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LINAC PARAMETERS

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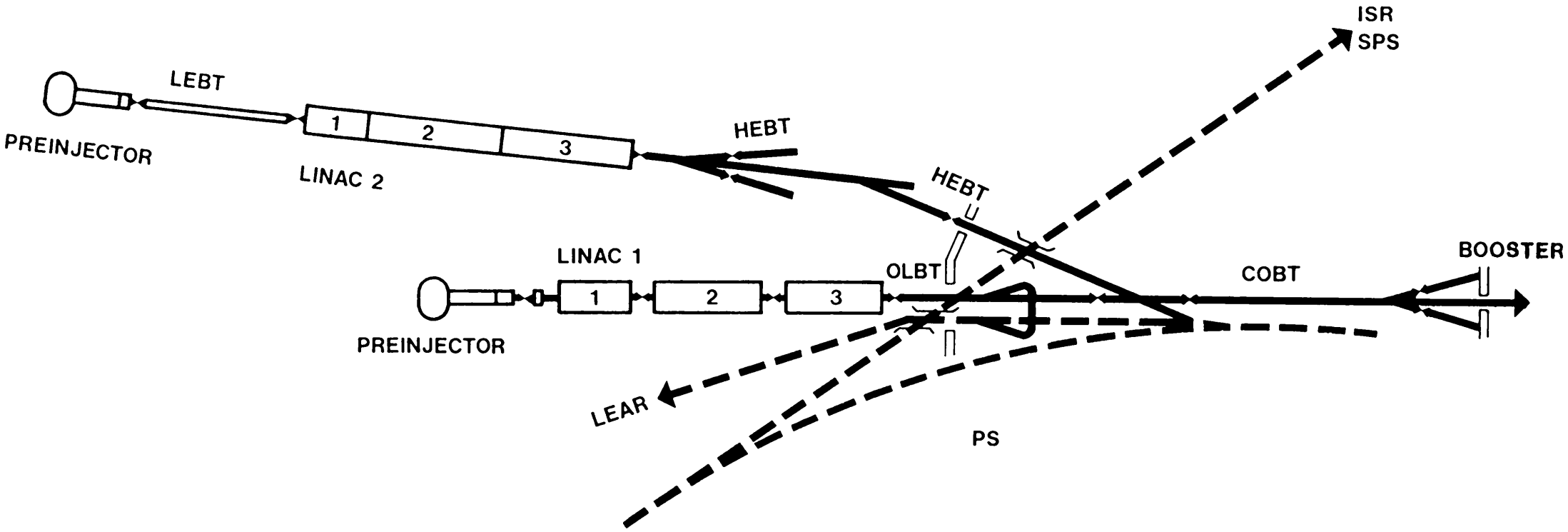
ISR
SPS
LEBT
PREINJECTOR
1
2
3
LINAC 2
HEBT
HEBT
LINAC 1
OLBT
COBT
BOOSTER
PREINJECTOR
1
2
3
LEAR
PS

The compiler would be pleased to hear of any errors in or omissions from this data list, especially as regards Linac 1. The next edition of this list will include data on the Common Beam Transport and Linac I RF System.

LINAC I

GENERAL

Construction started	1956	
First beam	1959	
Injector for	PS.PSB. (LEAR)	
Particles	P, d, α, (H^-)	
Data given for	P	
Maximum repetition rate	1	pps
Nominal energy	49.7	MeV

PREACCELERATOR

Beam current (max)	400	mA
Nominal energy	516	keV
Ion source	duoplasmatron with polarised expansion cup	
Hydrogen flow	6-10	mℓ/min
Arc current	$\simeq$ 70	A
Pulse length	(7)-80-100	μs
Source extraction	by column field	
High voltage source	Sames electrostatic generaotr	
Rated current	2	mA
Stability of voltage	±500	V
Beam load compensation	active	
Voltage swing (max and nominal)	70	kV
Accelerating column	high gradient, 2 gap voltage graded	
Gap length	60 + 52	mm
Number of sections	7 + 7	
Insulation of sections	porcelain	
Maximum gradient	49.6	kV/cm
Accelerating electrodes	titanium	
Aperture (min)	50	mm
Emittance (normalised)	2	π mm mrad
Vacuum system :-turbopumps	2 x 1500	ℓ/s
-pressure with H_2 flow	$\simeq$ 3 x 10^{-5}	Torr

BEAM CHOPPER AT	500	keV
Type	electrostatic	
Maximum voltage	15	kV
Minimum pulse length	< 500	ns
Rise time/Fall time	< 250	ns
LOW ENERGY BEAM TRANSPORT		
Length	1.85	m
Transverse matching		
Number of quadrupoles	6	
Quadrupole aperture	50	mm
Current (typ)	540	A
Pulse length (total)	550	μs
Maximum gradient	30	T/m
Longitudinal matching		
Type	single gap re-entrant buncher	
Frequency	202.57	MHz
Drift length	0.7	m
Modulation	17	keV
Peak power	2	kW
Beam guiding		
Type	H and V	
Number	1	
Current (dc)	± 5	A
Deflection	±20	mrad
Beam limiter		
Slits (set H + V)	1	
Beam diagnostics		
Current transformers (calibrated)	2	
LINEAR ACCELERATOR		
Type	Alvarez	
Current (max)	80	mA

Pulse length	0.5 - 80	μs
Overall length	29	m
Number of tanks	3	
RF frequency	202.57	MHz
Field mode	TM010	
Q	≅ 50 000	
RF duty factor	0.03	%
RF pulse length (up to)	300	μs
Effective shunt resistance	30	MΩ/m
Acceleration rate	1.7	MeV/m
RF input power, peak	8	MW
RF input power, mean	0.002	MW
Tank construction	copper liner in steel tank raft supported drift tubes	
Cooling	Water	

LINAC STRUCTURE

	Tank 1	Tank 2	Tank 3	
Input energy	0.52	9.87	30.45	MeV
Output energy	9.87	30.45	49.70	MeV
Cavity length	5.49	11.96	11.24	m
Inter-cavity spacing	0.40	0.37	-	m
Cavity diameter	1.076	0.928	0.812	m
Number of unit cells	42	41	27	
Drift tube diameter	140-62	178	178	mm
Drift tube bore	16-29	33	33	mm
Upper profile radius	-	38	38	mm
Lower profile radius	1-3	13	13	mm
Support stem diameter	2 × 16	2 × 38	2 × 38	mm
Gap/cell length	0.25	0.244-0.351	0.249-0.305	
Axial transit time factor	0.69-0.84	0.81-0.77	0.86-0.82	
Synchronous phase	-30	-30	-30	o
Mean axial field	2.75-2.34	2.35-2.46	2.15-2.26	MV/m
Peak surface field	17-13	12.6-10.5	11.5-11.3	MV/m

Cavity RF power		$\simeq$1.3	$\simeq$1.4	MW
Beam RF power				MW
Quadrupole effective length	27-106	114-152	229	mm
Adjustable quadrupoles	0	2	2	
Gradient (max)	62.5-12.8	10.8-6.2	4.2-3.7	T/m
Currents for above	13-134	5-28	5-28	A
Excitation	1/2 sinusoid	dc	dc	
Order	FD	FD	FD	
Vacuum pumps, turbo	2x1500	2x1500	2x1500	ℓ/s
Operating pressure (approx)	2×10^{-6}	2×10^{-6}	2×10^{-6}	Torr
Beam out of Linac at 50 MeV			80-100	mA

HIGH ENERGY BEAM TRANSPORT (OLBT)

(up to junction Linac II/PS/PSB)		
Length	18	m

TRANSVERSE MATCHING

Number of quadrupoles	6	
Aperture (beam tube)	110	mm
Current (pulse)	±10	A
Maximum gradient	4	T/m

BEAM GUIDING

Steering magnets (H+V combined)	2	
Current	±10	A
Deflection	± 3	mrad
(Manual adjustment of beam centre using slit and beam transformer)		
Height difference Linac 1/PS	3	mm

BEAM BENDING

EO-BHN01-Linac to LEAR		
Angle	-16	deg
Current (dc)	667	A
Aperture	100	mm
Length	481	mm

BEAM DIAGNOSTICS

Beam transformers	4 + 1
Target station	1
Dispersion object slit (used with BH3)	1
Emittance measurement performed manually using 2 sets of slits plus beam transformer	
SEM Grid H + V	1
Resolution	3.5 mm

DIVERS

Slits H + V	2
Vacuum system	ion pumps
Beam pipe aperture	95-145 mm
Chopper	1
Type	electromagnetic
Minimum pulse length	several microsecond
Rise/fall time	2/3 μs

RF SYSTEM - LINAC 1

In process of rejuvenation, data will be given on completion of work.

Linac II

GENERAL

Construction started	11/73	
First operational beam	9/78	
Injector for	PS.PSB	
Particles accelerated	P	
Maximum repetition rate	2	pps
Nominal energy	50	MeV

PREACCELERATOR

Beam current (normal)	340	mA
Nominal energy	760	keV
Ion source	duoplasmatron with polarised expansion cup	
Hydrogen flow	≅ 6	ml/min
Arc current	≅70	A
Pulse length (variable at source) (max)	150	μs
Source extraction	by column field	
High voltage source	Cockroft-Walton cascade (semi-conductor diodes)	
Maximum voltage	800	kV
Rated current	4	mA
Stability of voltage	$\pm 5 \times 10^{-4}$	
Beam load compensation	active	
Voltage swing (max)	100	kV
Voltage swing (normal) 150 μs	30-40	kV
Accelerating column	high gradient, 2 gap voltage graded	
Gap length	67 + 62	mm
Number of sections	10 + 9	
Insulation of sections	porcelain	
Maximum gradient	59.7	kV/cm

Accelerating electrodes	Titanium	
Aperture (min)	50	mm
Emittance (normalised)	2	π mm mrad
Vacuum system : - turbopumps	2 x 1500	l/s
- diode ion	2 x 500	l/s
- Pressure (with H_2 flow)	3 x 10^{-5}	torr

LOW ENERGY BEAM TRANSPORT

Length	6.5	m

Transverse matching

Number of quadrupoles	18	
Quadrupole aperture	55-97	mm
Current (max)	300	A
Pulse length (flat top)	≅220	μs
Maximum gradient	40	T/m

Longitudinal matching

Type			double drift harmonic buncher	
Buncher	1	2	3	
frequency	202.56	405.12	202.56	MHz
drift length	0.95	0.8	0.16	m
modulation	37	16	35	keV
peak power	10	20	10	kW

Beam guiding

type	H + V combined	
number	4	
currents	±10	A
deflection	±16	mrad

Beam diagnostics

Current transformers (calibrated)	5	
Emittance measurements H + V	2	

Mechanical scanning through beam for up to	40	pulses
Resolution	1	mrad
Number of wires	48	
Slit width	0.2	mm
Fast probe for bunch length measurement	1	
Resolution	<20	pS

Beam limiters

Sieve	1	
Transmission	≅33	%
Slits (sets H + V)	2	

Vacuum system

Main - triode ion 450 l/s	2	
Roughing - turbo 450 l/s	1	
Pressure (operational)	5×10^{-7}	torr

LINEAR ACCELERATOR

General

Type	Alvarez post coupled	
Current	50-150	mA
Pulse length (beam)	20-200	μs
Overall length	33.6	m
Number of tanks	3	
RF frequency	202.56	MHz
Field mode	TM010	
Q	60 000	
RF duty factor (max)	1/500	
RF pulse length (max	1 000	μs
Effective shunt resistance	36	MΩ/m
Acceleration rate	1.48	MeV/m
RF input power, peak (150 mA beam)	10	MW
RF input power, mean (1 pps) (typical max)	2.36	kW
Tank construction	copper clad steel, girder supported drift tubes	
Cooling	water	

Linac structure

	Tank 1	Tank 2	Tank 3	
Input energy	0.75	10.35	30.48	MeV
Output energy	10.35	30.48	50.0	MeV
Cavity length	6.939	12.958	13.359	m
Inter cavity spacing	0.15	0.20	-	m
Cavity diameter	0.94	0.90	0.86	m
Number of unit cells	52	44	32	
Number of post couplers	25	21	31	
Drift tube diameter	180	160	160	mm
Drift tube bore	20-25	30	30	mm
Upper profile radius	20	40	40	mm
Lower profile radius	4,5	10	10	mm
Support stem diameter	28	40	40	mm
Post coupler diameter	25	25	25	mm
Gap/cell length	0.222-0.314	0.201-0.294	0.262-0.316	
Axial transit time factor	0.676-0.804	0.873-0.835	0.865-0.816	
Synchronous phase	(-25)-(-35)	-25	-25	°
Mean axial field	1.790-2.164	1.994	1.920	MV/m
Peak surface field	10.0-9.3	12.6-9.6	10-9.7	MV/m
Cavity RF power	0.60	1.12	1.17	MW
Beam RF power, 150 mA	1.44	3.02	2.93	MW
Quadrupole effective length	35,40,55,80	114	114	mm
Gradient for 150 mA	93-32	23-20	20-19	T/m
Currents for above	229-137	215-188	187-178	A
Pulse length, quads (flat top)	220	220	220	µs
Order	FD	FD	FD	
Vacuum pumps, triode ion	2 x 500	4 x 500	4 x 500	l/s
Turbo roughing pumps	2 x 450	2 x 450	2 x 450	l/s
Operating pressure	1.3×10^{-8}	5×10^{-8}	9×10^{-8}	torr
Beam out of Linac at 50 MeV			150	mA

HIGH ENERGY BEAM TRANSPORT (HEBT)

(up to junction Linac 1/PS/PSB)

Length	54.15	m

Transverse matching

Number of quadrupoles	14	
Aperture (beam tube)	97	mm
Maximum gradient	$\sim$3	T/m
Pulse length (flat top)	$\sim$220	μs
Current	300	A

Beam guiding

Number of pick-ups (H + V combined)	5	
Steering magnets (H + V combined)	5(6)	
Current	±10	A
Deflection	± 3	mrad

Beam bending

BH1 - selection of measuring lines

Angle	0, ± 60	mrad
Current (pulsed)	0, ±1072	A
Pulse length (flat top)	$\sim$220	μs
Aperture	11.6	mm
Length	40	cm

BH2 - selection dump/PSB

Angle	0,300	mrad
Current	10.9	A
Aperture	10	cm
Length	1	m

Beam Diagnostics

Beam transformers (calibrated)	6	
Number of beam positon monitors	5	
Type	Magnetic	
	H + V combined	
Resolution	$\sim$ 0.5 mm	

Emittance measurements

H and V	NSPES	
Type	single pulse	
Measuring time	12	µS
Length	15.79	m
Deflection (pulsed)	magnetic	
Kickers (each plane)	2	
Current (sinusoidal)	$\sim$ 5000	A
Pulse length	72	µS
Useable pulse length	$\frac{5\pi}{6} - \frac{7\pi}{6}$	
Slit (variable)	0.5 - 3	mm
Matching quadrupoles	2	
Current	14,34	A
Number of collector wires	24	
Resolution	0.15 - 0.5	mrad
Spectrometer	NSPECTRO	
Type	single pulse	
Length	16.62	m
Spectrometer magnets (pulsed)	2	
Current	202,204	A
Deflection	54.3	0
Bending radius	1.20	m
Kickers (pulsed) (same type as H-V plane)	2	
Longitudinal lens	1	
Type	RF cavity	
Frequency	202.56	
"Bending Power"		

Object slits	2
Width	0.8-1.5
Number of collectors	24
Angle relative to beam	$\frac{\pi}{2} - \frac{\pi}{6}$
Resolution	5-15

CONTROL SYSTEM, LINAC II

Cycle time	0.84s
Computer	PDP 11/45
Memory	128 kWord
Number	2
Configuration	back-up scheme
Data base	64 kWord
Type	core
Process interface	CAMAC
Parallel branch Camac crates	7
Serial branch Camac crates	15
Camac modules	≅ 500
Crate access	via "branch mixer"
Work stations	2 + 1 mobile
Terminals	1
Analogue stations	2
Languages	Basic, Assembler, Fortran, Pascal
NIM crates	54
NIM modules	
Parameters	900
Status information	1700
A/D converters	350
D/A converters	170

RF SYSTEM - LINAC II

Chain	Designation	Amplifier configuration (tube type, output power)				
1	Buncher 1	RS 2024 30kW				
2	Buncher 2 2nd harmonic 405 MHz	RCA 7651 3kW	RCA 4665 22 kW			
3	Buncher 3 Energy corrector	RS 2024 30 kW				
4	Tank I	RS 2024 30 kW	TH 170 0.5 MW	TH170 2.5 MW		
5	Tank II	RCA 7651 5 kW	RS 2024 90 kW	TH 170 0.9 MW	TH 170 2.5 MW	TH 170 2.5 MW
6	Tank III	RCA 7651 5 kW	RS 2024 90 kW	TH 170 0.9 MW	TH 170 2.5 MW	TH 170 2.5 MW
7	Debuncher 11	RCA 7651	RS 2024			
8	Debuncher 12	RCA 7651 5 kW	RS 2024 90 kW			
9	Debuncher 13 Bunch rotator	RCA 7651 5 kW	RS 2024 90 kW			
10	Debuncher 14 2nd harmonic 405 MHz	RCA 7651 3 kW	RCA 5665 22 kW			

P. Tétu / PS

PS/HK/afm 14 June 1983

PS INSTRUMENTATION CONSULTANTS MEETING

Thursday, 16 June, 1983 at 09.00

Large PS Conference Room

Agenda :

1. Organizational matters.
2. Wire scanners for LPI.
3. Current work.
   We will pass around the table to hear the latest news.
4. Miscellaneous.

Note

Please take advantage of the possibility to employ a Spanish technical student for an 18-month period. This is a rare occasion to get help for instrumentation. Those who have not yet heard about this programme: contact C. Germain or L. Ghilardi.

H. Koziol

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