HER IR Optics with Spin Rotator

Status Report
Optics Team

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- ...
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

\[ \beta_x^{1/2}, \beta_y^{1/2}, D_x, D_y, -l_y, -l_x \]
Note: $\Delta$ stands for the phase advance difference between IP and location.
Orig. Chromatic Functions FF
Orig. Chromatic Functions Ring

Table name = TWISS
Ring with FF, Sextupoles ON
TITLE: SuperB FF
Mac OSX version 8.51/15

WxIP = 6.22
WyIP = 3.62
WxEND = 3.89
WyEND = 0.48
WxARC < 20
WyARC < 10
\[
\frac{L}{L_0} = \left( \frac{\beta_x \beta_y}{\beta_{x_0} \beta_{y_0}} \right)^{-1/2}
\]

\[\delta_{\text{beam}} \sim 5 \times 10^{-4}\]

2\% of E

\[\delta \iff 40\sigma_s\]
Chromatic β Functions

FF Chromatic Horizontal β-Functions with δ = ±10σ. Original Design NO SR V1.01.003.

FF Chromatic Vertical β-Functions with δ = ±10σ. 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: $x=20, y=0, \delta=-10$

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

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

ICmax: $x=20, y=0, \delta=-10$
Uli’s Spin Rotator

sol1  sol2  reflector  sol3  sol4  bend  bend

superb her spin rotator (long)

\[ \varphi = n \times 5.7^\circ ; n = 1, 3, ... \]

\[ \beta, (m), \beta, (m) \]

\[ D, (m) \]
HER IR with SR1 Linear Optics V7

φ = 3*5.7°

30. \( \beta_x^{1/2} \)  \( \beta_y^{1/2} \)  \( D_x \)

0.0 25. 50. 75. 100. 125. 150. 175. 200. 225. 250. s (m)

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 D (m)

Mac OS X version 8.51/15 05/01/09 14.57.42
Chromatic Functions FF

Ring with FF, Sextupoles ON
TITLE: SuperB HER FF
Mac OSX version 8.5/15
05/01/09 14.57.42

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Chromatic $\beta_y$ Functions with $\delta = \pm 10\sigma_s$. New Design with SR V1.03.007.

FF Chromatic Vertical $\beta$-Functions with $\delta = \pm 10\sigma_s$. Original Design NO SR V1.01.003.
HER IR with SR 2 Linear Optics V1.04

φ = 3*5.7°

\[ \beta_x^{1/2} \quad \beta_y^{1/2} \]

FFD

SR-bend

SR-sol

15/02/09 20:29:23
Chromatic Functions

Ring

FF

TITLE: SuperB FF
Mac OSX version 8.51/15
15/02/09 21.15.17

W

M

0.0 50.0
25.0 45.0
50.0 40.0
75.0 35.0
100.0 30.0
125.0 25.0
150.0 20.0
175.0 15.0
200.0 10.0
225.0 5.0
250.0 0.0

s (m)

0.0 25.0
50.0 75.0
100.0 125.0
150.0 175.0
200.0 225.0
250.0 275.0

dD/ds (m)

0.0 2.0
4.0 6.0
8.0 10.0

W_x W_y D_y' D_x'

1600. 1400. 1200. 1000. 800. 600. 400. 200. 0.0
**HER Bandwidth with SR**

\[ \delta_{\text{beam}} \sim 5 \times 10^{-4} \]

0.5\% of E

\[ \delta \leftrightarrow 10 \sigma_s \]
**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.