelope



Zoom Horizontal Envelope



Next Step

- Nominal beta and matched dispersion
- Small and Large beta, 0 and matched dispersion