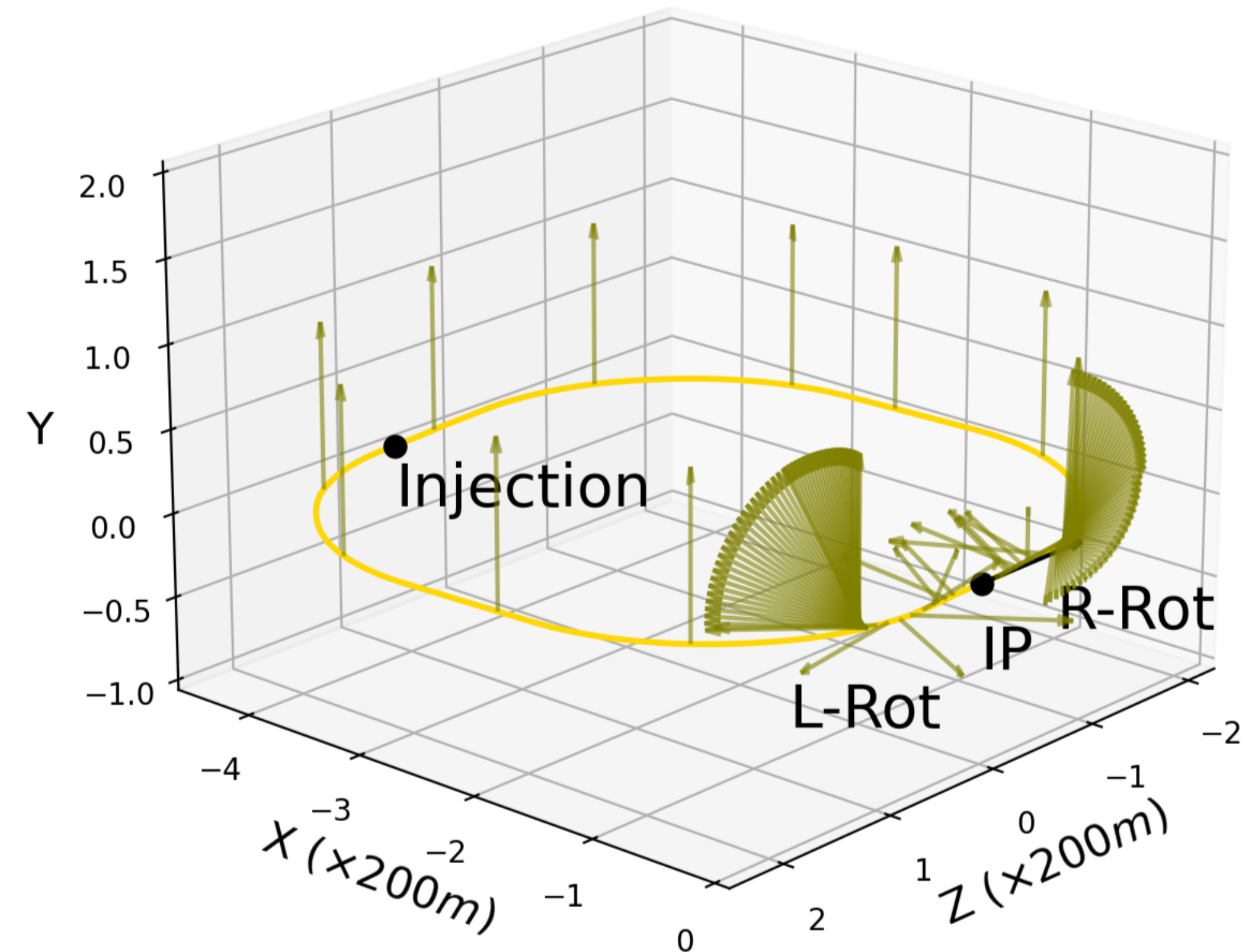




Studies of Position Offset of the Spin Rotator Magnets



Yuhao Peng
2026.02.02

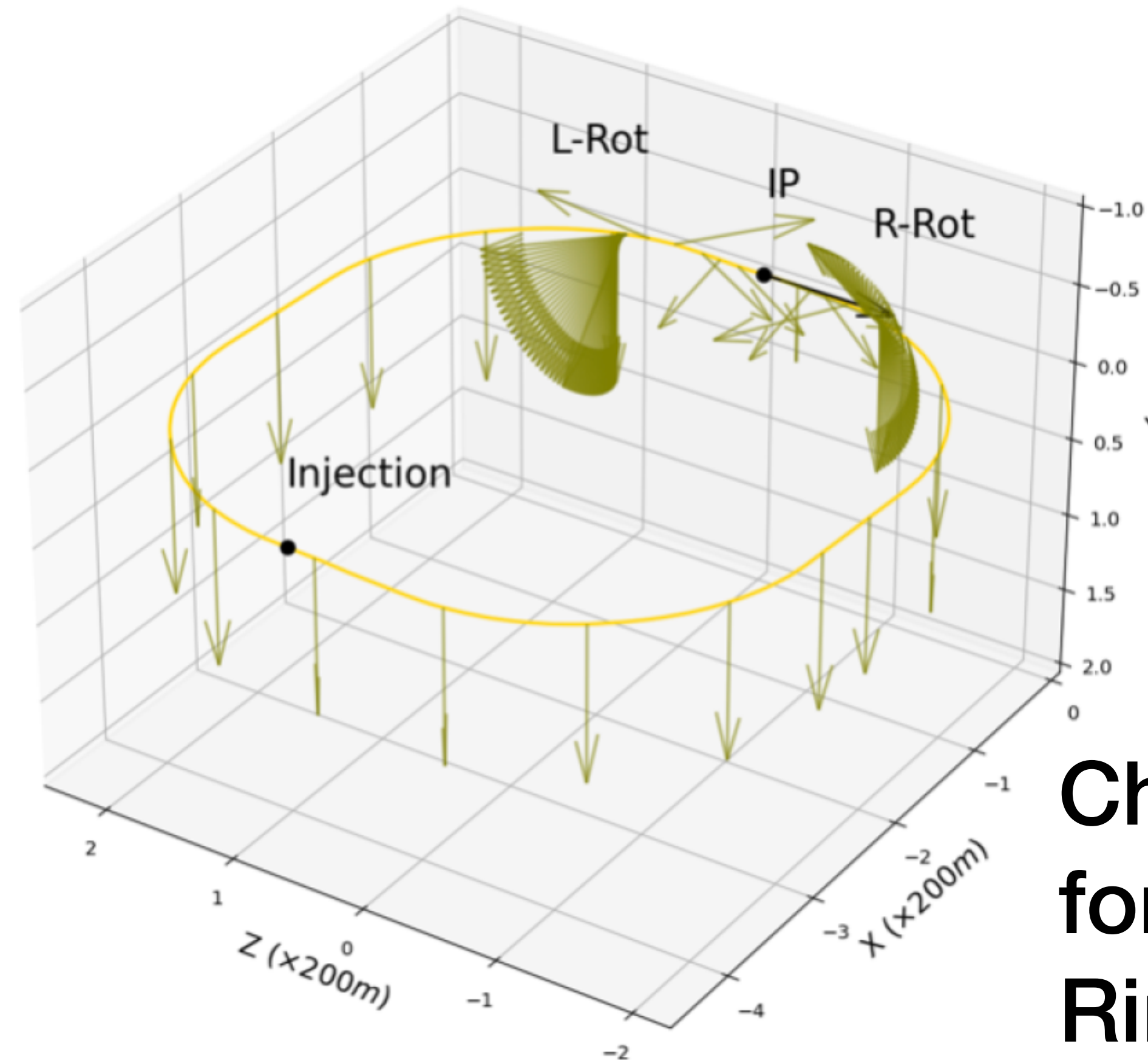
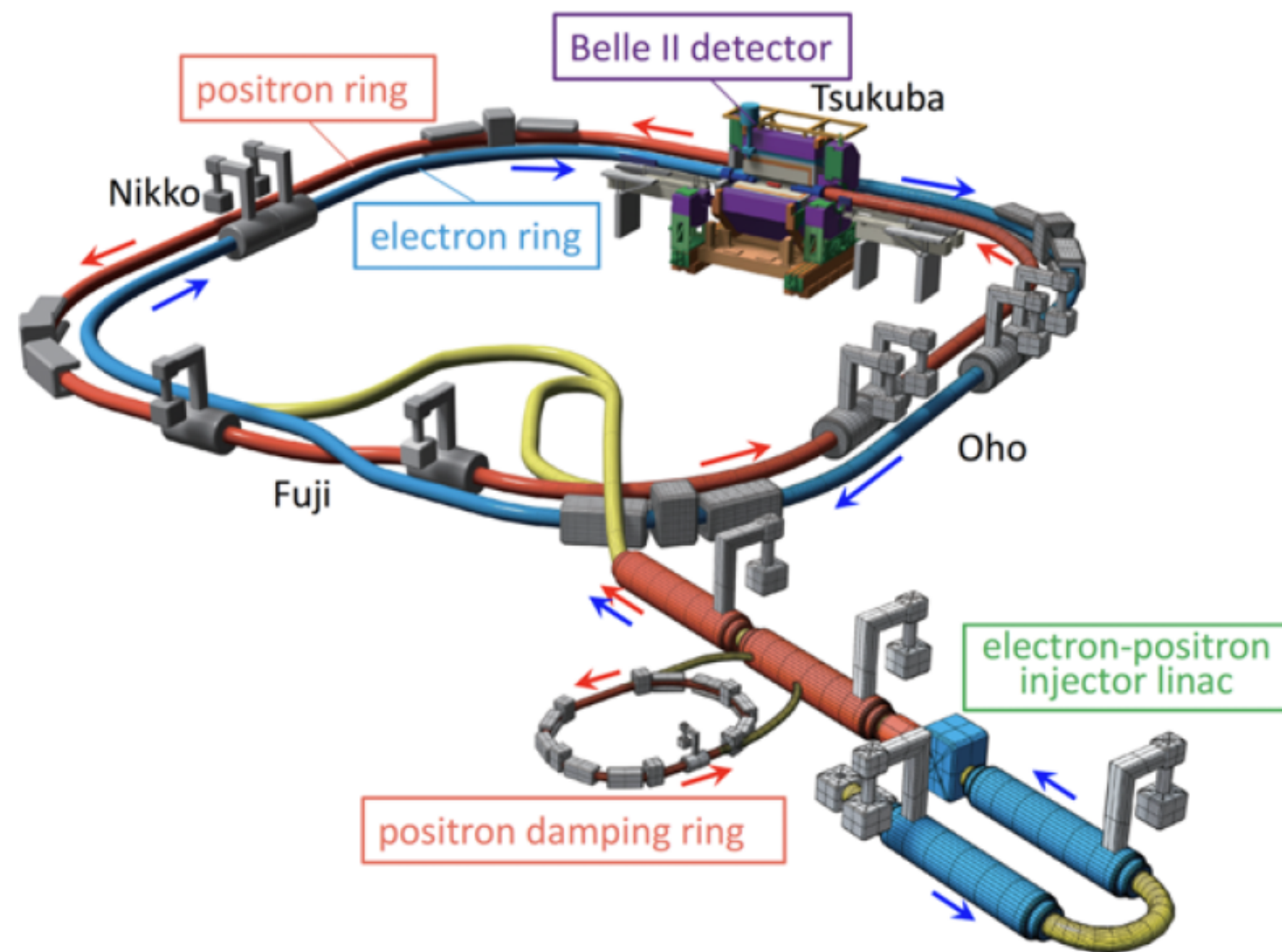


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numérique du Canada

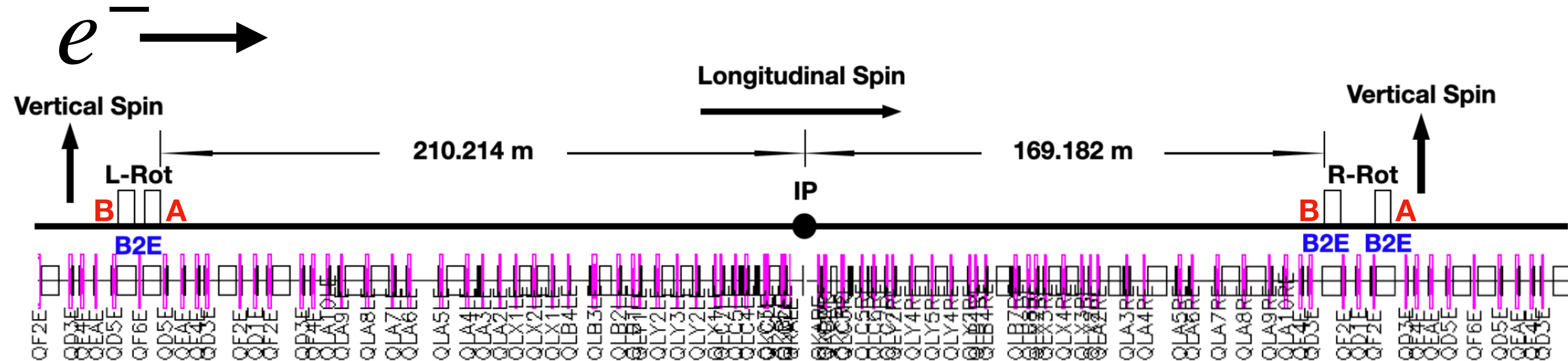
Purpose of Study

Explore the tolerance of the position offset of rotator magnets in the Rotator Ring (Rot) with Bmad simulations.



**Chiral Belle Upgrade
for the High Energy
Ring: Rotator Ring**

Brief Review of the Rotator Design



4 B2E dipoles in the SuperKEKB High Energy Ring (HER) are replaced with Rotator magnets

- L-Rot (made of **B2EAL** and **B2EBL**) is to rotate the vertical spin to the horizontal plane
- R-Rot (made of **B2EAR** and **B2EBR**) is to rotate the horizontal spin to the vertical direction

Displacement Shift of the Rotator

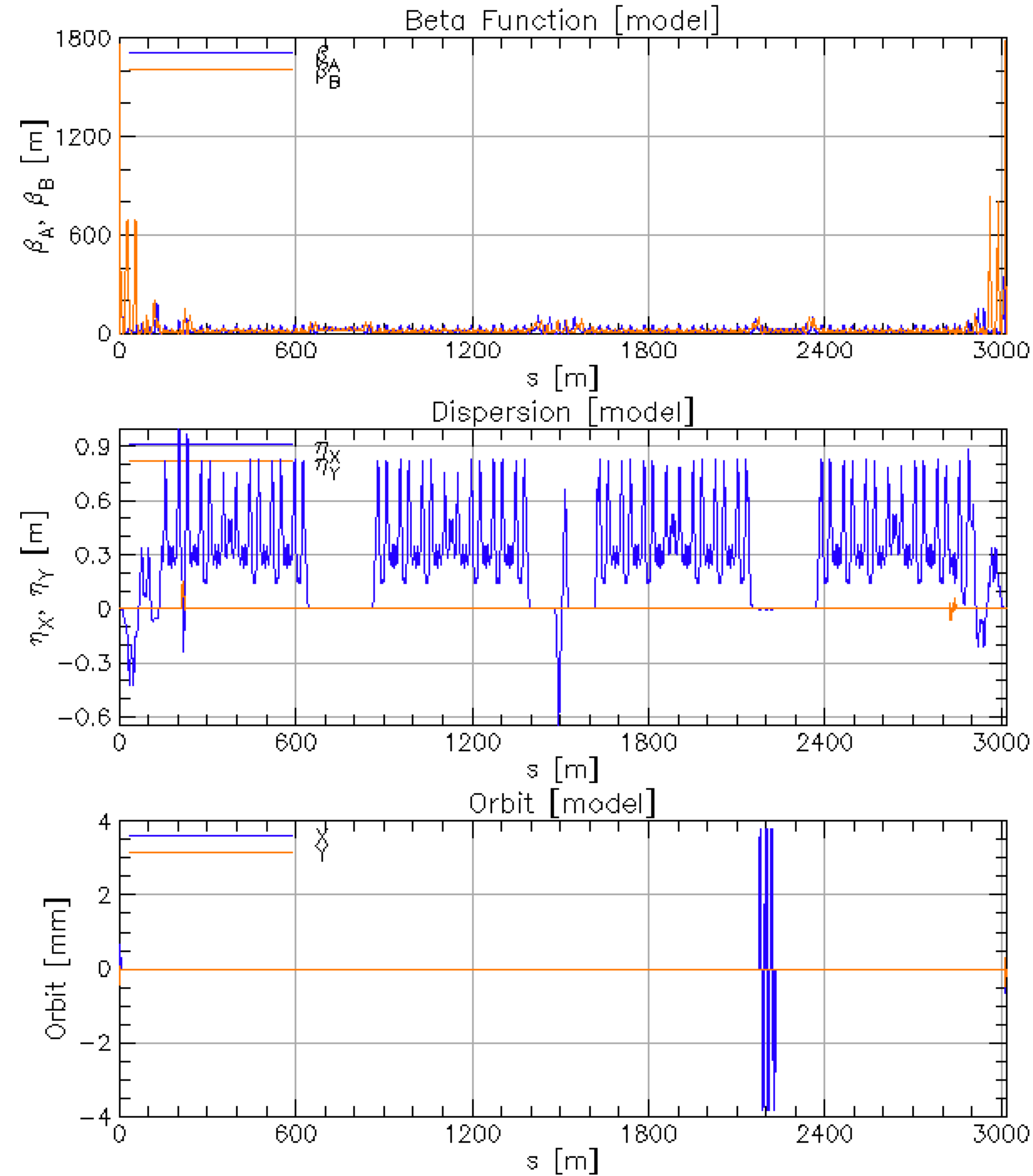


In reality, the rotator installation is not perfect and may be shifted from the axis.

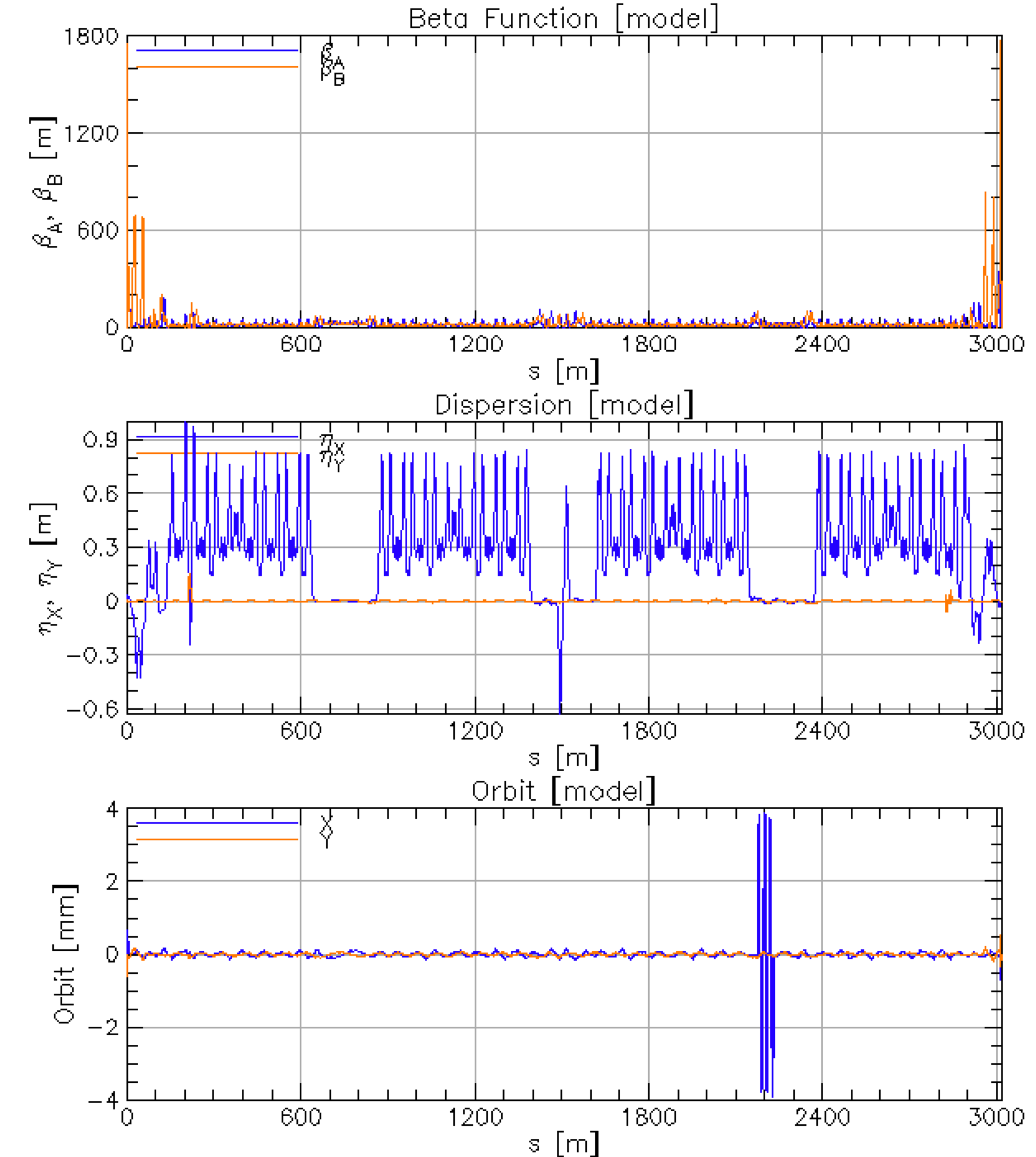
To study the tolerance of this offset, we run simulations using Bmad.

We initially focus on transverse displacement shifts.

B2EAL: $y_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

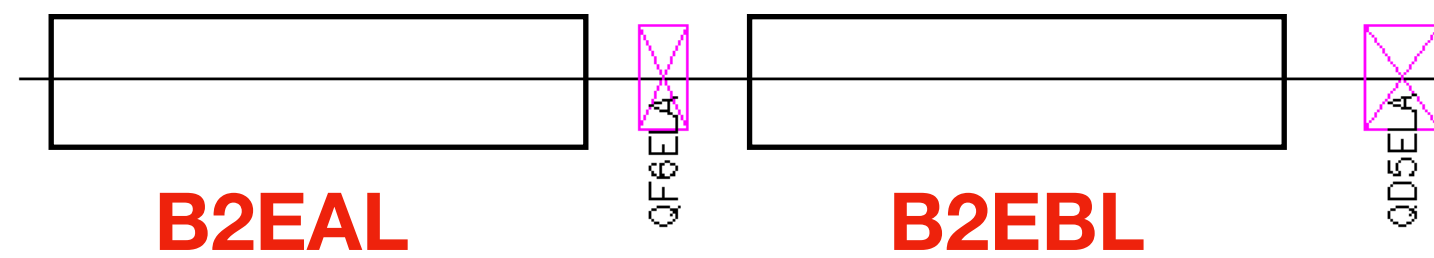
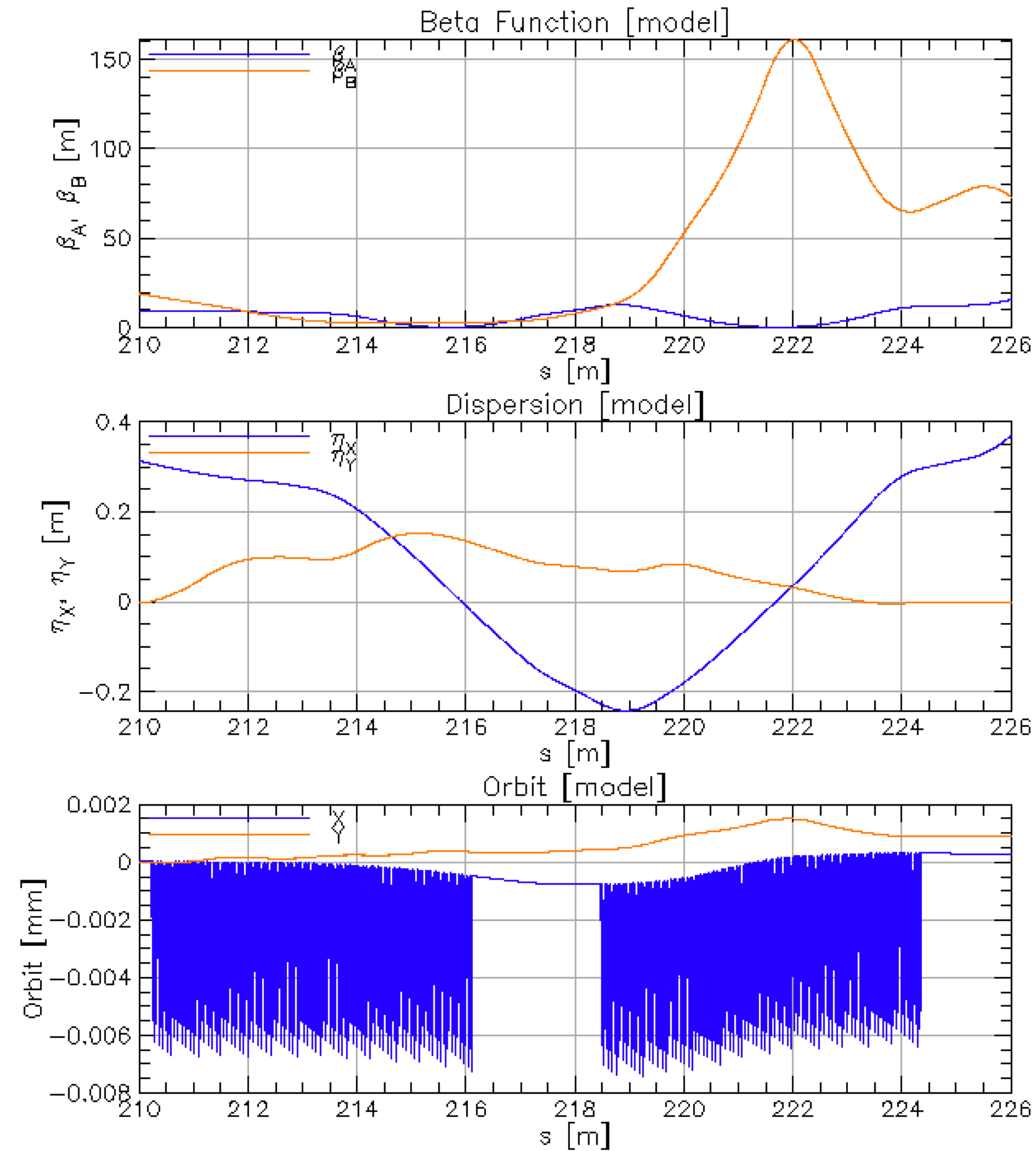
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

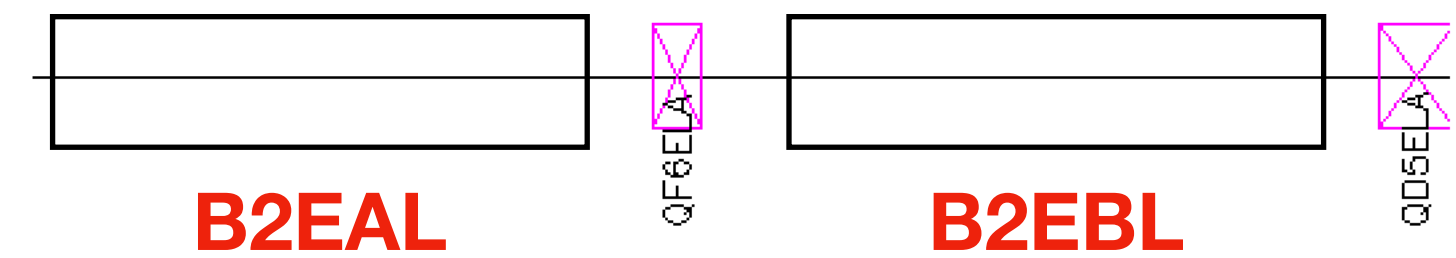
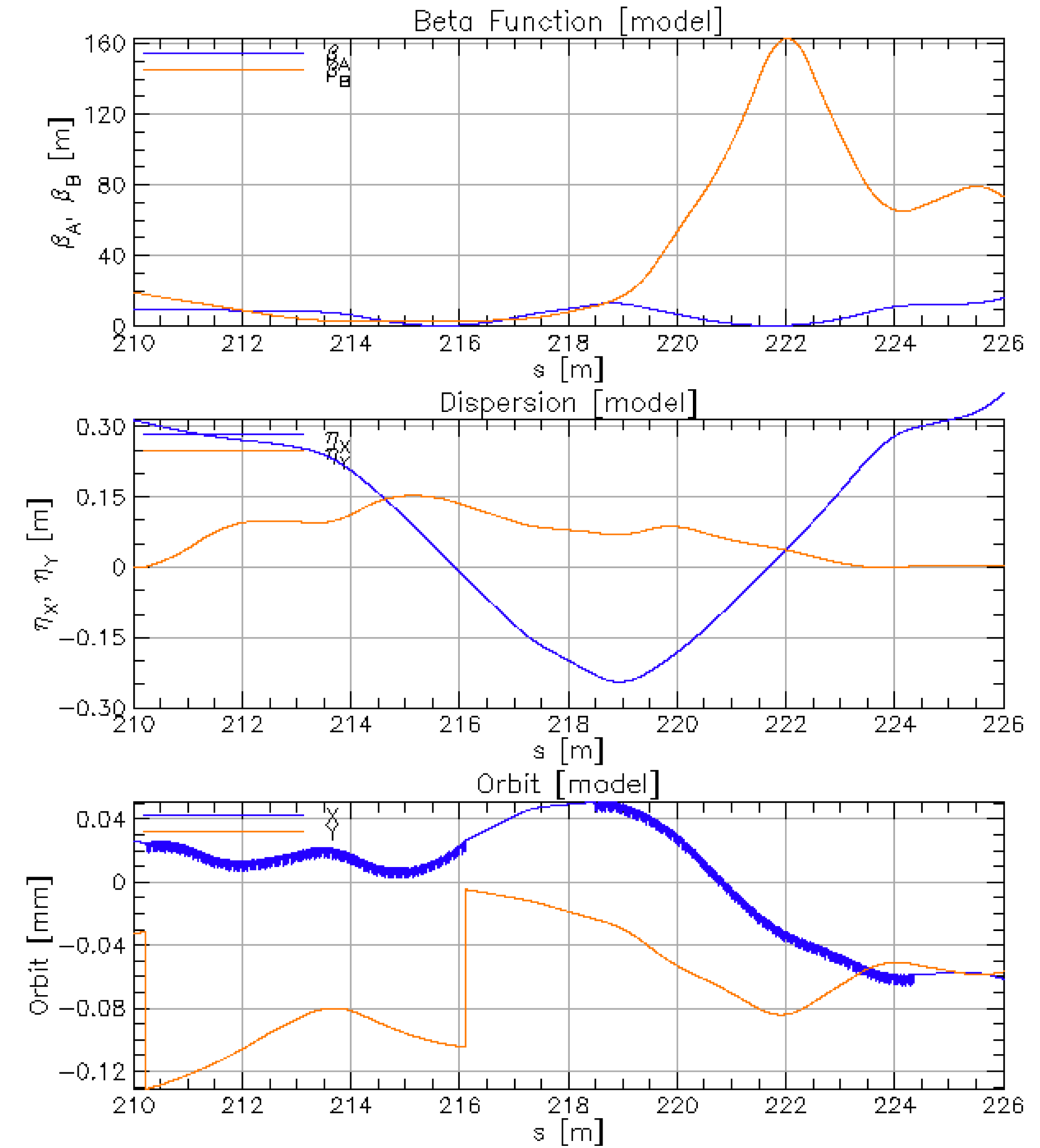
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EAL_y +0.1mm Left magnet A
	Model	Design	Model	Design		
Q	45.530947	45.530947	43.580015	43.580015	! Tune	
Chrom	1.621420	1.625086	1.425916	1.427488	! dQ/(dE/E)	
J_damp	0.968999	0.968759	1.000507	1.000510	! Damping Partition #	
Emittance	4.58840E-09	4.58971E-09	1.06053E-11	1.06161E-11	! Unnormalized	

L-Rot

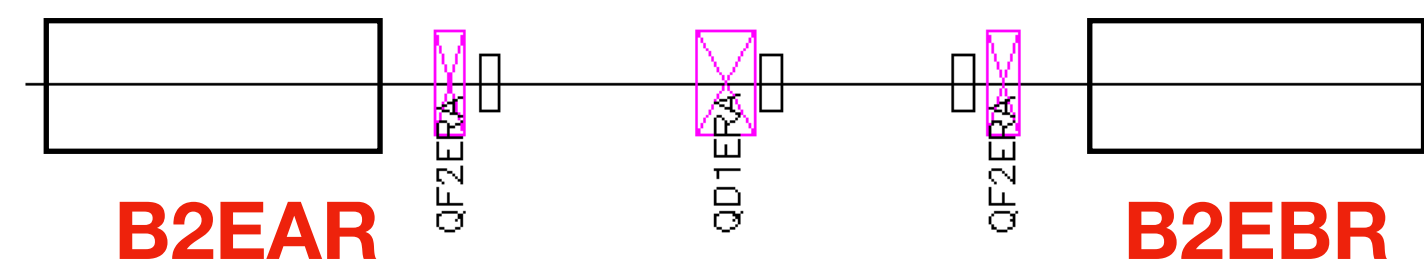
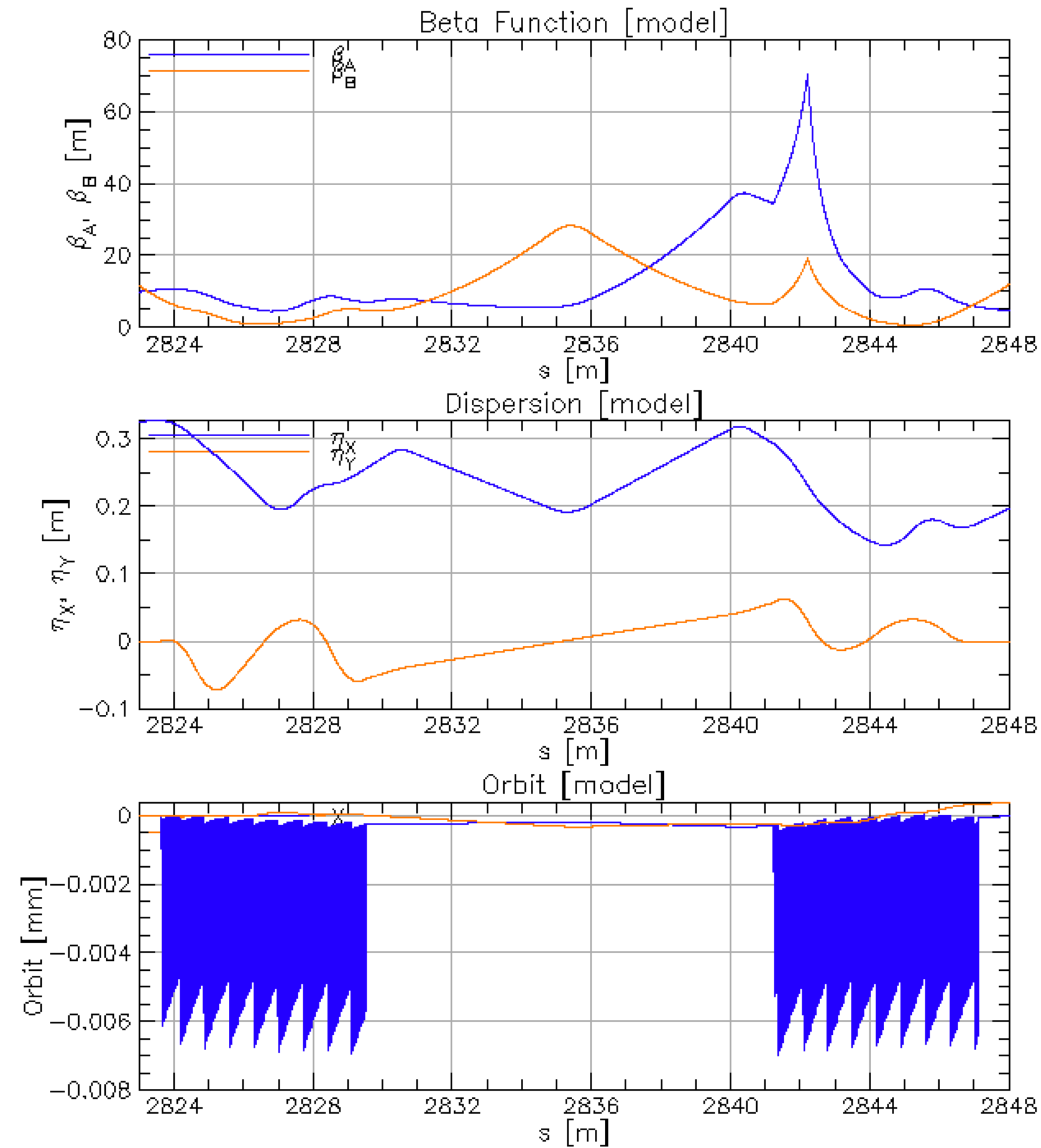


original

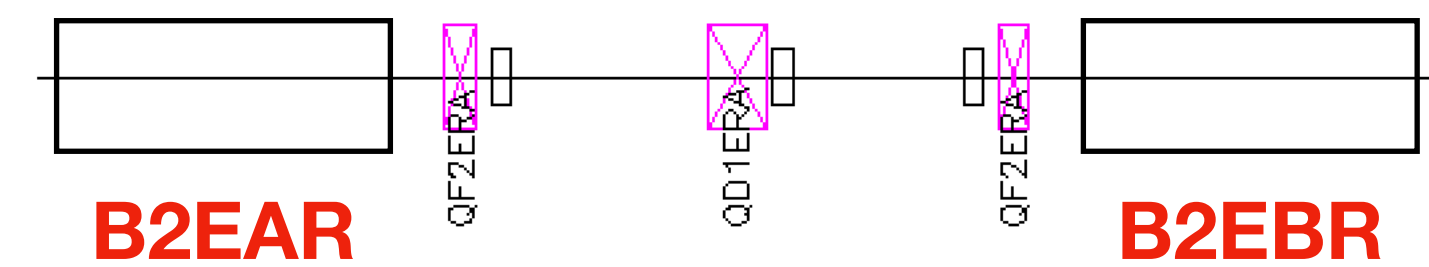
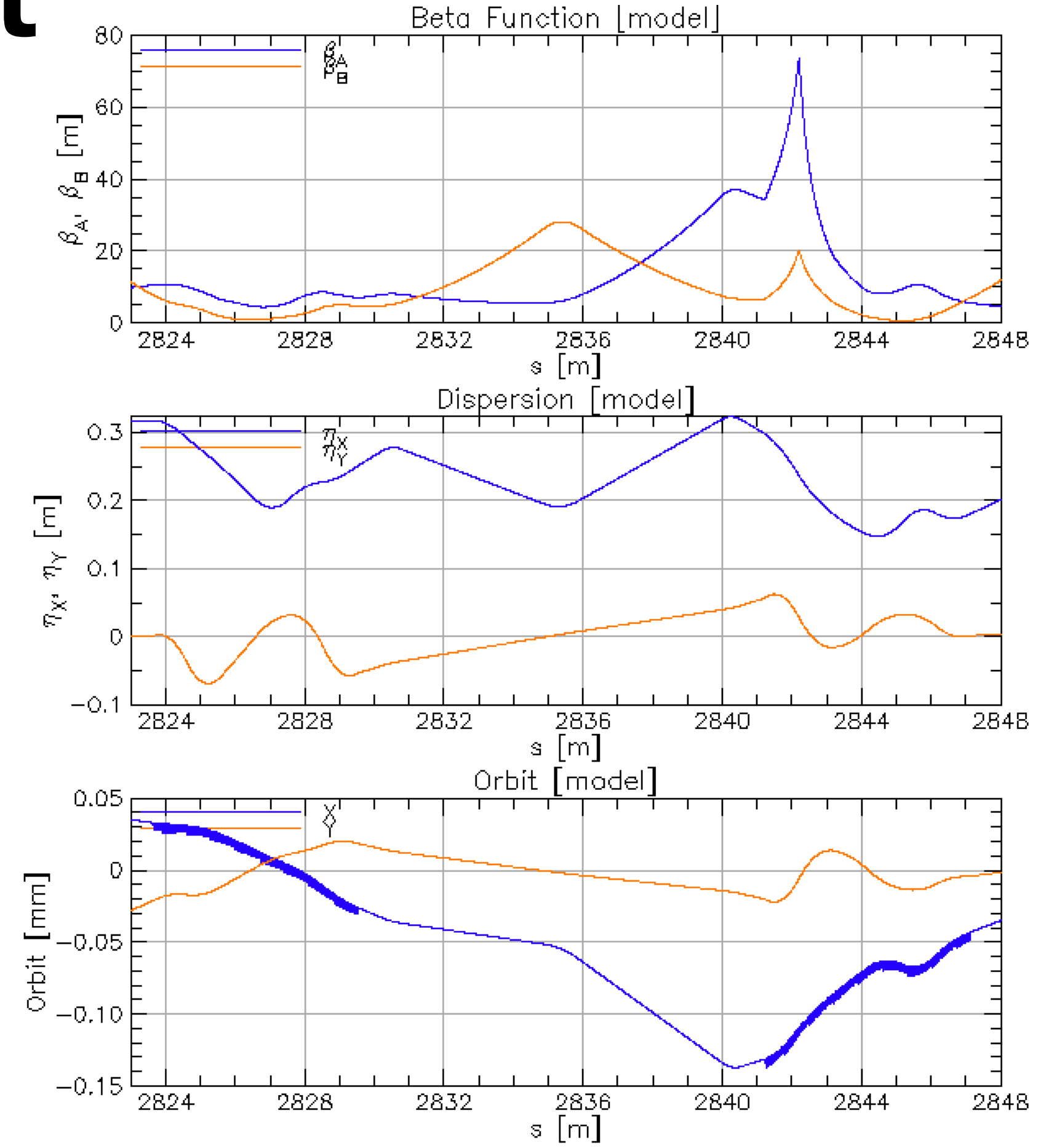


B2EAL_y +0.1mm

R-Rot

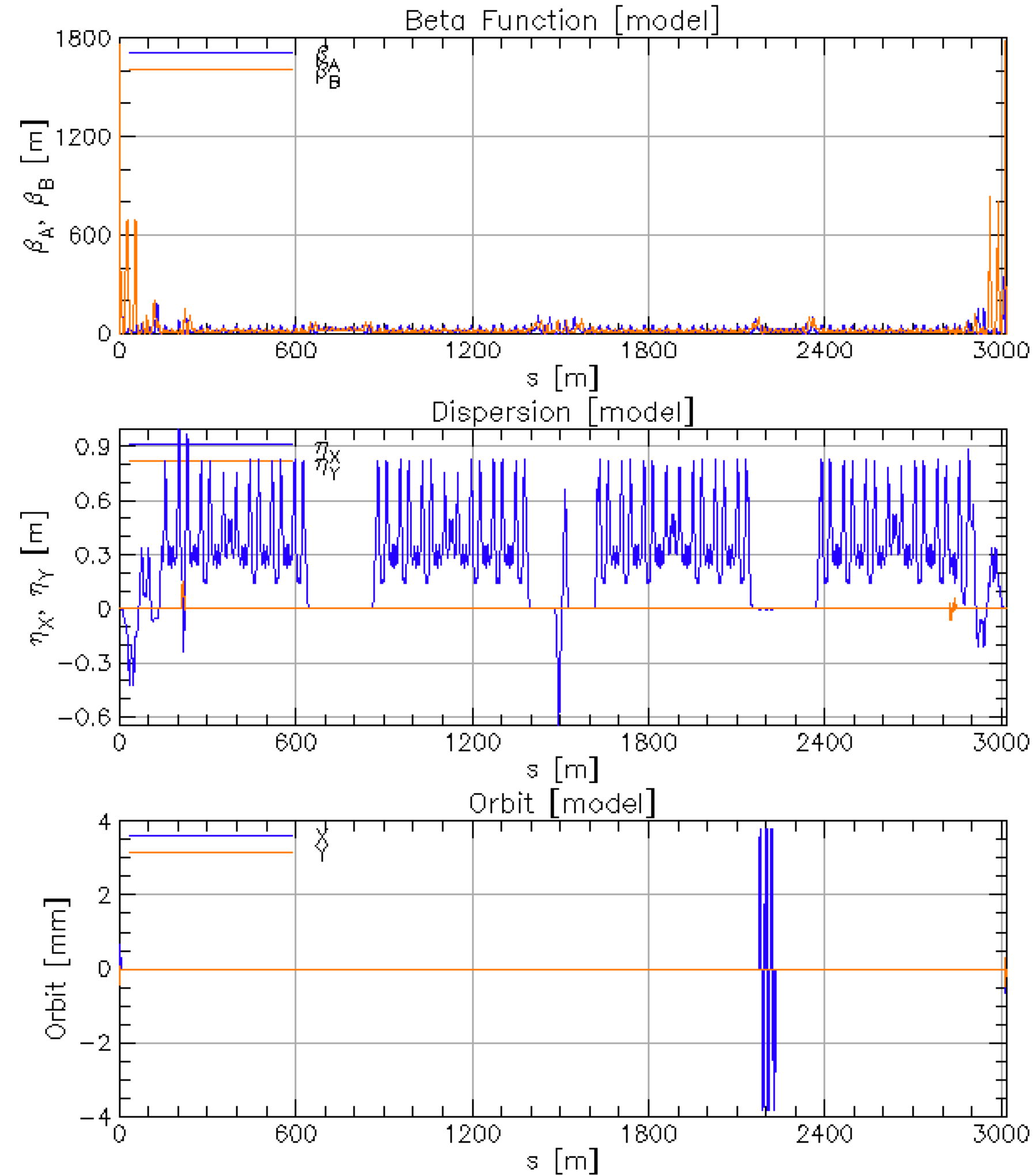


original

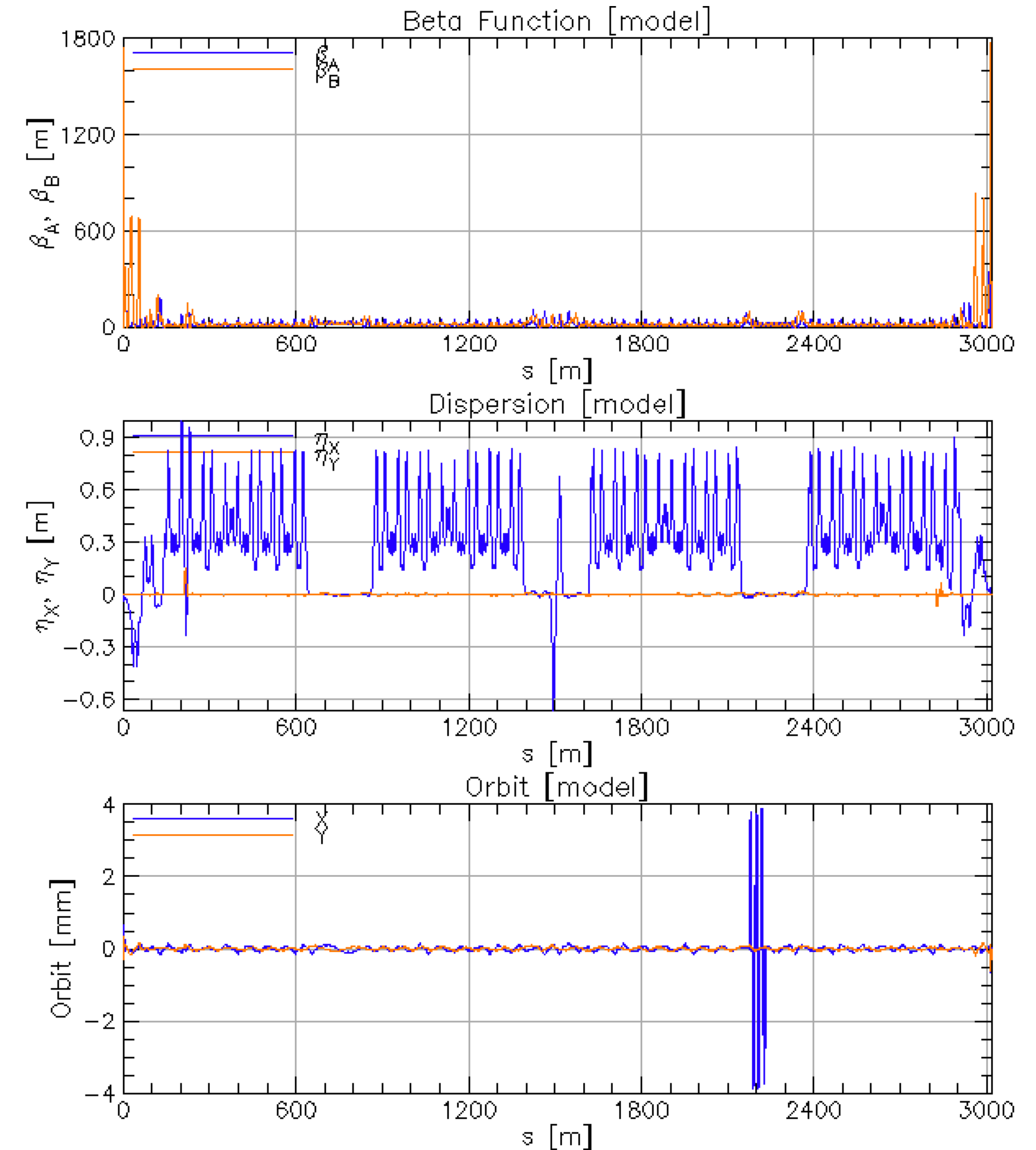


B2EAL_y +0.1mm

B2EAL: $y_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

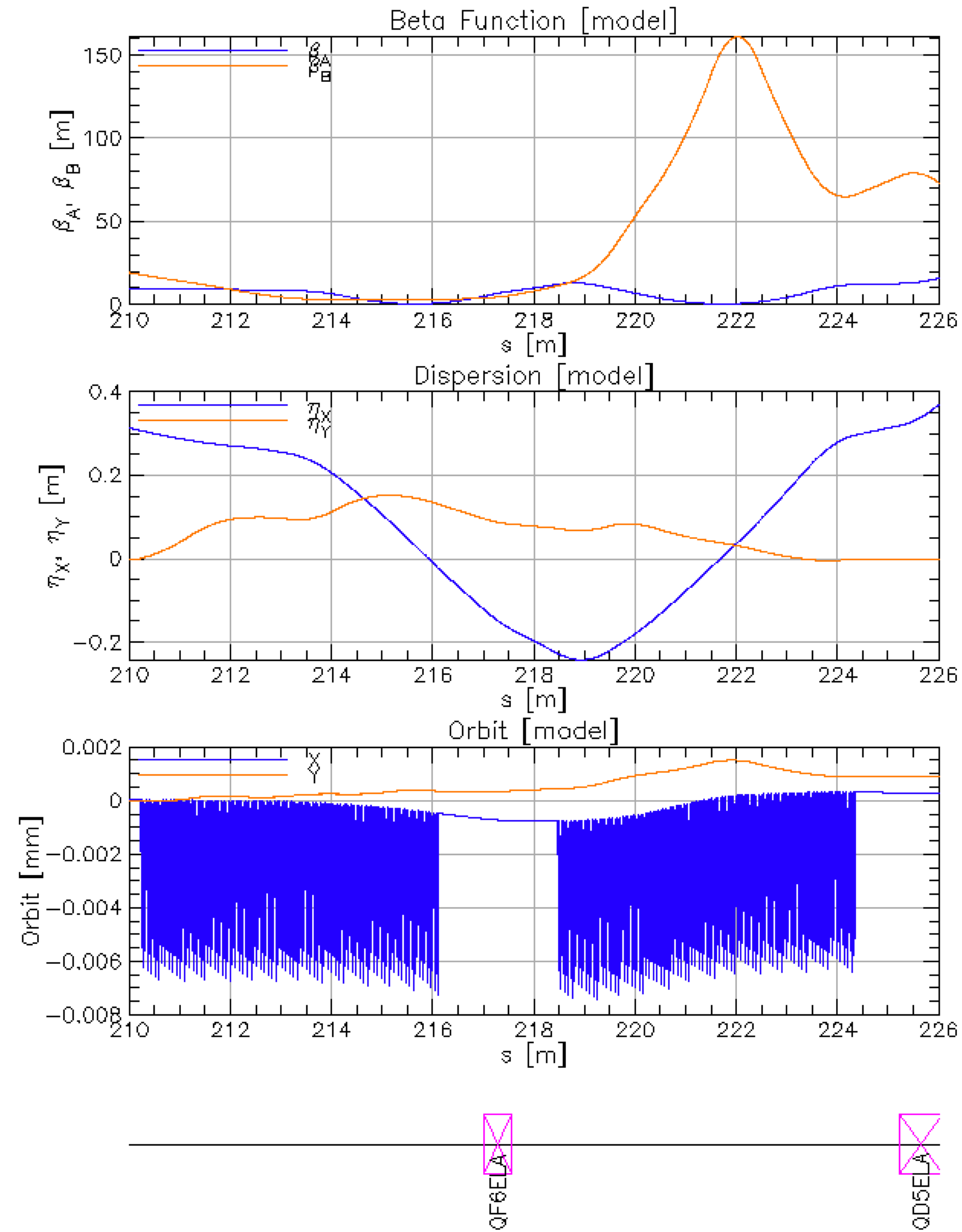
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

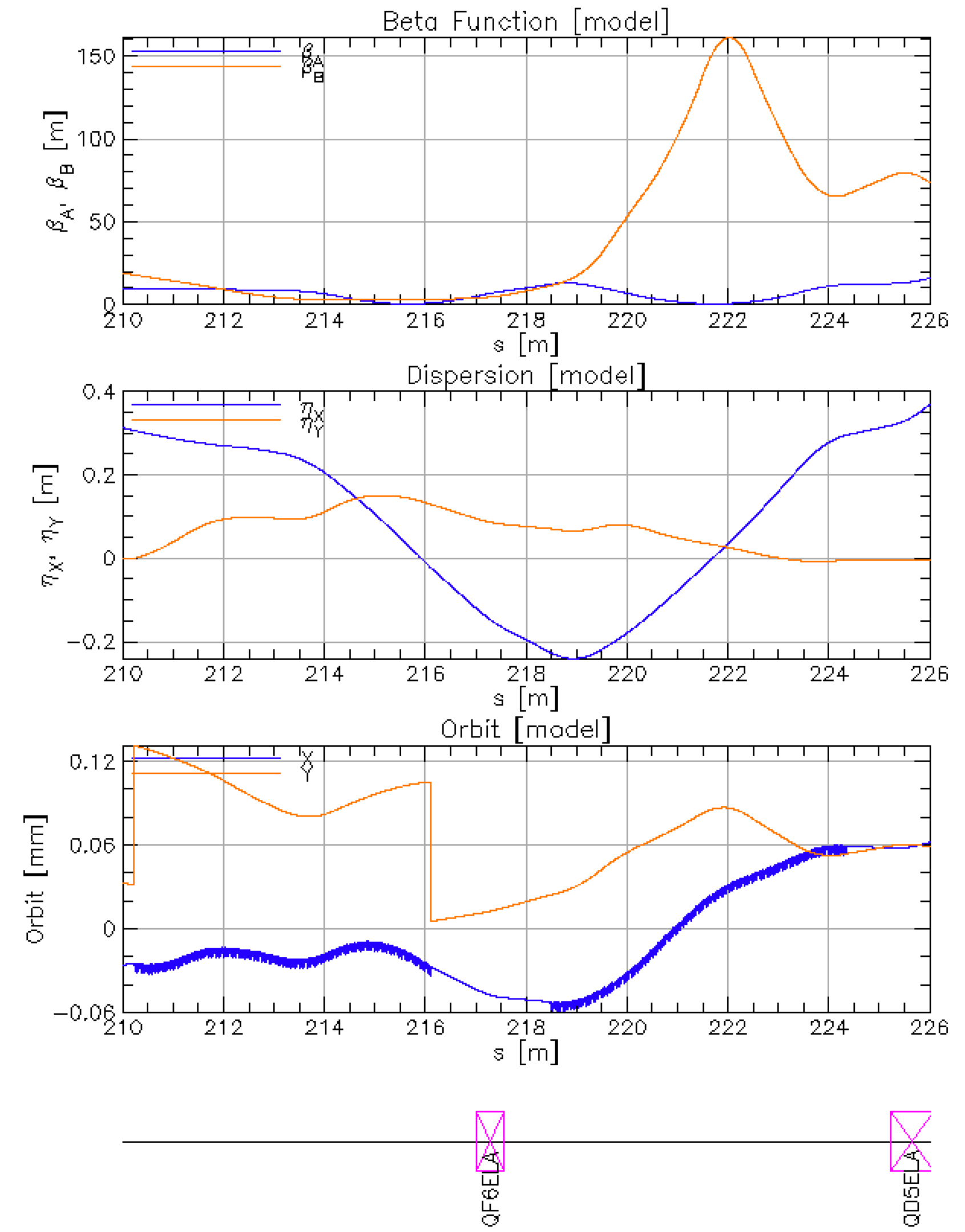
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EAL_y -0.1mm Left magnet A
	Model	Design	Model	Design		
Q	45.530898	45.530898	43.580404	43.580404	! Tune	
Chrom	1.567231	1.578311	1.799340	1.805565	! dQ/(dE/E)	
J_damp	0.962973	0.962243	1.000396	1.000383	! Damping Partition #	
Emittance	4.61455E-09	4.61862E-09	1.14756E-11	1.14953E-11	! Unnormalized	

L-Rot

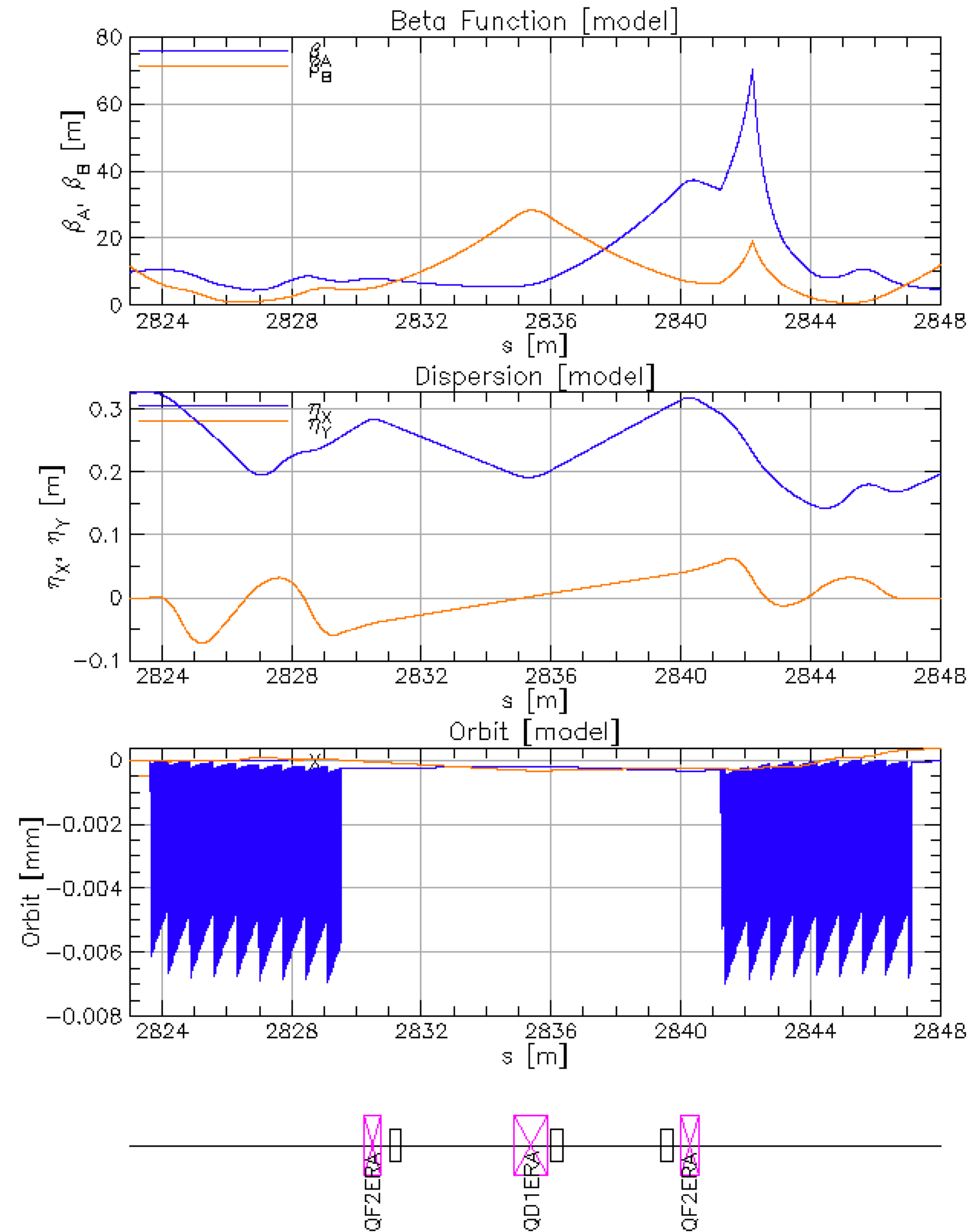


original

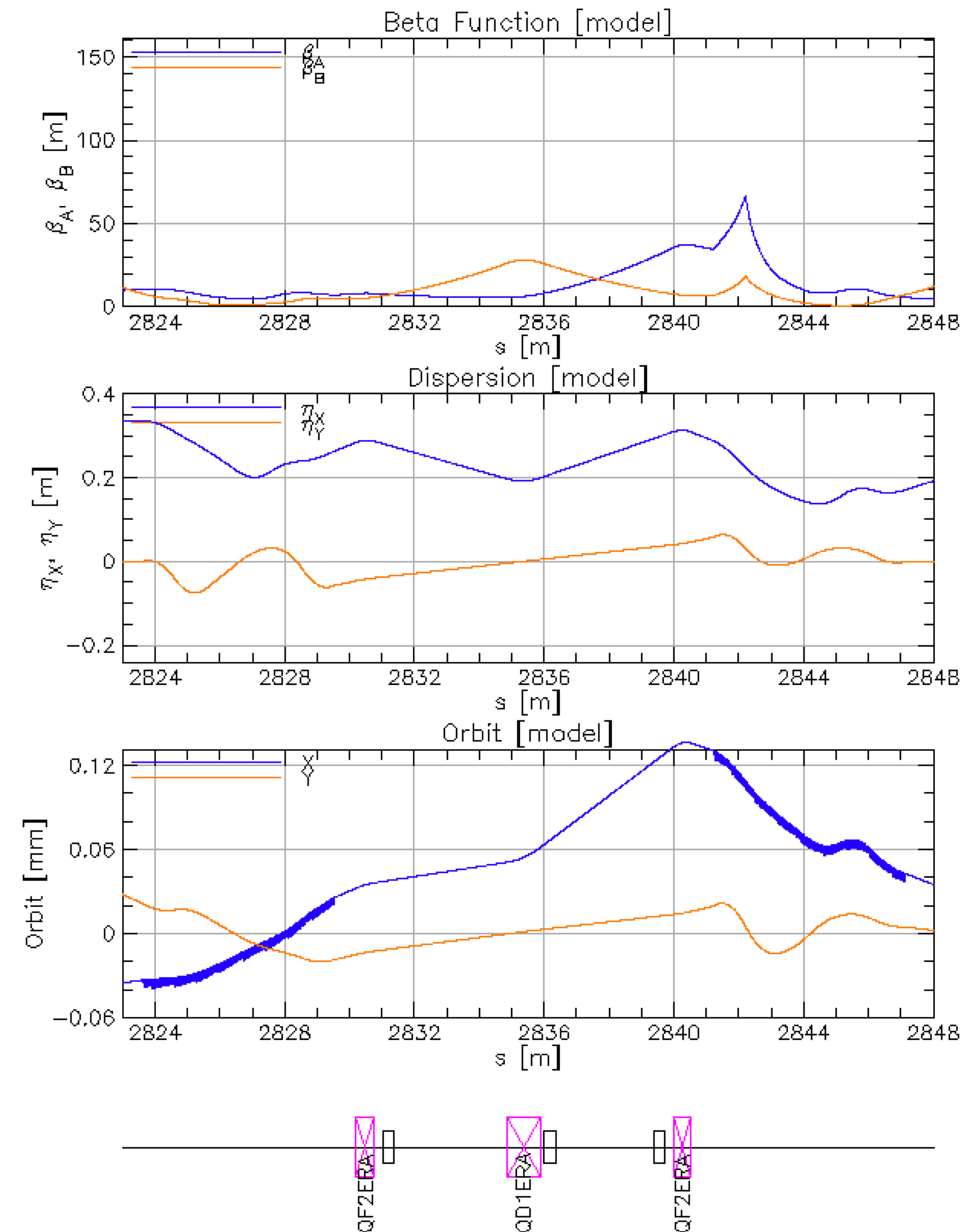


B2EAL_y -0.1mm

R-Rot

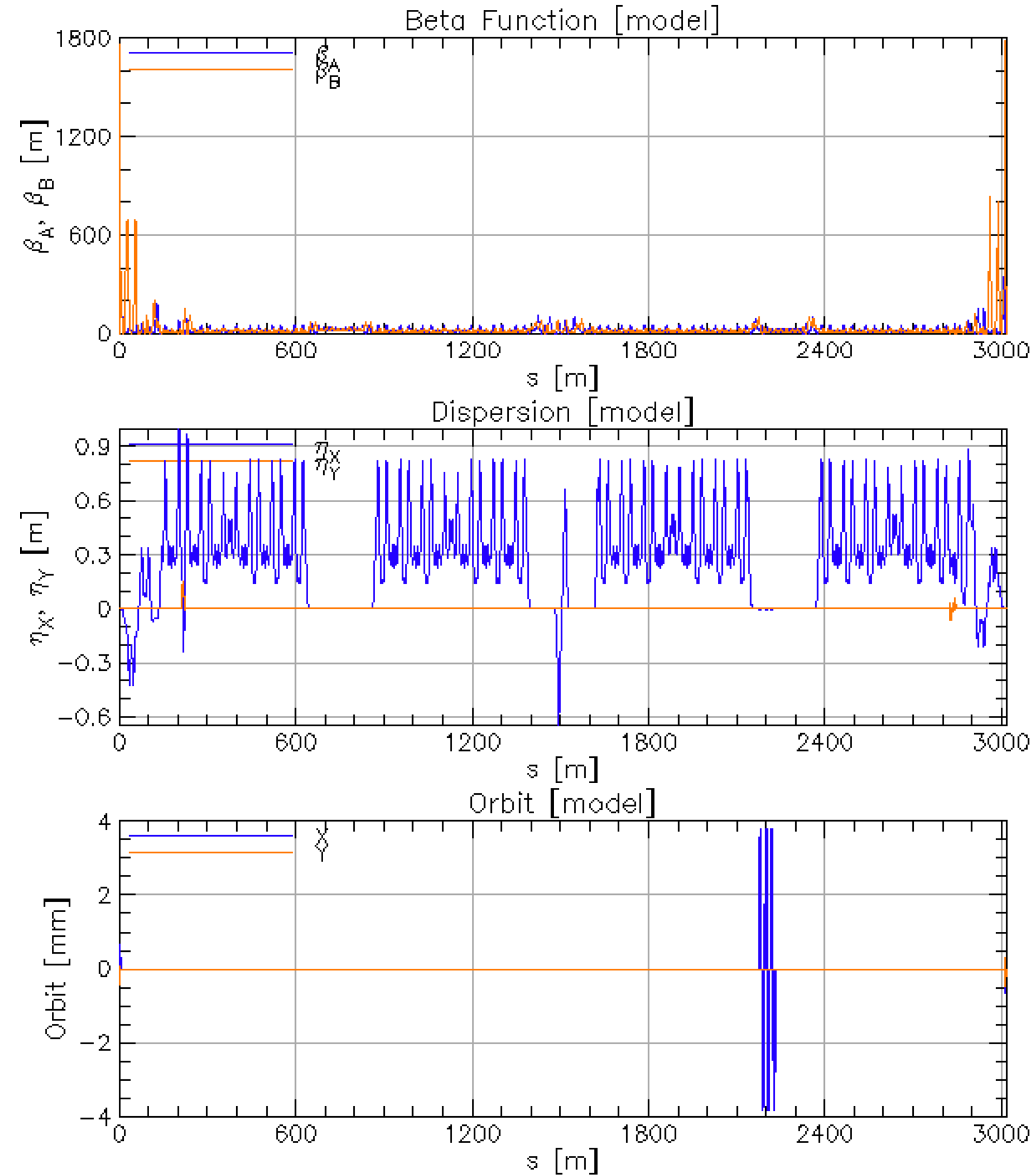


original

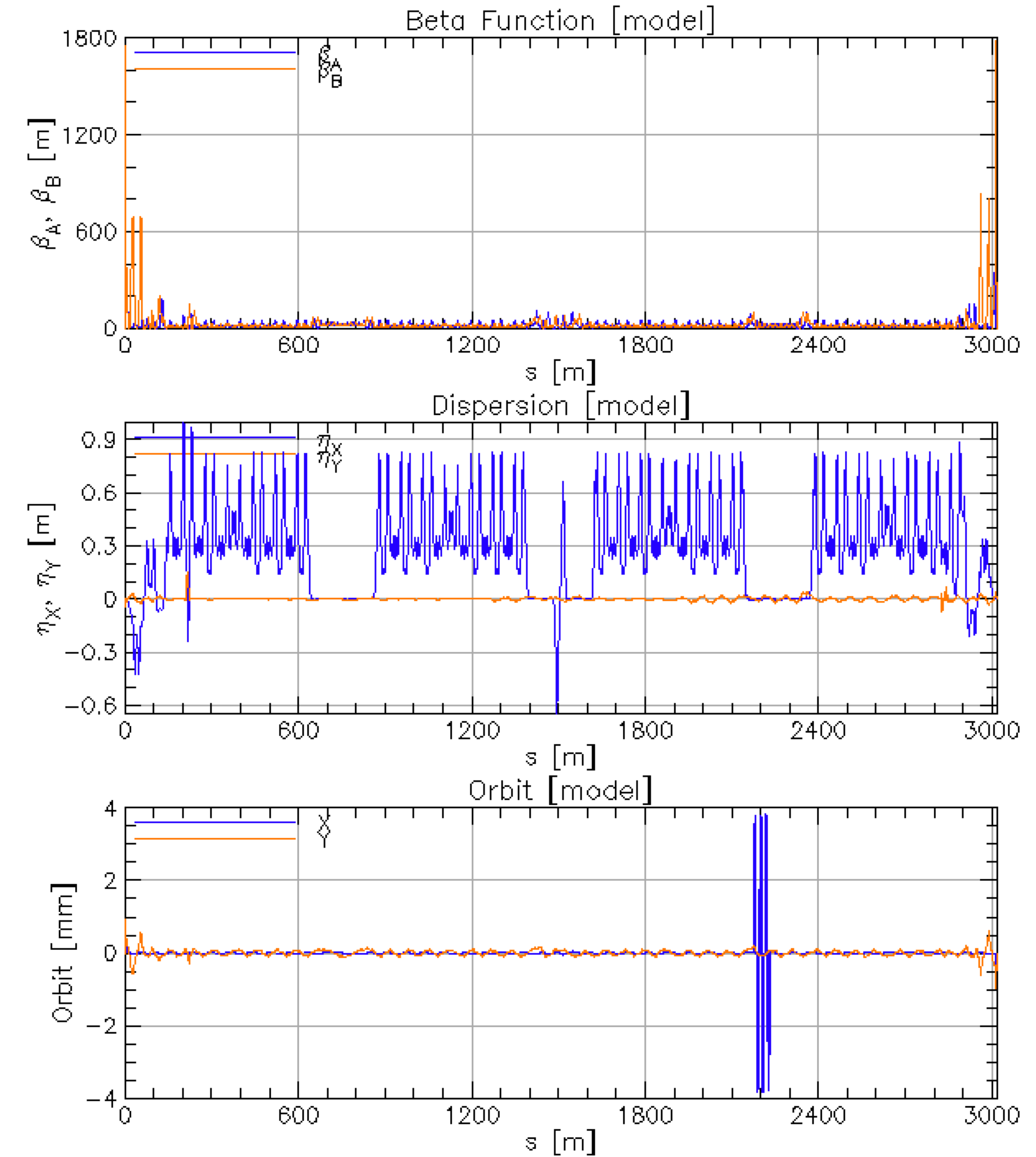


B2EAL_y -0.1mm

B2EBL: $y_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

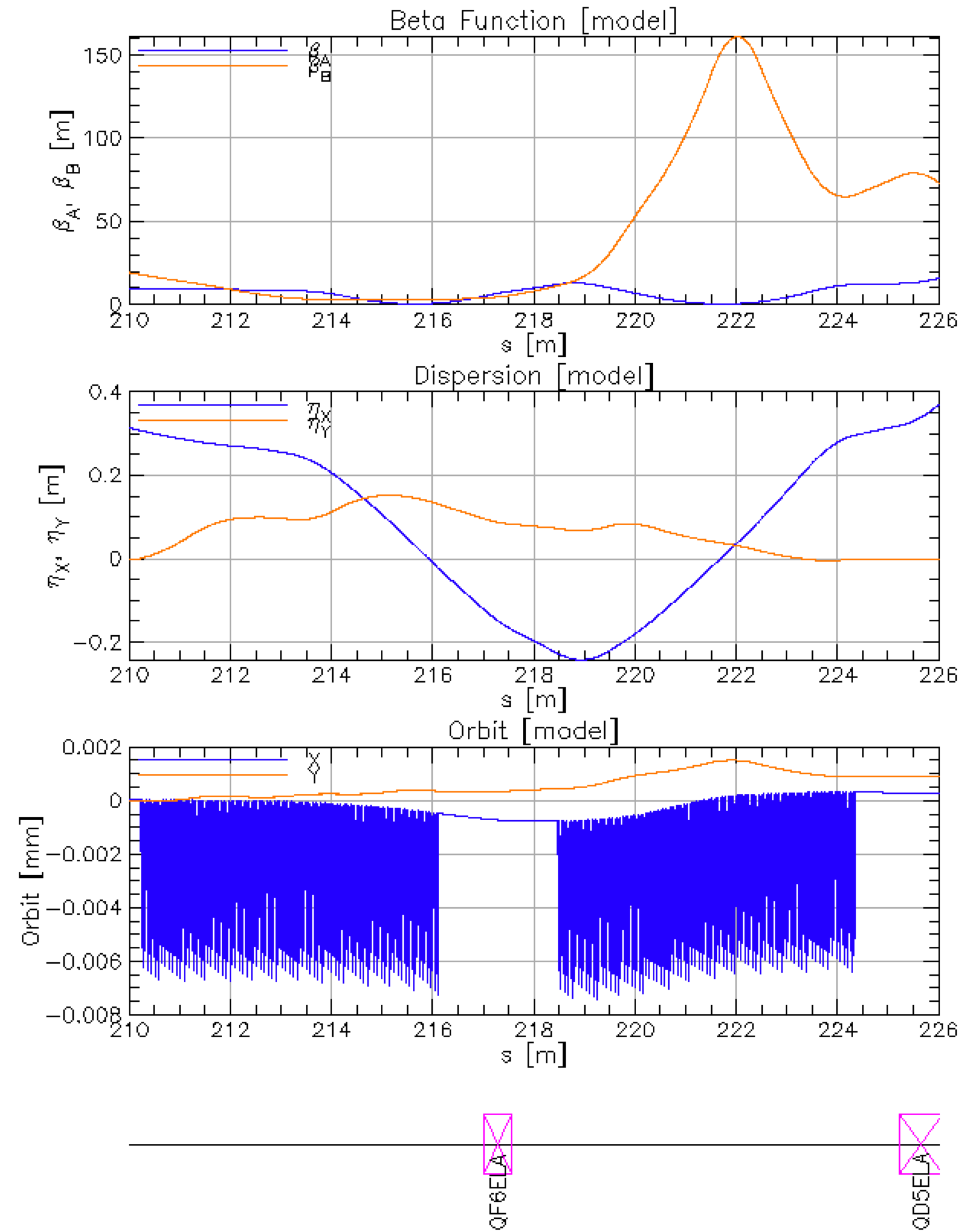
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

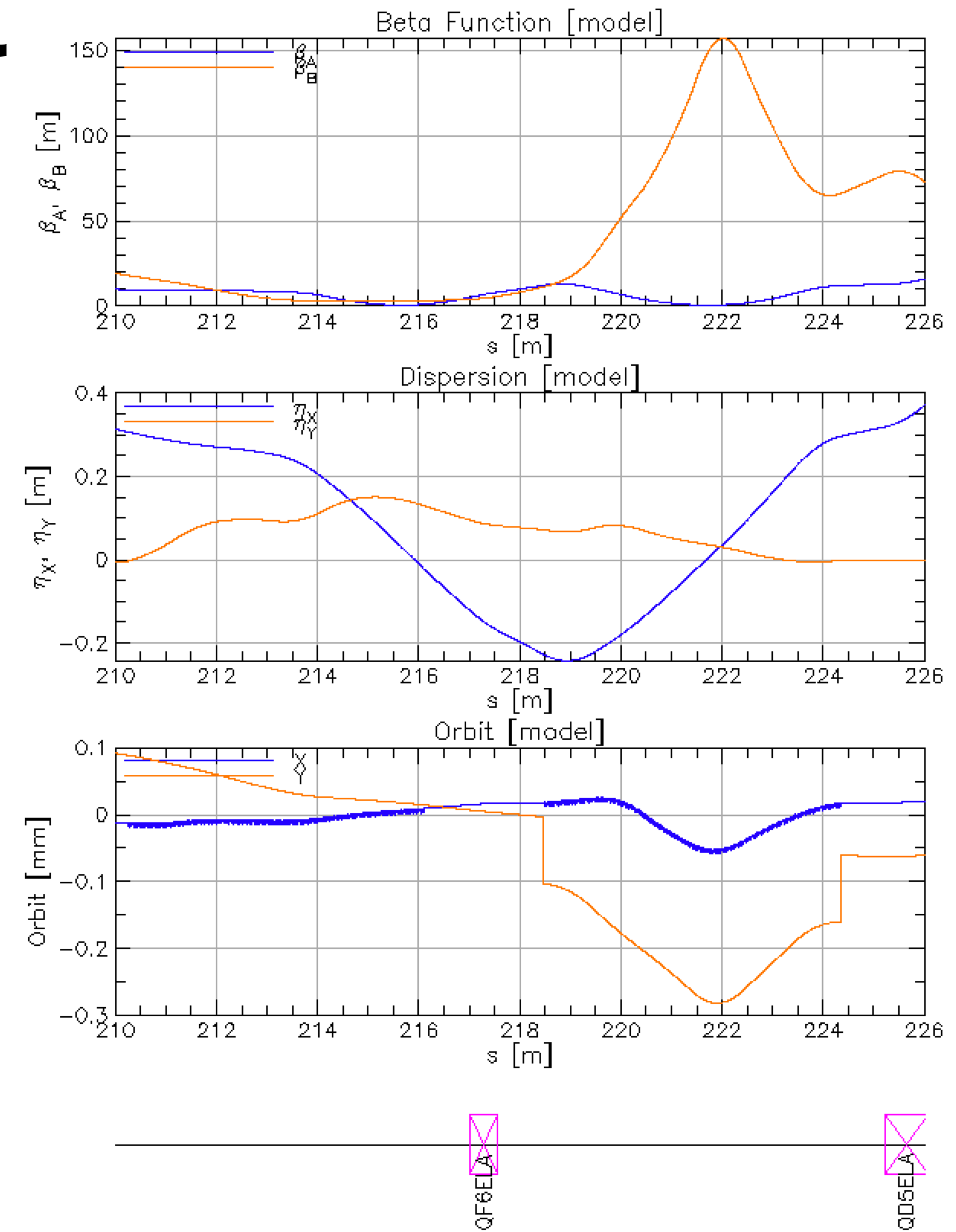
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EBL_y +0.1mm Left magnet B
	Model	Design	Model	Design		
Q	45.530965	45.530965	43.579864	43.579864	! Tune	
Chrom	1.541713	1.550011	1.580891	1.585571	! dQ/(dE/E)	
J_damp	0.965526	0.964968	1.007650	1.007634	! Damping Partition #	
Emittance	4.60301E-09	4.60605E-09	2.13480E-11	2.13891E-11	! Unnormalized	

L-Rot

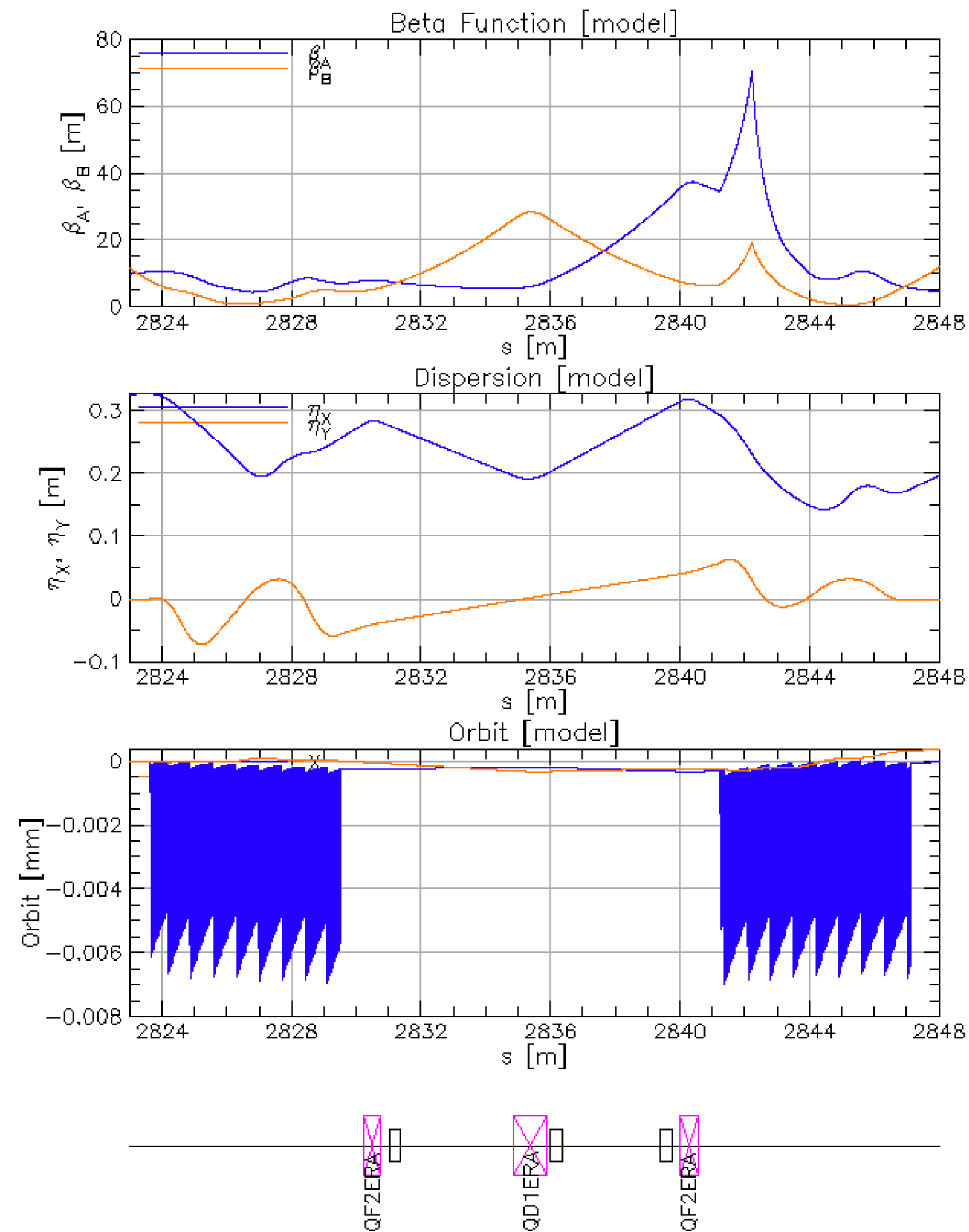


original

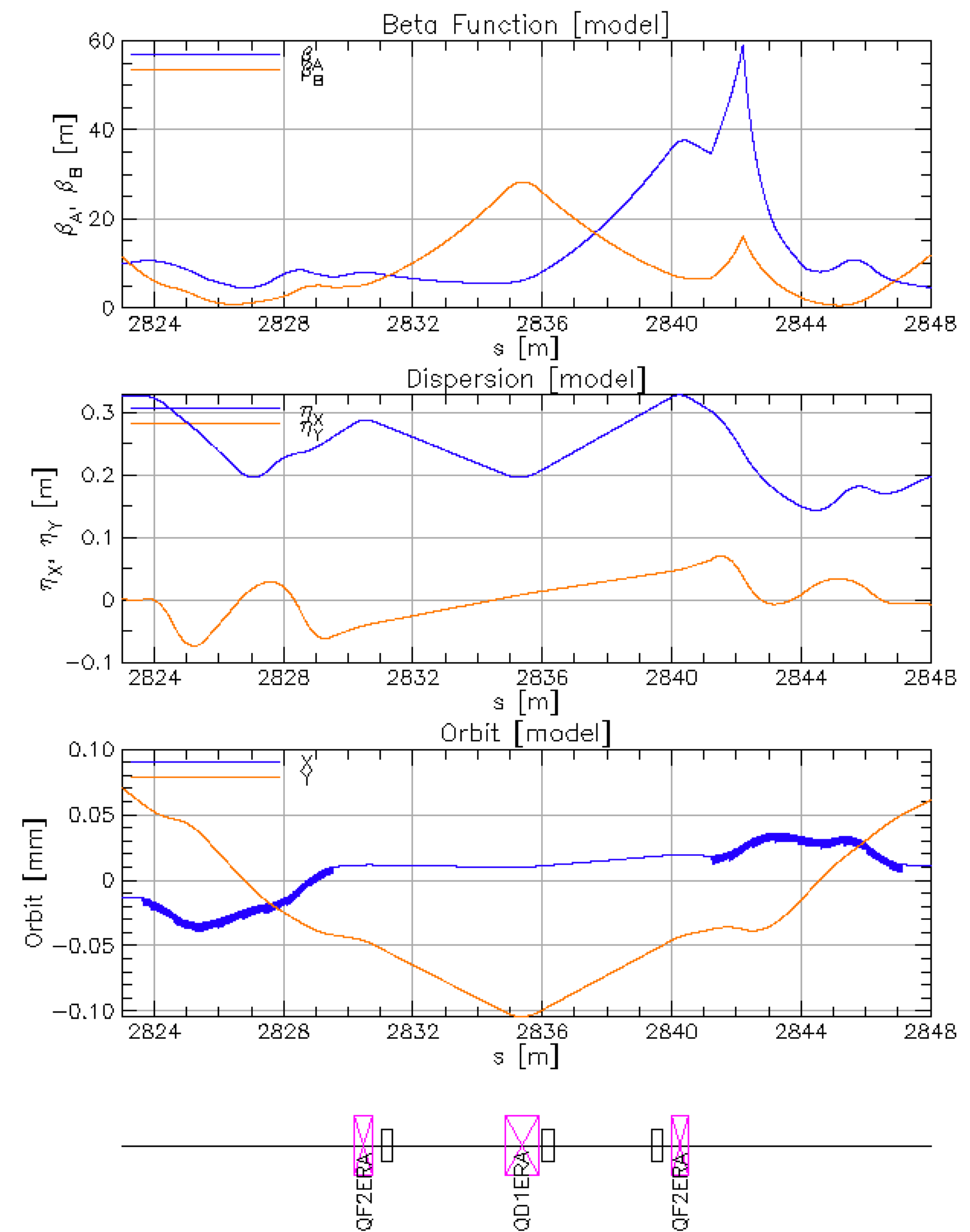


B2EBL_y +0.1mm

R-Rot

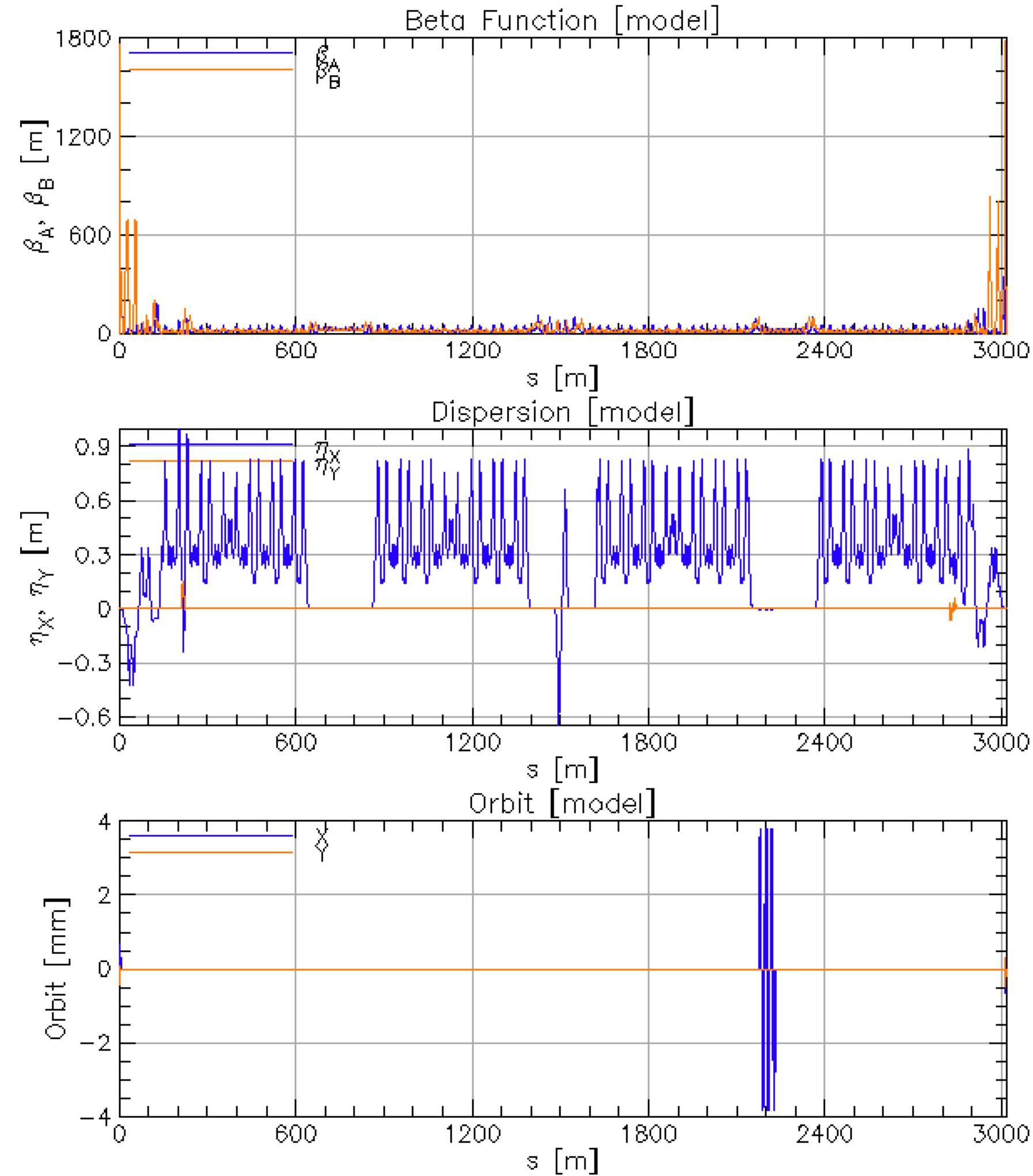


original

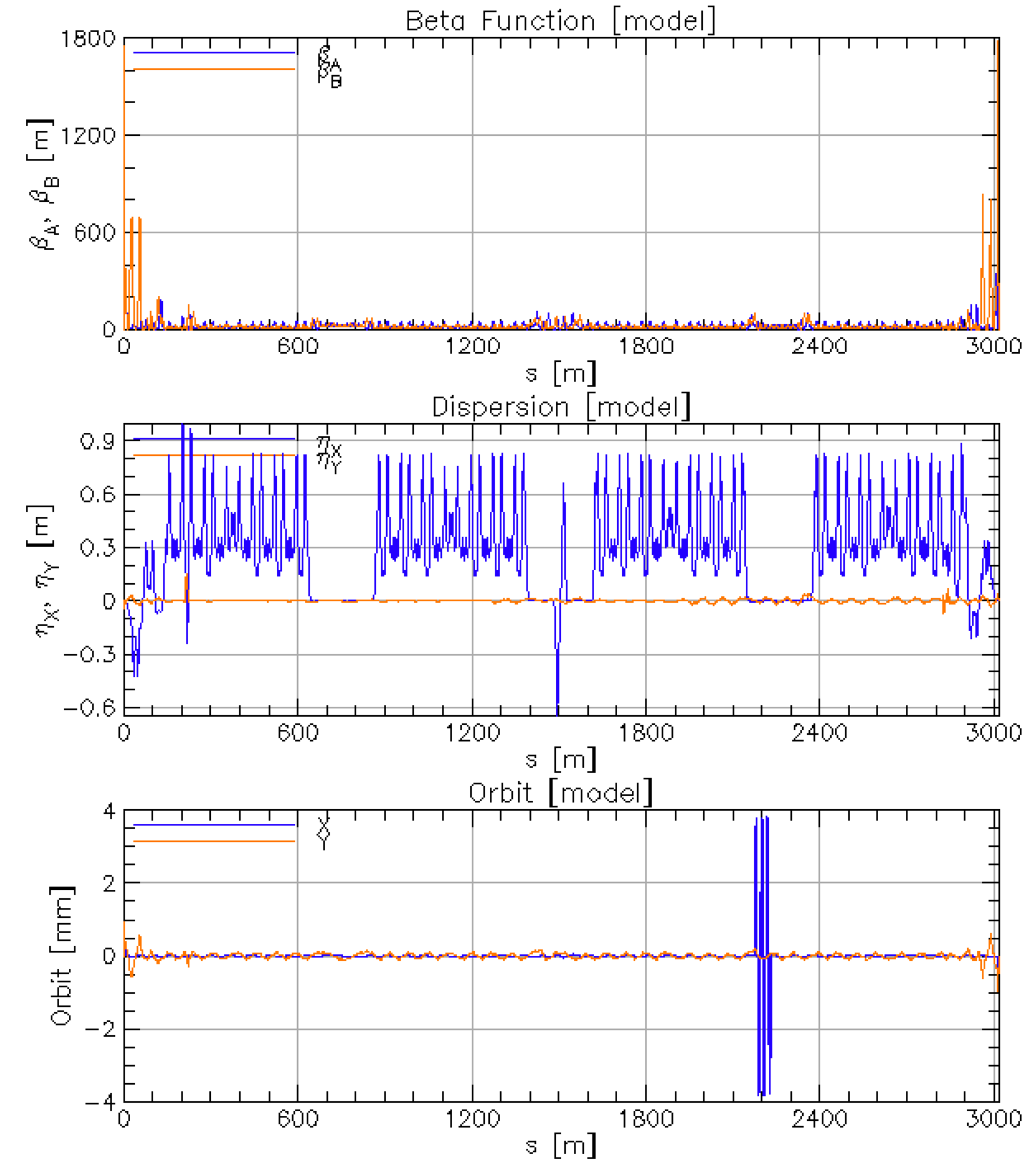


B2EBL_y +0.1mm

B2EBL: $y_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

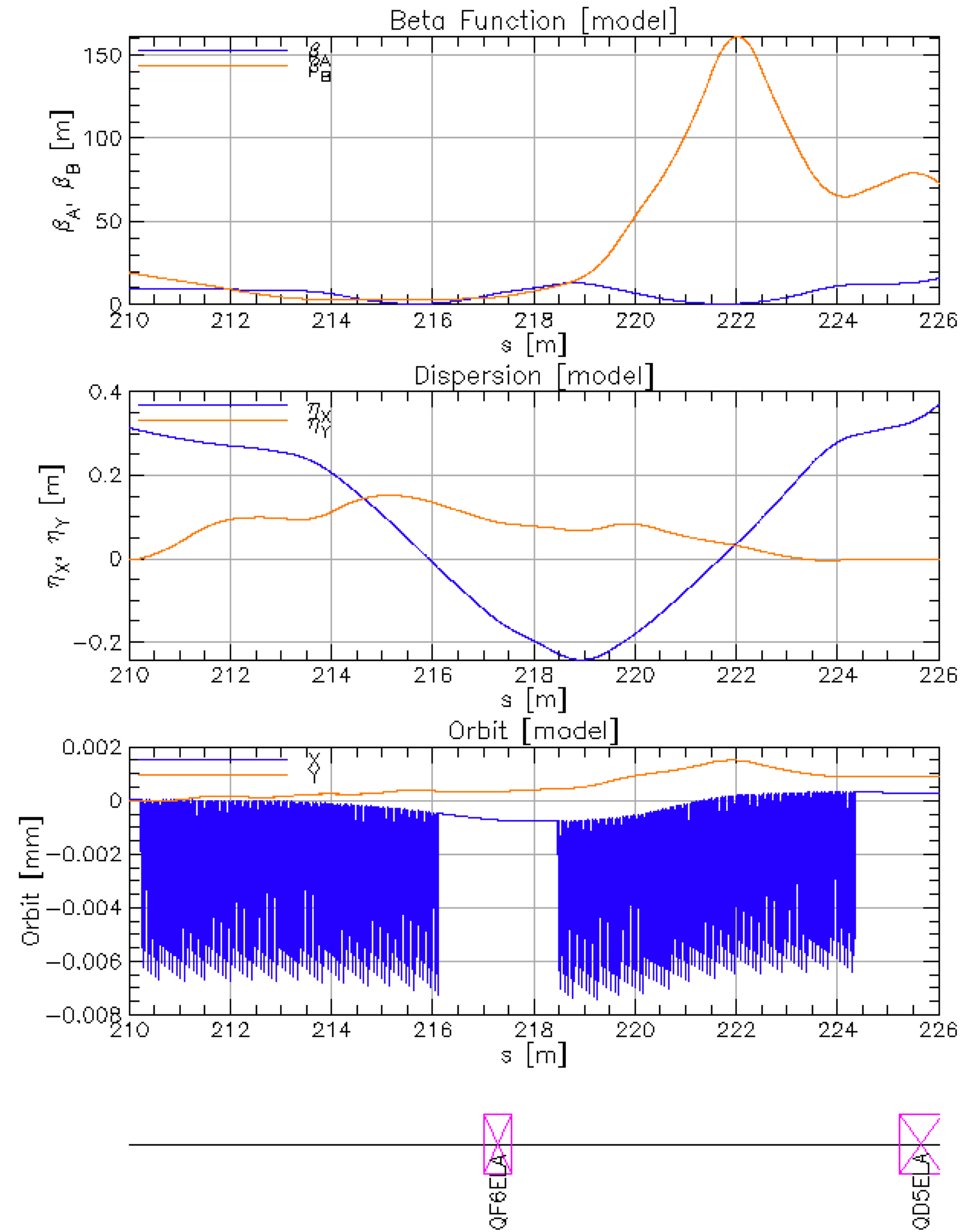
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

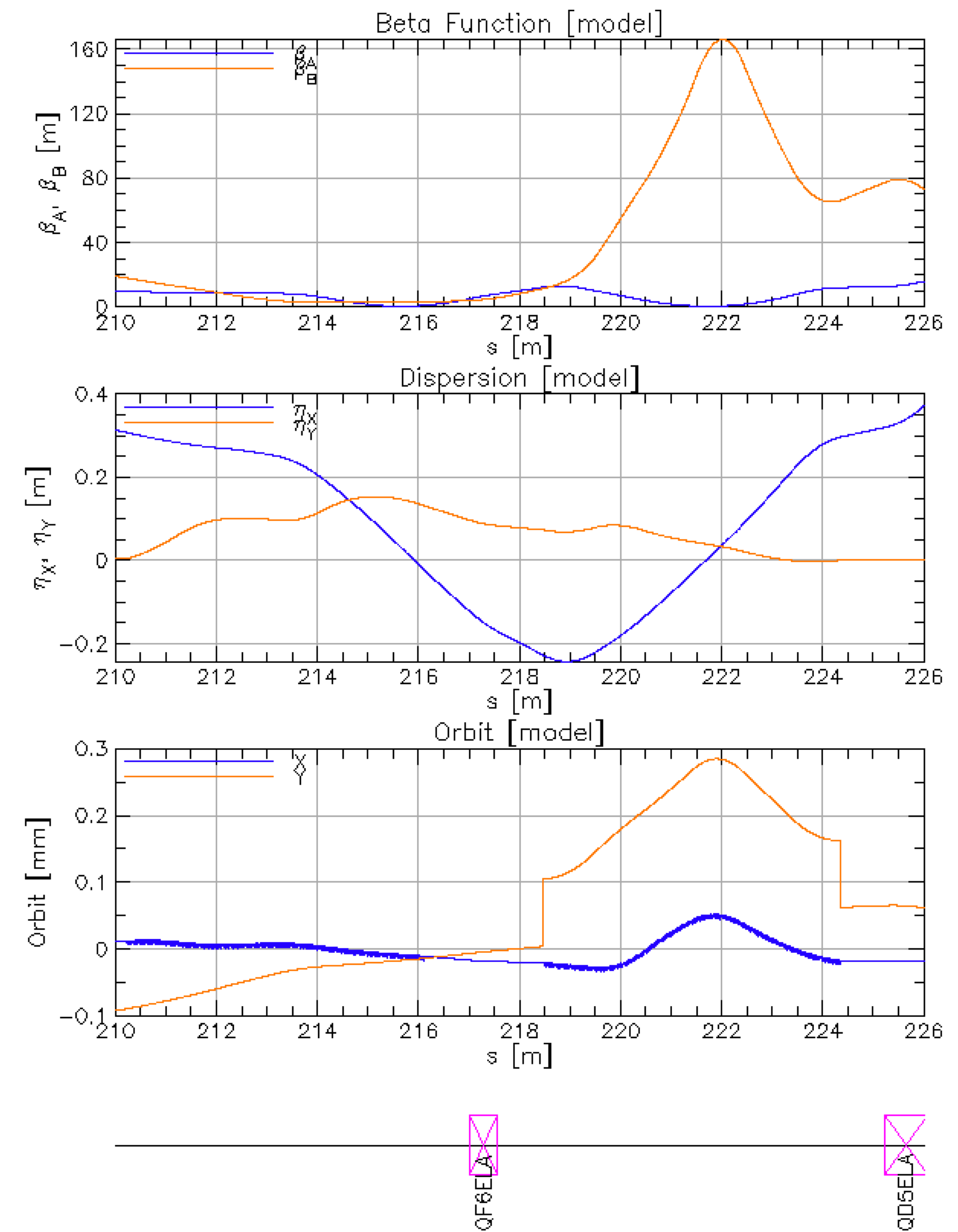
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EBL_y -0.1mm Left magnet B
	Model	Design	Model	Design		
Q	45.530912	45.530912	43.579943	43.579943	! Tune	
Chrom	1.586636	1.592981	1.589755	1.592759	! dQ/(dE/E)	
J_damp	0.966309	0.965895	1.006553	1.006576	! Damping Partition #	
Emittance	4.59336E-09	4.59564E-09	1.88499E-11	1.88792E-11	! Unnormalized	

L-Rot

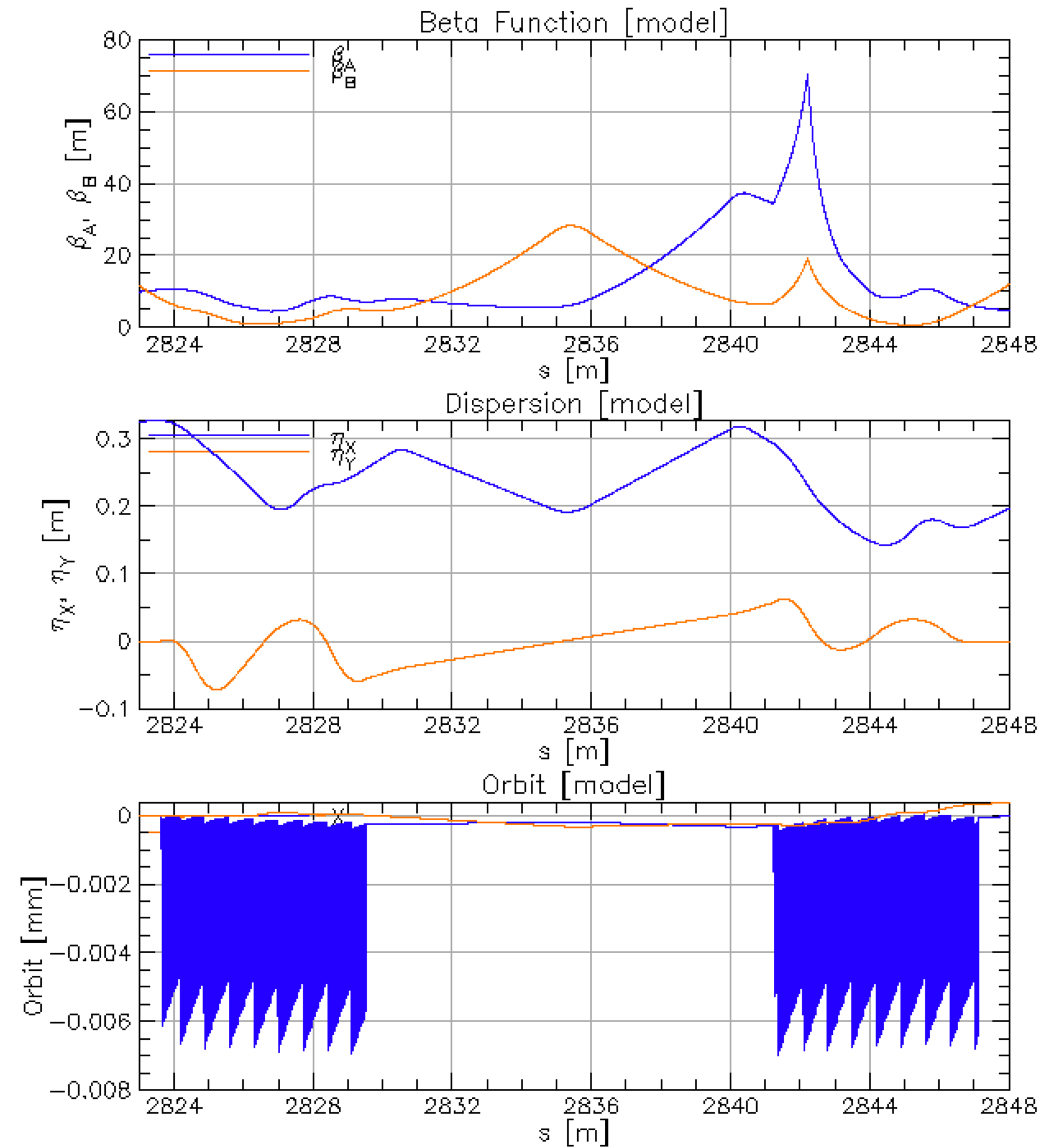


original

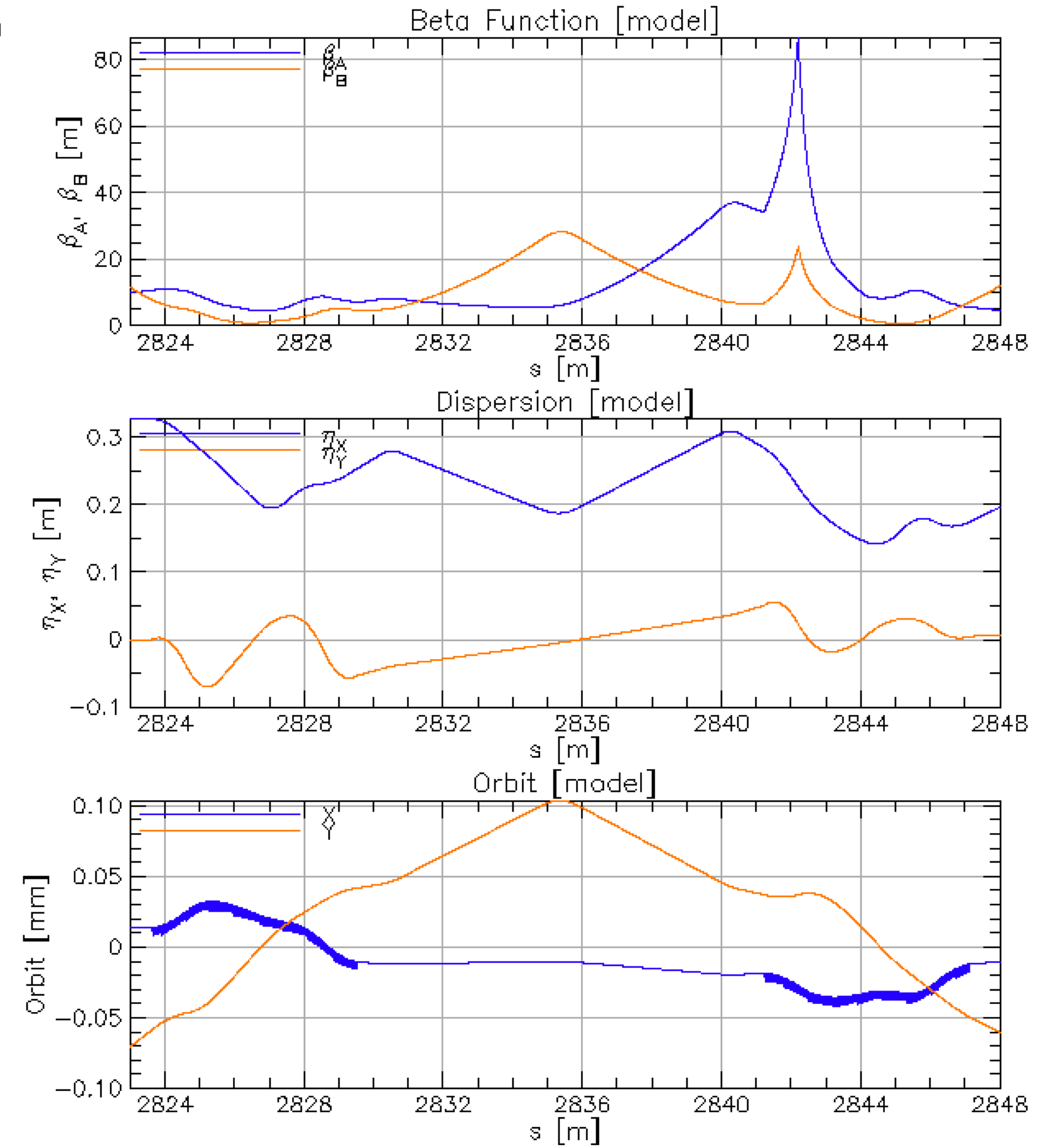


B2EBL_y -0.1mm

R-Rot



original



B2EBL_y -0.1mm

A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530994	45.530994		43.580709	43.580709	
Chrom	1.591891	1.599271		1.621929	1.625672	
J_damp	0.966040	0.965554		1.000295	1.000288	
Emittance	4.59794E-09	4.60062E-09		8.97933E-12	8.98123E-12	! Unnormalized
A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530947	45.530947		43.580015	43.580015	
Chrom	1.621420	1.625086		1.425916	1.427488	
J_damp	0.968999	0.968759		1.000507	1.000510	
Emittance	4.58840E-09	4.58971E-09		1.06053E-11	1.06161E-11	! Unnormalized
A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530898	45.530898		43.580404	43.580404	
Chrom	1.567231	1.578311		1.799340	1.805565	
J_damp	0.962973	0.962243		1.000396	1.000383	
Emittance	4.61455E-09	4.61862E-09		1.14756E-11	1.14953E-11	! Unnormalized
A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530965	45.530965		43.579864	43.579864	
Chrom	1.541713	1.550011		1.580891	1.585571	
J_damp	0.965526	0.964968		1.007650	1.007634	
Emittance	4.60301E-09	4.60605E-09		2.13480E-11	2.13891E-11	! Unnormalized
A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530912	45.530912		43.579943	43.579943	
Chrom	1.586636	1.592981		1.589755	1.592759	
J_damp	0.966309	0.965895		1.006553	1.006576	
Emittance	4.59336E-09	4.59564E-09		1.88499E-11	1.88792E-11	! Unnormalized

Rot ring

B2EAL_y +0.1mm

B2EAL_y -0.1mm

B2EBL_y +0.1mm

B2EBL_y -0.1mm

Long Term Tracking Studies

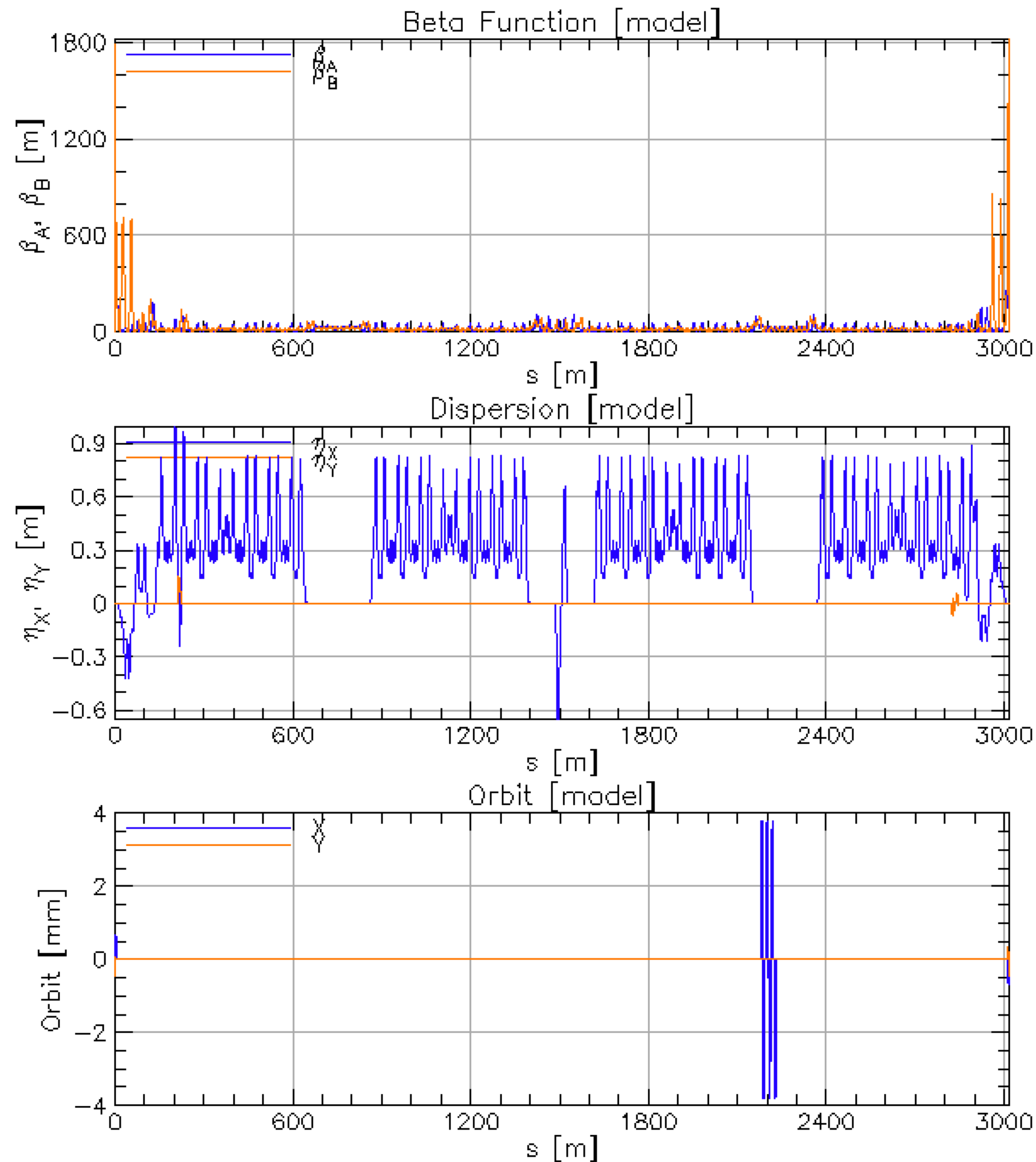
In the following studies, the rotator ring energy is shifted by 70 MeV to reach higher polarization lifetime.

A displacement shift of 0.1 mm is applied in both the x and y directions, with the sign chosen randomly ($\pm$).

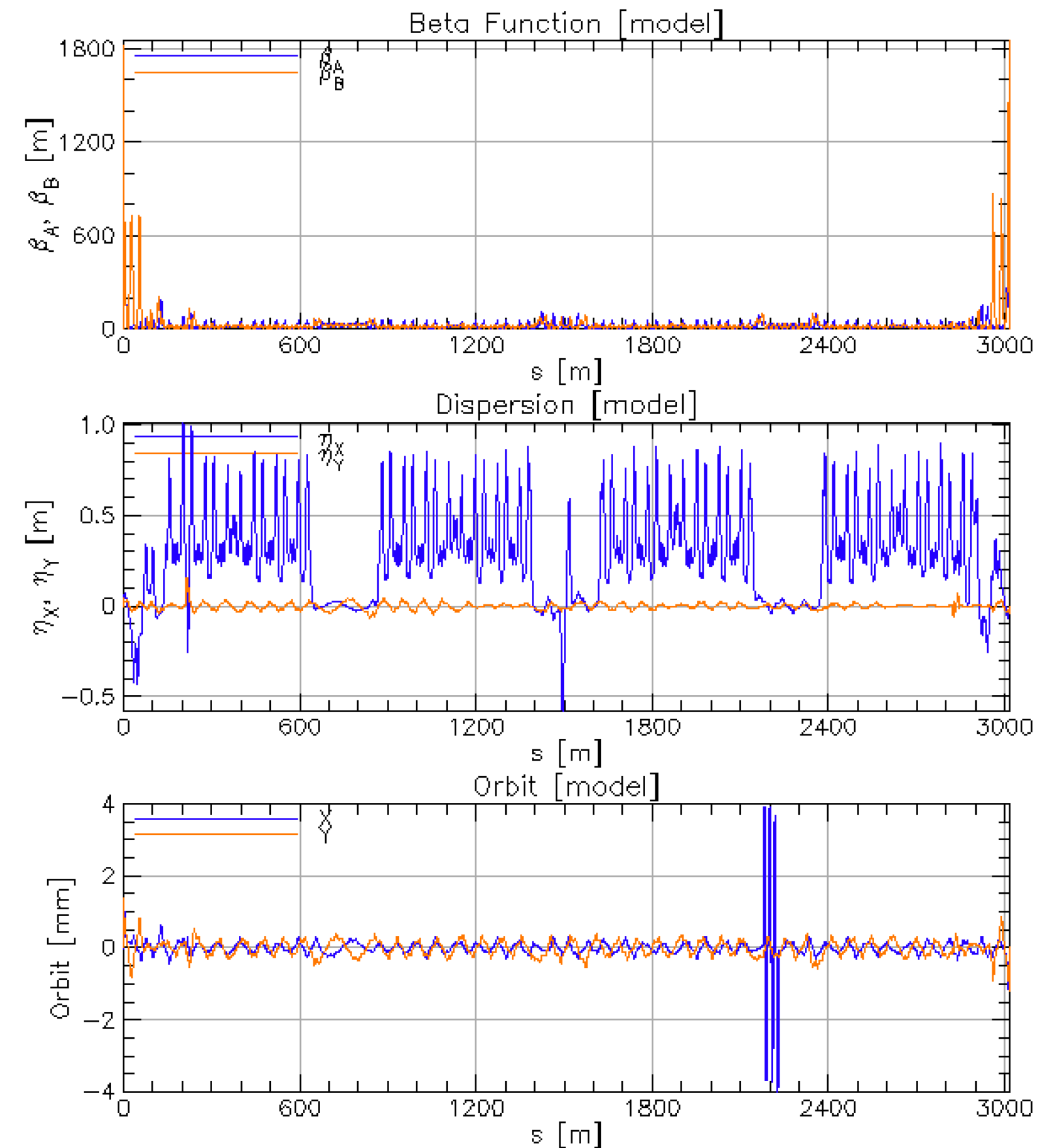
Track 100 particles for 2M turns in the ring for the long term tracking studies.

Comparison has been made between the rotator ring and the shifted rotator ring.

Shifted 0.1mm in both x and y for all rotator magnets



Rot ring with energy 7.07729Gev



Rot shifted

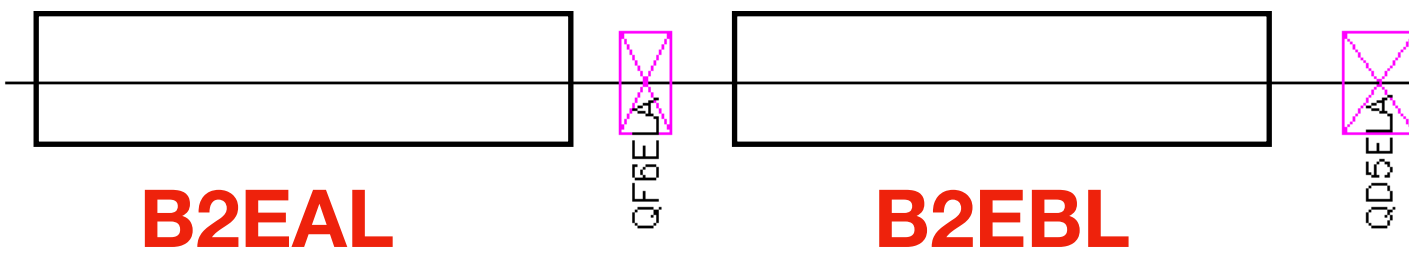
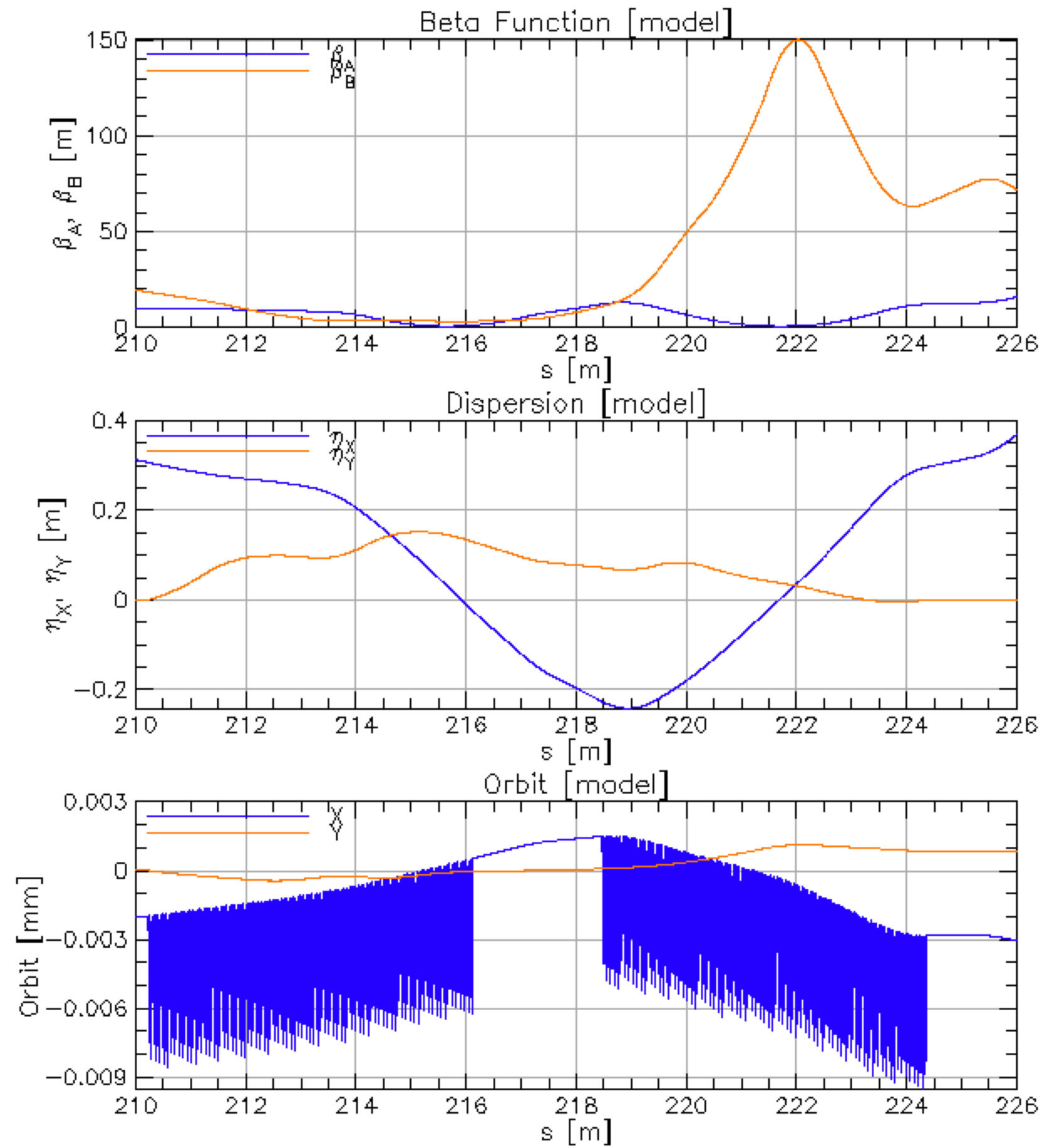
Ring Parameters Comparison

A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530994	45.530994		43.580709	43.580709	! Tune
Chrom	1.593504	1.591891		1.622866	1.621569	! dQ/(dE/E)
J_damp	0.999677	0.999274		0.999770	0.999765	! Damping Partition #
Emittance	4.43161E-09	4.43378E-09		5.45972E-13	5.45940E-13	! Unnormalized

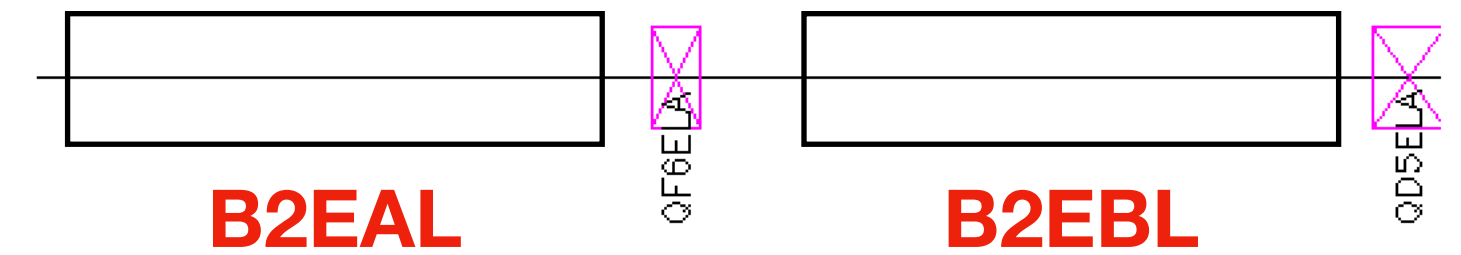
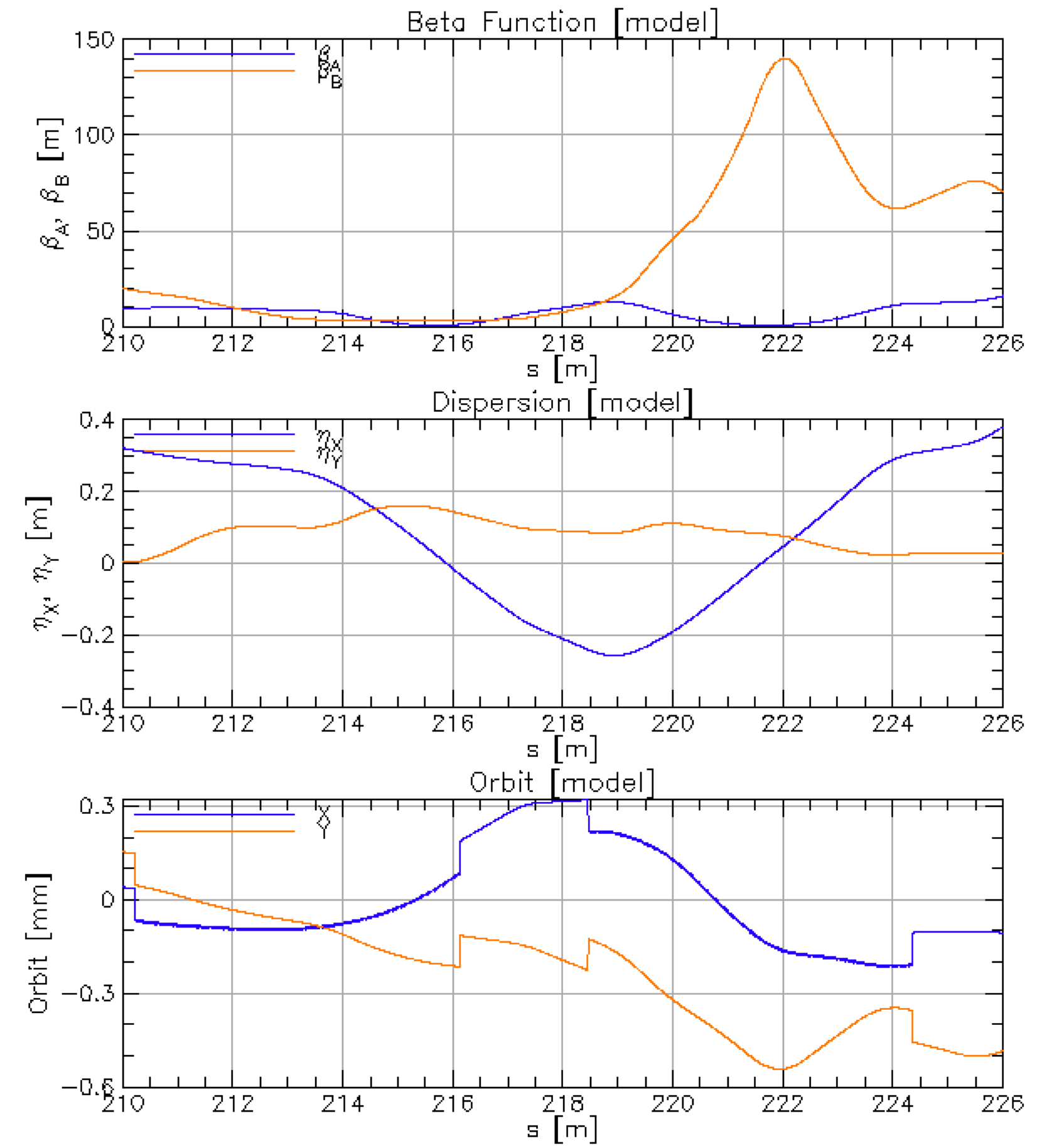
A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530868	45.530868		43.578985	43.578985	! Tune
Chrom	1.599964	1.607426		1.751420	1.755198	! dQ/(dE/E)
J_damp	0.965835	0.965350		1.000508	1.000500	! Damping Partition #
Emittance	4.68854E-09	4.69124E-09		1.31924E-11	1.32042E-11	! Unnormalized

A-Mode			B-Mode			
	Model	Design		Model	Design	
Q	45.530948	45.530948		43.577130	43.577130	! Tune
Chrom	1.464888	1.459801		0.734741	0.732367	! dQ/(dE/E)
J_damp	0.968245	0.968603		0.993279	0.993199	! Damping Partition #
Emittance	4.73516E-09	4.73350E-09		5.09943E-11	5.11034E-11	! Unnormalized

L-Rot

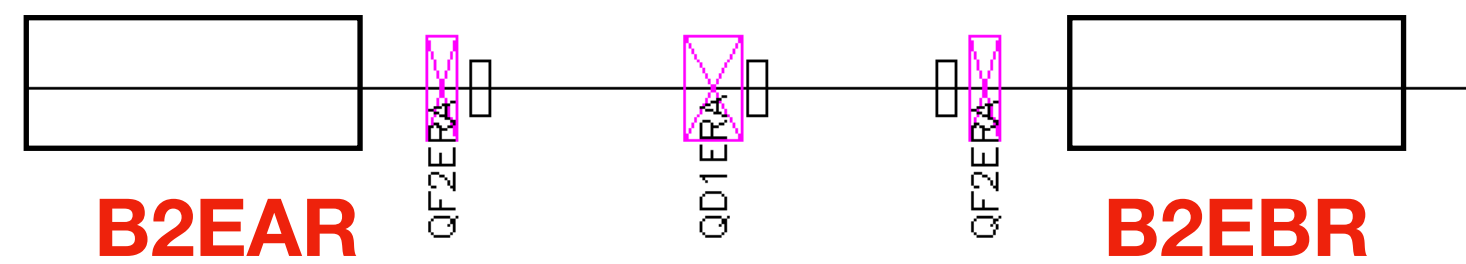
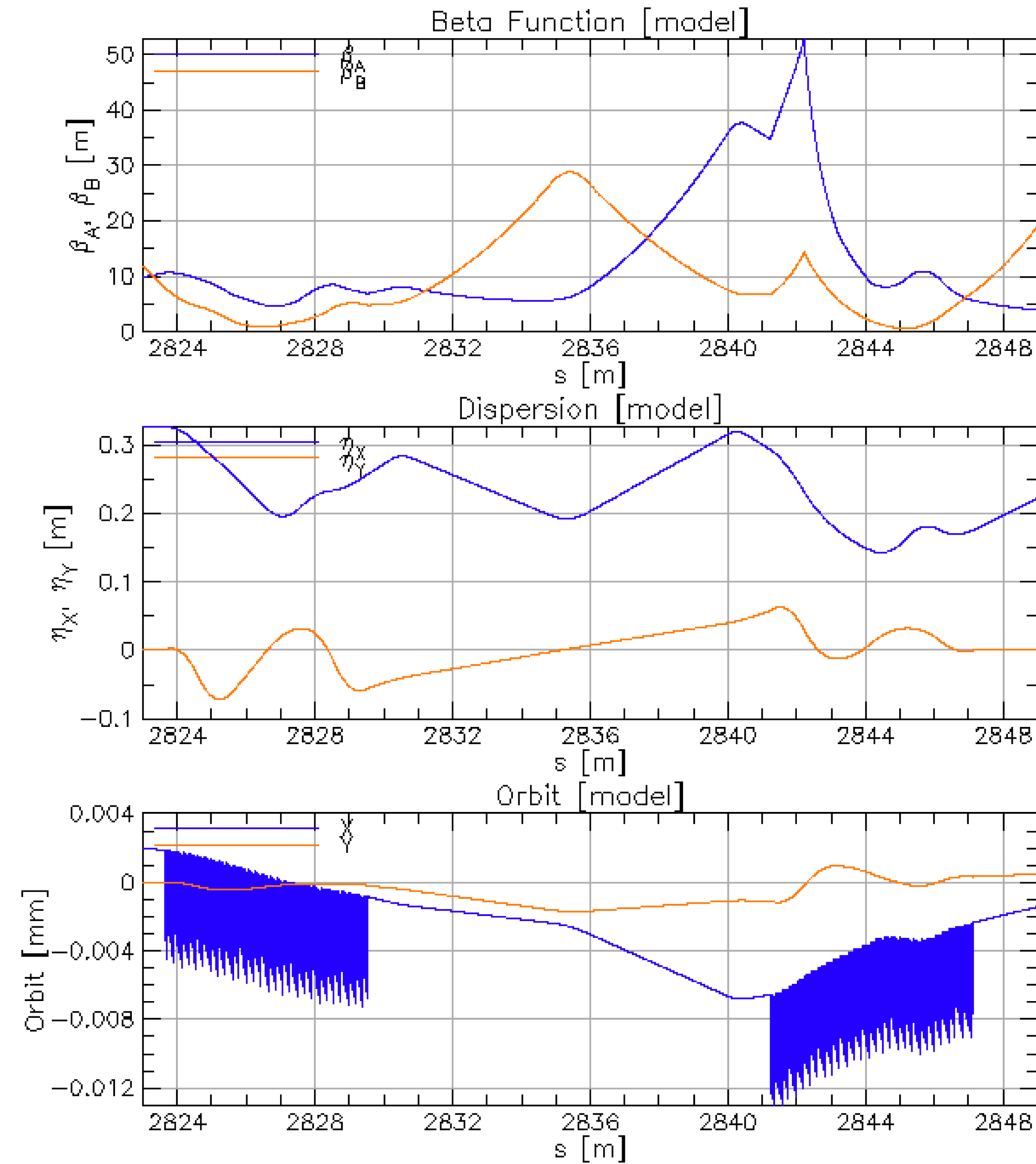


Not shifted

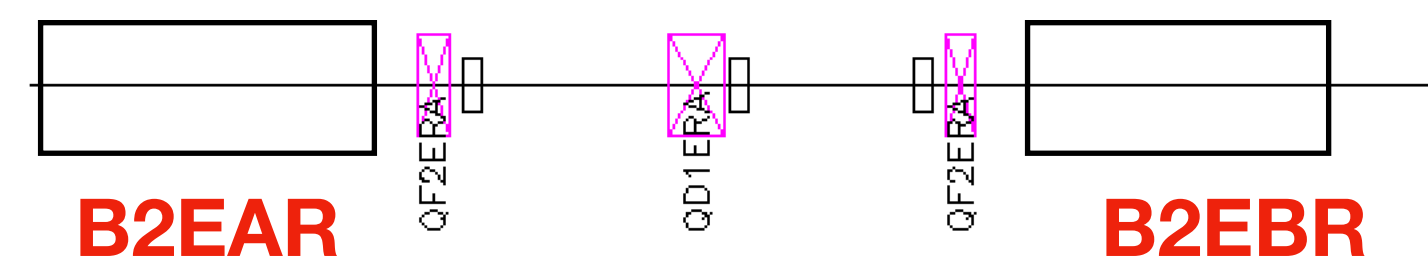
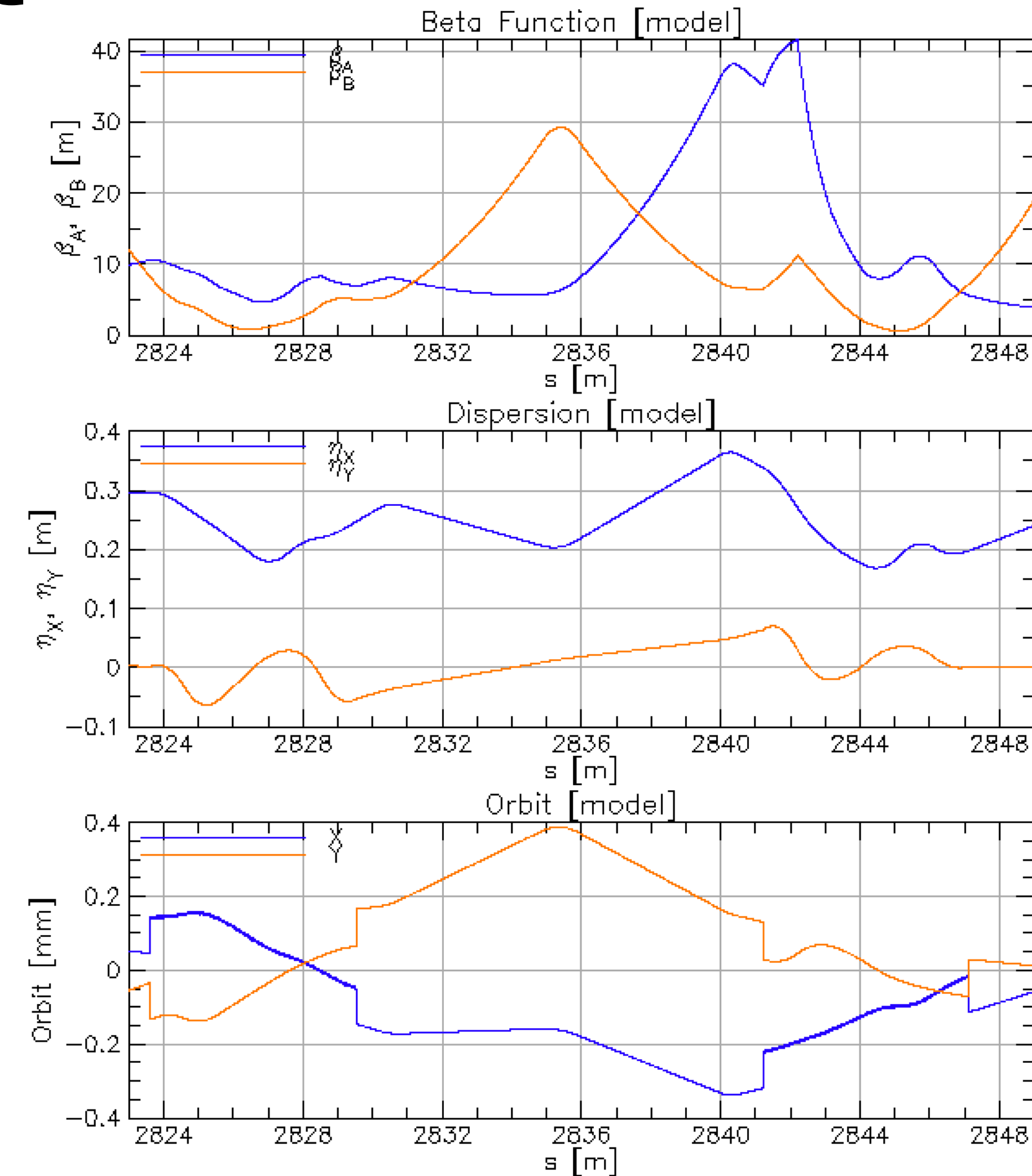


shifted

R-Rot



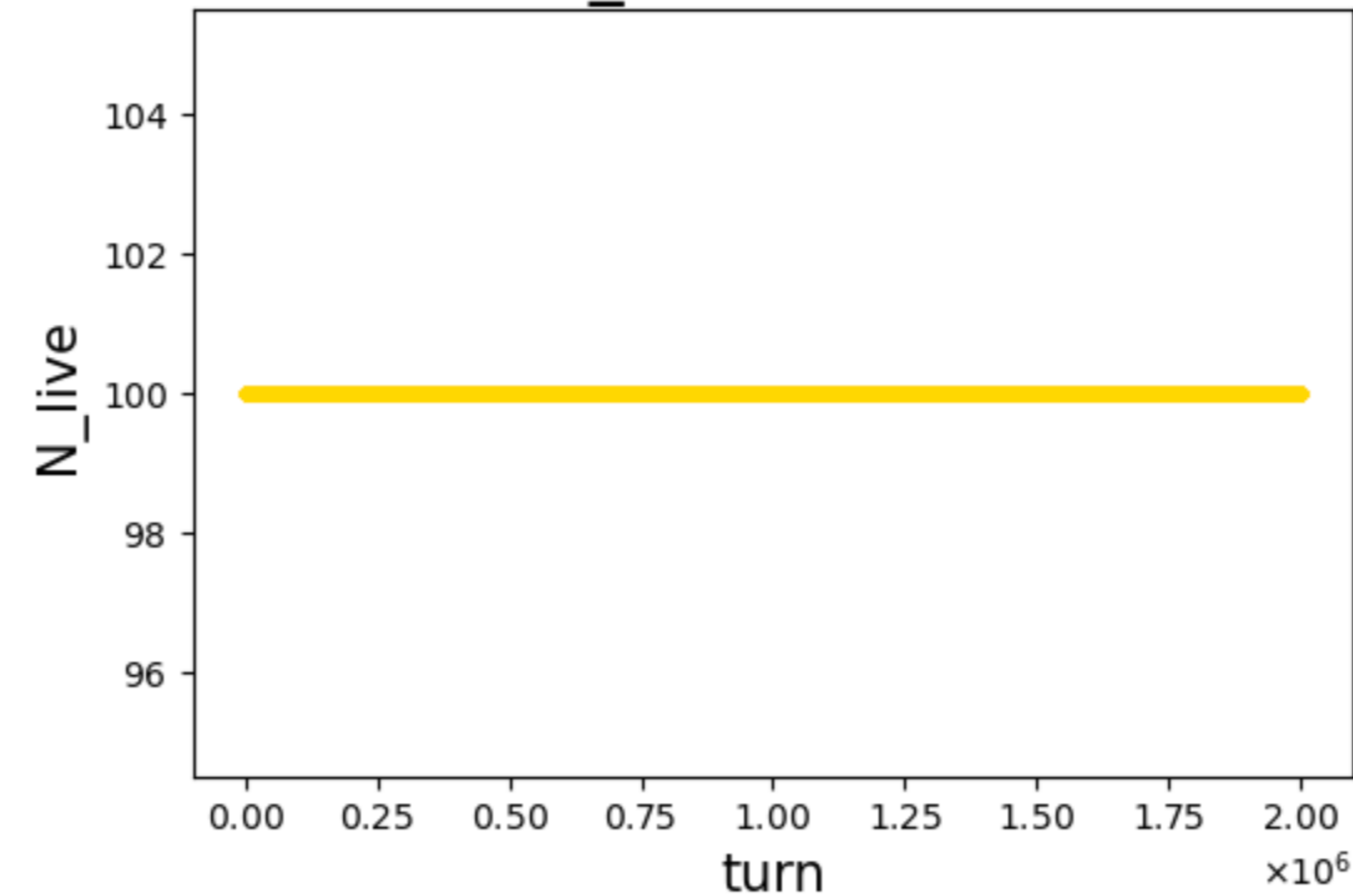
Not shifted



shifted

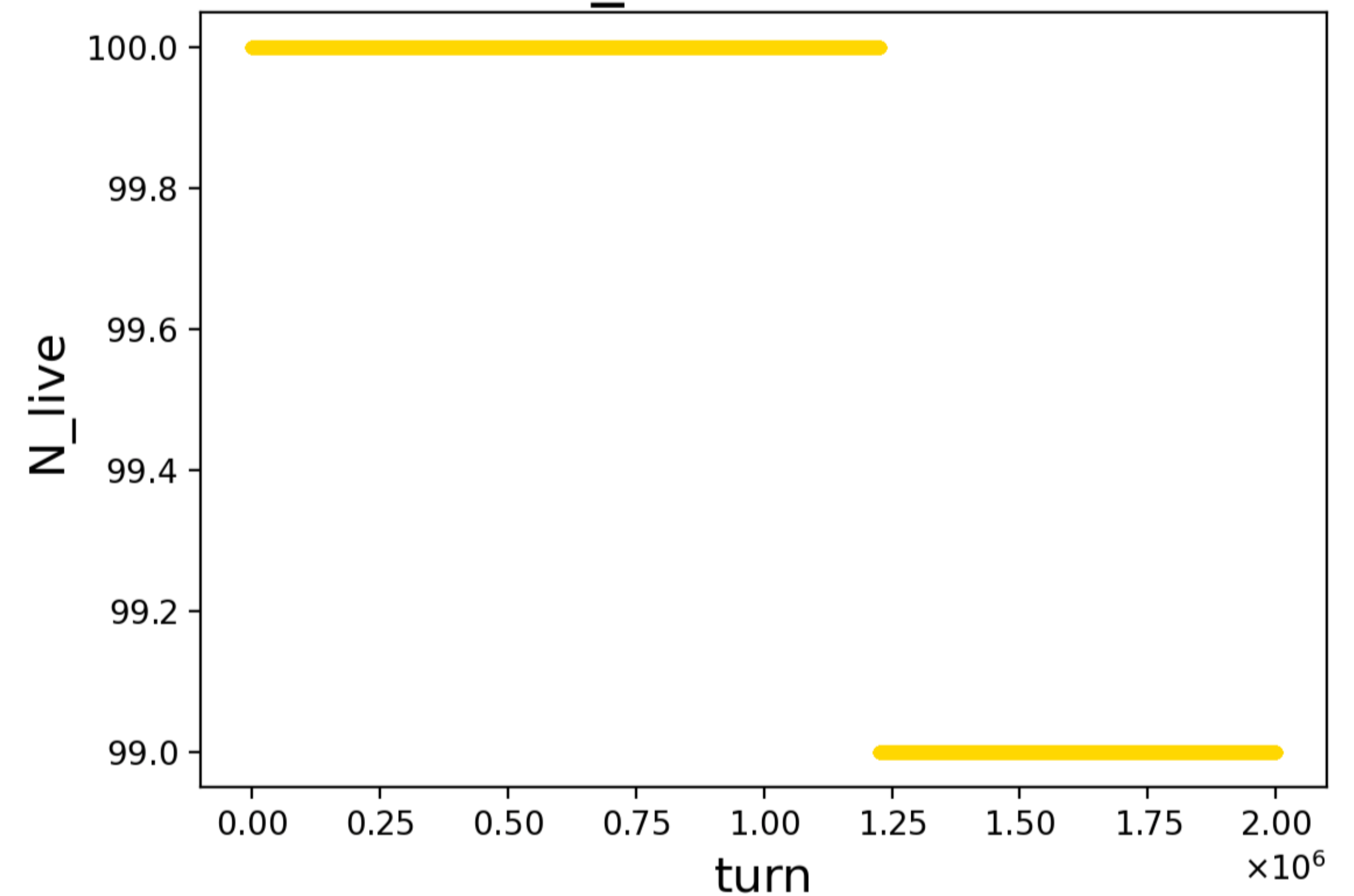
Lifetime Comparison

N_live vs turn



Not shifted

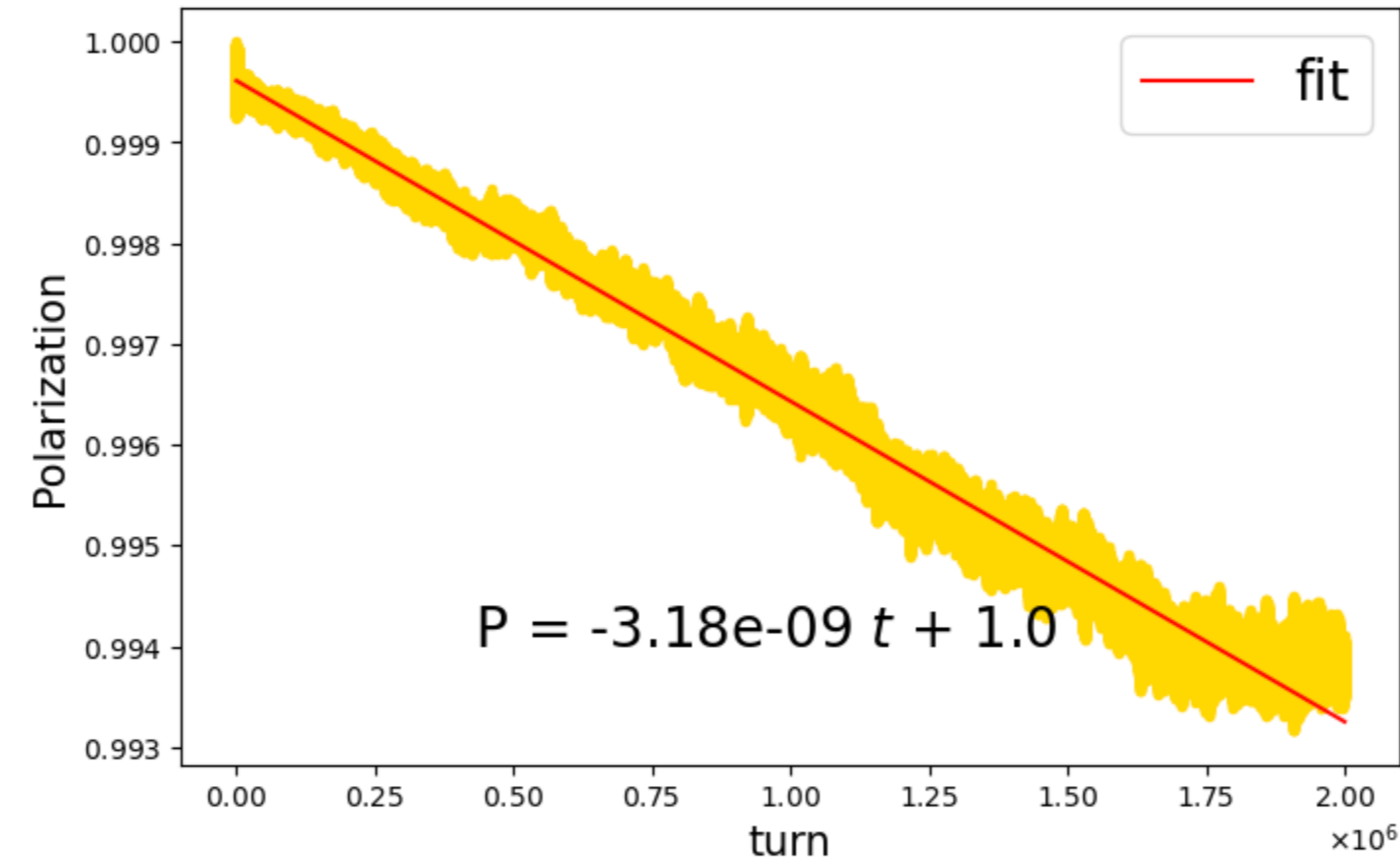
N_live vs turn



shifted

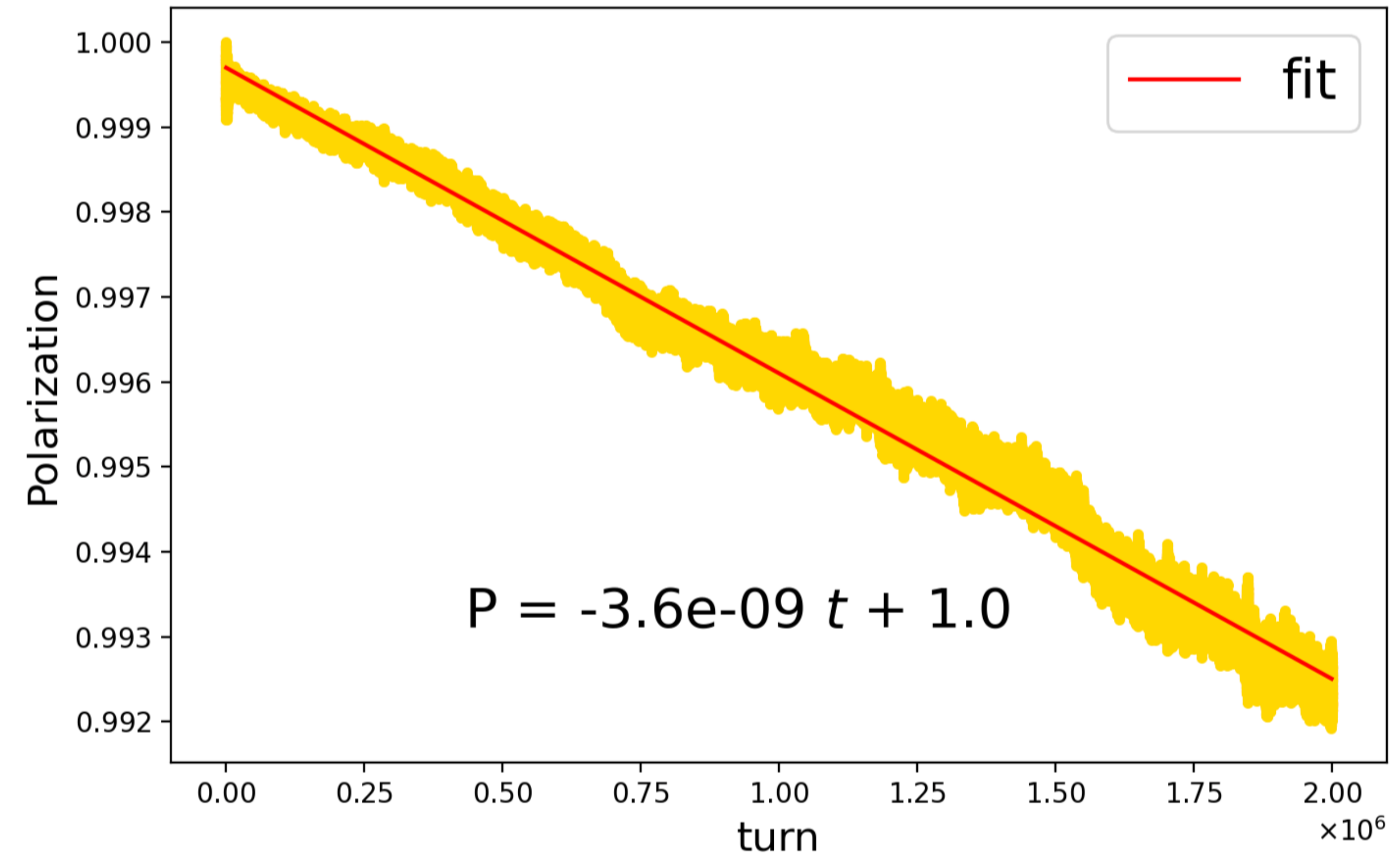
Polarization Lifetime Comparison

Polarization vs turn



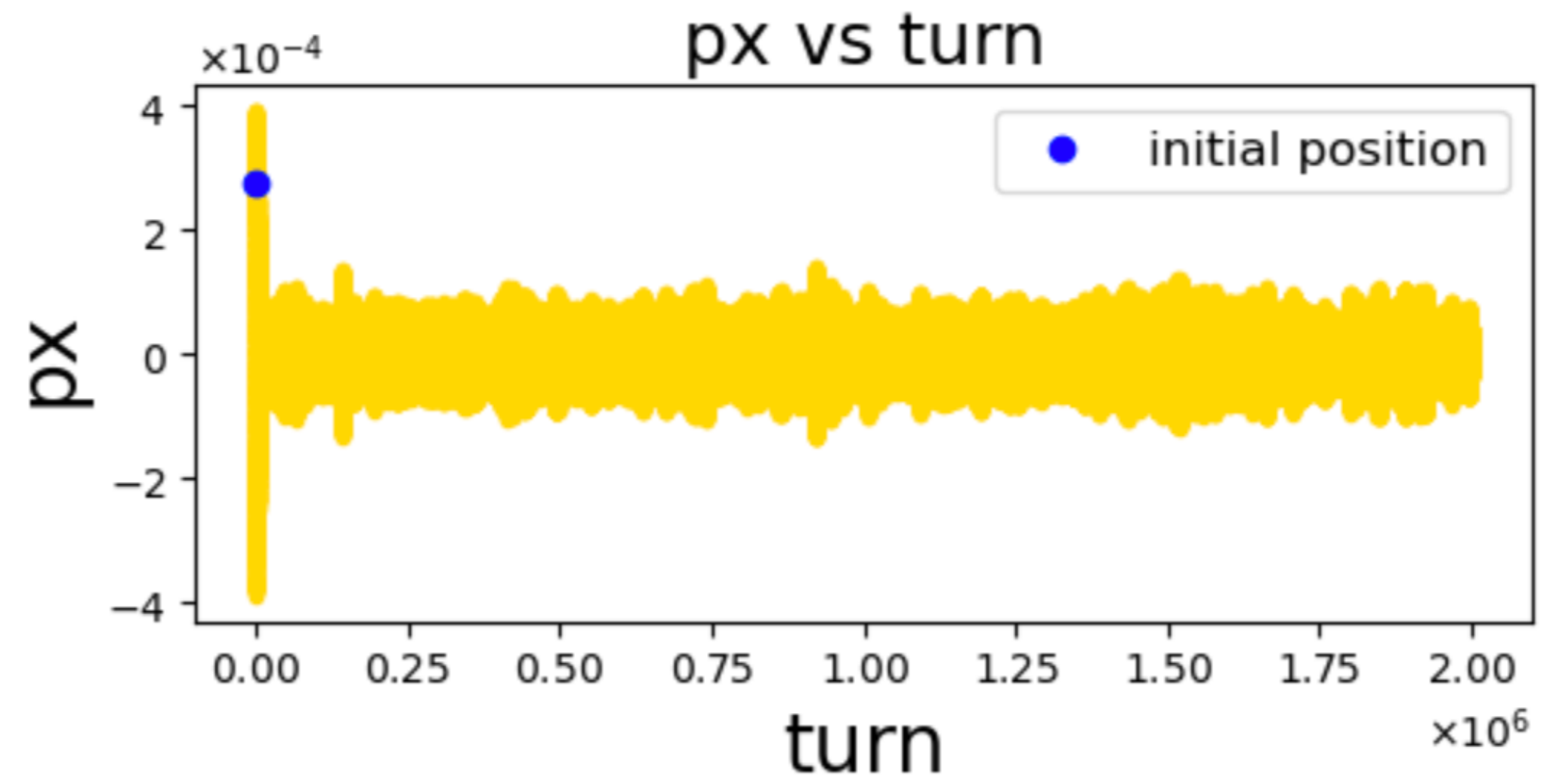
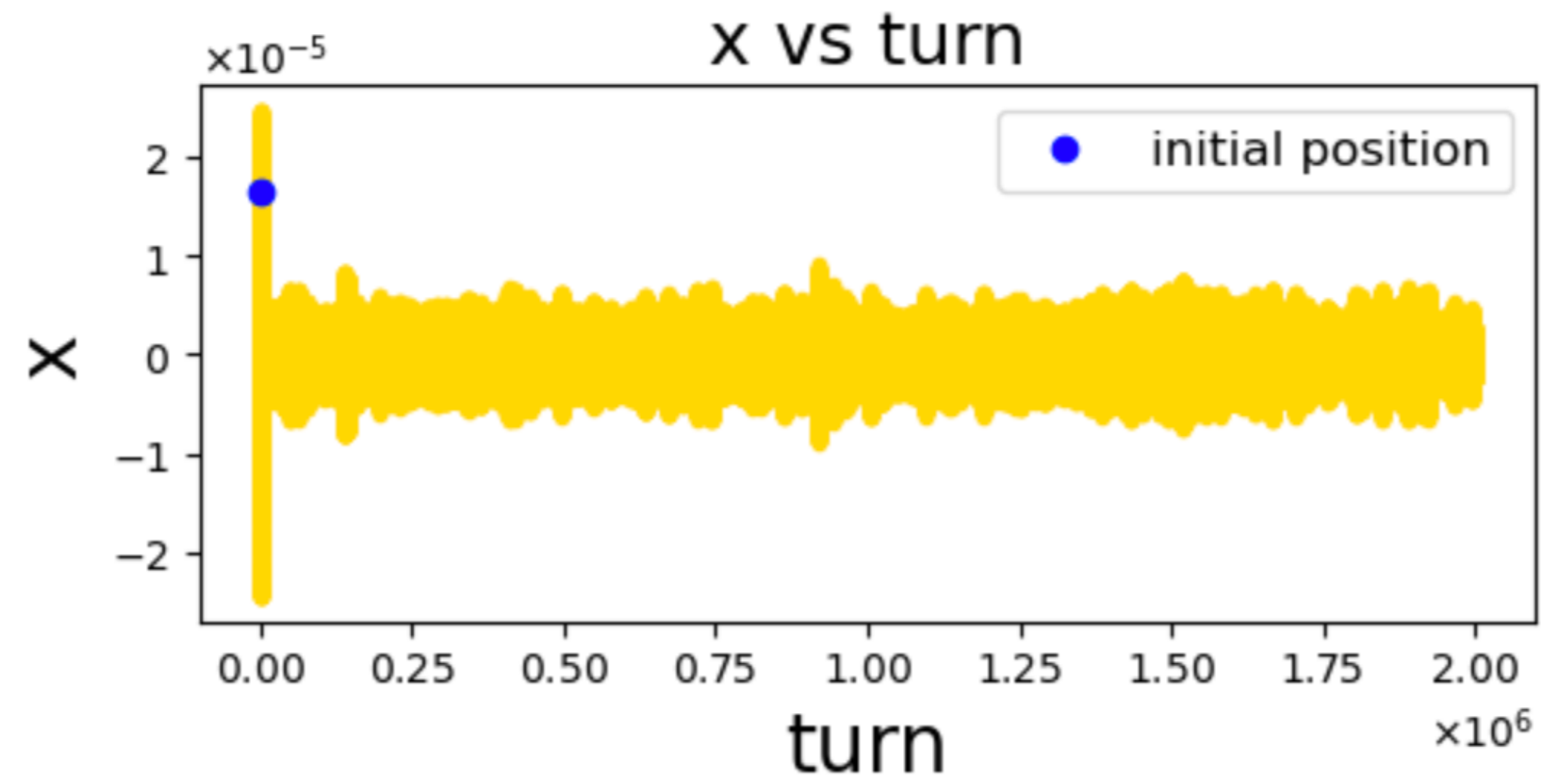
Not shifted

Polarization vs turn

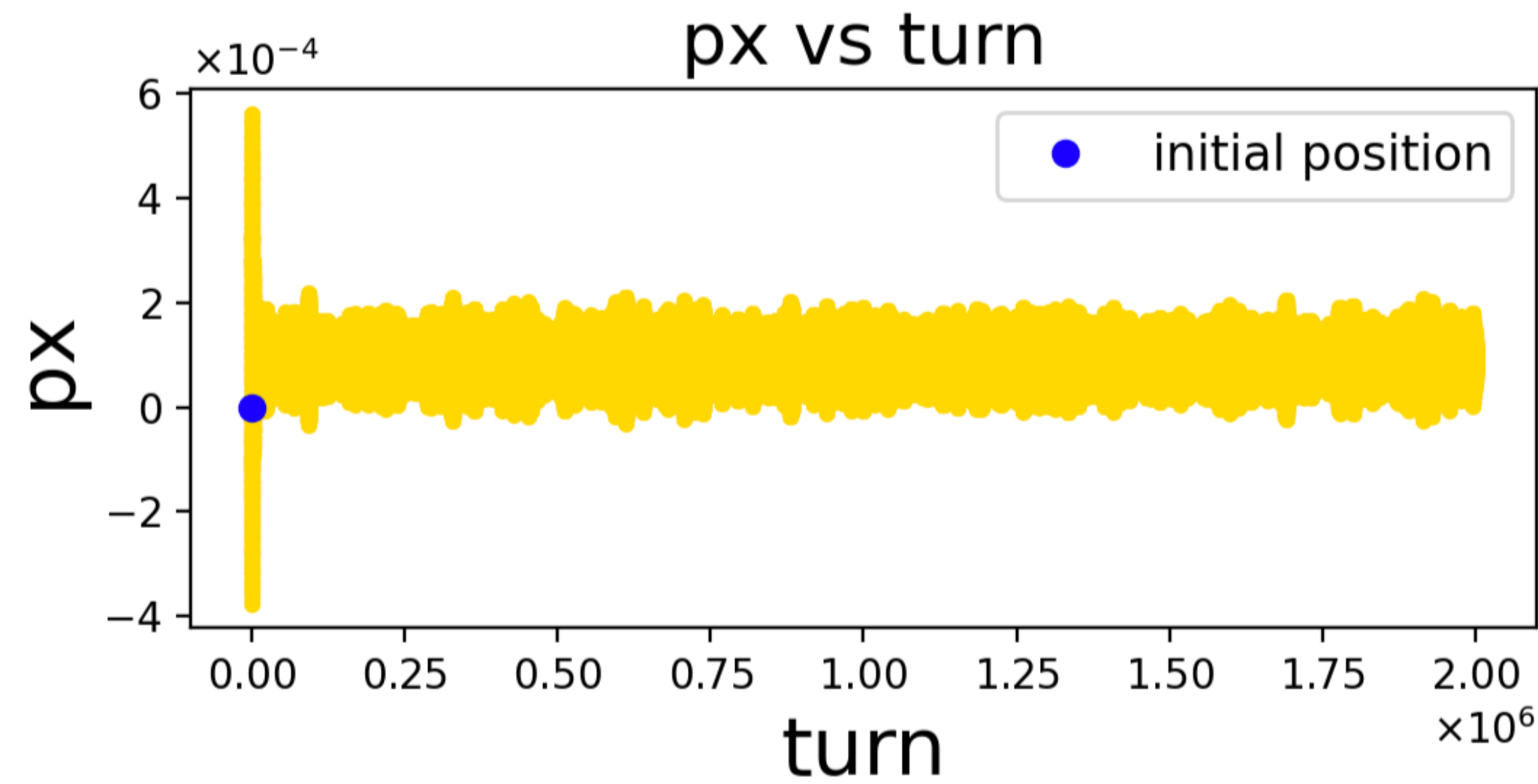
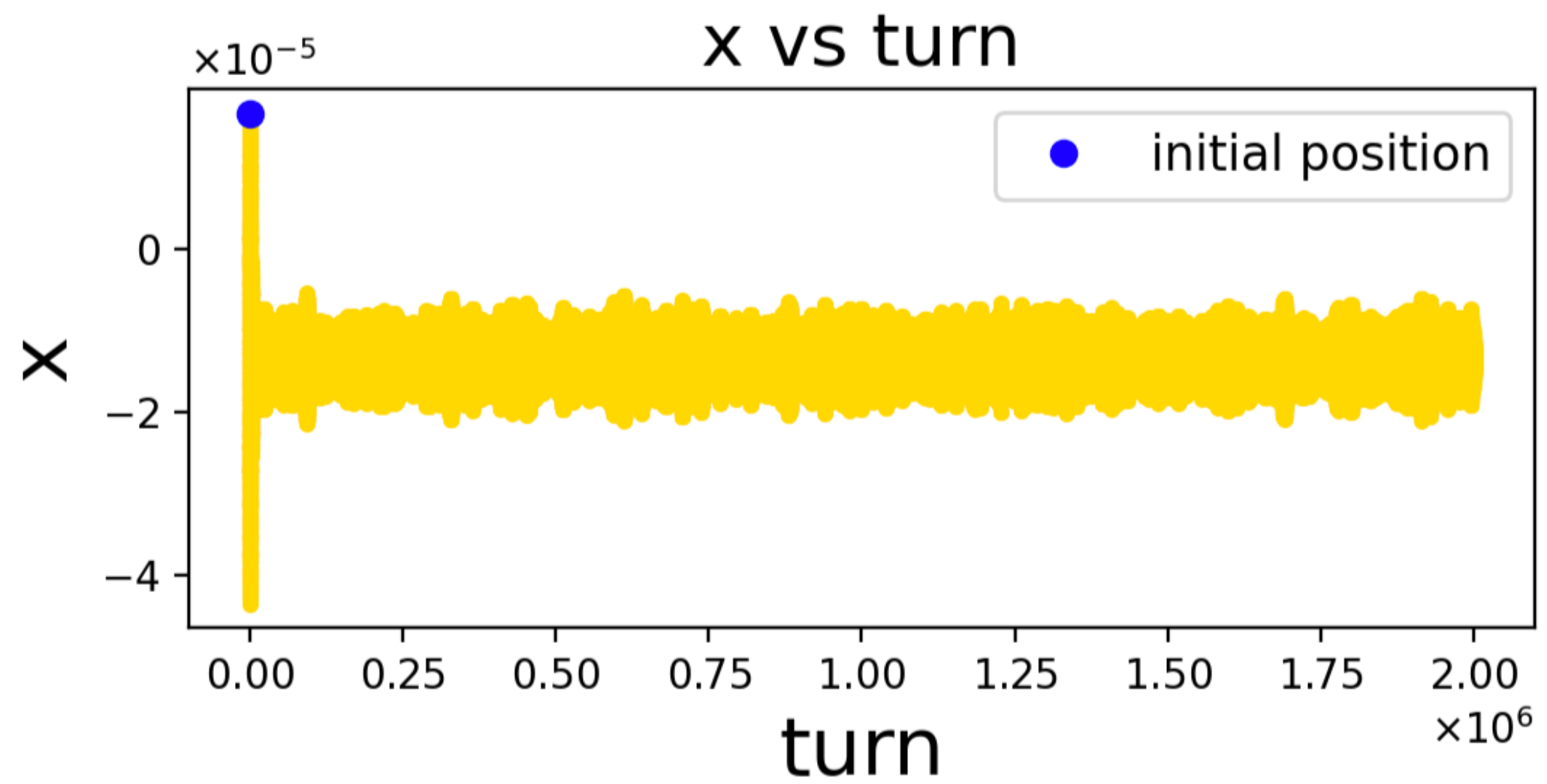


shifted

x-px vs turn

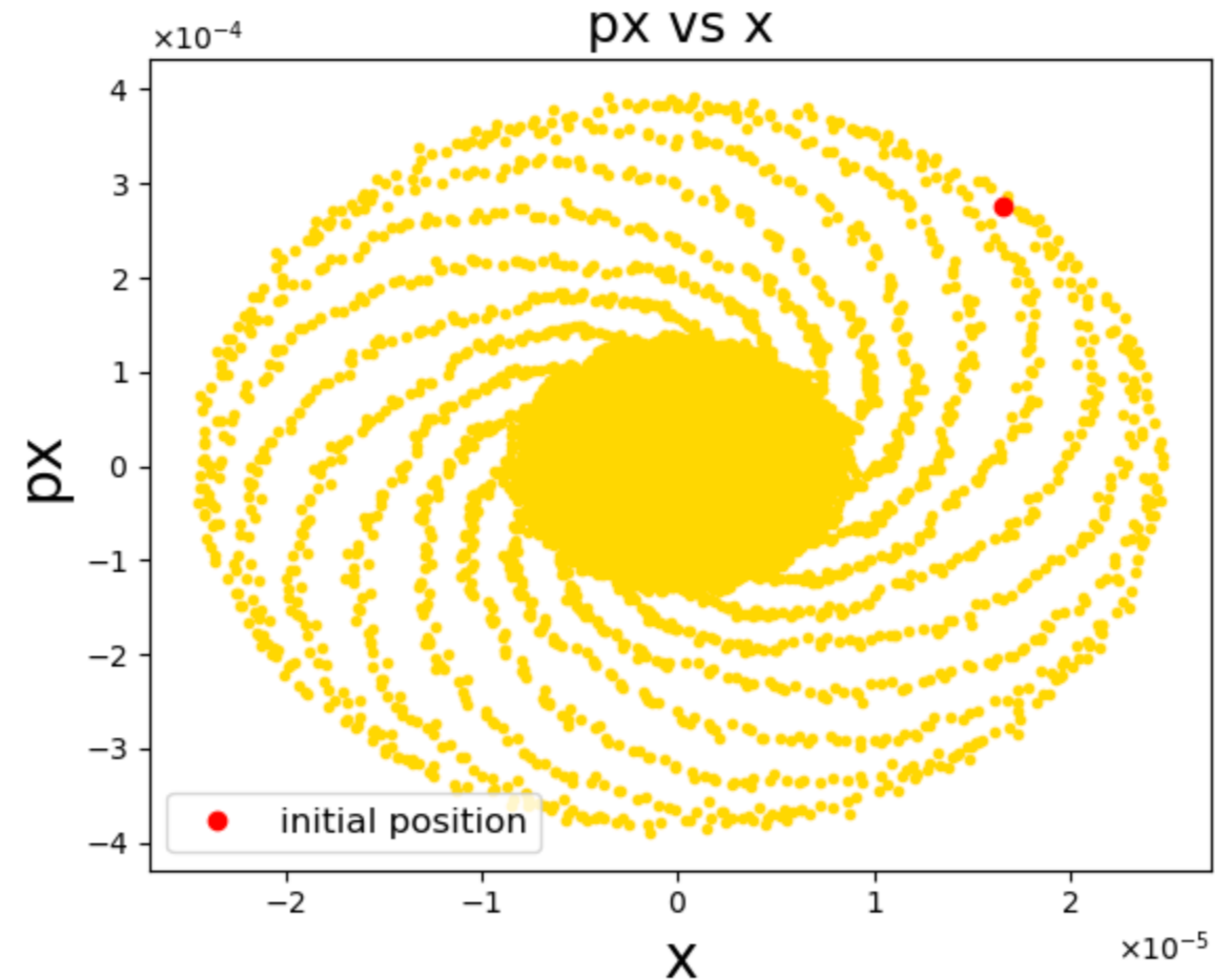


Not shifted

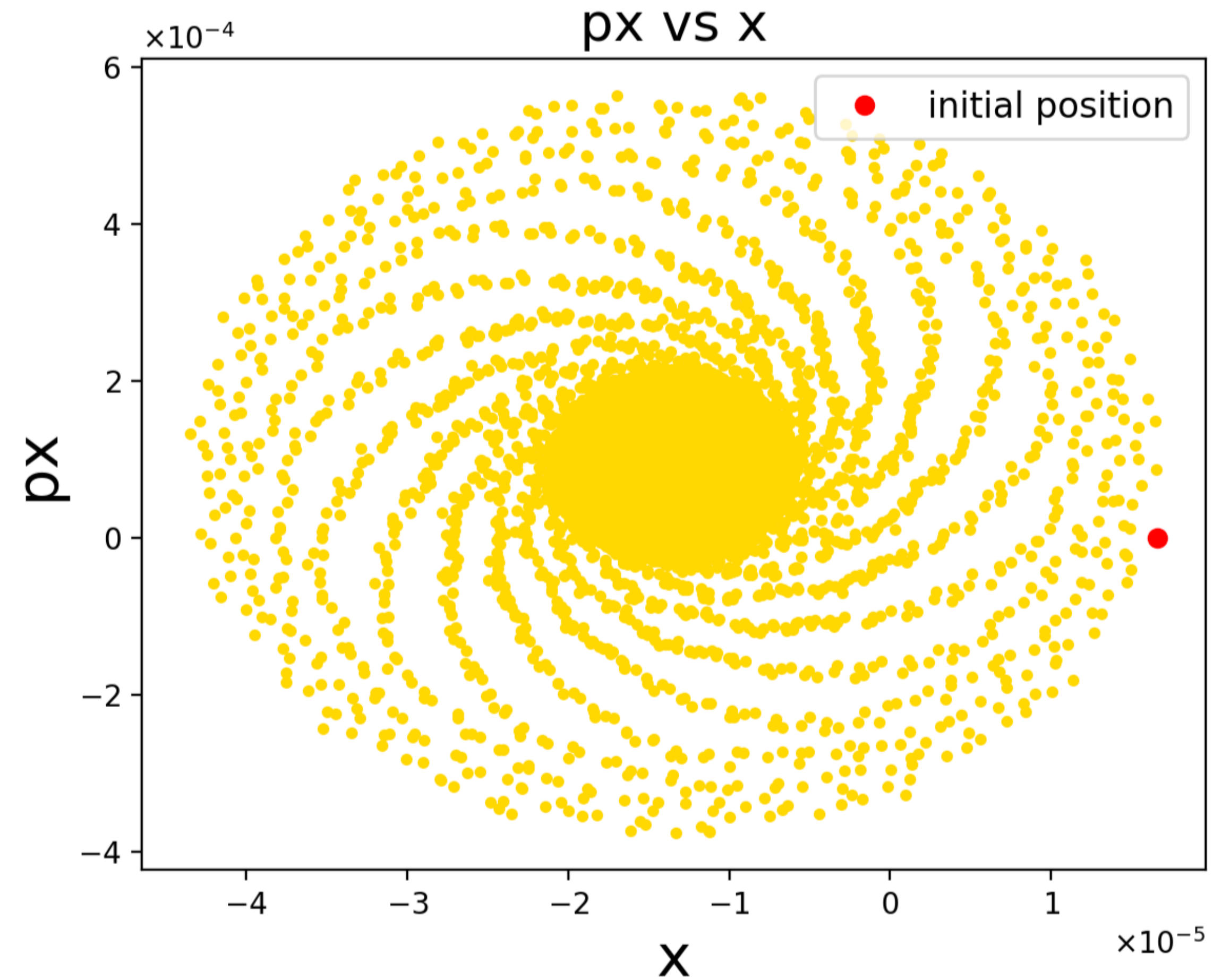


Shifted

x-px phase space

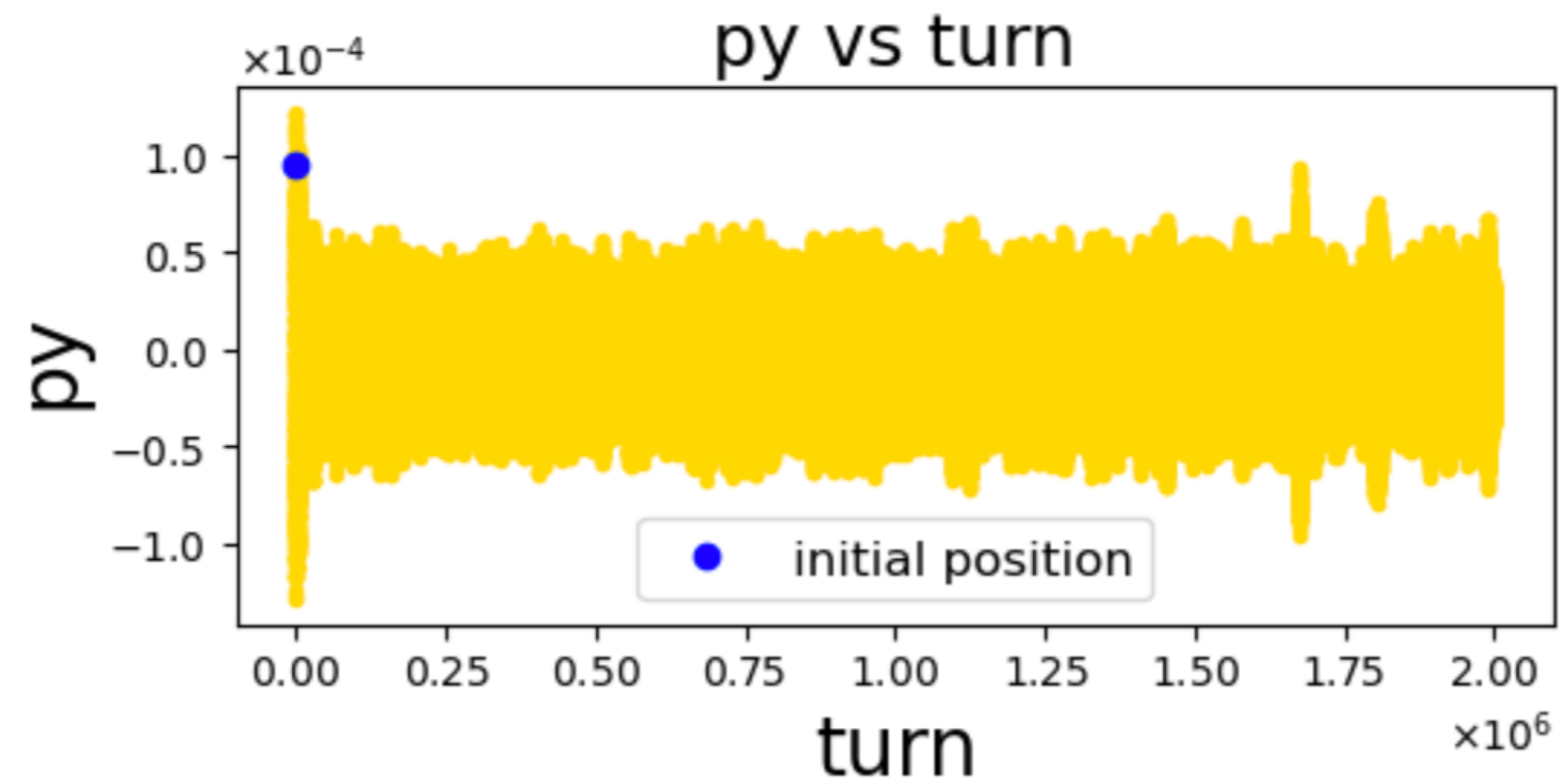
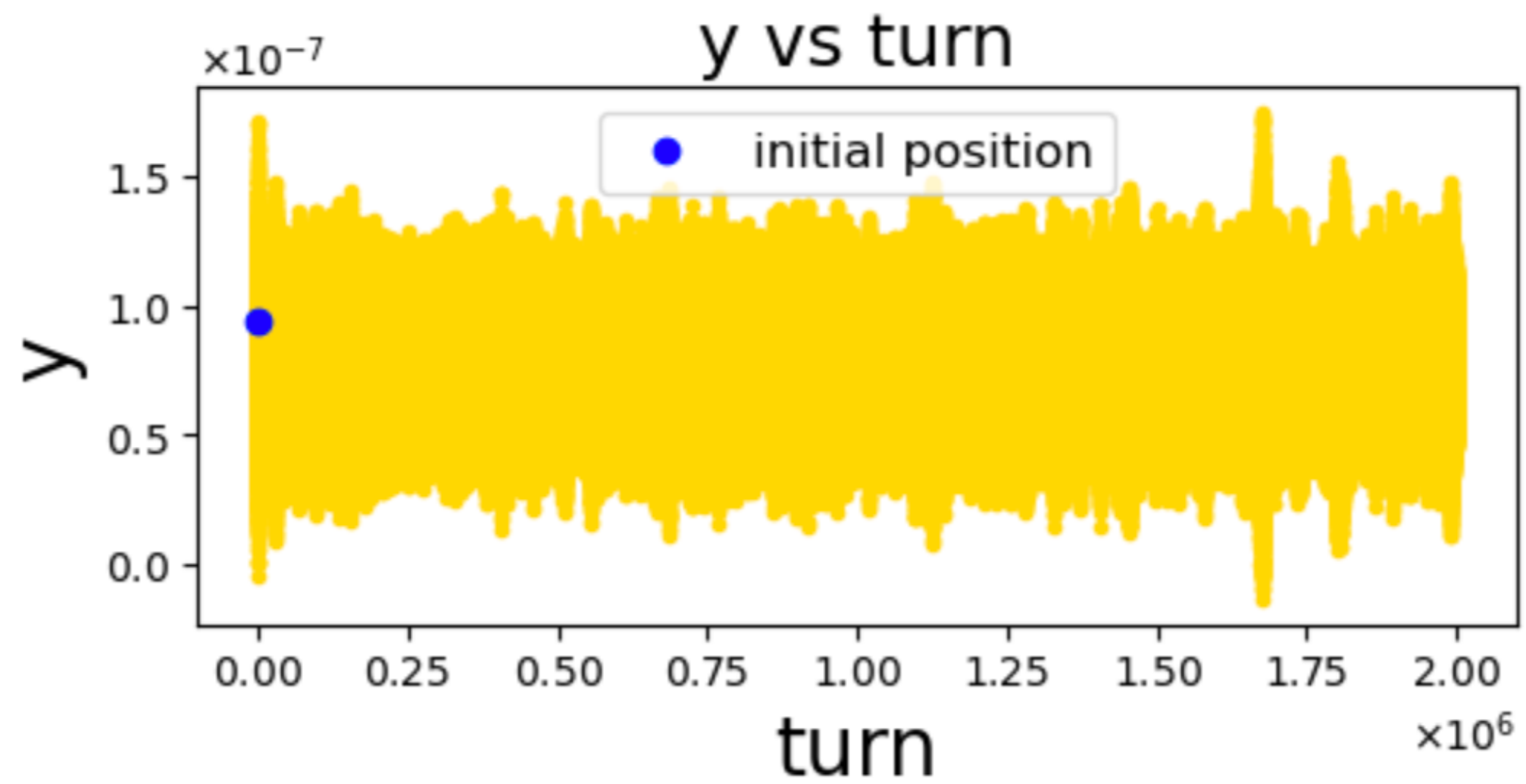


Not shifted

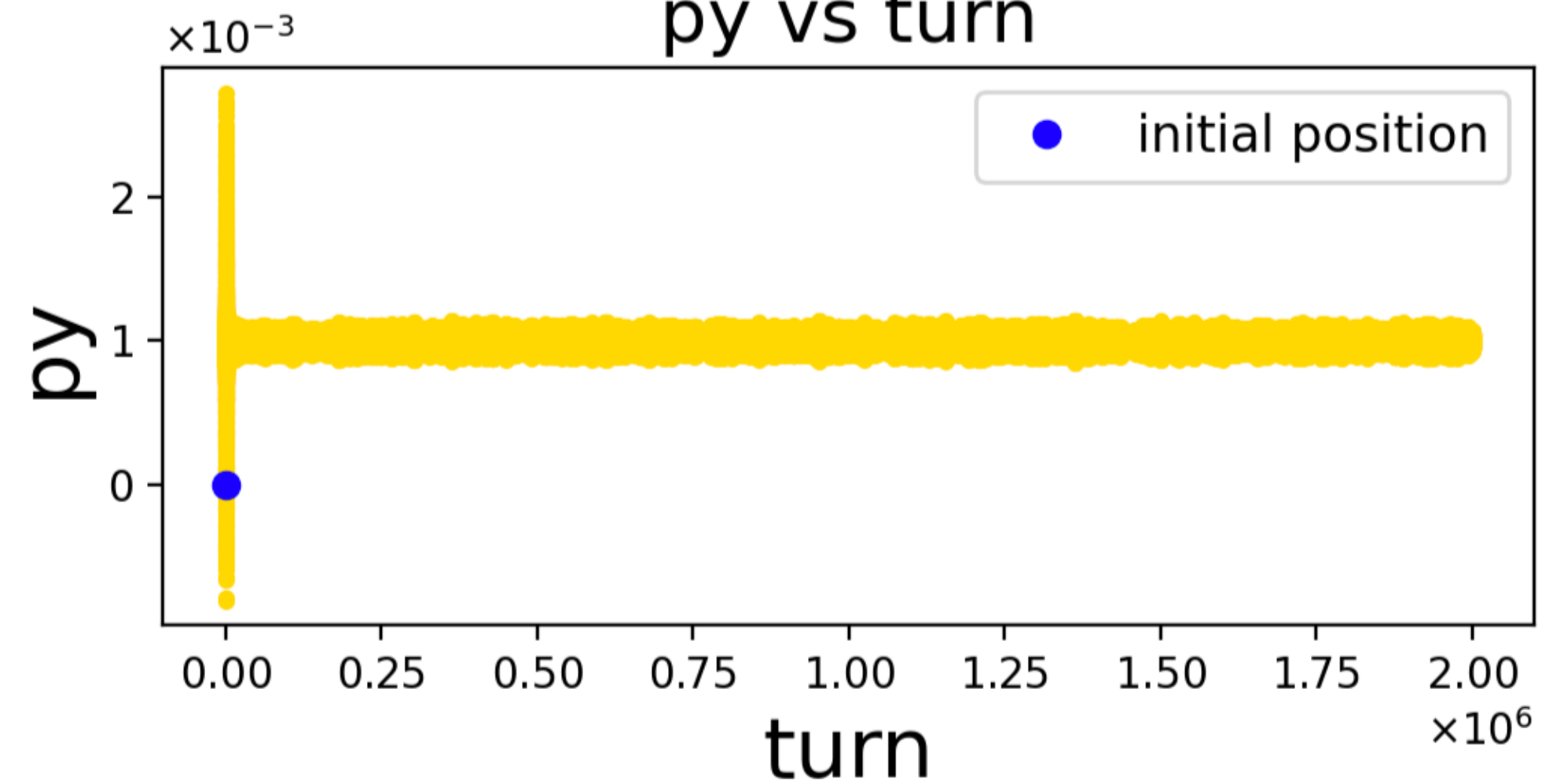
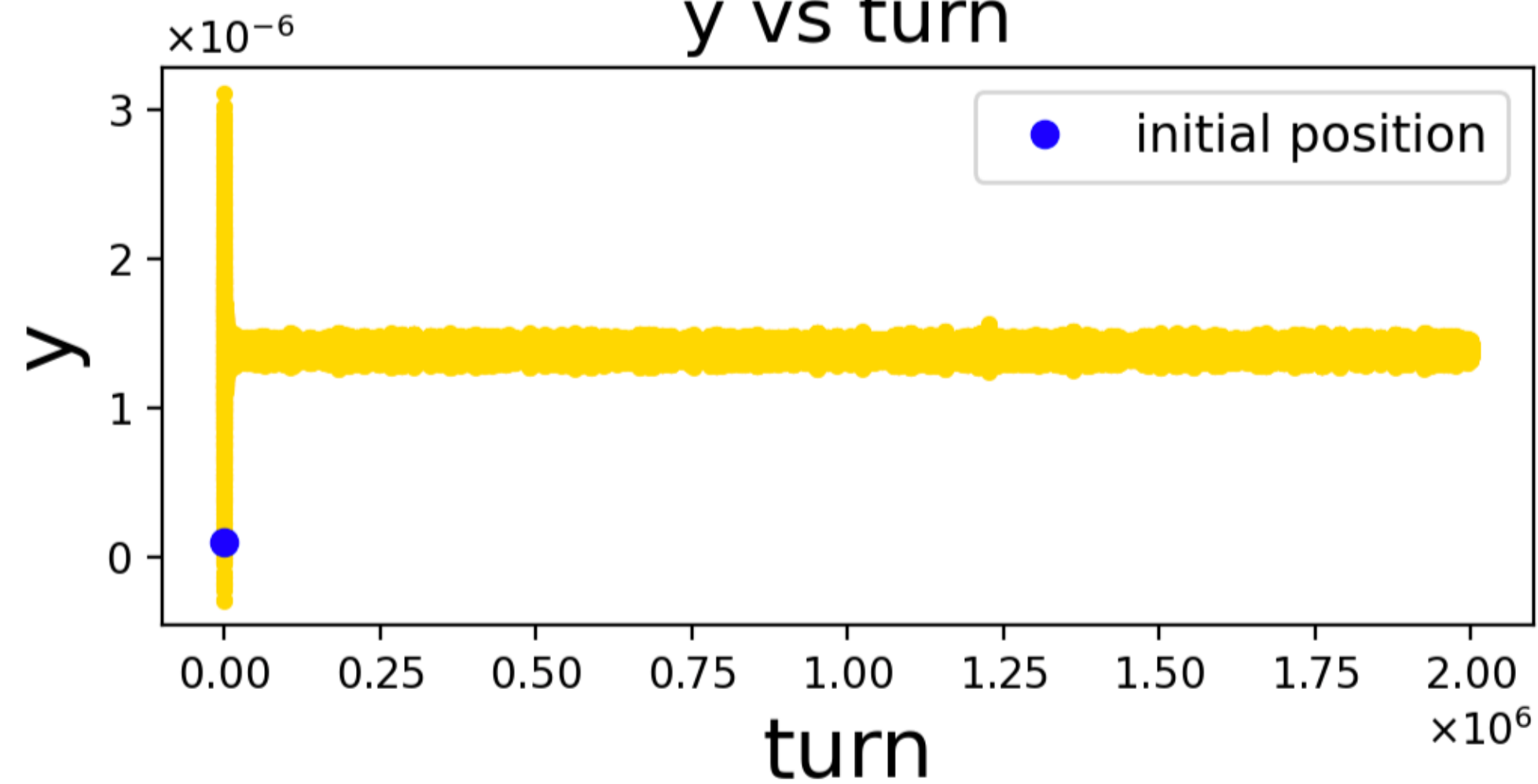


shifted

y-py vs turn

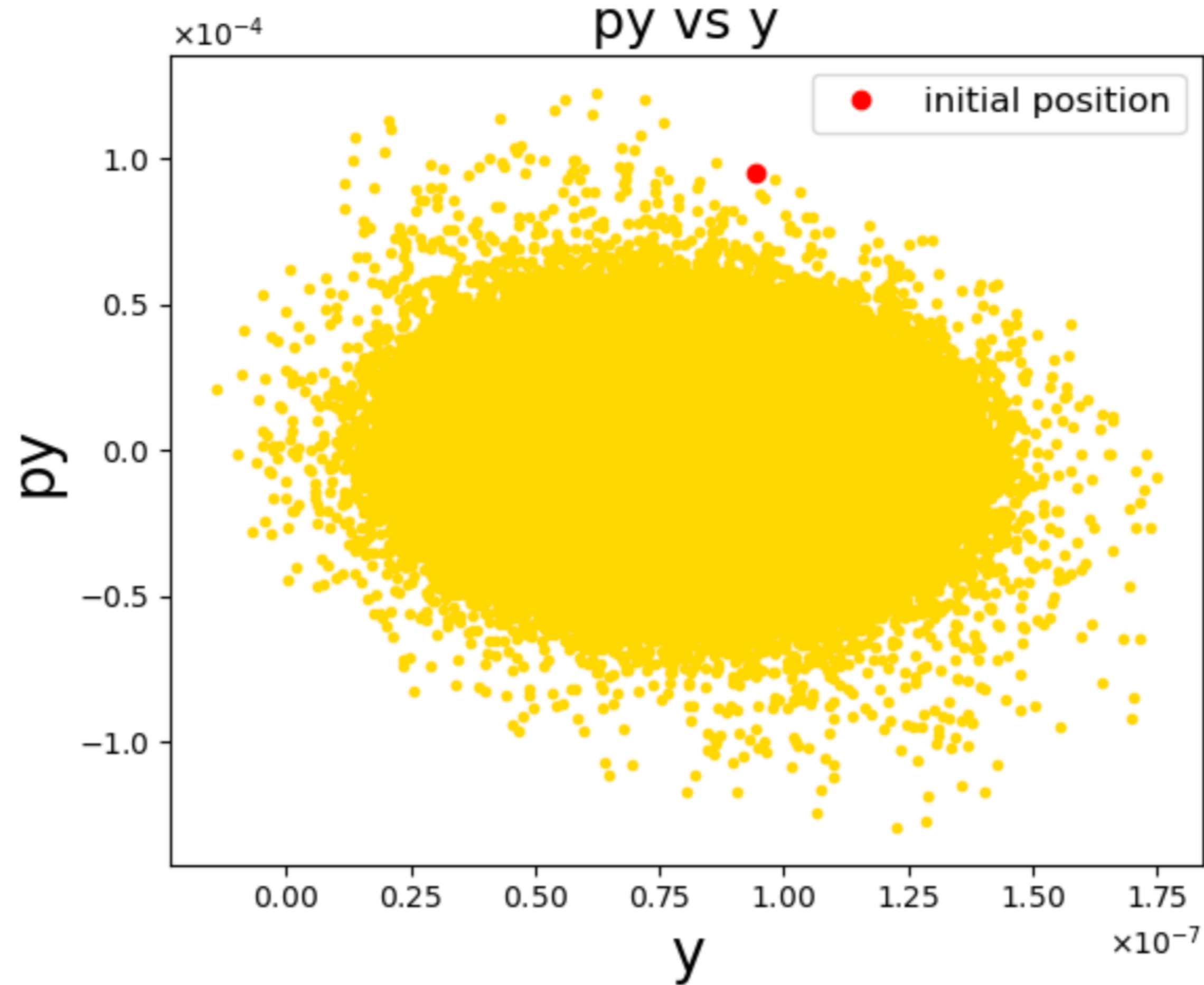


Not shifted

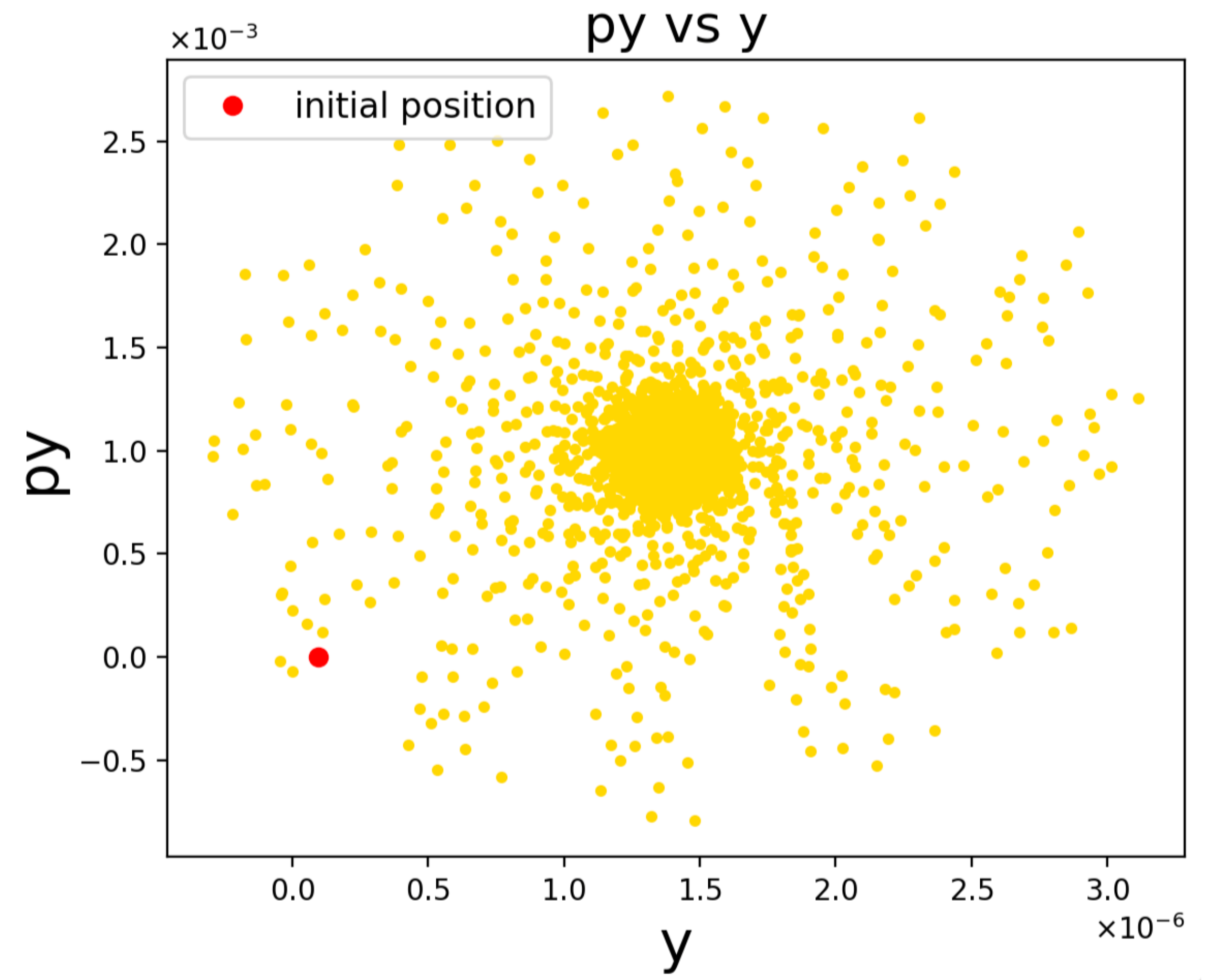


Shifted

y-py phase space

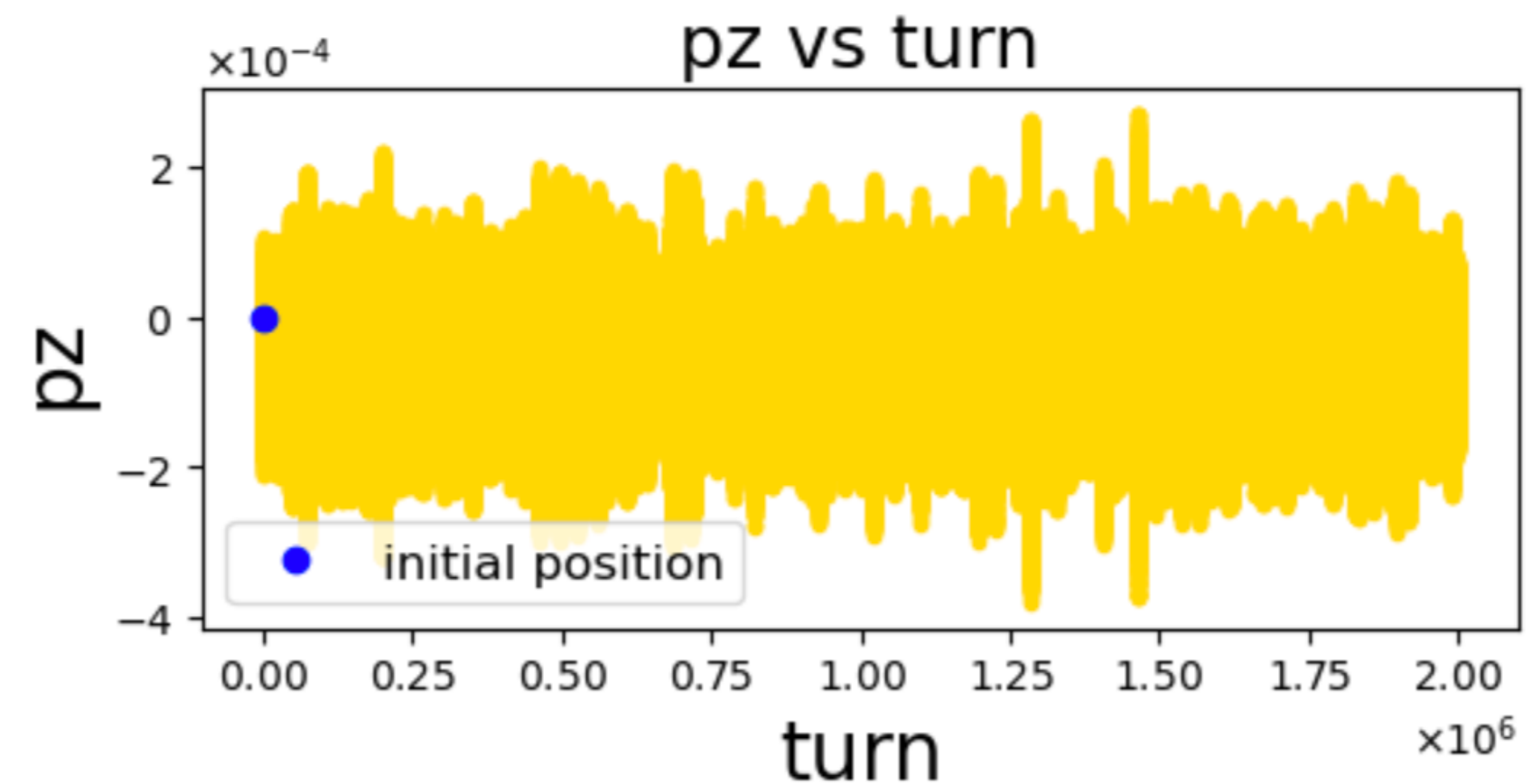
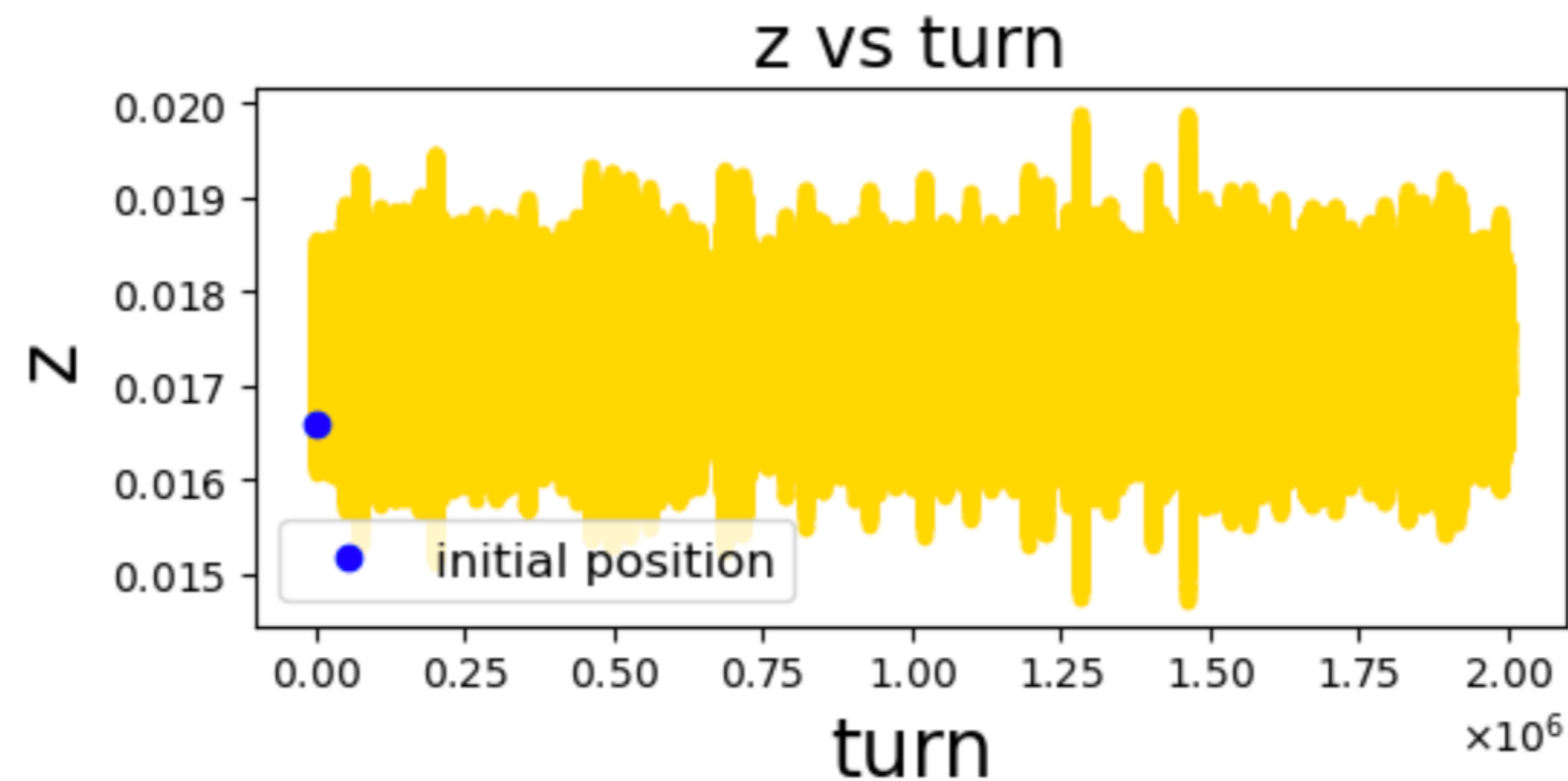


Not shifted

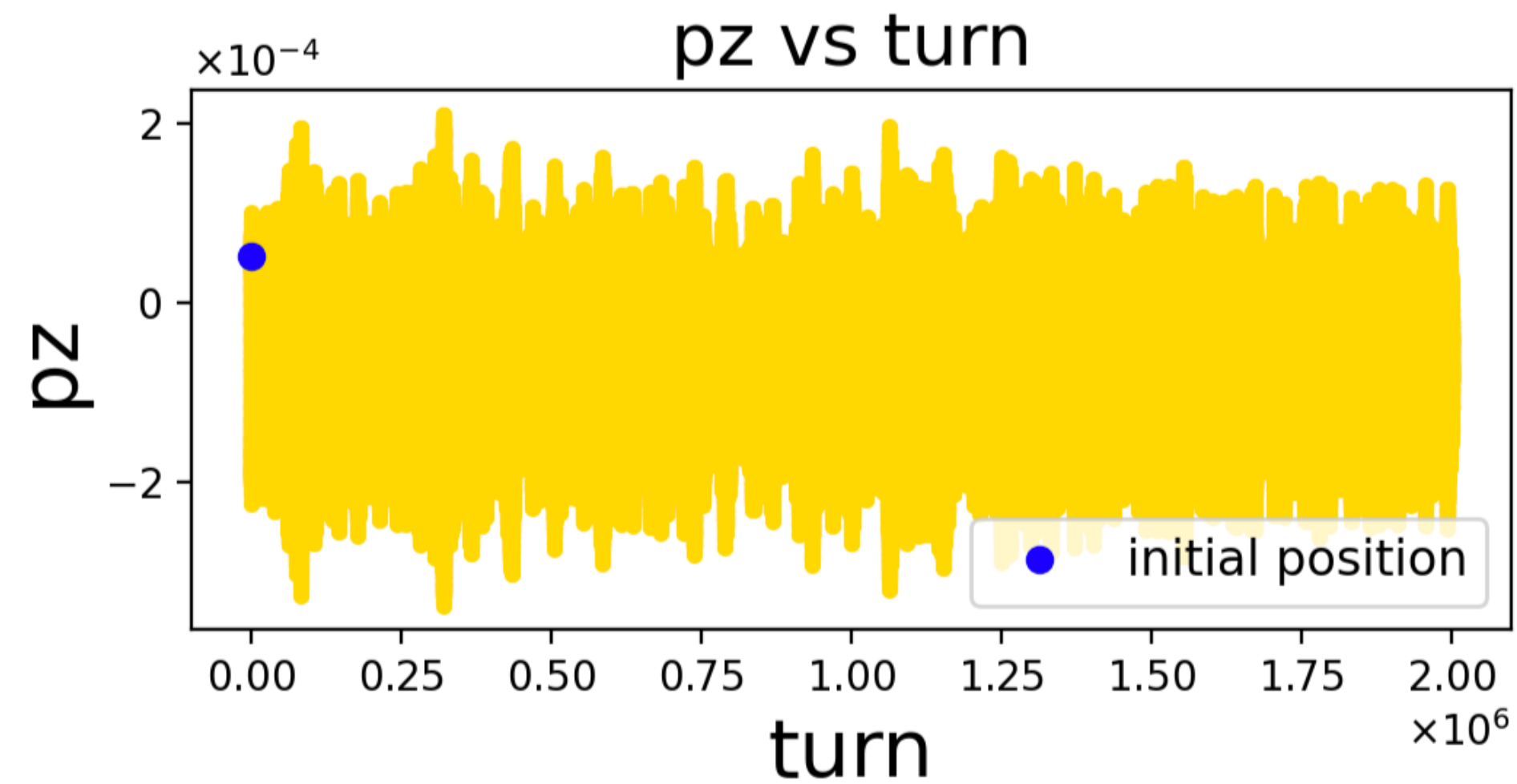
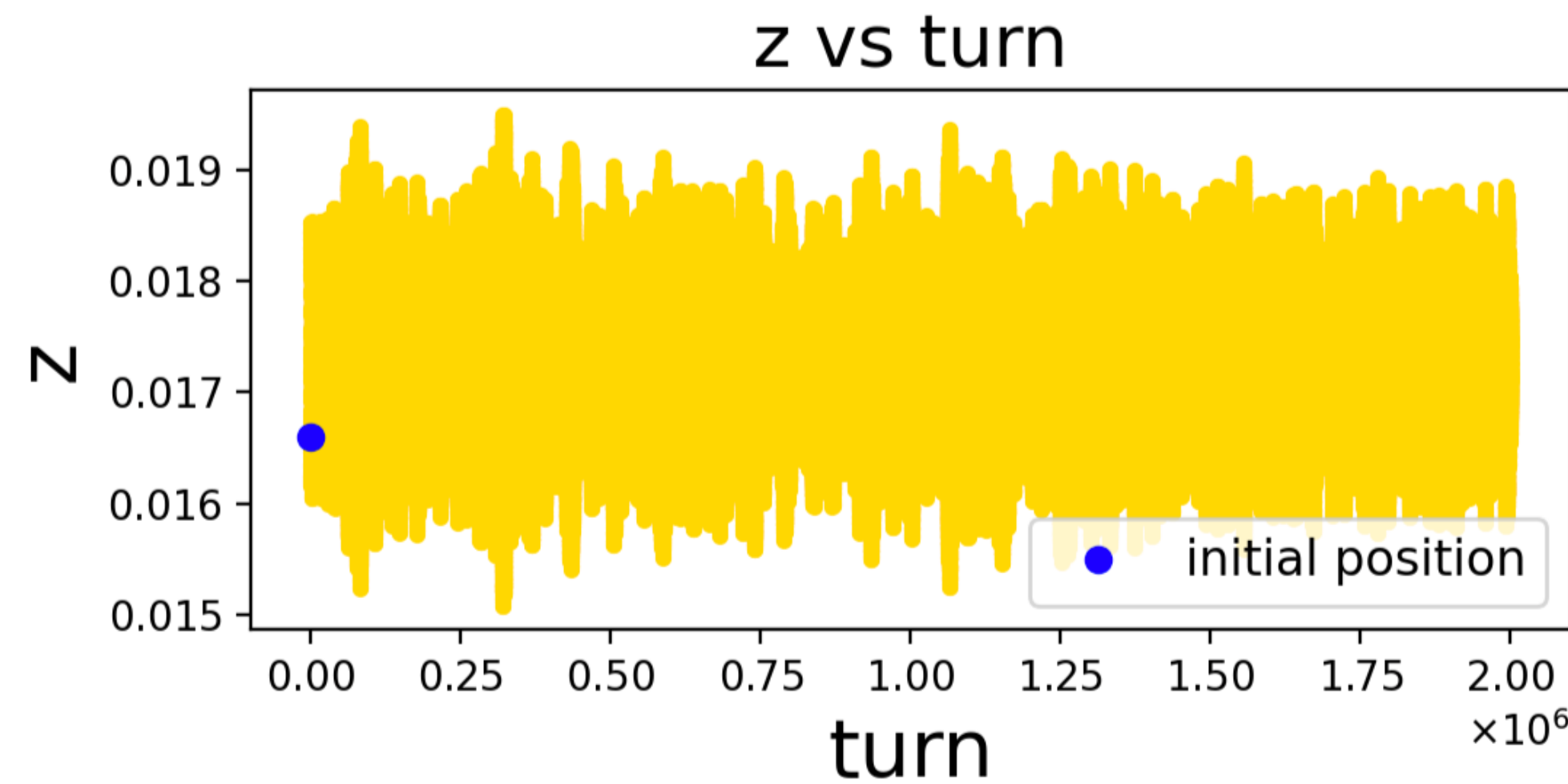


shifted

z-pz vs turn

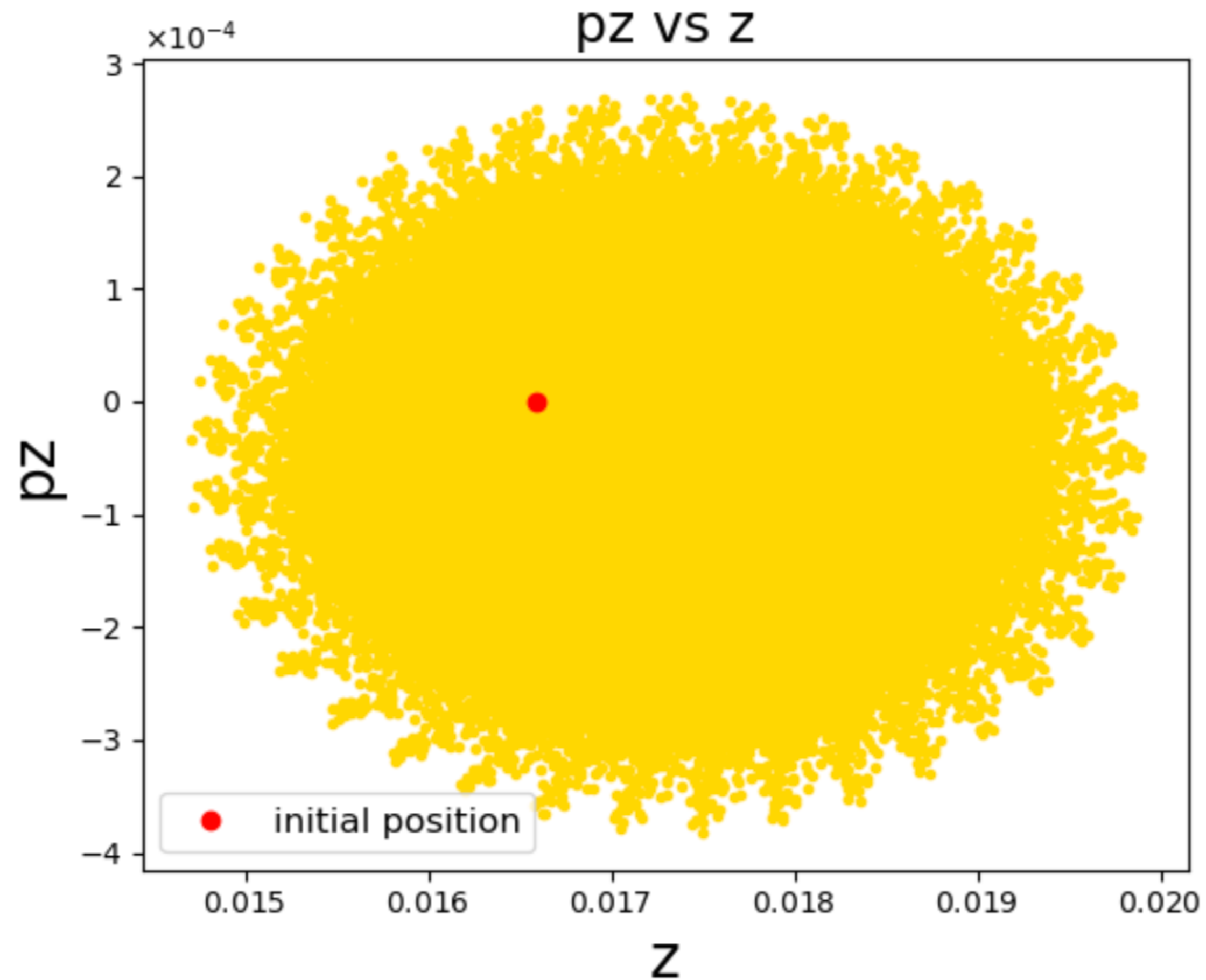


Not shifted

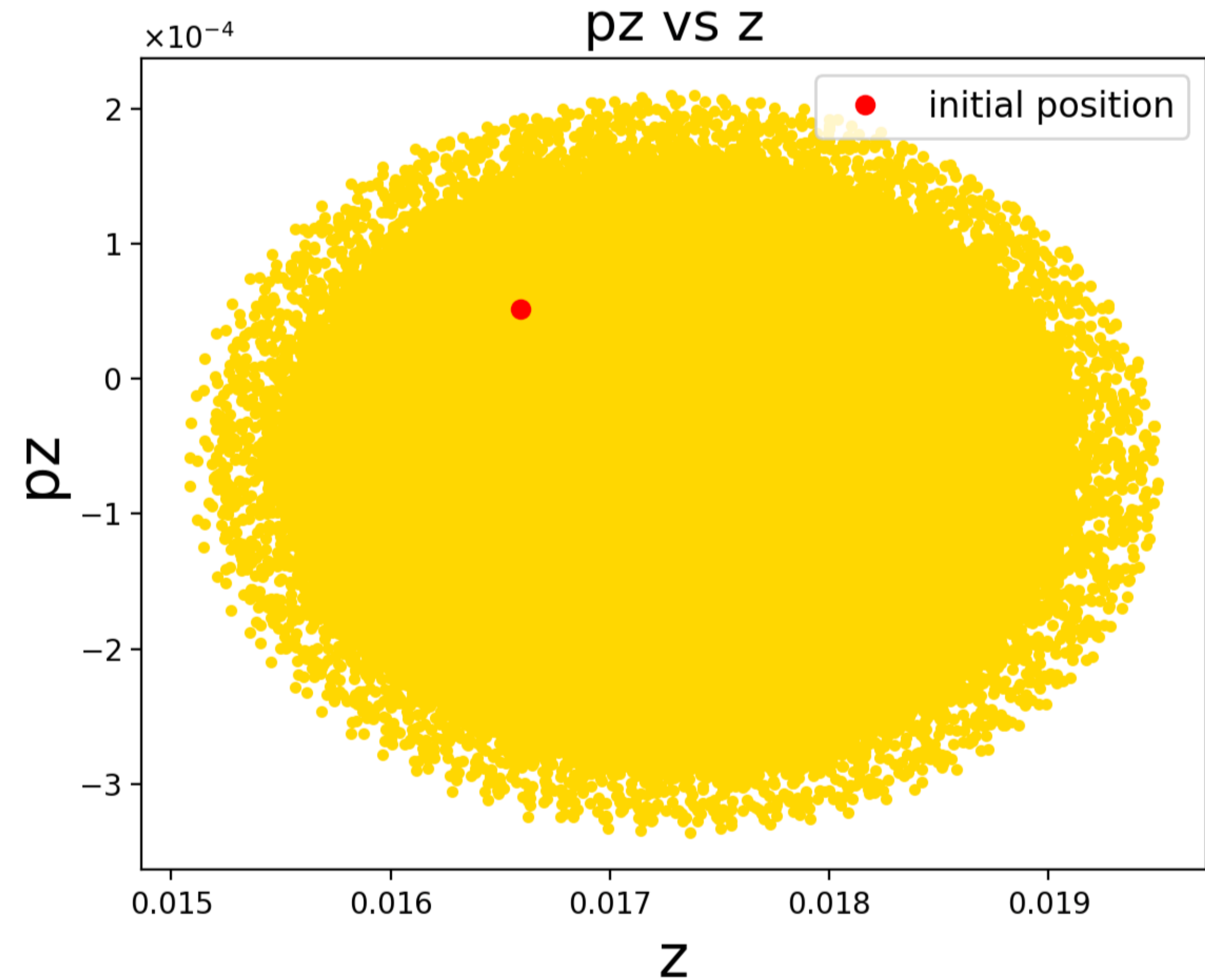


Shifted

z-pz phase space



Not shifted



shifted

Conclusion & Next Steps

Rotator ring with 0.1mm shift in x-y plane is stable and polarization lifetime is not affected

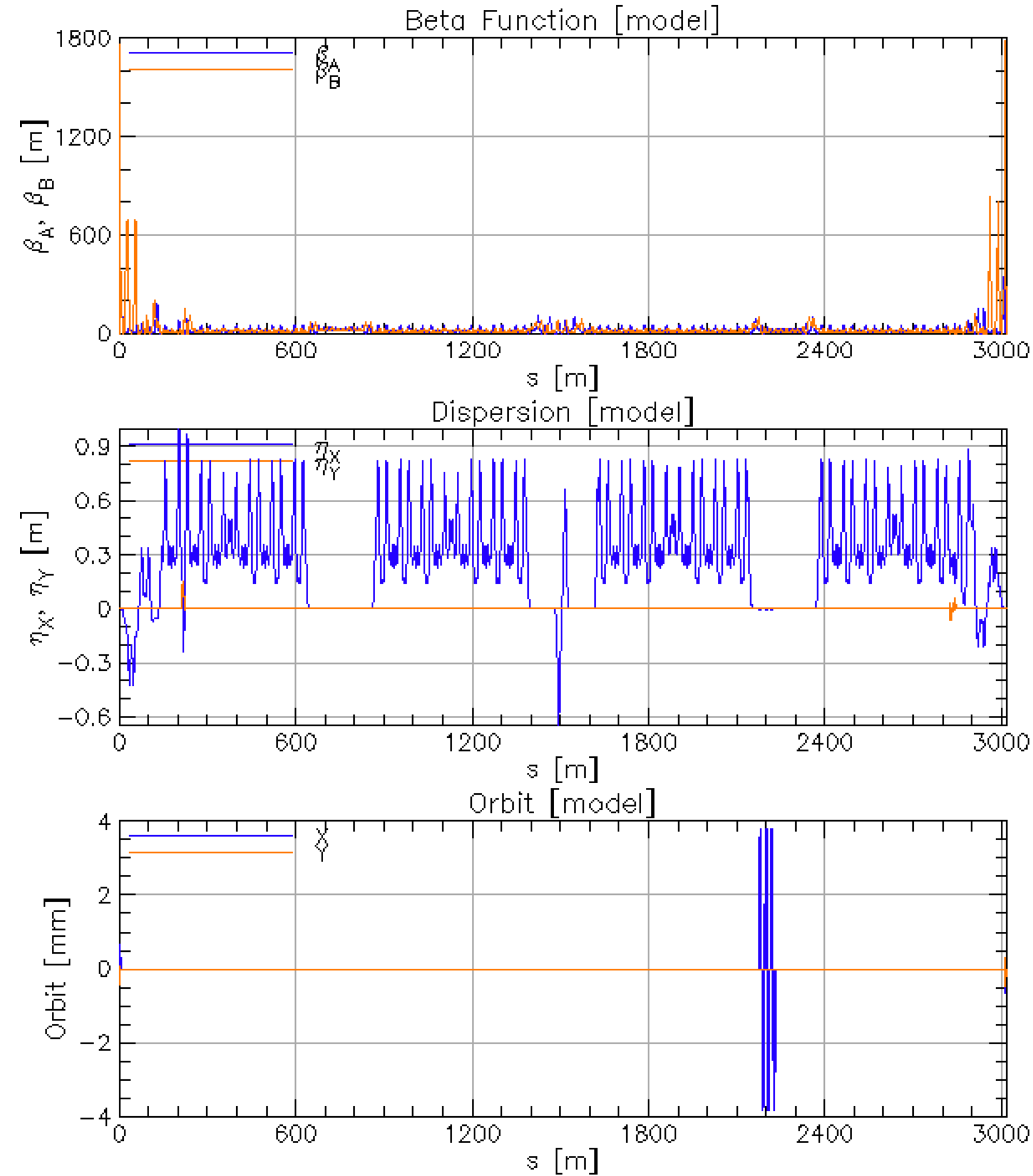
Explore higher shift value e.g. 0.5mm

Add tilt to the rotator displacement

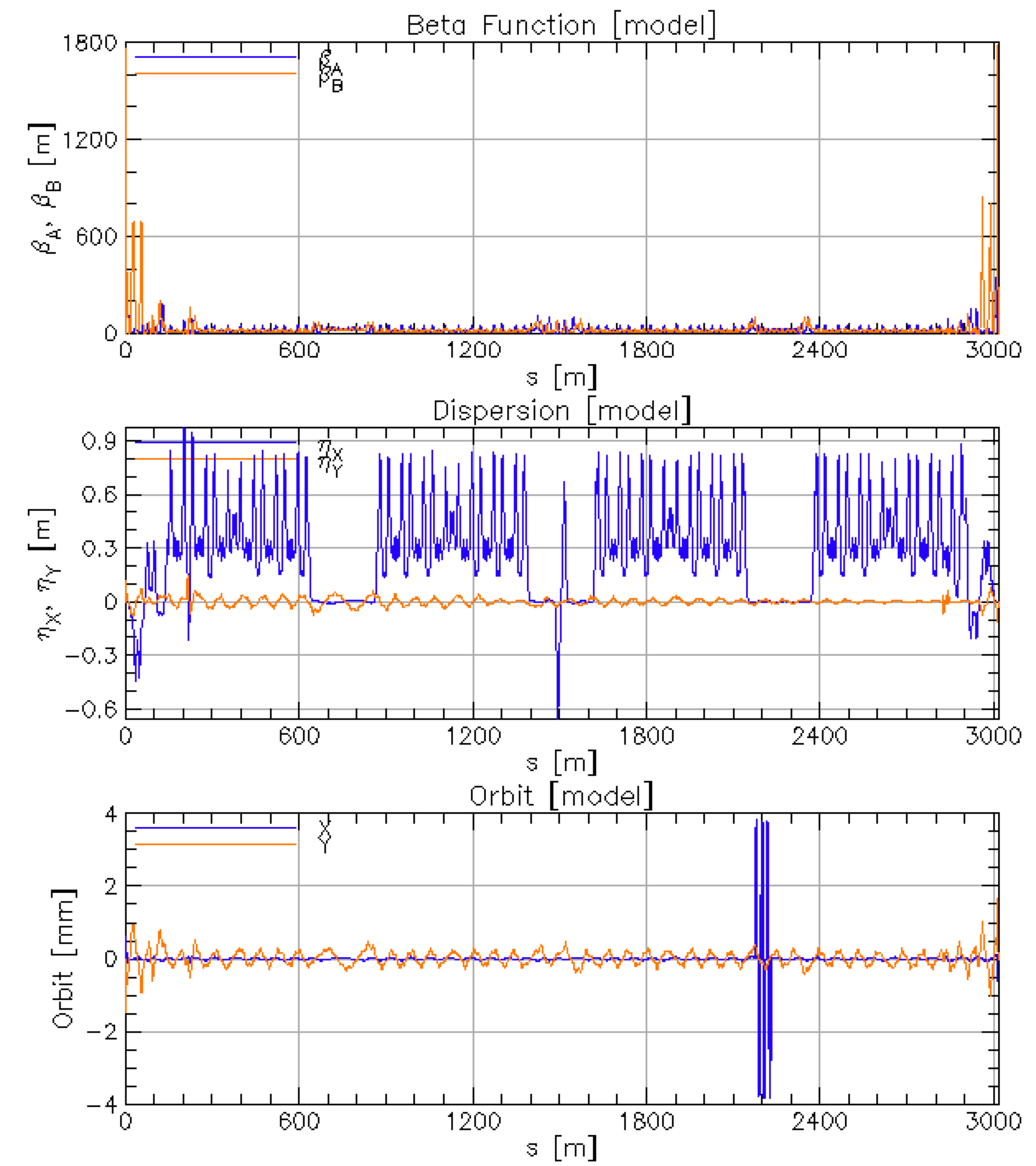
Running long-term tracking studies for the shifted Rotator ring

Backup Slides

B2EAR: $y_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

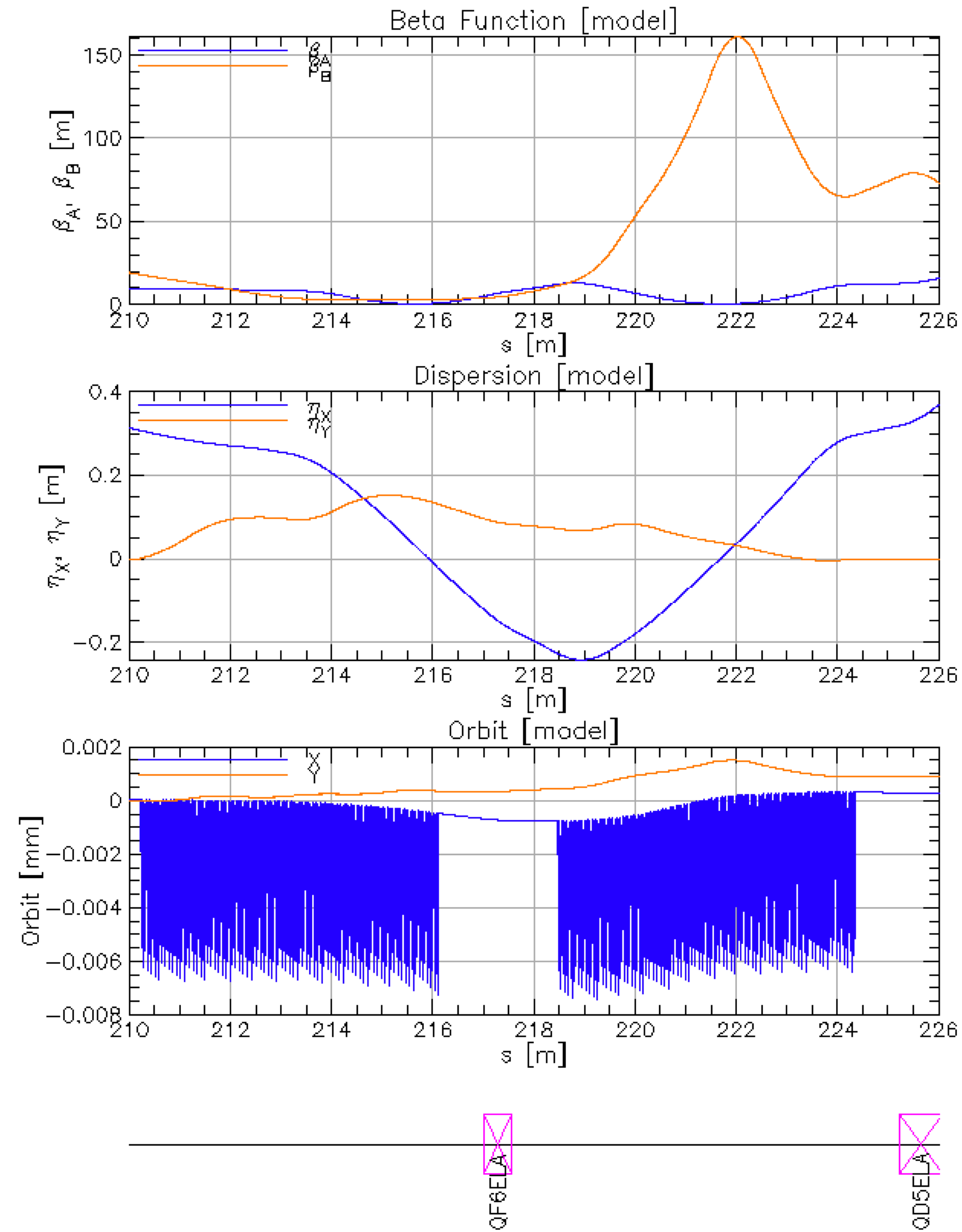
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

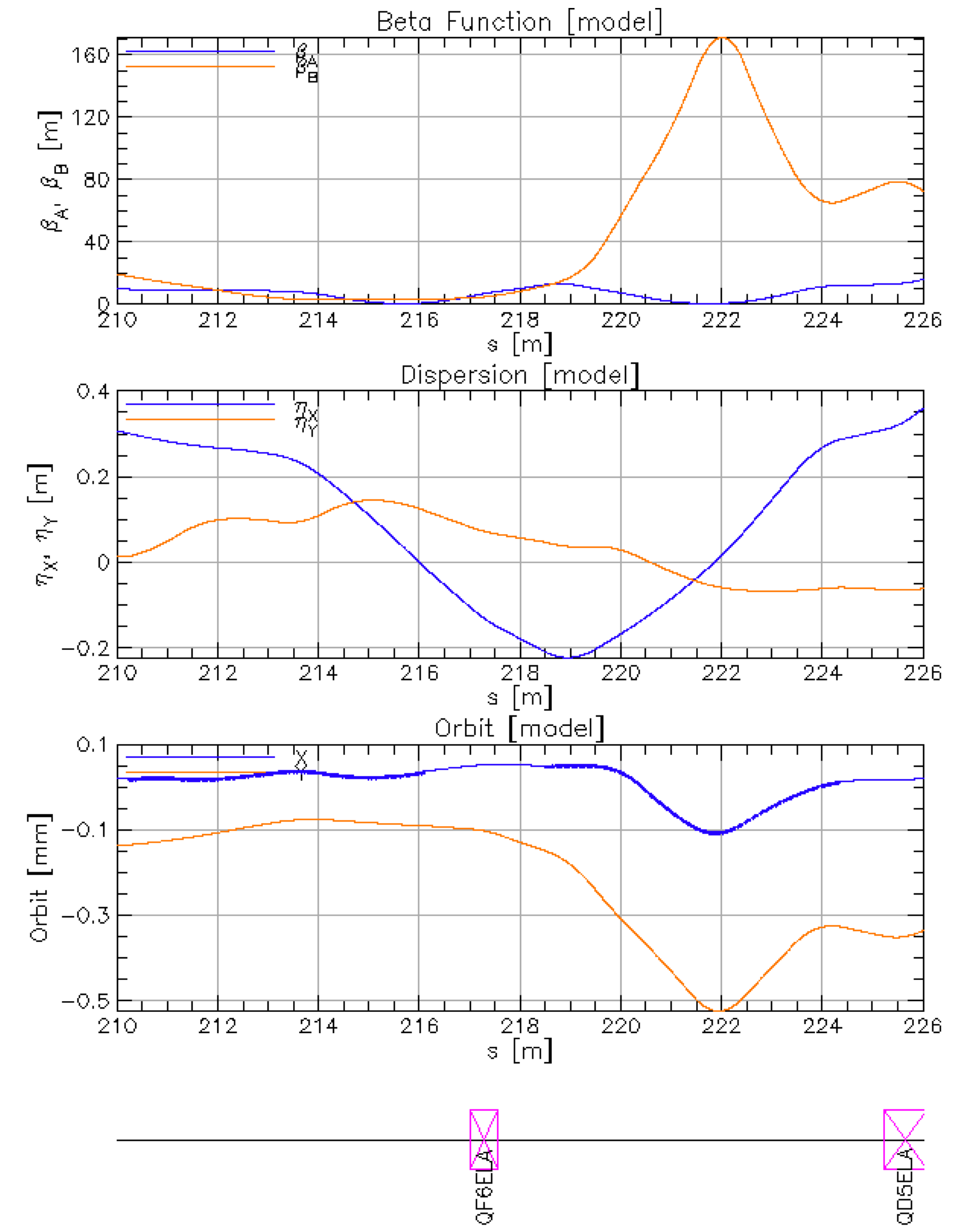
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EAR_y +0.1mm
	Model	Design	Model	Design		
Q	45.530896	45.530896	43.579536	43.579536	! Tune	
Chrom	1.522343	1.531413	1.779148	1.783723	! dQ/(dE/E)	
J_damp	0.967050	0.966458	1.029056	1.029217	! Damping Partition #	
Emittance	4.58778E-09	4.59104E-09	4.09864E-11	4.11368E-11	! Unnormalized	

L-Rot

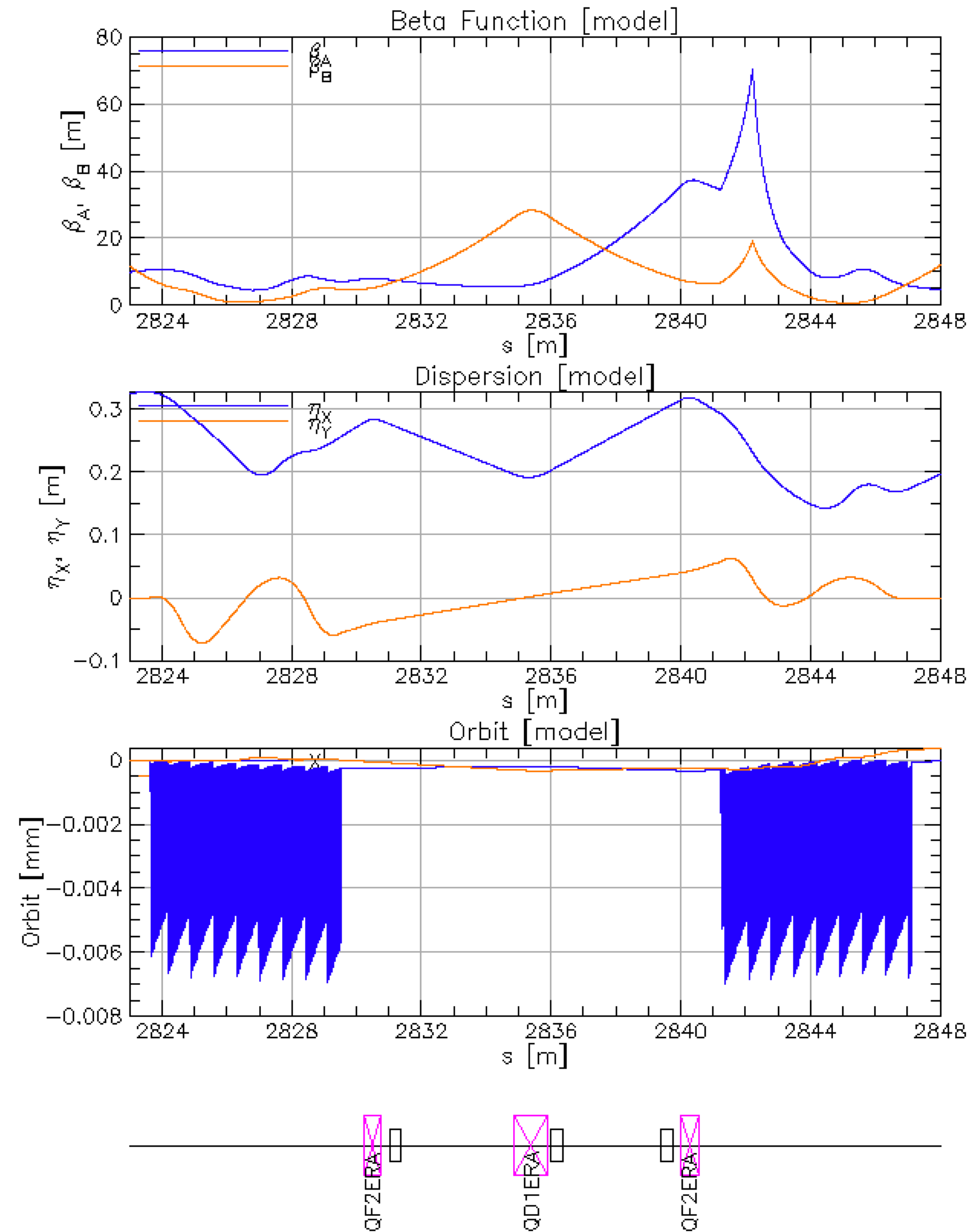


original

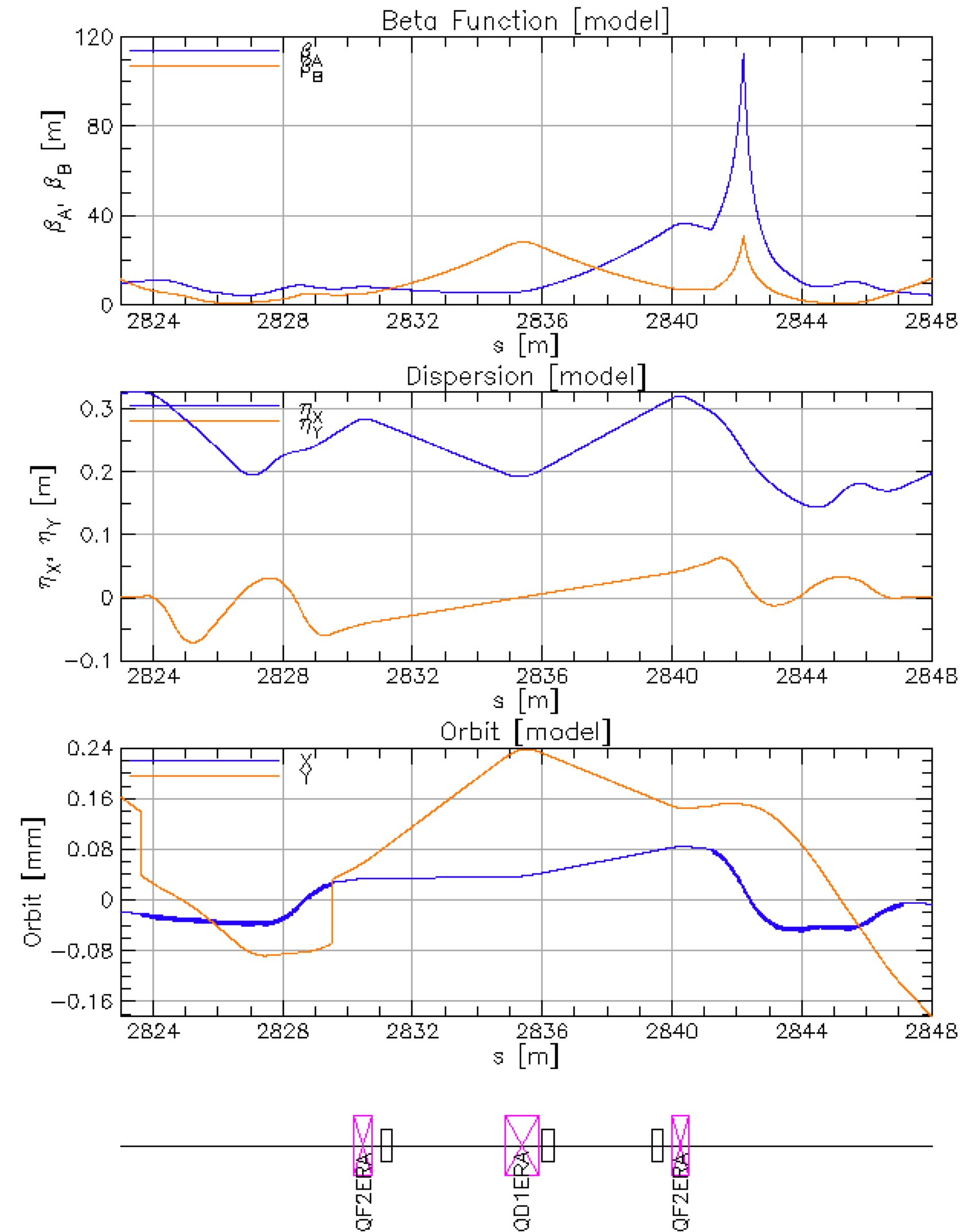


B2EAR_y +0.1mm

R-Rot

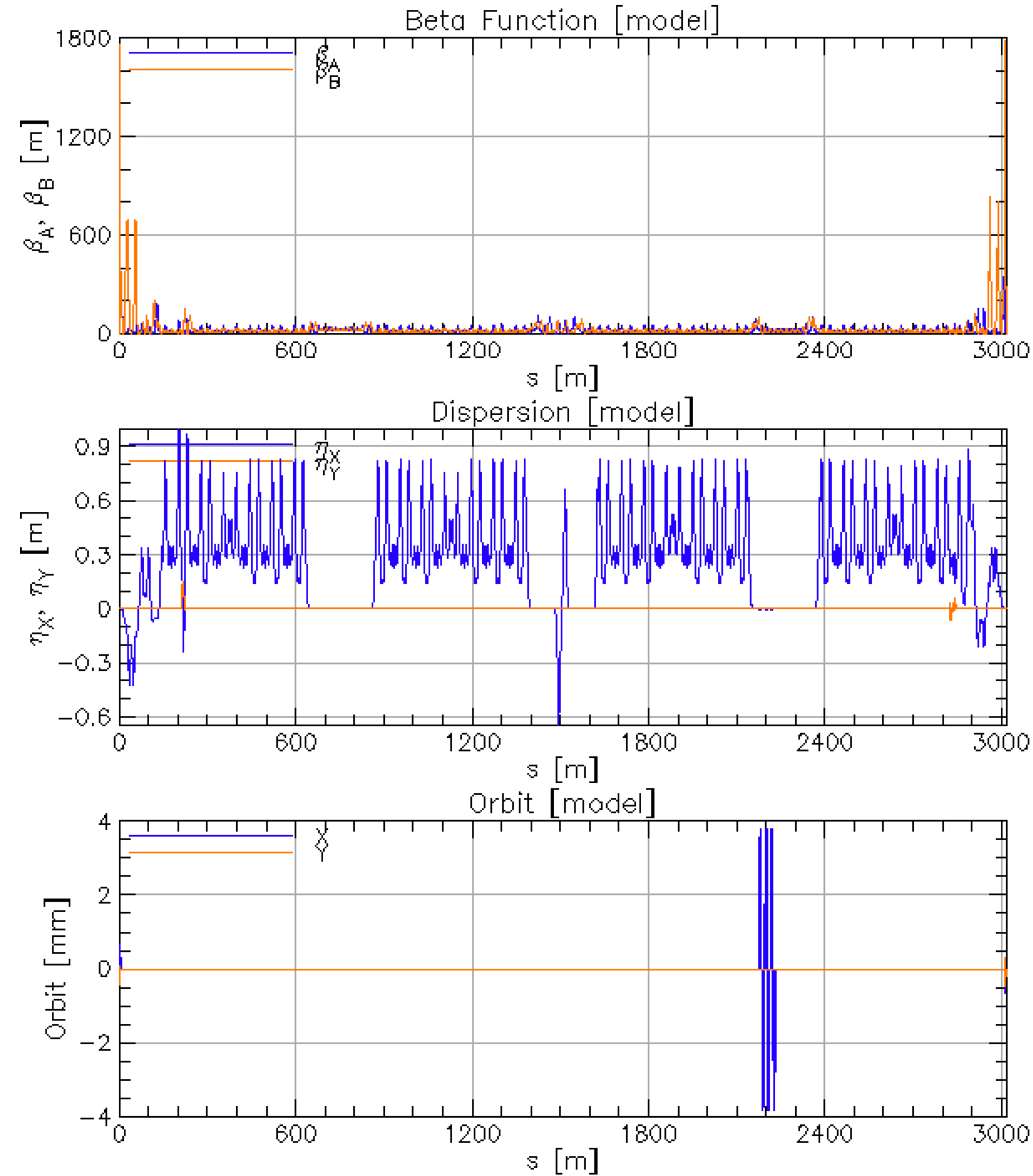


original

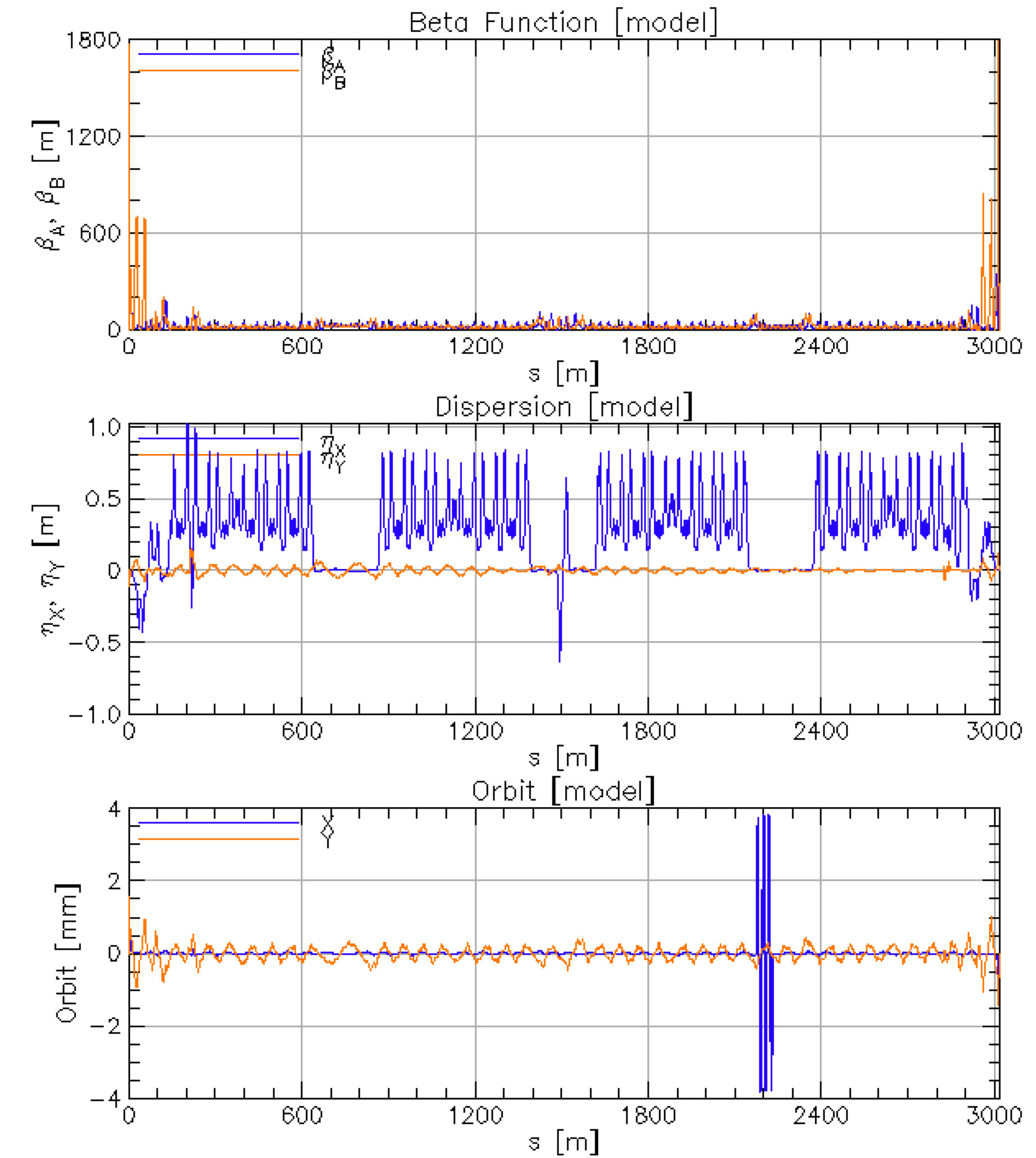


B2EAR_y +0.1mm

B2EAR: $y_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

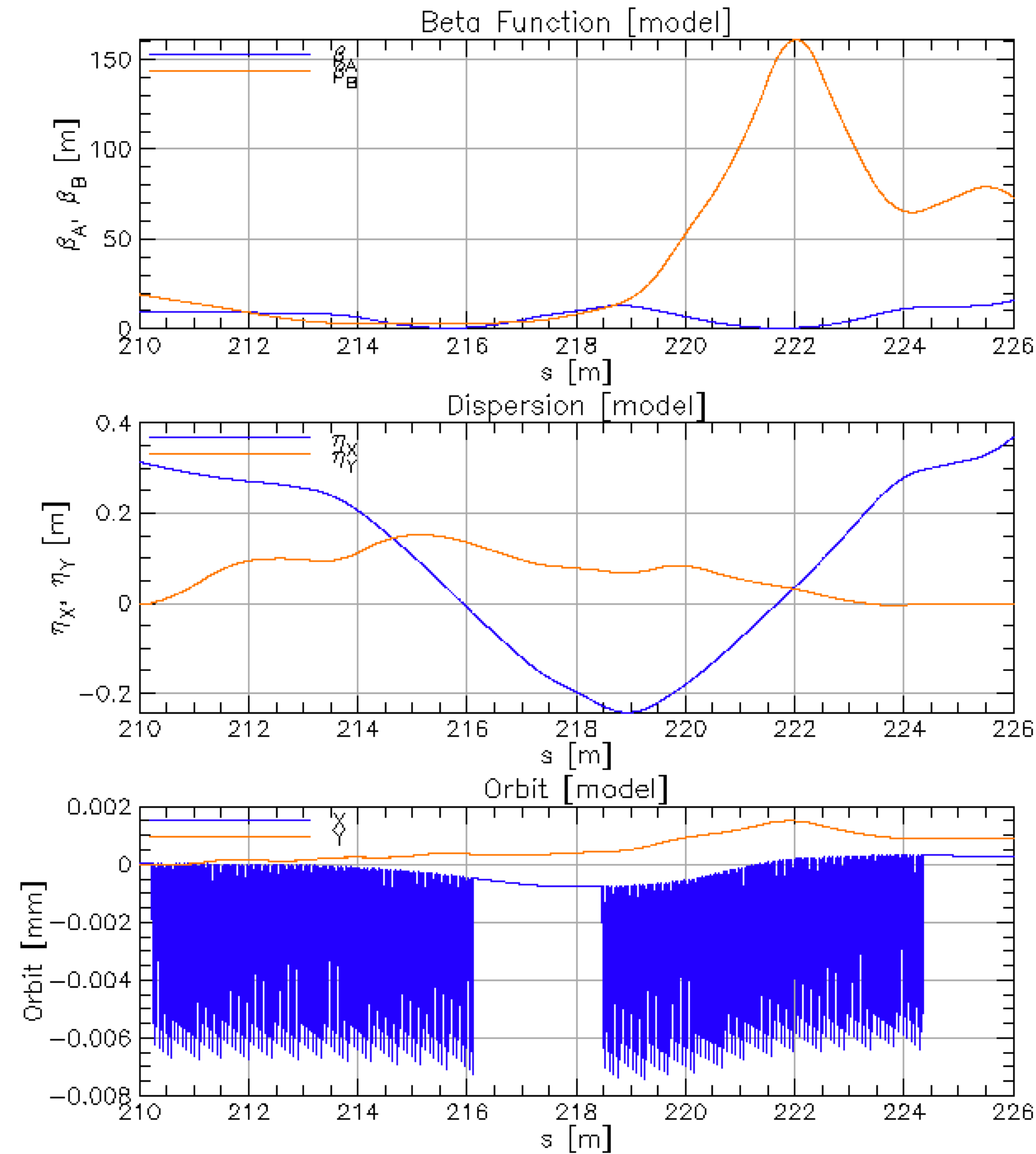
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EAR_y -0.1mm
	Model	Design	Model	Design		
Q	45.531033	45.531033	43.578941	43.578941	! Tune	
Chrom	1.450721	1.456350	1.385825	1.389290	! dQ/(dE/E)	
J_damp	0.963992	0.963602	1.032952	1.033085	! Damping Partition #	
Emittance	4.61051E-09	4.61262E-09	4.03531E-11	4.05114E-11	! Unnormalized	

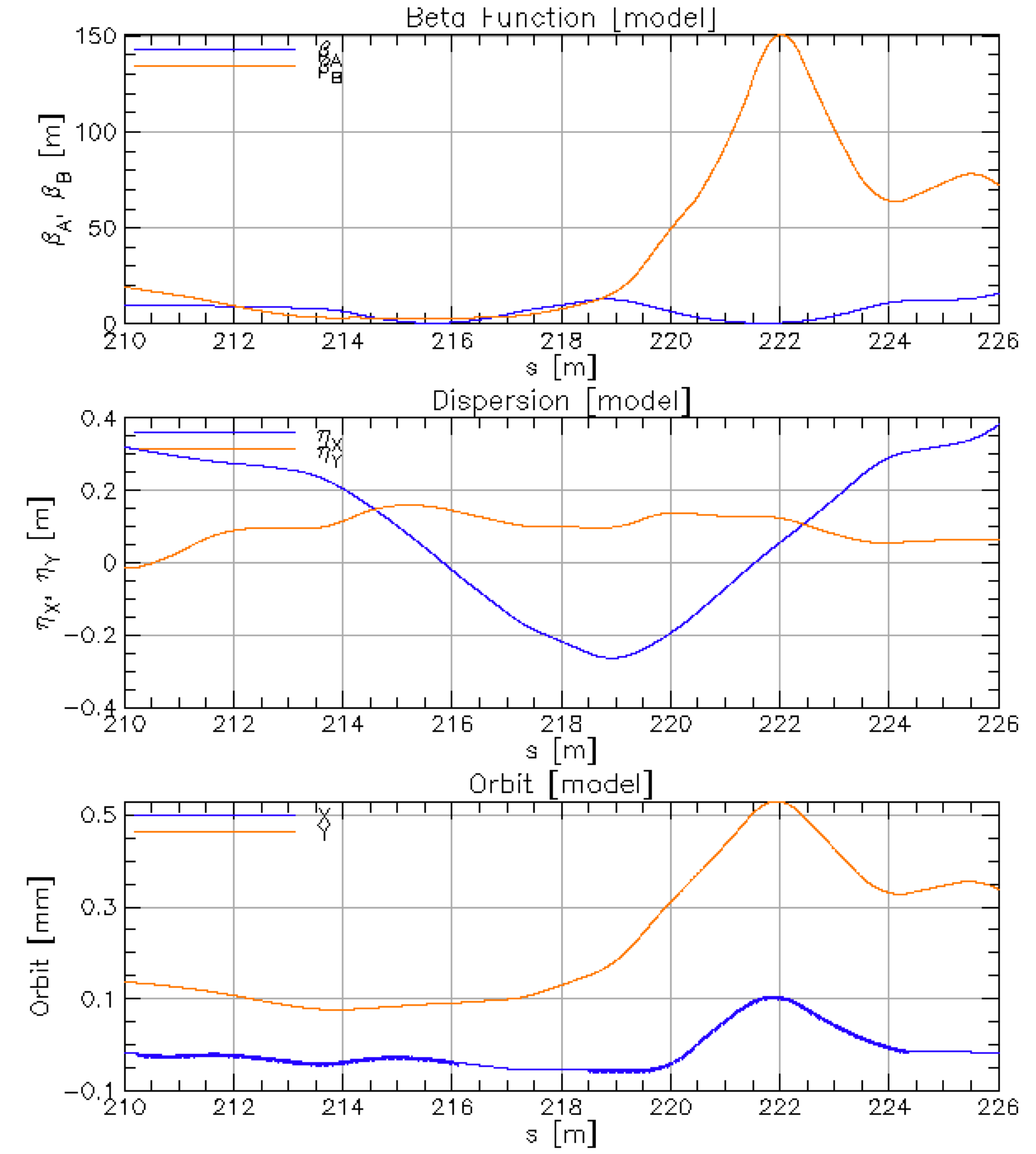
L-Rot



QF6ELA

QD5ELA

original

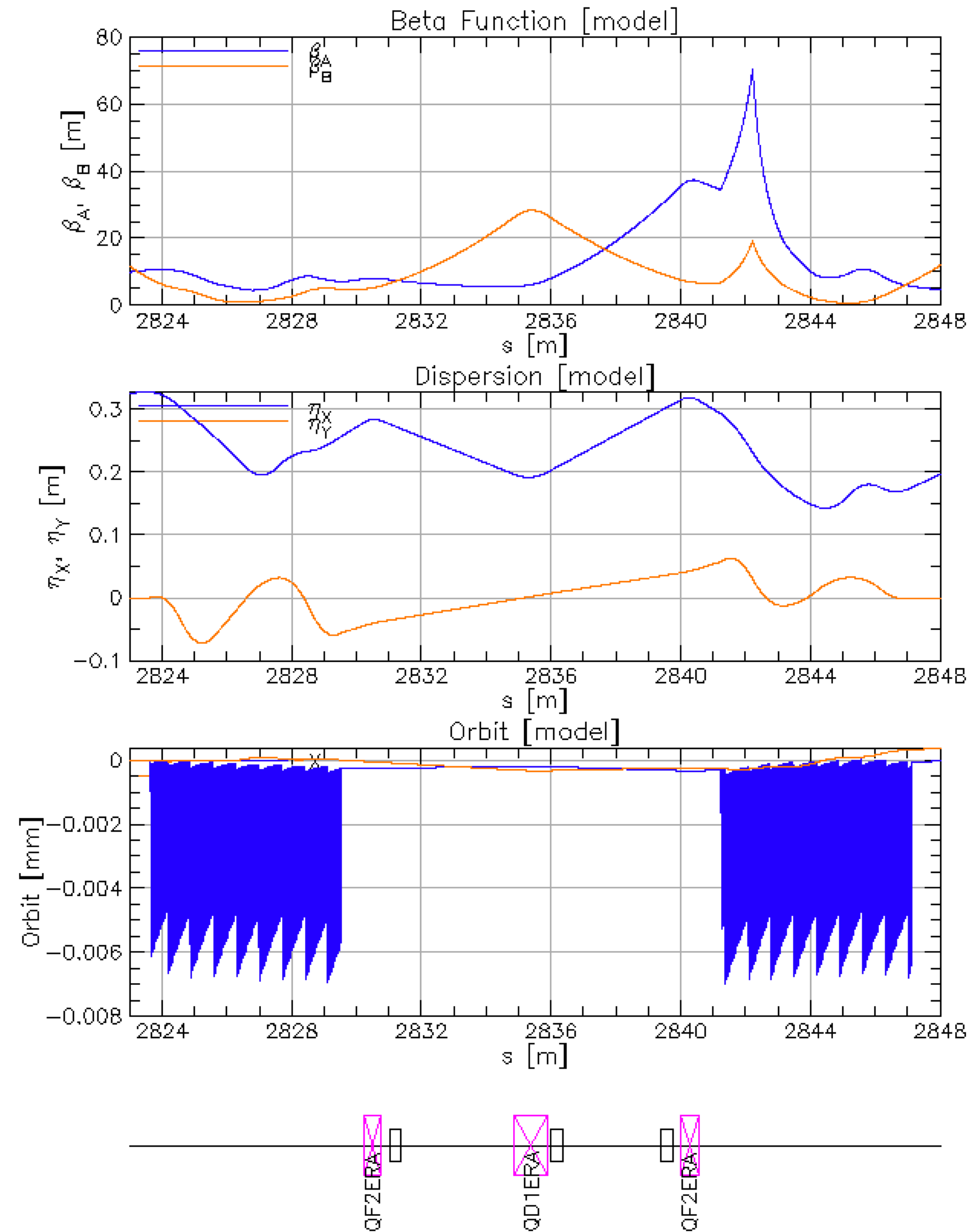


QF6ELA

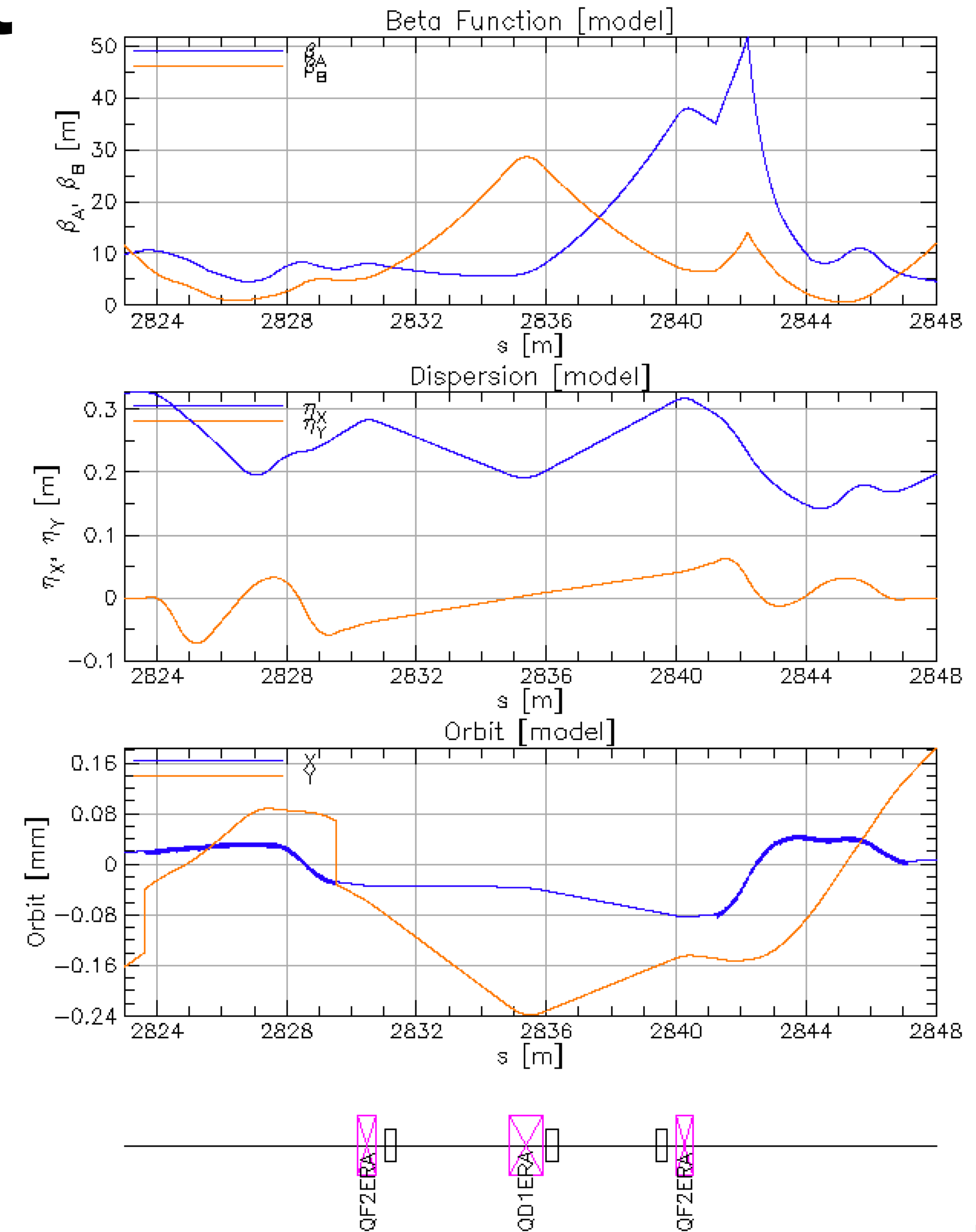
QD5ELA

B2EAR_y -0.1mm

R-Rot

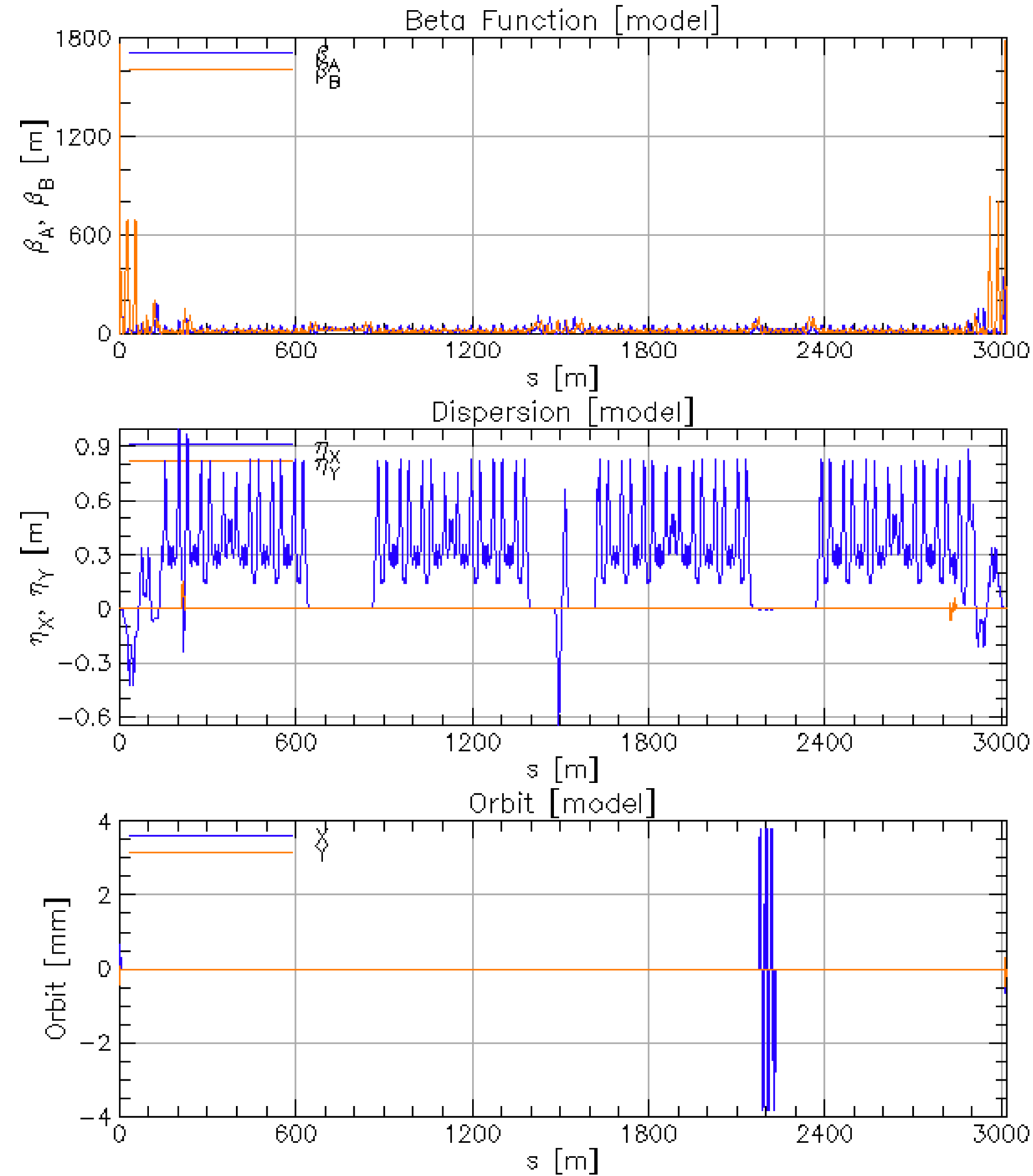


original

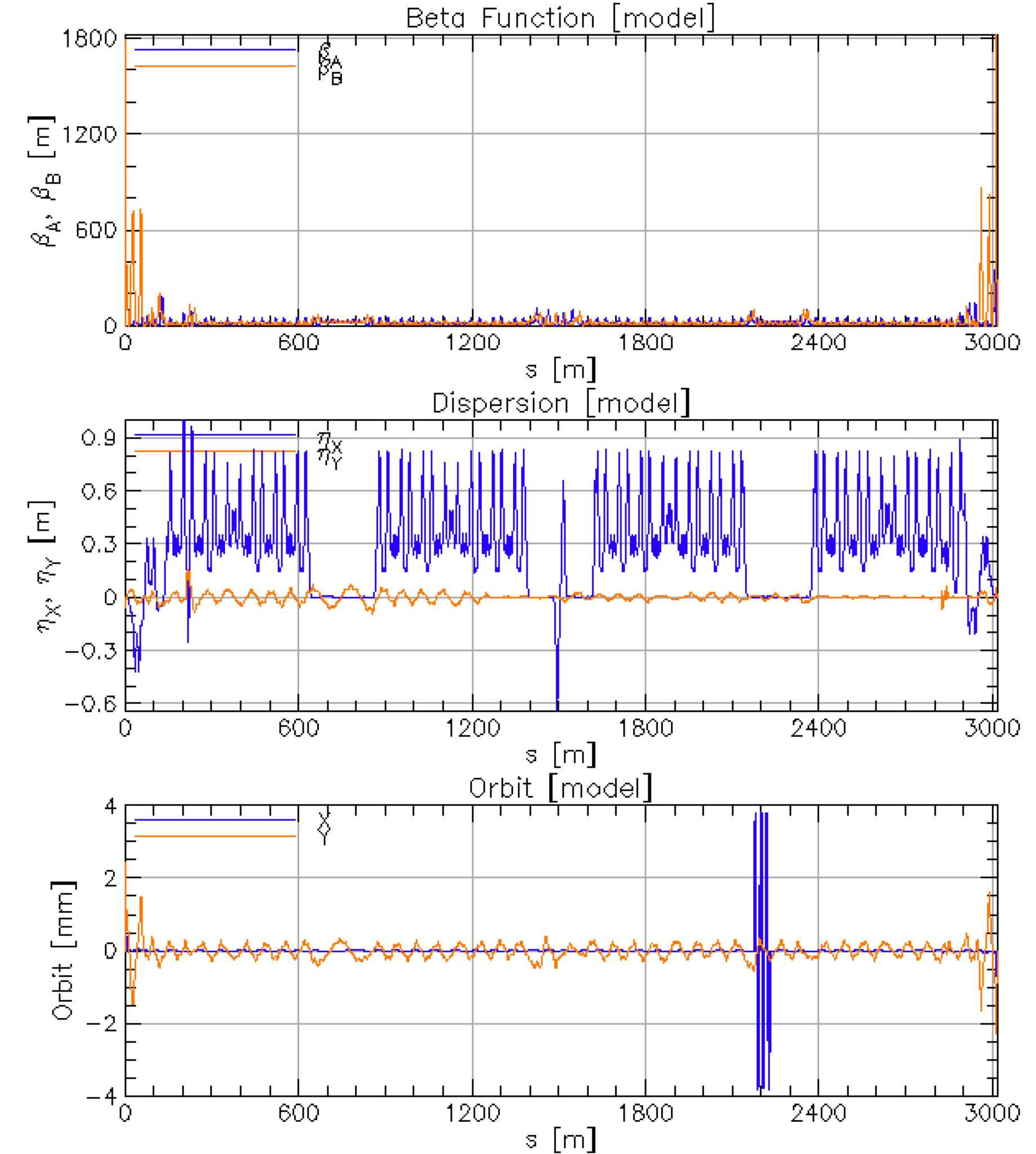


B2EAR_y -0.1mm

B2EBR: $y_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

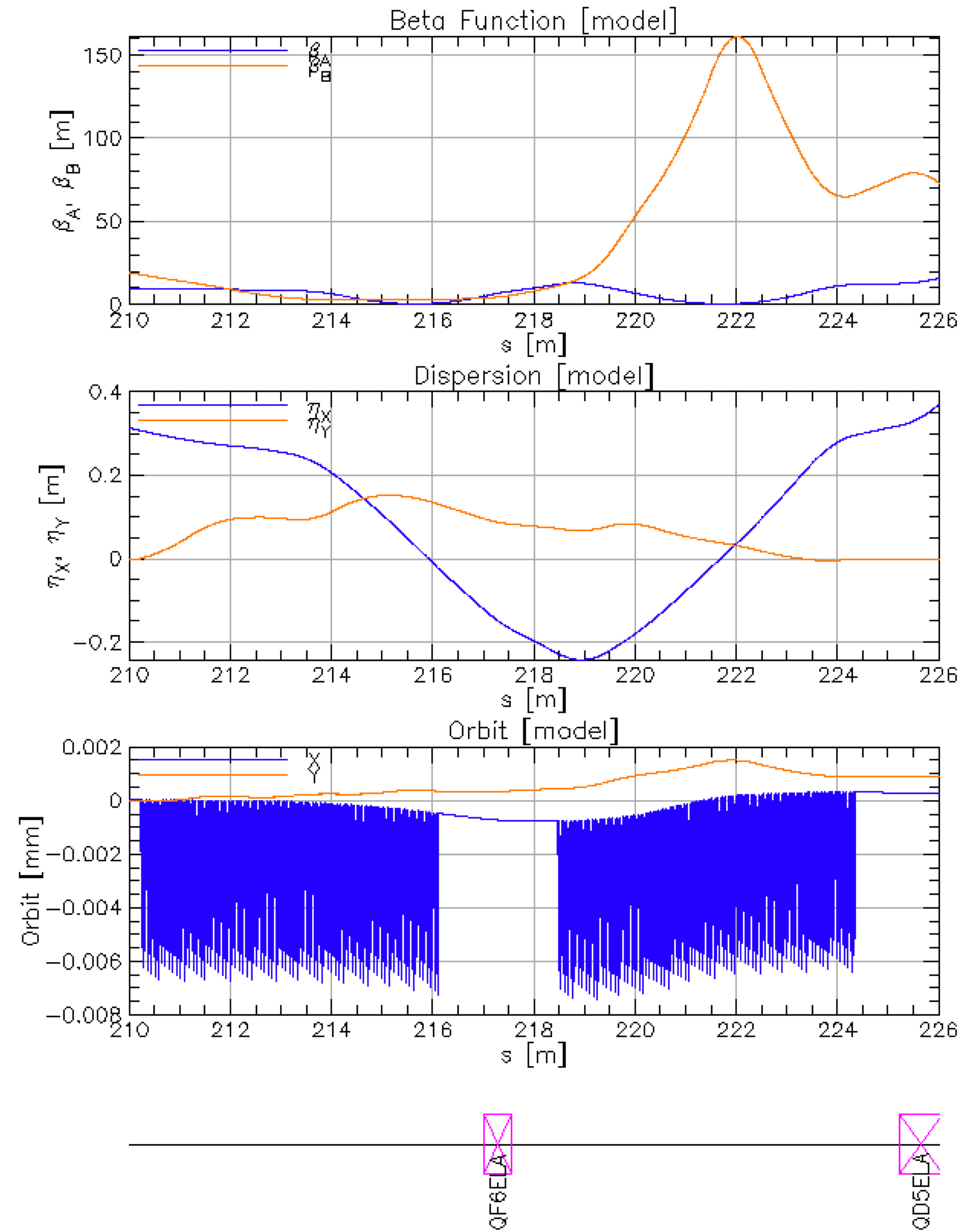
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

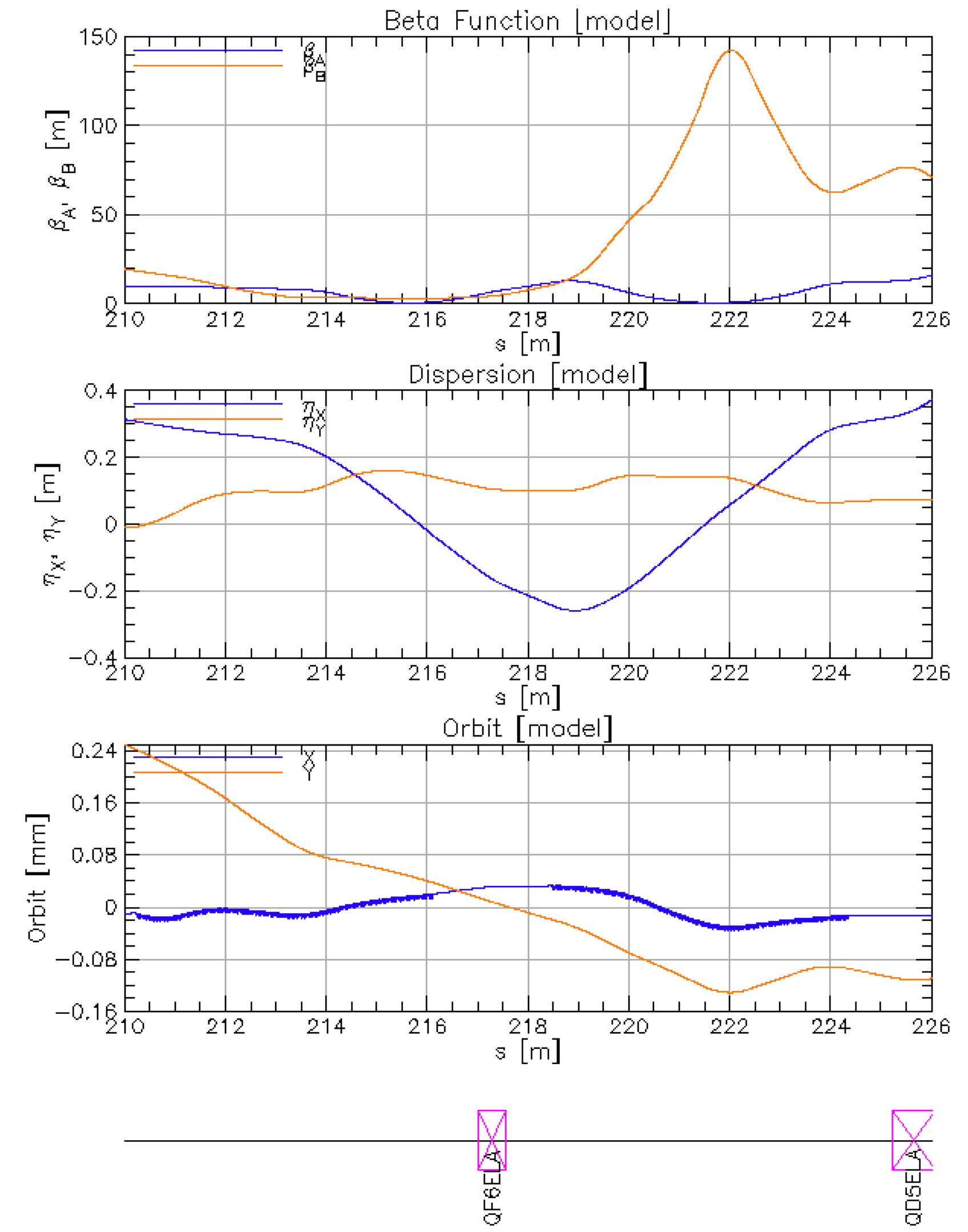
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EBR_y +0.1mm
	Model	Design	Model	Design		
Q	45.531118	45.531118	43.577655	43.577655	! Tune	
Chrom	1.267096	1.272229	1.283592	1.287377	! dQ/(dE/E)	
J_damp	0.963826	0.963434	1.026554	1.026556	! Damping Partition #	
Emittance	4.59768E-09	4.59974E-09	6.70798E-11	6.73998E-11	! Unnormalized	

L-Rot

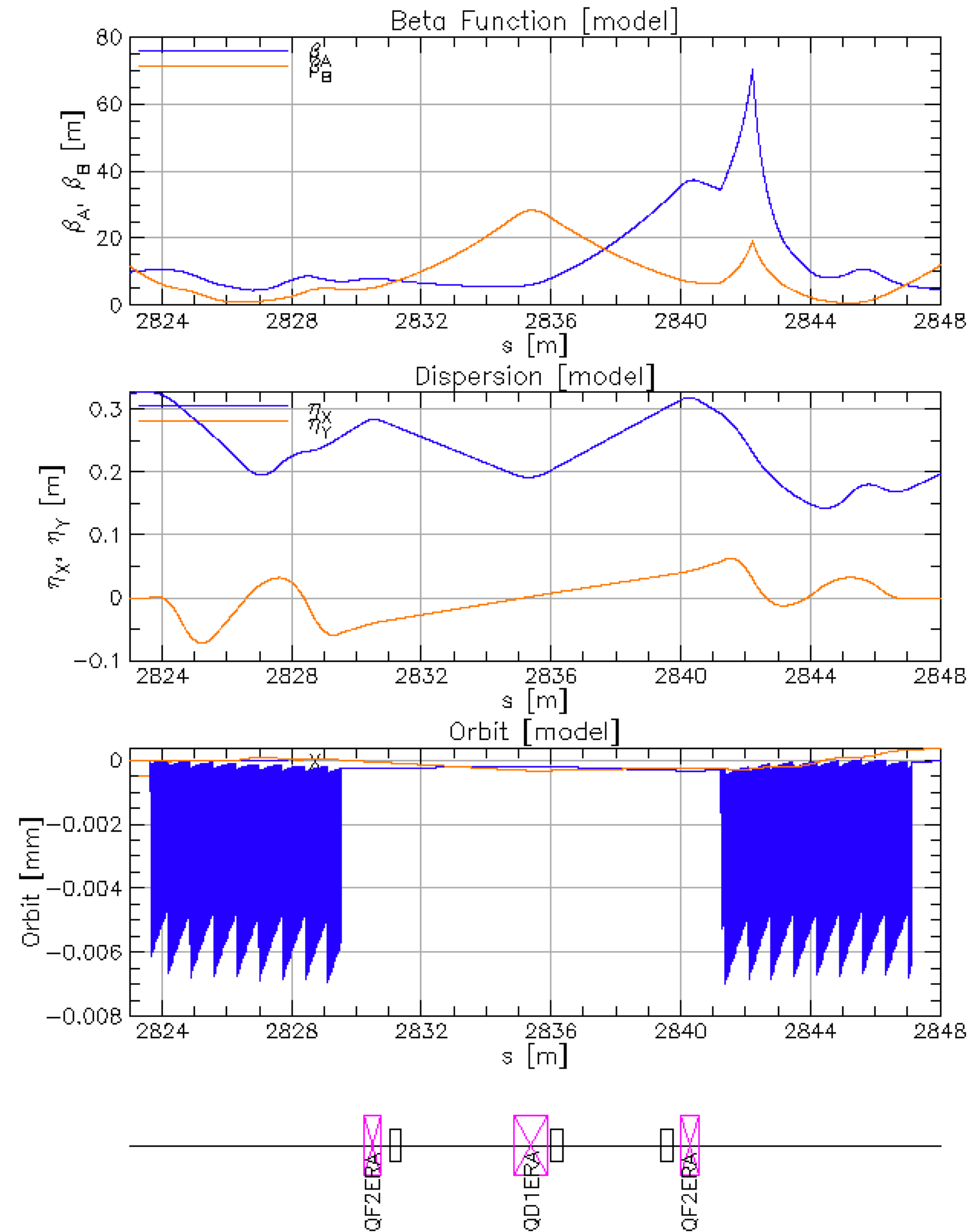


original

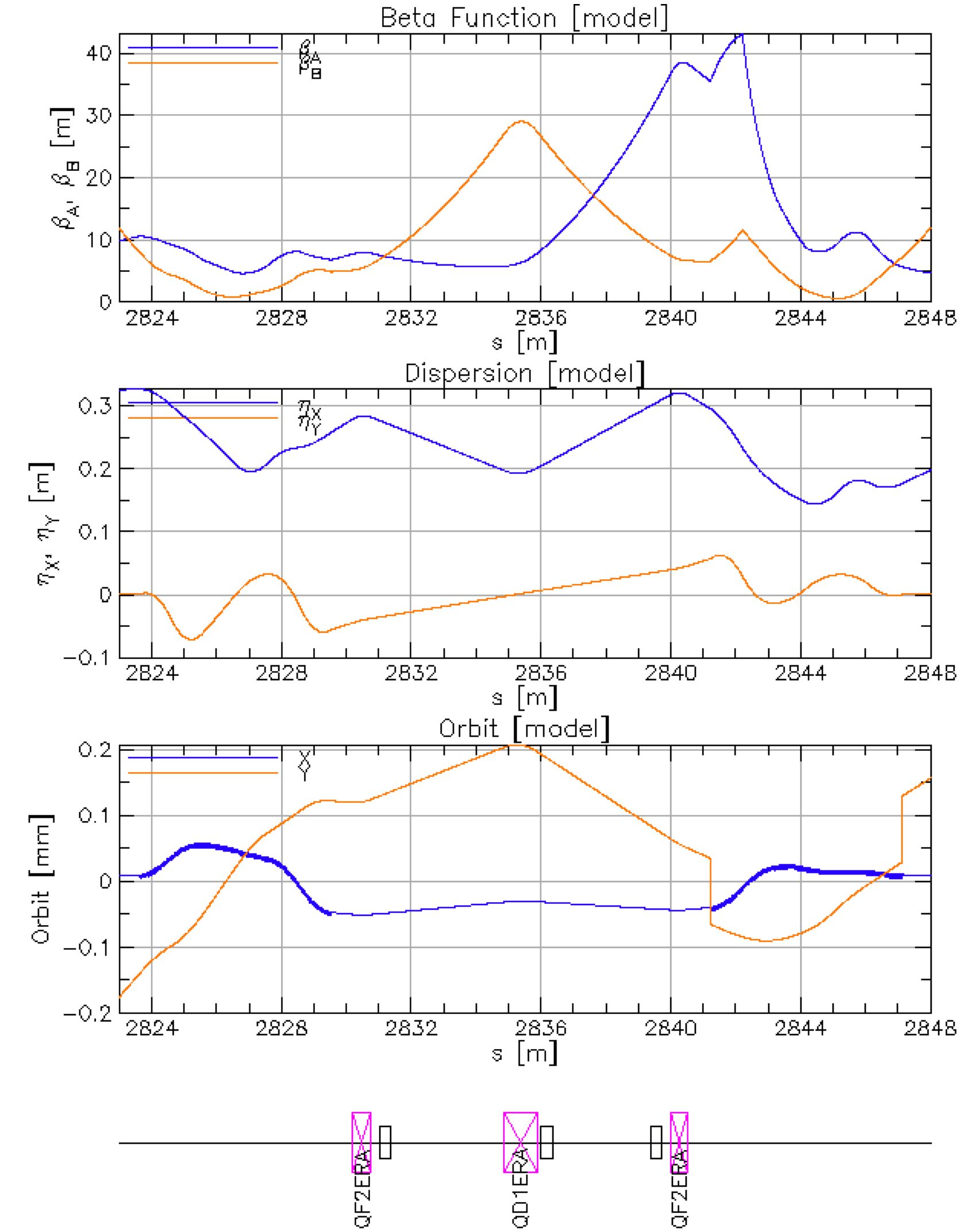


B2EBR_y +0.1mm

R-Rot

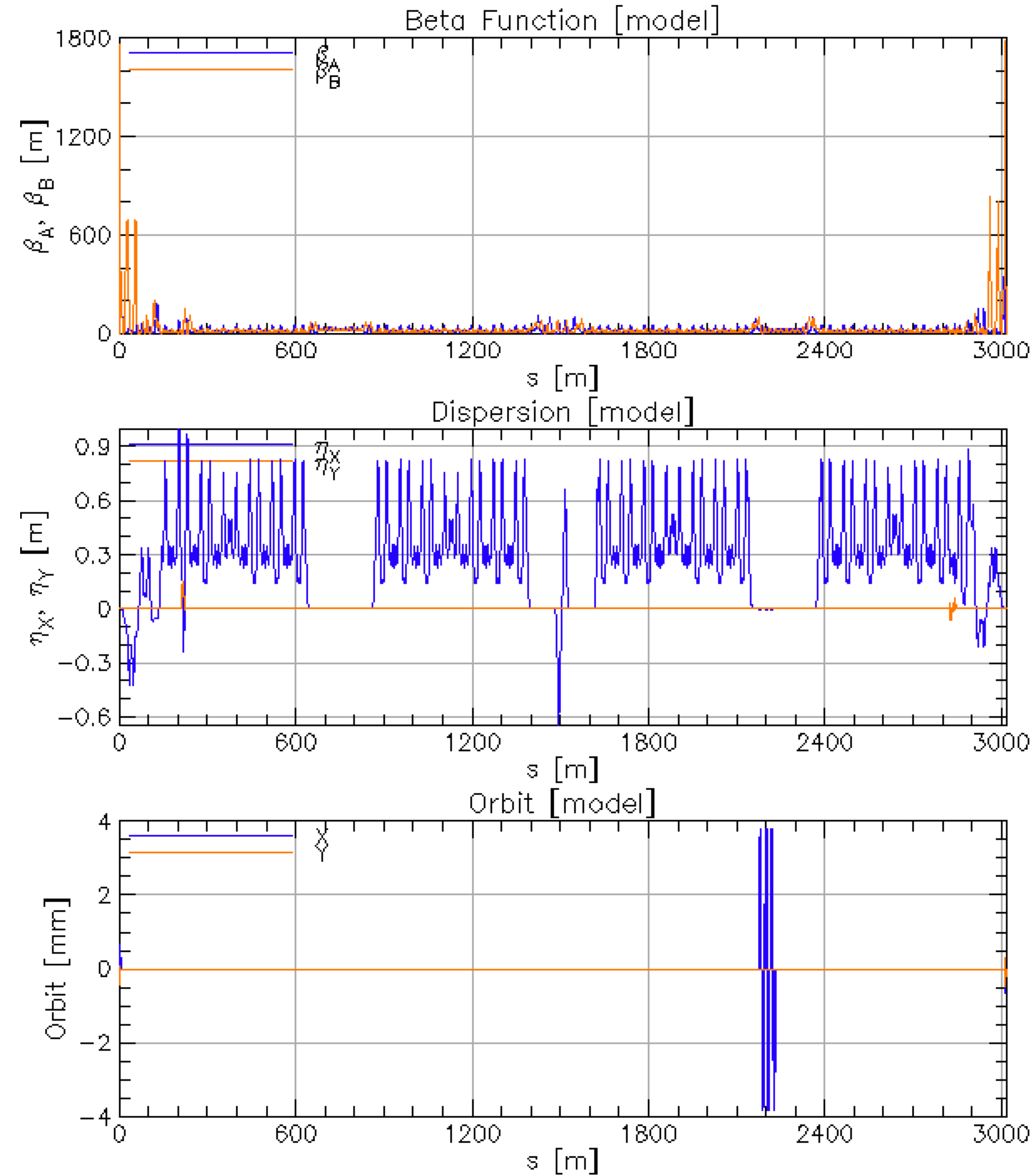


original

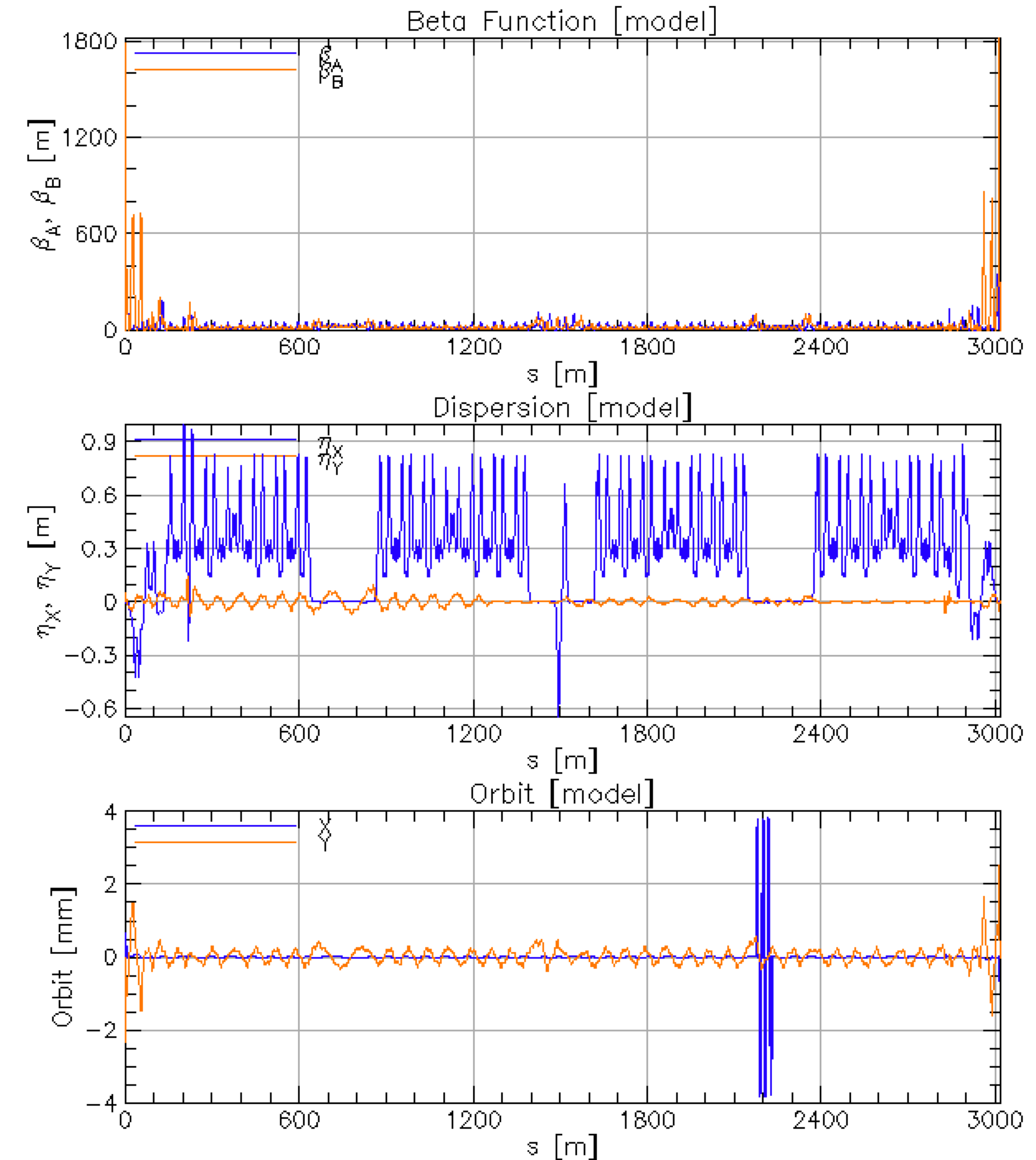


B2EBR_y +0.1mm

B2EBR: $y_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

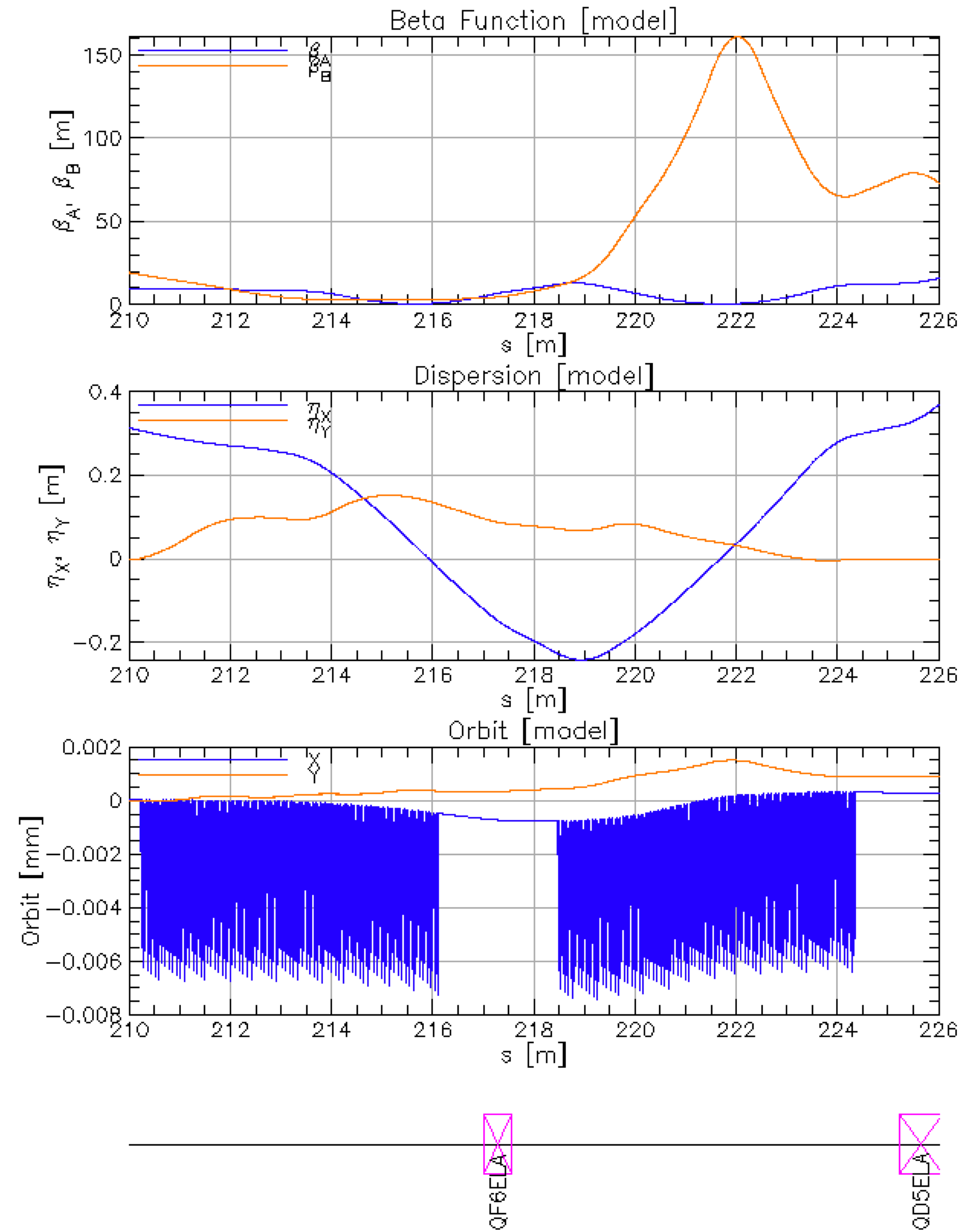
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

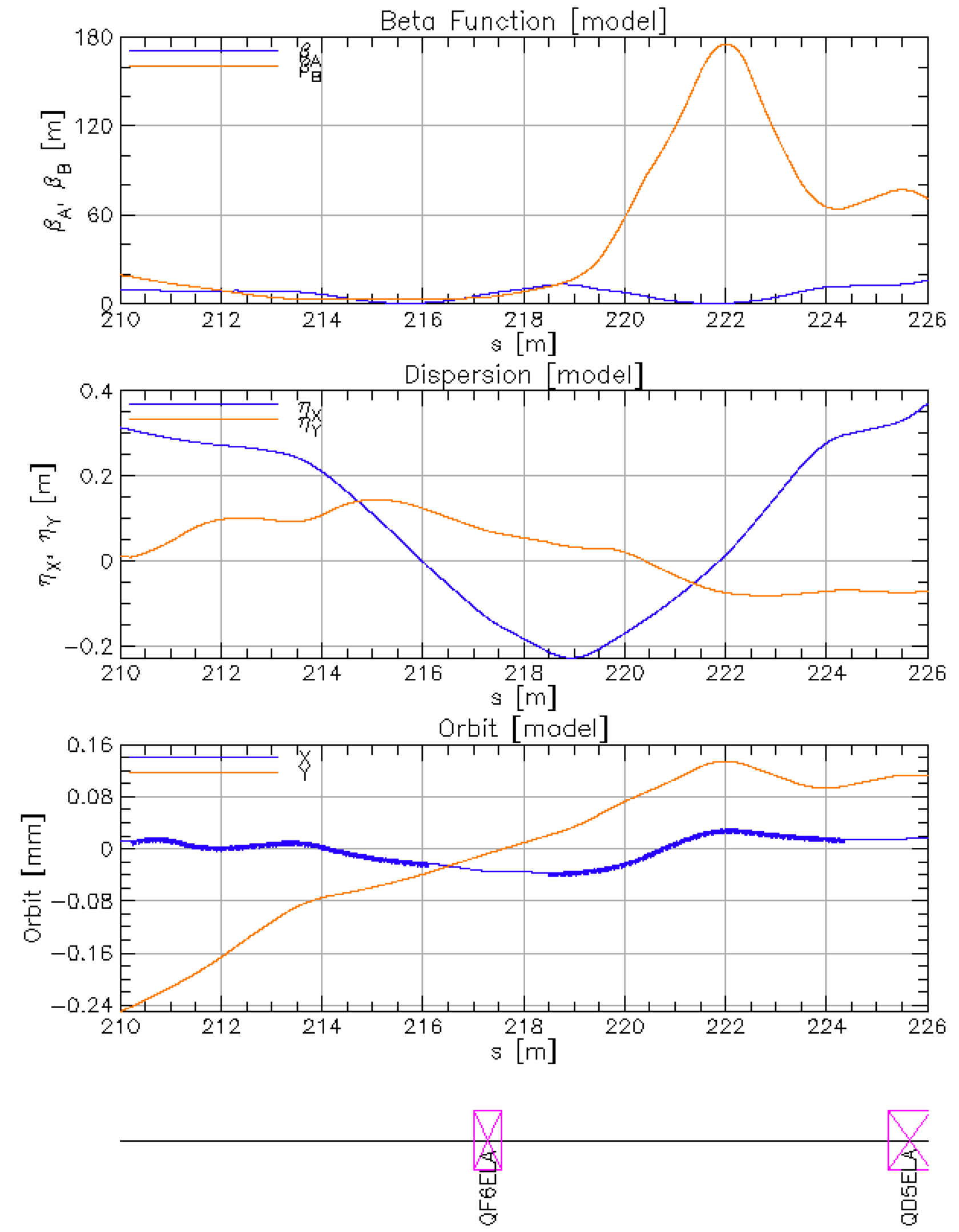
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EBR_y -0.1mm
	Model	Design	Model	Design		
Q	45.530909	45.530909	43.577863	43.577863	! Tune	
Chrom	1.363073	1.371619	1.280363	1.285302	! dQ/(dE/E)	
J_damp	0.965495	0.964898	1.023754	1.023837	! Damping Partition #	
Emittance	4.59068E-09	4.59391E-09	6.54311E-11	6.57508E-11	! Unnormalized	

L-Rot

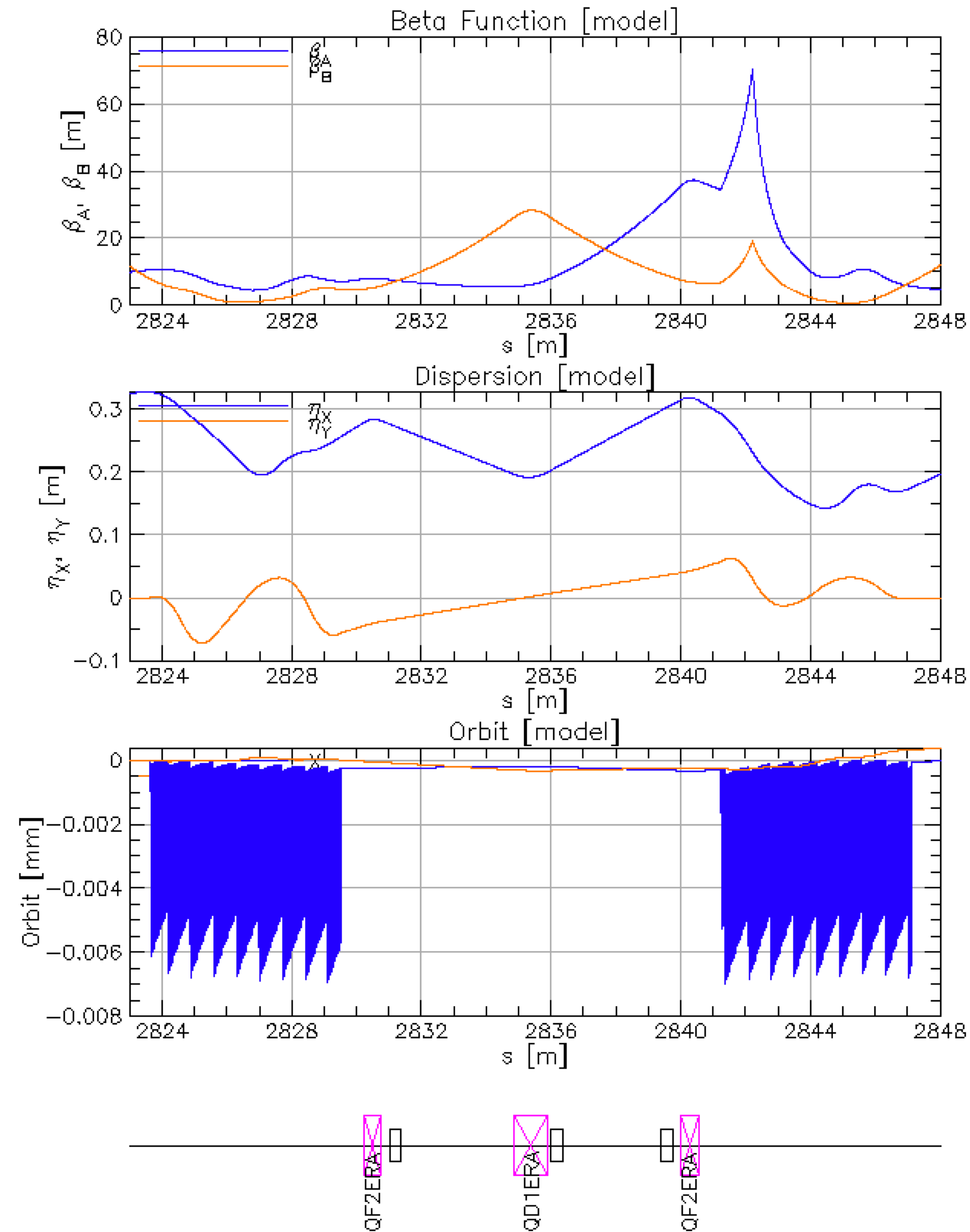


original

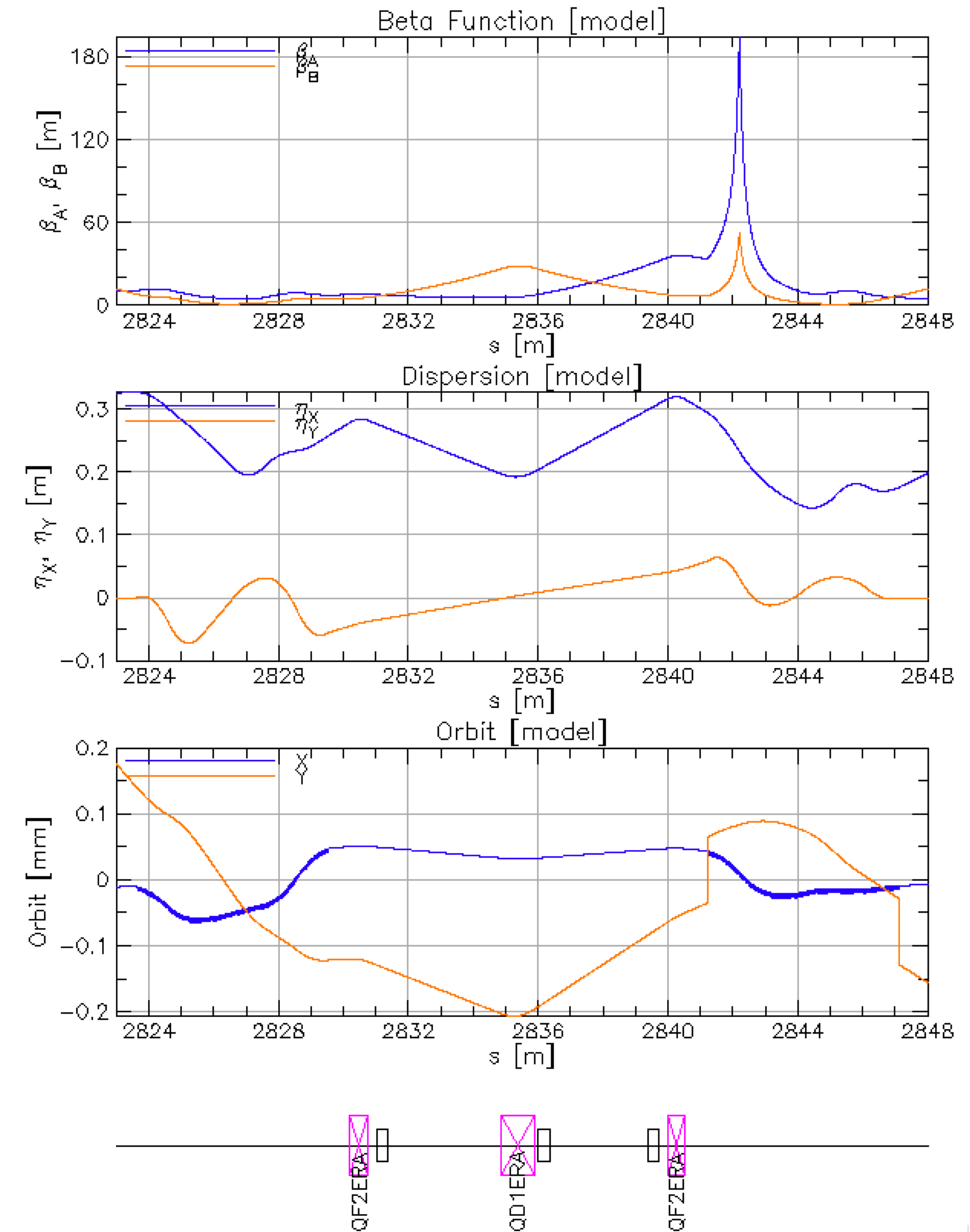


B2EBR_y -0.1mm

R-Rot



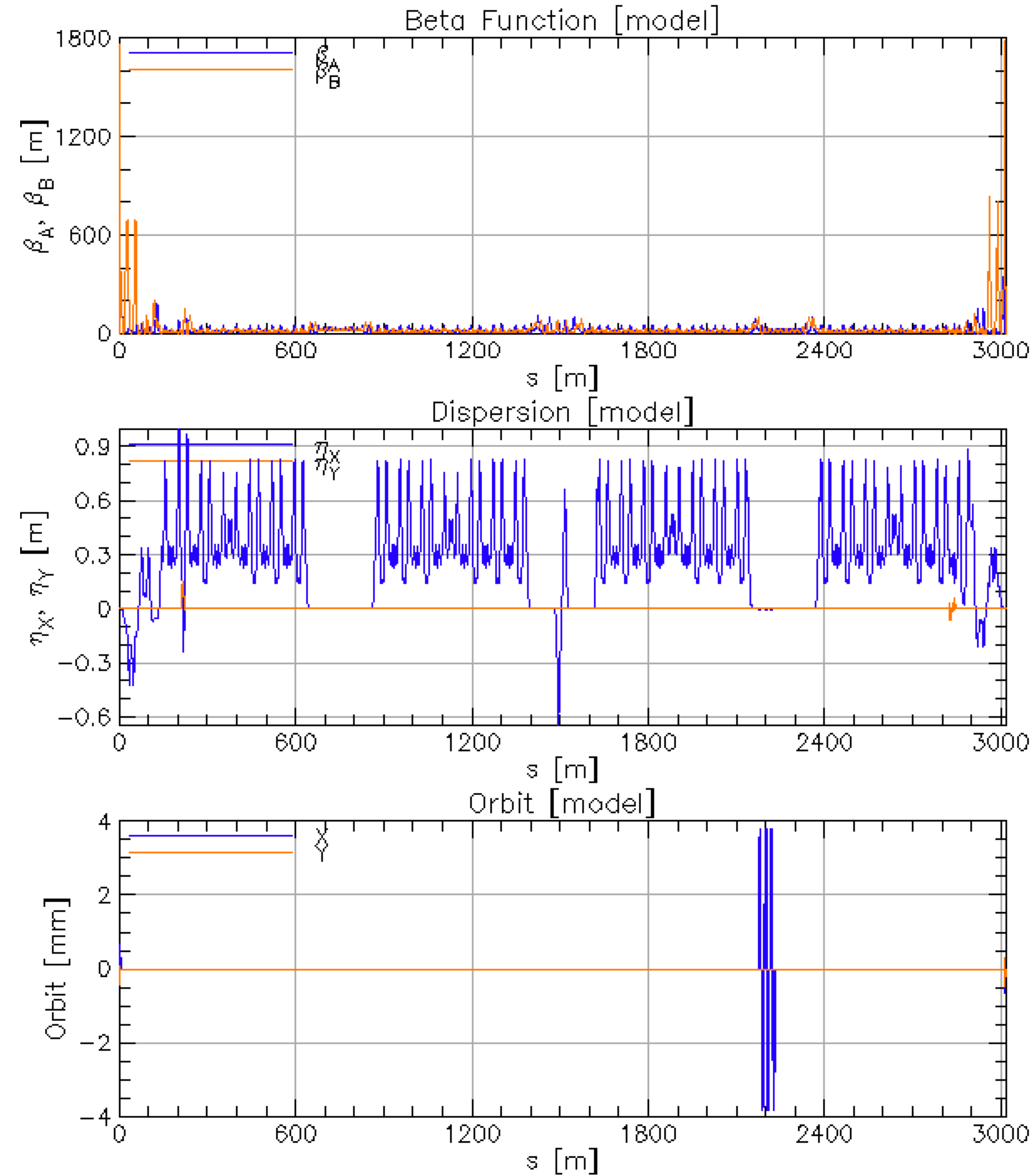
original



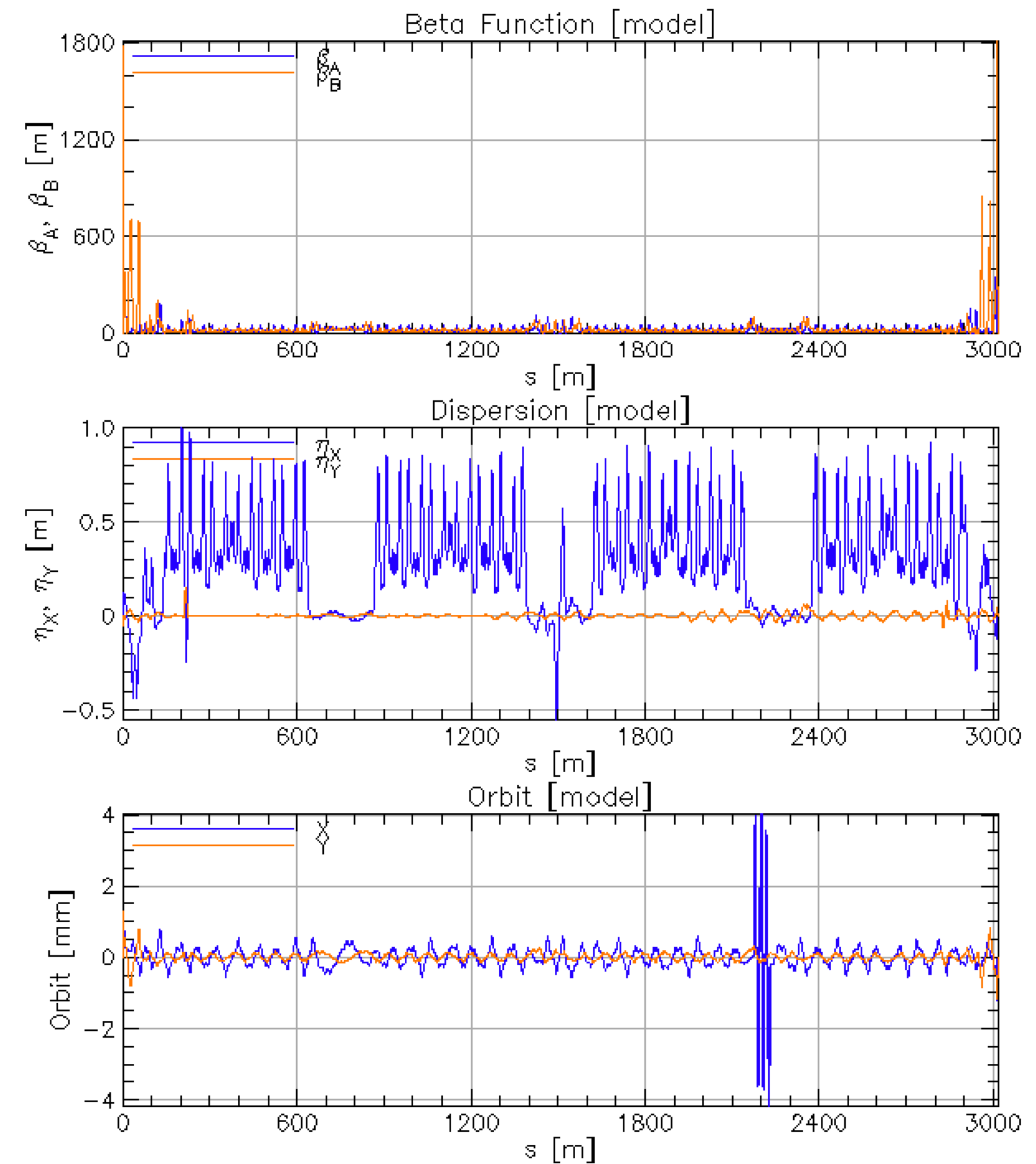
B2EBR_y -0.1mm

A-Mode			B-Mode			Rot ring
	Model	Design		Model	Design	
Q	45.530994	45.530994		43.580709	43.580709	
Chrom	1.591891	1.599271		1.621929	1.625672	
J_damp	0.966040	0.965554		1.000295	1.000288	
Emittance	4.59794E-09	4.60062E-09		8.97933E-12	8.98123E-12	! Unnormalized
A-Mode			B-Mode			B2EAL_y +0.1mm
	Model	Design		Model	Design	
Q	45.530896	45.530896		43.579536	43.579536	
Chrom	1.522343	1.531413		1.779148	1.783723	
J_damp	0.967050	0.966458		1.029056	1.029217	
Emittance	4.58778E-09	4.59104E-09		4.09864E-11	4.11368E-11	! Unnormalized
A-Mode			B-Mode			B2EAL_y -0.1mm
	Model	Design		Model	Design	
Q	45.531033	45.531033		43.578941	43.578941	
Chrom	1.450721	1.456350		1.385825	1.389290	
J_damp	0.963992	0.963602		1.032952	1.033085	
Emittance	4.61051E-09	4.61262E-09		4.03531E-11	4.05114E-11	! Unnormalized
A-Mode			B-Mode			B2EBL_y +0.1mm
	Model	Design		Model	Design	
Q	45.531118	45.531118		43.577655	43.577655	
Chrom	1.267096	1.272229		1.283592	1.287377	
J_damp	0.963826	0.963434		1.026554	1.026556	
Emittance	4.59768E-09	4.59974E-09		6.70798E-11	6.73998E-11	! Unnormalized
A-Mode			B-Mode			B2EBL_y -0.1mm
	Model	Design		Model	Design	
Q	45.530909	45.530909		43.577863	43.577863	
Chrom	1.363073	1.371619		1.280363	1.285302	
J_damp	0.965495	0.964898		1.023754	1.023837	
Emittance	4.59068E-09	4.59391E-09		6.54311E-11	6.57508E-11	! Unnormalized

B2EAL: $x_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

Ring Parameters Comparison

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized

HER

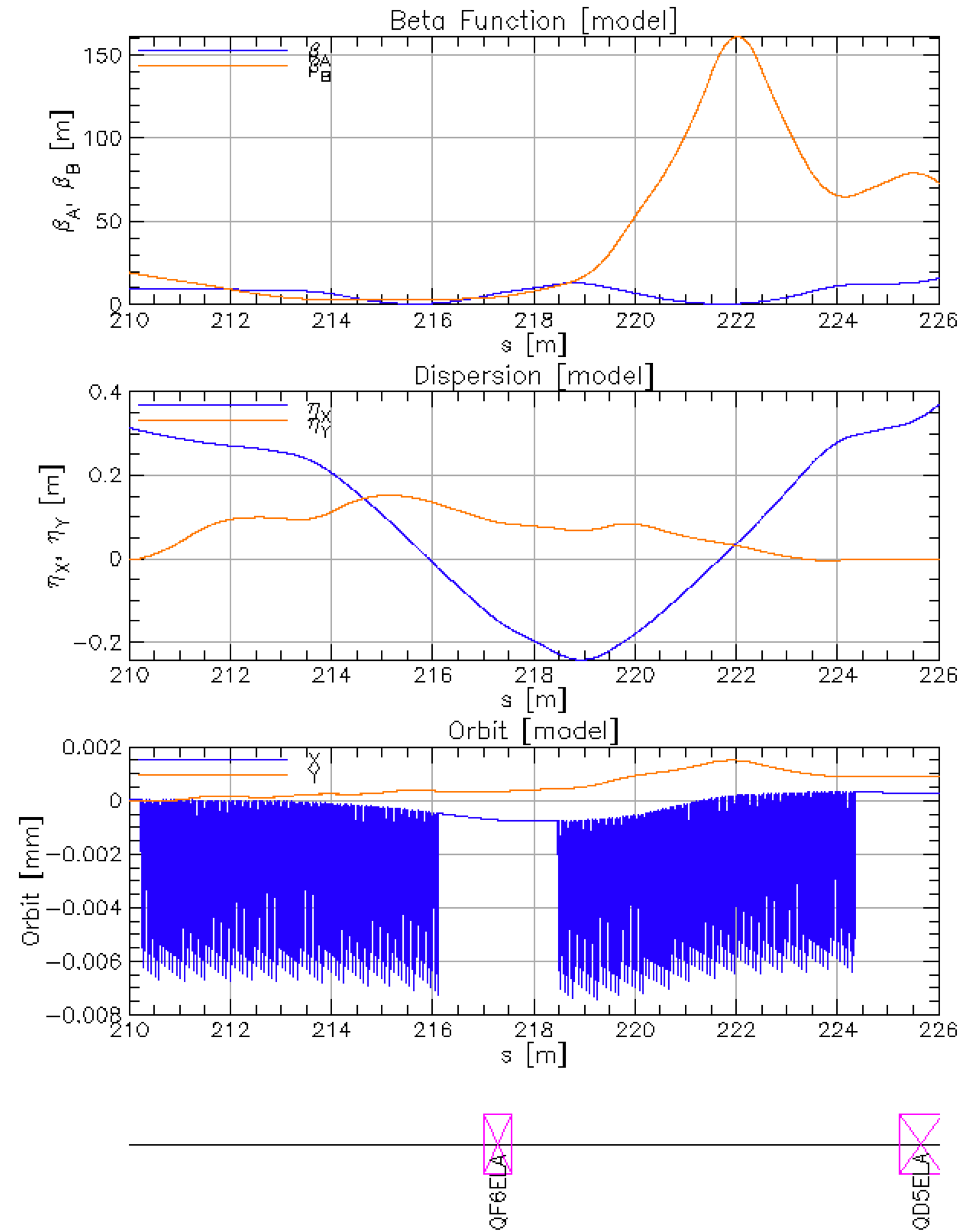
A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized

Rot ring

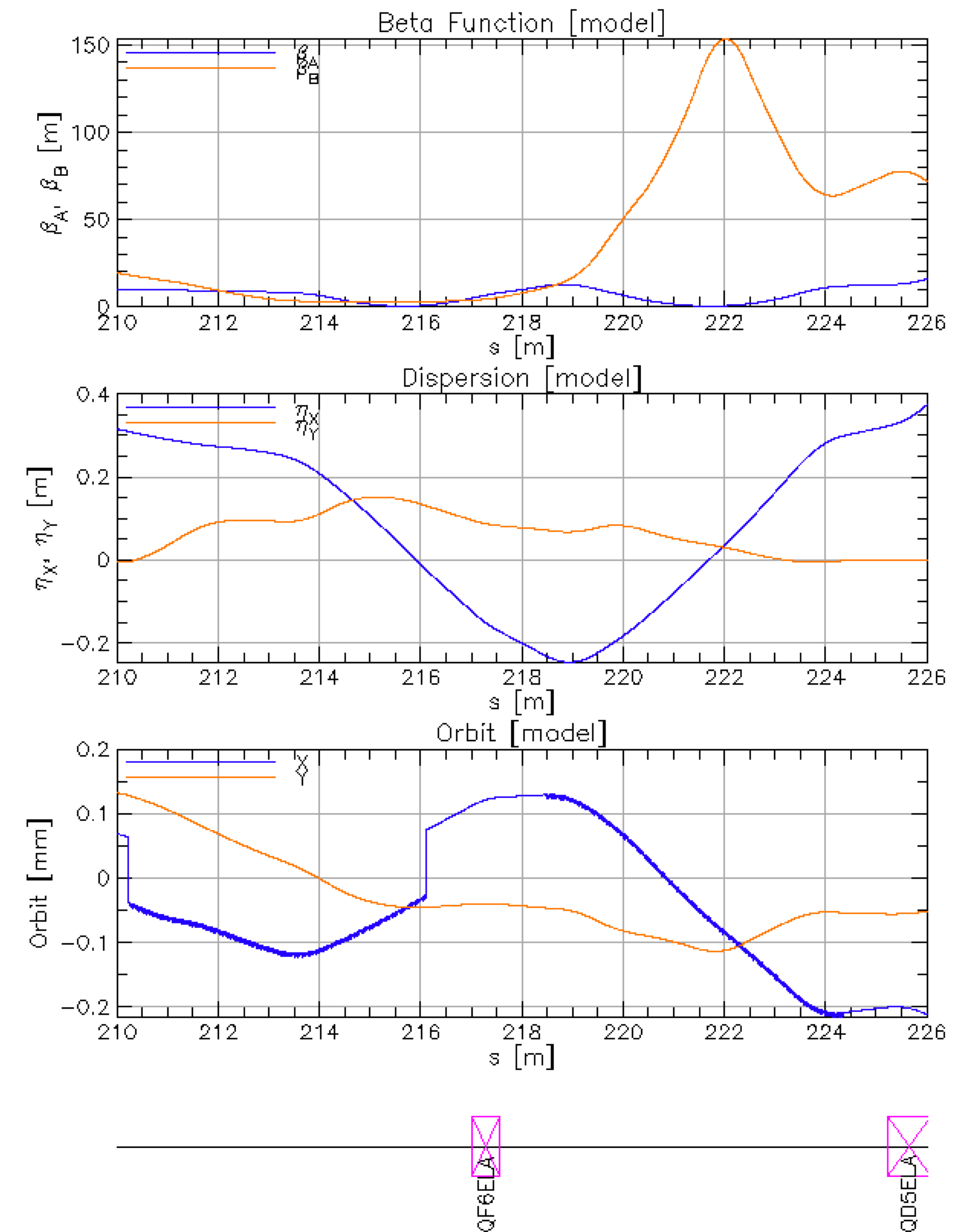
A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.531140	45.531140	43.578366	43.578366	! Tune
Chrom	1.582132	1.582132	0.498725	0.498725	! dQ/(dE/E)
J_damp	0.975002	0.975002	1.013658	1.013658	! Damping Partition #
Emittance	4.65520E-09	4.65520E-09	3.57291E-11	3.57291E-11	! Unnormalized

B2EAL_x +0.1mm

L-Rot

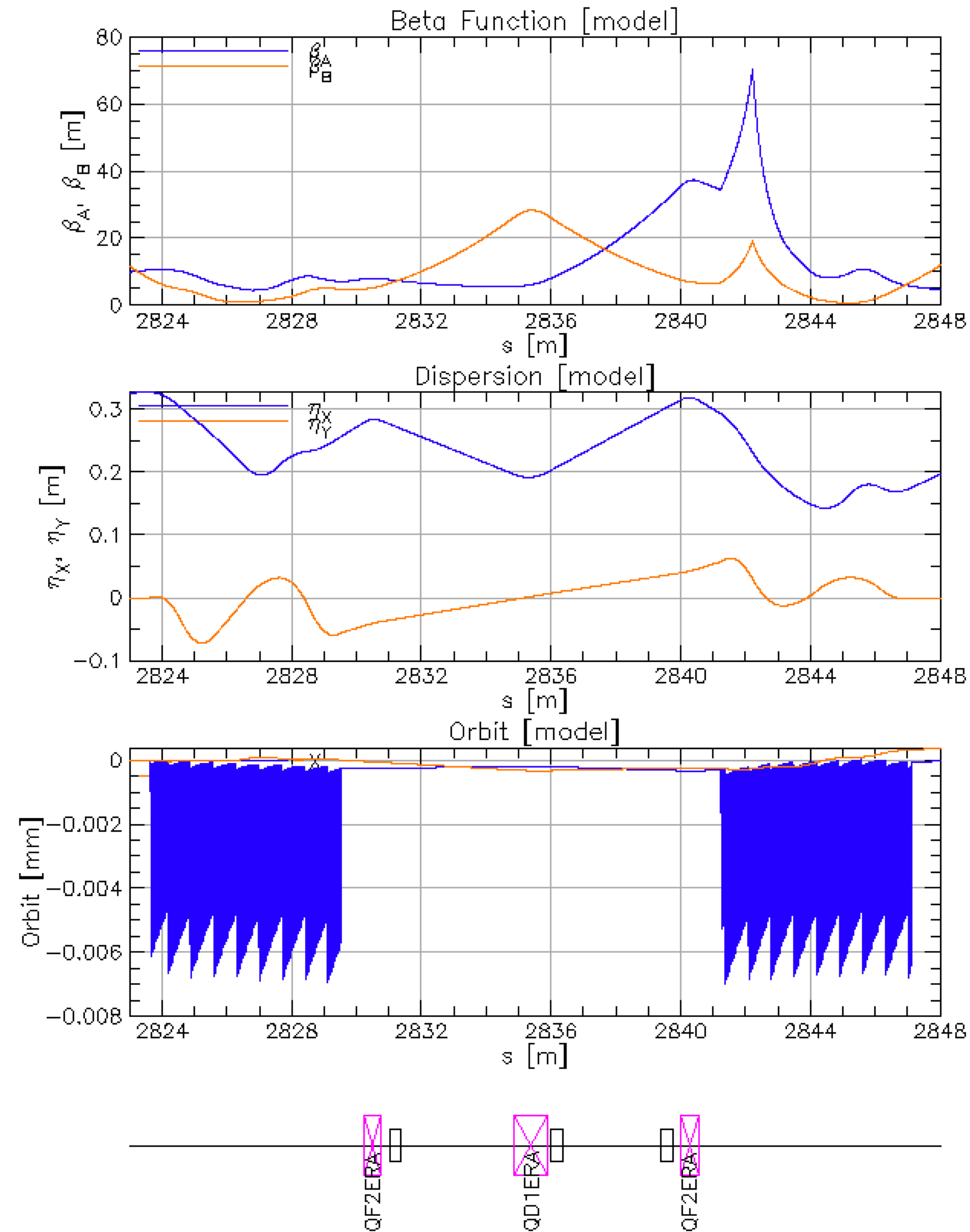


original

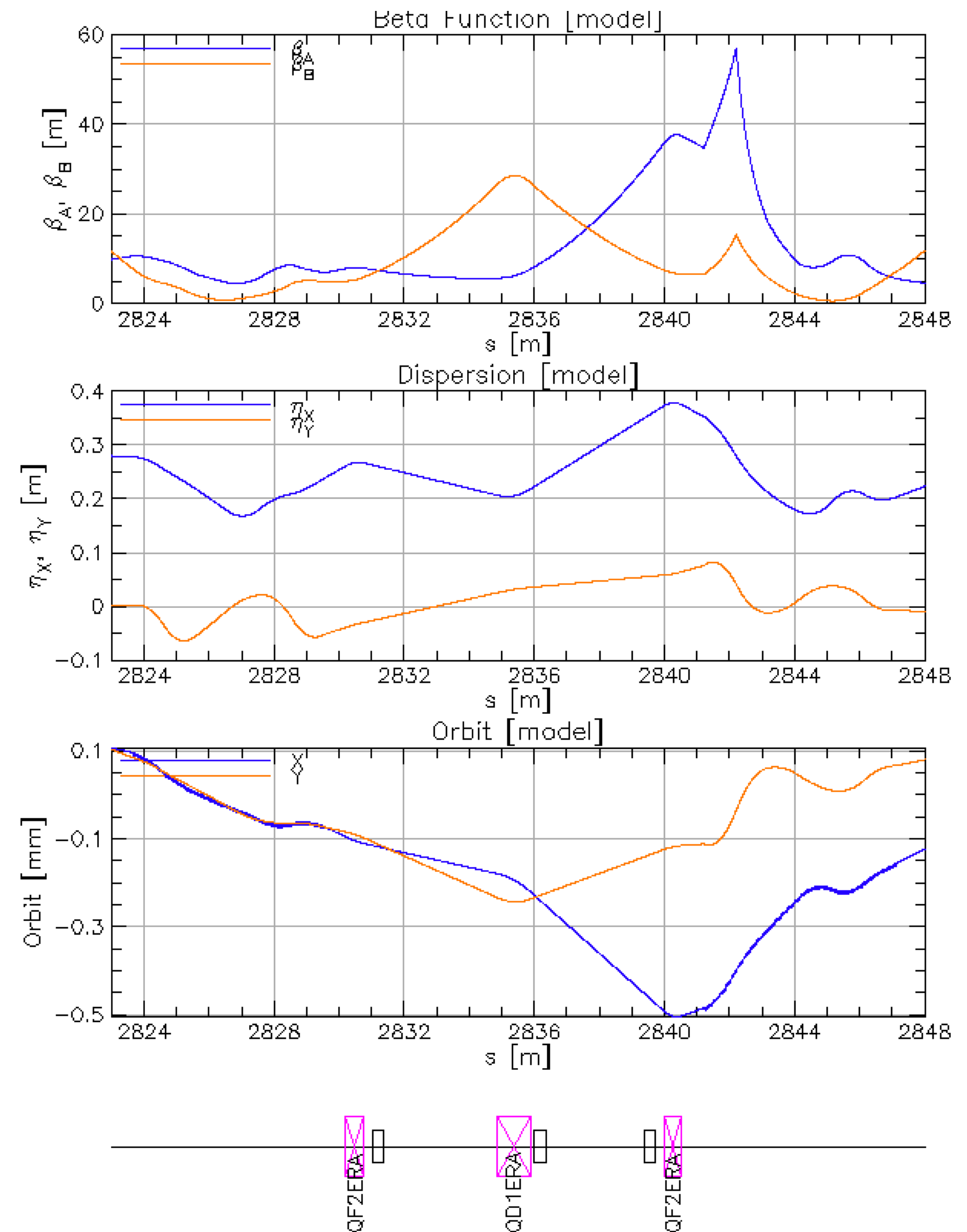


B2EAL_x +0.1mm

R-Rot

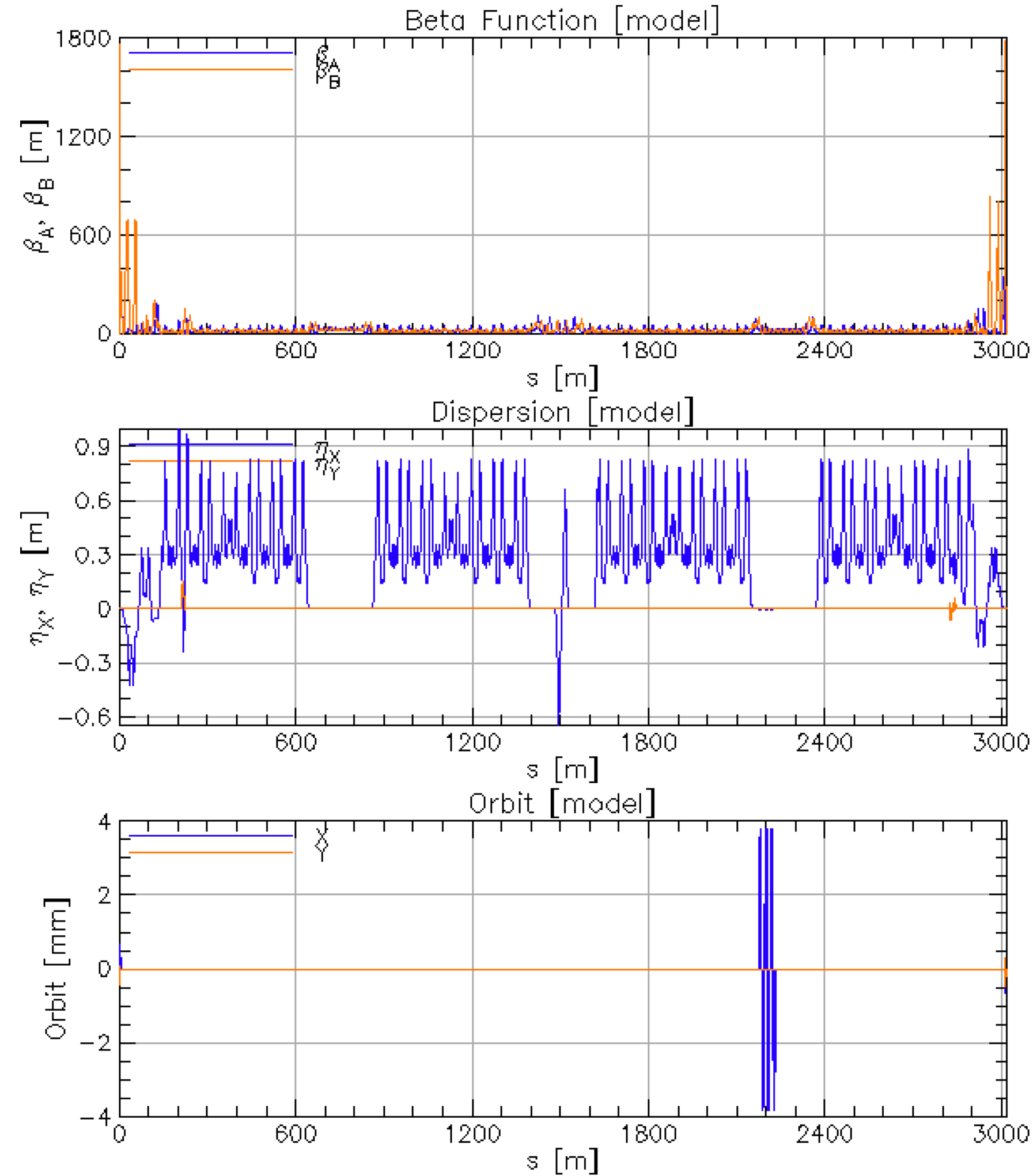


original

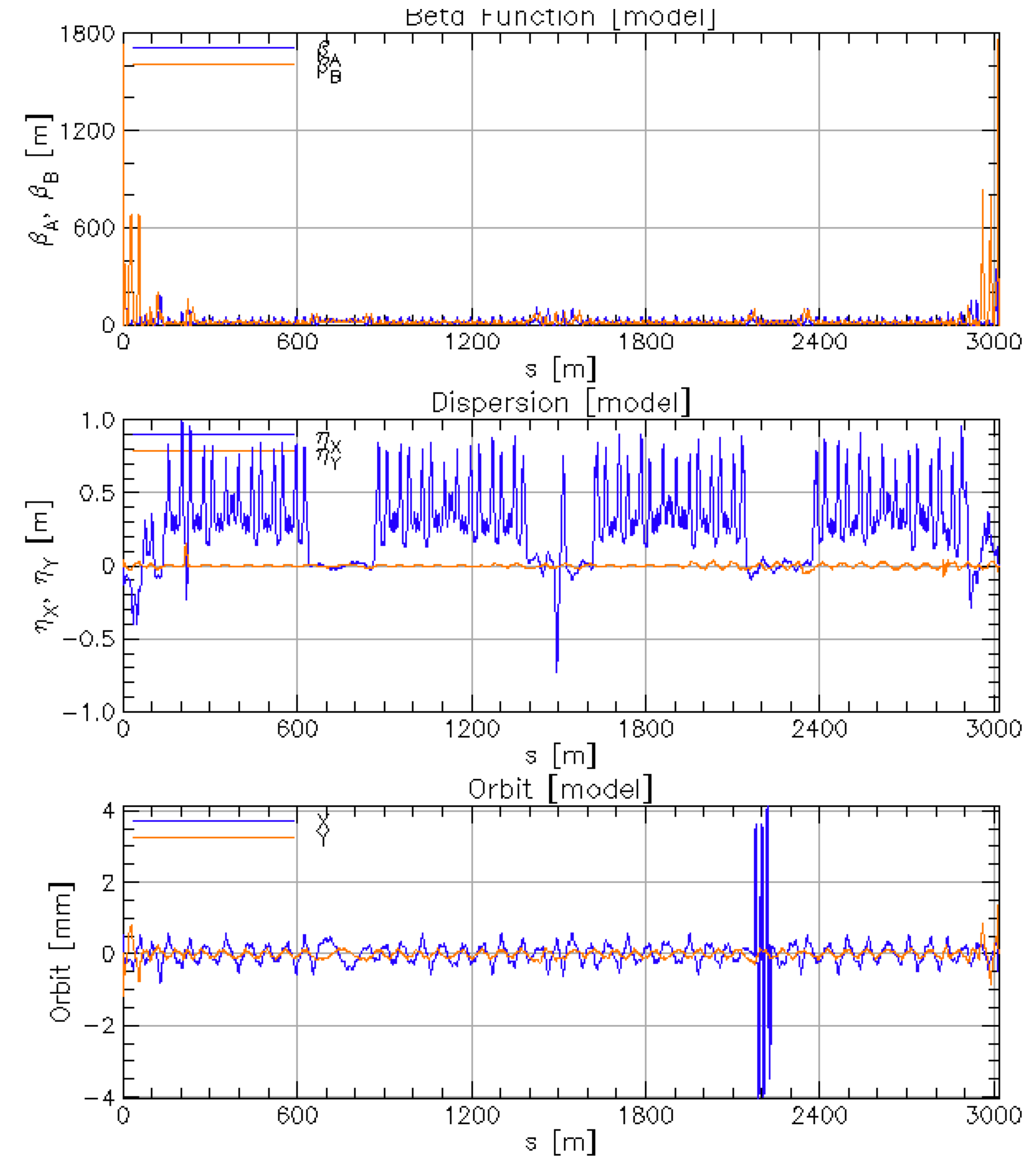


B2EAL_x +0.1mm

B2EAL: $x_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

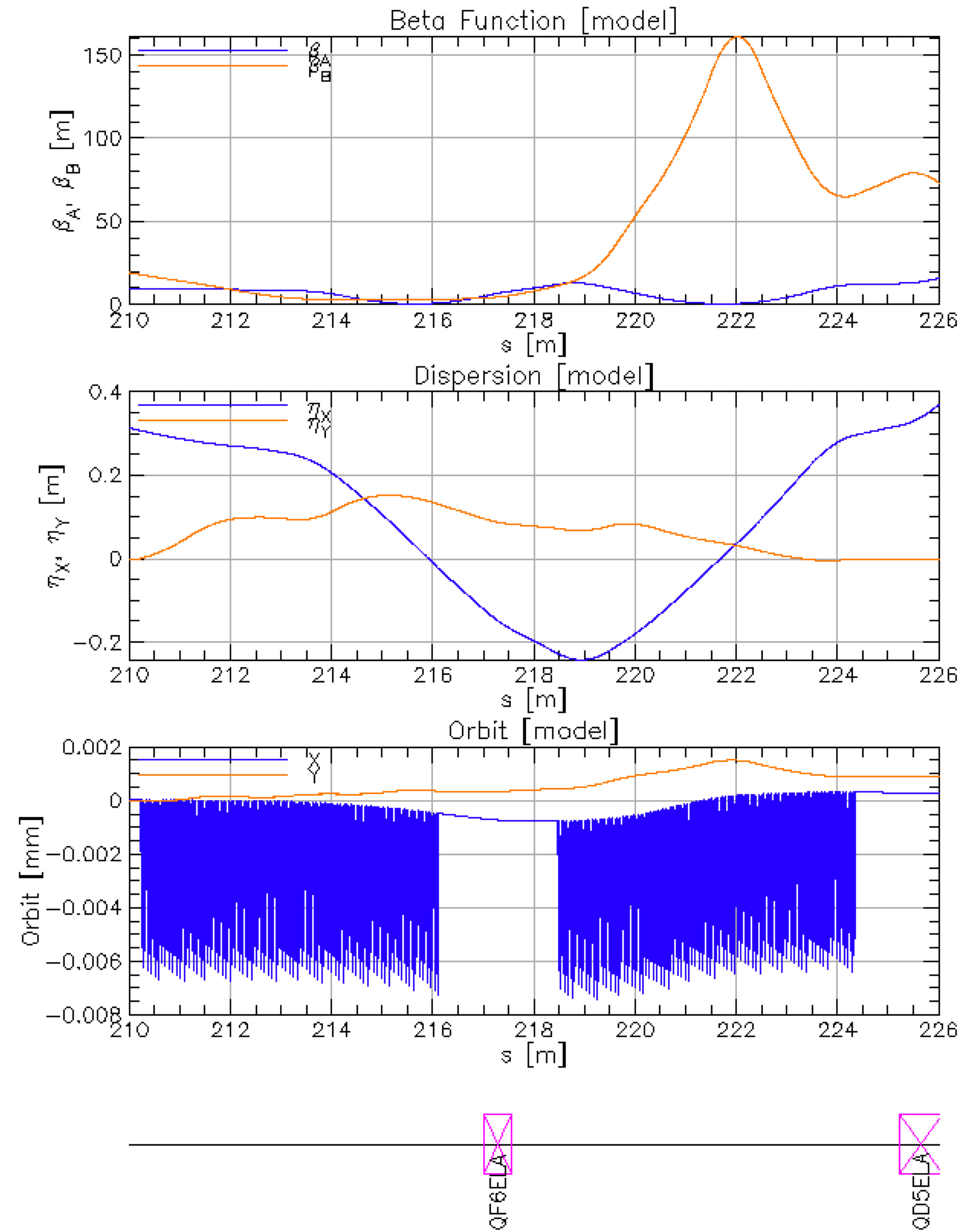
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

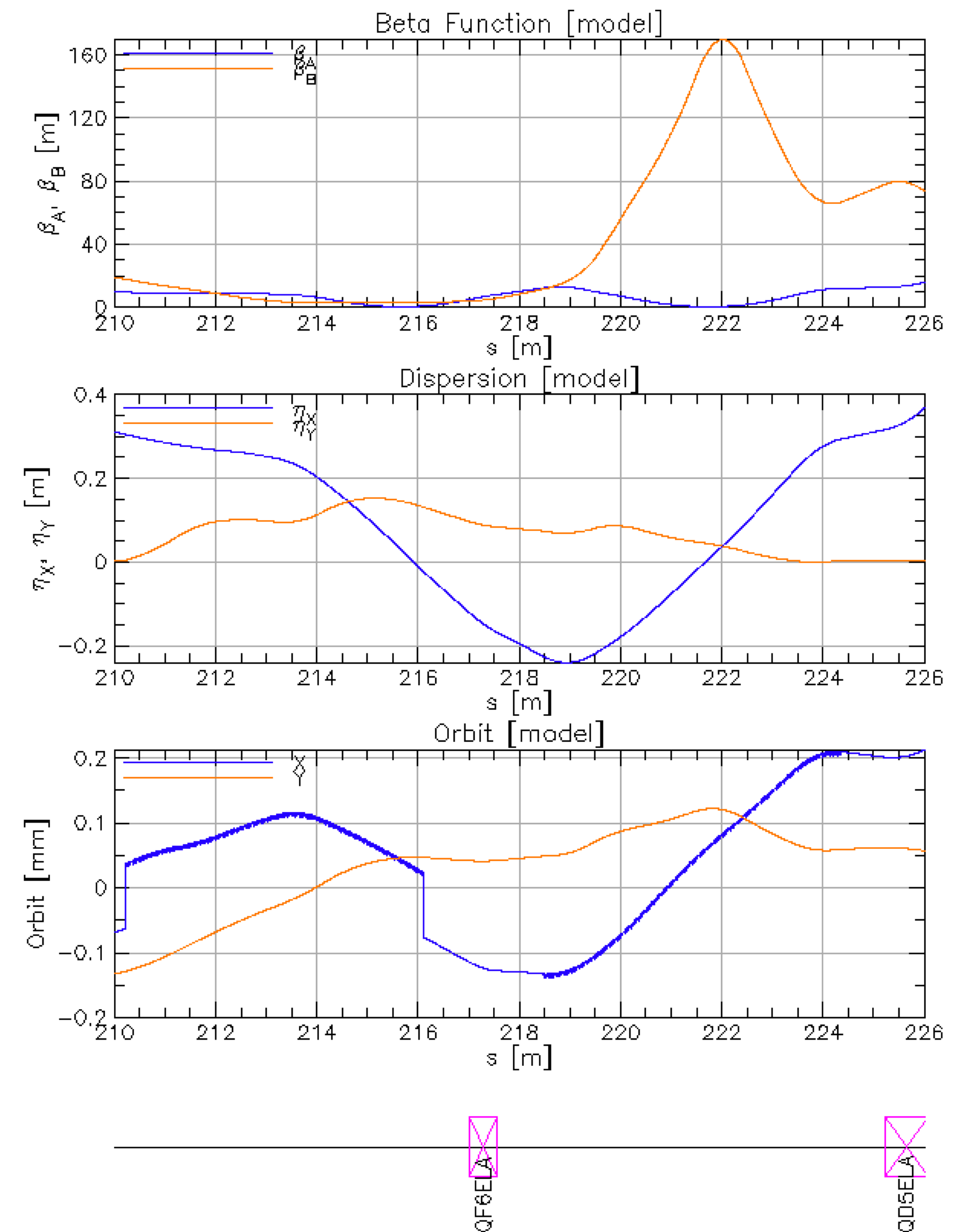
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EAL_x -0.1mm
	Model	Design	Model	Design		
Q	45.530774	45.530774	43.580756	43.580756	! Tune	
Chrom	1.449699	1.464931	2.550247	2.560895	! dQ/(dE/E)	
J_damp	0.954493	0.953527	1.008076	1.008144	! Damping Partition #	
Emittance	4.70714E-09	4.71332E-09	3.05479E-11	3.06114E-11	! Unnormalized	

L-Rot

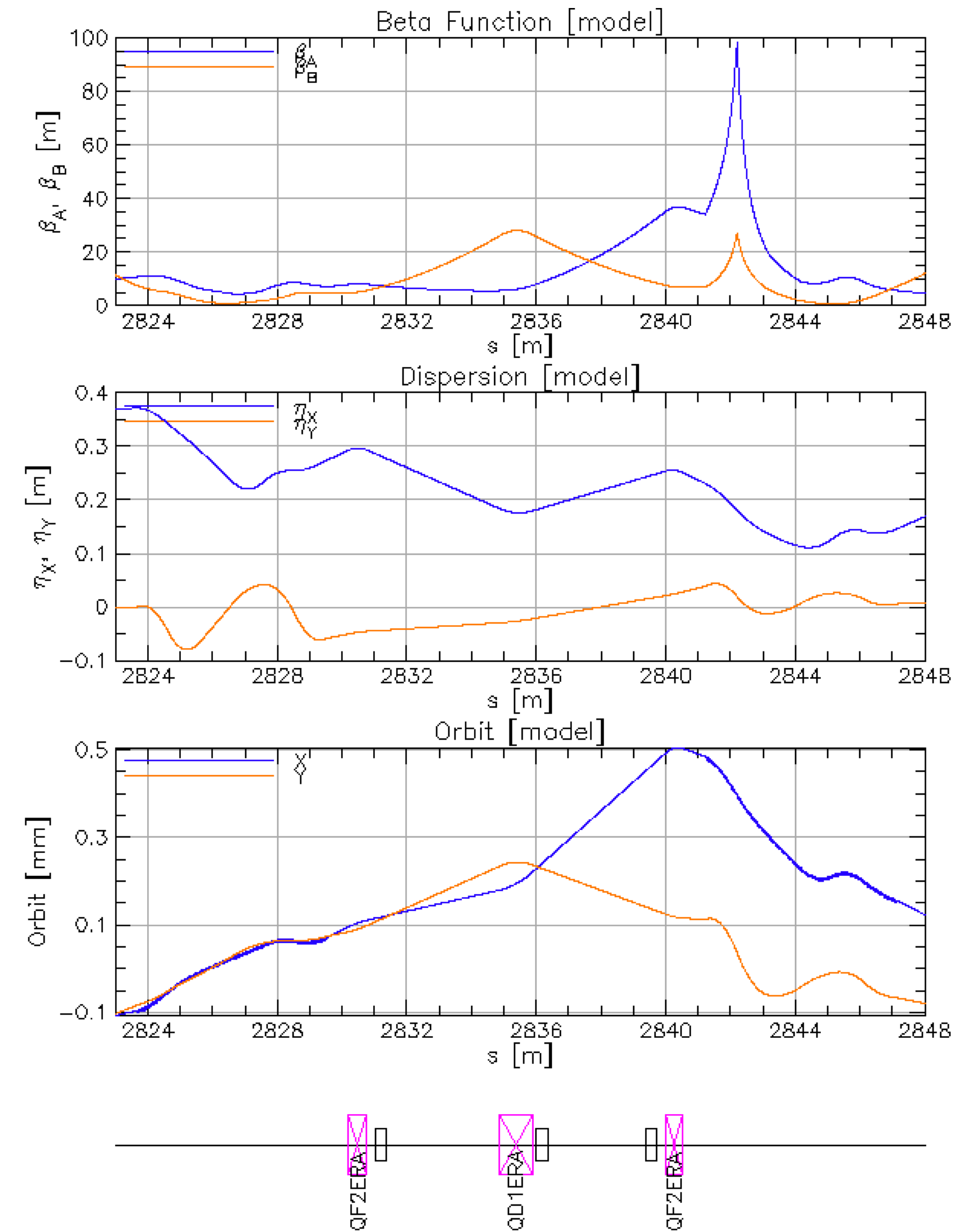
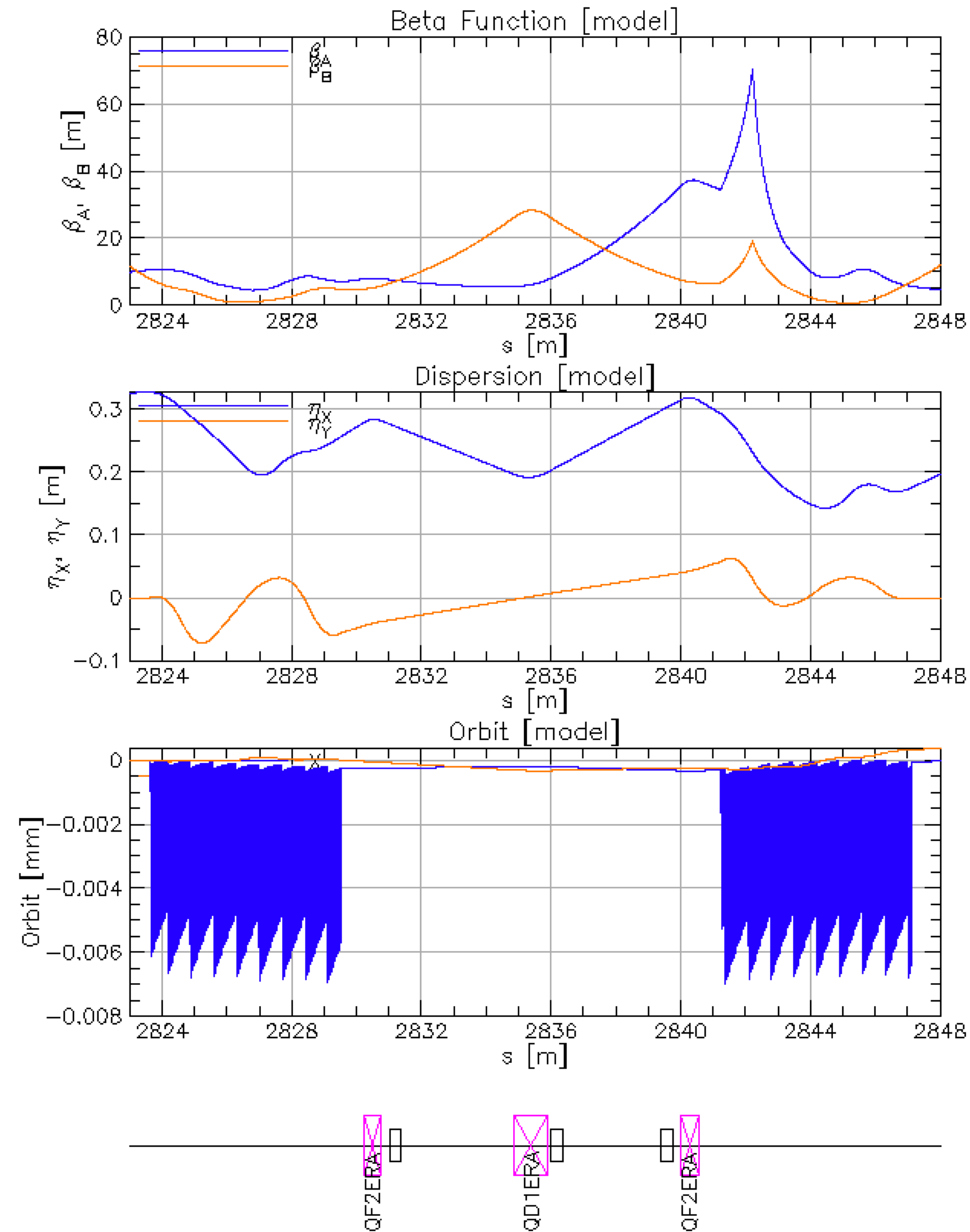


original

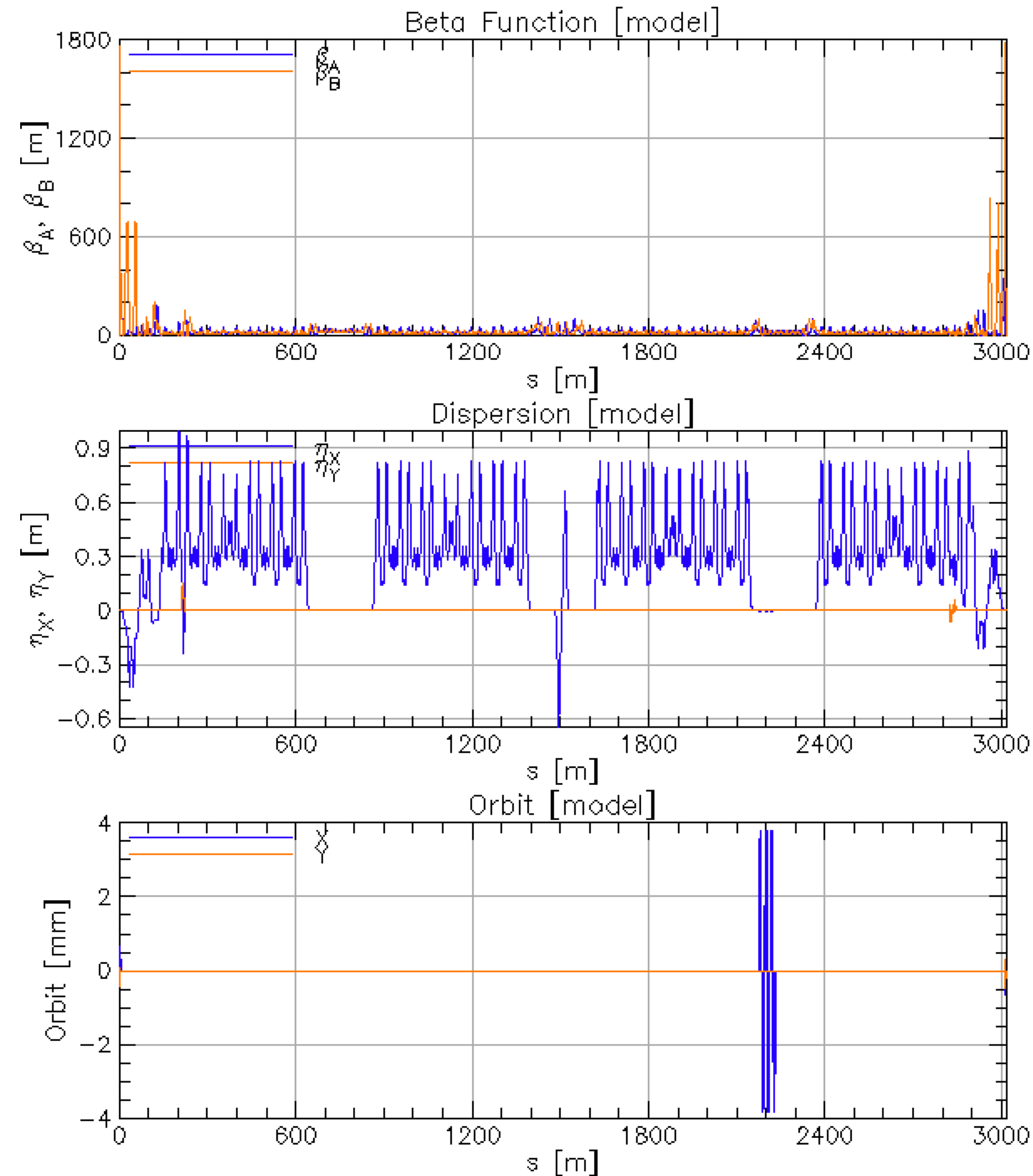


B2EAL_x -0.1mm

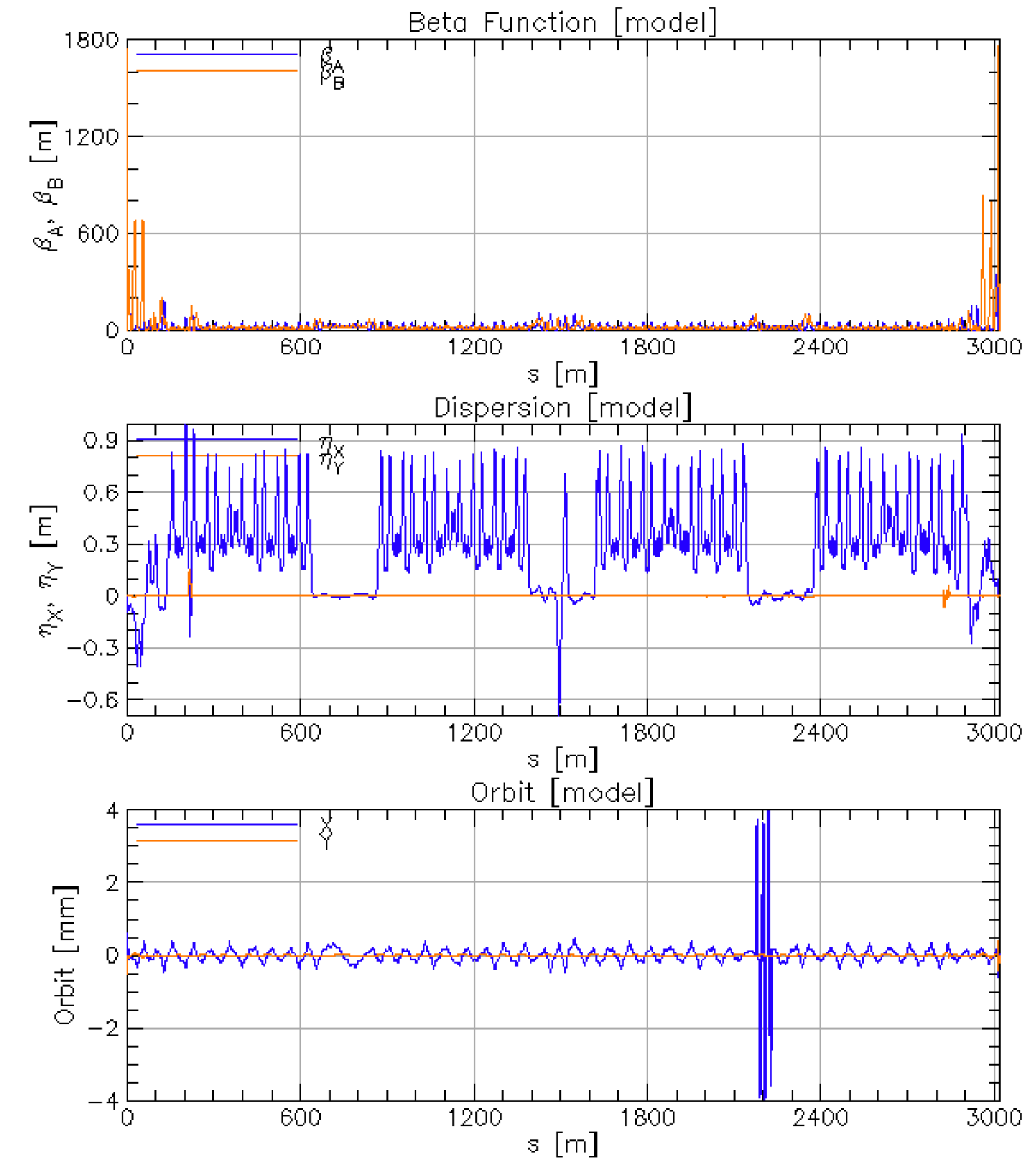
R-Rot



B2EBL: $x_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

Ring Parameters Comparison

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized

HER

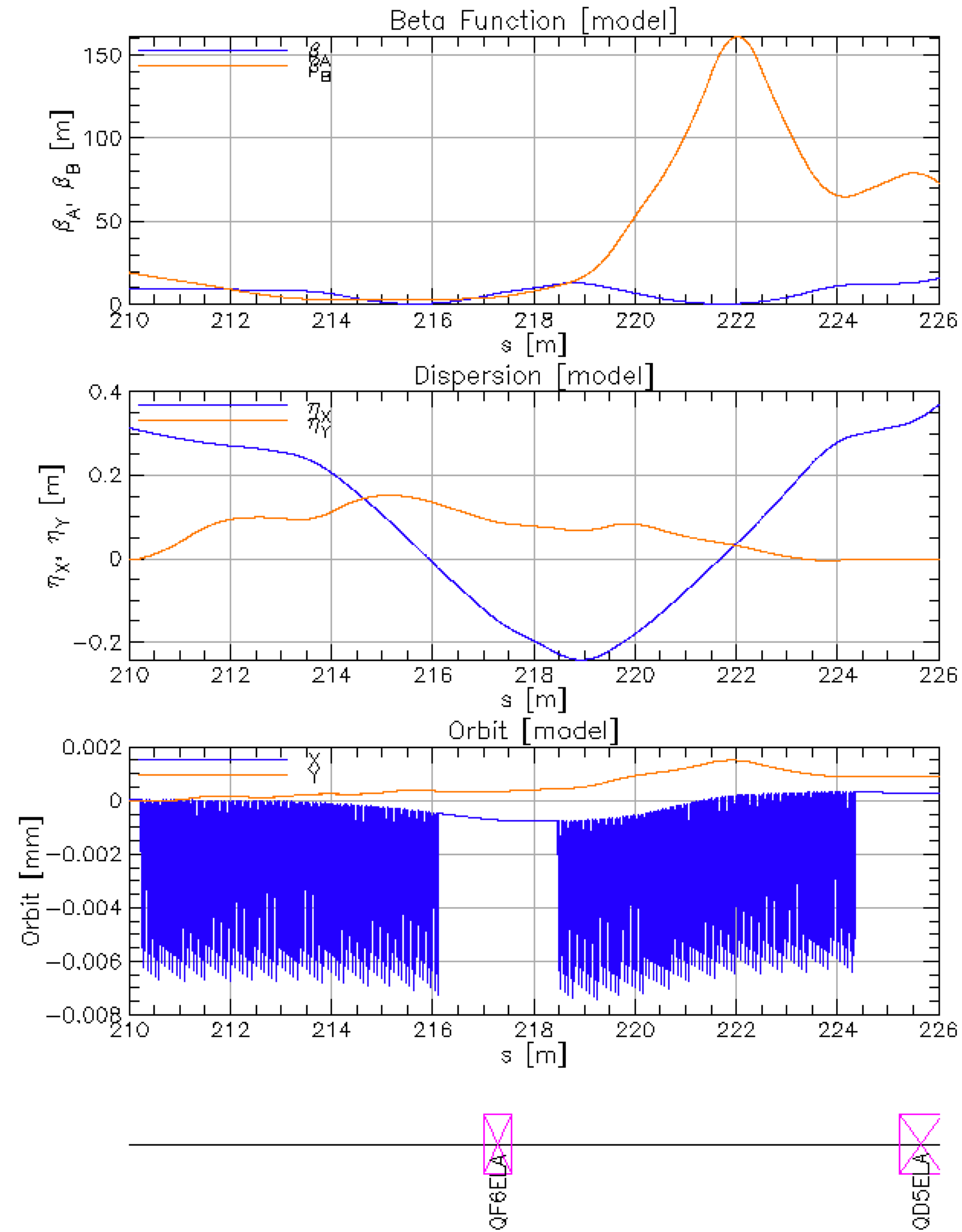
A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized

Rot ring

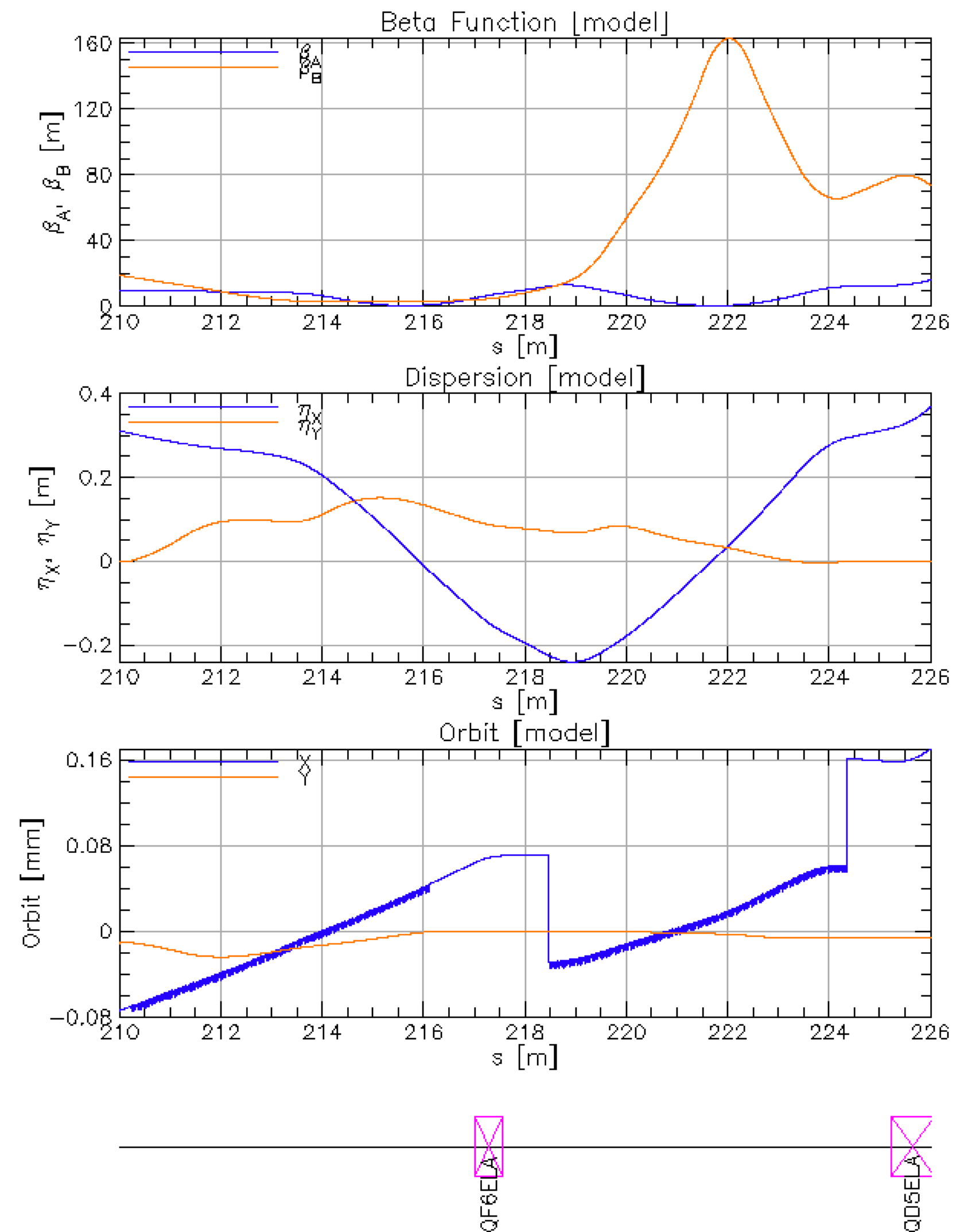
A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530817	45.530817	43.580719	43.580719	! Tune
Chrom	1.529718	1.545721	2.074789	2.085494	! dQ/(dE/E)
J_damp	0.958243	0.957195	1.000233	1.000221	! Damping Partition #
Emittance	4.65859E-09	4.66468E-09	9.07778E-12	9.08189E-12	! Unnormalized

B2EBL_x +0.1mm

L-Rot

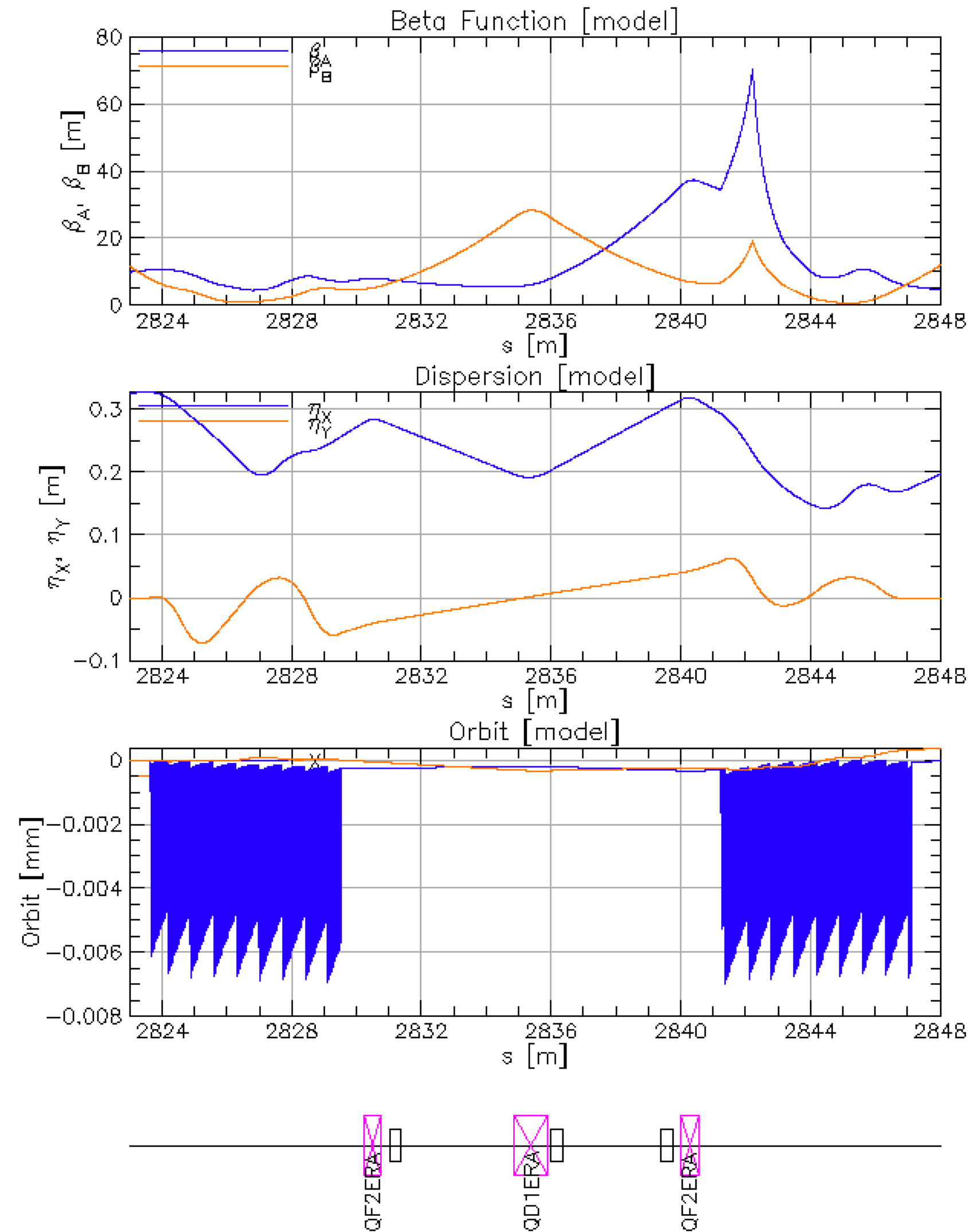


original

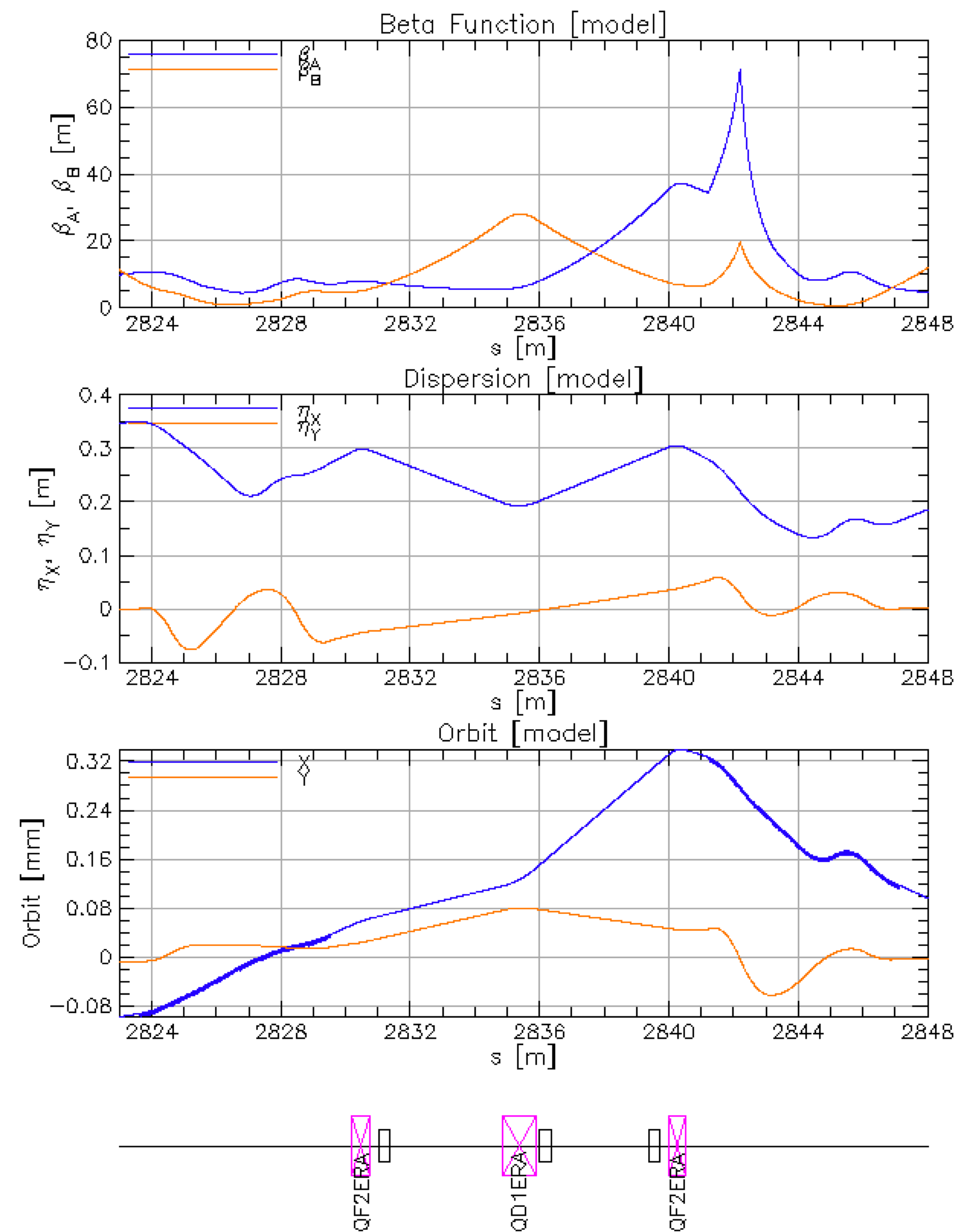


B2EBL_x +0.1mm

R-Rot

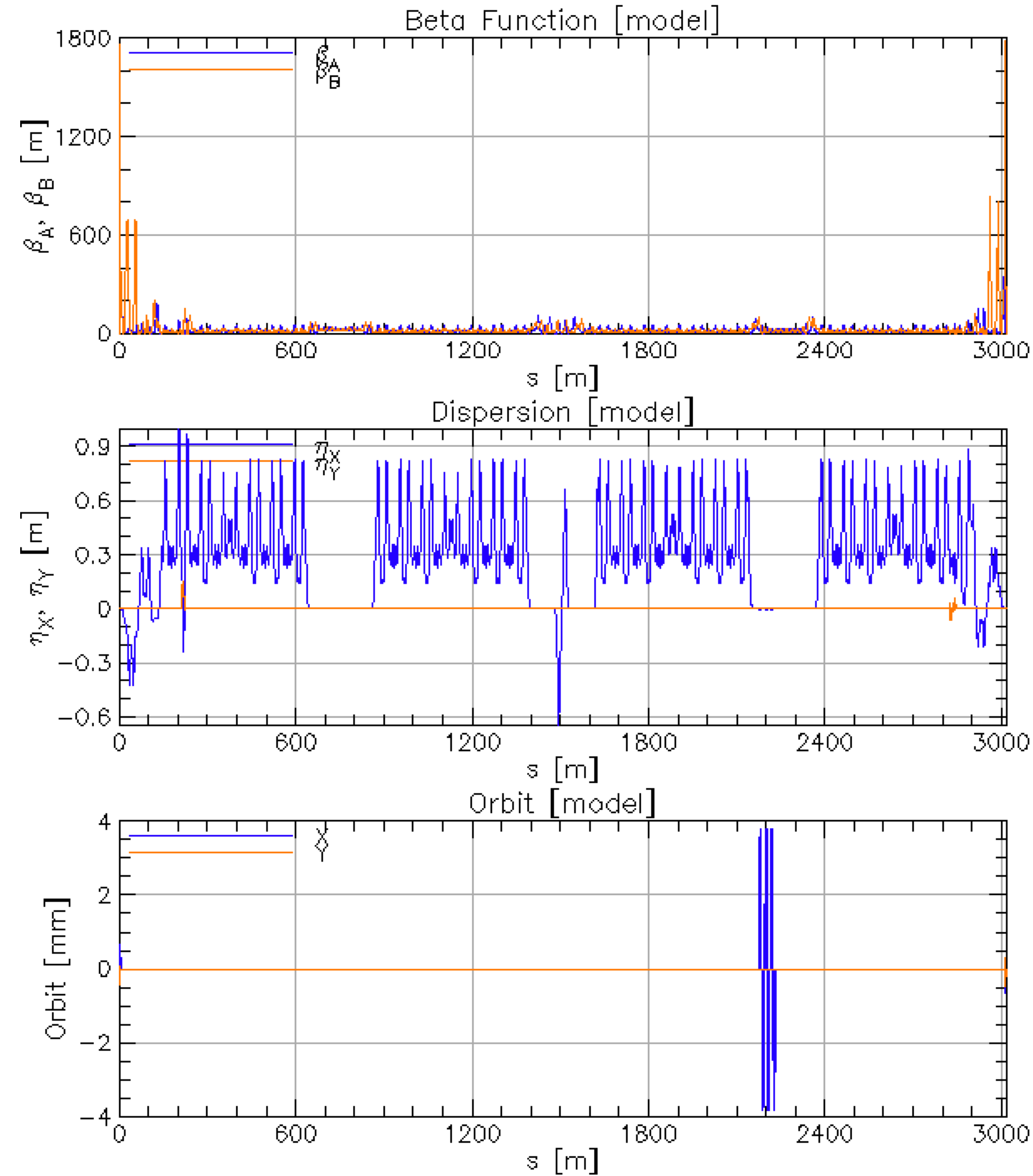


original

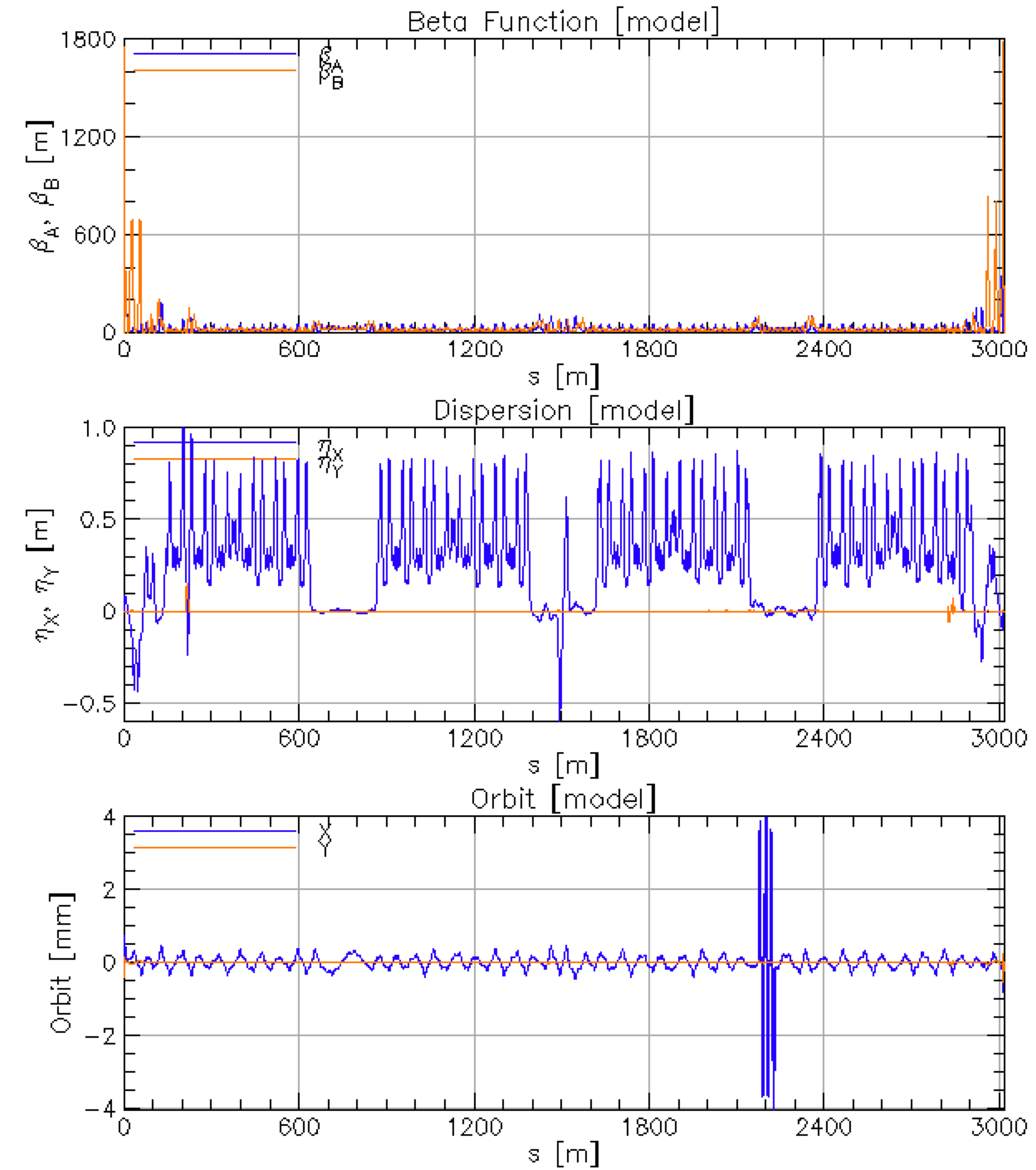


B2EBL_x +0.1mm

B2EBL: $x_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

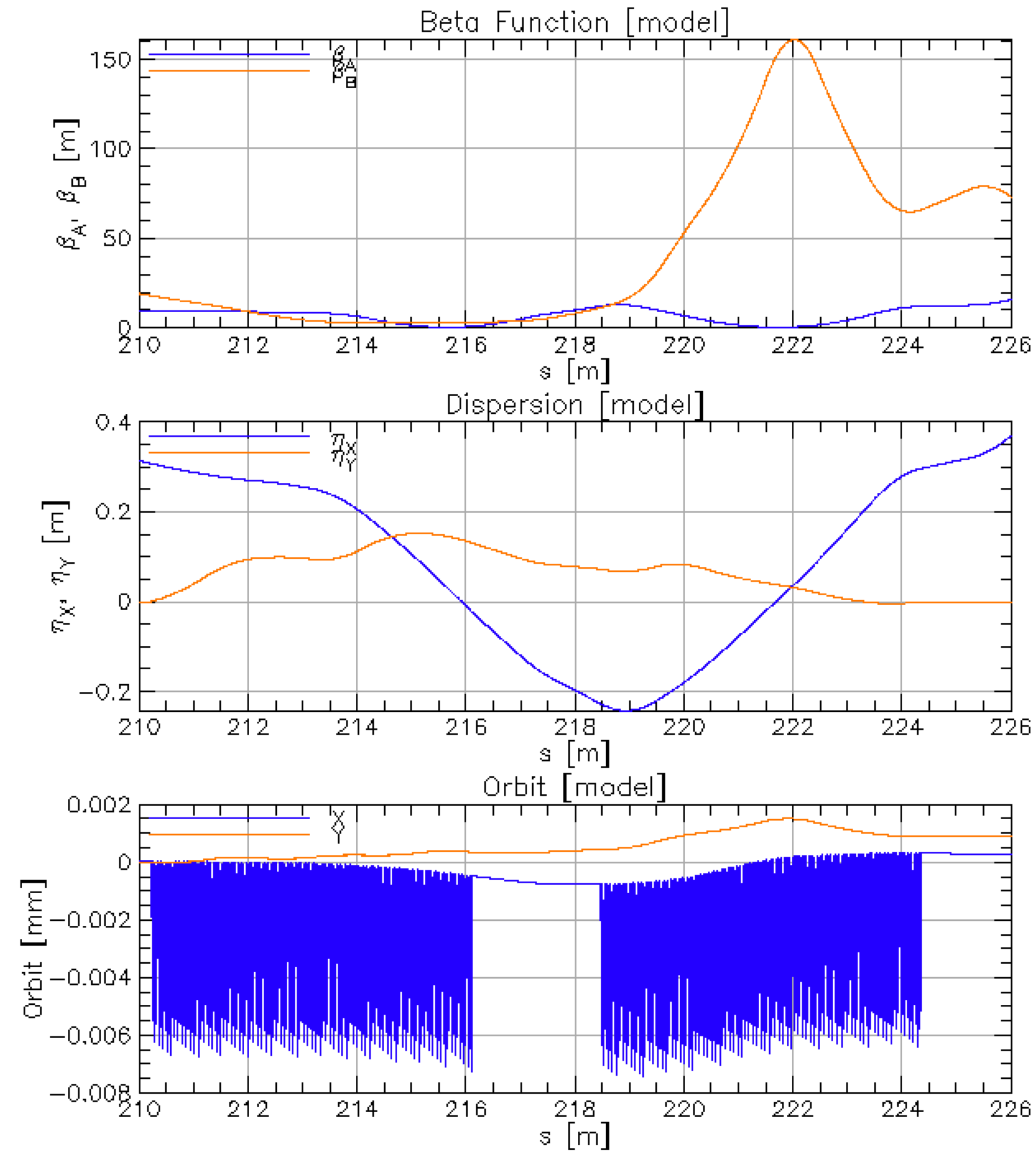
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EBL_x -0.1mm
	Model	Design	Model	Design		
Q	45.531017	45.531017	43.579742	43.579742	! Tune	
Chrom	1.645996	1.644621	1.151349	1.150909	! dQ/(dE/E)	
J_damp	0.973255	0.973347	1.000536	1.000539	! Damping Partition #	
Emittance	4.58835E-09	4.58795E-09	9.29439E-12	9.29531E-12	! Unnormalized	

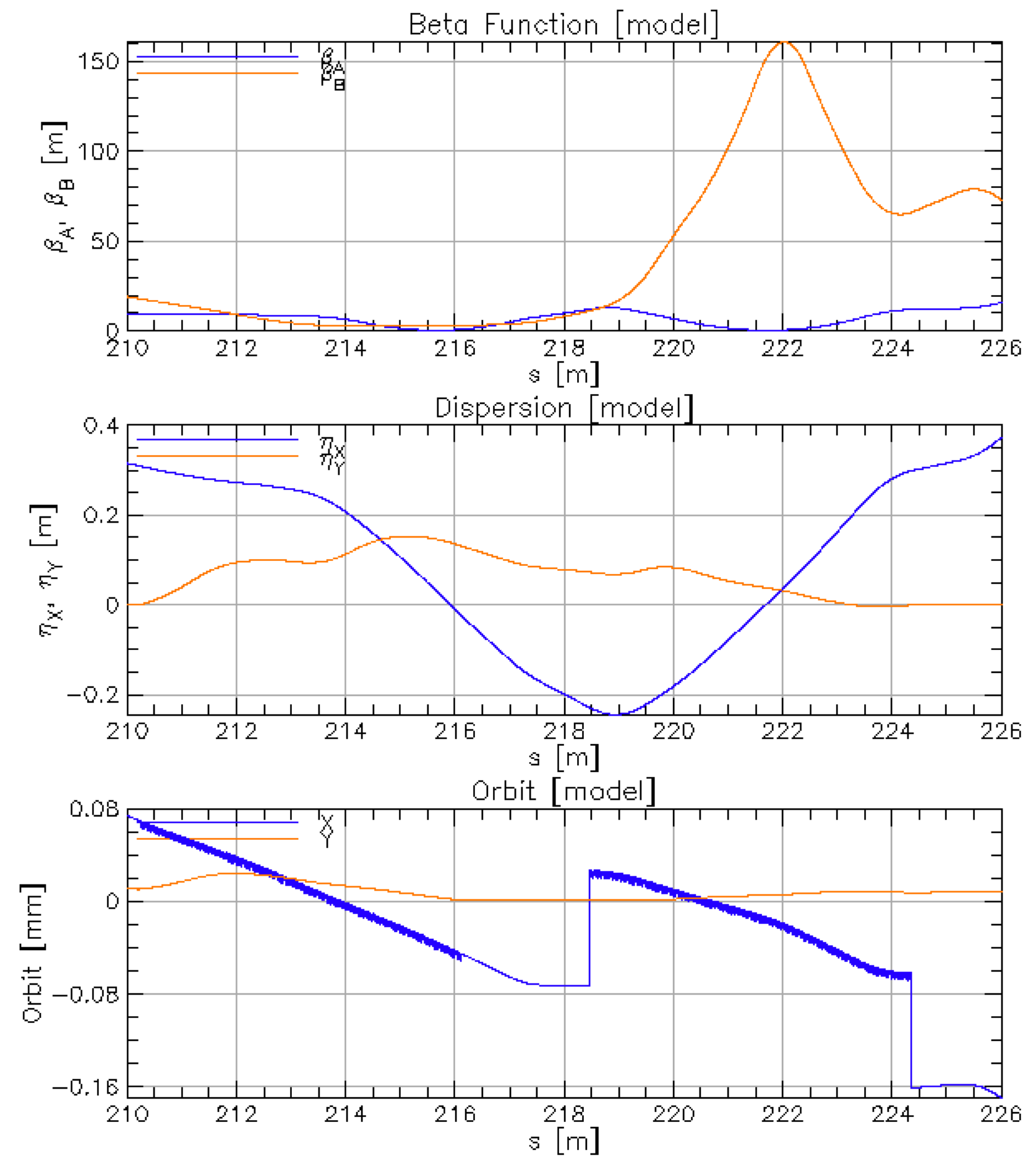
L-Rot



QF6ELA

QD5ELA

original

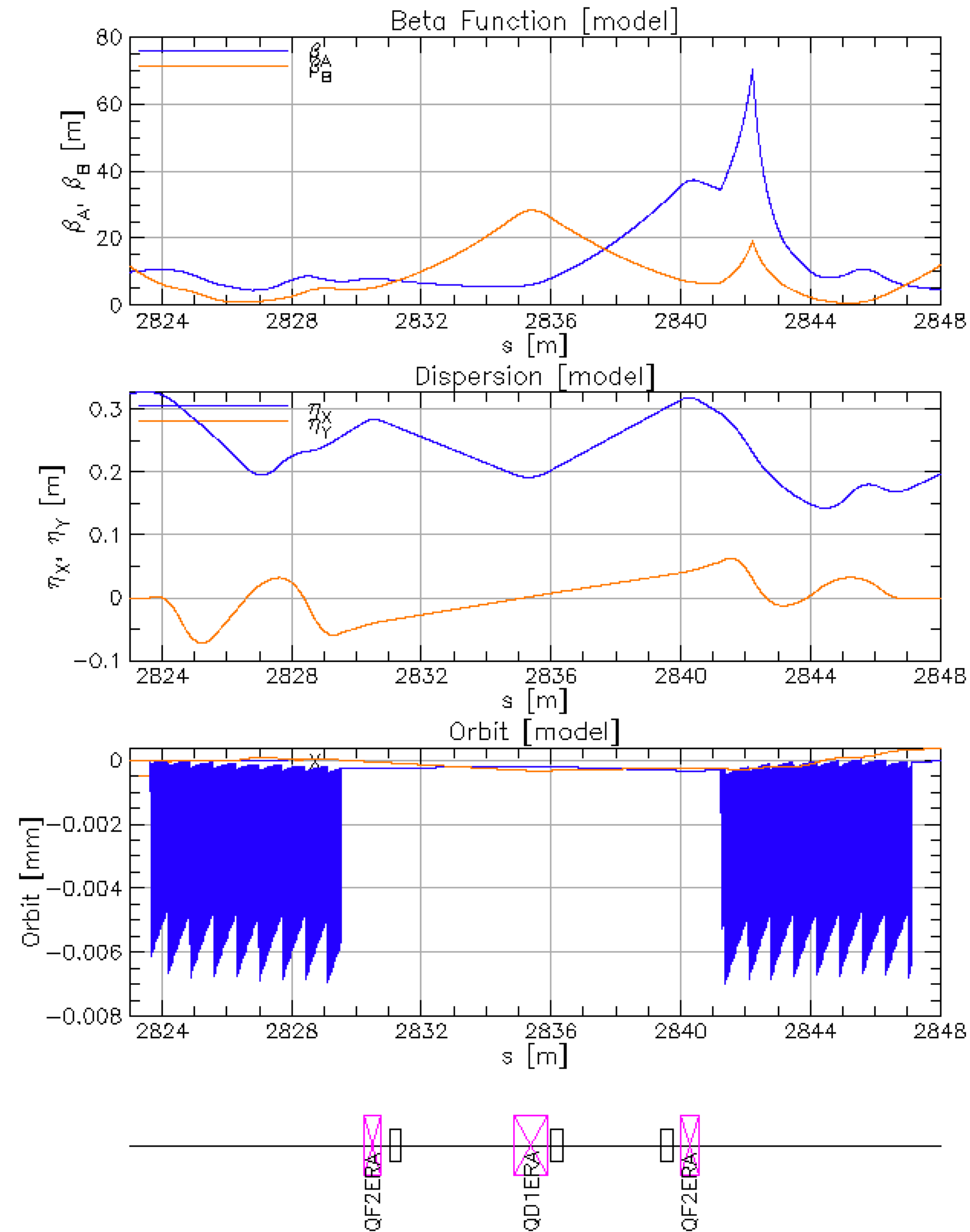


QF6ELA

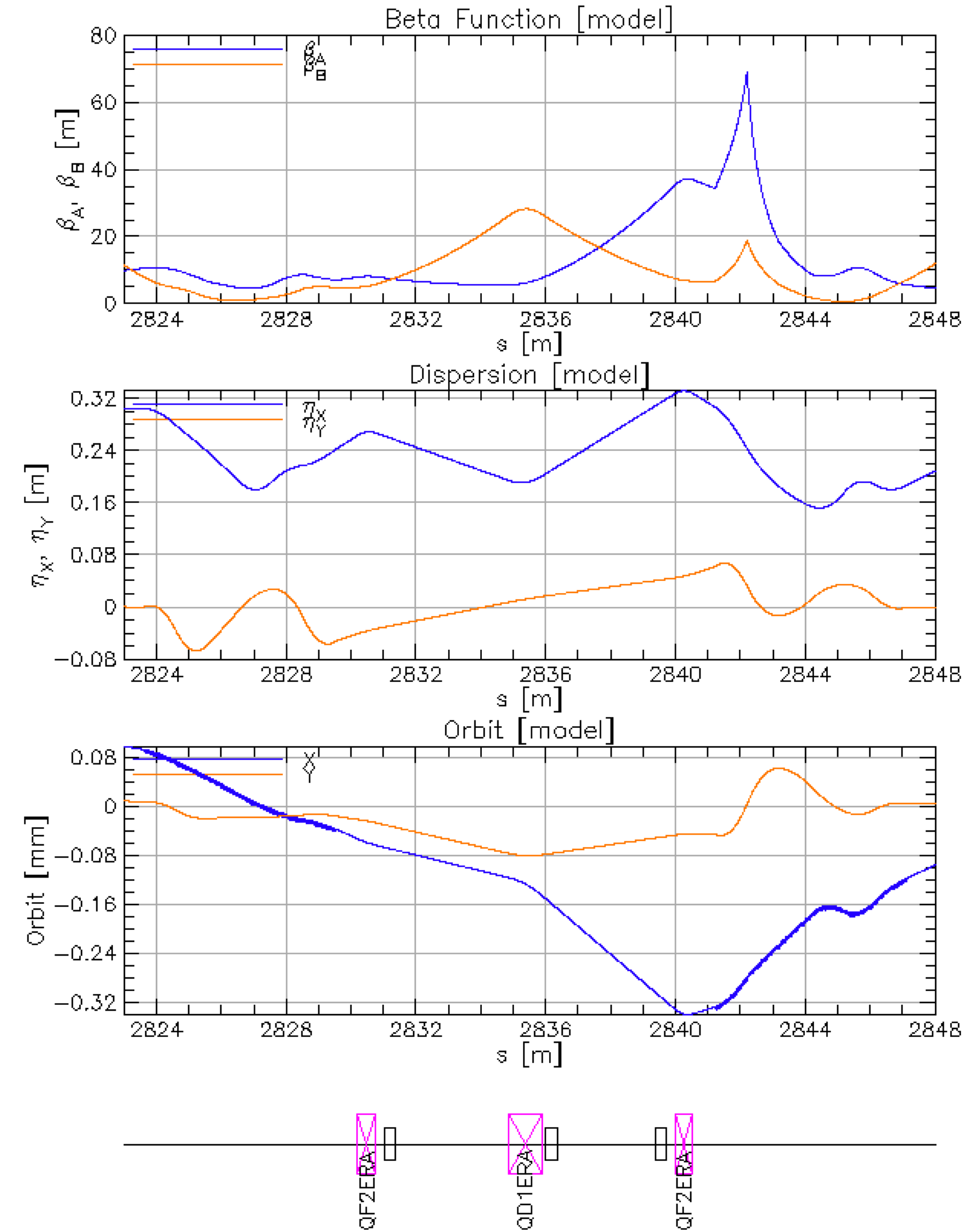
QD5ELA

B2EBL_x -0.1mm

R-Rot



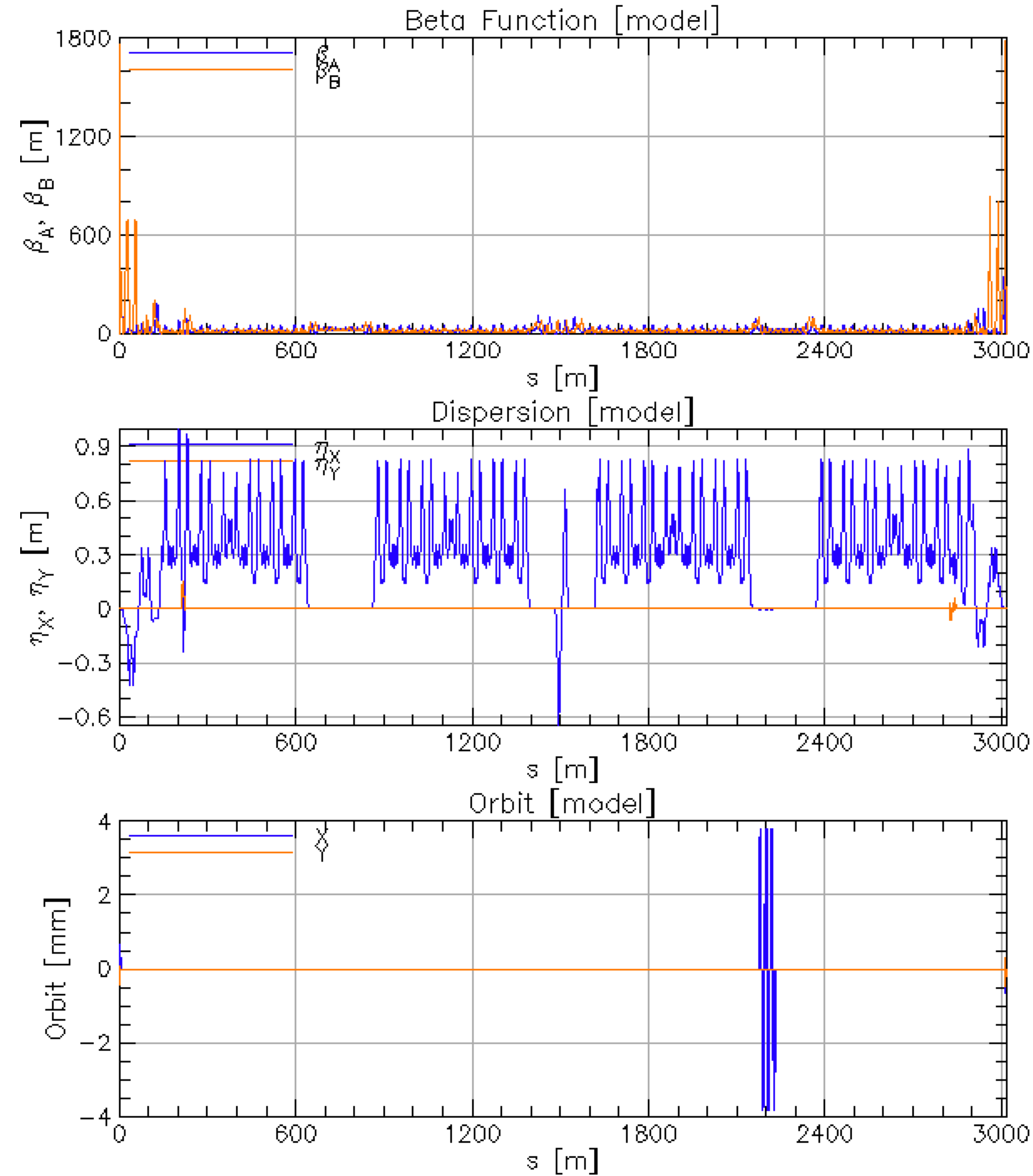
original



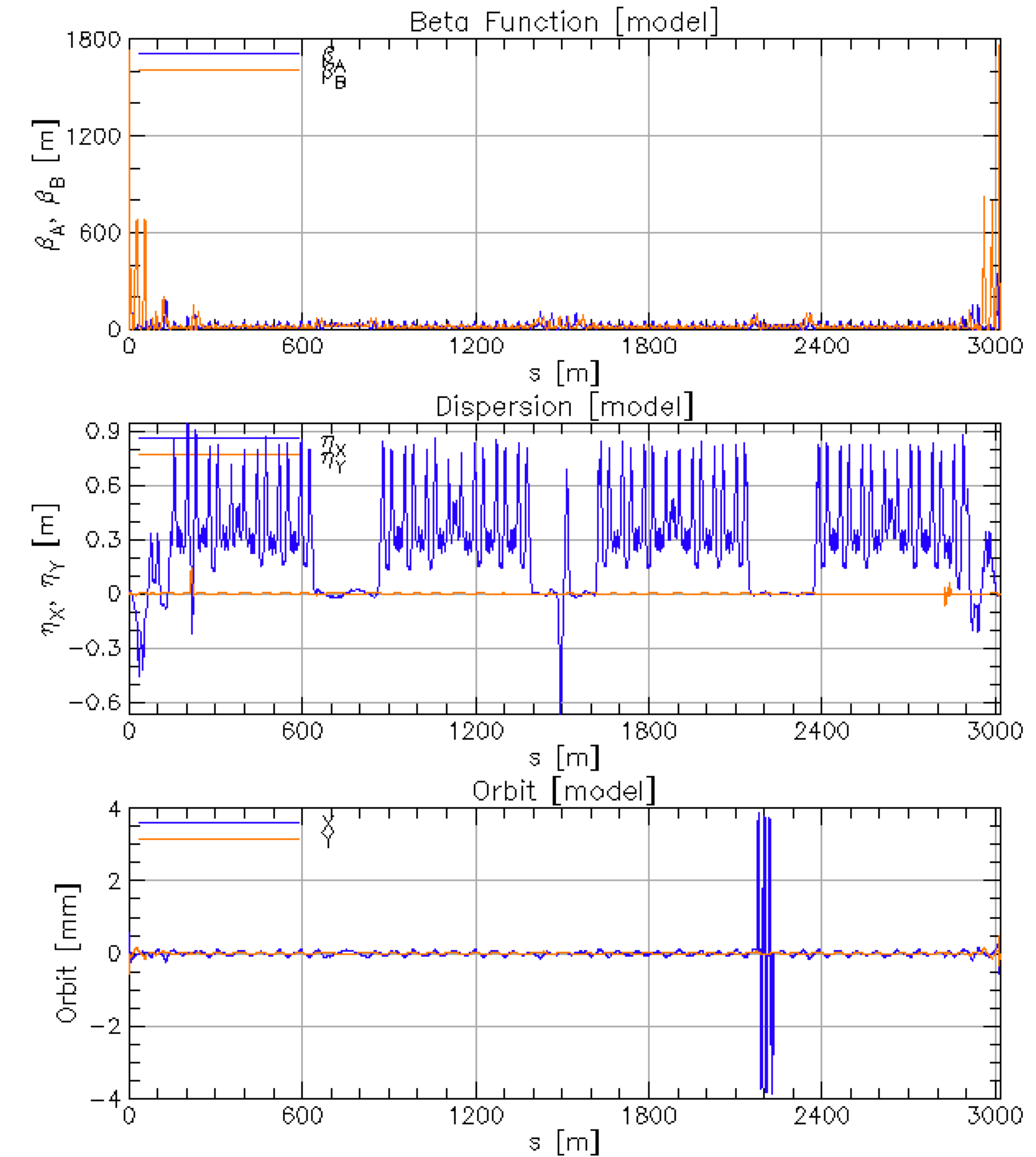
B2EBL_x -0.1mm

A-Mode			B-Mode			Rot ring
	Model	Design		Model	Design	
Q	45.530994	45.530994		43.580709	43.580709	
Chrom	1.591891	1.599271		1.621929	1.625672	
J_damp	0.966040	0.965554		1.000295	1.000288	
Emittance	4.59794E-09	4.60062E-09		8.97933E-12	8.98123E-12	! Unnormalized
A-Mode			B-Mode			B2EAL_x +0.1mm
	Model	Design		Model	Design	
Q	45.531140	45.531140		43.578366	43.578366	
Chrom	1.582132	1.582132		0.498725	0.498725	
J_damp	0.975002	0.975002		1.013658	1.013658	
Emittance	4.65520E-09	4.65520E-09		3.57291E-11	3.57291E-11	! Unnormalized
A-Mode			B-Mode			B2EAL_x -0.1mm
	Model	Design		Model	Design	
Q	45.530774	45.530774		43.580756	43.580756	
Chrom	1.449699	1.464931		2.550247	2.560895	
J_damp	0.954493	0.953527		1.008076	1.008144	
Emittance	4.70714E-09	4.71332E-09		3.05479E-11	3.06114E-11	! Unnormalized
A-Mode			B-Mode			B2EBL_x +0.1mm
	Model	Design		Model	Design	
Q	45.530817	45.530817		43.580719	43.580719	
Chrom	1.529718	1.545721		2.074789	2.085494	
J_damp	0.958243	0.957195		1.000233	1.000221	
Emittance	4.65859E-09	4.66468E-09		9.07778E-12	9.08189E-12	! Unnormalized
A-Mode			B-Mode			B2EBL_x -0.1mm
	Model	Design		Model	Design	
Q	45.531017	45.531017		43.579742	43.579742	
Chrom	1.645996	1.644621		1.151349	1.150909	
J_damp	0.973255	0.973347		1.000536	1.000539	
Emittance	4.58835E-09	4.58795E-09		9.29439E-12	9.29531E-12	! Unnormalized

B2EAR: $x_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

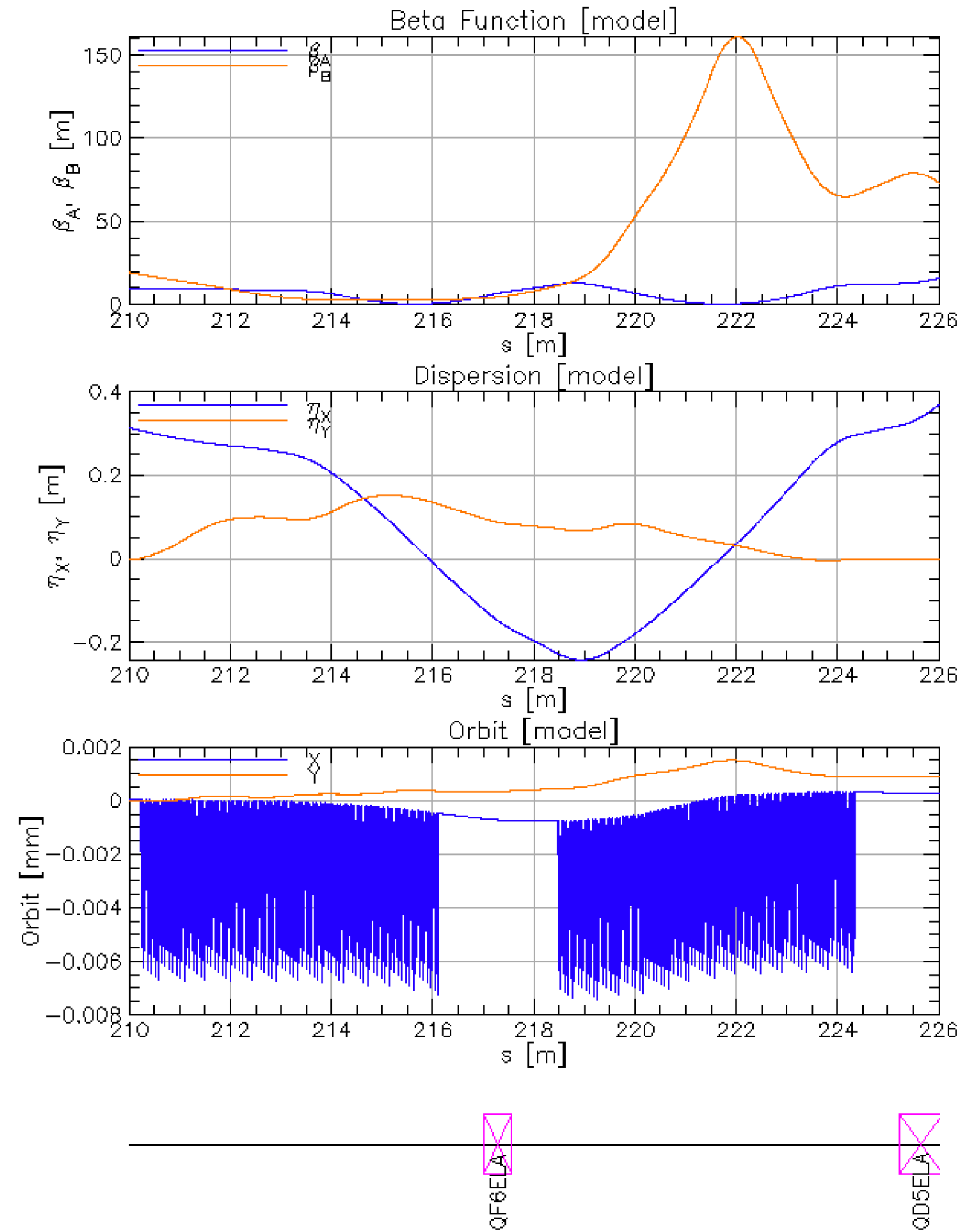
Ring Parameters Comparison

A-Mode			B-Mode			HER
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)	
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #	
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized	

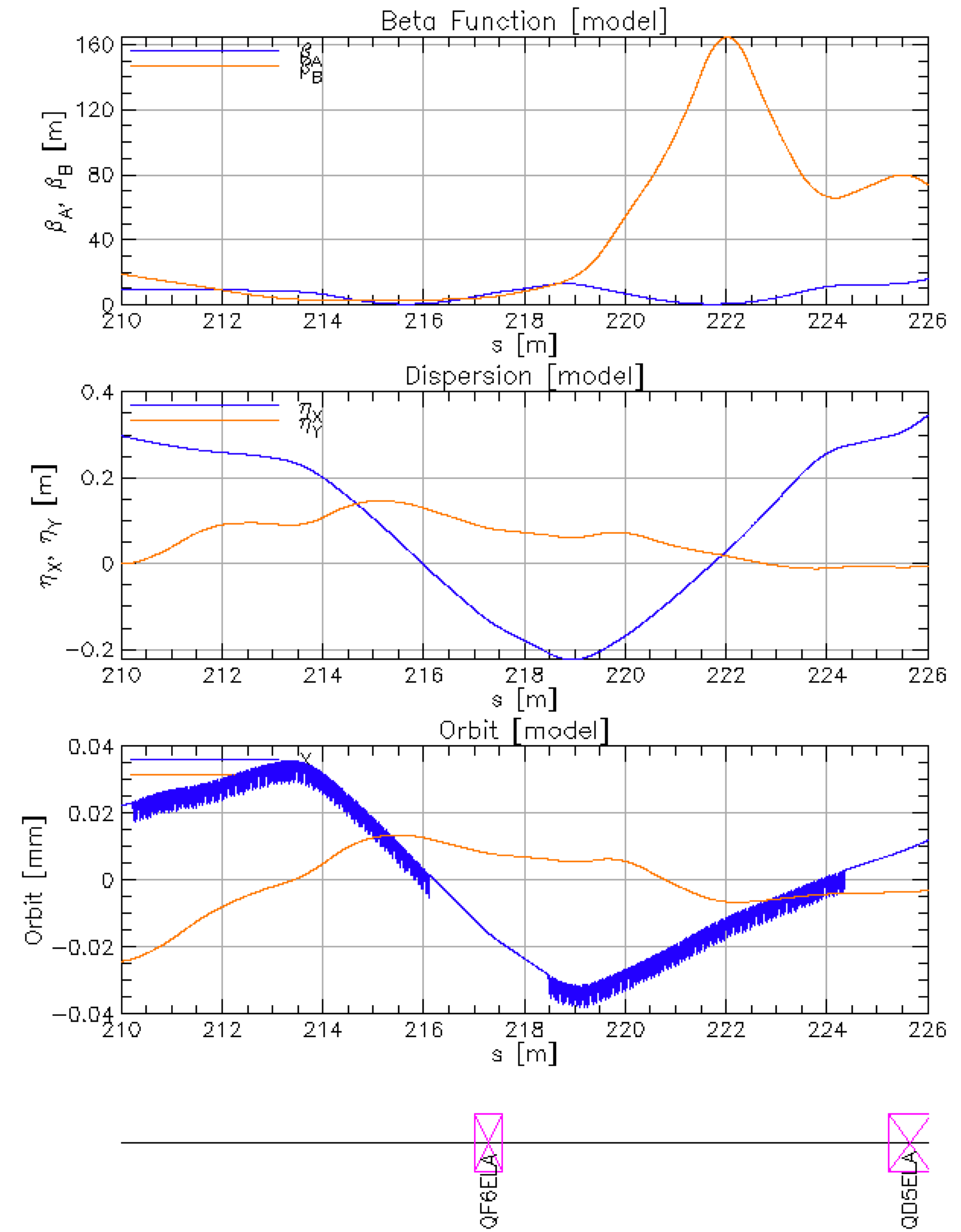
A-Mode			B-Mode			Rot ring
	Model	Design	Model	Design		
Q	45.530994	45.530994	43.580709	43.580709	! Tune	
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)	
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #	
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized	

A-Mode			B-Mode			B2EAR_x +0.1mm
	Model	Design	Model	Design		
Q	45.530916	45.530916	43.580768	43.580768	! Tune	
Chrom	1.611169	1.621602	2.048969	2.053608	! dQ/(dE/E)	
J_damp	0.968098	0.967419	1.000519	1.000517	! Damping Partition #	
Emittance	4.58697E-09	4.59078E-09	9.50437E-12	9.50845E-12	! Unnormalized	

L-Rot

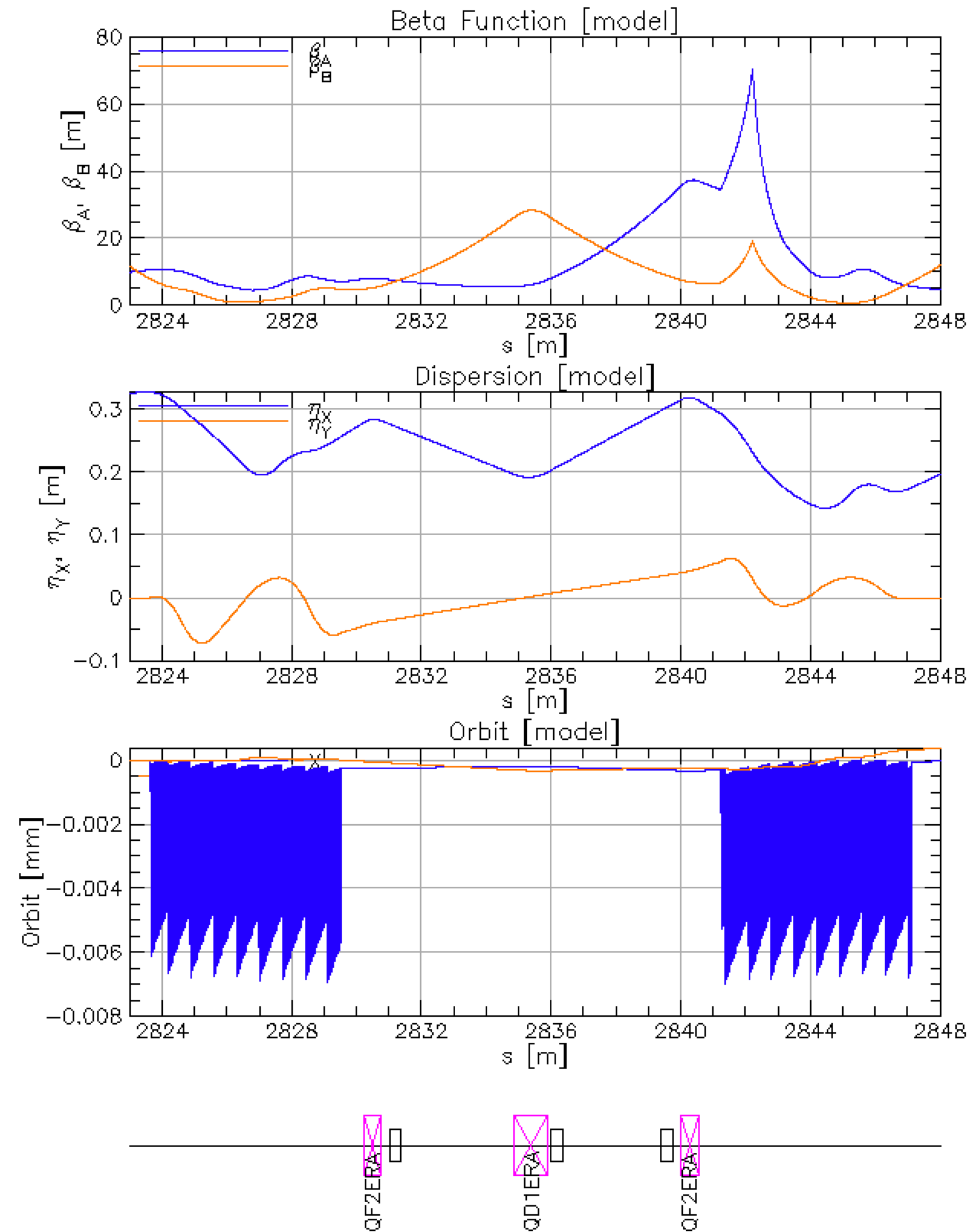


original

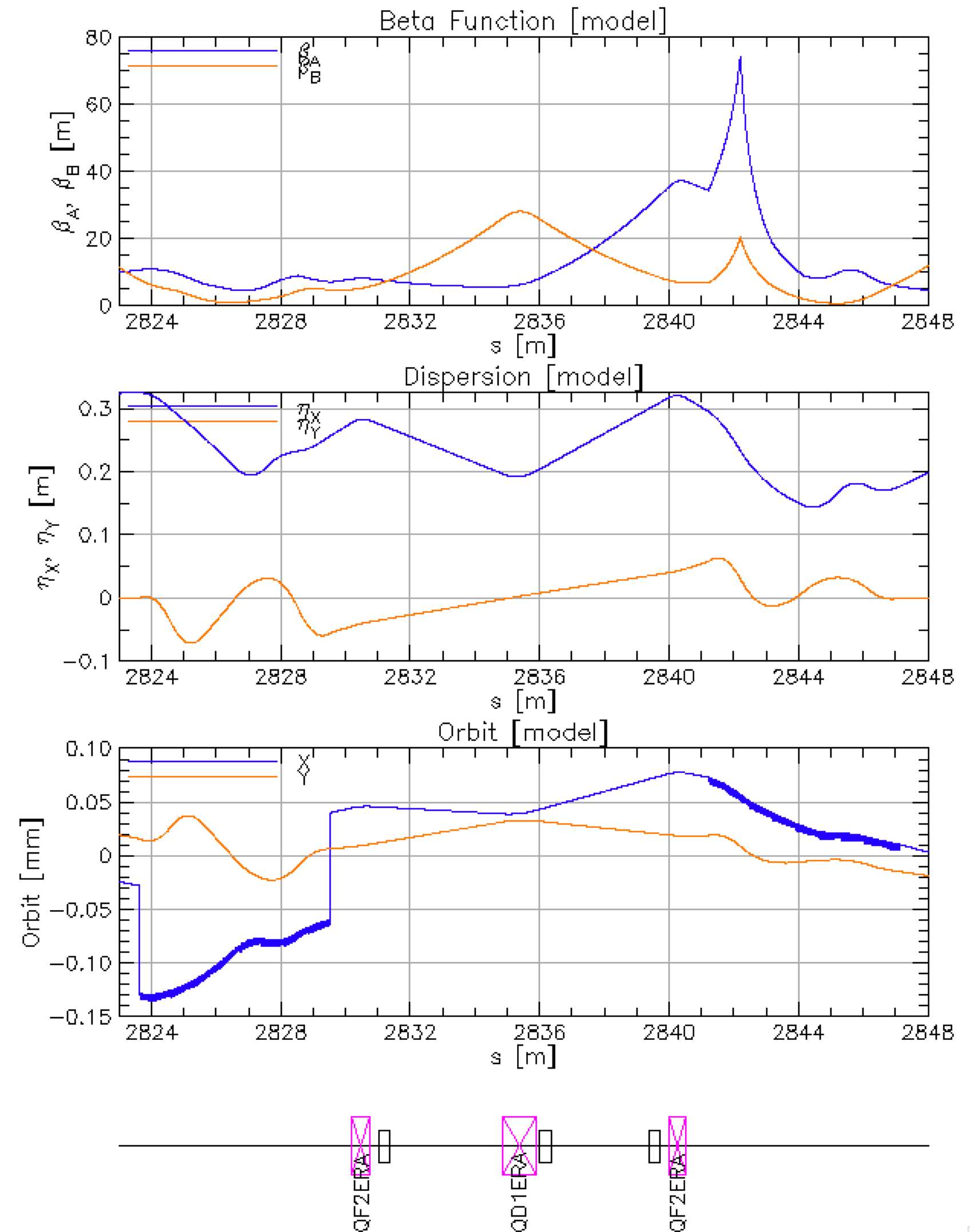


B2EAR_x +0.1mm

R-Rot

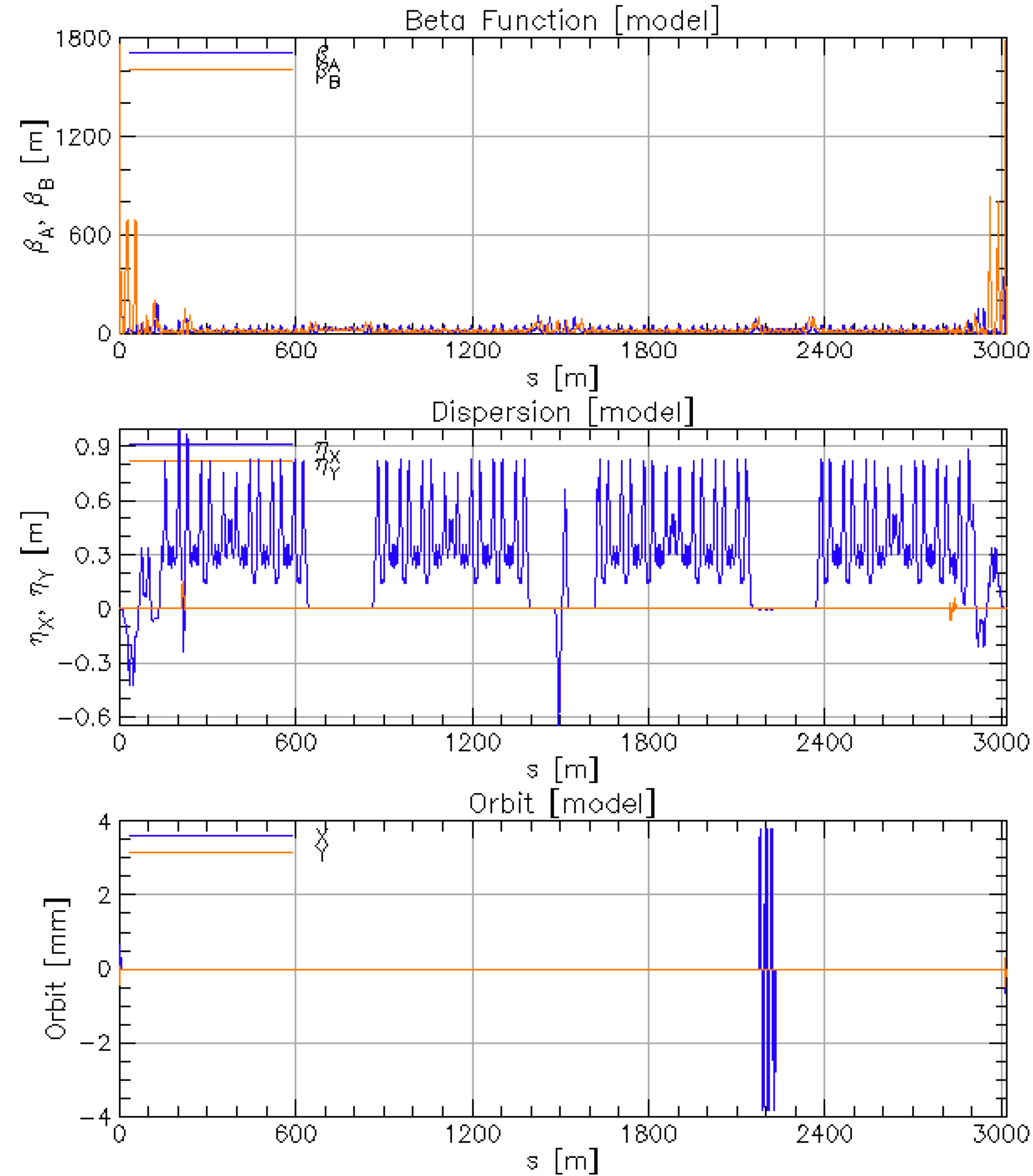


original

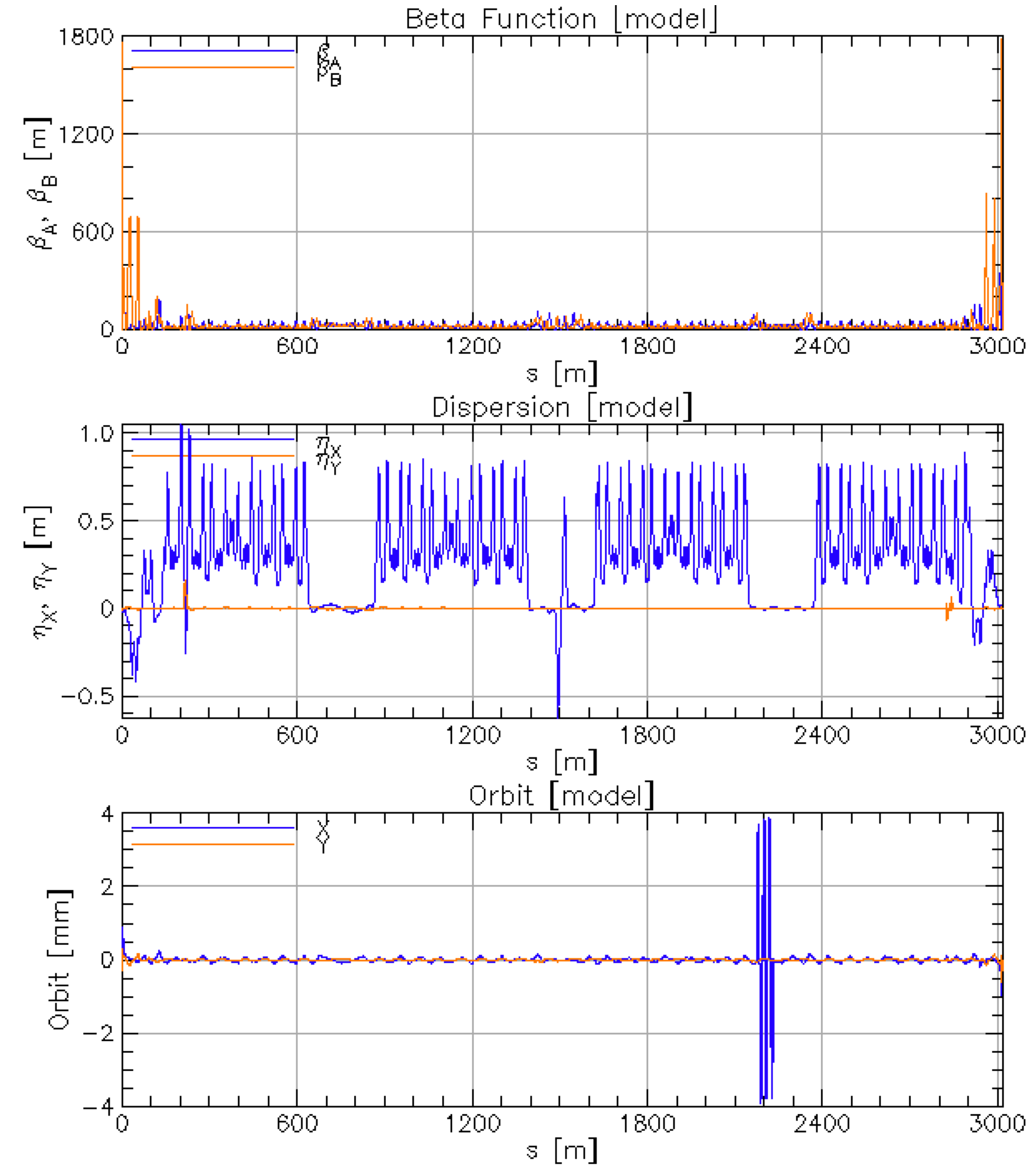


B2EAR_x +0.1mm

B2EAR: $x_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

Ring Parameters Comparison

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized

HER

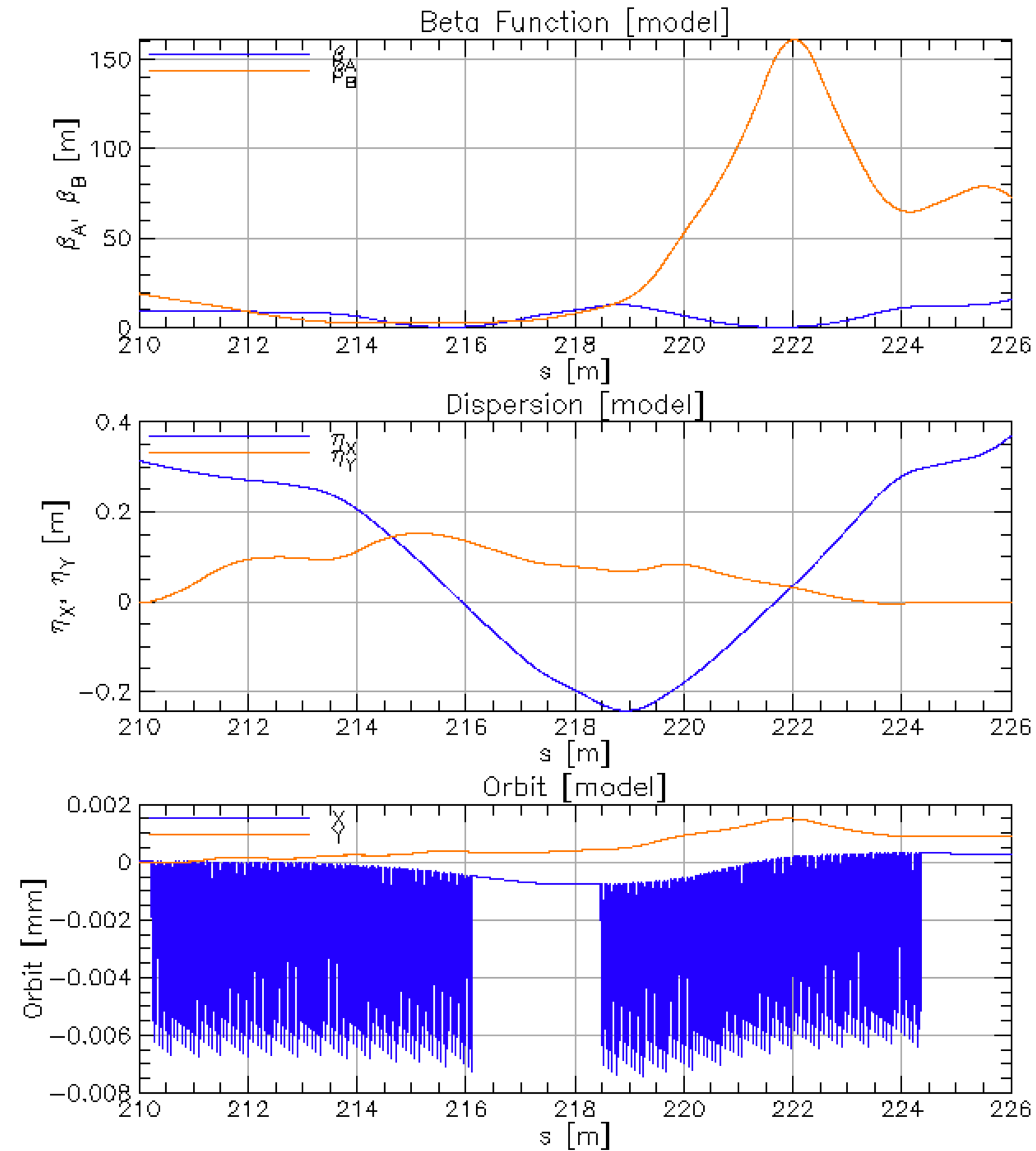
A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized

Rot ring

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530936	45.530936	43.579700	43.579700	! Tune
Chrom	1.579119	1.583510	1.171259	1.173644	! dQ/(dE/E)
J_damp	0.964325	0.964030	1.000934	1.000929	! Damping Partition #
Emittance	4.62541E-09	4.62706E-09	9.55769E-12	9.56134E-12	! Unnormalized

B2EAR_x -0.1mm

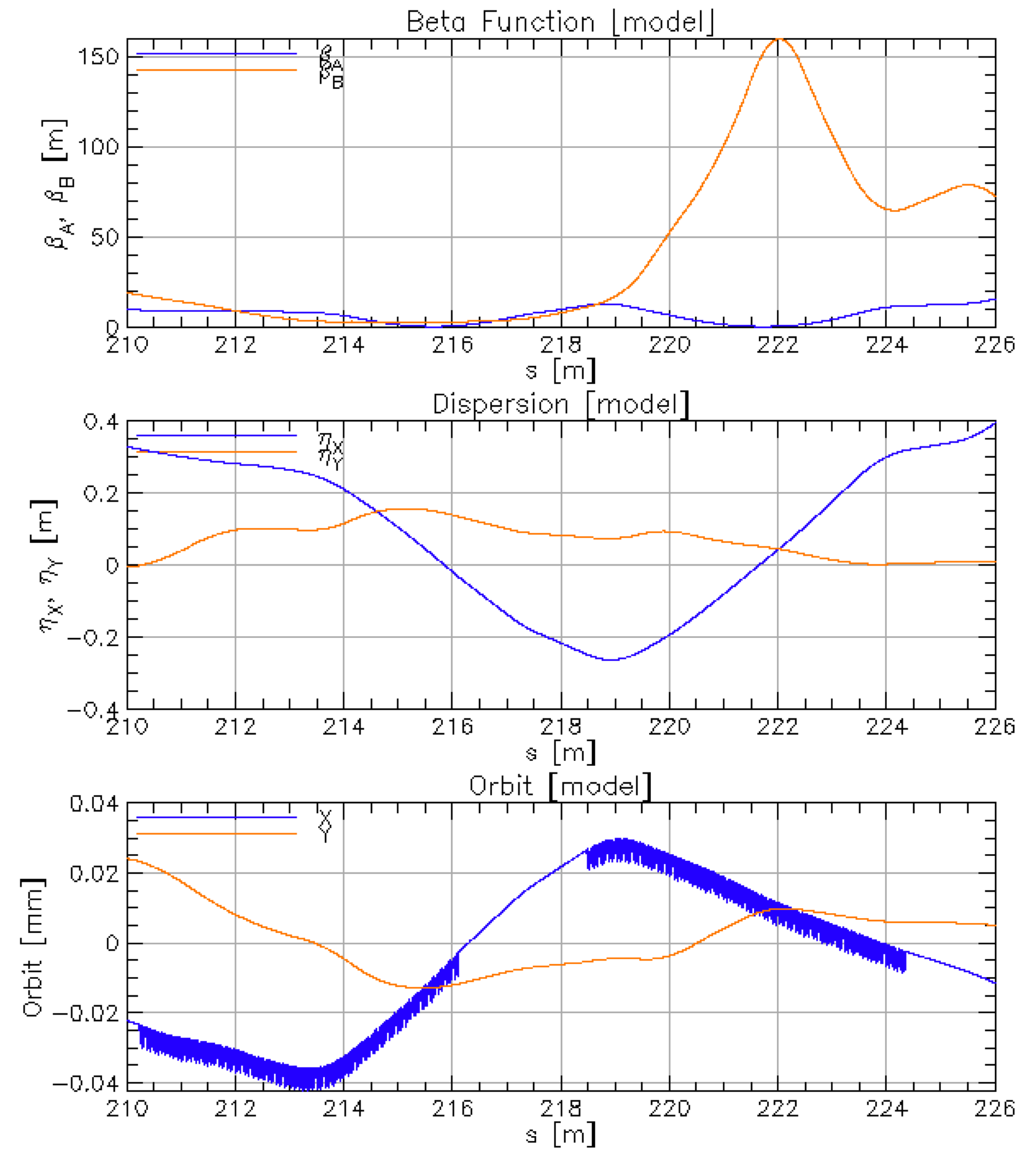
L-Rot



QF6ELA

QD5ELA

original

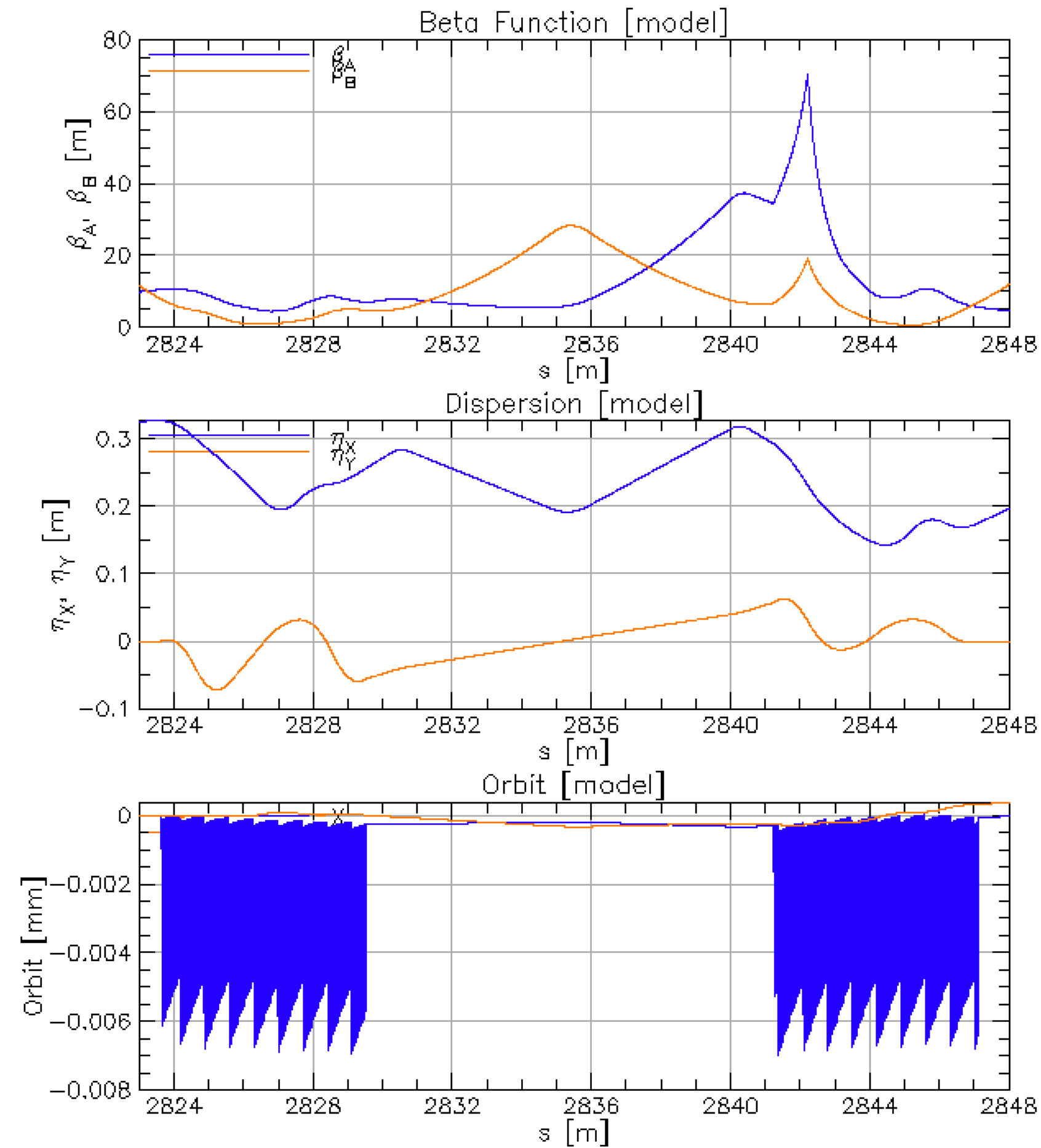


QF6ELA

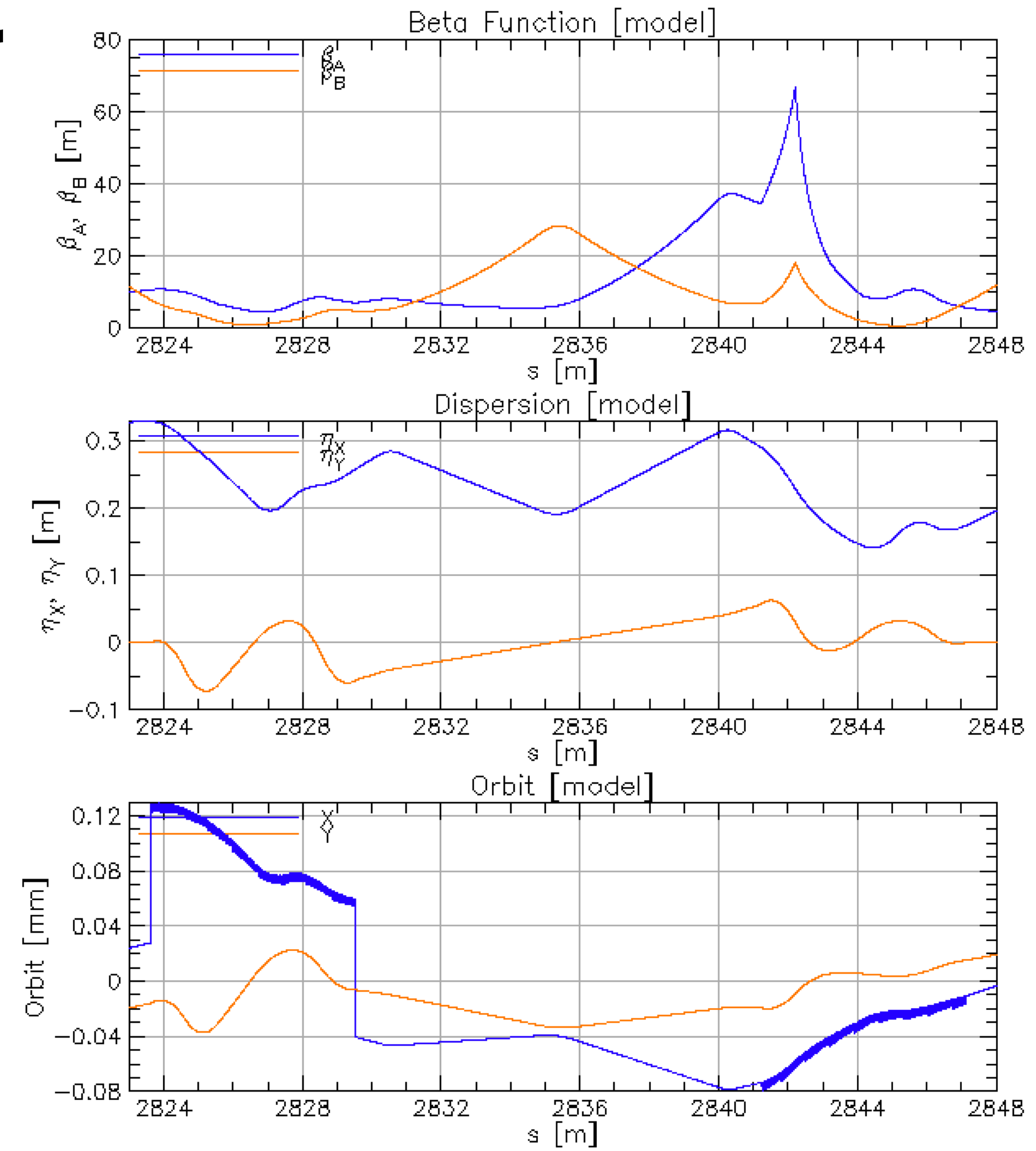
QD5ELA

B2EAR_x -0.1mm

R-Rot

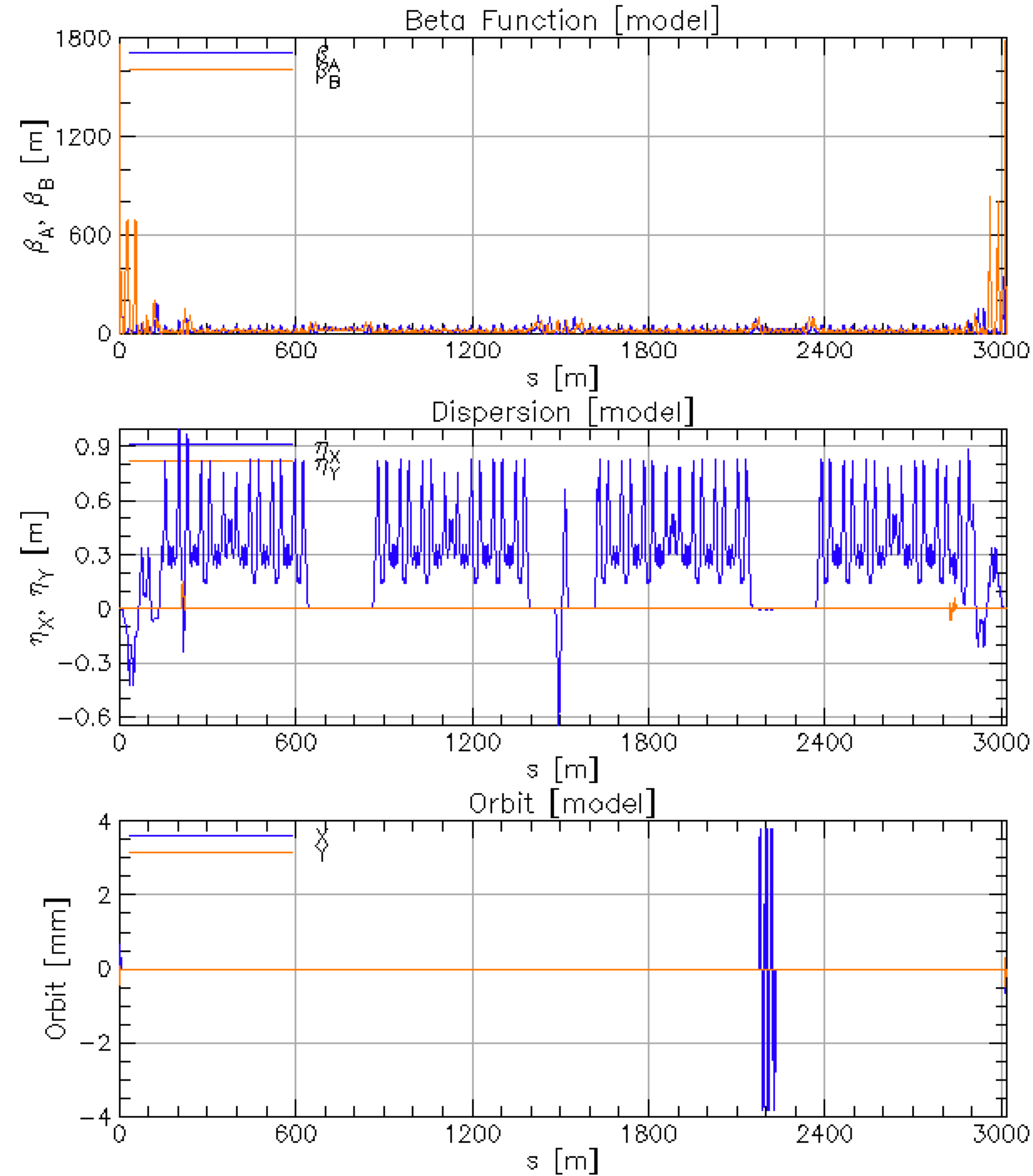


original

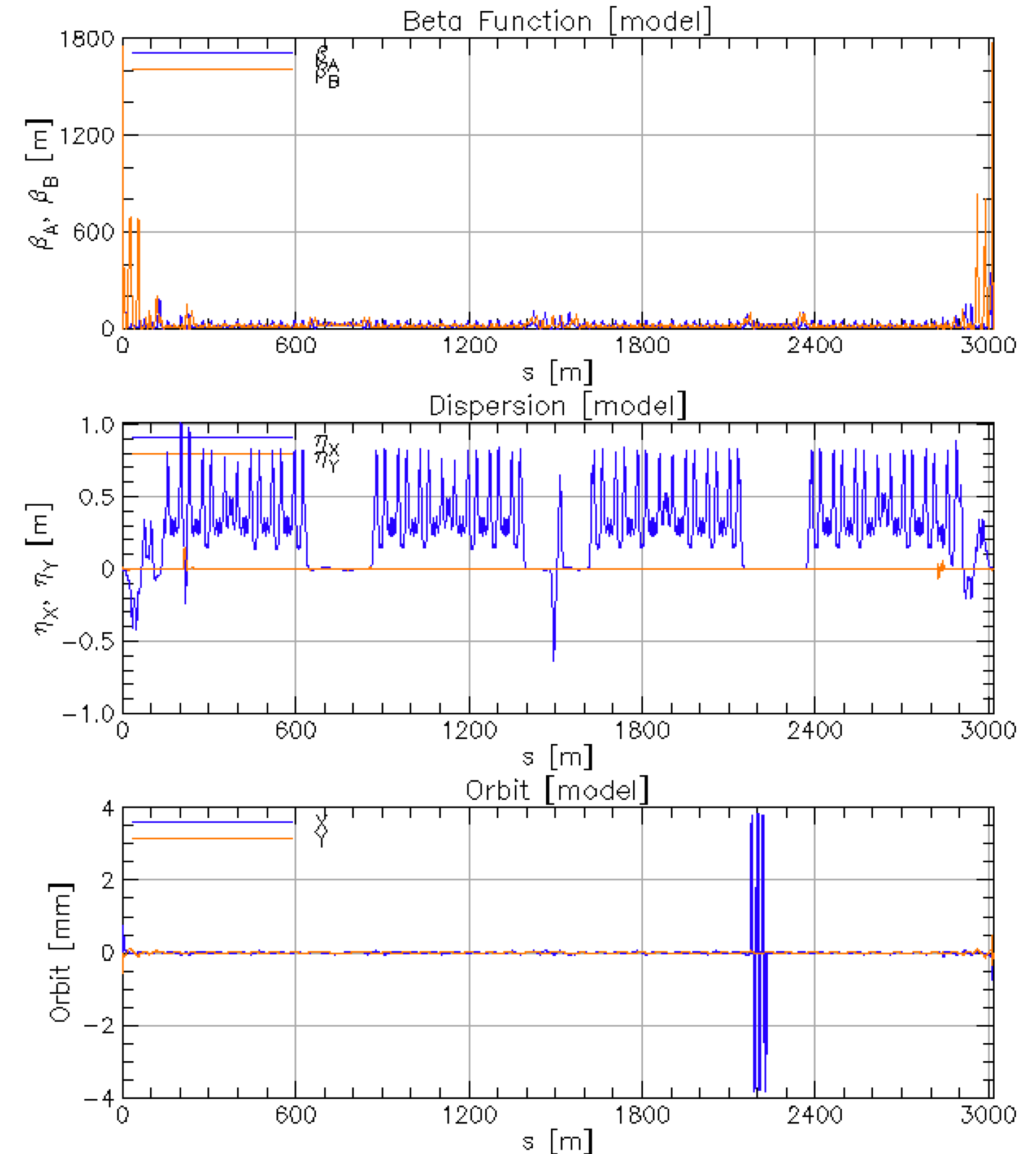


B2EAR_x -0.1mm

B2EBR: $x_{\text{offset}} = +0.1\text{mm}$



Original Rotator ring



shifted

Ring Parameters Comparison

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized

HER

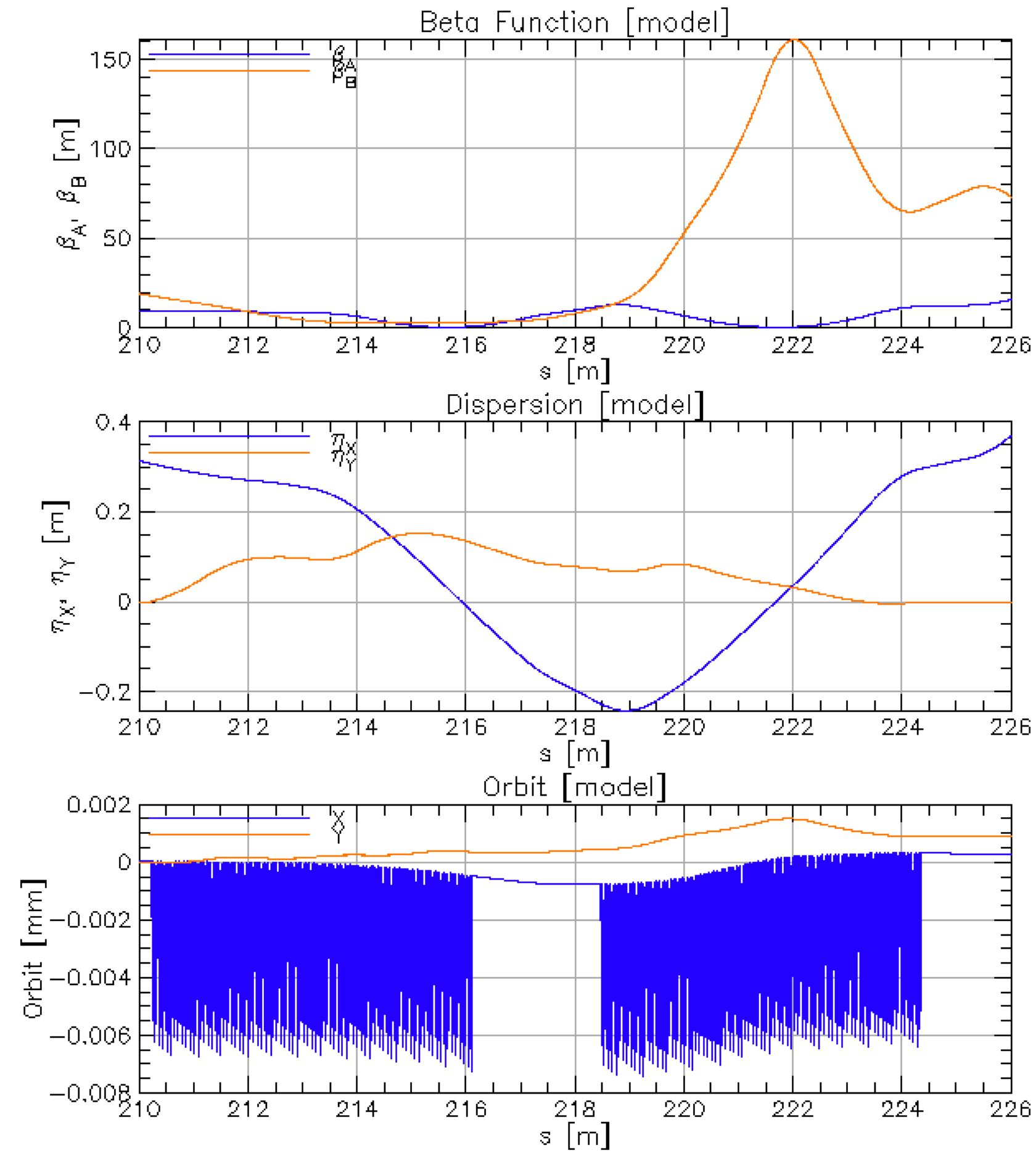
A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized

Rot ring

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530921	45.530921	43.580005	43.580005	! Tune
Chrom	1.604638	1.617485	1.446812	1.453279	! dQ/(dE/E)
J_damp	0.966477	0.965633	1.000448	1.000443	! Damping Partition #
Emittance	4.59883E-09	4.60342E-09	9.36143E-12	9.36467E-12	! Unnormalized

B2EBR_x +0.1mm

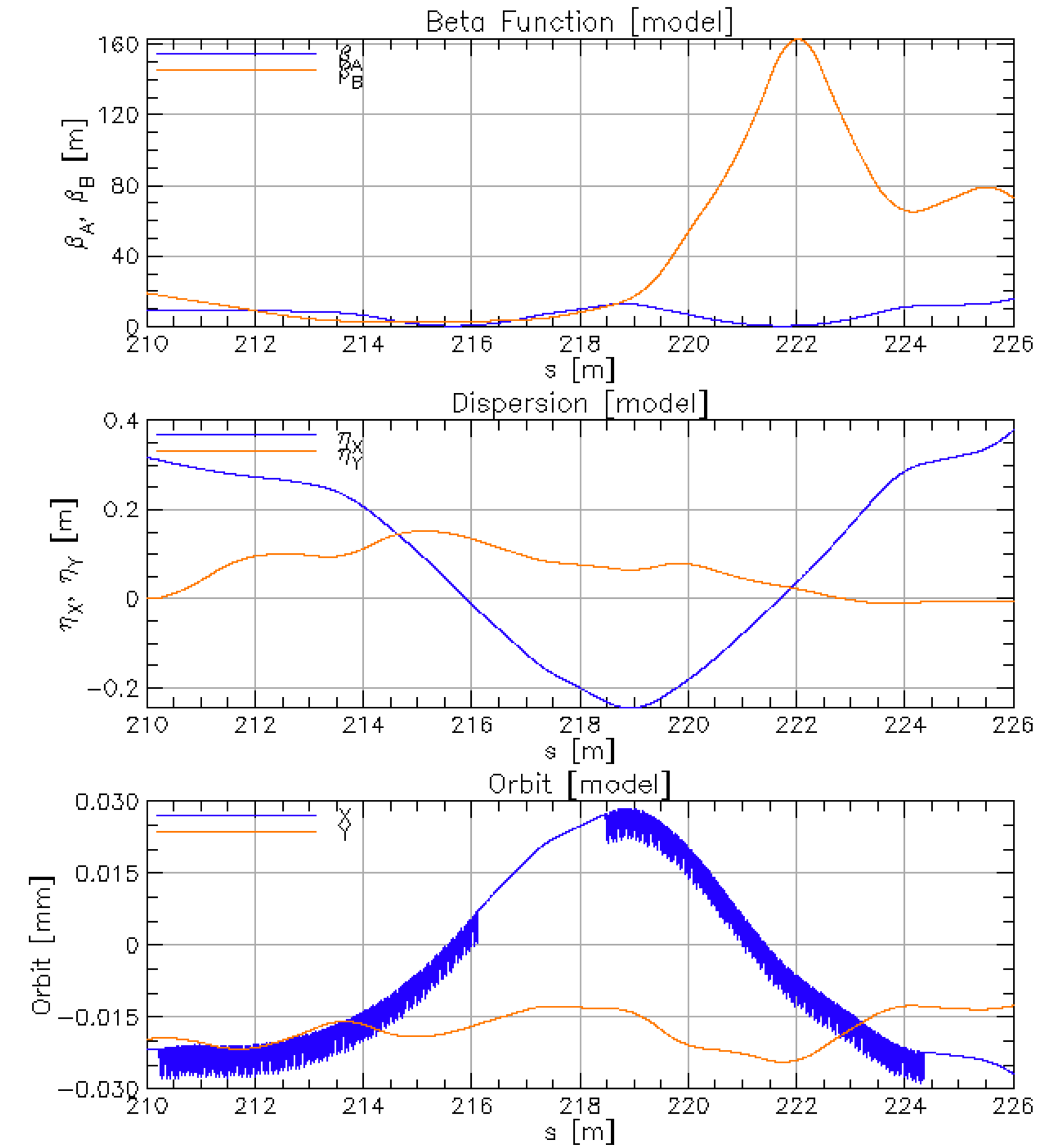
L-Rot



QF6ELA

QD5ELA

original

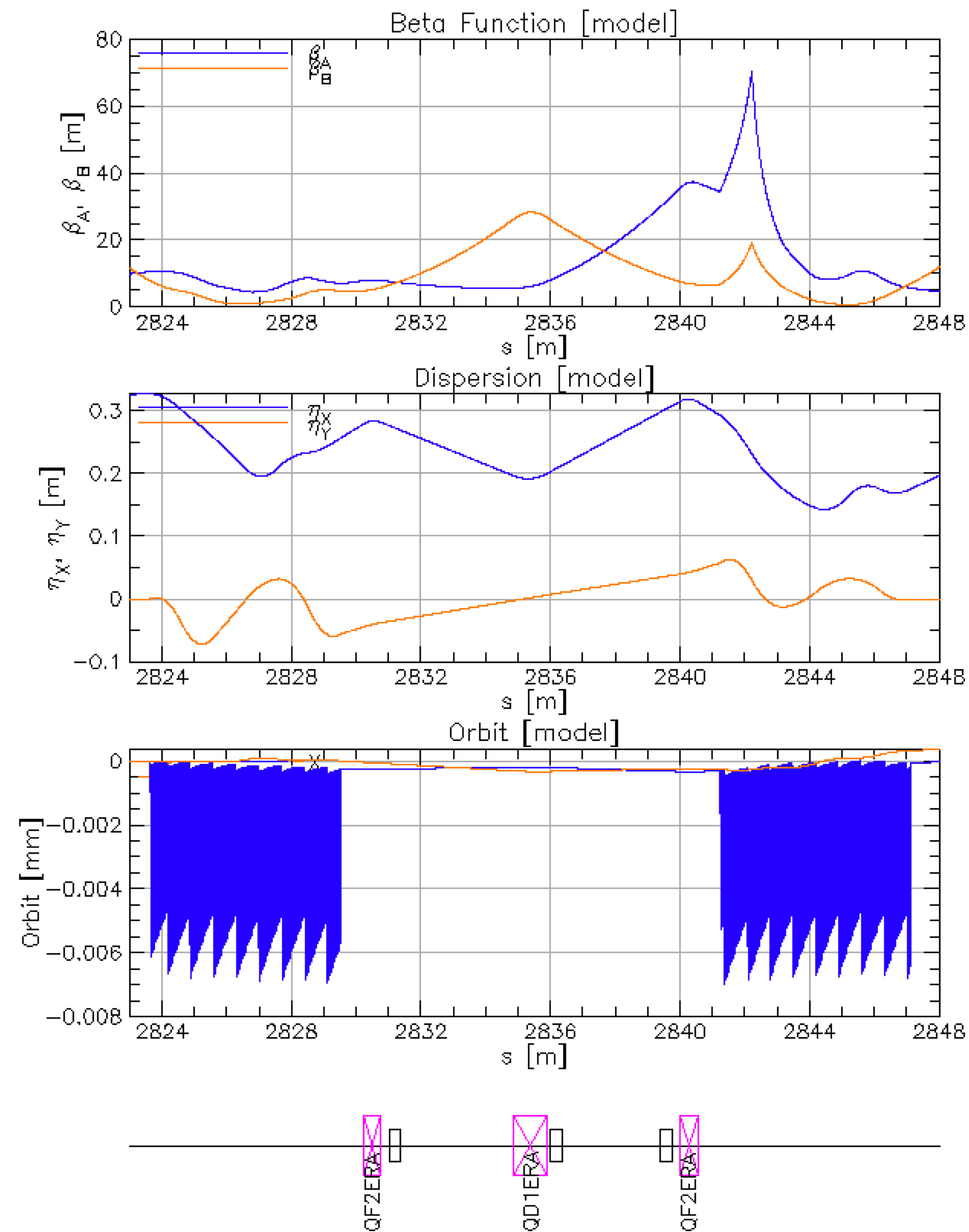


QF6ELA

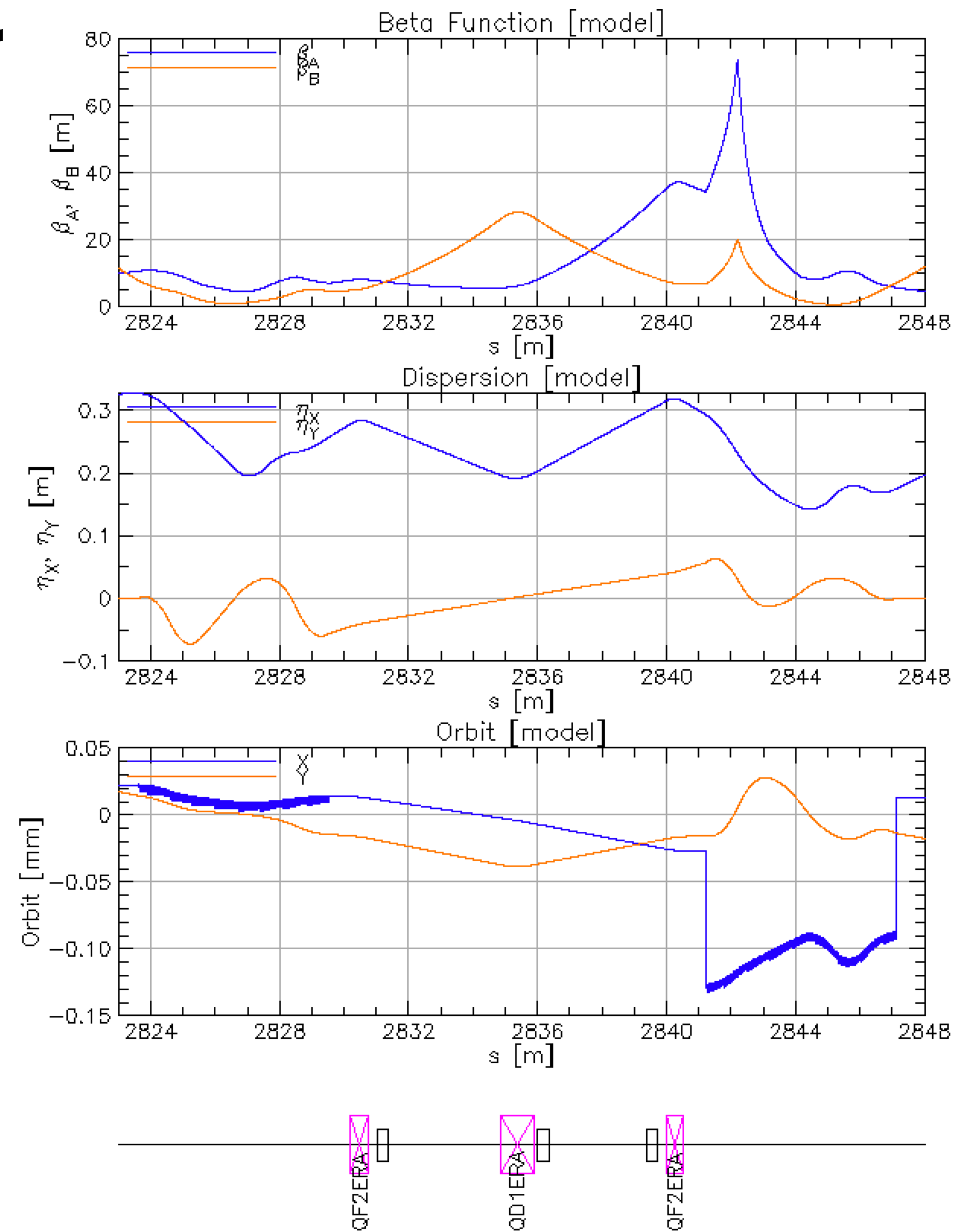
QD5ELA

B2EBR_x +0.1mm

R-Rot

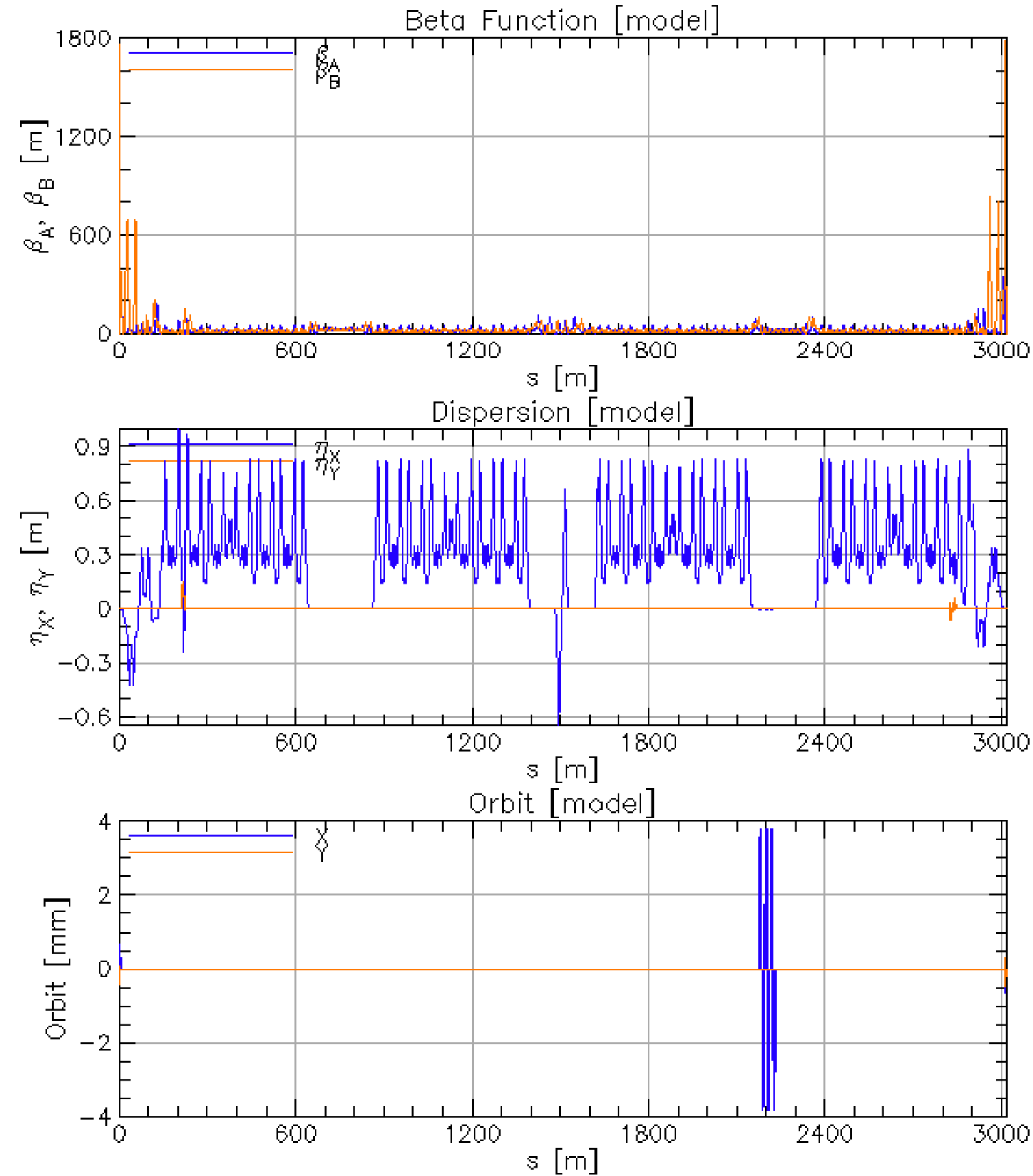


original

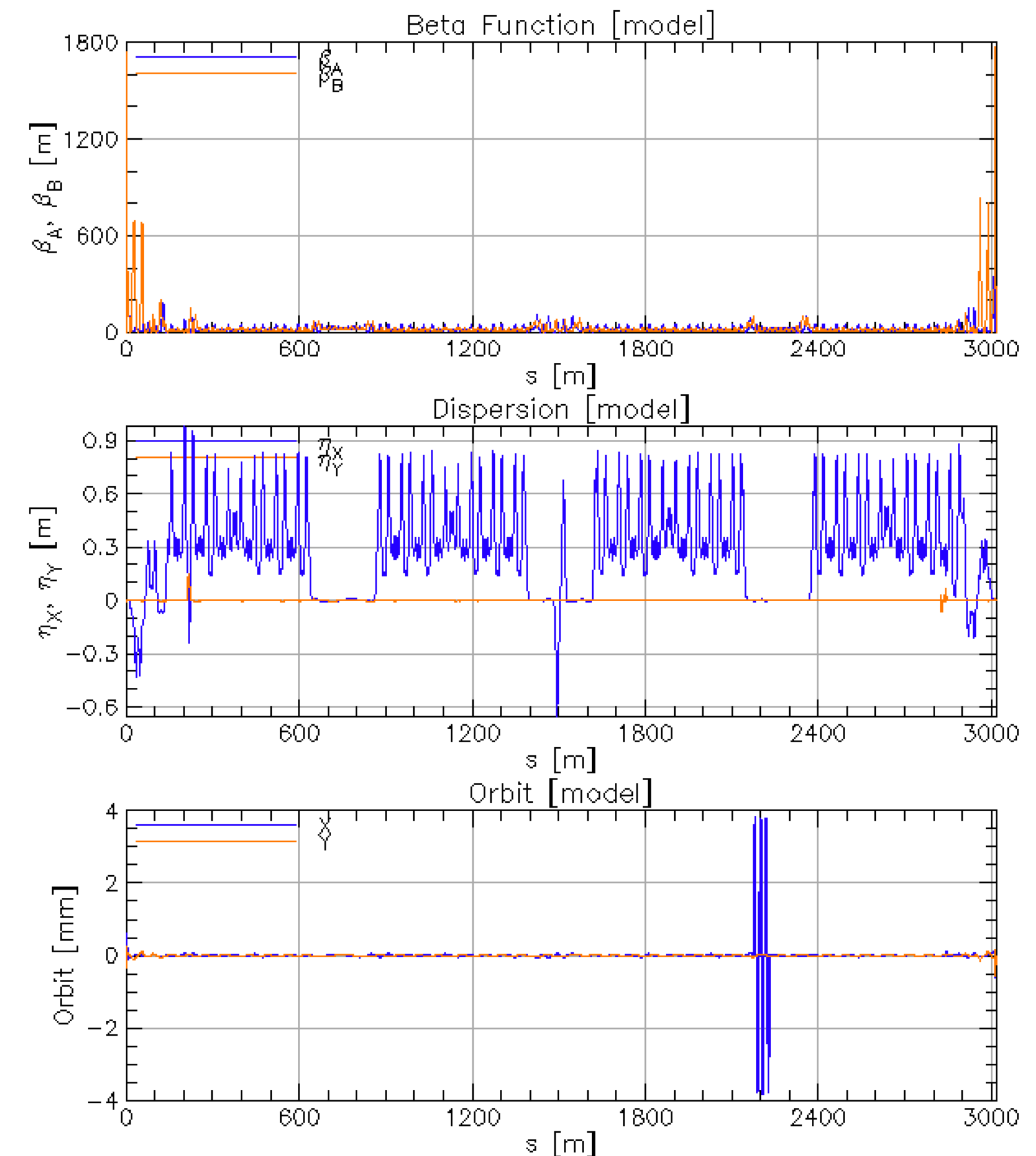


B2EBR_x +0.1mm

B2EBR: $x_{\text{offset}} = -0.1\text{mm}$



Original Rotator ring



shifted

Ring Parameters Comparison

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.593504	1.591891	1.622866	1.621569	! dQ/(dE/E)
J_damp	0.999677	0.999274	0.999770	0.999765	! Damping Partition #
Emittance	4.43161E-09	4.43378E-09	5.45972E-13	5.45940E-13	! Unnormalized

HER

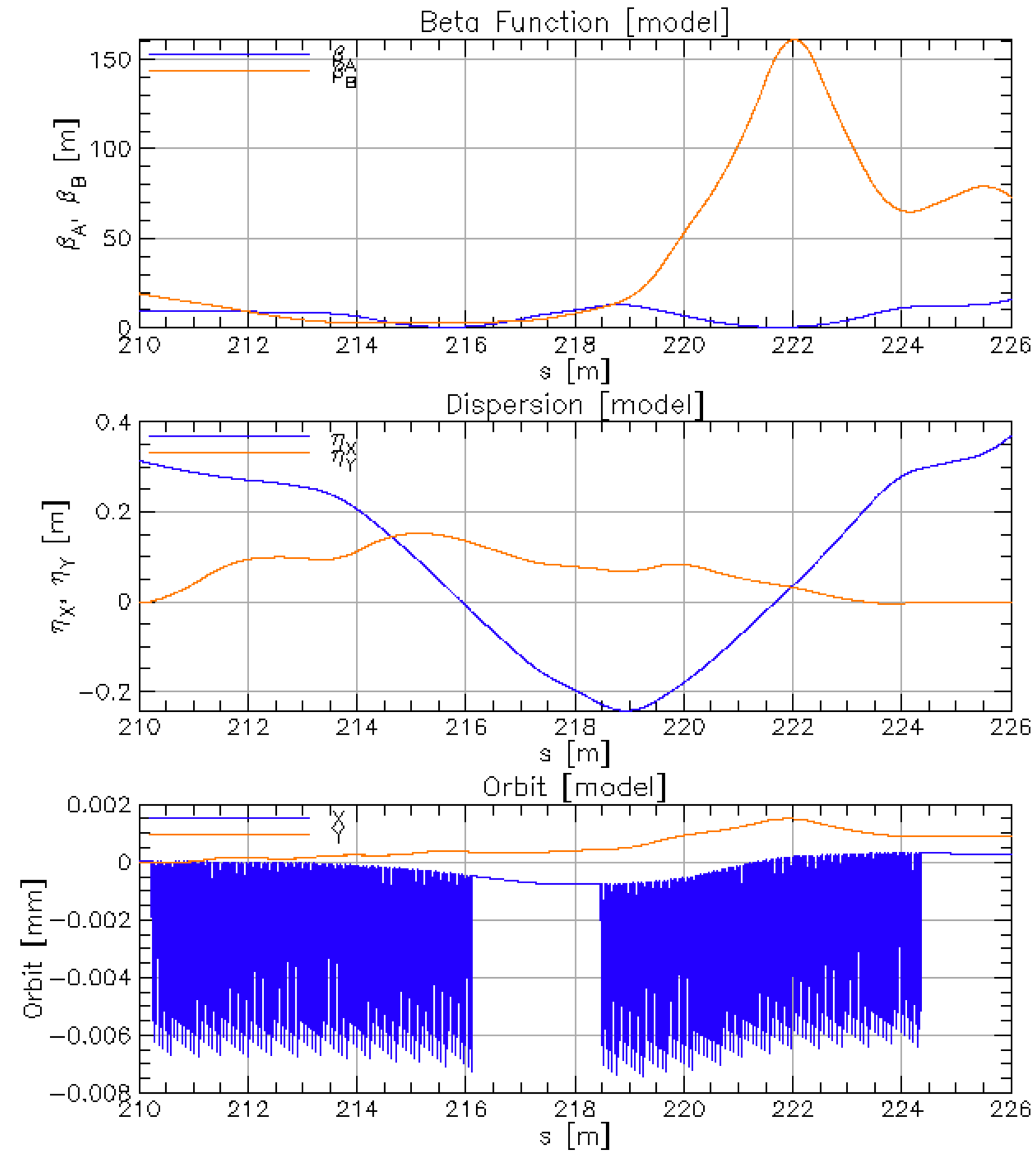
A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530994	45.530994	43.580709	43.580709	! Tune
Chrom	1.591891	1.599271	1.621929	1.625672	! dQ/(dE/E)
J_damp	0.966040	0.965554	1.000295	1.000288	! Damping Partition #
Emittance	4.59794E-09	4.60062E-09	8.97933E-12	8.98123E-12	! Unnormalized

Rot ring

A-Mode			B-Mode		
	Model	Design	Model	Design	
Q	45.530924	45.530924	43.580454	43.580454	! Tune
Chrom	1.588405	1.590367	1.785977	1.786927	! dQ/(dE/E)
J_damp	0.965661	0.965534	1.000672	1.000671	! Damping Partition #
Emittance	4.59926E-09	4.59997E-09	9.42847E-12	9.43025E-12	! Unnormalized

B2EBR_x -0.1mm

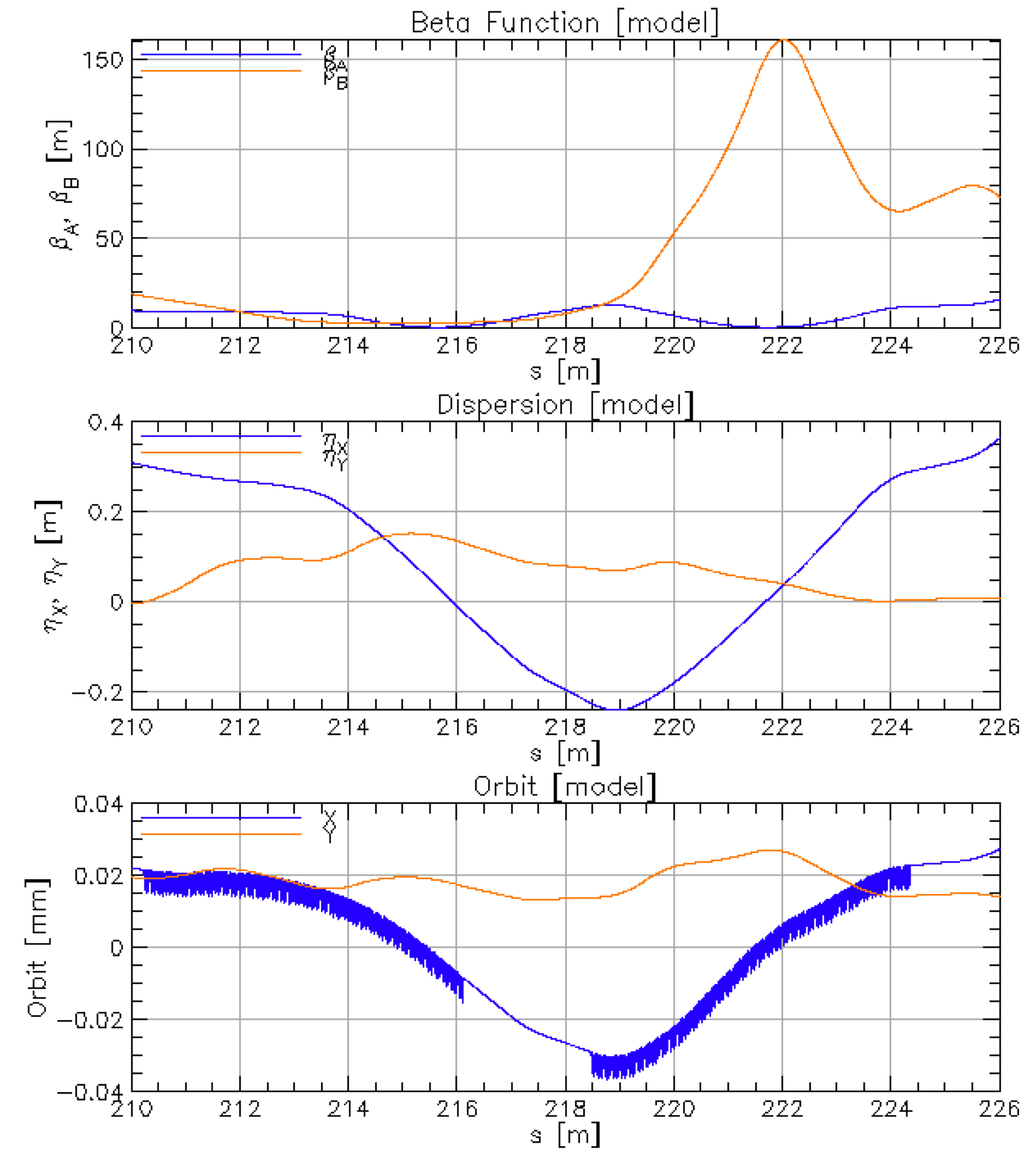
L-Rot



QF6ELA

QD5ELA

original

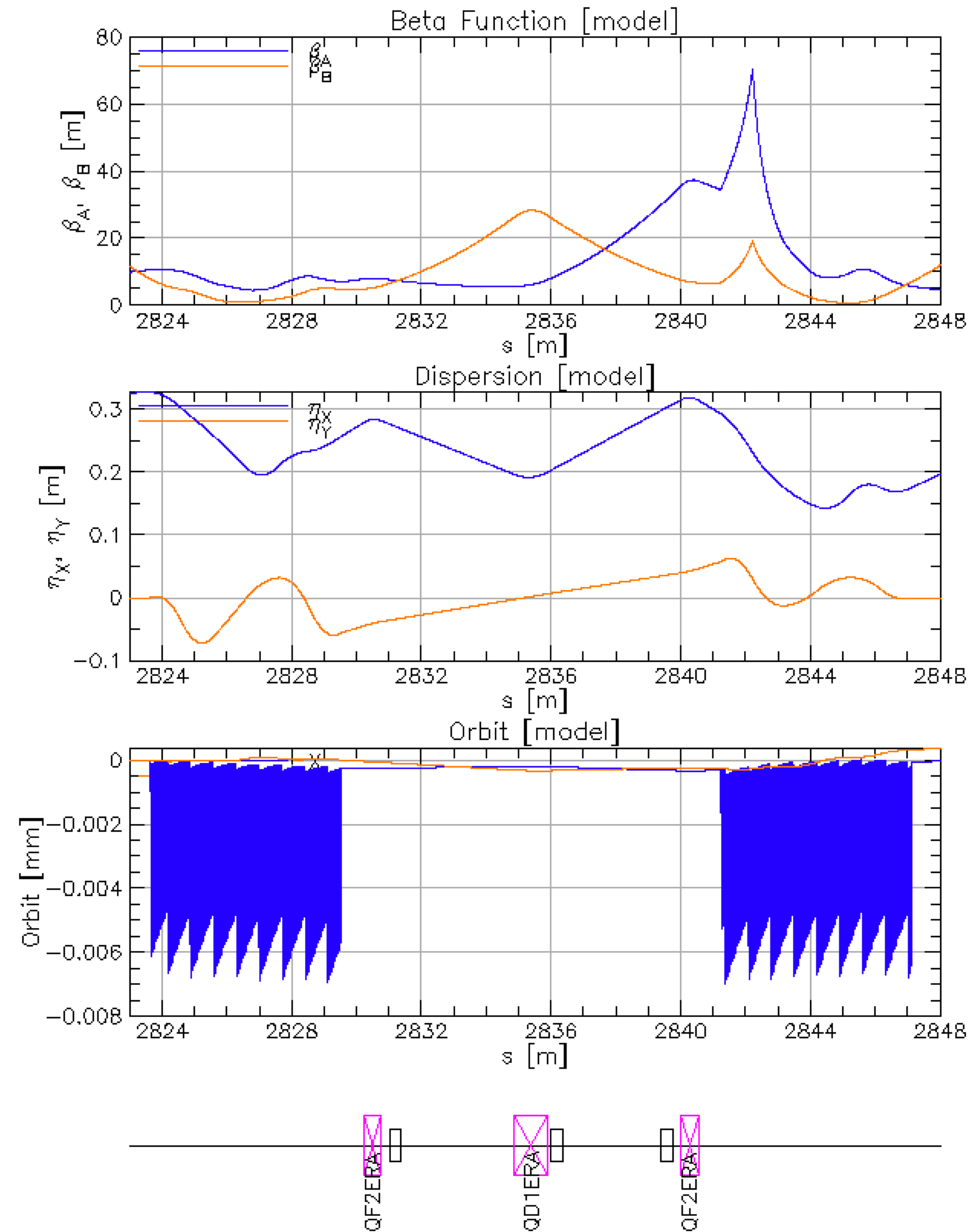


QF6ELA

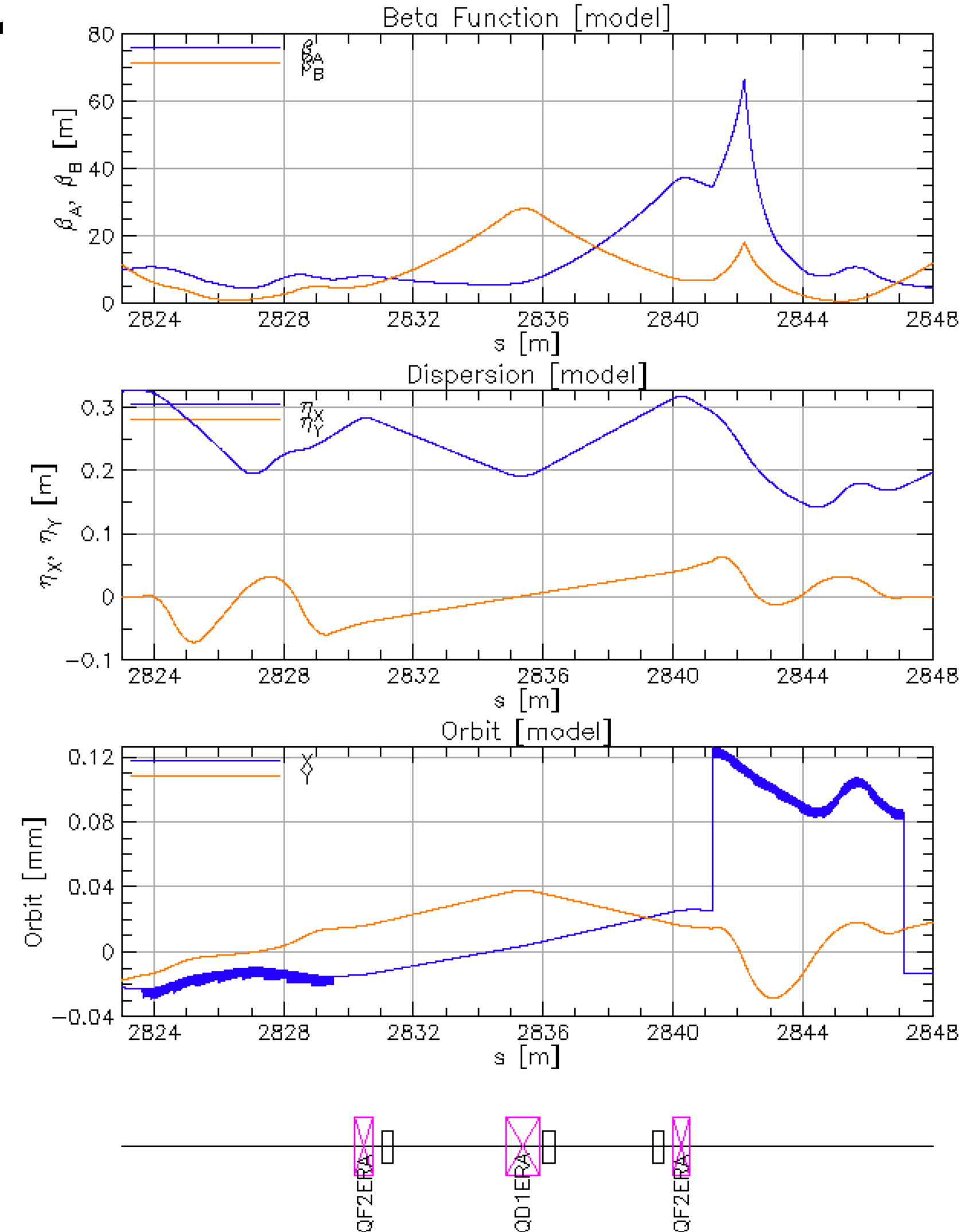
QD5ELA

B2EBR_x -0.1mm

R-Rot



original



B2EBR_x -0.1mm

A-Mode				B-Mode				
	Model	Design		Model	Design			
Q	45.530994	45.530994		43.580709	43.580709	! Tune		
Chrom	1.591891	1.599271		1.621929	1.625672	! dQ/(dE/E)		
J_damp	0.966040	0.965554		1.000295	1.000288	! Damping Partition #		
Emittance	4.59794E-09	4.60062E-09		8.97933E-12	8.98123E-12	! Unnormalized		Rot ring
A-Mode				B-Mode				
	Model	Design		Model	Design			
Q	45.530916	45.530916		43.580768	43.580768	! Tune		
Chrom	1.611169	1.621602		2.048969	2.053608	! dQ/(dE/E)		
J_damp	0.968098	0.967419		1.000519	1.000517	! Damping Partition #		
Emittance	4.58697E-09	4.59078E-09		9.50437E-12	9.50845E-12	! Unnormalized		B2EAR_x +0.1mm
A-Mode				B-Mode				
	Model	Design		Model	Design			
Q	45.530936	45.530936		43.579700	43.579700	! Tune		
Chrom	1.579119	1.583510		1.171259	1.173644	! dQ/(dE/E)		
J_damp	0.964325	0.964030		1.000934	1.000929	! Damping Partition #		
Emittance	4.62541E-09	4.62706E-09		9.55769E-12	9.56134E-12	! Unnormalized		B2EAR_x -0.1mm
A-Mode				B-Mode				
	Model	Design		Model	Design			
Q	45.530921	45.530921		43.580005	43.580005	! Tune		
Chrom	1.604638	1.617485		1.446812	1.453279	! dQ/(dE/E)		
J_damp	0.966477	0.965633		1.000448	1.000443	! Damping Partition #		
Emittance	4.59883E-09	4.60342E-09		9.36143E-12	9.36467E-12	! Unnormalized		B2EBR_x +0.1mm
A-Mode				B-Mode				
	Model	Design		Model	Design			
Q	45.530924	45.530924		43.580454	43.580454	! Tune		
Chrom	1.588405	1.590367		1.785977	1.786927	! dQ/(dE/E)		
J_damp	0.965661	0.965534		1.000672	1.000671	! Damping Partition #		
Emittance	4.59926E-09	4.59997E-09		9.42847E-12	9.43025E-12	! Unnormalized		B2EBR_x -0.1mm