PS/BR Note 82–11
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PROTON SYNCHROTRON BOOSTER (PSB)

PARAMETER LIST (VERSION 8)

compiled by K.H. Reich and K. Schindl

Note: This list gives a coherent set of operational values, consistent with measured data.
● denotes change made since the previous version.
For layout of rings and beam lines, see PS/BR Note 82–16, by M. Perrin.

1. MAIN PARAMETERS

● Energy, momentum, rigidity	injection	T_I	49.89	MeV
		p_I	310.0	MeV/c
		$B \times \rho$	1.0342	T·m
	transfer	T_T	800.0	MeV
		p_T	1463.3	MeV/c
		$B \times \rho$	4.881	T·m
● Protons per cycle	design		1.0×10^{13}	
	operational		2.0×10^{13}	
● Protons per ring	operational	N	5.0×10^{12}	
● Revolution period	injection	τ	1.670	μs
	transfer		0.6224	μs
● Circulating current $e(N/\tau)$	injection		0.48	A
	transfer		1.29	A
Number of superposed rings			4	
Number of periods			16	
Length of period			9.81748	m
Length of straight section 1		L1	2.540	m
Length of straight section 2 or 5		L2, L5	0.279	m
for beam optics			0.368	m
Length of straight section 3 or 4		L3, L4	0.590	m
for beam optics			0.653	m
● Repetition time	normal		1.20	s
	minimum		0.65	s
● Rise time	normal		400	ms
	minimum		320	ms

Flat-top time			60	ms
• Normal cycle length			650	ms
• Total power consumption (1.2 s rep. rate)			2.0	MW

2. GEOMETRY

Average radius		25	m
Circumference		157.0796	m
Magnetic bending radius	ρ	8.238878	m
Length of straight section path	L1	2.654	m
Length of triplet path		3.928077	m
Length of bending magnet path		1.6177	m
Centre to straight section radius		24.977487	m
Centre to triplet radius		24.914744	m
Beam level of ring 3 (as PS)		433.66	m
Vertical distance of rings		0.36	m

3. ORBIT PARAMETERS AND TRANSVERSE PHASE SPACE

Lattice 0.5D–L4–F–L5–B–L1–B–L2–F–L3–0.5D

• Betatron wave number	horiz.	Q_H	4.30–4.16		
(dynamic working point)	vert.	Q_V	5.45–5.24		
• Phase advance per period	horiz.	μ_H	96.8–93.6	deg	
	vert.	μ_V	122.6–117.9	deg	
Horizontal beta function	mean	β_H	5.95	m	See Fig. 1
($Q_H = 4.20$)	max.	β_H	7.63	m	
Vertical beta function	mean	β_V	4.70	m	
	max.	β_V	19.14	m	
Tuning range at injection		Q_H	4–5		
		Q_V	4–5.5		
Momentum compaction function	max.	$D = R \times \alpha_p$	1.70	m	
	min.		1.23	m	

Chromaticity ($Q_H = 4.2$)		ξ_H	−0.89	
($Q_V = 5.3$)		ξ_V	−1.74	
• Transition energy/rest energy		γ_{tr}	$Q_H - 0.13$	
• $(\Delta f/f)(\Delta p/p) = \gamma^{-2} - \gamma_{tr}^{-2} = \eta$	injection		0.844	
	transfer		0.230	
• Capacitance constant	injection	g_0	~ 2.4	
(for 5×10^{12} ppr)	transfer		~ 4.0	
• Beam emittance at injection	horiz.	ε_H	200	$\pi \cdot$mm$\cdot$mrad
(for 5×10^{12} ppr at 800 MeV)	vert.	ε_V	85	$\pi \cdot$mm$\cdot$mrad
• Beam emittance at transfer	horiz.	ε_H	40	$\pi \cdot$mm$\cdot$mrad
(PS injection point)	vert.	ε_V	20	$\pi \cdot$mm$\cdot$mrad
• Transverse acceptance		A_H	340	$\pi \cdot$mm$\cdot$mrad
(ideal closed orbit)		A_V	135	$\pi \cdot$mm$\cdot$mrad

4. MAIN BENDING MAGNETS

(C-core = Window frame without one return leg)

Number of units			32+1	
Physical length of unit			1.729	m
Magnet length (on orbit)		L_B	1.6177	m
Length of yoke			1.537	m
Magnetic length (straight)			1.615	m
Width of core			0.71	m
Total height of core			1.52	m
Total gap height			70	mm
Total gap width			238	mm
• Magnetic field	at 310.0 MeV/c		0.12553	T
	at 1463.3 MeV/c		0.59244	T
Coils, total number of turns per gap			12	
Weight of one complete unit			12.7	ton
Total iron weight			400	ton
Total copper weight			24	ton

Total inductance of 33 units		0.164	H
Total resistance of 33 units (35 deg)		0.350	Ω
Total stored energy (max.)		630	kJ
Current density (for I_{rms} = 1316 A)		3.6	A/mm^2
Total power losses (for I_{rms} = 1316 A)		0.64	MW

5. MAIN QUADRUPOLES*)

(Four standard profiles stamped from single laminations)

Number of units (rad. foc. + defoc.)		32 + 16	
Bore radius		60	mm
Physical length	L_F	0.566	m
	L_D	0.944	m
Magnetic length (magn. meas.)	L_F	0.5027	m
	L_D	0.8811	m
Magnetic length (adjusted to fit measured Q-values)	L_F	0.50357	m
	L_D	0.87894	m
Length of yoke	L_F	0.4559	m
	L_D	0.8343	m
Height of yoke		1.64	m
Width of yoke		0.56	m
Magnetic field gradient (without Q-tuning)	at 310.0 MeV/c	0.812	T/m
	at 1463.3 MeV/c	3.835	T/m
Coils, number of turns per pole		2	
Weight of one complete unit	F	3.13	ton
	D	5.64	ton
Iron weight	32 F lenses	93	ton
	16 D lenses	85	ton
Copper weight	32 F lenses	5.95	ton
	16 D lenses	4.64	ton

*) For correction elements, see Section 7.

Weight of one triplet + girder + corr. magnets		14.1	ton
Inductance	32 F lenses	7.7×10^{-3}	H
	16 D lenses	6.7×10^{-3}	H
Resistance	32 F lenses	0.076	Ω
	16 D lenses	0.056	Ω
Current density (for $I_{rms} = 1316$ A)		3.6	A/mm^2
Total stored energy (max.)	32 F lenses	30.0	kJ
	16 D lenses	26.0	kJ
• Total power losses ($I_{rms} = 1316$ A)	32 F lenses	0.14	MW
	16 D lenses	0.10	MW

6. MAIN POWER SUPPLY

(rectifier-inverter groups powered directly from the mains)

Cable resistance (bend. magnets + quadrupoles)	0.024	Ω
Total resistance (bend. + quad. + cables + filter)	0.507	Ω
Filter inductance	0.005	H
• Total inductance (bend. + quad. + cables + filter)	0.191	H
• Time constant of load	377	ms
• Maximum voltage applied	2700	V
Stand-by current I_1	576.0	A
• Injection current	583.3	A
Transfer current I_2	2757	A
Mean current (r.m.s. for 1.2 s rep. rate)	1316	A
Maximum d.c. power available	8.4	MW
Flat-top d.c. power	3.85	MW
Maximum active power (normal cycle)	8.4	MW
• Mean active power (normal cycle)	0.9	MW
• Minimum active power	−3.2	MW
• Maximum reactive power (after compensation)	0.5	MVAR

7. CORRECTION WINDINGS, CIRCUITS AND MAGNETS WITH THEIR POWER SUPPLIES

	Characteristics and Purpose	Magnets			Supplies		
		No.	Value	at current (A)	U_{max} (V)	I_{max} (A)	$(dI/dt)_{max}$ (kA/s)
• Integral $B\,d\ell$	Two turns per bend.magn. gap Equalization of $\bar{R}$ at 800 MeV	4	0.184 T·m	100	200	50	0.25
• Correction dipoles (old)	Type 1 (H,V)	4 × 11	3.3 mrad	20	25	20	0.25
(Deflections at 800 MeV)	Type 2 (H,V)	4 × 2	2.25 mrad	20	25	20	0.25
Correction dipoles (new)	In multipoles, H(V)	4 × 4	2.8(2.5) mrad	270	25	20	0.25
• Global Q-tuning supplies	All F(D) lenses in series, floating trim supplies	2	0.417 T/m	300	370	300	2
• Ring Q-tuning ("Q-strips")	One turn per pole of main quads	4 × 2	0.055 T/m	80	100	100	20
Quadrupoles	Stopbands	4 × 8	0.05 T	85	25	80	1.5
Skew quadrupoles	"Skew" injection	4 × 12	0.05 T	85	25	40	1.5
Sextupoles (old)	Chromaticity Stopbands	4 × 16 4 × 4	2.05 T/m 2.05 T/m	270 270	370 25	300 60	2 1.5
(new)	Stopbands	4 × 4	2.25 T/m	270	15	150	3
Skew sextupoles, types A, B	Stopbands	4 × 4, 4 × 4	2.3, 3.0 T/m	270	15	150	3
Octupoles (old)	Landau damping	4 × 16	80.4 T/m²	270	370	300	2
	Stopbands	4 × 4	80.4 T/m²	270	25	60	1.5
(new)	Stopbands	4 × 4	183.5 T/m²	270	15	150	3
Skew octupoles, types A, B	Stopbands	4 × 4, 4 × 4	110, 183.5 T/m²	270	15	150	3

8. RF ACCELERATING SYSTEM, FEEDBACK SYSTEMS, AND LONGITUDINAL PHASE SPACE

RF system characteristics

Number of cavities per ring			1*)	
Harmonic number		h	5	
• Accelerating frequency	injection transfer		2.937 8.03316	MHz MHz
• Energy gain per turn	normal cycle		~ 1.0–3.0	keV
• Synchronous phase angle		ϕ_s	4.8–15	deg
Peak cavity voltage	at injection during cycle	V_{rf}	1 12.7	kV kV
Cavity shunt impedance	(min.)		12	kΩ

*) A second cavity for an $h = 10$ system is being installed.

RF power loss per cavity	(max.)		6	kW
• Bucket area (min. at 0.137 T) (for $V_{rf} = 12$ kV, $N = 5 \times 10^{12}$ ppr)		A	2.47	MeV·rad
			0.123	eV·s
			7.84	mrad
$N = 0$			9.61	mrad
Synchronous oscillation frequency (no space charge)	after trapping	f_s	5500	Hz
	at transfer		2180	Hz

Beam characteristics

• Circulating current	after trapping		0.48	A
	at transfer		1.29	A
Bunching factor (mean/peak density, measured)	injection		0.47	
	transfer		0.30	
Spacing of bunch centres	at transfer		124.48	ns
			31.42	m
Bunch length and height	from linac	ΔE	± 170	keV
		$\Delta p/p$	$\pm 1.75 \times 10^{-3}$	
	after trapping	ΔE	± 350	keV
		$\Delta p/p$	$\pm 3.1 \times 10^{-3}$	
		$\Delta\phi$	277	deg
	at transfer	ΔE	± 1350	keV
		$\Delta\beta\gamma$	$\pm 1.68 \times 10^{-3}$	
		$\Delta p/p$	$\pm 1.06 \times 10^{-3}$	
		$\Delta\phi$	160	deg
		Δt	55.3	ns
		$\Delta\ell$	13.9	m
Bunch area	at transfer	ε_L	5.9	MeV·rad
			0.117	eV·s
			0.0075	rad

• **Beam control systems (individual per ring)**

Number of phase-loop PU electrodes		5
Number of radial-loop PU electrodes		4
Radial loops	Bandwidth	d.c.–2.3 kHz
Synchronization loop (equalization of frequency and phase between rings)	df/dt nom.	1 kHz/ms

			Tackling bunch oscillation mode	
Phase loops	Bandwidth	1–15 kHz	$m = 1$ (dipole)	$n = 0$ (in phase)
"Hereward" loops	Bandwidth	d.c.–10 kHz	$m = 2$ (quadr.)	$n = 0$
Coupled bunch mode systems	Bandwidth (around revolution harmonics)	±30 kHz	$m = 1,2,3,(4)$	$n = 1,2,3,4$

- **Transverse feedback system**

Number of systems		4 × 2 (H,V)	
Absolute gain (max.) at 800 MeV ($N = 5 \times 10^{12}$ ppr)		$\sim 2 \times 10^{-4}$	
Closed orbit suppression		~ 60	dB
Deflector characteristic impedance	(push/pull)	50	Ω
Power amplifiers (one per deflector electrode)	number	4 × 4	
	max. output	100	W
Over-all bandwidth (including filter)		30 kHz–50 MHz	
Time of flight from pos. PU electrode to deflector	50 MeV	1470	ns
	800 MeV	550	ns
Variable delay, minimum step		4	ns

9. INJECTION LINE (50 MeV) FROM LTB.BHZ10 TO INJECTION SEPTUM, AND INJECTION

Sieves	No.: 2	Reduction factor: 4

Dipoles	No.	Aperture $w \times h$ (cm)	Impedance R (Ω)	L (mH)	I_{max} a) (A)	$\int B\,d\ell$ (T·m)	Defl./I (mrad/A)	d.c./Pulsed	
BI·DHZ+VT	4 + 4 × 2	14.8 × 14.8	3.46	11.33	10	3.6×10^{-3}	0.35	Pulsed	Type 10 af
BI·DVT40	1	16 × 15	3.32	320	5	9.6×10^{-3}	1.85	d.c.	
BI·DHZ+VT70	4 × 1	7 × 7	9.68	7	10	5.3×10^{-3}	0.51	Pulsed	Type 9 af
BI1,2,4SMV	3	11.2 × 3	2.5×10^{-5}	4×10^{-3}	19 000	0.185	9.43×10^{-3}	Pulsed	
BI1BVT	1	12 × 12.4	0.06	13.8	268	0.206	Saturation	d.c.	
BI2,4BVT	2	12 × 12.4	0.05	8.4	268	0.161	Saturation	d.c.	
[illegible]·SMH	4 × 1	4 × 4	1.5×10^{-3} b)	6.5×10^{-3} b)	3 330	0.0709	0.0212	Pulsed	

Quadrupoles	No.	Aperture	Impedance R (Ω)	L (mH)	I_{max} a) (A)	$\int G\,d\ell / I$ (T/A)	
BI·QNO10–40	4	15 dia.	0.925	212	20	0.0326	d.c.
BI·QNO50,60	4 × 2	15 dia.	0.17	40	70	0.0116	d.c.

Kickers & bumpers	No.	Aperture $w \times h$ (cm)	U_{max} a) (kV)	I_{max} a) (A)	$\int B\,d\ell$ (T·m)	Defl./I (mrad/A)	Rise/Fall	Flat top (μs)
BI·DIS	5	5 × 9.8	24	500	4.1×10^{-3}	8×10^{-3}	70 ns	100 (130)
BI·KFA	4 × 1	12 × 7	15	600	0.01	1.7×10^{-2}	60 ns	2
BI·KSW16L4	4 × 1	13.2 × 13.2	7 (all four)	720	0.020	0.028	25–80 μs (all four)	
BI·KSW1L1	4 × 1	13.8 × 7		260	0.016	0.063		
BI·KSW1L4	4 × 1	13.2 × 13.2		48	0.005	0.094		
BI·KSW2L1	4 × 1	13.2 × 13.2		250	0.010	0.040		

a) For actual magnet cables, and power supply.
b) Magnets in series.

10. 800 MeV EJECTION, RECOMBINATION, TRANSFER (UP TO BTP.BHZ10) AND MEASURING LINES

Dipoles	No.	Type	Aperture	Impedance		I_{max} a)	$\int B\,d\ell$	Defl./I	d.c./ Pulsed
			$w \times h$ (cm)	R (Ω)	L (mH)	(A)	(T·m)	(mrad/A)	
BE.DHZ,VT4L1,11L1	4 × 2	1	13.8 × 13.8	1.12	70	20	0.0161	0.165	Pulsed
BE.SMH[b)] septum	4 × 1		8.0 × 2.45	0.0033	0.022	4620	0.275	0.0122	d.c.
BT3,2DVT10	2	8a	10.2 × 12.4	0.64	54	20	0.0275	0.28	d.c.
BT4,1DVT10	2		6.2 × 12.4	0.26	13.3	10	0.01	0.205	d.c.
BT4,1BVT10	2	Oerlikon	6.2 × 12.4	0.18	34	268	0.468	0.358	d.c.
BT.DHZ10	4	8af	10.2 × 12.4	0.64	41	20	0.0209	0.21	Pulsed
BT.DVT50,60 BTM.DHZ,VT10	2 2	} 4af	16 × 15	0.8	80	20	0.0185	0.19	Pulsed
BT3,2DVT20	2	8b	10.2 × 12.4	0.15	6	174	0.053	0.062	d.c.
BT4,1SMV10[b)] septum	2		6 × 10	0.04	0.46	2000	0.473	0.0485	d.c.
BT.SMV20 septum	1		6 × 10	0.02	0.23	2000	0.473	0.0485	d.c.
BT.BVT20	1	Oerlikon	12 × 12.4	0.36	64	268	0.489	0.374	d.c.
BT.DVT30,BT2DVT40	2	8af	10.2 × 12.4	0.7	36	20	0.0273	0.28	Pulsed
BT3.DVT40	1	8bf	10.2 × 12.4	0.11	2.2	174	0.053	0.062	d.c.
BT.SMV30[c)] double septum			6 × 7	1.9×10^{-4}	3.2×10^{-4}	4175	0.017	± 0.0017	Pulsed
BT.BHZ10	1	Tesla	29 × 14	0.4	370	260	0.794	0.626	± pulsed
BTM.BHZ10	1	Lintott	52 × 14	0.19	65	850	~ 2.01	365/600	d.c.

Quadrupoles	No.	Type	Aperture (cm)	Impedance R (Ω)	L (mH)	I_{max} a) (A)	$\int G\,d\ell/I$ (T/A)
BT.QNO10,20	2 × 2	Smit	15 dia.	0.17	40	268	0.0116
BT.QNO30	1					174	
BTM.QNO10	1					174	
BTM.QNO20	1					268	
BT.QNO40,50	2	Oerlikon	20 dia.	0.26	160	268	0.0117

Kickers & bumpers	No.	Aperture $w \times h$ (cm)	U_{max} a) (V)	I_{max} a) (A)	$\int B\,d\ell$ (T·m)	Defl./I (mrad/A)	Rise time	Flat top
BE.BSWL1	4 × 1	14.6 × 7.2	400[d)]	525	0.083	0.0325	5 ms	Sine wave
BE.BSWL4	4 × 2	14.6 × 14.4	400[d)]	600	0.074	0.0254	5 ms	Sine wave
BE.KFA	4 × 1	11.5 × 7	30000	1200	0.0405	0.0069	60 ns	~ 1 μs
BT4,1KFA10 BT.KFA20	2 1	11 × 5.3	30000	2400	0.04	0.0034	60 ns	~ 1 μs ~ 1.3 μs

a) Compatible for actual magnets, cables, and power supplies.
b) 4(2) levels powered in series. R and L as seen by supply.
c) Powered in parallel.
d) Series-parallel connection.

11. VACUUM SYSTEM

Vacuum chamber, inside total dimensions

Bending magnet	normal	horiz.	132	mm
		vert.	63	mm
	under vacuum	vert.	60.8	mm
Quadrupoles		horiz.	135	mm
		vert.	121	mm
Long straight section (diameter)			120	mm

Other components

Number of 440 l/s sputter ion pumps (4 rings + lines)		41 + 15
Number of mechanical pump groups		11 + 6
Number of Ti sublimation pumps (ring)		3
Number of manifolds (ring)		28
Number of quick-connect clamps (4 rings + lines)		750 + 130
Number of sectors I, R, T, TM		1 + 5 + 3 + 1
Number of sector valves	I	1 + 4 × 1
	R	4 × 5
	T	4 × 1 + 2 × 1 + 1
	TM	1
Average pressure	2×10^{-8}	Torr

12. WATER COOLING AND AIR CONDITIONING

Water cooling

Water flow	Tunnel	90	m^3/h
	Injection, transfer lines	22	m^3/h
	Surface buildings	50	m^3/h
Pressure inlet, outlet	Tunnel	10.5, 5.5	kg/cm^2
	Injection, transfer lines	18, 6	kg/cm^2
	Surface buildings	10, 5	kg/cm^2
Temperature inlet, outlet	Tunnel	16, 38	°C
	Injection, transfer lines	16, 45	°C
	Surface buildings	22, 37	°C

• 12. WATER COOLING AND AIR CONDITIONING

Air conditioning

Chilled water power installed		1.2×10^6	kcal/h
		1400	kW
Compressors	Tunnel	2	
	Surface building	2	
Air flow	Tunnel	70 000	m^3/h
	Surface buildings	132 000	m^3/h
Temperature	Tunnel	20 ± 0.5	°C
	Surface buildings (summer)	24–32	°C
Cooling power used (mean values, summer)	Tunnel	~ 200	kW
	Surface buildings	~ 300	kW
Power recuperation for heating (max., winter)		~ 400	kW

Device	Position	Number	Measuring	Bandwidth	Signal range [entry SOS[a] where applicable]	Sensitivity
Scintillation screens	I	3 + 4 × 3	Beam position and aspect ratio. Destroys beam		Min. 2 × 10^{9} p/cm^2	
(sensitive layer of	R	4 × 1				
doped Al_2O_3)	E	4 × 1				
	T	2 × 2 + 2				
	TM	2				
Scrapers	I	34	Beam losses in distributor and septum apertures	d.c.–3 MHz	1–100 mA	50 mV/mA
Beam current tranformers	I	1 + 4 × 1	Linac pulse intensity	< 0.01–1 MHz	1–200 mA	10 V/A
normalized	R	4 × 1	Protons in rings	0.001–10 kHz	1 × 10^{10}–1.2 × 10^{13}	0.5 V/1 × 10^{12} p
intermediate	R	4 × 1	Intensity in rings	0.1–1 MHz	2 mA–10 A	~ 1 V/A
fast	R	4 × 1	Betatron stacking, bunches	1 kHz–30 MHz	1 × 10^{11}–1 × 10^{13} ppr	~ 0.3 V/A
	T	1	Bunches and intensity	1 kHz–30 MHz	1 × 10^{11-1} × 10^{13} ppr	~ 0.3 V/A
	TM	1	Intensity	1 kHz–35 MHz	Digital only	1 V/10^{13} ppp
Beam position monitors						
magnetic	I	4 + 4 × 2	Inj. line steering	16 Hz–3 MHz	0.025–4 A·mm	0.5 V/(A·mm)
electrostatic[b]	R	4 × 17	Closed orbit	50 kHz–40 MHz	1 × 10^{11} (B_f = 0.3) to 4.25 × 10^{12} (B_f = 0.5) ppr	Σ = 2 × 10^{-13}/B_f to 2 × 10^{-12}/B_f V_{peak}/ppr
(out of 4 × 17)	R	4 × 4	Normalized radial position	d.c.–5 kHz	2 × 10^{10}–1 × 10^{13} ppr	−50 mV/mm
"half-turn"[b]	R	4 × 1	Injection mis-steering	250 Hz–25 MHz	0.005–10 A·mm	0.4 mV/(mA·mm)
quadrupolar	R	1	Aspect ratio oscillations	1 kHz–3 MHz		
type A[b]	T	4 × 1	Recombination steering	400 Hz–40 MHz	2 × 10^{11}–1.25 × 10^{14} (p per bunch × mm)	4 or 20 mV per (1 × 10^{11} p per bunch × mm)
type F[b]	T,TM	6,2	Recombination steering	250 Hz–40 MHz	2 × 10^{11}–1 × 10^{14} (p per bunch × mm)	2.5 or 12.5 mV per (1 × 10^{11} p per bunch × mm)
Q measurement: deflector + PU electrode + comp. counter	R	4 × 2	Coherent Q-value in each plane	d.c.–1 kHz Defl. frequency	n + 0.05 < Q < n + 0.45 n + 0.55 < Q < n + 0.95	
"Beamscope"	R	4 × 2	Transverse beam profiles by controlled-orbit bump and shaving on aperture restriction	Fastest loss ~ 1 ms	1 × 10^{11}–1 × 10^{13} ppr	Normalized by computer
Measuring targets	R	4 × 2	Transverse beam size	Beam loss in 1–10 ms	0.3 to 50 mm	
Beam loss monitors	I,R	4,16	Beam loss: integrated		1 × 10^{9}–1 × 10^{13}	
(Al cathode electron multipliers)	T	4	instantaneous		Protons lost (design)	
Transverse wide-band electrostatic PU electrodes (sensors for transverse feedback systems)	R	4	Transverse coherent oscillations	5 kHz–50 MHz (BOR)	Max. ± 3 V	6 × 10^{-15} × (N/B_f) V/mm
Longitudinal wide-band wall current monitor	R	4	Bunch shape and oscillations, longitudinal emittance	100 kHz–900 MHz (BOR)	20 mV–20 V	~ 1.5 V/A
Longitudinal mode analyser	R	4	Envelopes of longitudinal coupled bunch modes	d.c.–350 Hz	Min. 0.01 deg.	2 V/deg. (dipole mode)
800 MeV SEMs	TM	3 × 2	800 MeV recombined beam emittance, steering, matching	Analyses 5 or 20 bunches	5 × 10^{11}–1 × 10^{13} ppr	Normalized by computer

a) SOS = Signal Observation (multiplexing) System
b) Δ (50 mm) = Σ
c) Bunching factor B_f = mean/peak density

14. PEAK PERFORMANCE

• Intensity	experimental		2.4×10^{13}	ppp
	operational		2.0×10^{13}	ppp
• Emittances (for 2.0×10^{13} ppp)	horizizontal	800 MeV	55	$\beta\gamma\pi \cdot$ mm $\cdot$ mrad
		after recombin.	62	$\beta\gamma\pi \cdot$ mm $\cdot$ mrad
	vertical	800 MeV	28	$\beta\gamma\pi \cdot$ mm $\cdot$ mrad
		after recombin.	31	$\beta\gamma\pi \cdot$ mm $\cdot$ mrad
	longitudinal		7.5	mrad
• Operational density	vertical		6.5×10^{17}	p/$\beta\gamma\pi \cdot$ m $\cdot$ rad
	longitudinal		8.55×10^{12}	p/eV $\cdot$ s
• Average line density at ejection for 2.5 μs			3.2×10^{10}	p/m
• Current during 2.5 μs			1.28	A
• Current, average (2 $\times 10^{13}$ p every 1.2 s)			2.7	μA
Current, max. (2.4 $\times 10^{13}$ p every 0.84 s)			4.6	μA

Acknowledgements

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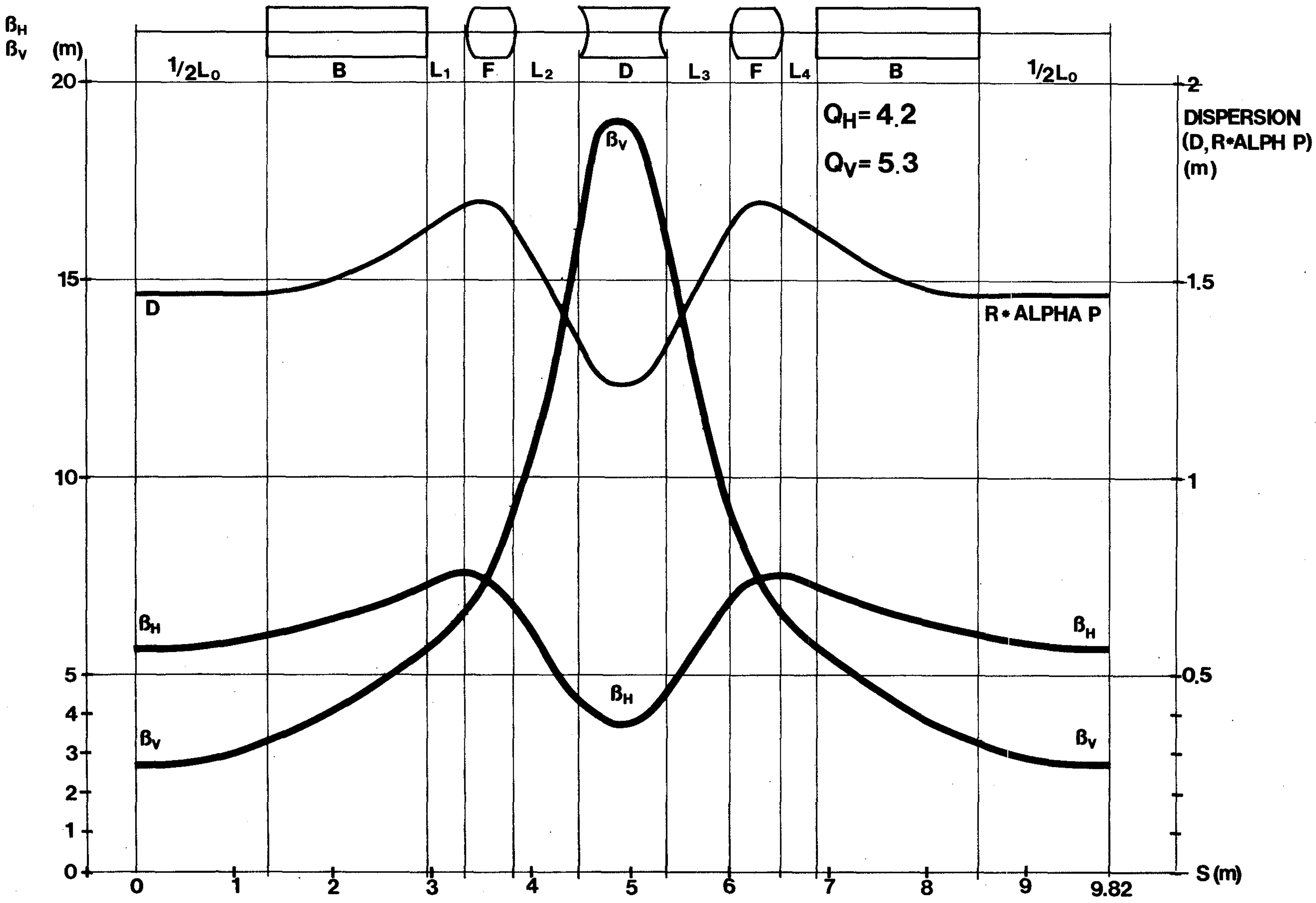
Distribution: BR Group
PS Scientific Staff
ISR Senior Staff
SPS Parameter list


ßH
ßV (m)
1/2L0
B
L1
F
L2
D
L3
F
L4
B
1/2L0
QH= 4.2
QV= 5.3
DISPERSION
(D, R*ALPH P)
(m)
ßV
D
R * ALPHA P
ßH
ßH
ßH
ßV
ßV
20
15
10
5
4
3
2
1
0
2
1.5
1
0.5
0
1
2
3
4
5
6
7
8
9
9.82
S (m)