Appendix: SPL parameter list

Parameter	Value	Comment
General linac parameters		*Tables 2.1 and 2.2*
Energy	3.56 GeV	
Beam power	4/5 MW	'Neutrino'/'EURISOL'
Bunch frequency	352.2 MHz	
Peak current	64 mA	Output
Average pulse current	40 mA	Output
Beam duty cycle (after chopper)	2.9/3.6%	'Neutrino'/'EURISOL'
Peak RF power	161.6 MW	Installed RF systems
Average RF plug power	17/21 MW	'Neutrino'/'EURISOL'
Repetition rate	50 Hz	
Beam pulse length	0.57/0.71+0.014 ms	'Neutrino'/'EURISOL'
RF efficiency	0.5/0.85/0.95	Klystron/power conv./waveguide
Number of 352.2 MHz klystrons	14	1 MW peak
Number of 704.4 MHz klystrons	44	5 MW peak
Primary cooling linac	16.8 MW	Heat capacity, *Table 5.5*
	1600 m^3/h	($\Delta T = 9$ K, $\Delta P = 5$ bar)
Cryo-compressors	3.6/4.4 MW	Heat capacity 'neutrino'/'EURISOL'
	600 m^3/h	($\Delta T = 5.7$ K, $\Delta P = 5$ bar)
Elec. power cooling/ventilation	4 MW	*Table 5.8*
Total power consumption	32/37 MW	'Neutrino'/'EURISOL', *Table 5.9*
Length	429 m	Without debuncher
Tunnel length	470 m	Including access area
Normal-conducting linac		
Energy	180 MeV	
RF frequency	352.2/704.4 MHz	0.095–90 MeV/90–180 MeV
Peak RF power	26.4 MW	Installed RF systems
Average RF power	0.9/1.2 MW	'Neutrino'/'EURISOL'
Average RF plug power	2.2/3 MW	'Neutrino'/'EURISOL'
Length	87 m	
Error amplitudes		Maximum, uniform distribution
Quadrupole gradient	$\pm 0.5\%$	
Quadrupole displacement	± 0.1 mm	
Quadrupole rotation (x,y)	± 0.5 deg	
Quadrupole rotation (z)	± 0.2 deg	
Cavity field phase	± 1 deg	
Cavity field amplitude	$\pm 1\%$	
Superconducting linac		
Input energy	180 MeV	
Output energy	3.56 GeV	
RF frequency	704.4 MHz	
Peak RF power	135.2 MW	Installed RF systems
Average RF power	6.0/7.2 MW	
Average RF plug power	14.9/17.8 MW	
Length	342 m	

table continued on next page

Parameter	Value	Comment
Cryogenic temperature	2 K	
Error amplitudes		Maximum, uniform distribution
Quadrupole gradient	$\pm 0.5/\pm 0.05\%$	Static/dynamic
Quadrupole displacement	$\pm 0.5/\pm 0.01$ mm	Static/dynamic
Quadrupole rotation (x,y)	$\pm 0.25/\pm 0.005$ deg	Static/dynamic
Quadrupole rotation (z)	$\pm 0.5/\pm 0.05$ deg	Static/dynamic
Cavity displacement	$\pm 0.5/\pm 0.01$ mm	Static/dynamic
Cavity rotation (x,y)	$\pm 0.08/\pm 0.005$ deg	Static/dynamic
Cavity field phase	± 1 deg	
Cavity field amplitude	$\pm 1\%$	
Ion source and LEBT		*Section 4.2.1*
Ion species	H^-	
Source current	80 mA	
Extraction voltage	95 kV	
Source length	1 m	
LEBT focusing type	solenoid	
LEBT length	<2 m	
Transverse output emittance	0.25 π mm mrad	(r.m.s., normalized)
Vacuum	10^{-5} mbar	
RFQ		*Table 4.1*
Input energy	0.095 MeV	
Output energy	3.0 MeV	
RF frequency	352.2 MHz	
Peak current	70 mA	
Average pulse current	70 mA	
Design current	100 mA	CW
Design duty cycle	100%	
Voltage	87–122 kV	
Modulation factor	1.0–1.7	
Maximum surface field	1.7 kilpatrick	
RF beam power	210 kW	(70 mA)
RF peak power (superfish)	884 kW	
RF peak power (expected)	1020 kW	
Number of klystrons	1	
No. of cells	560	
Length	5.95 m	
Beam aperture	3.7–4.1 mm	
Transverse output emittance	0.28 π mm mrad	r.m.s., normalized
Longitudinal output emittance	0.15 π deg MeV	At 352.2 MHz
	0.38 π mm mrad	r.m.s., normalized
Vacuum	10^{-7} mbar	
MEBT (chopper line)		*Table 4.3*
Beam energy	3 MeV	
Peak current	70/64 mA	Input/output
Average pulse current	70/40 mA	Input/output
Effective chopper plate voltage	400 V	Seen by beam

table continued on next page

Parameter	Value	Comment
Chopper plate voltage	500 V	
Chopper rise/fall time	< 2 ns	10–90%
Maximum chopper frequency	44 MHz	
Chopper repetition rate	1–50 Hz	
Maximum chopping factor	40%	
Chopper deflection angle	5.3 mrad	
RF frequency buncher cavities	352.2 MHz	
Maximum buncher voltage	150 kV	
RF peak power per buncher	16–18 kW	
Number of buncher cavities	3	At 352.2 MHz
Number of chopper structures	2	Inside quadrupoles
Number of quadrupoles	11	
Length of chopper plates	400 mm	
Chopper plate distance	20 mm	
Length	3.7 m	
Beam collimation	$\approx 9\%$	
Transverse output emittance	0.32 π mm mrad	r.m.s., norm., collimated
Longitudinal output emittance	0.17 π deg MeV	At 352.2 MHz
	0.43 π mm mrad	r.m.s., normalized
Vacuum	10^{-7} mbar	
DTL		*Table 4.4*
Input energy	3 MeV	
Output energy	40 MeV	
RF frequency	352.2 MHz	
Peak current	64 mA	
Average pulse current	40 mA	
Design RF duty cycle	14%	
Gradient E_0	3.3/3.5 MV/m	1st / (2nd,3rd) tank
Maximum surface field	1.4–1.7 kilpatrick	
Synchrotron phase	$-30 \rightarrow -20/-20$ deg	1st / (2nd,3rd) tank
RF beam power	1.5 MW	
RF peak power per tank	0.7/1.57/1.55 MW	1st/2nd/3rd tank
RF peak power	3.8 MW	
Number of klystrons	1/2/2	1st/2nd/3rd tank
Cells per tank	28/33/24	1st/2nd/3rd tank
Number of tanks	3	
Focusing tank 1	FOFODODO	
Focusing tank 2/3	FODO	
Length per tank	2.63/5.2/5.0 m	1st/2nd/3rd tank
Total length	13.4 m	
Transition to CCDTL	0.25 m	
Beam aperture	20 mm	
Quadrupole type	PMQ	
Quadrupole length	45/80 mm	1st / (2nd,3rd) tank
Outer drift tube diameter	90 mm	
Inner quadr. diameter	22 mm	
Transverse output emittance	0.34 π mm mrad	r.m.s., normalized
Longitudinal output emittance	0.19 π deg MeV	At 352.2 MHz

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Parameter	Value	Comment
	0.49 π mm mrad	r.m.s., normalized
Vacuum	10^{-7} mbar	
CCDTL		*Tables 4.5 and 4.6*
Input energy	40 MeV	
Output energy	92 MeV	
RF frequency	352.2 MHz	
Peak current	64 mA	
Average pulse current	40 mA	
Design RF duty cycle	14%	
Gradient E_0	2.8–3.9 MV/m	
Maximum surface field	1.4–1.7 kilpatrick	
Synchr. phase	−20 deg	
RF beam power	2 MW	
RF power per module	0.8 MW	
RF peak power	6.4 MW	
Number of klystrons	8	
Cells per cavity	3	
Cavities per module	3	
Number of cavities	24	
Number of modules	8	
Focusing	FODO	
Length	25.2 m	
Transition to SCL	0.25 m	
Beam aperture	28 mm	
Transverser output emittance	0.35 π mm mrad	r.m.s., normalized
Longitudinal output emittance	0.19 π deg MeV	At 352.2 MHz
	0.48 π mm mrad	r.m.s., normalized
Vacuum	10^{-7} mbar	
SCL		*Tables 4.7 and 4.8*
Input energy	92 MeV	
Output energy	180 MeV	
RF frequency	704.4 MHz	
Peak current (at 704.4 MHz)	128 mA	Every 2nd RF bucket filled
Average pulse current	40 mA	
Design RF duty cycle	14%	
Gradient E_0	4 MV/m	
Maximum surface field	1.1–1.2 kilpatrick	
Synchrotron phase	−20 deg	
RF beam power	3.6 MW	
RF peak power	15.1 MW	
Number of klystrons	5	
Cells per cavity	11	
Cavities per module	4–5	
Number of cavities	24	
Focusing	FODO	
Length	34.4 m	
Transition to SC linac	0.5 m	

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Parameter	Value	Comment
Beam aperture	32 mm	
Transverse output emittance	0.36 π mm mrad	r.m.s., normalized
Longitudinal output emittance	0.19 π deg MeV	At 352.2 MHz
	0.48 π mm mrad	r.m.s., normalized
Vacuum	10^{-7} mbar	
SC linac		*Tables 4.11, 4.12, 4.13, 4.14*
Input energy	180 MeV	
Output energy	3.56 GeV	
RF frequency	704.4 MHz	
Peak current (at 704.4 MHz)	128 mA	Every 2nd bucket filled
Average pulse current	40 mA	
Cryo duty cycle	4.6/5.5%	'neutrino'/'EURISOL'
Design cryo duty cycle	6%	
(R/Q)	290/570 Ω	Linac definition (β = 0.65/1.0)
Q_0	10^{10}	Min. performance goal (β = 0.65/1.0)
Q_l	0.9/1.0 $\times 10^6$	(β = 0.65/1.0)
Filling time τ_l	0.21/0.23 ms	Q_l/ω (β = 0.65/1.0)
Gradient E_0	19/25 MV/m	Without transit time factor (β = 0.65/1.0)
Synchronous phase	$-20 \rightarrow -15$ deg	
RF peak power	135.2 MW	
Number of klystrons	7/32	(β = 0.65/1.0)
Cells per cavity	5	
Active length per cavity	0.692/1.064 m	(β = 0.65/1.0)
Number of cavities	42/136	(β = 0.65/1.0)
Cavities per cryo-module	6/8	+4 quads / +2 quads (β = 0.65/1.0)
Foc. periods per cryo-module	2/1	(β = 0.65/1.0)
Number of cryo-modules	7/17	(β = 0.65/1.0)
Length of cryo-module	11.45/14.26 m	(β = 0.65/1.0)
Dist. between cryo-modules	0.8 m	
Focusing	FDO	
Period length	6.13/15.06 m	(β = 0.65/1.0) cryostat transitions
Length	85.8/256.1 m	(β = 0.65/1.0)
SC linac length	342 m	
Beam aperture	85/90 mm	Diameter
Transverse output emittance	0.36 π mm mrad	r.m.s., normalized
Longitudinal output emittance	0.20 π deg MeV	At 352.2 MHz
	0.50 π mm mrad	r.m.s., normalized
Vacuum	10^{-9} mbar	