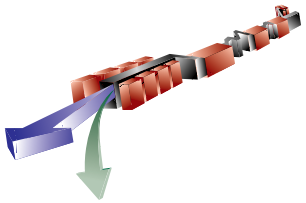
A Parameter Tables



A.1 FEL-Physics

A.1.1 Performance

A.1.1.1 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Electron energy	4.54	14.35		GeV
Electron Lorentz factor	8880	28082		
Normalized slice emittance	1.2	1.2		µm rad
Charge at undulator entrance	1	1		nC
Peak current	3400	3400		A
Longitudinal pulse form			Flat-Top	
Transverse pulse form			Gaussian	
RMS bunch length	23	23		µm
RMS bunch duration	77	77		fs
FWHM bunch length	69	69		µm
FWHM bunch duration	230	230		fs
Slice rms gamma spread			2.2	
Slice rms energy spread	0.025	0.010		%
Projected rms energy spread	0.2	0.06		%

A.1.1.2 Spontaneous Radiation

Parameter Name	Low Energy	High Energy	All Energies	Unit
Peak spontaneous power per pulse	9.2	92		GW
Average spontaneous power	0.29	2.9		W
Energy loss from spont. radiation	0.001	0.026		GeV
Rel. energy loss from spont. radiation	0.002	0.18		%
Non-radiative rel. energy loss	0.010	0.010		%
Max. overall field taper required			0.23	%
Delta E/E induced by spont. radiation	< 0.02	< 0.02		%
Spont. fund. trans. beam size	4.2	32		µm
Spont. fund. trans. beam divergence	6.2	2.0		µrad

A.1.1.3 FEL

Parameter Name	Low Energy	High Energy	All Energies	Unit
FEL parameter	14.5	5.0		10^{-4}
Rayleigh length	5.6	32		m
Slippage length	5593	559		nm
Cooperation length	165	48		nm
Power gain length	1.3	4.7		m
Field gain length	2.7	9.5		m
Saturation length incl. breaks	27	86		m
Peak saturation power	19	8		GW
Average saturation power	0.61	0.25		W
Fundamental radiation wavelength	15	1.5		Å
Photon energy of fundamental	0.82	8.2		keV
Number of coherent photons per pulse	27.9	1.1		10^{12} Photons/pulse
Peak photon flux	145	5.9		10^{24} Photons/s
Peak brightness	0.64	8.5		10^{32} *
Average brightness	0.2	2.7		10^{22} *
Instantaneous photon energy spread	0.24	0.06		%
Integrated photon energy spread	0.47	0.13		%
FEL rms fund. trans. beam size	31	28		µm
FEL ms fund. trans. beam divergence	3.8	0.43		µrad

* Ph./s/mm^2/mr^2/.1%bw

A.2 Photo-Injector

A.2.1 Gun-Laser

A.2.1.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Oscillator			CW mode-locked	
Ti:sapphire				
Oscillator pump			Frequ.-doubled CW	
Nd:YAG laser				
Amplifier			Ti:sapphire	
Amplifier pump			Nd:YAG or YLF	
Output wavelength			780	nm
Operating wavelength			260	nm
Pulse repetition rate			120	Hz
No. of micropulses			1	
Maximum micropulse energy on cathode			> 500	μJ
HWHM micropulse radius on cathode			0.9	mm
Micropulse risetime			1.0	ps
FWHM micropulse length			10	ps
Longitudinal micropulse form			various	
Longitudinal homogeneity on cathode			10	%
Transverse micropulse form			uniform	
Transverse homogeneity on cathode			10	%
RMS pulse-to-pulse energy jitter			<= 1	%
RMS pulse-to-pulse phase stability			<= 0.5	ps
Spot. diameter jitter at cathode (pk-pk)			1	%
Pointing stability (pk-pk of spot radius)			< 1	%

A.2.2 Gun

A.2.2.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Cathode material			metal (Cu or possibly Mg)	
Active diameter of cathode			12	mm
Cathode quantum efficiency at 266 nm			1	10^(-5)
Maximum extraction field			120	MV/m
Charge per bunch			1.0	nC
Longitudinal pulse form of electron bunch			truncated gaussian	
FWHM electron bunch length			3.0	mm
FWHM electrom bunch duration			10	ps
RMS electron bunch length			0.84	mm
RMS electron bunch duration			2.8	ps
Peak electron bunch current			100	A
RF frequency			2856	MHz
RF pulse duration			3-4	μs
Peak rf power			15	MW
Number of cells			1.6	
Electron beam energy at exit			7.0	MeV
Projected correlated electron energy			1.5	%

A.2.2.2 Solenoid

Parameter Name	Low Energy	High Energy	All Energies	Unit
Magnetic length			-	m
On-axis field			-	T

A.2.3 L-0

A.2.3.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Total length			14	m

A.2.3.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			7	MeV
Initial rms bunch length			0.83	mm
Initial charge			1	nC
Initial peak current			100	A
Final electron energy			150	MeV
Final normalized emittance			1	μm rad
Final rms bunch length			0.84	mm
Final charge			1	nC
Final peak current			100	A

A.2.3.3 Focusing

Parameter Name	Low Energy	High Energy	All Energies	Unit
Focussing structure			solenoids	

A.2.3.4 RF

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of linac sections			2	
RF phase at exit			0	degrees
Mean rf phase jitter tolerance			0.1	%
Mean rf voltage jitter tolerance			0.1	%
RMS pulse to pulse energy variation			0.1	%

A.2.4 DL-1

A.2.4.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
R56			+6.3	mm
Total bend angle			35	degrees
Total length			12	m

A.2.4.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			150	MeV
Initial normalized projected emittance			1	μm rad
Initital total energy spread			0.09	%
Initial slice energy spread			~0.003	%
Initial rms bunch length			0.83	mm
Initial peak current			100	A
Initial longitudinal slice brightness			734	A
Final electron energy			150	MeV
Final normalized projected emittance			1.02	μm rad
Final total energy spread			0.09	%
Final slice energy spread			~0.002	%
Final rms bunch length			0.83	mm
Final peak current			100	A
Final longitudinal slice brightness			734	A

A.2.4.3 Focusing

Parameter Name	Low Energy	High Energy	All Energies	Unit
Focussing components			quadrupole magnets	

A.2.4.4 Quadrupole Magnets

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of quadrupoles			9	
Max. focusing gradient			12	T/m
Magnetic length			0.15	m

A.2.4.5 Dipole Magnets

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of dipoles			2	
Max. deflection angle			17.5	degrees
Magnetic length			0.2	m

A.2.4.6 Diagnostics

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of profile monitors			5	
Number of x,y BPM pairs			9	

A.2.4.7 Vacuum

Parameter Name	Low Energy	High Energy	All Energies	Unit
Horizontal vacuum chamber ID			24	mm
Vertical vacuum chamber ID			24	mm

A.3 LINAC

A.3.1 General

A.3.1.1 S-Band Accelerator Section

Parameter Name	Low Energy	High Energy	All Energies	Unit
S-band rf frequency			2856	MHz
S-band klystron type			5045	
S-band acceleration gradient			19	MV/m
S-band Q			13000-14000	
S-band shunt impedance			53-60	MOhm/m
S-band mean iris diameter			23	mm
Peak S-band rf power			60	MW
Mean S-band f power			45	kW
Length of S-band rf section (s)			3	m

A.3.1.2 X-Band Accelerator Section

Parameter Name	Low Energy	High Energy	All Energies	Unit
X-band f frequency			11424	MHz
X-band mean iris diameter			9.4	mm
Length of X-band rf section (s)			0.6	m

A.3.2 L-1

A.3.2.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Total length			9.7	m

A.3.2.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			150	MeV
Initial normalized projected emittance			1.02	μm rad
Initital total energy spread			0.09	%
Initial slice energy spread			0.002	%
Initial rms bunch length			0.83	mm
Initial peak current			100	A
Initial longitudinal slice brightness			734	A
Final electron energy			270	MeV
Final normalized projected emittance			1.05	μm rad
Final total energy spread			1.68	%
Final slice energy spread			0.001	%
Final rms bunch length			0.83	mm
Final peak current			100	A
Final longitudinal slice brightness			691	A

A.3.2.3 Focusing

Parameter Name	Low Energy	High Energy	All Energies	Unit
Phase advance per cell			75	degrees
Number of quadrupoles			3	
Quadrupole magnetic length			0.1	m

A.3.2.4 RF

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of linac sections			3	
RF-Compression phase			-38	degrees
Mean rf phase jitter tolerance			0.1	%
Mean rf voltage jitter tolerance			0.1	%
RMS pulse to pulse energy variation			0.08	%

A.3.3 L-X

A.3.3.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Total length			0.6	m

A.3.3.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			270	MeV
Initial normalized projected emittance			1.05	μm rad
Initial total energy spread			1.68	%
Initial slice energy spread			0.001	%
Initial RMS bunch length			0.83	mm
Initial peak current			100	A
Initial longitudinal slice brightness			691	A
Final electron energy			250	MeV
Final normalized projected emittance			1.10	μm rad
Final total energy spread			1.79	%
Final slice energy spread			0.001	%
Final RMS bunch length			0.83	mm
Final peak current			100	A
Final longitudinal slice brightness			789	A

A.3.3.3 RF

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of RF sections			1	
RF phase			-180	degrees
RF phase tolerance			0.3	X-band degrees
RF voltage tolerance			0.25	%

A.3.4 BC-1

A.3.4.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Compressor type			chicane	
Total length			6.56	m
R56			-35.9	mm
Transverse offset of chicane			229	mm

A.3.4.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			250	MeV
Initial normalized projected emittance			1.10	μm rad
Initital total energy spread			1.79	%
Initial slice energy spread			0.001	%
Initial rms bunch length			0.83	mm
Initial peak current			100	A
Initial longitudinal slice brightness			789	A
Final electron energy			250	MeV
Final normalized projected emittance			1.20	μm rad
Final total energy spread			1.77	%
Final slice energy spread			0.005	%
Final rms bunch length			0.195	mm
Final peak current			500	A
Final longitudinal slice brightness			785	A

A.3.4.3 Dipole Magnet

Parameter Name	Low Energy	High Energy	All Energies	Unit
Total number of dipoles			4	
Bend angle of chicane dipoles			4.62	degrees
Magnetic length			0.2	m

A.3.4.4 Diagnostics

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of profile monitors			1	
Number of x,y BPMs			5	

A.3.5 L-2

A.3.5.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Total length of active accelerator			329	m

A.3.5.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			250	MeV
Initial normalized projected emittance			1.20	μm rad
Initital total energy spread			1.77	%
Initial slice energy spread			0.005	%
Initial rms bunch length			0.195	mm
Initial peak current			500	A
Initial longitudinal slice brightness			785	A
Final electron energy			4.54	GeV
Final normalized projected emittance			1.30	μm rad
Final total energy spread			0.75	%
Final slice energy spread			0.0003	%
Final RMS bunch length			0.195	mm
Final peak current			500	A
Final longitudinal slice brightness			748	A

A.3.5.3 Focusing

Parameter Name	Low Energy	High Energy	All Energies	Unit
Phase advance per cell			55	degrees
Number of quadrupoles			28	
Quadrupole magnetic length			0.1	m

A.3.5.4 RF

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of linac sections			109	
RF-compression phase			-43	degrees
Mean rf phase jitter tolerance			0.07	%
Mean rf voltage tolerance			0.07	%
RMS pulse to pulse energy variation			0.1	%

A.3.6 BC-2

A.3.6.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Compressor Type			chicane	
Total length			22.1	m
R56			-22.5	mm
Transverse offset of chicane			0.341	m

A.3.6.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			4.54	GeV
Initial normalized projected emittance			1.30	μm rad
Initital total energy spread			0.75	%
Initial slice energy spread			0.0003	%
Initial rms bunch length			0.195	mm
Initial peak current			500	A
Initial longitudinal slice brightness			748	A
Final electron energy			4.54	GeV
Final normalized projected emittance			2.0	μm rad
Final total energy spread			0.74	%
Final slice energy spread			0.0031	%
Final rms bunch length			0.023	mm
Final peak current			3407	A
Final longitudinal slice brightness			744	A

A.3.6.3 Dipole Magnet

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of dipoles			4	
Bend angle of chicane dipoles			1.878	degrees
Magnetic length			0.4	m

A.3.6.4 Diagnostics

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of profile monitors			1	
Number of x,y BPMs			1	

A.3.7 L-3

A.3.7.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Total length of active accelerator			553	m

A.3.7.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy			4.54	GeV
Initial normalized projected emittance			1.40	μm rad
Initital total energy spread			0.74	%
Initial slice energy spread			0.025	%
Initial rms bunch length			0.22	mm
Initial peak current			3400	A
Initial longitudinal slice brightness			743.8	A
Final electron energy	4.54	14.35		GeV
Final normalized projected emittance	3.0	1.50		μm rad
Final total energy spread	0.09	0.03		%
Final slice energy spread	0.025	0.008		%
Final rms bunch length	0.023	0.023		mm
Final peak current	3400	3400		A
Final longitudinal slice brightness	399	619		A

A.3.7.3 Focusing

Parameter Name	Low Energy	High Energy	All Energies	Unit
Phase advance per cell			30	degrees
Number of quadrupoles			47	
Quadrupole magnetic length			0.1	m

A.3.7.4 RF

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of linac sections	182			
RF phase	-	-10		degrees
Mean rf phase jitter tolerance	-	0.07		%
Mean rf voltage jitter tolerance	-	0.05		%
RMS pulse-to-pulse energy variation	-	0.04		%

A.3.8 DL-2

A.3.8.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Section type			dogleg	
Total length			68	
Total R56			0	mm
Number of horizontal bends			4	
Bend angle of horizontal bends			0.65	degrees
Horizontal offset			45	cm
Magnetic length of horizontal bends			2.62	m
Number of vertical bends			2	
Bend angle of vertical bends			0.136	degrees
Vertical angle			0.273	degrees
Magnetic length of vertical bends			0.4	m

A.3.8.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy	4.54	14.35		GeV
Initial normalized projected emittance	1.60	1.60		μm rad
Initital total energy spread	0.09	0.03		%
Initial slice energy spread	0.025	0.008		%
Initial rms bunch length	0.023	0.023		mm
Initial peak current	3400	3400		A
Initial longitudinal slice brightness	552	855		A
Final electron energy	4.54	14.35		GeV
Final normalized projected emittance	3.15	1.58		μm rad
Final total energy spread	0.09	0.03		%
Final slice energy spread	0.025	0.008		%
Final rms bunch length	0.023	0.023		mm
Final peak current	3400	3400		A
Final longitudinal slice brightness	552	855		A

A.3.9 DL-2

A.3.9.1 Quadrupole Magnet

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of quadrupoles			27	
Magnetic length			0.46	m

A.3.9.2 Diagnostics

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of profile monitors			6	
Number of x,y BPMs			28	

A.3.9.3 Collimators

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of collimators			4	
Collimator bore			1.2	mm

A.3.10 Beam-Dump

A.3.10.1 Subsystem

Parameter Name	Low Energy	High Energy	All Energies	Unit
Total length			10	m

A.3.10.2 Electron Beam

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy	4.54	14.35		GeV
Initial normalized projected emittance	-	1.53		μm-rad
Initial correlated energy spread	-	~0.10		%
Initial slice energy spread	-	~0.01		%
Initial rms bunch length	-	0.023		mm
Initial peak current	-	3400		A
Initial longitudinal slice brightness	-	104		A

A.3.10.3 Dipole Magnets

Parameter Name	Low Energy	High Energy	All Energies	Unit
Number of type-1 dipoles			2	
Magnetic length of type-1 dipoles			~1	m
Number of type-2 dipoles			5	
Magnetic length of type-2 dipoles			~0.5	m
Total max deflection angle			7.3	degrees

A.4 Undulator

A.4.1 Undulator

A.4.1.1 Undulator Magnet

Parameter Name	Low Energy	High Energy	All Energies	Unit
Undulator type			planar hybrid undulator	
Magnet material			NdFeB	
Magnet block dimensions (h, t, w)			66 mm × 9 mm × 56.5	mm
Permeable material			Va Permendur	
Pole block dimensions (h, t, w)			44 mm × 6 mm × 48	mm
Undulator period			30	mm
Full gap			6	mm
Nominal undulator field			1.325	T
Nominal undulator parameter			3.711	
Linear field taper			0.2	%
Number of magnet blocks per jaw			225	
Number of pole blocks per jaw			226	
Segment magnet array length			3.381	m
Segment end piece length			0.0195	m
Segment device length (w/ end pieces)			3.42	m
Number of segments			33	
Overall device length (w/o breaks)			112.860	m
Overall device length (w/ breaks)			121.045	m
Number of periods			3729	
Break length between segments 1 and 2			0.281	m
Break length between segments 2 and 3			0.256	m
Break length between segments 3 and 4			0.473	m
Regular short segment break length			0.187	m
Regular long segment break length			0.421	m
Break pattern after segment 4			short-short-long	
Wiggle plane			horizontal	

A.4.1.2 Electron Beam Optics

Parameter Name	Low Energy	High Energy	All Energies	Unit	
Focusing method			separated function		
Focusing scheme			FODO		
Quadrupole length			5	cm	
Quadrupole type			permanent magnet		
Focussing quadrupole gradient			107.1	T/m	
Defocussing quadrupole gradient			105.9	T/m	
Start section length (cells 01-03)			22.288	m	
Superperiod length (cells 04-06 etc.)			22.050	m	
Total length of undulator focussing lattice			121.513	m	
Total number of focussing cells			16.5		
Cell 01 length			7.463	m	
Cell 02 length			7.514	m	
Cell 03 length			7.311	m	
Cell 04 length			7.311	m	
Cell 05 length			7.428	m	
Cell 06 length			7.311	m	
Cell 07 length			7.311	m	
Cell 08 length			7.428	m	
Cell 09 length			7.311	m	
Cell 10 length			7.311	m	
Cell 11 length			7.428	m	
Cell 12 length			7.311	m	
Cell 13 length			7.311	m	
Cell 14 length			7.428	m	
Cell 15 length			7.311	m	
Cell 16 length			7.311	m	
Cell 17 length			3.714	m	
Ave beta-function			7.3	18.0	m/rad
Max beta-function			12.4	21.9	m/rad
Min beta-function			2.5	14.0	m/rad
Beta-function modulation			68	22	%
Phase advance per cell			83	25	degrees

A.4.1.3 Electron Trajectory Correction

Parameter Name	Low Energy	High Energy	All Energies	Unit
Trajectory correction scheme			quadrupole displacement	
Center distance between steering quads			3.59 - 3.78	m
Number of steering quadrupoles			33	
Max. transverse quad displacement			500	µm
Max. kick angle from focussing quadrupole	177	55		µrad
Max. kick angle from defocussing	175	55		µrad
Number of carbon wire stations			10	

A.4.1.4 Beam-Based-Alignment

Parameter Name	Low Energy	High Energy	All Energies	Unit
BPM rms resolution			1	µm
BPM offsets (uncorrelated)			50	µm
BPM offsets (correlated)			300	µm
BPM mean calibration errors			10	%
BPM rms calibration errors			3	%
Quadrupole offsets (uncorrelated)			50	µm
Quadrupole offsets (correlated)			300	µm
Mean beam energy error			2	%
RMS beam energy error			0.5	%
Quadrupole mean gradient error			0.3	%
Quadrupole rms gradient error			0.3	%
Undulator pole errors			0.04	%
Mover mean calibration errors			5	%
Mover rms calibration errors			3	%
Incoming trajectory bias			10	sigma
Incoming orbit jitter			0 - 0.1	sigma

A.4.1.5 Electron Beam at Entrance

Parameter Name	Low Energy	High Energy	All Energies	Unit
Initial electron energy	4.54	14.35		GeV
Initial normalized projected emittance	1.6	1.6		µm rad
Initial normalized slice emittance	1.2	1.2		µm rad
Initital total energy spread	0.08	0.03		%
Initial slice energy spread	0.018	0.006		%
Initial rms bunch length	23	23		mm
Initial fwhm bunch duration	230	230		fs
Initial pulse charge	1	1		nC
Initial peak current	3400	3400		A
Initial longitudinal slice brightness	854	747		A

A.4.1.6 Electron Beam inside Undulator

Parameter Name	Low Energy	High Energy	All Energies	Unit
Electron beam radius (rms)	32	28		µm
Electron beam divergence (rms)	4.3	1.5		µrad
Max undulation angle	418	132		µrad
Max. pk-pk undulation amplitude	4.0	1.3		µm
Max disp. function for ideal undulator	98	31		µm

A.4.1.7 Vacuum System

Parameter Name	Low Energy	High Energy	All Energies	Unit
Vacuum chamber height OD			6	mm
Vacuum chamber wall thickness			0.5	mm
Vacuum chamber material			copper plated stainless steel	
Bunch frequency			8.2	10^{12} s^{-1}
Skin depth			58	nm
Max inner surface roughness			0.050	µm
Beam pipe straightness			200	µm / m
Vacuum pressure			$< 10^{-7}$	mbar

A.4.1.8 Radiation Damage

Parameter Name	Low Energy	High Energy	All Energies	Unit
Expected radiation dose per year			4	kGy
Rad. to damge mag. face Delta B/B_(r)=1 %			100	kGy

A.4.1.9 Temperature Stability

Parameter Name	Low Energy	High Energy	All Energies	Unit
Tunnel temperature stability			1	K
Und. water systems temp. stability			0.1	K

A.4.1.10 Static Electron Beam Tolerances

Parameter Name	Low Energy	High Energy	All Energies	Unit
Electron energy stability	0.05	0.05		%
Peak current stability	20	20		%
Max. correlated rms energy spread	0.001	0.001		
Max. uncorrelated rms energy spread	0.0007	0.0002		
Horizontal and vertical beta matching	2	2		%
Max. horizontal and vertical dispersion	0.004	0.004		m
Max. horizontal and vertical dispersion	0.0010	0.0002		
Max. normalized slice emittance	1.2	1.2		μm rad
Max. normalized projected emittance	1.6	1.6		μm rad
Max. launch position error	6	6		μm
Max. launch angle error	0.9	0.3		μrad

A.4.1.11 Pulse-to-Pulse Electron Beam Tolerances

Parameter Name	Low Energy	High Energy	All Energies	Unit
Electron energy stability	0.05	0.05		%
Peak current stability	20	20		%
Max. correlated rms energy spread	0.001	0.001		
Max. uncorrelated rms energy spread	0.0006	0.0002		
Pulse-to-pulse angular stab. (rms)	6.3	5.5		μrad
Pulse-to-pulse positional stability (rms)	0.9	0.3		μm

A.4.1.12 Undulator Tolerances

Parameter Name	Low Energy	High Energy	All Energies	Unit
Transverse good field width			1000	µm
Max. trajectory walkoff per 10 m @ 15 GeV			5	µm
First magnetic field integral supression			5	G cm
Phase error			< 2	degrees
Relative BPM resolution			1	µm
RMS magnet error Delta B/B			0.1	%
Transverse quadrupole location jitter			< 100	nm
Quadrupole pole field error			< 2	%
Magnet block error Delta $B/B_{(rms)}$			±1	%
Magnet block easy axis angle error			±1	degree
Delta $B/B_{(rms)}$ after random assembly			0.66	%
Delta $B/B_{(rms)}$ after sorted assembly			0.1	%
Pole gap variation			±0.003	mm
Neighbor pole gap difference			±0.050	mm
Period variations between neighbor poles			±0.050	mm
Period variations: accumulated error			±0.050	mm
Pole thickness			-0.05	mm
Pole transverse displacement			±0.20	mm
Pole displacement in Z direction (top and			±0.10	mm
Pole face parallelism (top and bottom)			< 0.1	mm
Pole face parallelism (angle may open			< 0.1	degree
Pole gap rotation around Z over whole			< 0.3	degree
Undulator sag in Y direction due to its			< 0.002	mm
Undulator gap adjustment (possible)			±0.005	mm
Undulator gap adjustment (resolution)			0.001	mm
Undulator end motion (top and bottom)			0.080	mm
Undulator end motion (resolution)			< 0.001	mm
Supporting pillar alignment: X direction			±2.0	mm
Supporting pillar alignment: Y direction			±0.5	mm
Supporting pillar alignment: Z direction			±2.0	mm
Pitch, roll and yaw of pillars			0.75	mrad
Undulator vertical and horizontal remote			±2.0	mm
Undulator vertical and horizontal remote			< 0.002	mm
Drive system installation accuracy on			±0.5	mm
Drive system installation accuracy on			±0.05	mm
Drive system installation accuracy on			±1.0	mm

A.4.1.13 Segment Alignment Tolerances

Parameter Name	Low Energy	High Energy	All Energies	Unit
Horizontal segment location tolerance			250	μm
Vertical segment location tolerance			100	μm
Longitudinal segment location tolerance			500	μm
Segment roll tolerance			1000	μrad
Segment yaw tolerance			50	μrad
Segment pitch tolerance			250	μrad

A.4.1.14 Quadrupole Alignment Tolerances

Parameter Name	Low Energy	High Energy	All Energies	Unit
Horizontal quadrupole location tolerance			100	μm
Vertical quadrupole location tolerance			100	μm
Long. quadrupole location tolerance			-	μm
Quadrupole roll tolerance			10	mrad
Quadrupole yaw tolerance			-	mrad
Quadrupole pitch tolerance			-	mrad

A.4.1.15 BPM Alignment Tolerances

Parameter Name	Low Energy	High Energy	All Energies	Unit
Transverse BPM alignment tolerance			50	μm

A.5 X-Ray-Optics

A.5.1 Radiation-Source

A.5.1.1 FEL Radiation

Parameter Name	Low Energy	High Energy	All Energies	Unit
Radiation wavelength	15	1.5		Å
Macropulse rep rate			120	Hz
Number of micropulses/macropulse			1	
RMS pulse duration	77	77		fs
Peak 1st FEL harmonic power	19	8		10^9 W
Energy/FEL pulse	5.1	2.1		mJ
Number of photons/FEL pulse	28	1.1		10^{12}
FWHM source size (electron)	110	96		µm
FWHM source divergence (electron)	15	5.3		µrad
FWHM FEL mode & mode source size	109	96		µm
FWHM FEL mode & mode source	13	1.5		µrad
1st harmonic rms FEL Rayleigh waist	32	28		µm
1st harmonic FEL Rayleigh length	4.2	32		m
1st harmonic homogeneous bandwidth s	0.06	0.03		%
1st harmonic inhomogeneous	0.40	0.12		%
Peak 1st FEL harmonic power density	7	8		10^{11} W/mm^2
Peak 1st FEL harmonic field (@10m)	2.2	2.5		10^{10} V/m

A.5.1.2 Spontaneous Radiation

Parameter Name	Low Energy	High Energy	All Energies	Unit
Peak spontaneous power	9	92		GW
Time-averaged spontaneous power	0.3	2.9		W
90% total power bandwidth	0.006	0.025		keV
FWHM spontaneous source size	131	82		µm
FWHM spontaneous source divergence	15.5	4.9		µm