CESR-c

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- IR Magnet Layout & Quadrupole Parameters
- Solenoid Compensation
- 5.3GeV IR
- 1.88GeV IR
- Round beams

Magnet Layout and Quadrupole Parameters

- Permanent NdB quadrupole
  - Section 1
    - Length = 9.3cm
    - k = -8.78/E[GeV]
    - S= 33cm
  - Section 2
    - Length = 18.6cm
    - k = -9.57/E[GeV]
    - S = 43cm
- Superconducting Quadrupoles - warm bore
  - Quadrupole windings
    - Length = 65cm
    - Maximum Gradient = 42T/m
    - S_1 = 84cm
    - S_2 = 175cm
  - Skew quadrupole windings superimposed on quad
    - Length = 62cm
    - Maximum gradient = 4.2T/m
  - Vertical dipole windings superimposed on quad

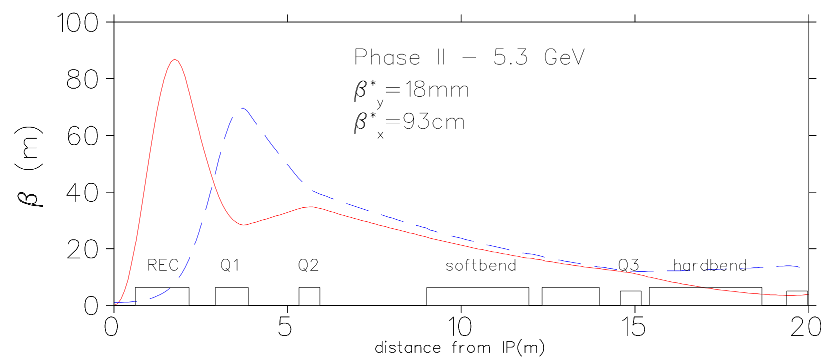
Solenoid Compensation

- CLEO Solenoid
  - Half length = 1.755 m
  - B < 1.5T
- Solenoid Compensation
  - Three pairs of antisymmetric skew elements ⇒
    - Full turn map does not couple horizontal and vertical motion outside compensation region
    - Map from outside region to IP does not couple horizontal betatron motion to vertical displacement.
  - Compensation largely accomplished by fixed 4.5° rotation of permanent magnet and both superconducting quads.
  - The three trim variable couplers are:
    - Skew quad windings on SC1 (sk1)
    - Skew quad windings on SC2 (sk2)
    - Resistive corrector skew quad 8m from IP (sk3)
  - *When B=0, compensation criteria cannot be satisfied*

Phase II - 5.3GeV IR

parameter	value
Beam energy	5.3GeV
β_v^*	18mm
β_h^*	93cm
$Q'_x(IR)$	-4.1
$Q'_y(IR)$	-11.3
crossing angle	2.4mrad
Bunch spacing	14ns
Solenoid	1.5T

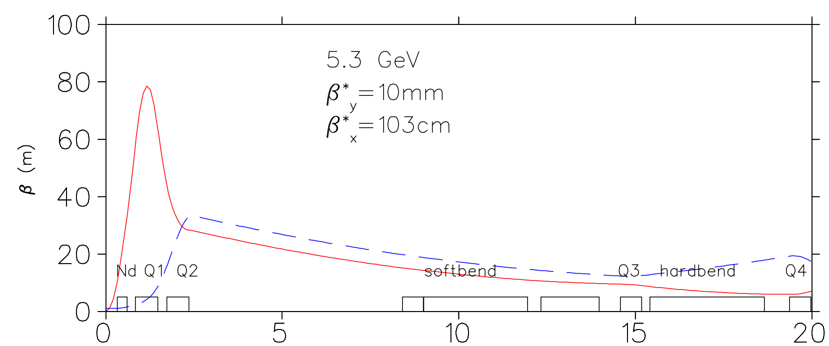
Quadrupole	length[cm]	S[m]	$K[m^{-2}]$
Q001	152.5	0.622	-0.84
Q01	95	2.924	0.64
Q02	65	5.33	-0.21

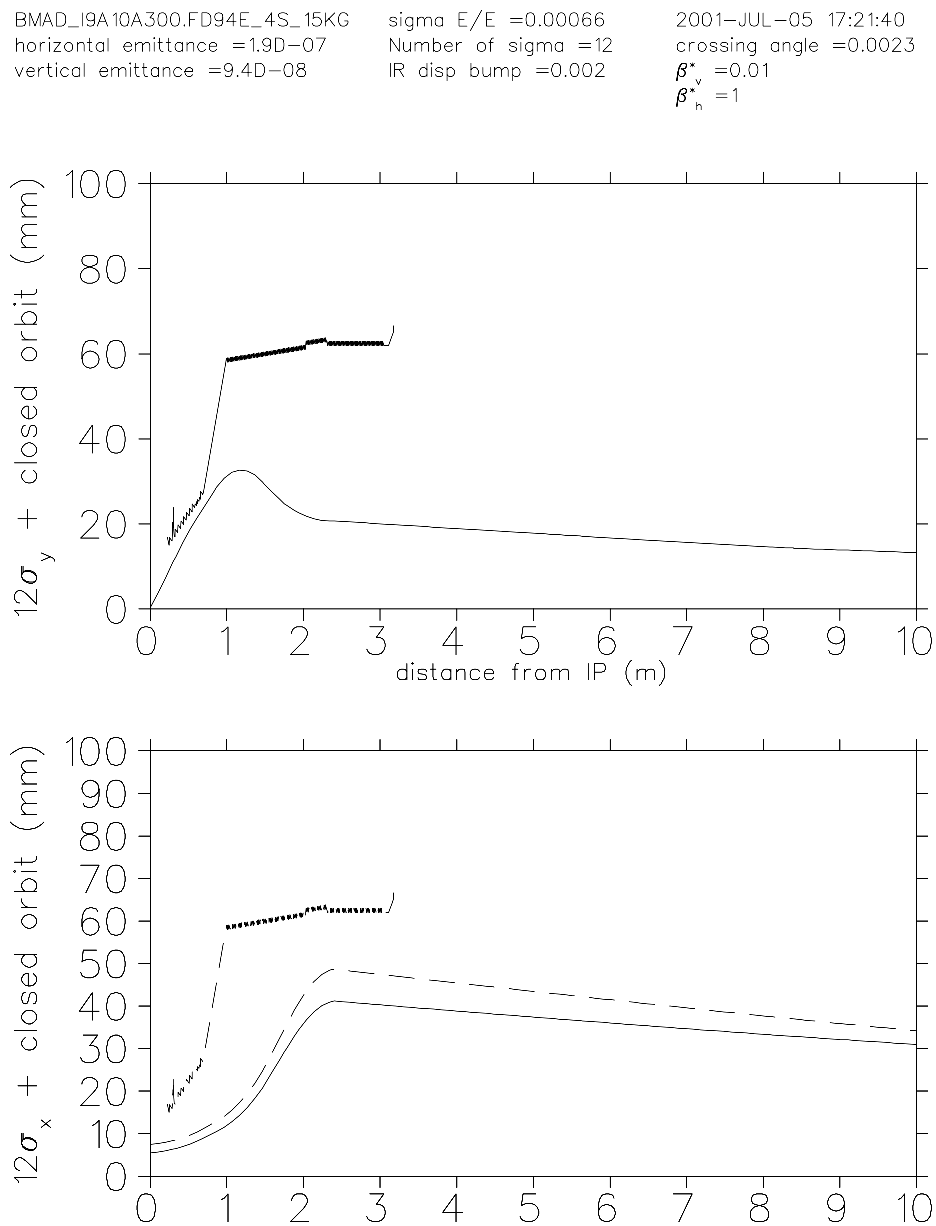


5.3GeV IR

parameter	value
Beam energy	5.3GeV
β_v^*	10mm
β_h^*	103cm
$Q'_x(IR)$	-2.46
$Q'_y(IR)$	-14.3
crossing angle	2.4mrad
Bunch spacing	14ns
Solenoid	1.5T

Quadrupole	length[cm]	S[m]	K[m^{-2}]
Q001	9.3	0.334	1.66
Q002	18.6	0.427	1.81
Q01	65	0.842	-2.31
Q02	65	1.754	1.36
SK1	62	0.867	-0.06
SK2	62	1.779	0.13
SK3	34	8.119	-0.06

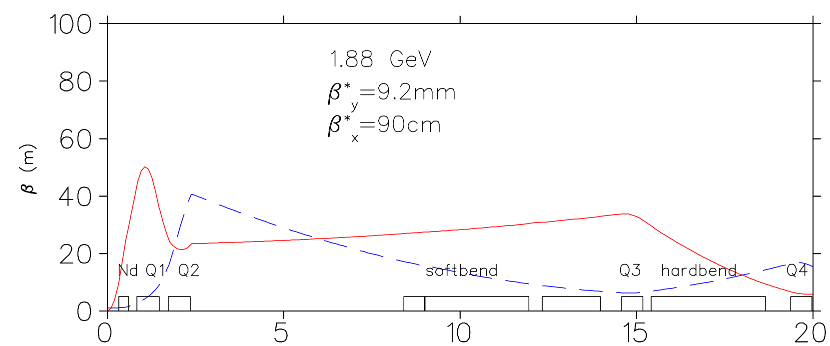




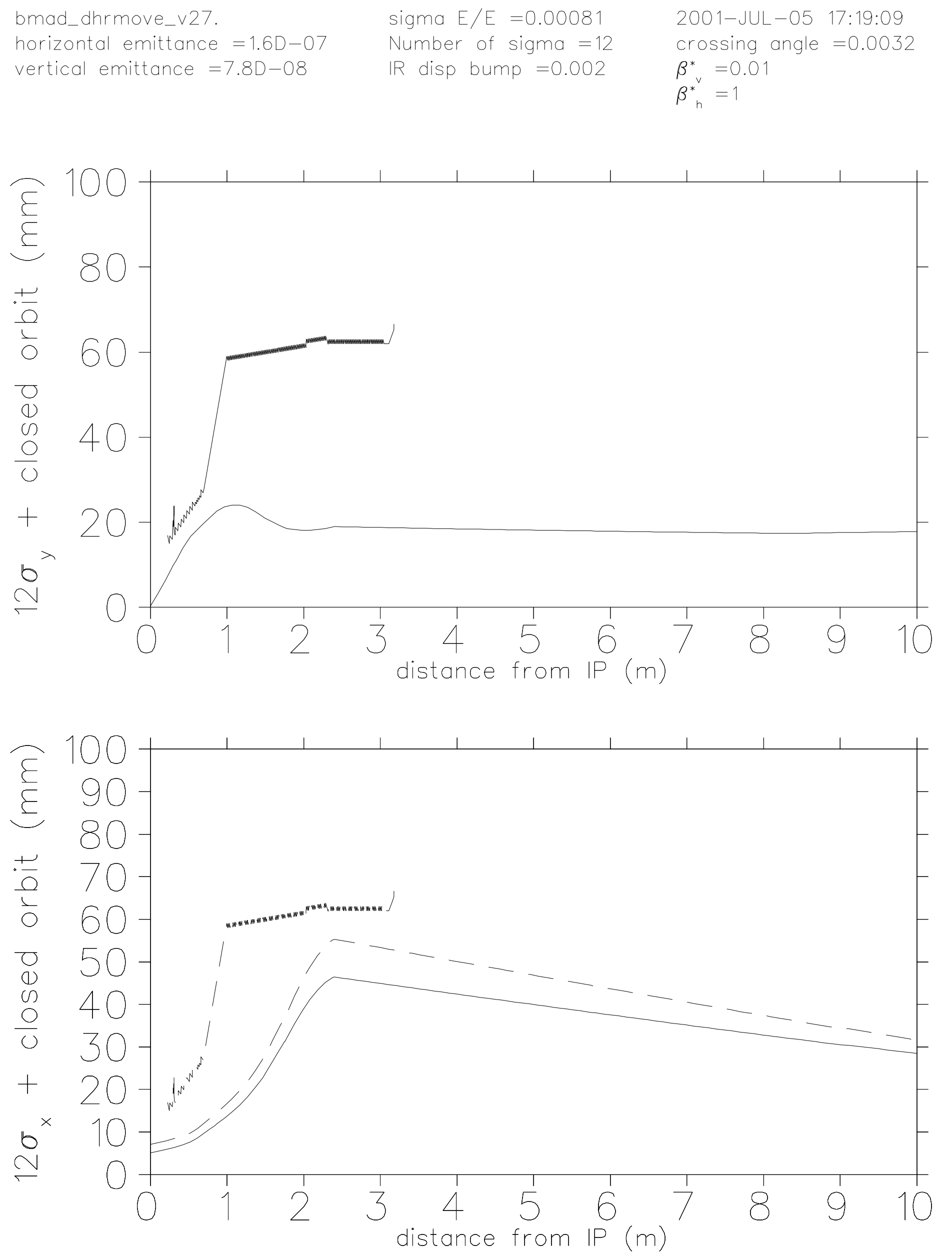
Solid line is displacement of closed orbit + 12σ. Vertical emittance is assumed to be half horizontal. Dashed line includes 2mm offset of the closed orbit at the IP.

1.88GeV IR

parameter	value
Beam energy	1.88GeV
β_v^*	10mm
β_h^*	90cm
$Q'_x(IR)$	-8.2
$Q'_y(IR)$	-3.7
crossing angle	3.0mrad
Bunch spacing	14ns
Solenoid	1.0T



Quadrupole	length[cm]	S[m]	K[m^{-2}]
Q001	9.3	0.334	0
Q002	18.6	0.427	-5.09
Q01	65	0.842	-1.93
Q02	65	1.754	1.32
SK1	62	0.867	-0.27
SK2	62	1.779	0.34
SK3	34	8.119	-0.11

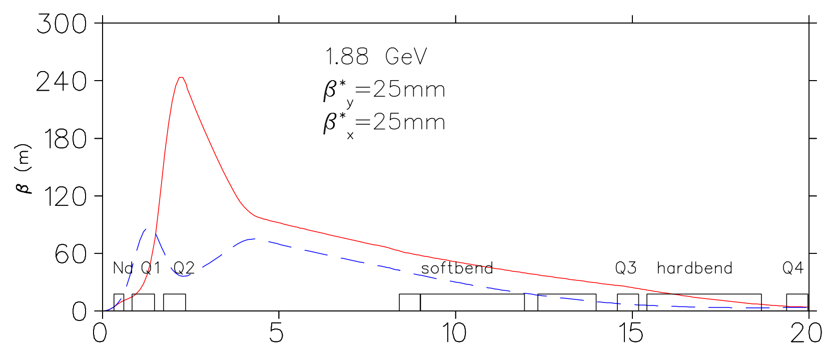


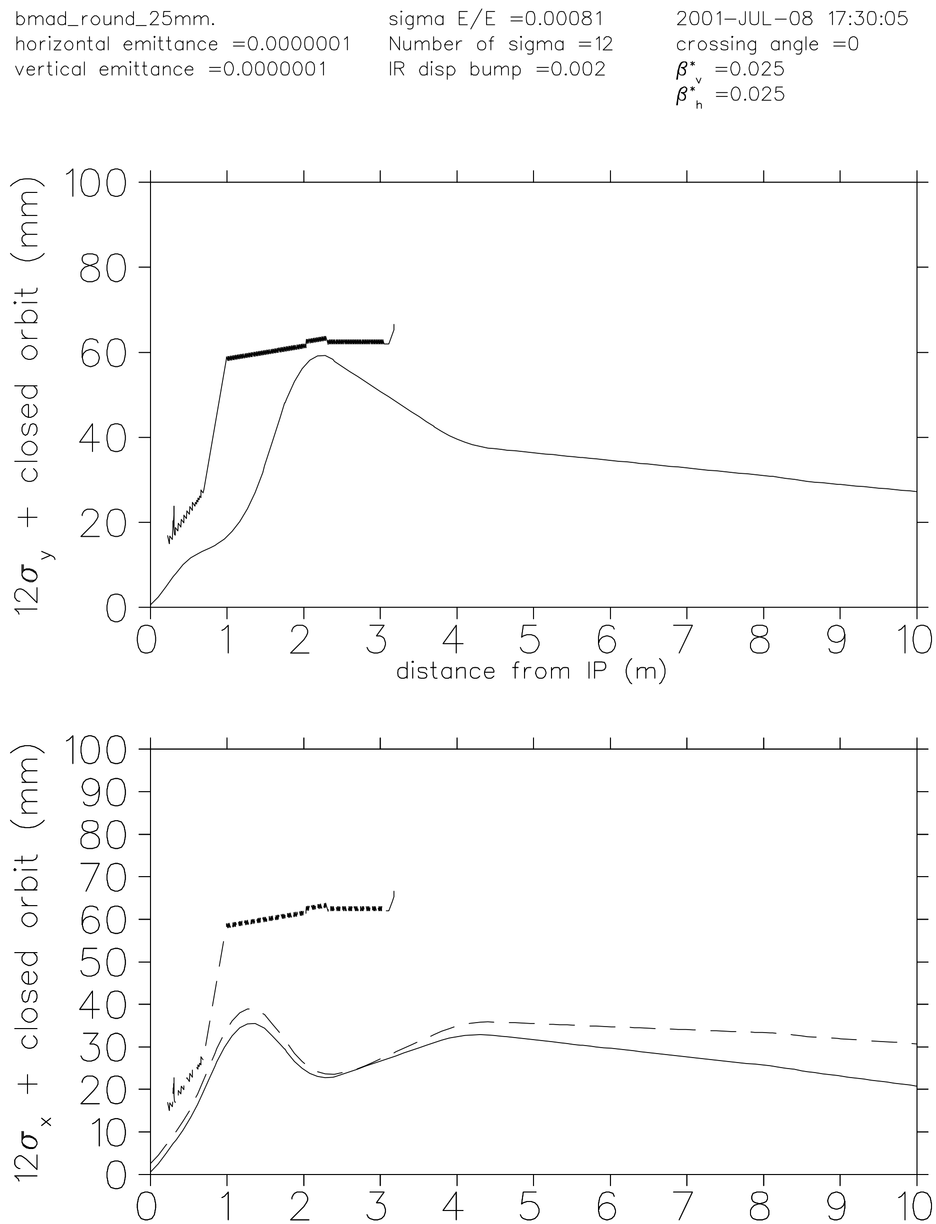
Solid line is displacement of closed orbit + 12σ. Vertical emittance is assumed to be half horizontal.

1.88GeV Round beam IR

parameter	value
Beam energy	1.88GeV
β_v^*	25mm
β_h^*	25mm
$Q'_x(IR)$	-22.2
$Q'_y(IR)$	-28.6
crossing angle	0mrad
Bunch spacing	366ns
Solenoid	1.0T

Quadrupole	length[cm]	S[m]	K[m^{-2}]
Q001	9.3	0.334	-4.67
Q002	18.6	0.427	-5.09
Q01	65	0.842	2.81
Q02	65	1.754	-1.70
Q02A	95	3.703	0.33
SK1	62	0.867	-0.32
SK2	62	1.779	0.13
SK3	34	8.119	0.13





Solid line is displacement of closed orbit + 12σ. Vertical emittance is equal to horizontal.

Round Beam Parameters

$$L = \frac{N^2 f_c}{4\pi\epsilon\beta^*} \tag{1}$$

$$\xi = \frac{N r_e}{\gamma}\frac{\beta}{4\pi\sigma^2} = \frac{N r_e}{\gamma}\frac{1}{4\pi\epsilon} \tag{2}$$

$$\Rightarrow L = \frac{N\gamma f_c}{r_e\beta}\xi \tag{3}$$

- Emittance limited by IR aperture
- Possible parameters
  - ϵ=100nm
  - ξ =0.1
  - β^*=25mm
  - f_c =390.1kHz
  - E=1.88GeV

$\Rightarrow$

- $N = 1.64 \times 10^{11}$, ($I_b = 10.3$mA)
- $L_b = 3.3 \times 10^{31} cm^{-2} s^{-1}$
- $N_b = 7, \rightarrow L = 2.3 \times 10^{32} cm^{-2} s^{-1}$ (head on)

LUMINOSITY SCALING

- Simulation indicates that limiting beam-beam tune shift scales as $\delta^{\frac{1}{3}}$
- If we suppose that limiting bunch current $I_b \propto E$

  - E=5.3GeV
  - $\beta_v^* = 21$mm
  - $I_b \sim 8.5$mA
  - $\delta = 2.2 \times 10^{-4}$
  - $\xi_v = 0.07$
  - Nine trains of five bunches
  - $L = 1.3 \times 10^{33} cm^{-2} s^{-1}$

  - E=1.88GeV
  - $\beta_v^* = 10$mm
  - $I_b \sim 3$mA
  - $\delta = 1.1 \times 10^{-4}$
  - $\Rightarrow \xi_v = 0.056$
  - Nine trains of five bunches
  - $\Rightarrow L = 2.7 \times 10^{32} cm^{-2} s^{-1}$