

Parameter Lists at Different Energies

Tanaji Sen

The design is optimized at a luminosity of $10^{33} \text{ cm}^{-2} \text{ sec}^{-1}$. At this luminosity, the maximum energy per beam is 185GeV, assuming that the synchrotron radiation power from both beams is limited to 100MW. The FODO cell length, dipole and quadrupole lengths are chosen at this energy. These parameters are held fixed as the operating energy is changed.

In the tables that follow, the following parameters are held constant at the values shown in this table.

Circumference [km]	233.00
Revolution frequency [kHz]	1.2867
Arc radius [m]	31031.880
Bend radius [m]	25968.098
β_x^*, β_y^* [cm]	100.000, 5.000
Ratio of emittances	0.050
Number of cells	861
Bend angle in half-cell [mrad]	3.64697
Length of cell [m]	226.345
Length of all dipoles in cell [m]	189.410
Quadrupole length [m]	0.494
Cell packing fraction	0.189
Harmonic number	310882

$e^+ - e^-$ Collider Parameters

Energy [GeV]	185.00
Luminosity	1.00×10^{33}
Synch. radiation power(both beams) [MW]	100.712
σ_x^*, σ_y^* [microns]	77.520, 3.876
Number of bunches	126
Bunch spacing [km]	1.8492
Particles per bunch	4.851×10^{11}
Bunch current [mA]	0.100
Emittances [nano-m]	6.009, 0.300
Beam-beam parameter	0.10650
Damping decrement	0.01080
Single beam current [mA]	12.600
Brho [Tesla-m]	617.078
Arc tune	215.356
Phase advance per cell [deg]	90.000
Dipole field [T]	0.02376
Focal length of cell [m]	80.025
Quad gradient [T/m]	15.595
Quad field at $1\sigma_x^{max}$ /dipole field	1.000
Cell: $\beta_x^{max}, \beta_x^{min}$ [m]	386.395, 66.295
Cell: $\sigma_x^{max}, \sigma_x^{min}$ [mm]	1.524, 0.631
Cell: $\sigma_y^{max}, \sigma_y^{min}$ [mm]	0.341, 0.141
Max apertures required [cm]	2.524, 1.341
Max and min disp. [m]	1.117, 0.534
Momentum compaction	0.2226E-04
Energy loss per turn [GeV]	3.996
Damping time [turns]	46
RF Voltage [GV]	4.57254
Synchronous phase [deg]	60.930
Relative energy spread	0.9834E-03
RF acceptance	0.9822E-02
Synchrotron tune	0.11501
Bunch length [mm]	7.058
Longitudinal emittance [eV-sec]	0.01346
Bremm cross-section [barns]	0.36022
Bremm lifetime [hrs]	23.6
Polarization time [hrs]	2.215
Critical energy [keV]	452.611
Critical wavelength [Å]	0.023
Number of photons/m/sec	0.115E+17
Gas load [torr-L/m-sec]	0.104E-07
Linear Power load(both beams) [kW/m]	0.517
specif press. rise [Torr/mA]	0.138E-12
specific current [mA]	7238.604
spec. current/beam current	574.49

Energy [GeV]	45.00
Luminosity	16.98×10^{33}
Synch. radiation power(both beams) [MW]	54.046
σ_x^*, σ_y^* [microns]	150.849, 7.542
Number of bunches	46599
Bunch spacing [km]	0.0050
Particles per bunch	2.011×10^{11}
Bunch current [mA]	0.04145
Emittances [nano-m]	22.755, 1.138
Beam-beam parameter	0.04500
Damping decrement	0.00016
Single beam current [mA]	1931.485
Brho [Tesla-m]	150.100
Arc tune	53.839
Phase advance per cell [deg]	22.500
Dipole field [T]	0.00578
Focal length of cell [m]	290.051
Quad gradient [T/m]	1.047
Quad field at $1\sigma_x^{max}$ /dipole field	0.726
Cell: $\beta_x^{max}, \beta_x^{min}$ [m]	706.857, 476.078
Cell: $\sigma_x^{max}, \sigma_x^{min}$ [mm]	4.011, 3.291
Cell: $\sigma_y^{max}, \sigma_y^{min}$ [mm]	0.897, 0.736
Max apertures required [cm]	5.011, 1.897
Max and min disp. [m]	11.902, 9.786
Momentum compaction	0.2924E-03
Energy loss per turn [GeV]	0.0140
Damping time [turns]	3216
RF Voltage [GV]	0.05729
Synchronous phase [deg]	14.136
Relative energy spread	0.2392E-03
RF acceptance	0.2400E-02
Synchrotron tune	0.13365
Bunch length [mm]	19.409
Longitudinal emittance [eV-sec]	0.00219
Bremm cros-section [barns]	0.45368
Bremm lifetime [hrs]	168.9
Polarization time [hrs]	2600.792
Critical energy [keV]	6.514
Critical wavelength [Å]	1.593
Number of photons/m/sec	0.430E+18
Gas load [torr-L/m-sec]	0.387E-06
Linear Power load(both beams) [kW/m]	0.277
specif press. rise [Torr/mA]	0.336E-13
specific current [mA]	29758.71
spec. current/beam current	15.41

Energy [GeV]	100.00
Luminosity	4.19×10^{33}
Synch. radiation power(both beams) [MW]	100.036
σ_x^*, σ_y^* [microns]	129.876, 6.494
Number of bunches	1466
Bunch spacing [km]	0.1589
Particles per bunch	4.851×10^{11}
Bunch current [mA]	0.100
Emittances [nano-m]	16.868, 0.843
Beam-beam parameter	0.06591
Damping decrement	0.00171
Single beam current [mA]	146.600
Brho [Tesla-m]	333.556
Arc tune	101.305
Phase advance per cell [deg]	42.337
Dipole field [T]	0.01284
Focal length of cell [m]	156.701
Quad gradient [T/m]	4.305
Quad field at $1\sigma_x^{max}$ /dipole field	0.931
Cell: $\beta_x^{max}, \beta_x^{min}$ [m]	457.441, 214.718
Cell: $\sigma_x^{max}, \sigma_x^{min}$ [mm]	2.778, 1.903
Cell: $\sigma_y^{max}, \sigma_y^{min}$ [mm]	0.621, 0.426
Max apertures required [cm]	3.778, 1.621
Max and min disp. [m]	3.737, 2.594
Momentum compaction	0.8535E-04
Energy loss per turn [GeV]	0.341
Damping time [turns]	293
RF Voltage [GV]	0.54255
Synchronous phase [deg]	38.966
Relative energy spread	0.5316E-03
RF acceptance	0.5320E-02
Synchrotron tune	0.13347
Bunch length [mm]	12.605
Longitudinal emittance [eV-sec]	0.00702
Bremm cros-section [barns]	0.40317
Bremm lifetime [hrs]	58.4
Polarization time [hrs]	47.992
Critical energy [keV]	71.484
Critical wavelength [Å]	0.145
Number of photons/m/sec	0.726E+17
Gas load [torr-L/m-sec]	0.653E-07
Linear Power load(both beams) [kW/m]	0.513
specif press. rise [Torr/mA]	0.747E-13
specific current [mA]	13391.418
spec. current/beam current	91.35

Energy [GeV]	150.00
Luminosity	1.70×10^{33}
Synch. radiation power(both beams) [MW]	100.181
σ_x^*, σ_y^* [microns]	90.533, 4.527
Number of bunches	290
Bunch spacing [km]	0.8034
Particles per bunch	4.851×10^{11}
Bunch current [mA]	0.100
Emittances [nano-m]	8.196, 0.410
Beam-beam parameter	0.09042
Damping decrement	0.00576
Single beam current [mA]	29.000
Brho [Tesla-m]	500.334
Arc tune	168.852
Phase advance per cell [deg]	70.565
Dipole field [T]	0.01927
Focal length of cell [m]	97.966
Quad gradient [T/m]	10.329
Quad field at $1\sigma_x^{max}$ /dipole field	0.944
Cell: $\beta_x^{max}, \beta_x^{min}$ [m]	378.660, 101.382
Cell: $\sigma_x^{max}, \sigma_x^{min}$ [mm]	1.762, 0.912
Cell: $\sigma_y^{max}, \sigma_y^{min}$ [mm]	0.394, 0.204
Max apertures required [cm]	2.762, 1.394
Max and min disp. [m]	1.594, 0.880
Momentum compaction	0.3336E-04
Energy loss per turn [GeV]	1.727
Damping time [turns]	86
RF Voltage [GV]	2.11084
Synchronous phase [deg]	54.913
Relative energy spread	0.7973E-03
RF acceptance	0.7980E-02
Synchrotron tune	0.11555
Bunch length [mm]	8.537
Longitudinal emittance [eV-sec]	0.01070
Bremm cros-section [barns]	0.37513
Bremm lifetime [hrs]	30.6
Polarization time [hrs]	6.320
Critical energy [keV]	241.259
Critical wavelength [Å]	0.043
Number of photons/m/sec	0.215E+17
Gas load [torr-L/m-sec]	0.194E-07
Linear Power load(both beams) [kW/m]	0.514
specif press. rise [Torr/mA]	0.112E-12
specific current [mA]	8927.612
spec. current/beam current	307.85

Energy [GeV]	200.00
Luminosity	0.90×10^{33}
Synch. radiation power(both beams) [MW]	100.446
σ_x^*, σ_y^* [microns]	70.083, 3.504
Number of bunches	92
Bunch spacing [km]	2.5326
Particles per bunch	4.851×10^{11}
Bunch current [mA]	0.100
Emittances [nano-m]	4.912, 0.246
Beam-beam parameter	0.11317
Damping decrement	0.01365
Single beam current [mA]	9.200
Brho [Tesla-m]	667.111
Arc tune	242.621
Phase advance per cell [deg]	101.394
Dipole field [T]	0.02569
Focal length of cell [m]	73.127
Quad gradient [T/m]	18.449
Quad field at $1\sigma_x^{max}$ /dipole field	1.019
Cell: β^{max}, β^{min} [m]	409.565, 52.226
Cell: $\sigma_x^{max}, \sigma_x^{min}$ [mm]	1.418, 0.506
Cell: $\sigma_y^{max}, \sigma_y^{min}$ [mm]	0.317, 0.113
Max apertures required [cm]	2.418, 1.317
Max and min disp. [m]	0.956, 0.423
Momentum compaction	0.1859E-04
Energy loss per turn [GeV]	5.459
Damping time [turns]	36
RF Voltage [GV]	6.11941
Synchronous phase [deg]	63.136
Relative energy spread	0.1063E-02
RF acceptance	0.1064E-01
Synchrotron tune	0.11276
Bunch length [mm]	6.499
Longitudinal emittance [eV-sec]	0.01448
Bremm cross-section [barns]	0.35427
Bremm lifetime [hrs]	19.4
Polarization time [hrs]	1.500
Critical energy [keV]	571.87
Critical wavelength [Å]	0.018
Number of photons/m/sec	0.911E+16
Gas load [torr-L/m-sec]	0.820E-08
Linear Power load(both beams) [kW/m]	0.515
specif press. rise [Torr/mA]	0.149E-12
specific current [mA]	6695.709
spec. current/beam current	727.79

Energy [GeV]	250.00
Luminosity	0.55×10^{33}
Synch. radiation power(both beams) [MW]	101.290
σ_x^*, σ_y^* [microns]	57.460, 2.873
Number of bunches	38
Bunch spacing [km]	6.1316
Particles per bunch	4.851×10^{11}
Bunch current [mA]	0.100
Emittances [nano-m]	3.302, 0.165
Beam-beam parameter	0.13469
Damping decrement	0.02666
Single beam current [mA]	3.800
Brho [Tesla-m]	833.889
Arc tune	321.393
Phase advance per cell [deg]	134.314
Dipole field [T]	0.03211
Focal length of cell [m]	61.402
Quad gradient [T/m]	27.465
Quad field at $1\sigma_x^{max}$ /dipole field	1.212
Cell: $\beta_x^{max}, \beta_x^{min}$ [m]	607.860, 24.810
Cell: $\sigma_x^{max}, \sigma_x^{min}$ [mm]	1.417, 0.286
Cell: $\sigma_y^{max}, \sigma_y^{min}$ [mm]	0.317, 0.064
Max apertures required [cm]	2.417, 1.317
Max and min disp. [m]	0.710, 0.262
Momentum compaction	0.1311E-04
Energy loss per turn [GeV]	13.328
Damping time [turns]	18
RF Voltage [GV]	14.41596
Synchronous phase [deg]	67.594
Relative energy spread	0.1329E-02
RF acceptance	0.1330E-01
Synchrotron tune	0.11938
Bunch length [mm]	5.410
Longitudinal emittance [eV-sec]	0.01883
Bremm cross-section [barns]	0.33763
Bremm lifetime [hrs]	13.8
Polarization time [hrs]	0.491
Critical energy [keV]	1116.939
Critical wavelength [Å]	0.009
Number of photons/m/sec	0.470E+16
Gas load [torr-L/m-sec]	0.423E-08
Linear Power load(both beams) [kW/m]	0.519
specif press. rise [Torr/mA]	0.187E-12
specific current [mA]	5356.567
spec. current/beam current	1409.62