Electron Beam Parameters

Electron Beam Design Parameters	Nominal Operation Mode		Special Operation Mode	
	Long Pulses	Short Pulses	Large Bandwidth	Ultra-Short Pulses
Charge per bunch (pC)	**200**	**10**	200	10
Beam energy for 1 Å (GeV)	5.8	5.8	5.8	5.8
Core slice emittance (mm.mrad)	0.43	0.18	0.43	0.25
Projected emittance (mm.mrad)	0.65	0.25		0.45
Energy spread (keV, rms)	350	250	25000	1000
Relative energy spread (%, rms)	0.006	0.004	0.3	0.02
Peak current at undulator (kA)	2.7	1.6	3	15
Bunch length (fs, rms)	25	2	22	0.3
Bunch compression factor	125	533	136	5000
Repetition rate (Hz)	100	100	100	100
Number of bunches / RF pulse	2	2	2	2
Bunch spacing (ns)	28	28	28	28

X-Ray Parameters

FEL Beam Design Parameters	Nominal Operation Mode		Special Operation Mode	
	Long Pulses	Short Pulses	Large Bandwidth	Ultra-Short Pulses
Undulator period (mm)	15	15	15	15
Undulator parameter	1.2	1.2	1.2	1.2
Energy spread (keV)	350	250	17000 (FW)	1000
Saturation length (m)	47	50	50	50
Saturation pulse energy (μJ)	150	3	100	15
Effective saturation power (GW)	2.8	0.6	2	50
Photon pulse length (fs, rms)	21	2.1	15	0.06
Beam radius (μm)	26.1	17	26	17
Divergence (μrad)	1.9	2	2	2.5
Number of photons ($\times 10^9$)	73	1.7	50	7.5
Special bandwidth, rms (%)	0.05	0.04	3.5 (FW)	0.05
Peak brightness (# photon/mm^2. $mrad^2$. s^1.0.1% bandwidth)	7.10^{32}	1.10^{32}	8.10^{30}	$1,3.10^{33}$
Average brightness (# photon/ mm^2. mrad2.s^1.0.1% bandwidth)	$2,3.10^{21}$	$5,7.10^{18}$	3.10^{19}	$7,5.10^{18}$

Bunch Compressor Parameters

	BC 1			
Bending magnet length, L_B	0.25 m			
Drift, L_{D1}	6.0 m			
Drift, L_{D2}	1 m			
Beam energy	330 MeV			
Matching condition at last bend	$\beta_x < 5$ m, $\alpha_x = 0$, $\beta_y < 40$ m			
Operation mode	200 pC Normal	10 pC Normal	200 pC (BW)	10 pc (as)
Bending angle	3.82°	3.82°	3.82°	3.82°
R_{56}	55.1 mm	55.1 mm	55.1 mm	55.1 mm
Peak current at last bend	233 A	14 A	220 A	15 A
Slice norm. emittance last bend	0.3 mm.mrad	0.11 mm.mrad	0.3 mm.mrad	
Bunch length, rms σ_z	87.1 µm	66.8 µm	87 µm	
Compression factor	10	5	10	5

Bunch Compressor Parameters

	BC 2			
Bending magnet length, L_B	0.5 m			
Drift, L_{D1}	7.0 m			
Drift, L_{D2}	1 m			
Beam energy	2100 MeV			
Matching condition at last bend	$\beta_x < 3$ m, $\alpha_x = 0$, $\beta_y < 40$ m			
Operation mode	200 pC Normal	10 pC Normal	200 pC (BW)	10 pc (as)
Bending angle	2.15°	2.15°	2.15°	2.15°
R_{56}	–20.7 mm	–20.7 mm	–20.7 mm	–20.7 mm
Peak current at last bend	3000 A	830 A	3970 A	15000 A
Slice norm. emittance last bend	0.3 mm.mrad	0.13 mm.mrad	0.34 mm.mrad	
Bunch length, rms σ_z	5.1 µm	1 µm	4.8 µm	0. 2 µm
Compression factor	14	30	18	

200pC Tolerances

+ SwissFEL

	arrival time	peak current	energy
goals:	20 fs	5 %	0.05 %
S-Band Phase [deg]	0.19	0.23	0.32
S-Band Voltage [rel]	0.001	0.00026	0.0011
X-Band Phase [deg]	30	0.061	0.86
X-Band Voltage [rel]	0.0051	0.0017	0.0058
Linac 1 Phase [deg]	0.15	0.084	0.43
Linac 1 Voltage [rel]	0.001	0.0041	0.0046
Linac 2 Phase [deg]	5.2e+003	1.6e+002	2.2e+003
Linac 2 Voltage [rel]	0.15	0.87	0.0051
Linac 3 Phase [deg]	4.6e+003	1.8e+002	2.9e+003
Linac 3 Voltage [rel]	0.12	0.19	0.0041
Charge [pC]	19	1.9	47
initial arrival time [fs]	6.2e+002	68	2.9e+003
Initial Energy [rel]	0.00097	0.00031	0.0011
BC1 angle [rel]	0.052	0.0011	0.014
BC2 angle [rel]	0.19	0.0011	0.015

10pC Tolerances

+ SwissFEL

	arrival time	peak current	energy
goals:	5 fs	15 %	0.05 %
S-Band Phase [deg]	0.033	0.11	0.54
S-Band Voltage [rel]	0.00018	0.00019	0.0019
X-Band Phase [deg]	>10*	0.044	1.5
X-Band Voltage [rel]	0.00081	0.0017	0.0095
Linac 1 Phase [deg]	0.045	0.098	0.74
Linac 1 Voltage [rel]	0.00024	0.0037	0.0049
Linac 2 Phase [deg]	1.3e+004	33	1.1e+003
Linac 2 Voltage [rel]	0.0038	0.13	0.0052
Linac 3 Phase [deg]	1.6e+003	27	9.1e+002
Linac 3 Voltage [rel]	0.0029	0.15	0.0039
Charge [pC]	3.4	0.47	71
initial arrival time [fs]	1.1e+003	44	9.8e+002
Initial Energy [rel]	0.0002	0.00039	0.0023
BC1 angle [rel]	> 0.01*	0.00069	0.022
BC2 angle [rel]	> 0.01*	0.0011	0.035