



HER IR Optics with Spin Rotator

Status Report

Optics Team

- Pantaleo Raimondi
- Marica Biagini
- Jerry Yocky
- Yuri Nosochkov
- Martin Donald
- Uli Wienands
- Yunhai Cai
- ...

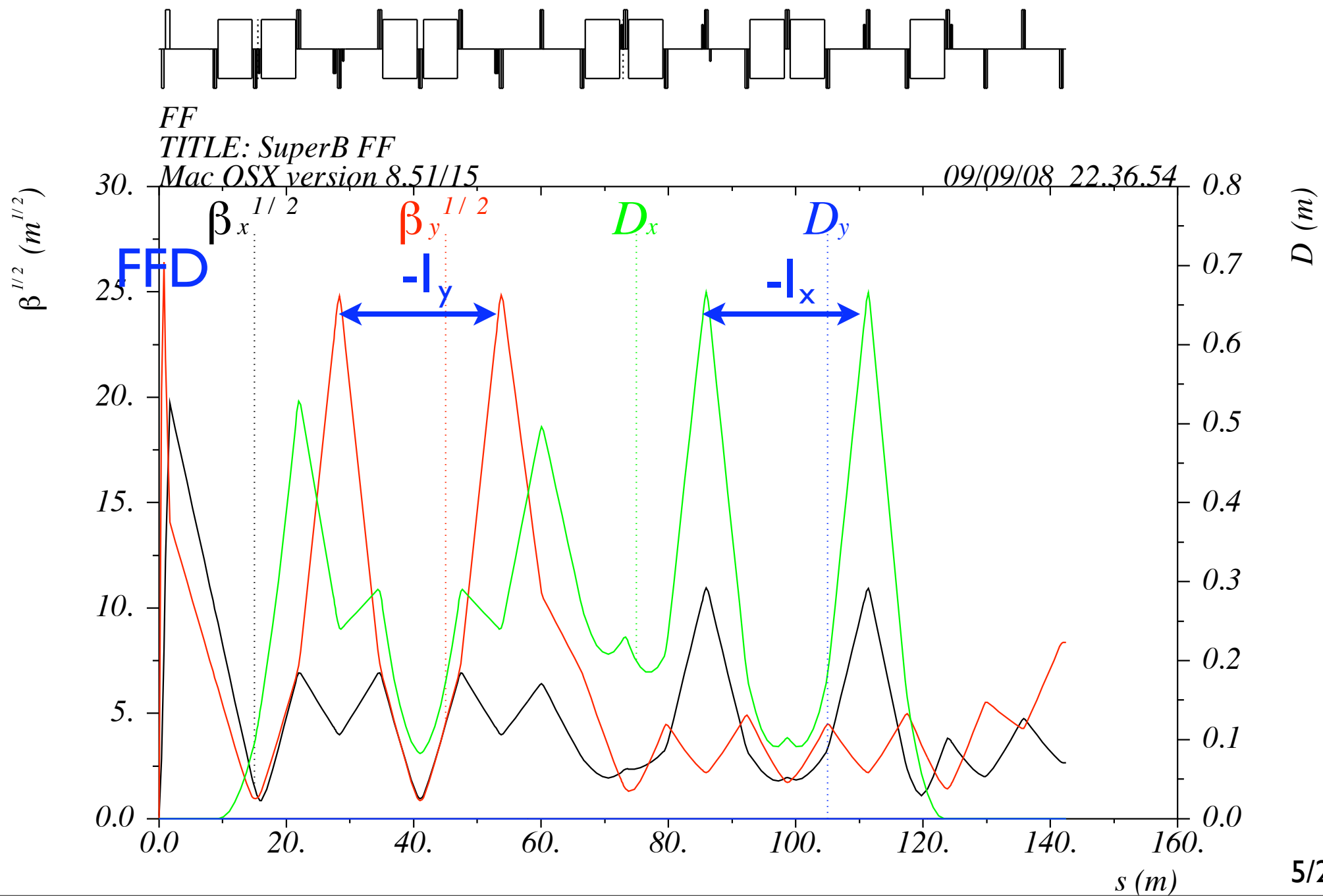
Outline

- Scope of work.
- Original IR Design from Pantaleo & Marica.
- Spin rotator version 1 -> lessons learned.
- Status of Spin rotator version 2.
- Next Steps.

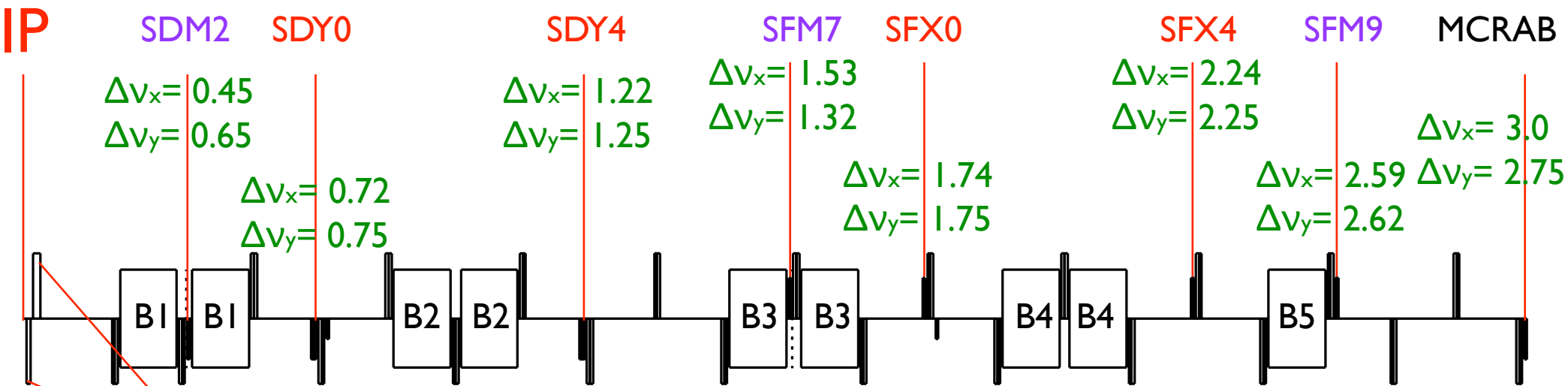
Scope of Work

Introduce spin rotator on both sides of IP in the HER to provide longitudinal polarized electrons at IP and thereby maintaining the **chromatic characteristic** of the original design necessary for the crab waist scheme, **the band width and dynamic aperture.**

Original HER FF design



Original HER FF design

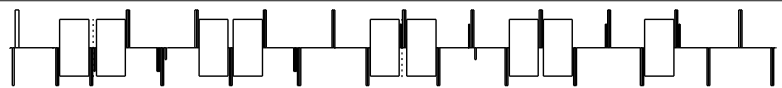


FF

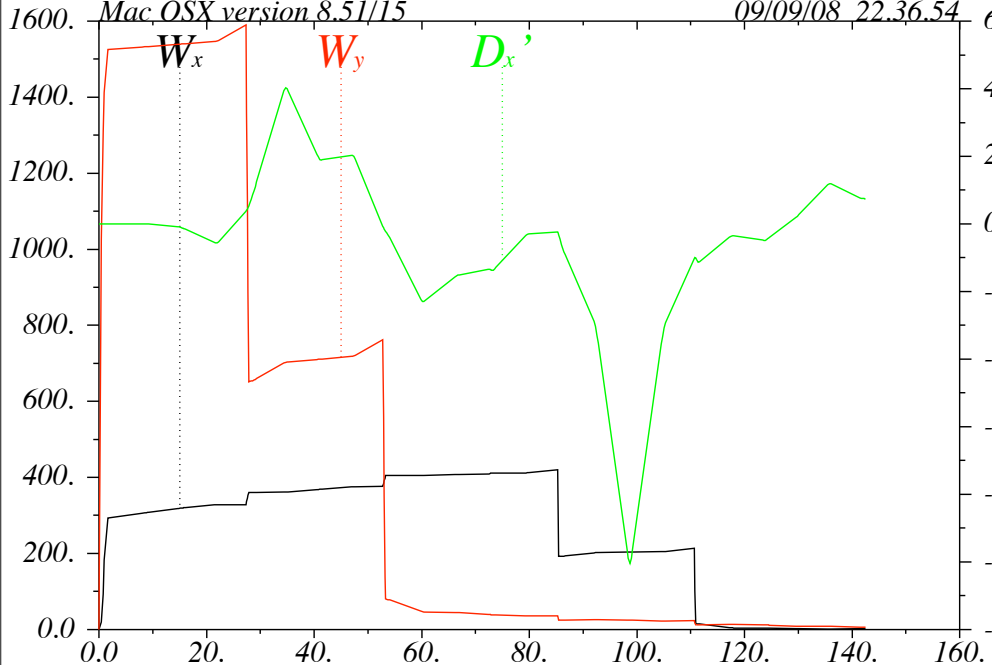
TITLE: SuperB FF

		entrance		exit
QD0	S=0.4	$\Delta v_x = 0.009$ $\Delta v_y = 0.0009$		S=0.8 $\Delta v_x = 0.016$ $\Delta v_y = 0.003$
QF1	S=1.0	$\Delta v_x = 0.017$ $\Delta v_y = 0.057$		S=1.7 $\Delta v_x = 0.019$ $\Delta v_y = 0.50$

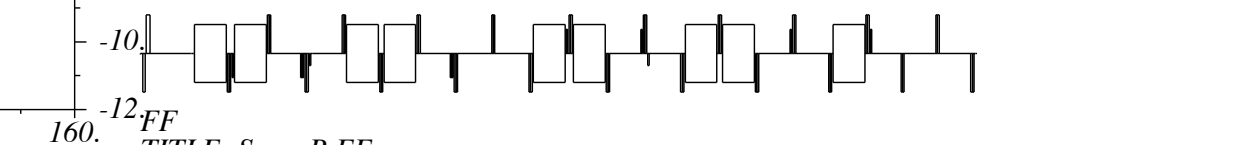
Note: Δ stands for the phase advance difference between IP and location



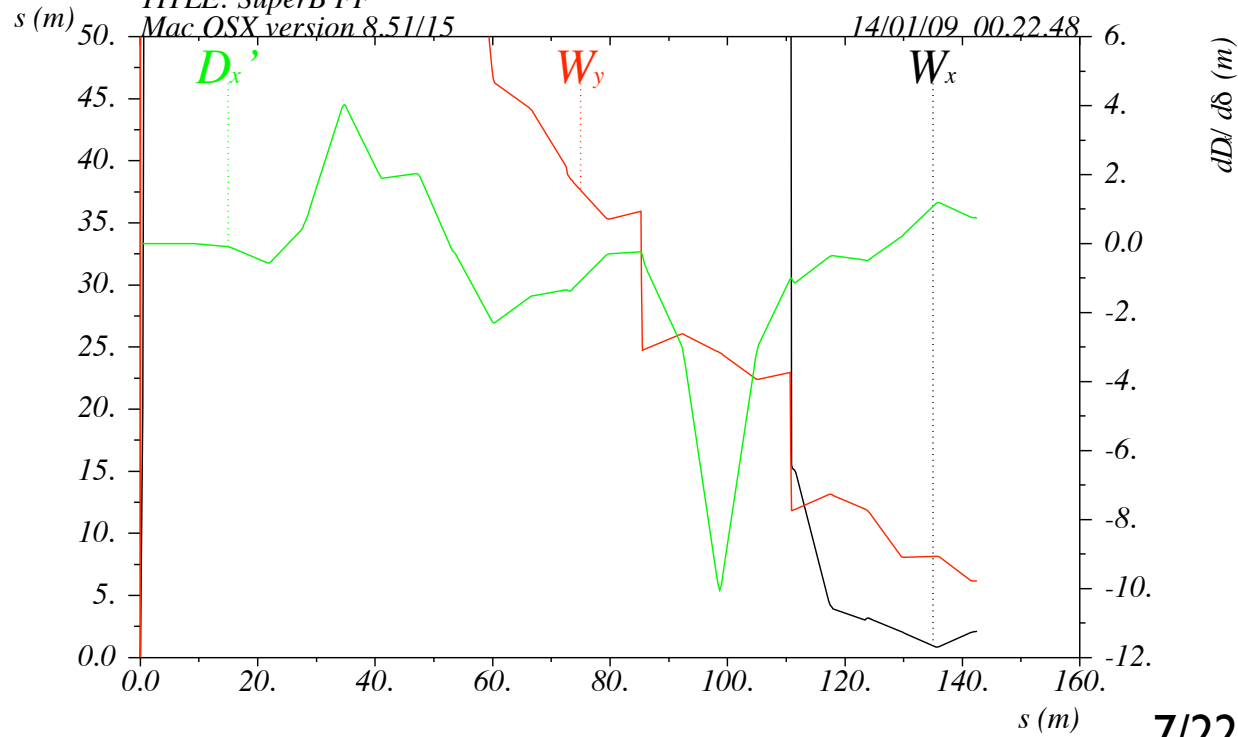
FF
 TITLE: SuperB FF
 Mac.OSX version 8.51/15
 09/09/08 22.36.54



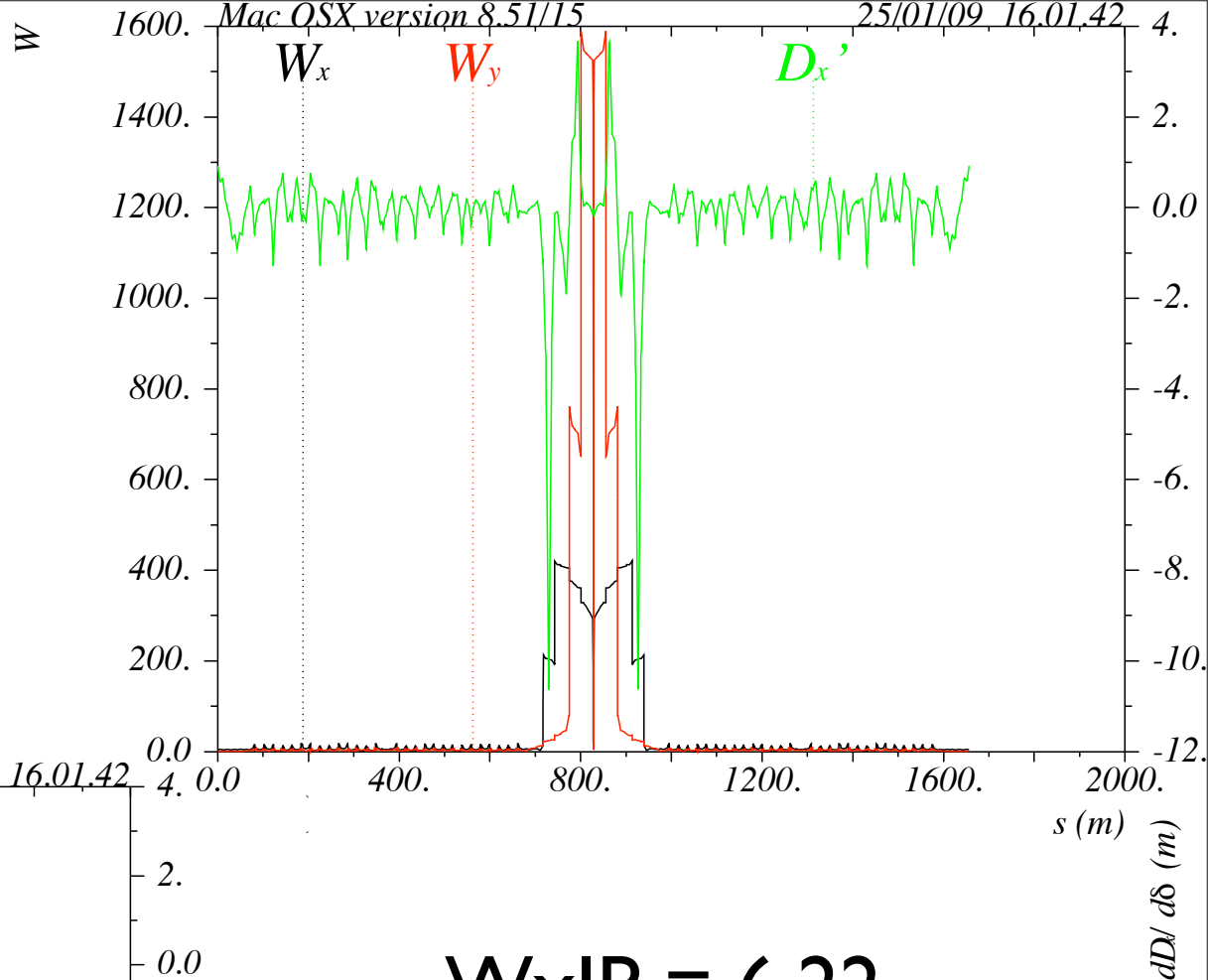
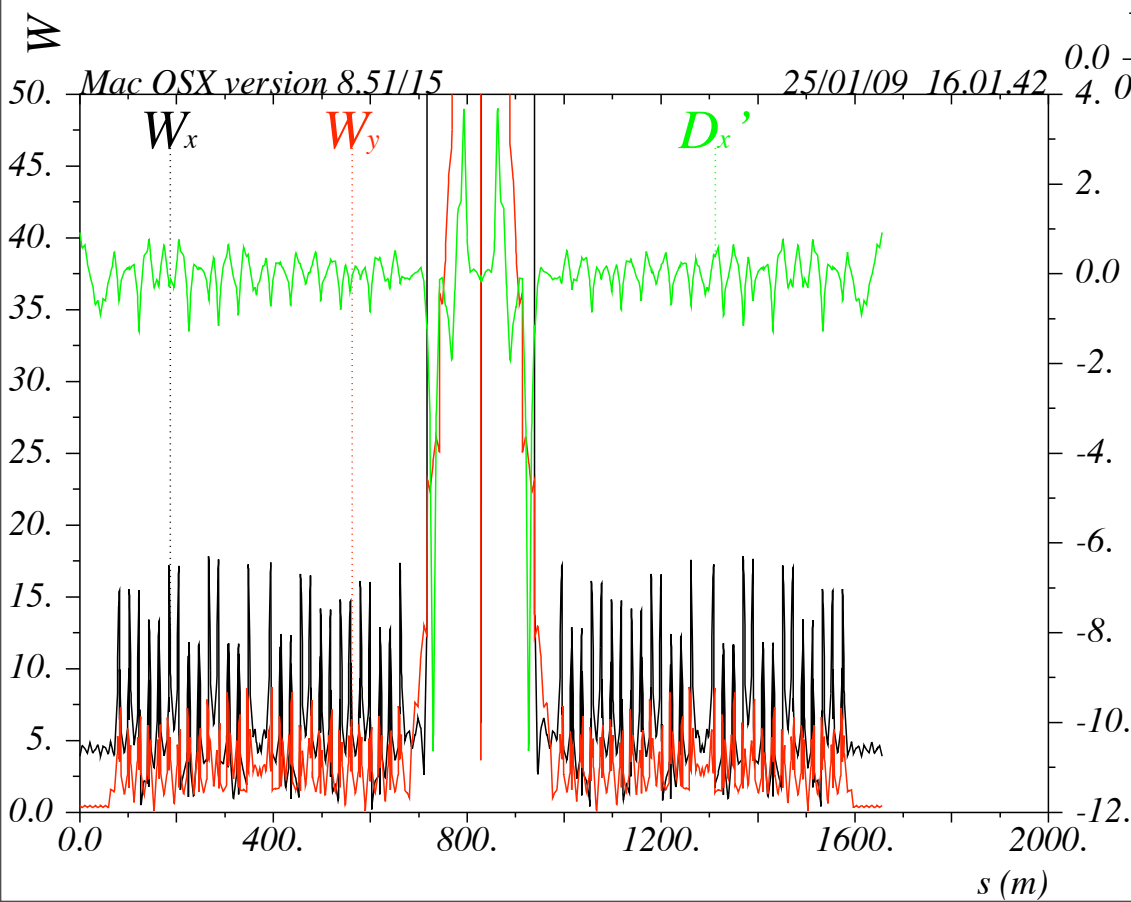
Orig. Chromatic Functions FF



FF
 TITLE: SuperB FF
 Mac.OSX version 8.51/15
 14/01/09 00.22.48



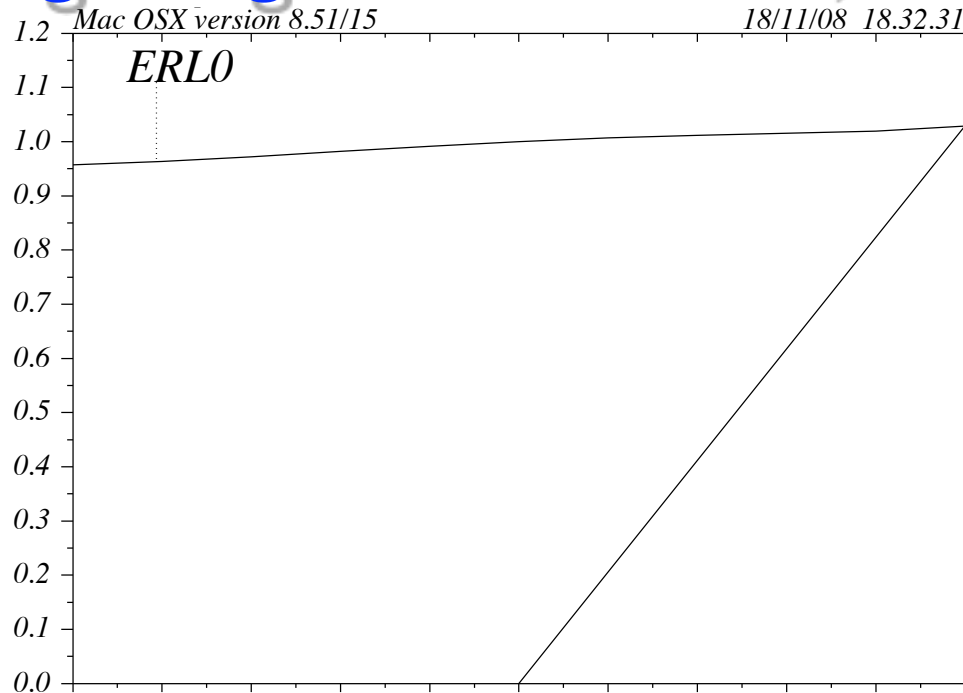
Orig. Chromatic Functions Ring



$W_{xIP} = 6.22$
 $W_{yIP} = 3.62$
 $W_{xEND} = 3.89$
 $W_{yEND} = 0.48$
 $W_{xARC} < 20$
 $W_{yARC} < 10$

HER orig. Ring IP Bandwidth, NO SR

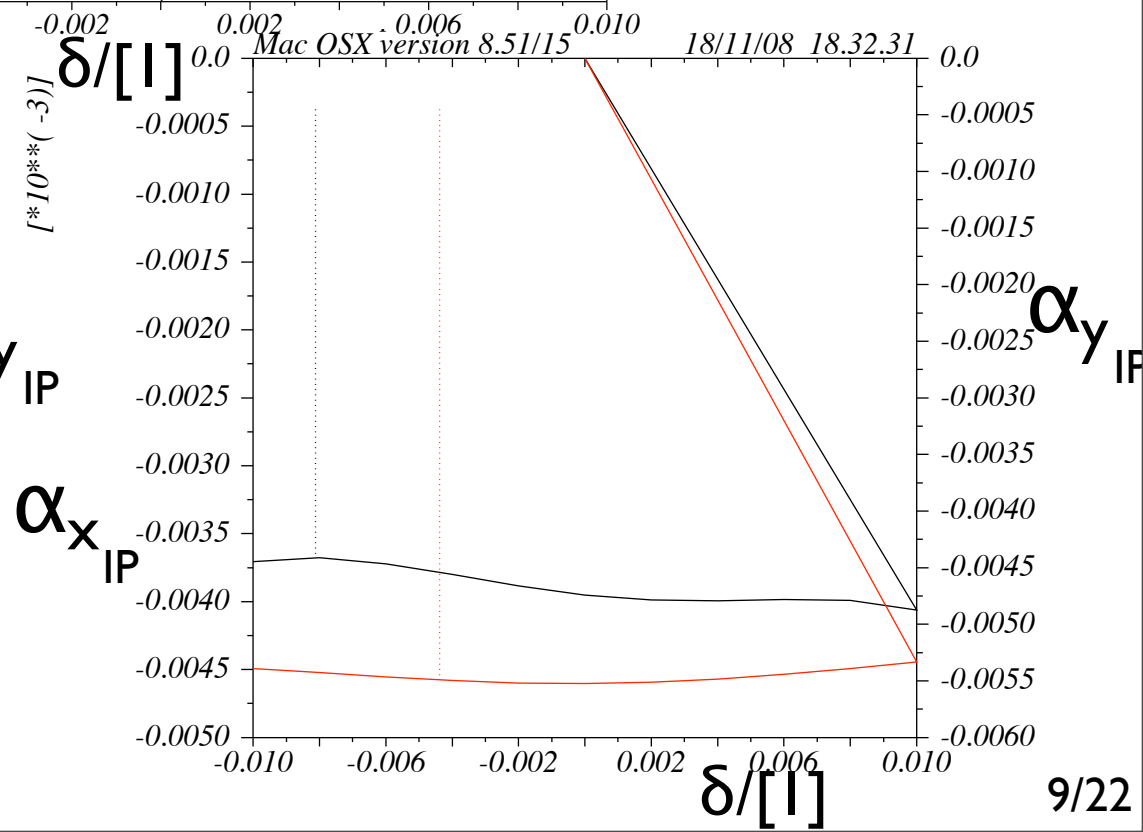
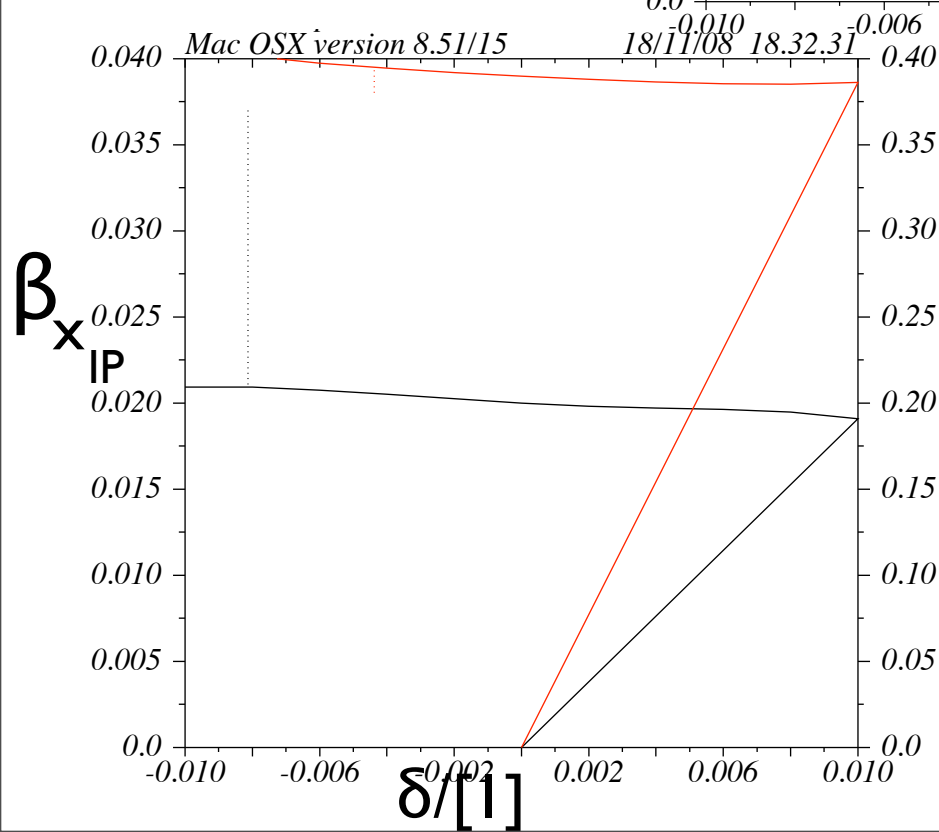
$$\frac{L}{L_0} = \left[\frac{\beta_x^* \beta_y}{\beta_{x_0}^* \beta_{y_0}} \right]^{-\frac{1}{2}}$$



$\delta_{\text{BEAM}} \sim 5 \cdot 10^{-4}$

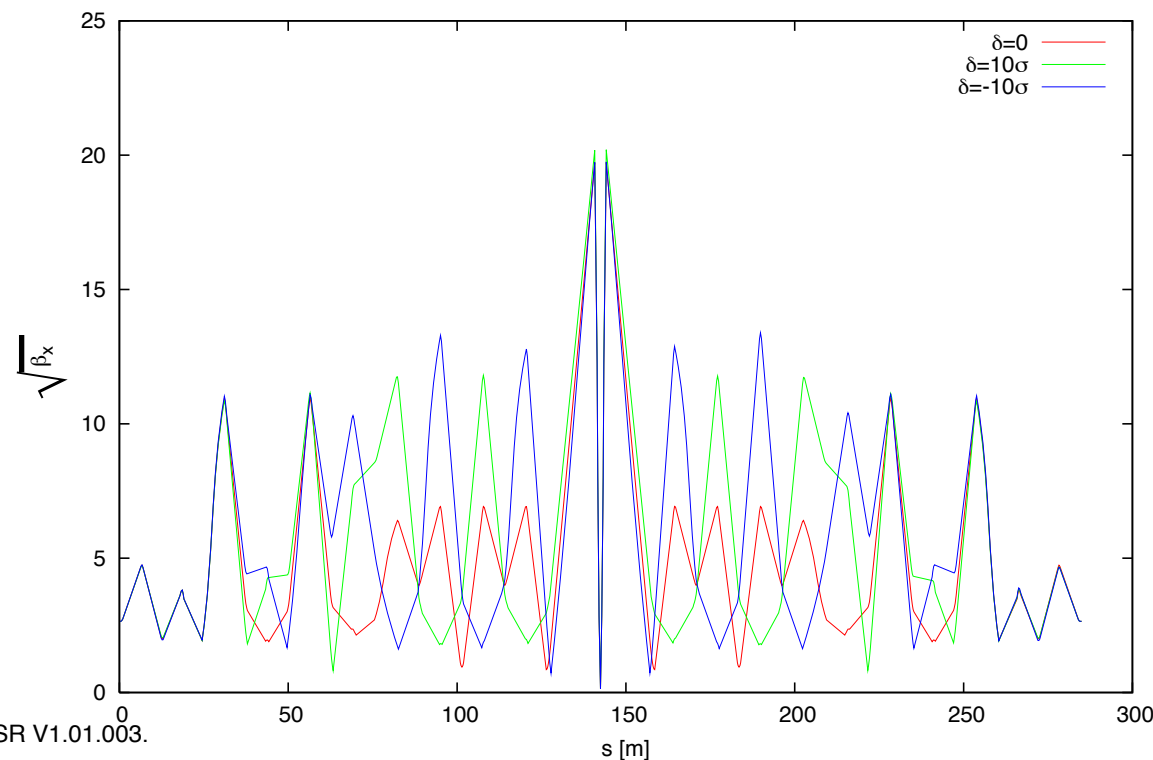
2% of E

$\delta \Leftrightarrow 40\sigma_s$

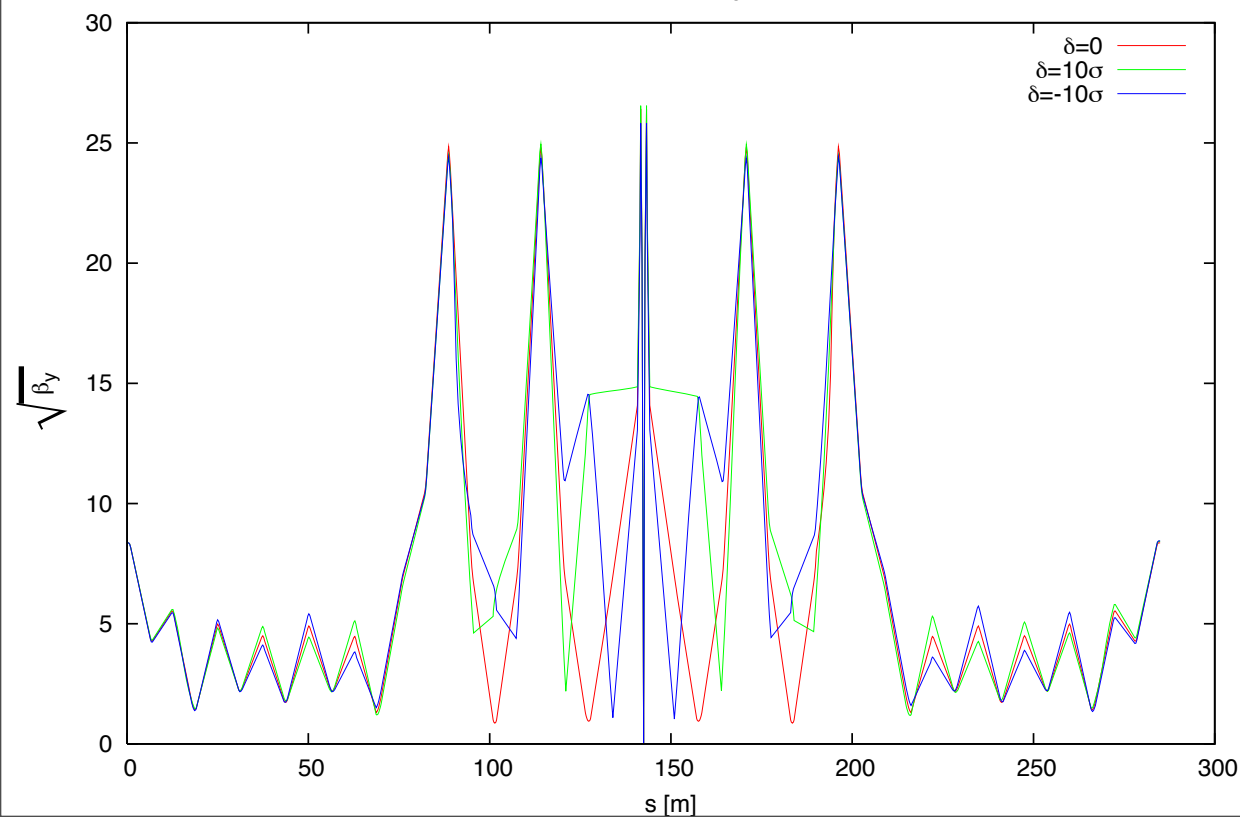


Chromatic β Functions

FF Chromatic Horizontal β -Functions with $\delta = \pm 10\sigma_s$. Original Design NO SR V1.01.003.



FF Chromatic Vertical β -Functions with $\delta = \pm 10\sigma_s$. Original Design NO SR V1.01.003.



HER without SR MAD Tracking no error

ICmax: $x=60, y=0, \delta=0$

ICmax: $x=40, y=0, \delta=10$

ICmax: $x=20, y=0, \delta=-10$

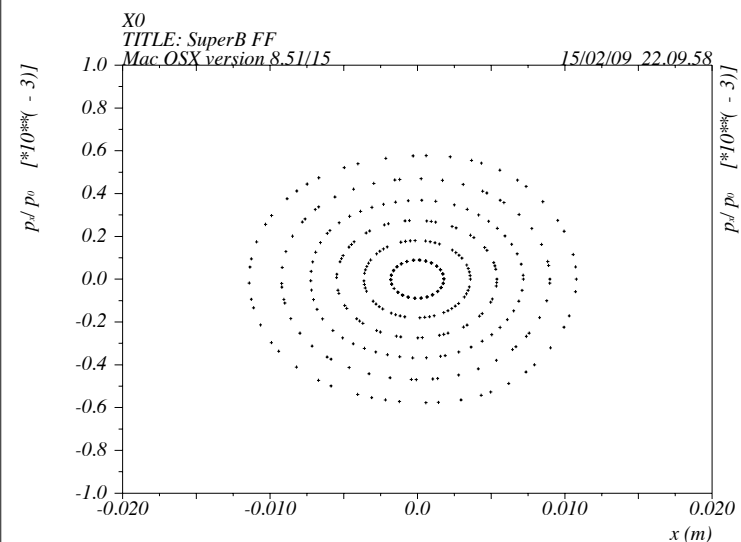


Table name = TRAC

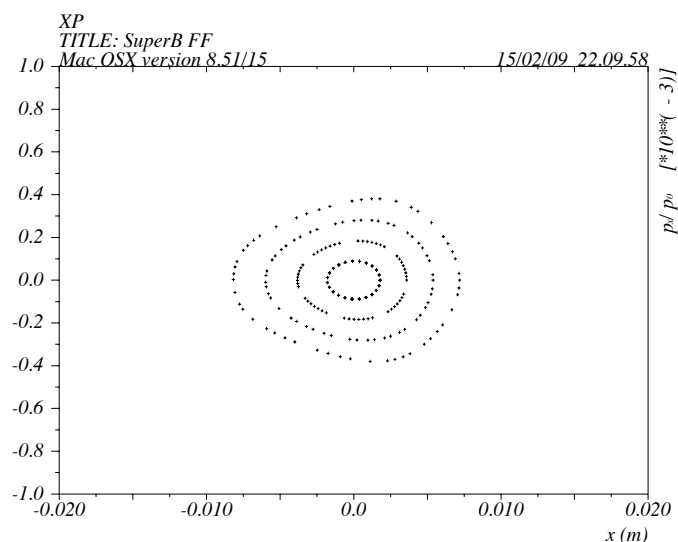


Table name = TRAC

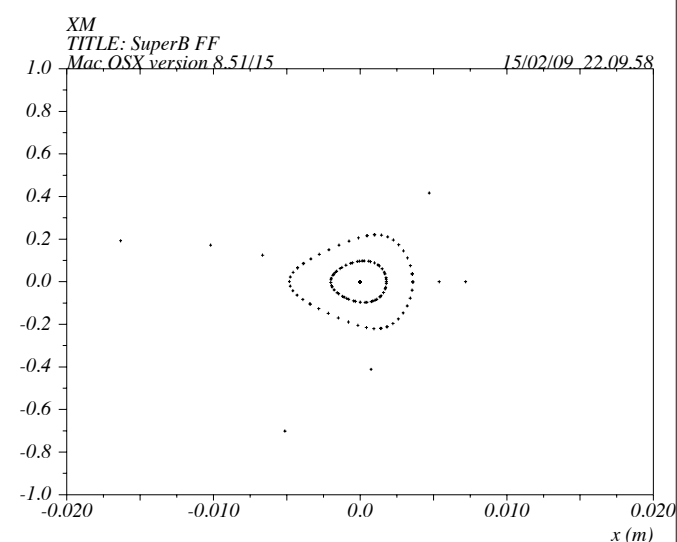


Table name = TRAC

ICmax: $x=20, y=0, \delta=0$

ICmax: $x=20, y=0, \delta=10$

ICmax: $x=20, y=0, \delta=-10$

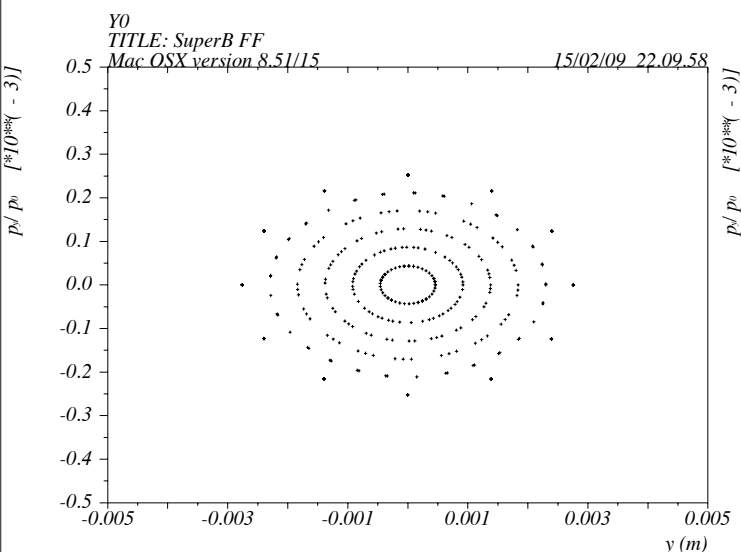


Table name = TRAC

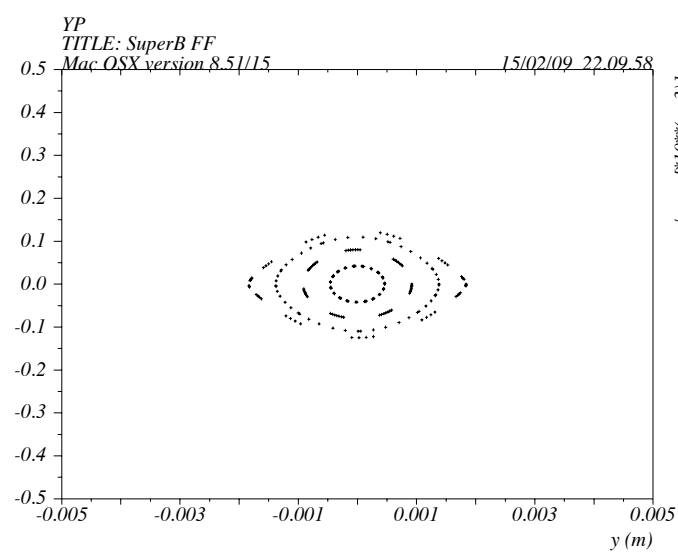


Table name = TRAC

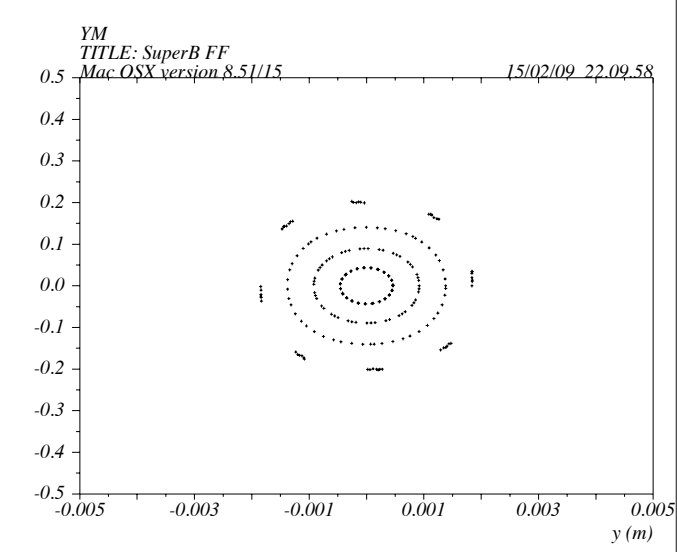


Table name = TRAC

Uli's Spin Rotator

sol1 sol2

reflector

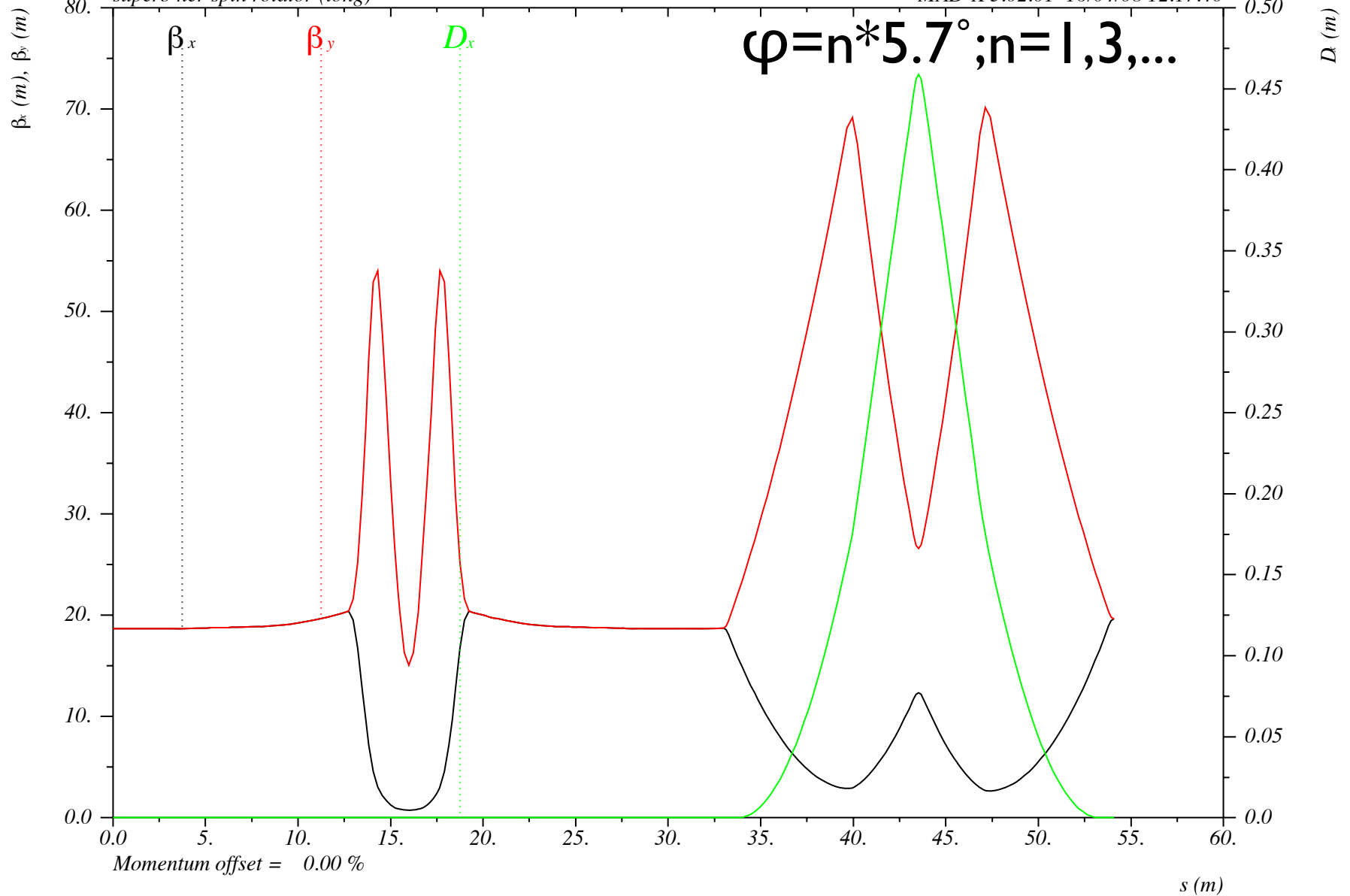
sol3 sol4

bend

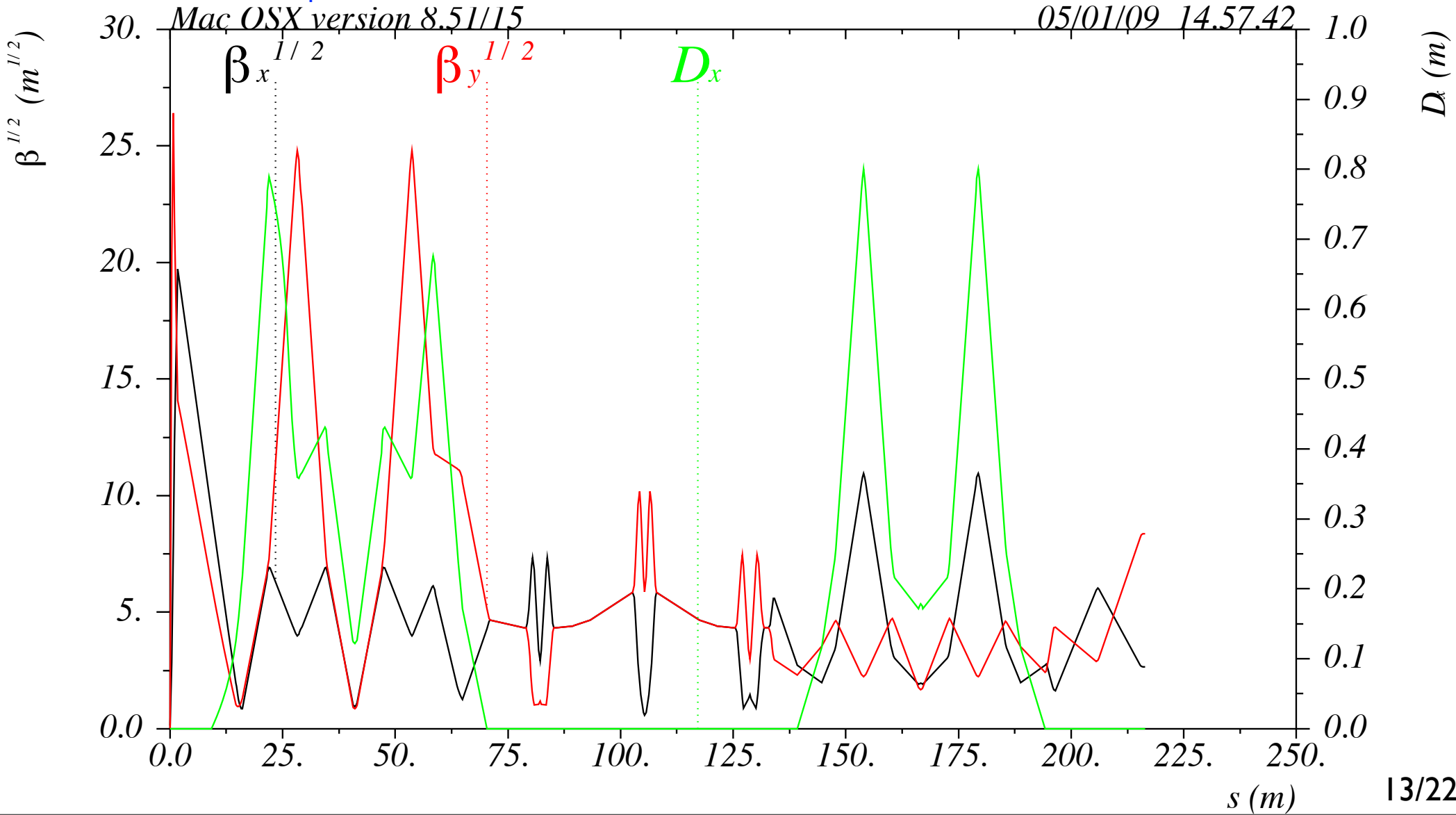
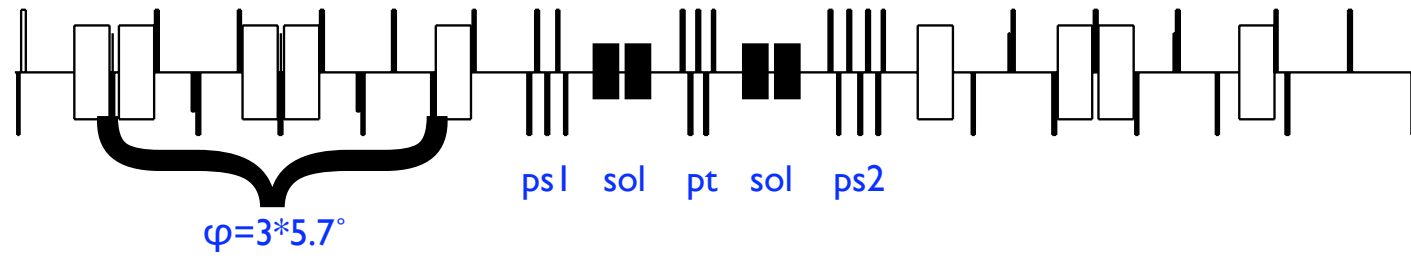
bend

superb her spin rotator (long)

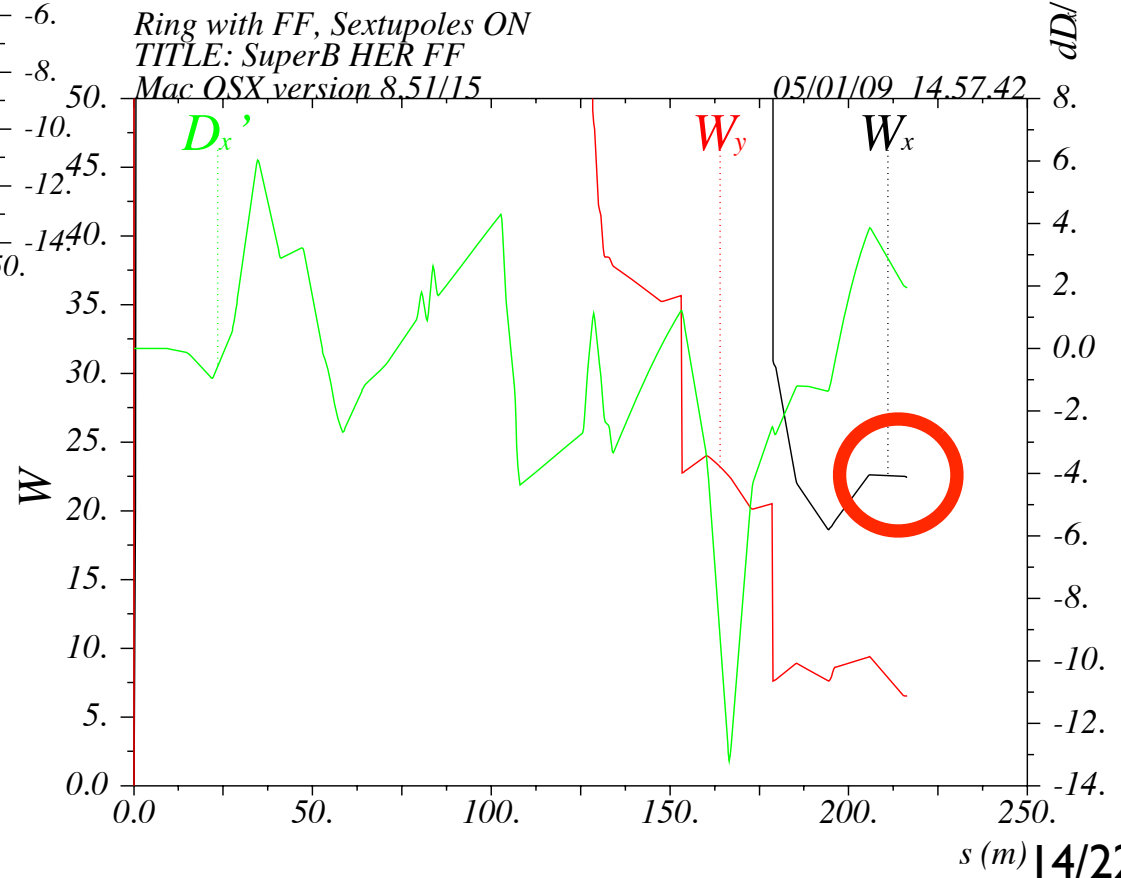
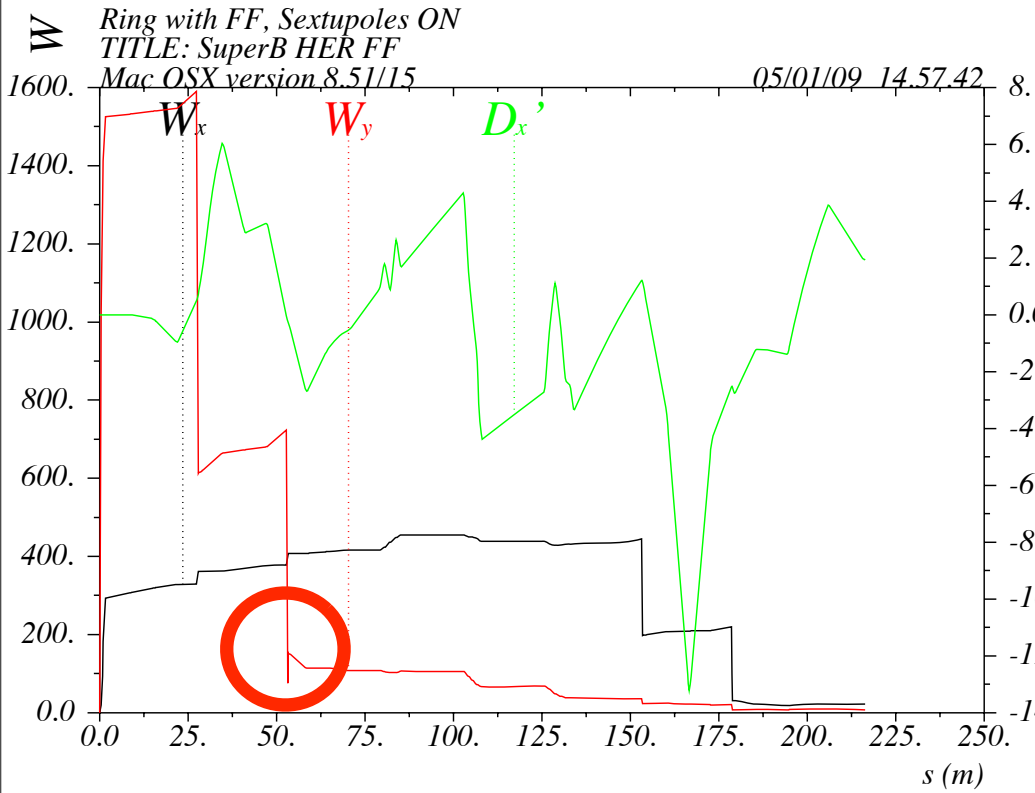
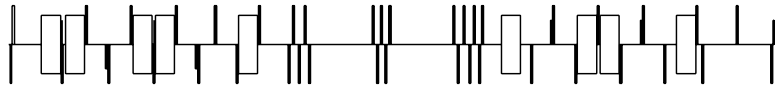
MAD-X 3.02.01 16/04/08 12.17.40



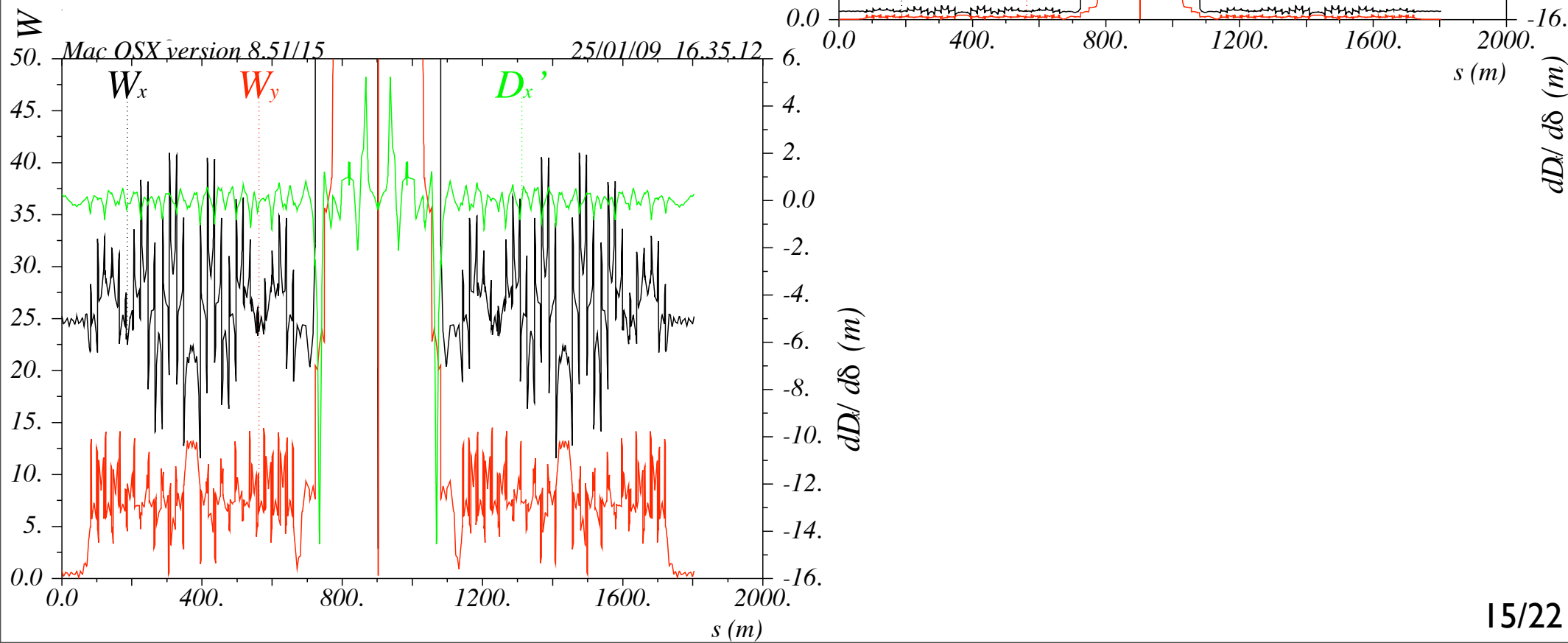
HER IR with SRI Linear Optics V7



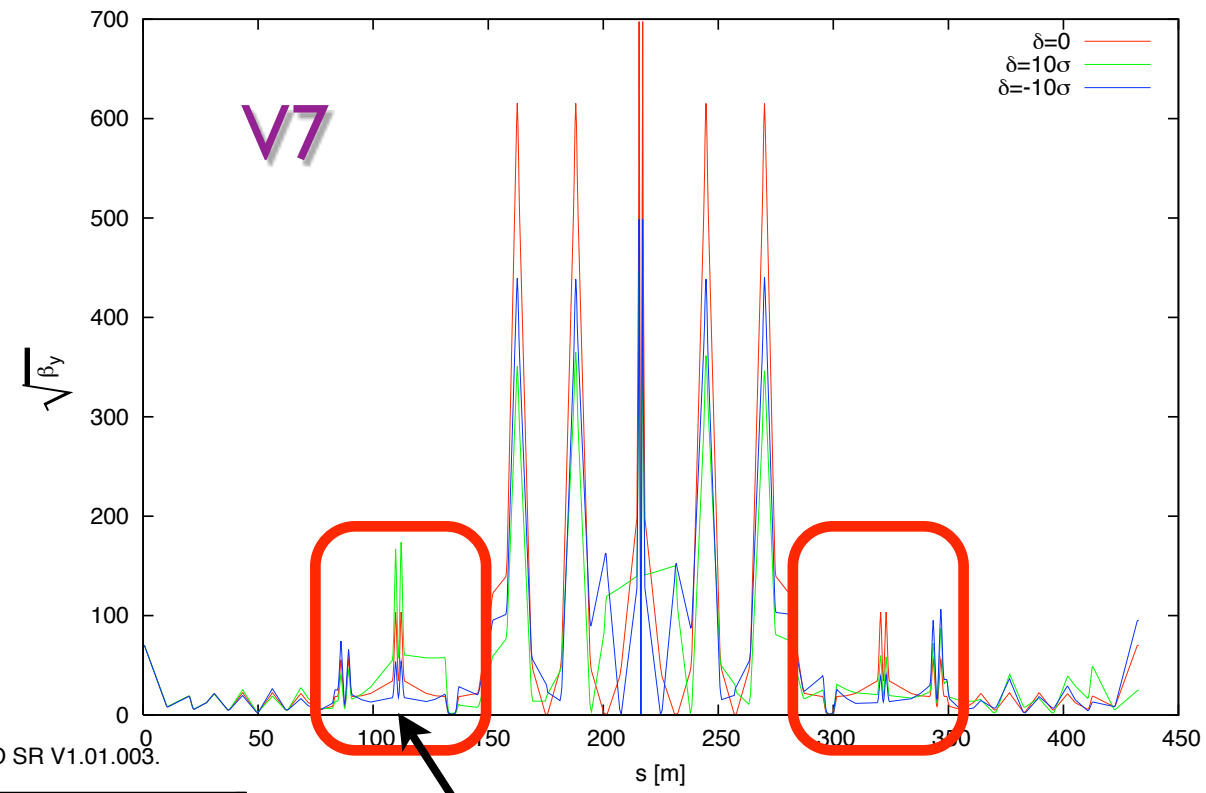
Chromatic Functions FF



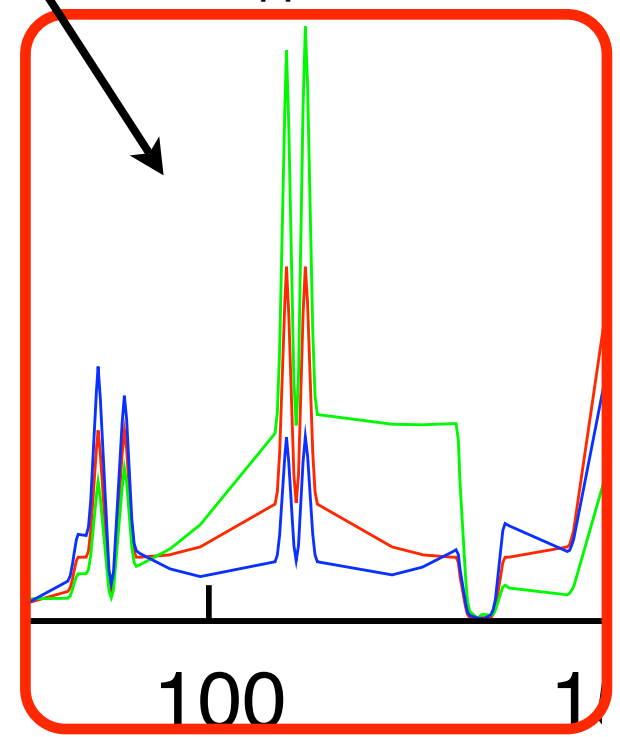
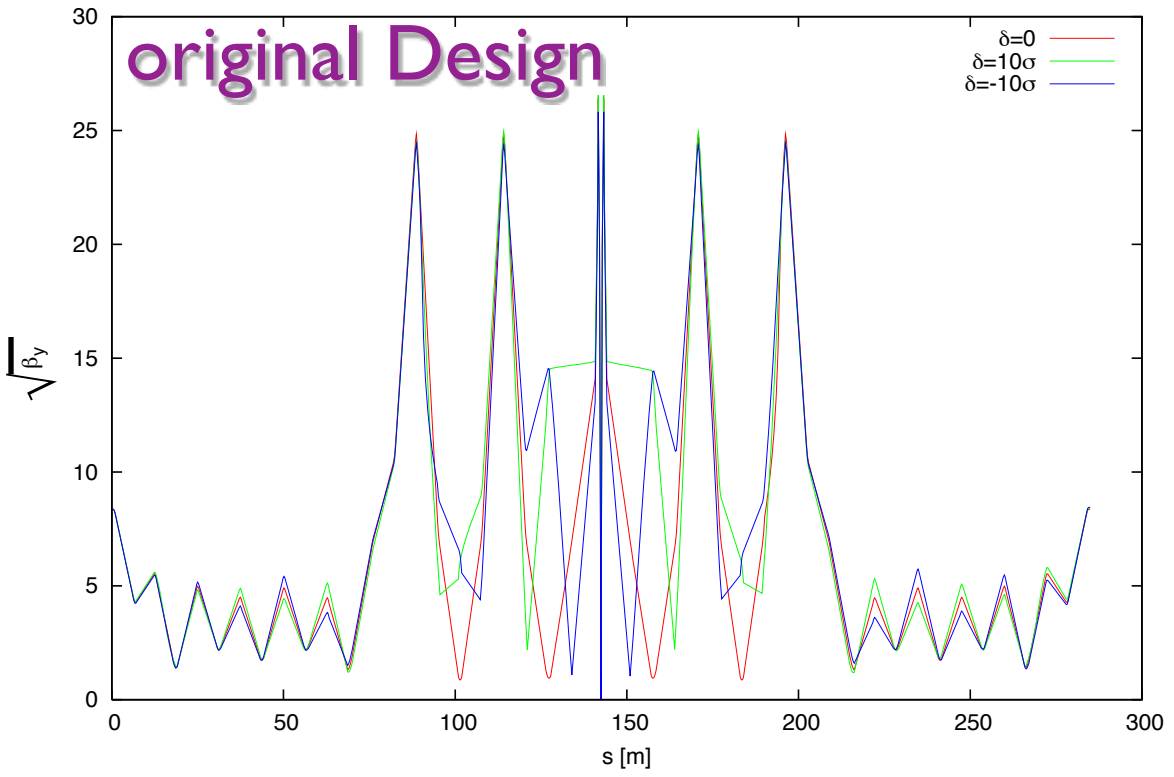
Chromatic Functions Ring



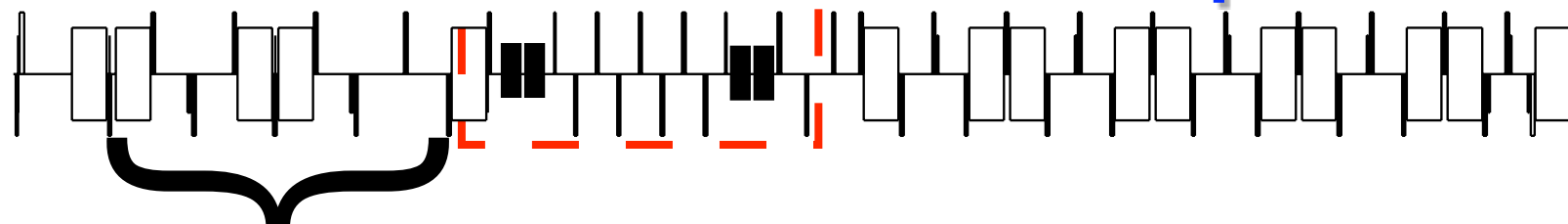
Chromatic β_y



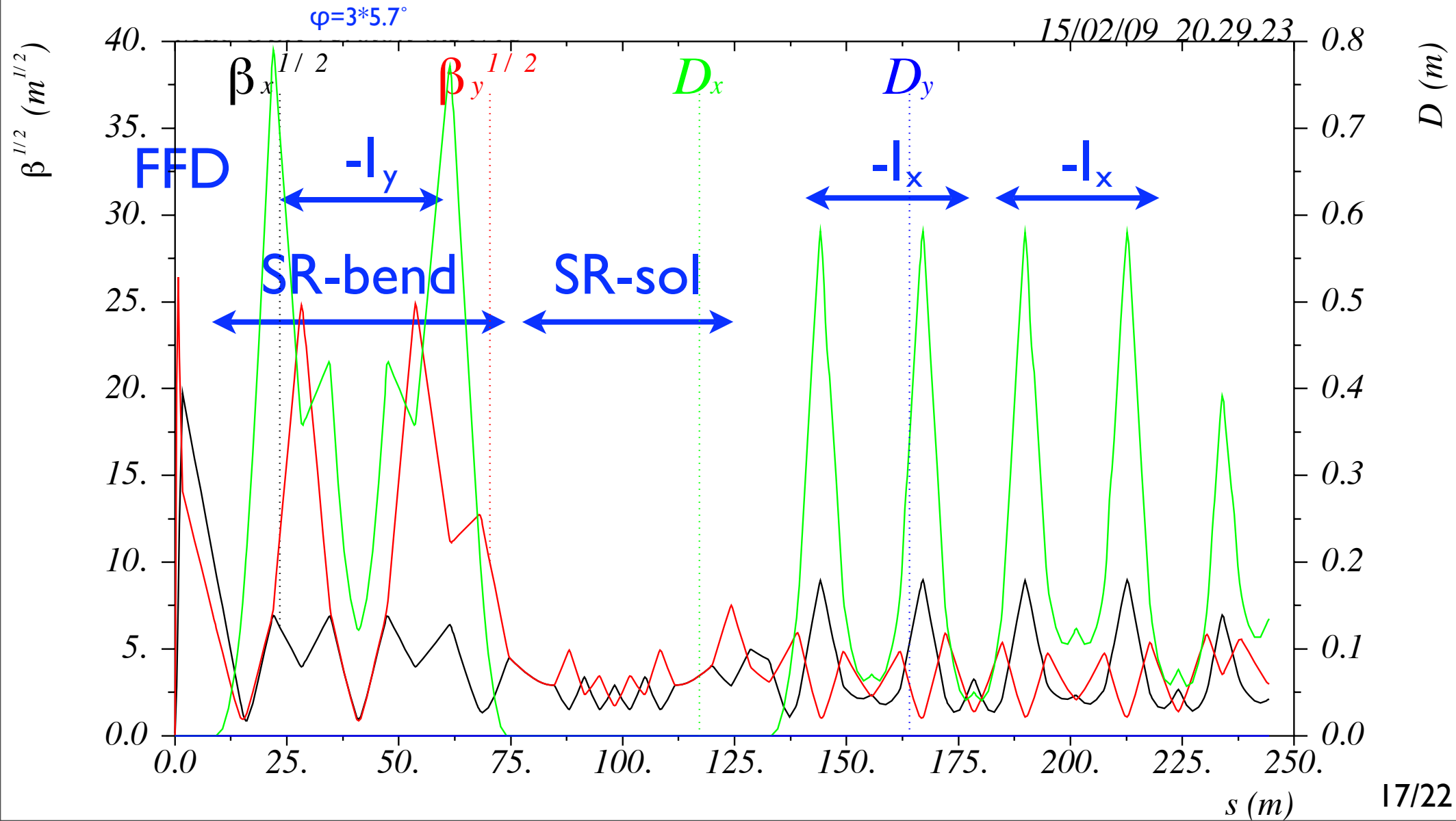
FF Chromatic Vertical β -Functions with $\delta = \pm 10\sigma_s$. Original Design NO SR V1.01.003.



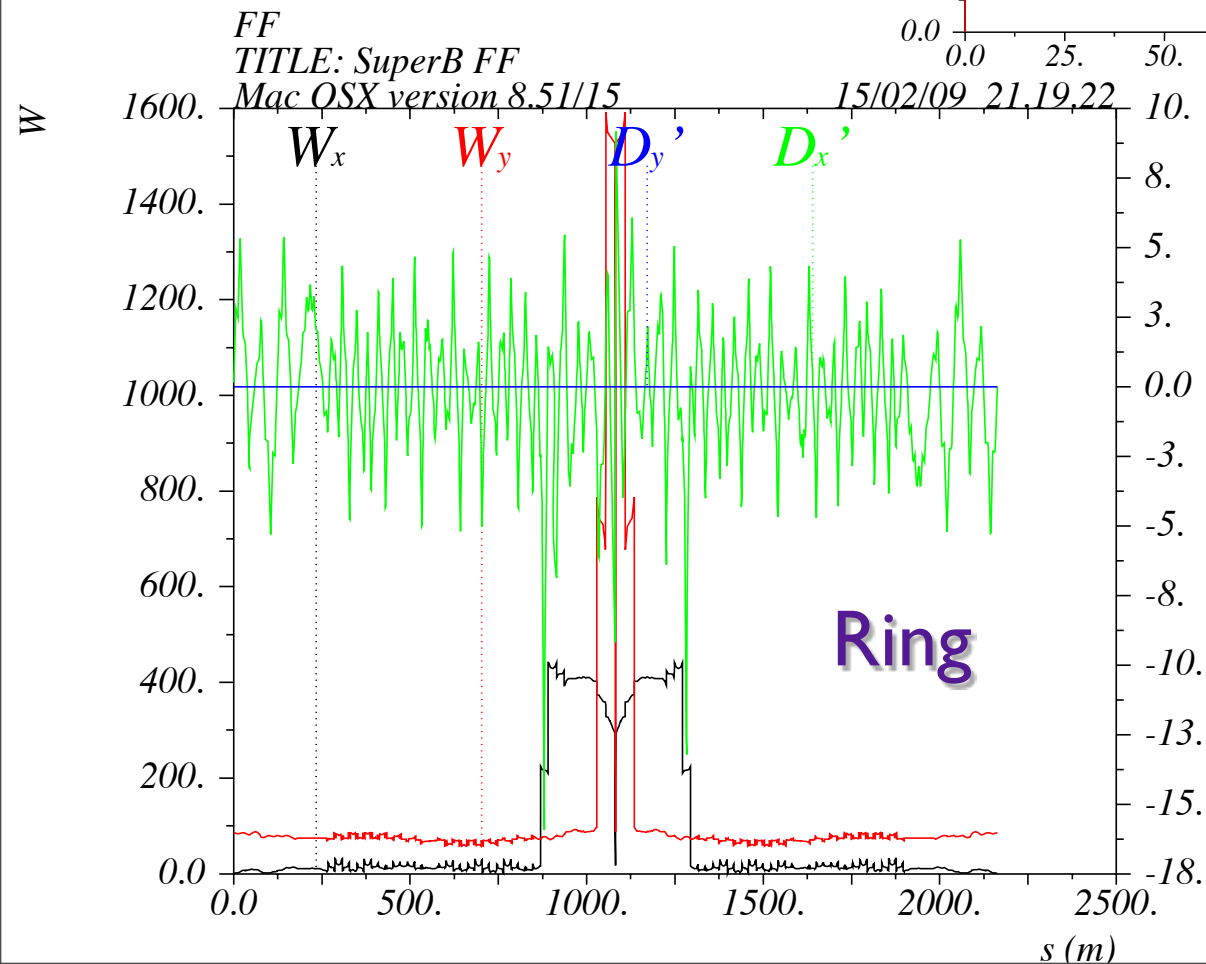
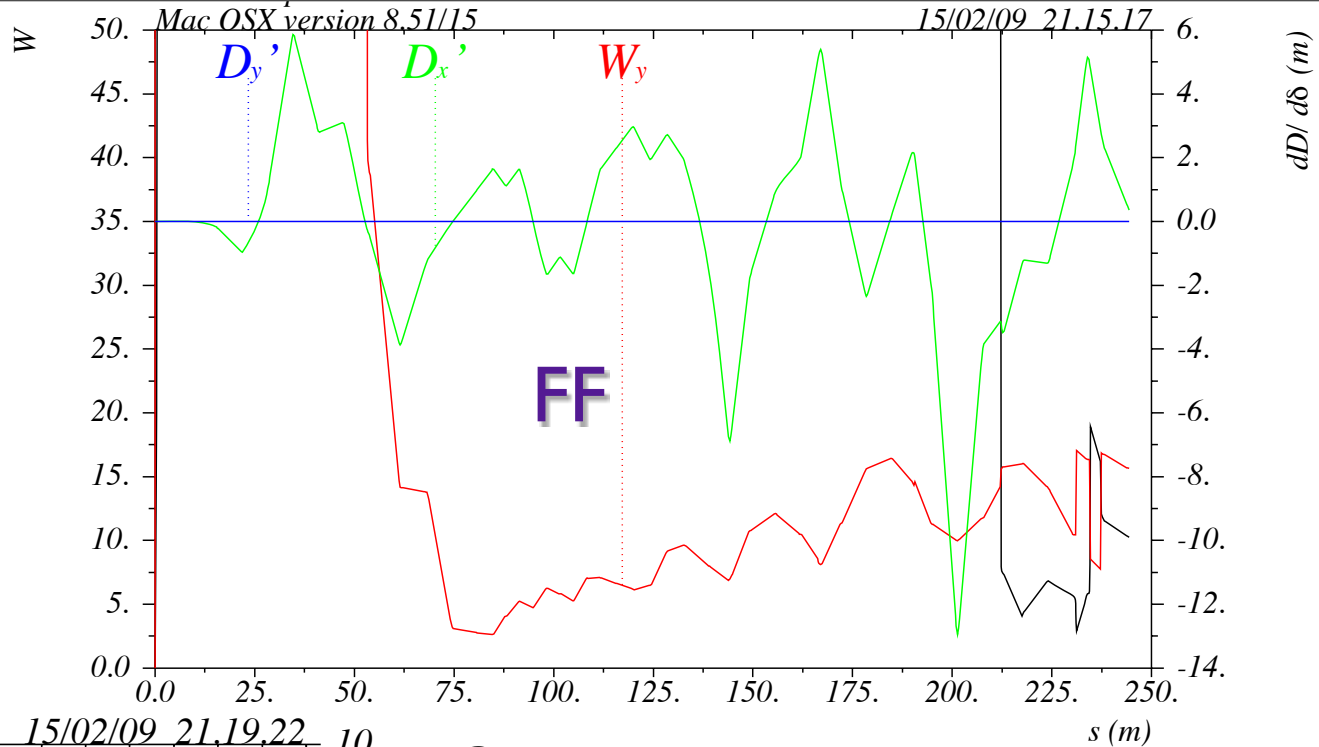
HER IR with SR 2 Linear Optics V1.04



$$\varphi = 3 * 5.7^\circ$$



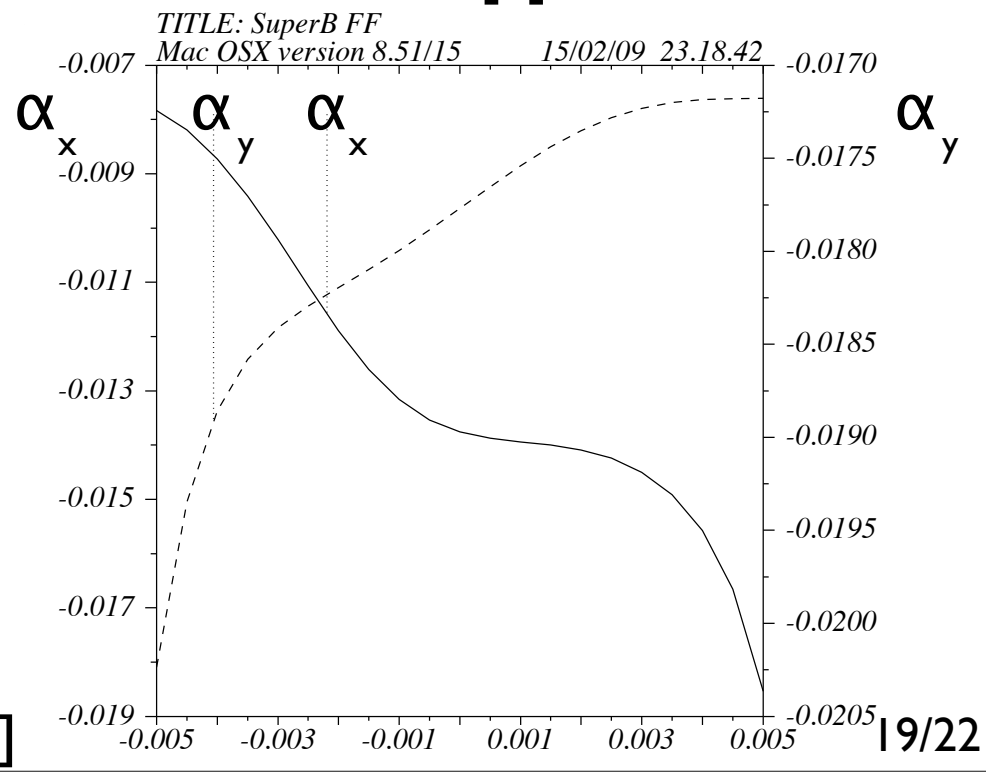
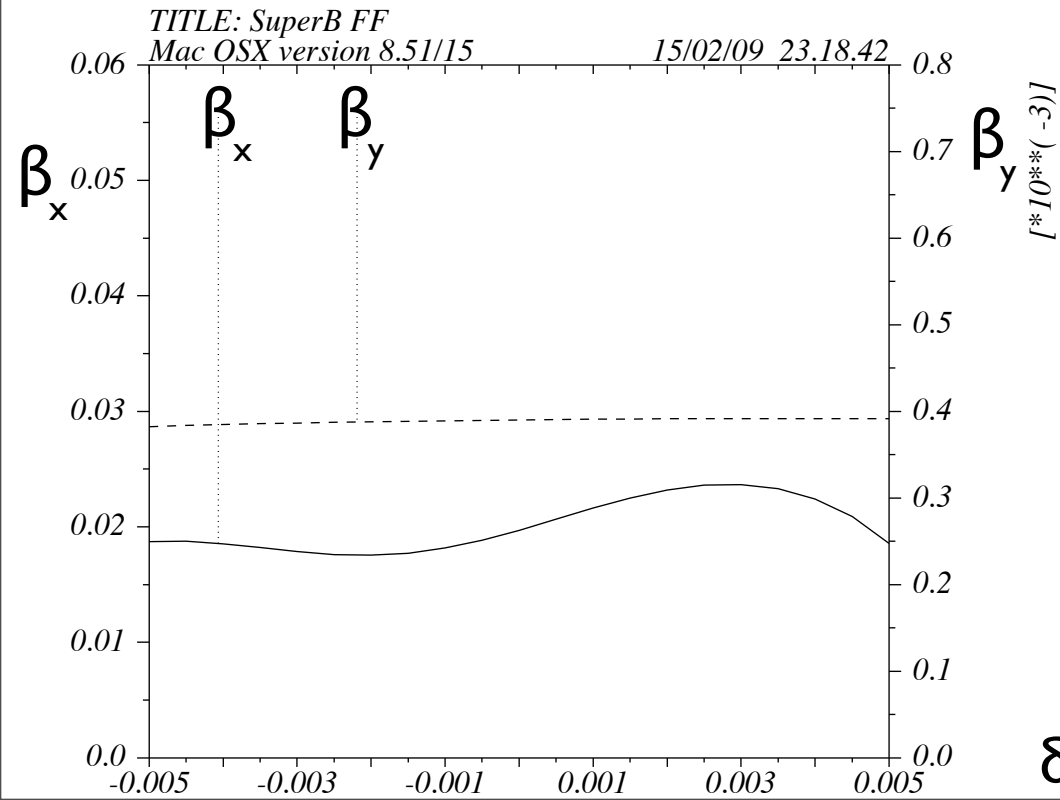
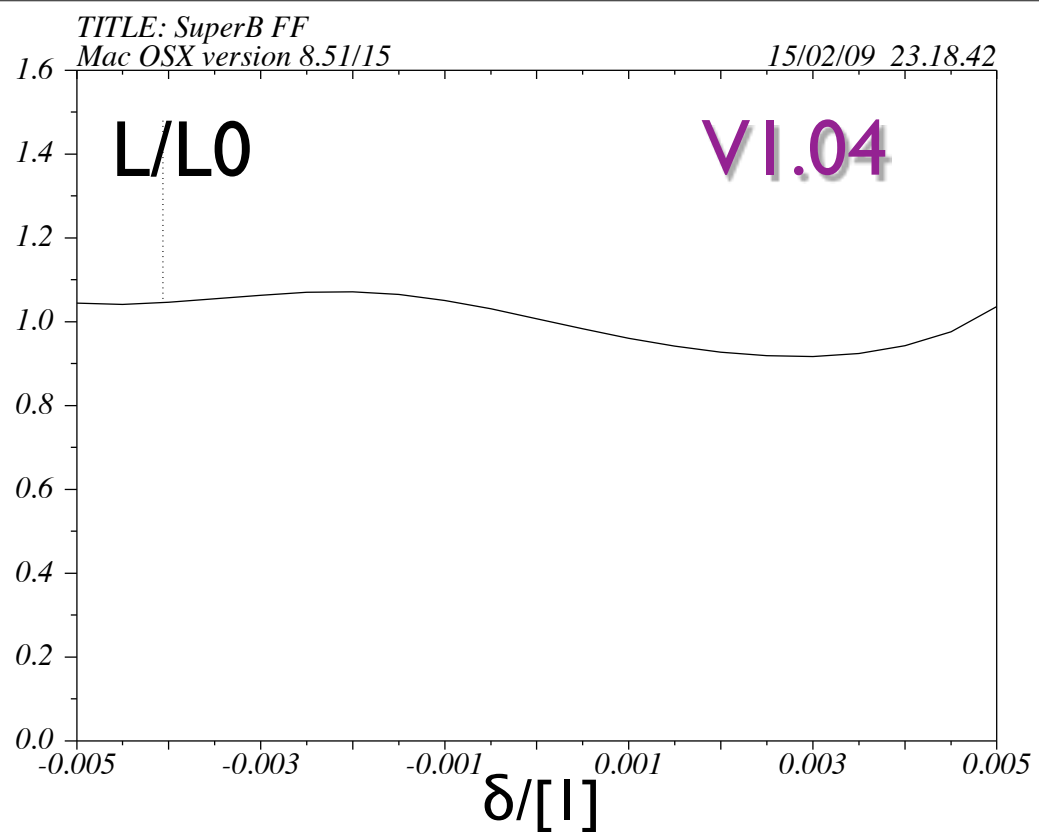
Chromatic Functions



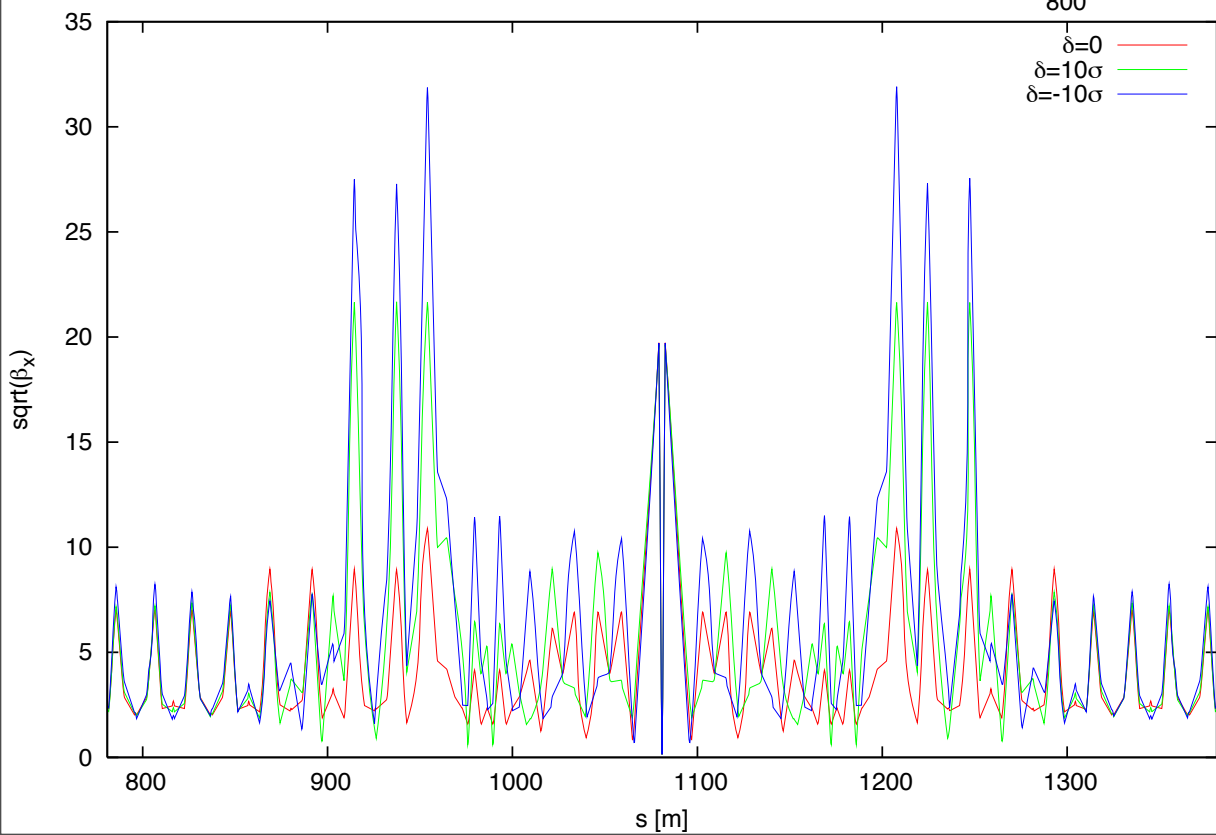
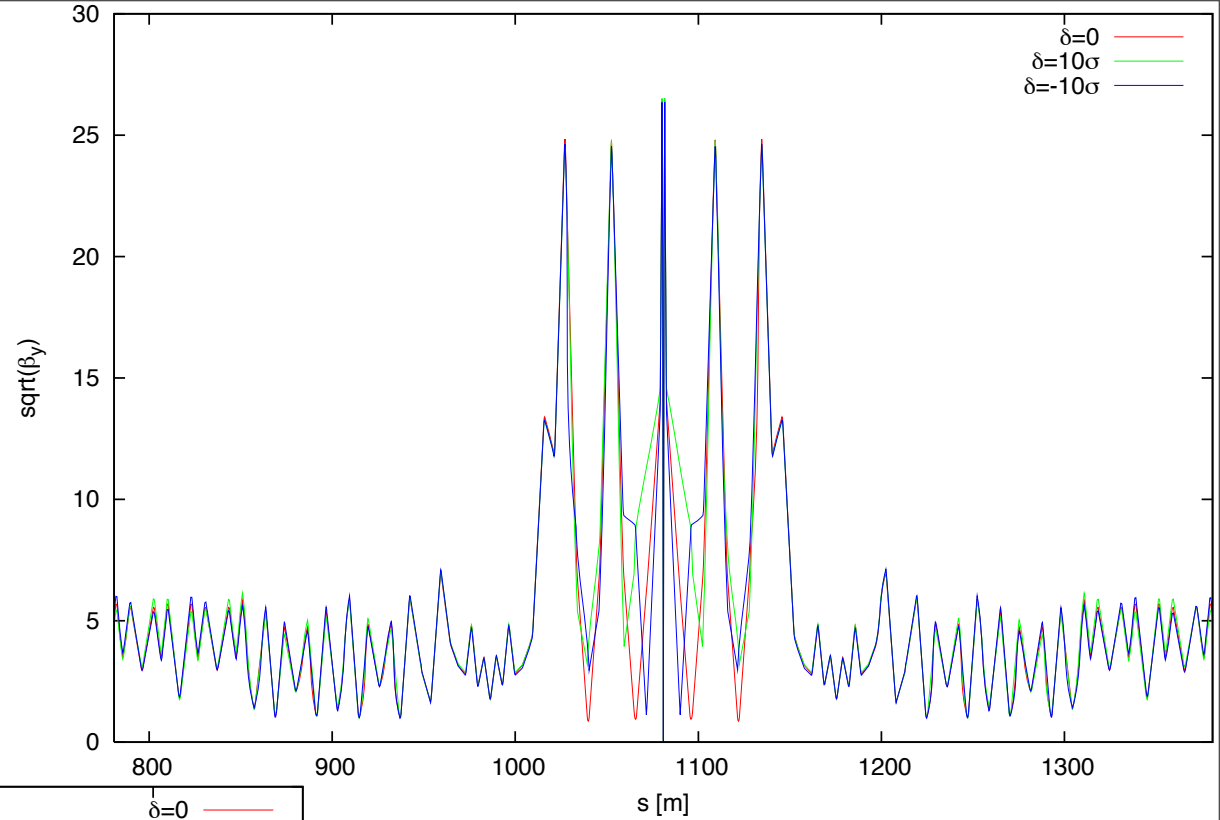
HER Bandwidth with SR

$$\delta_{\text{BEAM}} \sim 5 \cdot 10^{-4}$$

$$0.5\% \text{ of } E$$
$$\delta \Leftrightarrow 10\sigma_s$$

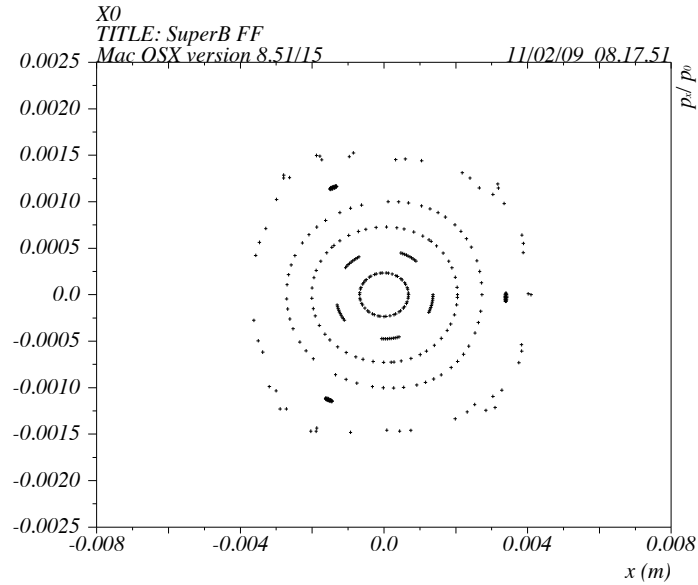


VI.04 Chromatic β

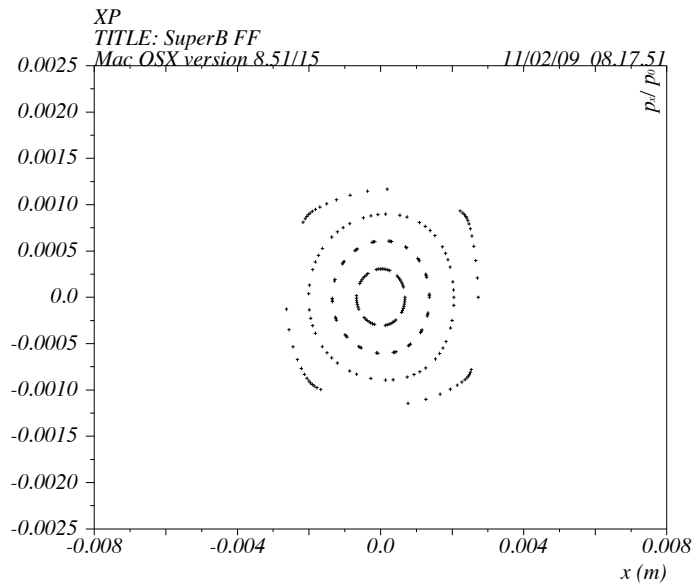


HER with SR 2 MAD Tracking no error

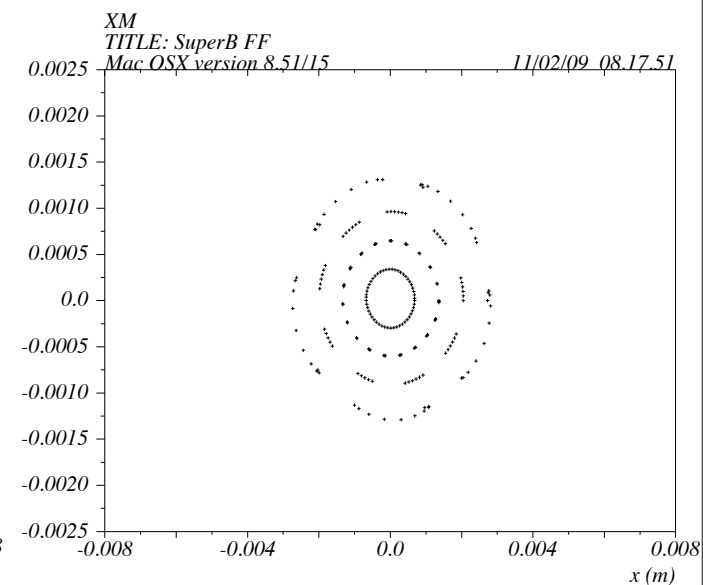
ICmax: $x=60, y=0, \delta=0$



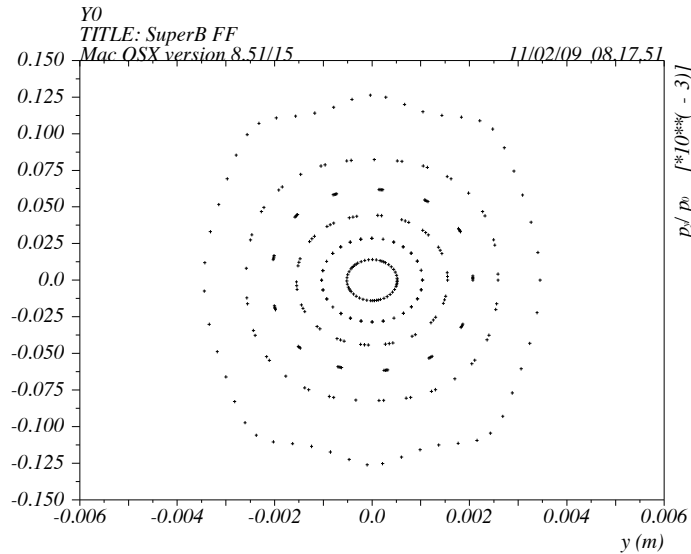
ICmax: $x=40, y=0, \delta=10$



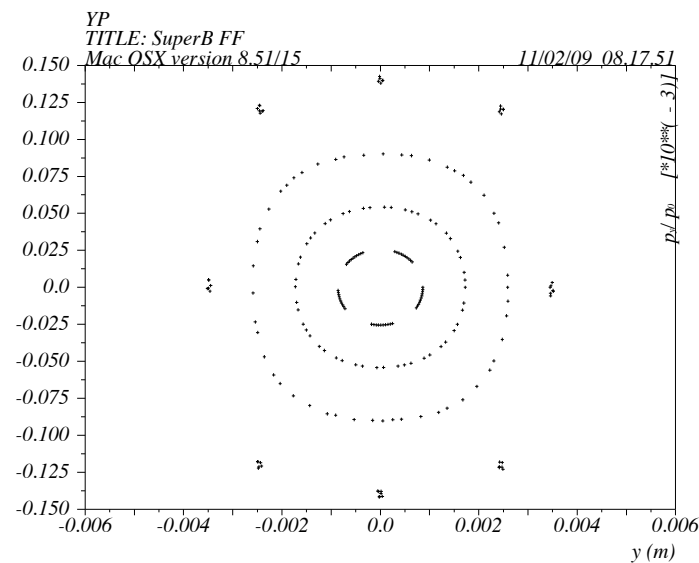
ICmax: $x=40, y=0, \delta=-10$



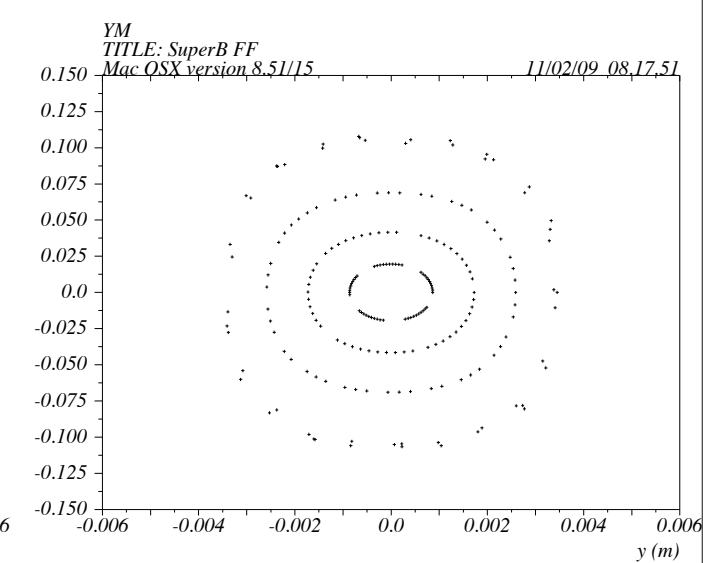
ICmax: $x=0, y=20, \delta=0$



ICmax: $x=0, y=20, \delta=10$



ICmax: $x=0, y=20, \delta=-10$



Status (Paris Meeting)

Proof of principle: We have a design for an IR with spin rotator that satisfies the condition necessary for crab waist scheme and sufficient dynamic aperture.

Next Goal (mini MAC)

Full solution for machine with no errors: We have a complete IR design with reversed bends and closed geometry with same length as LER.