

ESSnuSB accumulator ring parameter list

Last updated by Maja Olvegård, 2019-09-13

Parameter	Unit	Value	Comment
Beam parameters, incoming			
Kinetic energy	GeV	2.5	
Momentum	GeV/c	3.308	
Relativistic Lorentz factor	-	3.664	
Relativistic speed	c	0.962	
Magnetic rigidity	Tm	11.03	
Transverse emittance, rms normalized	π mm mrad	0.35	
Energy spread			
Average macro-pulse current (protons for neutrons)	mA	50	No injection or extraction gaps in this pulse.
Macro-pulse duration (protons for neutrons)	μ s	2860	Maximum possible macro-pulse duration is ~2900 μ s
Bunch frequency	MHz	352.2	RF frequency in linac is 352.2 MHz (up to spoke section) and 704.4 MHz (elliptical section).
Number of particles per macropulse	#	8.93E+14	
Number of batches	#	4	Each linac macro-pulse is split into 4 batches. Each batch is accumulated separately.
Number of particles per batch	#	2.23E+14	This is the batch intensity for all pulsing schemes.
Chopping factor			
Accumulator ring			
Circumference	m	384	more precise: 384.0134 m
Arc length	m	40	
Length of straight sections	m	56	
Revolution time	μ s	1.331	
Extraction gap duration, at the time of injection	μ s	0.133	Gap for ramping the extraction kickers, generated in the linac. Duration corresponds to 10% of revolution time.
Pulsing scheme A, BASELINE			
Linac pulsing frequency	Hz	28	
Batch frequency	Hz	1351.35	
Micro-bunch frequency	MHz	352.20	
Micro-bunch intensity	#	1.10E+9	
Injection gap duration	μ s	100	This is the gap between the batches/fills.
Batch duration	μ s	640	
H- beam current in linac	mA	62.07	Nominal linac current increased to compensate for 10% injection gaps and ~10% extraction gap.
Number of injected turns	#	481	
Number of particles per injected turn	#	4.64E+11	
Beam current at extraction	A	29.83	

Pulsing scheme B			
Linac pulsing frequency	Hz	70	
Batch frequency	Hz	70	
Micro-bunch frequency	MHz	352.2	
Micro-bunch intensity	#	8.86E+8	
Batch duration	μ s	794.4	10% for extraction gap added to pulse duration
H- "compensated" beam current, linac	mA	50	
Number of injected turns	#	597	
Number of particles per injected turn	#	3.74E+11	
Beam current at extraction	A	29.83	
Pulsing scheme C			
Linac pulsing frequency	Hz	70	
Batch frequency	Hz	70	
Micro-bunch frequency	MHz	352.2	
Micro-bunch intensity	#	7.04E+8	
Batch duration	μ s	1000.0	1331 μ s corresponds to a 1000 injected turns
H- "compensated" beam current, linac	mA	39.72	ca 30 mA for a 1000 injected turns
Number of injected turns	#	751	1000 injected turns for a batch duration of 1331 μ s
Number of particles per injected turn	#	2.97E+11	
Beam current at extraction	A	29.83	
Accumulator lattice and optical parameters			
General			
Transition gamma	-	5.825	
Chromaticity, horizontal	-	-11.2	
Chromaticity, vertical	-	-12.4	
Range of chromaticity correction, horizontal	-		
Range of chromaticity correction, vertical	-		
Tune, horizontal	-	8.2-8.3	
Tune, vertical	-	8.3-8.4	
Tune, longitudinal	-		
Momentum compaction factor, alpha	-	0.02947	
Phase slip factor, eta	-	-0.0450	
Acceptance of primary collimator	π mm mrad	120	Preliminary
Acceptance of secondary collimator	π mm mrad		
Ring acceptance	π mm mrad	400	Preliminary
Dipole aperture			
Bunching factor		>0.9	

Space charge tune shift			-0.028	Gaussian beam
Arc lattice				
Number of FODO cells per arc	#		4	
phase advance per FODO cell, horizontal	π		0.25	
phase advance per FODO cell, vertical	π		0.267	
Bending radius of arc dipole	m		8.48	
Magnetic field strength in arc dipole	T		1.301	
Number of dipoles per arc	#		8	
Number of quadrupoles per arc	#		8	
Number of sextupoles per arc	#		5	Work in progress!
Twiss, ring				
Maximum horizontal beta	m		28.7	
Minimum horizontal beta	m		2.85	
Average horizontal beta, $\langle\beta_x\rangle$	m		10.8	
Maximum vertical beta	m		35.1	
Minimum vertical beta	m		2.74	
Average vertical beta, $\langle\beta_y\rangle$	m		11.4	
Maximum horizontal dispersion	m		4.879	
Twiss, arc				
Maximum horizontal beta	m		15.9	
Minimum horizontal beta	m		3	
Average horizontal beta, $\langle\beta_x\rangle$	m		8.37	
Maximum vertical beta	m		16.3	
Minimum vertical beta	m		2.74	
Average vertical beta, $\langle\beta_y\rangle$	m		8.16	
Maximum horizontal dispersion	m		4.879	
Twiss, injection				
Maximum horizontal beta	m		28.7	
Minimum horizontal beta	m		2.86	
Average horizontal beta, $\langle\beta_x\rangle$	m		12.5	
Maximum vertical beta	m		35	
Minimum vertical beta	m		2.86	
Average vertical beta, $\langle\beta_y\rangle$	m		13.6	
Maximum horizontal dispersion	m		1.60E-05	
At the center of injection				

Horizontal beta	m	10	
Horizontal alpha	-	0.0479	
Horizontal dispersion	m	-0.1028	
Vertical beta	m	20	
Vertical alpha	-	0.0239	
x'	rad	0	
y'	rad	0	
RF			
Dual-harmonic			
Voltage, harmonic 1	kV	5	
Voltage, harmonic 2	kV	2.5	
Bucket height	MeV		
Bucket area			
Barrier bucket			
Voltage	kV	10	
Signal shape		sinusoidal	
Barrier RF phase	degrees	160	The RF wave extends from 160 to 180 degrees and from -180 to -160 degrees.
Beam parameters at extraction			
Transverse beam emittance (100%)	π mm mrad	120	
Normalized beam emittance (100%)	π mm mrad	423	
Transverse distribution shape	-		
Extraction gap duration	μ s	0.1	We assume a 0.133 μ s incoming extraction gap from the linac. At the time of extraction this must be >0.1 μ s.
Pulse duration	μ s	1.23	
Maximum energy spread	%	± 0.2	