SLAC-R-0173

Catalogue Of High-Energy Accelerators

Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94309

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SLAC-R-173

IXth International Conference on High-Energy Accelerators

CATALOGUE OF HIGH-ENERGY ACCELERATORS

SLAC
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COVER ILLUSTRATIONS

Front: Computer reconstruction of a 10 prong multihadron event in the SPEAR magnetic detector, produced by the annihilation of e^+e^- at 5 GeV in the center of mass. Large rectangles represent shower counter latches, small rectangles-trigger counters. Dots and squares are fiducial points. Coded times of arrival of shower pulse heights are indicated. The axial magnetic field strength is 4 KG.

Back: Axial view of the SPEAR magnetic detector (with iron end caps removed) surrounding the west interaction region vacuum chamber. From the interaction point outward, particles traverse four sets of cylindrical spark chambers, trigger counters, the magnet coil, shower counter, magnet flux return and muon spark chamber planes. The objects in the foreground are the innermost quadrupoles of the storage rings' low beta insertion.

FOREWORD

It has become customary to issue an up-to-date catalogue of the parameters and performance of high-energy accelerators at the time of the International Accelerator Conferences. Accordingly, we have sent out data sheets to the various laboratories, requesting their co-operation in obtaining this information. The forms are identical to those used for the 1971 CERN conference and we thank M. H. Blewett for her kind permission to use them again.

We would like to express our warmest thanks to all those who have returned the filled-out data sheets that include considerable new information.

Unfortunately, sheets for a few of the machines were not returned to us, at least by the publication deadline. Rather than publish out-of-date or incorrect material, we have not included any data for these machines. (They are shown with an asterisk in the Table of Contents.)

In contrast to previous years you will find in this catalogue a new section listing parameters of a few new major projects that are not yet funded. Realizing that such information is at best tentative, reply to our questionnaire was left as an option for the laboratories contacted and is therefore in no way complete. Further, the authors of these pages which were returned wish us to emphasize that their data is subject to change, however we feel that this information may reflect the direction in which the High Energy Accelerator field is currently moving.

G. E. Fischer

Ruth Thor Nelson

CONTENTS

NAME OF MACHINE CERN SPS
INSTITUTION CERN Laboratory II
LOCATION Geneva - Pays de Gex (F)

PERSON IN CHARGE J.B. Adams
DATA SUPPLIED BY G. von Holtey
DATE January 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1971
FIRST BEAM OBTAINED, OR GOAL (date) end of 1976
TOTAL COST OF FACILITY 1150 MSF
FUNDED BY 11 Member States of CERN
TOTAL ACCELERATOR STAFF (now) 360
ANNUAL OPERATING BUDGET -

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 2200 m; Tunnel sect. Ø = 4 m
MAGNET 80 x 44 cm; Mag. Gap 15 x 4.5 cm
"DONUT" 4.5 x 4.5 cm; Aperture 11.0 x 4.3 cm

Injector System

TYPE improved CPS
OUTPUT (max) 10^{13} ppp at 10 to 14 GeV/c
BEAM EMITTANCE (10 GeV/c) H: 2.6π V: 3.3π mm-mrad
INJECTION PERIOD 23 usec, or 1 turns
INFLECTOR TYPE pulsed magnetic kicker

Magnet System

FOCUSING TYPE AG separate function
No. MAG. UNITS 744+216 Length (ea) 6.26/3.085 m
STRAIGHT SECT. 216 Total S.S. Length 1260 m
FOCUSING ORDER FODO
BETATRON OSC. FREQ. ν_H 27.6 ν_V 27.55
FIELD, AT INJ. 450 G, at max 18 kG
RISE TIME 3.4 sec; Flat-top time 0.7 to 2.0 sec
MAG. WEIGHT (tons) Fe 13500, Cu 1400
POWER INPUT (MW) PEAK 135 MEAN 36

Acceleration System

HARMONIC No. 4620 No. Cavities 2
RF RANGE 200.2 MHz
ORBIT FREQ. 43.3 kHz
ENERGY GAIN 3.6 MeV/turn
RADIATION LOSS - keV/turn
RF POWER INPUT (kW) PEAK 1.0 MW

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	400 ± .025	
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)*	0.17 (0.11)	
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)*	12 (22.5)	
INTERNAL BEAM (part/pulse)	10^{13}	
(part/sec) *	$1.7\ 10^{12}$	($1.1\ 10^{12}$)
CURRENT (mA)	69.5	
BEAM EMITTANCE (mm-mrad)	0.2 π	
SCHEDULED OPERATION (hr/wk)	-	

"ON BEAM" - % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA ca 27000 m^2
BEAM LINES TO ____ Stations
STATIONS SERVED AT SAME TIME ____
BEAM SEPARATORS ____ SPECTROMETERS ____
ON-LINE COMPUTERS WITH ____ Inputs
BUBBLE CHAMBERS, in-house ____ Users' ____
TOTAL POWER INSTALLED FOR RESEARCH ____ MW
No. USER GROUPS: in-house ____ outside ____
TOTAL RESEARCH STAFF, in-house ____ outside ____
ANNUAL RESEARCH BUDGET, in-house ____
SCHEDULED RESEARCH TIME, hours/week ____

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

* for 0.7 sec (2.0 sec) flat top.

Published Articles Describing Machine

The 300 GeV Programme, CERN/1050, January 1972.

NAME OF MACHINE: CERN Proton Synchrotron (CPS)
INSTITUTION: European Organization for Nuclear Research
LOCATION: Meyrin, Geneva, Switzerland

PERSON IN CHARGE: G.L. Munday
DATA SUPPLIED BY: O. Barbalat - L. Hoffmann
DATE: February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): 1955
FIRST BEAM OBTAINED, OR GOAL (date): November 24, 1959
TOTAL COST OF FACILITY: 200 MFr. Sw. (1954-1959)
FUNDED BY: CERN Member States
TOTAL ACCELERATOR STAFF (now): 460
ANNUAL OPERATING BUDGET***: 52 MFr. Sw.

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 200 m; Tunnel sect. 6 x 6 m
MAGNET 1.16 x 0.94 m; Mag. Gap 10.0 x 15.0 cm
"DONUT" 7.4 x 15.0 cm; Aperture 7.0 x 14.6 cm

Injector System

TYPE: Linac or Booster
OUTPUT: 50/300 mA at 50/800 MeV
BEAM EMITTANCE: 20 x 20 π / 30 x 12 π mm-mrad
INJECTION PERIOD: 20/2.5 μsec, or 3/1 turns
INFLECTOR TYPE: electrostatic dc and pulsed magnetic kicker or septum and pulsed kicker

Magnet System

FOCUSING TYPE: AG Field Index, n= 288
No. MAG. UNITS: 100 Length (ea): 4.26 m
STRAIGHT SECT.: 100 Total S.S. Length: 188 m
FOCUSING ORDER: FOFDOD
BETATRON OSC. FREQ. ν_H: 6.25 ν_V: 6.25
FIELD, AT INJ.: 147 G, at max: 14 kG
RISE TIME: 0.7-1.0 sec; Flat-top time: 0.5-0.7 sec
MAG. WEIGHT (tons) Fe: 3000, Cu: 130
POWER INPUT (MW) PEAK: 41 MEAN: 2.8

Acceleration System

HARMONIC No.: 20 No. Cavities: 10
RF RANGE: 2.9 to 9.55 MHz
ORBIT FREQ. RANGE: 0.145 to 0.478
ENERGY GAIN: (max) 80
RADIATION LOSS: -- keV/turn
RF POWER INPUT (kW) PEAK: 1000 MEAN: 300

Other Relevant Parameters or Notable Features

*** Including developments, Linac and Booster

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	25	28
RESOLUTION ΔE/E (%)	± 0.05	
REPET. RATE (pulse/sec)	~ 0.5	
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)	20-25	
INTERNAL BEAM (part/pulse)	$1.5 \cdot 2 \cdot 10^{12}$	$5-6 \cdot 10^{12}$ (with Booster)
(part/sec)	10^{12}	$3 \cdot 10^{12}$
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)	1 π	

SCHEDULED OPERATION (hr/wk): 145 (excluding yearly shutdown)
"ON BEAM": 91 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)	
Slow ejected protons	$0.5 \cdot 10^{12}$	0.1	24	1.0	on 3 targets
π^-	$4 \cdot 10^5$	1	6	4	
π^+	$1.2 \cdot 10^6$	2	6	2	
$p^+ \pi^+$	$1.6 \cdot 10^6$	2	15	2	
K^+	$2.4 \cdot 10^4$	3	2.8	1.75	
K^-	$2 \cdot 10^3$				

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA: 20.000 m^2
BEAM LINES TO: 17 + ISR + 3 tests Stations
STATIONS SERVED AT SAME TIME: 10 + ISR + tests
SEPARATED BEAMS: 10 SPECTROMETERS: 10
ON-LINE COMPUTERS: 13
BUBBLE CHAMBERS, in-house: 3 Users':
TOTAL POWER USED FOR RESEARCH: 27 MW (average)
No. USER GROUPS: mixed 15+5** outside 15 + 40** **
TOTAL RESEARCH STAFF*: in-house 190 outside 620 + 500
ANNUAL RESEARCH BUDGET, in-house: 90 MFr. Sw
SCHEDULED RESEARCH TIME, hours/week: 125

** Bubble chamber picture analysis

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

- 800 MeV Booster Injector
- Transformations for use as SPS injector

* For the whole of CERN

PUBLISHED ARTICLES DESCRIBING MACHINE

Regenstreif, E., CERN 59-29, CERN 60-26, CERN 62-3.

Hine, M.G.N., Int. Conf. Instrum. for High Energy Accel., LRL, Sept. 60, 214-222.

Lapostolle, P., Onde électrique 40, 489-504 (1960).

Adams, J.B., Nature 185, 568-72 (1960).

Germain, P., Industries Atomiques 7, 3-10/61-73 (1963).

Reich, K.H., Kerntechnik 3, (8) 345-55 (1961).

Hereward, H.G., Nucl. Instr. Meth. 20, 9-11 (1963).

Standley, P.H., Fourth Int. Conf. High Energy Acc. Dubna 1963, 99-109 (USAEC Conf. 114)

Fifth Int. Conf. High En. Acc. Frascati, 1965, 80-85.

Baconnier et al. Seventh Int. Conf. High En. Acc. Erevan 1969, 565-575.

Baconnier et al. U.S. Nat. Acc. Conf. Chicago 1971.

PS Staff, Ninth Int. Conf. High Energy Accelerators Stanford 1974

PUBLISHED ARTICLES (cont.)

NAME OF MACHINE Booster for the CPS (PSB) PERSON IN CHARGE K.H. Reich
INSTITUTION CERN, European Org. Nucl. Res. DATA SUPPLIED BY H. Koziol, K.H. Reich
LOCATION Meyrin, Geneva, Switzerland DATE 8th March 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) January 1968
FIRST BEAM OBTAINED, OR GOAL (date) May 1972
TOTAL COST OF FACILITY 60 MFr (Swiss)
FUNDED BY CERN Member States
TOTAL ACCELERATOR STAFF (now) 72
ANNUAL OPERATING BUDGET 8 MFr (including develop.)

ACCELERATOR PARAMETERS

Physical Dimensions (Mean) (width x height)
RING DIAM. 50 m; Tunnel sect. 4.05 x 5.15 m
MAGNET 0.7 x 1.52m Gap 24.1 x 7.0 cm
"DONUT" [1] x [1] cm; Aperture [1] x [1] cm

Injector System
TYPE Improved CERN PS Linac
OUTPUT 50 mA at 50 MeV
BEAM EMITTANCE $30\pi \times 30\pi$ (95% of beam) mm-mrad
INJECTION PERIOD 100 μsec, or 4 x 15 turns
INFLECTOR TYPE magnetic (1 for multiturn, 1 for monoturn)

Magnet System [2]
FOCUSING TYPE AG, sep. functions; triplets
No. MAG. UNITS 32 Length (ea) (mag.) 1.618 m
STRAIGHT SECT. [3] Total S.S. Length [3] m
FOCUSING ORDER $\frac{1}{2}$L1, B, L2, F, L3, D, L4, F, L5, B, $\frac{1}{2}$L1
BETATRON OSC. FREQ. ν_H 4 to 5 ν_V 4 to 5.3
FIELD, AT INJ. 1253 G, at max 5.93 kG
RISE TIME 0.60 sec; Flat-top time 0.08 sec
MAG. WEIGHT (tons) Fe 580, Cu 34.6 (B+F+D)
POWER INPUT (MW) PEAK 5.6 [4] MEAN 1.64 [4]

Acceleration System
HARMONIC No. 5 No. Cavities 1 per ring
RF RANGE 2.997 8.033 MHz
ORBIT FREQ. 0.599 1.607 MHz
ENERGY GAIN 1 keV/t
RADIATION LOSS – keV/turn
RF POWER INPUT (kW) PEAK 4 x 7 Mean 4 x 4

Other Relevant Parameters or Notable Features 4 rings stacked on top of each other. Bending magnets and quadrupoles combined to 4-gap units. Linac beam switched to 4 rings by vertical deflector. At 800 MeV the 4 beams are ejected sequentially and combined by vertical bending septum and kicker magnets.

Publications describing machine:
Proc. Int. Accelerator Conferences:
VI (Cambridge): Bovet, Reich (p.315)
VII (Yerevan): Bigliani et al. (p.433)
VIII (Geneva): Bovet et al. (p.102,380)
IX (1974): Baribaud et al.; Reich
Proc. Nat. Accelerator Conference:
4th (Chicago): Asseo et al; Bigliani; Bigliani et al; Brückner; Koziol, Reich; Rufer, Unterlerchner; Sacherer, Sherwood.
5th (San Francisco): Bovet; Baribaud, Metzger; Rabany.

ACCELERATOR PERFORMANCE

(present, at 800 MeV)	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	0.800	
RESOLUTION	$\Delta p/p \pm 1.3 \times 10^{-3}$	
REPET. RATE (pulse/sec)	as CPS, max 0.87	
PULSE WIDTH	4 x 0.622	
DUTY FACTOR, macroscopic (%)	$2.16\ 10^{-4}$ %	
INTERNAL BEAM (part/pulse)	7×10^{12} ppp	
(part/sec)	(goal 1.3×10^{13} ppp)	
CURRENT (mA)	400 mA	
BEAM EMITTANCE (mm-mrad)	H: 28π; V: 13π	
SCHEDULED OPERATION (hr/wk)	1974 : ∿ 3000 h	
"ON BEAM" % OF SCHEDULED TIME		

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
	CPS INJECTOR			

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA ____ m²
BEAM LINES TO ____ Stations
STATIONS SERVED AT SAME TIME ____
BEAM SEPARATORS ____ SPECTROMETERS ____
ON-LINE COMPUTERS WITH ____ Inputs
BUBBLE CHAMBERS, in-house ____ Users' ____
TOTAL POWER INSTALLED FOR RESEARCH ____ MW
No. USER GROUPS: in-house ____ outside ____
TOTAL RESEARCH STAFF, in-house ____ outside ____
ANNUAL RESEARCH BUDGET, in-house ____
SCHEDULED RESEARCH TIME, hours/week ____

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Mobile console in PSB equipment rooms giving full access to central control computer.

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[1]

	section	apert. (und. vac.)
in bend. mag.	13.8x6.8	13.2x6.1
in triplet	13.8x12.4	13.5x12.1
in L1	Ø 12.3	Ø 12.0

[2] Data for quadrupoles

	F	D
number	32	16
magn. length (m)	0.50	0.88
bore radius	0.06	
gradient (T/m)	0.81 (inj)	
	3.83 (max)	

[3] L_1: 16x2.54m; L_2, L_5: 16x0.28m; L_3, L_4: 16x0.59m;

[4] At output of power supply.

Publ. (cont.) Int. Conf. Magnet Technology:
3rd (Hamburg): Asner et al. (p.418)
4th (Brookhaven): Pahud (p.718).

NAME OF MACHINE SATURNE
INSTITUTION C.E.A.
LOCATION SACLAY - FRANCE

PERSON IN CHARGE GOUTTEFANGEAS
DATA SUPPLIED BY
DATE JAN. 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1955
FIRST BEAM OBTAINED, OR GOAL (date) August 1958
TOTAL COST OF FACILITY in 1957 - 82 MF
FUNDED BY C.E.A
TOTAL ACCELERATOR STAFF (now) 102
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 22 m; Tunnel sect. m
MAGNET 1.77 x 2 m; Mag. Gap 17.5 x 52.75 cm
"DONUT" 10.648 cm; Aperture 10.6 x 34 cm

Injector System
TYPE Linac
OUTPUT (max) 40mA at 20 MeV
BEAM EMITTANCE 18 mA in 2,8 π mm-mrad
INJECTION PERIOD 600 μsec, or 550 turns
INFLECTOR TYPE. electrostatic V=100 KV E = 66.6 KV/cm

Magnet System
FOCUSING TYPE Weak
No. MAG. UNITS 4 Length (ea) 13.255 m
STRAIGHT SECT. 4 Total S.S. Length 16 m
FOCUSING ORDER
BETATRON OSC. FREQ. ν_H 0.721 ν_V 0.884
FIELD, AT INJ. 771 G, at max 15 kG
RISE TIME 0.87 sec; Flat-top time 0.5 sec
MAG. WEIGHT (tons) Fe 1x080, Cu 55
POWER INPUT (MW) PEAK 24 MEAN 1

Acceleration System
HARMONIC No. 2 No. Cavities 1
RF RANGE 1.6 8.44 MHz
ORBIT FREQ.
ENERGY GAIN 1.16
RADIATION LOSS keV/turn
RF POWER INPUT (kW) PEAK 36 6

Other Relevant Parameters or Notable Features

acceleration of deutons
5.10^{11} d/pulse at 2,3 GeV

Published Articles Describing Machine
Onde electrique n° 387 (juin 50)

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	3	3
RESOLUTION ΔE/E (%)	3.4	
REPET. RATE (pulse/sec)	0.22 with Flat top	
PULSE WIDTH	0.45	
DUTY FACTOR, macroscopic (%)	9	
INTERNAL BEAM (part/pulse)	$1.2 10^{12}$	$1.6 10^{12}$
(part/sec)	$2.6 10^{12}$	$3.5 10^{11}$
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)	π x 28 / π x 8	
SCHEDULED OPERATION (hr/wk)	130	168

"ON BEAM" 71 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm²)	ENERGY (GeV)	ΔE/E (%)
π+	$.6 \times 10^5$	16	2	2
p	6×10^{10}	25x12 *	3	0.2
p	8×10^{10}	10x15 *	1	0.05
d	4.4×10^{10}		2.7	
α	2×10^9	350x150 *	0.7	
n	$.5 \times 10^7$	28	2 GeV/c	

(* emittance π 10^{-6})

RESEARCH PROGRAM
TOTAL EXPERIMENTAL AREA 3480 m²
BEAM LINES TO 0 Stations
STATIONS SERVED AT SAME TIME 3
BEAM SEPARATORS 0 SPECTROMETERS 2
ON-LINE COMPUTERS WITH 8 Inputs
BUBBLE CHAMBERS, in-house Users'
TOTAL POWER INSTALLED FOR RESEARCH 22 MW
No. USER GROUPS: in-house 2 outside 12
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week 93

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

- acceleration of particles α $1,2\ 10^{11}$ α/pulse at 1.2 GeV/A
- a superconducting quadrupole doublet OGA permits to increase the number of pions by a factor 4
- A renovation of Saturne is being studied. With a new magnet and the same injector, one should obtain 1.10^{12} p/s external in 3 mmmrad at 1 GeV (max. energy 2.7 - 3 GeV)

NAME OF MACHINE 10 GeV Proton Synchrotron
INSTITUTION Nat.Lab.for High Energy Phys.
LOCATION Tsukuba, Japan

PERSON IN CHARGE T. Nishikawa
DATA SUPPLIED BY
DATE March, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) April, 1971
FIRST BEAM OBTAINED, OR GOAL (date) 1975
TOTAL COST OF FACILITY 4×10^9 Yen
FUNDED BY Japanese Government
TOTAL ACCELERATOR STAFF (now) 65
ANNUAL OPERATING BUDGET 5×10^8 Yen

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 108 m; Tunnel sect. 4.0 x 4.7 m
MAGNET 85 x 70 m; Mag. Gap 5.6 x 14 cm
"DONUT" 5.0 x 14 cm; Aperture 5.0 x 14 cm

Injector System
TYPE 20 MeV Linac + 500 MeV Booster
OUTPUT (max) 1.6×10^{-3} at 500 MeV
BEAM EMITTANCE 75π(H) x 10π(V) mm-mrad
INJECTION PERIOD 5×10^5 μsec, or 9 turns
INFLECTOR TYPE magnetic

Magnet System
FOCUSING TYPE AG separated function
No. MAG. UNITS 48(bng) Length (ea) 3.2 (bng) m
STRAIGHT SECT. 4(long) Total S.S. Length 48.4(ℓ) m
FOCUSING ORDER FODO
BETATRON OSC. FREQ. ν_H 7.25 ν_V 7.25
FIELD, AT INJ. 1.5 kG, at max 13 (17.5) kG
RISE TIME 0.5(0.85) sec; Flat-top time 0.5 sec
MAG. WEIGHT (tons) Fe 680, Cu 30
POWER INPUT (MW) PEAK 13(25) MEAN 4.5(8.6)

Acceleration System
HARMONIC No. 9 No. Cavities 3
RF RANGE 6.0 to 7.9 MHz
ORBIT FREQ. 0.67 to 0.88
ENERGY GAIN 12.6
RADIATION LOSS 19.6 (16.7) keV/turn
RF POWER INPUT (kW) PEAK 46 mean 26.5

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	8(12)	
RESOLUTION ΔE/E (%)	0.2(0.1)	
REPET. RATE (pulse/sec)	1/2	
PULSE WIDTH	0.4	
DUTY FACTOR, macroscopic (%)	25	
INTERNAL BEAM (part/pulse)	$>2 \times 10^{12}$	(10^{13})
(part/sec)	$>10^{12}$	(5×10^{12})
CURRENT (mA)	>280	(1415)
BEAM EMITTANCE (mm-mrad)	$13\pi \times 1.7\pi$	$(9\pi \times 1.2\pi)$
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 3500 m^2
BEAM LINES TO 3 Stations
STATIONS SERVED AT SAME TIME
BEAM SEPARATORS 3 SPECTROMETERS 2
ON-LINE COMPUTERS WITH 2 Inputs
BUBBLE CHAMBERS, in-house 1 Users'
TOTAL POWER INSTALLED FOR RESEARCH 11 MW
No. USER GROUPS: in-house 3 outside 9
TOTAL RESEARCH STAFF, in-house 25 outside 60
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

NAME OF MACHINE: Booster Synchrotron for 10-GeV PS
INSTITUTION: Nat.Lab.for High Energy Phys.
LOCATION: Tsukuba, Japan

PERSON IN CHARGE: T. Nishikawa
DATA SUPPLIED BY: T. Nishikawa
DATE: March, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): April, 1971
FIRST BEAM OBTAINED, OR GOAL (date): 1974
TOTAL COST OF FACILITY:
FUNDED BY: Japanese Government
TOTAL ACCELERATOR STAFF (now): 10
ANNUAL OPERATING BUDGET:

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 6 m; Tunnel sect. ____ ____ m
MAGNET 0.7 × 0.8 m; Mag. Gap 7.2 × 14.0 cm
"DONUT 7.0 × 16.0 m; Aperture 5.6 × 14.0 cm

Injector System

TYPE: Linac
OUTPUT (max) 100 mA at 20 MeV
BEAM EMITTANCE 10π (norm.) mm-mrad
INJECTION PERIOD 5.5 usec, or 9 turns
INFLECTOR TYPE: magnetic

Magnet System

FOCUSING TYPE: combined function
No. MAG. UNITS 8 Length (ea) 2.6 m
STRAIGHT SECT. 8 Total S.S. Length 17 m
FOCUSING ORDER: FDDFO
BETATRON OSC. FREQ. ν_H 2.25 ν_V 2.25
FIELD, AT INJ. 1.97 G, at max 11.0 kG
RISE TIME 0.025 sec; Flat-top time – sec
MAG. WEIGHT (tons) Fe 88.1, Cu 6.57
POWER INPUT (MW) PEAK ____ MEAN 0.5

Acceleration System

HARMONIC No. 1 No. Cavities 1
RF RANGE 1.616 to 6.027 MHz
ORBIT FREQ. 1.616 to 6.027
ENERGY GAIN max. 7
RADIATION LOSS ____ keV/turn
RF POWER INPUT (kW) PEAK 60 mean 40

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	0.5	
RESOLUTION ΔE/E (%)	0.3	
REPET. RATE (pulse/sec)	20	
PULSE WIDTH	0.06 μs	
DUTY FACTOR, macroscopic (%)	1.2×10^{-6}	
INTERNAL BEAM (part/pulse)	0.5×10^{12}	(2×10^{12})
(part/sec)	1×10^{13}	(4×10^{13})
CURRENT (mA)	480 (1900)	
BEAM EMITTANCE (mm-mrad)	75π(H)×10π(V)	
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" ____ % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA ____ m^2
BEAM LINES TO ____ Stations
STATIONS SERVED AT SAME TIME ____
BEAM SEPARATORS ____ SPECTROMETERS ____
ON-LINE COMPUTERS WITH ____ Inputs
BUBBLE CHAMBERS, in-house ____ Users' ____
TOTAL POWER INSTALLED FOR RESEARCH ____ MW
No. USER GROUPS: in-house ____ outside ____
TOTAL RESEARCH STAFF, in-house ____ outside ____
ANNUAL RESEARCH BUDGET, in-house ____
SCHEDULED RESEARCH TIME, hours/week ____

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

NAME OF MACHINE NIMROD
INSTITUTION RUTHERFORD LABORATORY
LOCATION CHILTON, DIDCOT, BERKS., UK

PERSON IN CHARGE D A GRAY
DATA SUPPLIED BY D A GRAY
DATE January 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1957
FIRST BEAM OBTAINED, OR GOAL (date) August 1963
TOTAL COST OF FACILITY £10M to first operation
FUNDED BY Science Research Council
TOTAL ACCELERATOR STAFF (now) 330 incldg expl area
ANNUAL OPERATING BUDGET ~ £8M (Lab. total)

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 53.27 m; ~~x~~ Machine Room 61 x 9 m
MAGNET 3.15 x 2.74 m; Mag. Gap 116 x 28.4 cm
"DONUT" x cm; Aperture 100 x 20 cm

Injector System
TYPE Alvarez linac
OUTPUT (max) 45 at 14.9
BEAM EMITTANCE At 18 mA 100% in 50 mm-mrad
INJECTION PERIOD 350 μsec, or 120 turns
INFLECTOR TYPE Electrostatic

Magnet System
FOCUSING TYPE Weak n = 0.6
No. MAG. UNITS 8 Length (ea) 14.751 m
STRAIGHT SECT. 8 Total S.S. Length 30.44 m
FOCUSING ORDER -
BETATRON OSC. FREQ. ν_H 0.71 ν_V 0.87
FIELD, AT INJ. 299 G, at max 14.2 kG
RISE TIME 0.75 sec; Flat-top time Up to 0.95 sec
MAG. WEIGHT (tons) Fe 7,000, Cu 250
POWER INPUT (MW) PEAK 160 MEAN 2.5

Acceleration System
HARMONIC No. 4 No. Cavities 1 unit 2 gaps
RF RANGE 1.416 7.980 MHz
ORBIT FREQ. .354 to 1.995 MHz
ENERGY GAIN 5.5 keV/turn
RADIATION LOSS Negligible keV/turn
RF POWER INPUT (kW) PEAK 45 Mean 20

Other Relevant Parameters or Notable Features

a) Vacuum vessel is double glass-epoxy laminate system.

b) Magnet is C-type, with field correction using 'crenellations'.

Published Articles Describing Machine

i) Nimrod - A 7 GeV proton synchrotron. Ruth. Lab. Report NIRL/R/44 (1965).

ii) The work of the Rutherford Laboratory 1972. Ruth. Lab. Report RHEL/R270 (1973).

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	7.1	8.0
RESOLUTION ΔE/E (%)	0.015	
REPET. RATE (pulse/sec)	22	
PULSE WIDTH (ms)	450	
DUTY FACTOR, macroscopic (%)	20	
INTERNAL BEAM (part/pulse)	3×10^{12}	4.2×10^{12} *
(part/sec)	1.1×10^{12}	1.7×10^{12}
CURRENT (mA)	-	-
BEAM EMITTANCE (mm-mrad)		
SCHEDULED OPERATION (hr/wk)	120 average for research and machine development.	

"ON BEAM" 88 % OF SCHEDULED TIME for research.

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	Momentum ENERGY (GeV)	ΔE/E (%)	
p	4.5×10^{11}	0.1	7.8	0.7	Extracted beam.
π^-, π^+	5×10^5		1-4	2-10	
π^-	4×10^7	6	0.2	10	
K^+	3×10^3		1.0-2.0	2	
K^-	6×10^3 (K^-)		0.4-1.0	6	

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 7300 m²
BEAM LINES TO 9 Stations
STATIONS SERVED AT SAME TIME 9
BEAM SEPARATORS - SPECTROMETERS -
ON-LINE COMPUTERS WITH - Inputs
BUBBLE CHAMBERS, in-house 0 Users' -
TOTAL POWER INSTALLED FOR RESEARCH 24 MW
No. USER GROUPS: in-house 4 outside 12
TOTAL RESEARCH STAFF, in-house 39 outside 141
ANNUAL RESEARCH BUDGET, in-house -
SCHEDULED RESEARCH TIME, hours/week 94 average in 1973

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

*
1) Second-harmonic cavity commissioned in 1973 gave 40% increase.
Characteristic of cavity:
Harmonic No.8. Drift tube acceleration.
RF Voltage 8 kV peak.
RF power kW 21 peak 12 mean.

2) New 70 MeV injector being built ready for 1975. Should give x 5 beam.

NAME OF MACHINE Zero Gradient Synchrotron
INSTITUTION Argonne National Laboratory
LOCATION Argonne, Illinois USA

PERSON IN CHARGE Ronald L. Martin
DATA SUPPLIED BY Ronald L. Martin
DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) June 1959
FIRST BEAM OBTAINED, OR GOAL (date) Sept. 1963
TOTAL COST OF FACILITY $50 M
FUNDED BY US AEC
TOTAL ACCELERATOR STAFF (now) 230
ANNUAL OPERATING BUDGET $10.5 M

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 54.7 m; Tunnel sect. 12.7 x 10.4 m
MAGNET 1.4 x 2.6 m; Mag. Gap 14.6 x 136.5 cm
"DONUT" 14.6 x 82.2 cm; Aperture 13.3 x 81.3 cm

Injector System
TYPE Linac
OUTPUT (max) 40 mA at 50 MeV
BEAM EMITTANCE 25 π mm-mrad
INJECTION PERIOD 100 μsec, or 60 turns
INFLECTOR TYPE dc magnetic

Magnet System
FOCUSING TYPE weak field index, n = 0 (wedge foc)
No. MAG. UNITS 8 Length (ea) 16.3 m
STRAIGHT SECT. 8 Total S.S. Length 41.45 m
FOCUSING ORDER
BETATRON OSC. FREQ. ν_H 0.83 ν_V 0.81 (at inj)
FIELD, AT INJ. 482 G, at max 21.5 kG
RISE TIME 0.85 sec; Flat-top time 0-1 sec
MAG. WEIGHT (tons) Fe 4700, Cu 68
POWER INPUT (MW) PEAK 110 MEAN 10

Acceleration System
HARMONIC No. 8 No. Cavities 1 (3 gaps)
RF RANGE 4.4 to 14.0 MHz
ORBIT FREQ. 0.55 to 1.75 MHz
ENERGY GAIN 10 keV/turn
RADIATION LOSS keV/turn
RF POWER INPUT (kW) PEAK 60 Mean 30

Other Relevant Parameters or Notable Features

Only high energy synchrotron using wedge focusing

ACCELERATOR PERFORMANCE

	Normal (~~or Goal~~)	Maximum Achieved
ENERGY (GeV)	12.0	12.7
RESOLUTION ΔE/E (%)	±0.01	±0.01
REPET. RATE (pulse/sec)	0.30	0.5
PULSE WIDTH (sec)	0.70	1.0 (max flattop)
DUTY FACTOR, macroscopic (%)	20	20
INTERNAL BEAM (part/pulse) $\times 10^{12}$	2.5	3.8
(part/sec) $\times 10^{12}$	0.8	1.5
CURRENT (mA)	700	1000
BEAM EMITTANCE (mm-mrad) (int)	25 π	150 π
SCHEDULED OPERATION (hr/wk)	80	135 ave for year

"ON BEAM" 90 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
π	10^5	1	0.5-8	±(0.75-2)
K	10^3	1	0.5-6	±2
K^0	2×10^5	200	0.2-2.5	
n	10^6	6	2-11	

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 13000 m^2
BEAM LINES TO 17 Stations
STATIONS SERVED AT SAME TIME 13 peak, 7 average
BEAM SEPARATORS 4 SPECTROMETERS 1
ON-LINE COMPUTERS WITH 5 Inputs
BUBBLE CHAMBERS, in-house 1 Users' 0 (1 streamer chamber)
TOTAL POWER INSTALLED FOR RESEARCH 30 MW
No. USER GROUPS: in-house 5 outside 30
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house $3.5 M
SCHEDULED RESEARCH TIME, hours/week 120 ave.

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

2 simultaneous external beams
Resonant Extraction - 90% (40 μsec - 700 msec)
Titanium vacuum chamber installed 1972
Polarized protons to 8.5 GeV/c 1973
70% polarization - 5 x 10^8/pulse internal
200 MeV injection from booster 1974

Published Articles Describing Machine

L.C. Teng, "Status of the Argonne 12.5-BeV Zero Gradient Synchrotron," Dubna - 1963 Proceedings, pp. 223-232.

NAME OF MACHINE ZGS Booster Synchrotron I
INSTITUTION Argonne National Laboratory
LOCATION Argonne, Illinois USA

PERSON IN CHARGE Ronald L. Martin
DATA SUPPLIED BY James D. Simpson
DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) Former 2.2 GeV Cornell Electron Syn.
FIRST BEAM OBTAINED, OR GOAL (date) October 1971
TOTAL COST OF FACILITY
FUNDED BY US AEC (Development and AI)
TOTAL ACCELERATOR STAFF (now) 8
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 12 m; Tunnel sect. ____ ____ m
MAGNET 0.40 x 0.55 m; Mag. Gap 3.5 x 10.0 cm
"DONUT" 2.5 x 8.0 cm; Aperture 2.8 x 6.4 cm

Injector System

TYPE Linac (H^- Ion)
OUTPUT (max) 5 mA at 50 MeV
BEAM EMITTANCE 25 mm-mrad
INJECTION PERIOD 200 μsec, or 300 turns
INFLECTOR TYPE None. Strips H^- to H^+ after injection.

Magnet System

FOCUSING TYPE AG field index, n = 26.1
No. MAG. UNITS 12 Length (ea) 3.16 m
STRAIGHT SECT. ____ Total S.S. Length 13.2 m
FOCUSING ORDER ODFO
BETATRON OSC. FREQ. ν_H 3.375 ν_V 3.375
FIELD, AT INJ. 1.7 kG, at max 3.5 kG
RISE TIME 16 m sec; Flat-top time ____ sec
MAG. WEIGHT (tons) Fe 60, Cu 2.7
POWER INPUT (MW) PEAK ____ MEAN 0.15

Acceleration System

HARMONIC No. 1 No. Cavities 1
RF RANGE 1.8 to 3.3 MHz
ORBIT FREQ. ____ ____
ENERGY GAIN 5.5 (max)
RADIATION LOSS ____ keV/turn
RF POWER INPUT (kW) PEAK 50 ____

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	0.2	0.2
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)	30	
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)		
INTERNAL BEAM (part/pulse)	10^{12}	1.5×10^{11} (accel)
(part/sec)		
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)	5.0 π	
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" ____ % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA ____ m^2
BEAM LINES TO ____ Stations
STATIONS SERVED AT SAME TIME ____
BEAM SEPARATORS ____ SPECTROMETERS ____
ON-LINE COMPUTERS WITH ____ Inputs
BUBBLE CHAMBERS, in-house ____ Users' ____
TOTAL POWER INSTALLED FOR RESEARCH ____ MW
No. USER GROUPS: in-house ____ outside ____
TOTAL RESEARCH STAFF, in-house ____ outside ____
ANNUAL RESEARCH BUDGET, in-house ____
SCHEDULED RESEARCH TIME, hours/week ____

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

R. L. Martin, Proceedings 1971 Particle Accelerator Conference, Chicago, Illinois, "The Argonne ZGS Booster," p. 957.

NAME OF MACHINE ZGS Booster Synchrotron II
INSTITUTION Argonne National Laboratory
LOCATION Argonne, Illinois USA

PERSON IN CHARGE Ronald L. Martin
DATA SUPPLIED BY James D. Simpson
DATE February 1974

HISTORY AND STATUS Procurement begun

CONSTRUCTION STARTED (date) February 1974
FIRST BEAM OBTAINED, OR GOAL (date) January 1976
TOTAL COST OF FACILITY
FUNDED BY US AEC (AI)
TOTAL ACCELERATOR STAFF (now) 8
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 13.7 m; Tunnel sect. ____ × ____ m
MAGNET ____ × ____ m; Mag. Gap 3.1 × 10 cm
"DONUT" ____ × ____ cm; Aperture ____ × ____ cm

Injector System

TYPE Linac (H^- Ion)
OUTPUT (max) 5 mA at 50 MeV
BEAM EMITTANCE 2.5 mm-mrad
INJECTION PERIOD 250 μsec, or 400 turns
INFLECTOR TYPE None. Strips H^- to H^+ after injection.

Magnet System

FOCUSING TYPE AG
No. MAG. UNITS ____ Length (ea) ____ m
STRAIGHT SECT. ____ Total S.S. Length 19.8 m
FOCUSING ORDER FDFODO
BETATRON OSC. FREQ. ν_H 2.2 ν_V 2.32
FIELD, AT INJ. 2.8 kG, at max 10 kG
RISE TIME 16 m sec; Flat-top time ____ sec
MAG. WEIGHT (tons) Fe ____, Cu ____
POWER INPUT (MW) PEAK ____ MEAN ____

Acceleration System

HARMONIC No. 1 No. Cavities 2
RF RANGE 2.2 to 5.3 MHz
ORBIT FREQ. ____ ____
ENERGY GAIN 10 keV/turn (max)
RADIATION LOSS ____ keV/turn
RF POWER INPUT (kW) PEAK 80 ____

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	0.5	
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)	60	
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)		
INTERNAL BEAM (part/pulse)	5×10^{12}	
(part/sec)		
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)		
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" ____ % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA ____ m^2
BEAM LINES TO ____ Stations
STATIONS SERVED AT SAME TIME ____
BEAM SEPARATORS ____ SPECTROMETERS ____
ON-LINE COMPUTERS WITH ____ Inputs
BUBBLE CHAMBERS, in-house ____ Users' ____
TOTAL POWER INSTALLED FOR RESEARCH ____ MW
No. USER GROUPS: in-house ____ outside ____
TOTAL RESEARCH STAFF, in-house ____ outside ____
ANNUAL RESEARCH BUDGET, in-house ____
SCHEDULED RESEARCH TIME, hours/week ____

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

NAME OF MACHINE: Alternating Gradient Synchrotron
INSTITUTION: Brookhaven National Laboratory
LOCATION: Upton, New York
PERSON IN CHARGE: R.R. Rau
DATA SUPPLIED BY: A. van Steenbergen
DATE: January 28, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): 1953
FIRST BEAM OBTAINED, OR GOAL (date): July 29, 1960
TOTAL COST OF FACILITY: $30.65 M
FUNDED BY: USA-AEC
TOTAL ACCELERATOR STAFF (now): 538
ANNUAL OPERATING BUDGET: $17 M

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 256.9 m; Tunnel sect. 5.49 x 5.49 m
MAGNET 0.84, 0.99 m; Mag. Gap 5.67 x 31.75 cm
"DONUT 7.9 x 17.4 cm; Aperture 6.35 x 13.33 cm

Injector System
TYPE: Alvarez Linear Accelerator
OUTPUT (max) 100 at 200.3
BEAM EMITTANCE 10 π mm-mrad
INJECTION PERIOD ≤150 μsec, or ≤ 30 turns
INFLECTOR TYPE: pulsed magnetic

Magnet System
FOCUSING TYPE: AG
No. MAG. UNITS 240 Length (ea) 2.28, 1.90, resp. m
STRAIGHT SECT. * Total S.S. Length 270 m
FOCUSING ORDER: (F/2)o(F/2)(D/2)o(D/2)
BETATRON OSC. FREQ. ν_H 8.75 ν_V 8.75
FIELD, AT INJ. 251 G, at max 13.1 kG
RISE TIME 0.45 sec; Flat-top time 1.0 sec
MAG. WEIGHT (tons) Fe 4000, Cu 400
POWER INPUT (MW) PEAK 30 MEAN 2.4

Acceleration System
HARMONIC No. 12 No. Cavities 12 double
RF RANGE 2.52 4.46 MHz
ORBIT FREQ. 0.210 0.380
ENERGY GAIN 192
RADIATION LOSS - keV/turn
RF POWER INPUT (kW) PEAK 1000

Other Relevant Parameters or Notable Features

* 24 x 3 m; 72 x 1.5 m; 144 x 0.6 m

Published Articles Describing Machine

G.K. Green, E.D. Courant, "The Proton Synchrotron," Handbuck der Physik 44, 218-340 (1959).

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)		33
RESOLUTION ΔE/E (%)		0.1
REPET. RATE (pulse/sec)		0.5
PULSE WIDTH		1.2 sec flat top
DUTY FACTOR, macroscopic (%)		50
INTERNAL BEAM (part/pulse)	$6\ 10^{12}$	$>9\ 10^{12}$
(part/sec)	$2.5\ 10^{12}$	$4.5\ 10^{12}$
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)	0.8 π	x 3.0 π
SCHEDULED OPERATION (hr/wk)	(6d/7d)	

"ON BEAM" 100 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)		ENERGY (GeV)	ΔE/E (%)
FEB, Protons	$6\ 10^{12}$		28	0.2
SEB, Protons	$4\ 10^{12}$		28	0.2
K^+, K^-	$10^5, 4\ 10^4$		3	± 2
K^+, K^-	$3\ 10^5, 10^5$		1	± 1.5
π^-	10^6		20	± 2
$\bar{p}$	10^5		3	± 2
n	$3\ 10^7$			
K_o	10^6		3-20	

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 15000 m²
BEAM LINES TO 10 Stations
STATIONS SERVED AT SAME TIME 6
BEAM SEPARATORS 12 SPECTROMETERS 6
ON-LINE COMPUTERS WITH 2 Inputs
BUBBLE CHAMBERS, in-house 2 Users' 0
TOTAL POWER INSTALLED FOR RESEARCH 54 MW
No. USER GROUPS: in-house 5 outside 63 involved
TOTAL RESEARCH STAFF, in-house 138 outside -
ANNUAL RESEARCH BUDGET, in-house $5.0 M
SCHEDULED RESEARCH TIME, hours/~~week~~ 4 weeks ≅ 500 hrs.

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

50-MeV Linac injector replaced by 200-MeV Linac. New magnet system power supply and rf system for doubling repetition rate. New ring vacuum system. Magnet system modularized. New external beam branches, SEB system. Addition of third FEB system for υ physics area.

NAME OF MACHINE Bevatron
INSTITUTION Lawrence Berkeley Laboratory
LOCATION Univ. of Calif., Berkeley, Calif.

PERSON IN CHARGE Edward J. Lofgren
DATA SUPPLIED BY Kenneth C. Crebbin
DATE February, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1949
FIRST BEAM OBTAINED, OR GOAL (date) Feb. 1954
TOTAL COST OF FACILITY $31 M
FUNDED BY USAEC
TOTAL ACCELERATOR STAFF (now) 135
ANNUAL OPERATING BUDGET ∿$5.4 M

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 38.23 m; Tunnel sect. -- -- m
MAGNET 6.1x2.75 m; Mag. Gap 152 × 30 cm
"DONUT" -- x -- cm; Aperture 112 × 25 cm

Injector System

TYPE Cockroft-Walton and Linac
** OUTPUT (max) 25 (*) mA at 19.2(4.8/Amu) MeV
BEAM EMITTANCE 25 mm-mrad
INJECTION PERIOD 600 μsec, or 300 turns
INFLECTOR TYPE 3 Magnet Achromatic + E.S

Magnet System

FOCUSING TYPE Weak Field index n=0.67
No. MAG. UNITS 144 Length (ea) 0.66 m
STRAIGHT SECT. 4 Total S.S. Length 6.1 m
FOCUSING ORDER -----
BETATRON OSC. FREQ. ν_H 0.647 ν_V 0.922
FIELD, AT INJ. 417 G, at max 15.53 kG
RISE TIME 1.7 sec; Flat-top time 0.3 → 2.0 sec
MAG. WEIGHT (tons) Fe 9700, Cu 347
POWER INPUT (MW) PEAK 121 MEAN 6.0

Acceleration System

HARMONIC No. 1 No. Cavities 1 (2 gaps)
RF RANGE 0.24 2.50 MHz
ORBIT FREQ. .497 (.252) to 2.47 (2.41) MHz
ENERGY GAIN 1.5 (0.75) KeV/turn
RADIATION LOSS ------- keV/turn
RF POWER INPUT (kW) PEAK 72 DC ----

( ) Values for 1 Amu others for protons

Other Relevant Parameters or Notable Features

** Four injector systems. See appropriate one for more details.

Published Articles Describing Machine

1) F.G.H. Lothrop, D.M. Evans, Digital Control of Bevatron Accel. Cycle, Vol. NS-18 Number 3, June 1971.
2) D.M. Evans, et al, Bevatron Guide Field Control, Vol. NS-18 Number 3, June 1971.
3) R.A. Byrns, J.T. Tanabe, The Bevatron Cryopump, Vol. NS-20 Number 3, June 1973.
4) K.C. Crebbin et al, First Phase of Heavy Ion Acceleration at the Bevatron, Vol. NS-20 Number 3, June 1973.

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	5.4-6.1	6.2 (2.75/Amu)
RESOLUTION ΔE/E (%)	∿0.02	∿0.03
REPET. RATE (pulse/sec)	∿0.2	0.29
PULSE WIDTH	1.5 sec at 5.4 GeV	
DUTY FACTOR, macroscopic (%)	25	----
INTERNAL BEAM (part/pulse)	4×10^{12}	6.0×10^{12}
(part/sec)	0.75×10^{12}	1.5×10^{12}
CURRENT (mA)	1.9×10^{3}	2.4×10^{3}
BEAM EMITTANCE (mm-mrad)	∿330 radial	
SCHEDULED OPERATION (hr/wk)	158	----

"ON BEAM" 87 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	* FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
P	4.5×10^{11}	0.18	6.2	∿0.03
^{2}H	$\sim3.8\times10^{10}$	Minimum	5.5	∿.02
^{4}He	$\sim3.8\times10^{9}$	at	11.0	∿.02
^{12}C	$\sim1.9\times10^{7}$	Peak	33.0	∿.02
^{14}N	$\sim1.0\times10^{7}$	Field	38.5	∿.02
^{16}O	$\sim3.8\times10^{6}$		44.0	∿.02
^{20}Ne	$\sim1.9\times10^{4}$		55.0	∿.02

*These values for the 19.2(4.8/Amu) injector.

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA ∿7000 m²
BEAM LINES TO 5 Prim (6 sec from 2 Prim) Stations
STATIONS SERVED AT SAME TIME 3 prim + 6 sec.
BEAM SEPARATORS 11 SPECTROMETERS ---
ON-LINE COMPUTERS 3-PDP-5; 2-PDP-8; 1-PDP-9; 2-PDP-11
BUBBLE CHAMBERS, in-house 0 Users' 0
TOTAL POWER INSTALLED FOR RESEARCH 21 MW
No. USER GROUPS: in-house 10 outside 22
TOTAL RESEARCH STAFF, in-house ---- outside ----
ANNUAL RESEARCH BUDGET, in-house ----
SCHEDULED RESEARCH TIME, hours/week ∿142

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Installation of cryogenic vacuum pumping reduced base pressure to ∿3×10^{-7} Torr from 2×10^{-6} Torr and reduced pumpdown time required to reach full beam intensity.

With the completion of the Bevalac project, there will be three different injectors available for the Bevatron.

NAME OF MACHINE 200/500 GeV Synchrotron
INSTITUTION National Accelerator Lab.
LOCATION Batavia, Illinois U.S.A.

PERSON IN CHARGE P. J. Reardon
DATA SUPPLIED BY F. T. Cole/H. L. Allen
DATE March 1, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1969
FIRST BEAM OBTAINED, OR GOAL (date) March 1, 1972
TOTAL COST OF FACILITY $230M
FUNDED BY USAEC
TOTAL ACCELERATOR STAFF (now) 275
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 2000 m; Tunnel sect. 3.05 × 2.44 m
MAGNET 0.64x0.33 m; Mag. Gap 13 × 5.2 cm
"DONUT" 12.7,5.2 cm; Aperture 12.5 × 5 cm

Injector System

TYPE 8-GeV Booster
OUTPUT (max) 350 at 8-GeV
BEAM EMITTANCE 3π mm-mrad
INJECTION PERIOD twelve 1.6 μsec pulses in 0.8 sec. μsec, or turns
INFLECTOR TYPE Electromagnetic

Magnet System

FOCUSING TYPE AG field index, n = sep fn
No. MAG. UNITS 1014 Length (ea) 6.1 m
STRAIGHT SECT. 50.9 Total S.S. Length 305.4 m
FOCUSING ORDER Q OBBBB Q OBBBB(FODO)
BETATRON OSC. FREQ. ν_H 19.25 ν_V 19.25 (300 GeV)
FIELD, AT INJ. 396 G, at max 13.5 kG (300 GeV)
RISE TIME 2.4 sec; Flat-top time 1 sec
MAG. WEIGHT (tons) Fe 9000, Cu 850
POWER INPUT (MW) PEAK 60 MEAN 36

Acceleration System

HARMONIC No. 1113 No. Cavities 15
RF RANGE 53.08 53.10 MHz
ORBIT FREQ. 0.04769 to 0.04771
ENERGY GAIN 2.6 MeV/turn
RADIATION LOSS - keV/turn
RF POWER INPUT (kW) PEAK 1800 800

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	300	400
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)	1/6	(1/12 at 400 GeV
PULSE WIDTH	1 sec	1/4 at 200 GeV 1 sec at 300 GeV
DUTY FACTOR, macroscopic (%)	16%	25% at 200 GeV
INTERNAL BEAM (part/pulse)	5×10^{12}	7×10^{12} at 300 GeV
(part/sec)	10^{12}	10^{12}
CURRENT (mA)	0.8	1.0
BEAM EMITTANCE (mm-mrad)	0.1π	0.1π
SCHEDULED OPERATION (hr/wk)	140 (overall average)	

"ON BEAM" 60 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
π, K	10^7 @ 150	up to 200	0.1 - 2.1	
π, K	10^7 @ 100	up to 200	0.014 - 1.0	
n	$10^8/cm^2$	up to 300		
K^o	$10^6/cm^2$	up to 300		
ν	$10^6/m^2$	up to 200	5	
μ	10^6 @ 150	up to 150	2	
p	Extracted protons	100 - 400		

* Approx. flux per 10^{13} interacting protons @ 300 GeV

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 10,500 m^2
BEAM LINES TO 6 Primary Targets plus 2 Internal Targets Stations
STATIONS SERVED AT SAME TIME 7
BEAM SEPARATORS 0 SPECTROMETERS 4
ON-LINE COMPUTERS WITH 20 Inputs
BUBBLE CHAMBERS, in-house 2 Users' 0
TOTAL POWER INSTALLED FOR RESEARCH 35 MW
No. USER GROUPS: in-house 15 outside 100
TOTAL RESEARCH STAFF, in-house 60 outside 1000
ANNUAL RESEARCH BUDGET, in-house $5M
SCHEDULED RESEARCH TIME, hours/week 120

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

1. Operating results from NAL, D. E. Young, National Accelerator Conference, IEEE Transactions NS-203, p. 191, (1973).

NAME OF MACHINE Booster Synchrotron PERSON IN CHARGE P. J. Reardon
INSTITUTION National Accelerator Lab. DATA SUPPLIED BY E. L. Hubbard
LOCATION Batavia, Illinois, U.S.A. DATE March 1, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1969
FIRST BEAM OBTAINED, OR GOAL (date) 1971
TOTAL COST OF FACILITY $17,000,000
FUNDED BY USAEC
TOTAL ACCELERATOR STAFF (now) (Part of NAL
ANNUAL OPERATING BUDGET Accelerator Div.)

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 151 m; Tunnel sect. 3.0 2.4 m
MAGNET 46 x 33 m; Mag. Gap 15.2 x 5.7 cm
"DONUT" none cm; Aperture 16.5 x 4.2 cm

Injector System
TYPE Linear Accelerator
OUTPUT (max) 80 mA at 203 MeV
BEAM EMITTANCE 10 π mm-mrad
INJECTION PERIOD 8 usec, or 3 turns
INFLECTOR TYPE Wire Septum

Magnet System
FOCUSING TYPE Alternating Gradient
No. MAG. UNITS 96 Length (ea) 3.04 m
STRAIGHT SECT. 24 Total S.S. Length 144 m
FOCUSING ORDER FOFDOOD
BETATRON OSC. FREQ. ν_H 6.72 ν_V 6.78
FIELD, AT INJ. 490 G, at max 6.7 kG
RISE TIME .033 sec; Flat-top time none sec
MAG. WEIGHT (tons) Fe 250, Cu 36
POWER INPUT (MW) PEAK 1.8 MEAN 1.3

Acceleration System
HARMONIC No. 84 No. Cavities 16
RF RANGE 30.3 52.8 MHz
ORBIT FREQ. 0.36 0.63 k Hz
ENERGY GAIN 600 keV/turn max
RADIATION LOSS keV/turn
RF POWER INPUT (kW) PEAK 880

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	8	8
RESOLUTION $\Delta E/E$ (%)	0.1	
REPET. RATE (pulse/sec)	15	15
PULSE WIDTH (μsec)	1.6	1.6
DUTY FACTOR, macroscopic (%)		
INTERNAL BEAM (part/pulse)	(4×10^{12})	1×10^{12}
Part/main-ring cycle	(5×10^{13})	1×10^{13}
CURRENT (mA)	380	100
BEAM EMITTANCE (mm-mrad)	6.5π	
SCHEDULED OPERATION (hr/wk)	164	164

"ON BEAM" 95 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX	BEAM AREA (cm^2)	ENERGY (GeV)	$\Delta E/E$ (%)
p	1×10^{13}	0.3	8	
(Particles/main-ring cycle - main-ring cycle time varies from 3 to 12 sec.)				

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA none m^2
BEAM LINES TO Stations
STATIONS SERVED AT SAME TIME
BEAM SEPARATORS SPECTROMETERS
ON-LINE COMPUTERS WITH Inputs
BUBBLE CHAMBERS, in-house Users'
TOTAL POWER INSTALLED FOR RESEARCH MW
No. USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

1. Booster Synchrotron, E. L. Hubbard, ed., National Accelerator Lab. Report TM-405 (1973)

2. The NAL Booster Synchrotron Magnet Power Supply Servo, A. R. Donaldson and R. A. Winje, National Accelerator Conference, IEEE Transactions NS-20, 3, p. 409, (1973)

3. Synchronous Transfer of Beam from the NAL Fast Cycling Booster Synchrotron to the NAL Main Ring System, J. A. Dinkel, J. E. Griffin, E. L. Hubbard, R. E. Peters, and L. C. Teng. National Accelerator Conference, IEEE Transactions NS-20, 3, p. 409, (1973)

76-GeV IHEP

NAME OF MACHINE Proton Synchrotron — PERSON IN CHARGE Yu.M.Ado
INSTITUTION Institute of High Energy Ph. — DATA SUPPLIED BY E.F.Trojanov
LOCATION Serpukhov, USSR — DATE February, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1962
FIRST BEAM OBTAINED, OR GOAL (date) October, 1967
TOTAL COST OF FACILITY
FUNDED BY
TOTAL ACCELERATOR STAFF (now)
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 472 m; Tunnel sect. 6 × 8 m
MAGNET m; Mag. Gap × cm
"DONUT" 195x11.5m; Aperture 17 × 11.5 cm

Injector System
TYPE Linac
OUTPUT (max) 120 mA at 100 Mev
BEAM EMITTANCE 10π (90%) (norm) mm-mrad
INJECTION PERIOD 36 usec, or 3 turns
INFLECTOR TYPE electrostatic

Magnet System
FOCUSING TYPE AG Field Index n=443
No. MAG. UNITS 120 Length (ea) 72x10+48x9.3m
STRAIGHT SECT. 120 Total S.S. Length 287.5 m
FOCUSING ORDER F O D O
BETATRON OSC. FREQ. ν_H 9.80 ν_V 9.85
FIELD, AT INJ. 76 G, at max 13 kG
RISE TIME 2.5 sec; Flat-top time 2 sec
MAG. WEIGHT (tons) Fe 20,000, Al 700
POWER INPUT (MW) PEAK 80 MEAN 15

Acceleration System
HARMONIC No. 30 No. Cavities 52
RF RANGE 2.6 to 6.1 MHz
ORBIT FREQ. 0.086 to 0.202 MHz
ENERGY GAIN 180 kev/turn
RADIATION LOSS - keV/turn
RF POWER INPUT (kW) PEAK 300 mean 80

Other Relevant Parameters or Notable Features

There are 12 superperiods and in each there are 2 long straight sections, each 4.86m long.

Published Articles Describing Machine

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	70	76
RESOLUTION ΔE/E (%)	0.03	
REPET. RATE (pulse/sec)	1/8	
PULSE WIDTH		2.0sec
DUTY FACTOR, macroscopic (%)	25	
INTERNAL BEAM (part/pulse)	2.2×10^{12}	~~2.7×10^{12}~~ 1×10^{11}
(part/sec)	2.7×10^{11}	3.4×10^{11}
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)	1π	
SCHEDULED OPERATION (hr/wk)	90(average for year)	

"ON BEAM" 88 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/pulse)	BEAM AREA (cm²)	ENERGY (GeV)	ΔE/E (%)
π^-	10^4-10^6	4	30-65	1
$\pi^+ + p$	10^6	1	40-70	2
π^-	$\geq 10^6$	1	20-50	1
e^-	10^4-10^6	4	20-45	2
K^+	5-10	-	17-40	0.25
$\bar{p}$	5-10^6	-	10-25	0.5
μ^-	$> 10^6$	900	20-40	

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 23,300 m²
BEAM LINES TO 13 Stations
STATIONS SERVED AT SAME TIME 3-5
BEAM SEPARATORS 2 SPECTROMETERS 5
ON-LINE COMPUTERS WITH 5 Inputs
BUBBLE CHAMBERS, in-house - Users' 2
TOTAL POWER INSTALLED FOR RESEARCH 30 MW
No. USER GROUPS: in-house 6 outside 6
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Fast beam extraction system is operating on 3 directions.

There is neutral beam with intensity 10^6-10^7 ppp.

NAME OF MACHINE ITEP P.S.
INSTITUTION ITEP
LOCATION Moscow, USSR

PERSON IN CHARGE Goldin L.L.
DATA SUPPLIED BY Goldin L.L.
DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1956
FIRST BEAM OBTAINED, OR GOAL (date) 1961, 1973*
TOTAL COST OF FACILITY
FUNDED BY
TOTAL ACCELERATOR STAFF (now)
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 80 m; Tunnel sect. m
MAGNET 2 x 2 m; Mag. Gap × cm
"DONUT" × cm; Aperture 11 × 8 cm

Injector System

TYPE Linear Accelerator
OUTPUT (max) 200mA at 24.6 MeV
BEAM EMITTANCE 60 mm-mrad
INJECTION PERIOD 4 μsec, or 1 turns
INFLECTOR TYPE Electrostatic

Magnet System

FOCUSING TYPE Strong
No. MAG. UNITS 96 Length (ea.) 1,910 m
STRAIGHT SECT. 2.35 M Total S.S. Length 37.6 m
FOCUSING ORDER FODFODFDFDFDFD
BETATRON OSC. FREQ. ν_H 9.3 ν_V 9.3
FIELD, AT INJ. 240 G, at max 12 kG
RISE TIME 0.8 sec; Flat-top time 0.3 sec
MAG. WEIGHT (tons) Fe 3000, Cu 500
POWER INPUT (MW) PEAK 27 MEAN 3.5 MWT

Acceleration System

HARMONIC No. 4 No. Cavities 5
RF RANGE 1.09 - 4.77 MHz
ORBIT FREQ. 0.252 - 1.19
ENERGY GAIN 15 KeV
RADIATION LOSS keV/turn
RF POWER INPUT (kW) PEAK 12-KW/cavity

Other Relevant Parameters or Notable Features

* After reconstruction

** The accelerator is in the course of ajustement after reconstruction.

ACCELERATOR PERFORMANCE **

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	10	10.4
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)		
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)		
INTERNAL BEAM (part/pulse)		
(part/sec)		
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)		
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 7000 m^2
BEAM LINES TO Stations
STATIONS SERVED AT SAME TIME
BEAM SEPARATORS SPECTROMETERS
ON-LINE COMPUTERS WITH Inputs
BUBBLE CHAMBERS, in-house Users'
TOTAL POWER INSTALLED FOR RESEARCH MW
No. USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

NAME OF MACHINE 10 GeV proton Synchrophazotron — PERSON IN CHARGE A.M.Baldin
INSTITUTION Joint Inst.for Nucl. Research — DATA SUPPLIED BY I.N.Semenyushkin
LOCATION Dubna, USSR — DATE July 1971

HISTORY AND STATUS

CONSTRUCTION STARTED (date) ~~1957~~ 1952
FIRST BEAM OBTAINED, OR GOAL (date)
TOTAL COST OF FACILITY
FUNDED BY
TOTAL ACCELERATOR STAFF (now)
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 72 m; Tunnel sect. ____ ____ m
MAGNET 7.5.5.3 m; Mag. Gap 40 × 200 cm
"DONUT" ____ × ____ cm; Aperture 35 × I20 cm

Injector System

TYPE Linac
OUTPUT (max) I.0 at 9.4
BEAM EMITTANCE II I0 mm-mrad
INJECTION PERIOD 350 μsec, or 50 turns
INFLECTOR TYPE electrostatic

Magnet System

FOCUSING TYPE weak field Index, n=0.66
No. MAG. UNITS 48 Length (ea) 3.7 m
STRAIGHT SECT. 4 Total S.S. Length 32 m
FOCUSING ORDER
BETATRON OSC. FREQ. ν_x 0.626 ν_z 0.892
FIELD, AT INJ. I50 G, at max 12.6 kG
RISE TIME 3.0 sec; Flat-top time 0.5 sec
MAG. WEIGHT (tons) Fe 36000, Cu 2.700
POWER INPUT (MW) PEAK I40 MEAN I3

Acceleration System

HARMONIC No. I No. Cavities I
RF RANGE 0.2 to I.45 MHz
ORBIT FREQ. 0.2 to I.45
ENERGY GAIN 2.4
RADIATION LOSS ____ keV/turn
RF POWER INPUT (kW) PEAK 500 I50

Other Relevant Parameters or Notable Features

Published Articles Describing Machine

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	I0	I0 ±0.0I
RESOLUTION ΔE/E (%)	0.08	0.II
REPET. RATE (pulse/sec)		0.5
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)	I0	
INTERNAL BEAM (part/pulse)	x10^9 I.0	I2
(part/sec)	x10^9 I.0	I5
CURRENT (mA)	I5Π (v) 80Π (H)	
BEAM EMITTANCE (mm-mrad)		
SCHEDULED OPERATION (hr/wk)		I20
"ON BEAM" 90 % OF SCHEDULED TIME		

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Π^-	~10^4	5	2-7	±I
Π^+	~10^3	5	2-5	±I
Sep. K, $\bar{p}$				
Π^+	d		0.6-5	+I
	n		I-5	+2

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 2700 9 m^2
BEAM LINES TO ____ Stations
STATIONS SERVED AT SAME TIME 3
BEAM SEPARATORS ____ SPECTROMETERS ____
ON-LINE COMPUTERS WITH ____ Inputs
BUBBLE CHAMBERS, in-house I Users I
TOTAL POWER INSTALLED FOR RESEARCH 26 MW
No. USER GROUPS: in-house ____ outside ____
TOTAL RESEARCH STAFF, in-house ____ outside ____
ANNUAL RESEARCH BUDGET, in-house ____
SCHEDULED RESEARCH TIME, hours/week ____

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

acceleration of deuterons up to I0 GeV I=I0^{I0} pulse, He_4^2 up to 20 BeV I=I0^7 α/p

Slowly extraction of beem from synchrophazotron (τ =400 msec, efficiency 94%)

NAME OF MACHINE Bonn 2.5 GeV Synchrotron
INSTITUTION Physikal. Institut d. Univ.
LOCATION D-53 Bonn, Nussallee 12

PERSON IN CHARGE K.H. Althoff, G. Knop, G. Nöldeke, W. Paul
DATA SUPPLIED BY D. Husmann
DATE 22.1.1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) April 1965
FIRST BEAM OBTAINED, OR GOAL (date) March 1967
TOTAL COST OF FACILITY DM 12.3×10^6
FUNDED BY Federal Rep. of Germany and State of Nordrhein-Westfalen
TOTAL ACCELERATOR STAFF (now) 19
ANNUAL OPERATING BUDGET 1.8×10^6

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 22.15 m; Tunnel sect. 2.2 x 4.1 m
MAGNET 695.74 m; Mag. Gap 6 x 20 cm
"DONUT" 4.2 x 12 cm; Aperture 4 x 9 cm

Injector System
TYPE Linac
OUTPUT (max) 250 at 25
BEAM EMITTANCE 3 mm-mrad
INJECTION PERIOD 1 μsec, or 5 turns
INFLECTOR TYPE septum magnet

Magnet System
FOCUSING TYPE AG $n = +23.26 \; -22.26$
No. MAG. UNITS 12 Length (ea) 4.005 m
STRAIGHT SECT. 12 Total S.S. Length 21.48 m
FOCUSING ORDER OFDO
BETATRON OSC. FREQ. ν_H 3.4 ν_V 3.4
FIELD, AT INJ. 110 G, at max 11 kG
RISE TIME 8.8 sec; Flat-top time ____ sec
MAG. WEIGHT (tons) Fe 133, Cu 10
POWER INPUT (MW) PEAK .80 MEAN ____

Acceleration System
HARMONIC No. 116 No. Cavities 1 or 2
RF RANGE ____ 499.67 MHz
ORBIT FREQ. ____ 4.3074
ENERGY GAIN 330 keV/turn
RADIATION LOSS max. 325 keV/turn
RF POWER INPUT (kW) PEAK 80 mean 40

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	2.3	2.5
RESOLUTION ΔE/E (%)	____	0.5
REPET. RATE (pulse/sec)	____	50
PULSE WIDTH	max.	1 msec
DUTY FACTOR, macroscopic (%)	max.	5
INTERNAL BEAM (part/pulse)	____	4×10^{10}
(part/sec)	____	2×10^{12}
CURRENT (mA)	____	0.32 μA
BEAM EMITTANCE (mm-mrad)	____	1
SCHEDULED OPERATION (hr/wk)	____	150

"ON BEAM" 85 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm²)	ENERGY (GeV)	ΔE/E (%)
e^-	10^{12}	0.1	.5 - 2.3	.5
γ	5×10^{11}	eff. qu.	at 2.1 GeV	

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 1100 m²
BEAM LINES TO 6 Stations
STATIONS SERVED AT SAME TIME 2
BEAM SEPARATORS - SPECTROMETERS 8
ON-LINE COMPUTERS max 2, with 7 Inputs (total)
BUBBLE CHAMBERS, in-house - Users' -
TOTAL POWER INSTALLED FOR RESEARCH 1.2 MW
No. USER GROUPS: in-house 8 outside 4
TOTAL RESEARCH STAFF, in-house 50 outside 5
ANNUAL RESEARCH BUDGET, in-house 2.5×10^6
SCHEDULED RESEARCH TIME, hours/week 150

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Ejection of electrons up to 2.3 GeV
On line computer with CAMAC interface

Published Articles Describing Machine

K.H. Althoff et al. : The 2.5 GeV Electron Synchrotron of the University of Bonn, Nuclear Instr. a. Meth. 61 (1968), 1 - 30

NAME OF MACHINE DESY
INSTITUTION Deutsches Elektronen-Synchrotron
LOCATION Hamburg, Germany

PERSON IN CHARGE H. Schopper
DATA SUPPLIED BY H. Kumpfert
DATE January 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1959
FIRST BEAM OBTAINED, OR GOAL (date) February 1964
TOTAL COST OF FACILITY 110 MDM (orig.constr.costs)
FUNDED BY Federal Government, City of Hamburg
TOTAL ACCELERATOR STAFF (now) 80
ANNUAL OPERATING BUDGET 6 MDM

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 100.84 m; Tunnel sect. 3.7 x 8.8 m
MAGNET 0.77/0.69 m; Mag. Gap 5.6(8.8) x 14.4 (9.0) cm
"DONUT" x cm; Aperture 3.8(7.0) x 10(10.0) cm

Injector System

TYPE Electron/Positron* Linacs**
OUTPUT (max) 200 mA(e^-) at 300 - 500 MeV
BEAM EMITTANCE 2 π mm-mrad
INJECTION PERIOD 1 μsec, or 1 turns
INFLECTOR TYPE septum + fast kicker magnet

Magnet System

FOCUSING TYPE AG Field Index n 69.51 (F) 70.16 (D)
No. MAG. UNITS 48 Length (ea) 4.15 m
STRAIGHT SECT. 48 Total S.S. Length 117.6 m
FOCUSING ORDER FODO
BETATRON OSC. FREQ. ν_H 6.29 ν_V 6.23
FIELD, AT INJ. 315(42) G, at max 7.9 kG
RISE TIME 9×10^{-3} sec; Flat-top time max. 3.1×10^{-3} sec
MAG. WEIGHT (tons) Fe 570, Cu 77
POWER INPUT (MW) PEAK ____ MEAN 1.7

Acceleration System

HARMONIC No. 528 No. Cavities 16
RF RANGE 499.666 to 499.645 MHz
ORBIT FREQ. 0.9463
ENERGY GAIN max. 1250 keV/turn
RADIATION LOSS max. 8830 keV/turn
RF POWER INPUT (kW) PEAK 1000 mean 700

Other Relevant Parameters or Notable Features

*Positron Data: 1.6 mA ($|\frac{\Delta E}{E}| \leq \frac{1}{2}$ %) at 380 MeV

**The old 40 MeV-Electron Linac (140 mA max.) is still in use

Published Articles Describing Machine

Die Atomwirtschaft, July 1964

Proc. 1973 US Particle Accelerator Conference, San Francisco, (Improvements)

DESY Annual Reports

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	7.4	7.5
RESOLUTION ΔE/E (%)	± 0.25	± 0.25
REPET. RATE (pulse/sec)	50	50
PULSE WIDTH	3.1	3.1
DUTY FACTOR, macroscopic (%)	15.4	15.4
INTERNAL BEAM (part/pulse)	4×10^{11}	5×10^{11}
(part/sec)	2×10^{13}	2.5×10^{13}
average CURRENT (mA)	64	80
BEAM EMITTANCE (mm-mrad)		
SCHEDULED OPERATION (hr/wk)	168	

"ON BEAM" 90 - 95 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
2 x e^-	5×10^{12}		1-7.25	± 0.25
	$\varepsilon_z \approx 0.1\pi$ xmmxmrad			
or	$\varepsilon_r \approx 0.5\pi$ xmmxmrad			
	50 % < η < 85 %			
2 x e^+	10^{11}		1-7.25	± 0.25
3 x γ				
3 x converted γ (test beams)				
2 x Synchrotron Radiation				

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 6400 m^2
BEAM LINES TO 17 Stations
STATIONS SERVED AT SAME TIME 6 x e^- or γ + test & synchr. rad. beams
BEAM SEPARATORS ____ SPECTROMETERS 11
ON-LINE COMPUTERS WITH 20 Inputs
BUBBLE CHAMBERS, in-house ____ Users' ____
TOTAL POWER INSTALLED FOR RESEARCH 23 MW
No. USER GROUPS: in-house: 3 outside: 2 mixed : 9
TOTAL RESEARCH STAFF, ~~in-house~~ ~~outside~~ 275
ANNUAL RESEARCH BUDGET, in-house 7.5 MDM
SCHEDULED RESEARCH TIME, hours/week 136

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

- flat top operation (duty factor 15.4 %)
- 2 e^+/e^- beams (fast extraction) for DORIS
- max. circulating currents (e^-) up to 80 mA average as compared to 30 mA
- e^+ beams (slow extraction) for use in normal e^--experimental areas
- additional p^+-acceleration capability expected for 1975

NAME OF MACHINE Electron Synchrotron
INSTITUTION Laboratori Naz.dl CNEN
LOCATION Frascati - Italy

PERSON IN CHARGE Ubaldo Bizzarri
DATA SUPPLIED BY " "
DATE February 1974.

HISTORY AND STATUS

CONSTRUCTION STARTED (date) January 1956
FIRST BEAM OBTAINED, OR GOAL (date) Feb.9, 1959
TOTAL COST OF FACILITY $ 2.0 M
FUNDED BY CNEN
TOTAL ACCELERATOR STAFF (now) 30
ANNUAL OPERATING BUDGET $ 150.000

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 8.74 m; Tunnel sect. _____ _____ m
MAGNET 096x08 m; Mag. Gap 8.6 x 23 cm
"DONUT" 7.7x21 cm² Aperture 5.7 x 19.2 cm

Injector System
TYPE Microtron
OUTPUT (max) 30 at 12.4
BEAM EMITTANCE H:8 V:4 mm-mrad
INJECTION PERIOD 2 usec, or 100 turns
INFLECTOR TYPE Electrostatic

Magnet System
FOCUSING TYPE weak FIELD INDEX 0.61
No. MAG. UNITS 4 Length (ea) 5.65 m
STRAIGHT SECT. 4 Total S.S. Length 27.4 m
FOCUSING ORDER _____
BETATRON OSC. FREQ. ν_H _____ ν_V _____
FIELD, AT INJ. ~110 G, at max 10.2 kG
RISE TIME 23 sec; Flat-top time _____ sec
MAG. WEIGHT (tons) Fe 100, Cu 10.
POWER INPUT (MW) PEAK _____ MEAN 0.150
Magnet supply LC Resonant cirquit

Acceleration System
HARMONIC No. 4 No. Cavities 1
RF RANGE 43.7 MHz
ORBIT FREQ. 10.9
ENERGY GAIN ~ 4
RADIATION LOSS max 25 keV/turn
RF POWER INPUT (kW) PEAK 10 MEAN 4

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)		1.1
RESOLUTION ΔE/E (%)		0.1
REPET. RATE (pulse/sec)		20
PULSE WIDTH		4 msec
DUTY FACTOR, macroscopic (%)		8
INTERNAL BEAM (part/pulse)		$2+5.10^{10}$
(part/sec)		$4+10.10^{11}$
CURRENT (mA)		
BEAM EMITTANCE (mm-mrad)		20H 4V
SCHEDULED OPERATION (hr/wk)		141

Extracted beam

"ON BEAM" 75% % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e⁻	2.10^{11}	0eq	0.5+1	<0.5
γ	$1.3.10^{11}$	0eq	0.4+1	
γ	$0.5.10^{11}$	0eq	1	
*				

* 30-50% polarized

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA _____ m²
BEAM LINES TO 5 Stations
STATIONS SERVED AT SAME TIME 1
BEAM SEPARATORS _____ SPECTROMETERS 1
ON-LINE COMPUTERS WITH _____ Inputs
BUBBLE CHAMBERS, in-house 2 Users' 1
TOTAL POWER INSTALLED FOR RESEARCH 2.5 MW
No. USER GROUPS: in-house 3 outside 7
TOTAL RESEARCH STAFF, in-house 18 outside 44
ANNUAL RESEARCH BUDGET, in-house _____
SCHEDULED RESEARCH TIME, hours/week 141

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

- Proc . 2nd UN Conf. Peaceful Uses Atomic Energy Geneva 1958, Paper 15/8/1374, UN, NEw York (1958)
- Nuovo Cimento Suppl. 3, 324 (1959)
- Nuovo Cimento Suppl. 24 (1962)
- Lettere al Nuovo Cimento Vol. 1, 16, 820 (1969)
- Frascati Reports (available on request)

NAME OF MACHINE 1.3 GeV Electron Synchrotron PERSON IN CHARGE K. Huke
INSTITUTION Inst.for Nuclear Study, Univ. DATA SUPPLIED BY K. Huke
LOCATION Tanashi, Tokyo, Japan of Tokyo DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1957 January
FIRST BEAM OBTAINED, OR GOAL (date) 1961 (750 MeV)
TOTAL COST OF FACILITY ~ $ 2M*
FUNDED BY Japanese Government
TOTAL ACCELERATOR STAFF (now) 14
ANNUAL OPERATING BUDGET ~ $ 0.1M*
*(salaries not included)

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 10.9 m; Tunnel sect. 2.8 × (dia) 14 m
MAGNET 0.7 × 0.53 m; Mag. Gap 5.4 × 15 cm
"DONUT" 4.5 × 15 cm; Aperture 3.5 × 11 cm

Injector System
TYPE Linac
OUTPUT (max) 100 mA at inflector, 9 MeV
BEAM EMITTANCE 8 mm-mrad
INJECTION PERIOD 1 μsec, or 10 turns
INFLECTOR TYPE Electro-static plate and pulsed magnets for multi-turn.

Magnet System
FOCUSING TYPE AG
No. MAG. UNITS 8 Length (ea) 3.14 m
STRAIGHT SECT. 8 Total S.S. Length 9.60 m
FOCUSING ORDER 1/2 O, 1/2 D,F, 1/2 D, 1/2 O
BETATRON OSC. FREQ. ν_H ~ 2.25 ν_V ~ 2.25
FIELD, AT INJ. 80 G, at max 11 kG
RISE TIME 20~19 msec; Flat-top time --- sec
MAG. WEIGHT (tons) Fe 53, Cu 7.9
POWER INPUT (MW) PEAK stored 0.18 MJ MEAN 0.402

Acceleration System
HARMONIC No. 16 No. Cavities 1
RF RANGE ~ 138 fixed MHz
ORBIT FREQ. ~ 8.6
ENERGY GAIN peak 10
RADIATION LOSS 64 (max) keV/turn
RF POWER INPUT (kW) PEAK 20 MEAN 4 ~ 5

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	1.3	1.3
RESOLUTION ΔE/E (%)	0.1	0.1
REPET. RATE (pulse/sec)	22.5	22.5
PULSE WIDTH	~ 3	6(max)
DUTY FACTOR, macroscopic (%)	~ 5	10
INTERNAL BEAM (part/pulse) $\times 10^{10}$	2	4 at 1 GeV
(part/sec) $\times 10^{11}$	4	8 at 1 GeV
CURRENT (mA)	30	60
BEAM EMITTANCE (mm-mrad)	5	5
SCHEDULED OPERATION (hr/wk)	144	168

"ON BEAM" 95 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	4×10^{11}	0.6×0.8	1	0.3
γ	$e\times10^{10}$	2.2	1.14	brems.
		(at 3.1 m from radiator)		
Soft X-ray				

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 1000 m^2
BEAM LINES TO 3 (two γ, one e & γ) Stations
STATIONS SERVED AT SAME TIME max 2
BEAM SEPARATORS none SPECTROMETERS 4 (25, 18, 5, 6 tons)
ON-LINE COMPUTERS WITH 2 (TOSBAC-40) Inputs
BUBBLE CHAMBERS, in-house 0 Users' 1
TOTAL POWER INSTALLED FOR RESEARCH 0.45 MW
No. USER GROUPS: in-house 2 outside 5
TOTAL RESEARCH STAFF, in-house 16 outside 45
ANNUAL RESEARCH BUDGET, in-house ~ $ 0.05M*
SCHEDULED RESEARCH TIME, hours/week 132

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Epoxy-resin doughnuts were replaced by thin stainless steel bellows.
Add a fast extraction system to supply electrons to the 300 MeV storage ring.

Published Articles Describing Machine

1. H. Kumagai, et al., Japanese J. appl. Phys. 1 (1962) 66.
2. Annual Reports from 1960 to 1973, Institute for Nuclear Study, University of Tokyo.
3. K. Huke, et al., Japanese J. appl. Phys. 7 (1968) 1274.

NAME OF MACHINE Lund Electron Synchrotron — PERSON IN CHARGE Facility: Bengt Forkman, Machine: Rune Alvinsson
INSTITUTION Univ of Lund, Inst of Phys — DATA SUPPLIED BY Rune Alvinsson
LOCATION Lund, Sweden — DATE January 22, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1957
FIRST BEAM OBTAINED, OR GOAL (date) Dec. 1960
TOTAL COST OF FACILITY ~ $ 1 M excl. buildings
FUNDED BY Swedish Atom. Research Council
TOTAL ACCELERATOR STAFF (now) 8
ANNUAL OPERATING BUDGET ~ $ 30 000 excl. salaries

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 10.8 m; Tunnel sect. _____ _____ m
MAGNET 0.55x0.39 m; Mag. Gap 4.6 x 13.5 cm
"DONUT" 4 x 7 cm; Aperture 3.6 x 6.5 cm

Injector System

TYPE Microtron
OUTPUT (max) 75 mA at 10 MeV
BEAM EMITTANCE Hor. 20, vert. 50 mm-mrad
INJECTION PERIOD 5 μsec, or 40 turns
INFLECTOR TYPE Electrostatic

Magnet System

FOCUSING TYPE AG
No. MAG. UNITS 16 Length (ea) 1.4 m
STRAIGHT SECT. 16 Total S.S. Length 11.2 m
FOCUSING ORDER FOFDOD
BETATRON OSC. FREQ. ν_H 1.77 ν_V 1.77
FIELD, AT INJ. 100 G, at max. 11.0 kG
RISE TIME 0.04 sec; Flat-top time _____ sec
MAG. WEIGHT (tons) Fe 24, Cu 11.2
POWER INPUT (MW) PEAK _____ MEAN 0.185

Acceleration System

HARMONIC No. 45 No. Cavities 2
RF RANGE _____ 399.10 MHz
ORBIT FREQ. _____ 8.87 MHz
ENERGY GAIN max. 60
RADIATION LOSS max. 50 keV/turn
RF POWER INPUT (kW) PEAK 12 MEAN 3

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved	
ENERGY (GeV)	_____	1.2	
RESOLUTION ΔE/E (%)	_____	_____	
REPET. RATE (pulse/sec)	12.5	_____	
PULSE WIDTH	_____	5 msec.	
DUTY FACTOR, macroscopic (%)	_____	6	
INTERNAL BEAM (part/pulse)	_____	2.4×10^{10}	(0.8 GeV)
(part/sec)	_____	3×10^{11}	(- " -)
CURRENT (mA)	_____	50	(- " -)
BEAM EMITTANCE (mm-mrad)	_____	_____	
SCHEDULED OPERATION (hr/wk)	120	_____	

"ON BEAM" 85 - 90 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
bremsstr.				
synchr. light				

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 300 m^2
BEAM LINES TO 4 Stations
STATIONS SERVED AT SAME TIME 4
BEAM SEPARATORS _____ SPECTROMETERS 1
ON-LINE COMPUTERS WITH 2x1.6 bit digital inputs
BUBBLE CHAMBERS, in-house 1 Users' 0
TOTAL POWER INSTALLED FOR RESEARCH 0.8 MW
No. USER GROUPS: in-house 3 outside _____
TOTAL RESEARCH STAFF, in-house 29 outside _____
ANNUAL RESEARCH BUDGET, in-house $ 25 000 excl. salaries
SCHEDULED RESEARCH TIME, hours/week 112

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

Wernholm, O., Arkiv för Fysik 37, 527 (1964)

NAME OF MACHINE NINA
INSTITUTION DARESBURY LABORATORY
LOCATION DARESBURY, WARRINGTON, U.K.

PERSON IN CHARGE PROFESSOR A. ASHMORE
DATA SUPPLIED BY D. J. THOMPSON
DATE 21ST JANUARY, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) NOVEMBER, 1963
FIRST BEAM OBTAINED, OR GOAL (date) 2nd DECEMBER 1966
TOTAL COST OF FACILITY £4.5.10^6
FUNDED BY SCIENCE RESEARCH COUNCIL
TOTAL ACCELERATOR STAFF (now) 110 (inc. exp area)
ANNUAL OPERATING BUDGET £1.2 M

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)

RING DIAM. 70 m; Tunnel sect. 6.7 x 5.8 m
MAGNET — x — m; Mag. Gap — x — cm
"DONUT" 17.3 x 5.0 m; Aperture 15.0 x 4.4 F cm
13.5 7.0 11.2 6.1 D

Injector System

TYPE IRIS LOADED WAVEGUIDE LINAC
OUTPUT (max) 500 at 43
BEAM EMITTANCE 3.2 mm-mrad
INJECTION PERIOD 0.73 μsec, or 1 turns
INFLECTOR TYPE PULSED MAGNETIC

Magnet System

FOCUSING TYPE AG
No. MAG. UNITS 40 Length (ea) 3.2625 m
STRAIGHT SECT. 3.5m Total S.S. Length 90 m
FOCUSING ORDER 1.0 m FODO
BETATRON OSC. FREQ. ν_H 5.21 ν_V 5.26
FIELD, AT INJ. 69 G, at max 7.45* kG
RISE TIME 9m sec; Flat-top time — sec
MAG. WEIGHT (tons) Fe 360, Cu 40
POWER INPUT (MW) PEAK — MEAN 0.95

Acceleration System

HARMONIC No. 300 No. Cavities 5
RF RANGE 407.88 MHz
ORBIT FREQ. 1.36 MHz
ENERGY GAIN 470 (max.) keV/turn
RADIATION LOSS 2700* keV/turn
RF POWER INPUT (kW) PEAK 480 Mean (rating) 150

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	1.0 to 5.0	5.2
RESOLUTION ΔE/E (%)	—	—
REPET. RATE (pulse/sec)	53	—
PULSE WIDTH	2 msec	3 msec
DUTY FACTOR, macroscopic (%)	7	11
INTERNAL BEAM (part/pulse)	8.10^{10}	$2.4.10^{11}$
(part/sec)	4.10^{12}	$1.2.10^{13}$
CURRENT (mA)	18	54
BEAM EMITTANCE (mm-mrad)	—	

SCHEDULED OPERATION (hr/wk) 168 hrs/wk 5 wks in 7
"ON BEAM" 82 % OF SCHEDULED TIME for research

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Electron	2.10^{12}	0.6	1.0-5.0	—
Photon	3.10^{11}	4.0	0.8-5.0	—
Tagged Photon	10^6	1.0	0.25-4.5	

Two synchrotron radiation beams (λ_c = 0.94 Å*)

RESEARCH PROGRAM**

TOTAL EXPERIMENTAL AREA 3000 m^2
BEAM LINES TO 5 (inc. test beam) Stations
STATIONS SERVED AT SAME TIME 3 (inc. test beam)
BEAM SEPARATORS — SPECTROMETERS 5
ON-LINE COMPUTERS WITH 6 Inputs
BUBBLE CHAMBERS, in-house — Users' —
TOTAL POWER INSTALLED FOR RESEARCH 15 MW
No. USER GROUPS: in-house 2 outside 6
TOTAL RESEARCH STAFF, in-house 35 outside 88
ANNUAL RESEARCH BUDGET, in-house £2.2 M
SCHEDULED RESEARCH TIME, hours/~~week~~year 5900 in 1973
5000 in 1974

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

A.W. MERRISON, CONTEMPORARY PHYS. 8, 4 (1967), p.373
DNPL Reports 1-6 and Annual Reports

* Refers to 5.0 GeV

** Excluding Synchrotron Radiation Facility

NAME OF MACHINE: Cornell 12 GeV Electron Synchrotron
INSTITUTION: Cornell University
LOCATION: Ithaca, N.Y.

PERSON IN CHARGE: Maury Tigner
DATA SUPPLIED BY: M. Tigner
DATE: January, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): April, 1965
FIRST BEAM OBTAINED, OR GOAL (date): May, 1967
TOTAL COST OF FACILITY: $11.5 M
FUNDED BY: National Science Foundat.
TOTAL ACCELERATOR STAFF (now): 45
ANNUAL OPERATING BUDGET: $1 M

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 250 m; Tunnel sect. 2 x 3 m
MAGNET: 20 x .29 m; Mag. Gap 2.5/3.7 x 10 cm
"DONUT": none cm; Aperture 2.5 x 5.5 cm

Injector System
TYPE: Varian S-Band TW Linac
OUTPUT (max): 100 MA at 150 MeV
BEAM EMITTANCE: .16 mm-mrad
INJECTION PERIOD: 2.5 μsec, or 1 turns
INFLECTOR TYPE: Pulsed Magnetic

Magnet System
FOCUSING TYPE: Alternating Gradient
No. MAG. UNITS: 192 Length (ea): 3.4 m
STRAIGHT SECT.: 6 Total S.S. Length: 48 m
FOCUSING ORDER: FDDF
BETATRON OSC. FREQ. ν_H: 10.75 ν_V: 10.75
FIELD, AT INJ.: 50 G, at max: 4 kG
RISE TIME: 8×10^{-3} sec; Flat-top time: - sec
MAG. WEIGHT (tons) Fe: 100, Cu: 25
POWER INPUT (MW) PEAK: - MEAN: 1.1

Acceleration System
HARMONIC No.: 1800 No. Cavities: 6
RF RANGE: fixed 714 MHz
ORBIT FREQ.: 0.395 MHz
ENERGY GAIN: 6 MeV/turn, Max.
RADIATION LOSS: 1.8×10^4 keV/turn
RF POWER INPUT (kW) PEAK: 1500 220

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	12	12.2
RESOLUTION ΔE/E (%)	.5	.5
REPET. RATE (pulse/sec)	60	60
PULSE WIDTH	2×10^{-3} sec.	2×10^{-3} sec.
DUTY FACTOR, macroscopic (%)	12×10^{11}	12×10^{10}
INTERNAL BEAM (part/pulse)	10^{11}	3×10^{10}
(part/sec)	6×10^{12}	1.8×10^{11}
CURRENT (mA)	7	2
BEAM EMITTANCE (mm-mrad)	-	-
SCHEDULED OPERATION (hr/wk)	144	144

"ON BEAM" 85 % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
γ	10^{11}	1	12	-
ℓ	10^{12}	.5	12	

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA: 1400 m^2
BEAM LINES TO: 5 Stations
STATIONS SERVED AT SAME TIME: 2
BEAM SEPARATORS: - SPECTROMETERS: 2
ON-LINE COMPUTERS WITH: 2 Inputs
BUBBLE CHAMBERS, in-house: none Users': none
TOTAL POWER INSTALLED FOR RESEARCH: 3 MW
No. USER GROUPS: in-house: 4 outside: 4
TOTAL RESEARCH STAFF, in-house: 25 outside: 20
ANNUAL RESEARCH BUDGET, in-house: $1.8 M
SCHEDULED RESEARCH TIME, hours/week: 135

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

NAME OF MACHINE Orsay Electron Linear Accelerator
INSTITUTION Lab. Accelerateur Linéaire*
LOCATION ORSAY (France)

PERSON IN CHARGE P. BRUNET
DATA SUPPLIED BY P. BRUNET
DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1956
FIRST BEAM OBTAINED, OR GOAL (date) 1959
TOTAL COST OF FACILITY 10^8 F fr.
FUNDED BY National Ministry of Education
TOTAL ACCELERATOR STAFF (now) 50
ANNUAL OPERATING BUDGET 1.5×10^6 F

ACCELERATOR PARAMETERS

Physical Dimensions

ACCELERATOR LENGTH 360 m, DIAM.
TUNNEL SIZE (L×H×W) m³

Injection System

TYPE Electron Buncher
OUTPUT 1000 mA AT 12(1.5μs), 20(0.02μs) MeV
BEAM EMITTANCE 5 mm-mrad
INJECTION PERIOD 1.5 μs 50 RF cycles

Acceleration System

No. SECTIONS 1 +38 length (ea) 6 m
FIELD MODE π/2 FREQUENCY 2999 MHz
GROUP VELOCITY Tapered c; Phase Vel. ∿ 1.0 c
WAVE TYPE TM-01 FILLING TIME 0.7 and 0.9 μsec
SHUNT IMPEDANCE (MΩ/cm) 0.45
ATTENUATION (Np/m) 0.54 and 0.92 (total)
IRIS, aperture 1.8 to 2.7 cm, thickness 3 mm
IRIS SPACING (cm) 2.5
Q 10.150 and 11.800
POWER UNITS, No. 39 TYPE Klystrons
POWER RATING (MW/unit) 25 and 20
FEED SPACING (m) 6
RF POWER DEMAND (MW) PEAK 860 MEAN 0.13

Focusing System doublets and triplets
QUADRUPOLES, No. 13 sets SPACING 6 to 25 m
GRADIENTS 11 T/m

Other Relevant Parameters or Notable Features

$e^- \rightarrow e^+$ converter after 16 sections e.g. ≃ 1.0 GeV

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
electrons		
ENERGY (GeV)	2.3	2.1
ENERGY GAIN (MeV/m)	10	10
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)	1.25 to 50	50
PULSE WIDTH (μs)	0.02&1.5	1.5
DUTY FACTOR, macroscopic (%)	10^{-4}&8.10^{-3}	8.10^{-3}
BEAM CURRENT (μA)	7.5	7.5
BEAM EMITTANCE (mm-mrad)	0.3	
positrons	ACO	DCI
ENERGY (GeV)	0.25	1.3
ENERGY GAIN (MeV/m)	10	10
RESOLUTION ΔE/E (%)	2	2
REPET. RATE (pulse/sec)	50	50
PULSE WIDTH (μs)	1.5	0.02
DUTY FACTOR, macroscopic (%)	8×10^{-3}	10^{-4}
BEAM CURRENT (μA)	2.5×10^{-2}	3×10^{-3}
BEAM EMITTANCE (mm-mrad)	6π	1.6π

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm²)	ENERGY (GeV)	ΔE/E (%)
e^-	1×10^{13}	0.2	1.8	1
e^+	3×10^9	0.8	0.25	2 (ACO)

RESEARCH PROGRAM (Linac only)

TOTAL EXPERIMENTAL AREA 250 m²
BEAM LINES TO 5 Stations
STATIONS SERVED AT SAME TIME 2
BEAM SEPARATORS 0 SPECTROMETERS 1
ON-LINE COMPUTERS WITH Inputs
BUBBLE CHAMBERS, in-house outside
TOTAL POWER INSTALLED FOR RESEARCH MW
No. USER GROUPS, in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week

Published Articles Describing Machine

Onde Electrique (juillet 1969)

Recent or Planned Modifications to Machine

- Linac beams are not directly used for physics experiments any more, but only for injection in storage rings : ACO in 74, DCI and ACO in 75.
- The last experimental remaining room can handle a 500 MeV e^- or e^+ beam.

* Université PARIS-SUD
Dependent on I.N.2.P.3 (Institut National de Physique Nucléaire et de Physique des Particules).

NAME OF MACHINE: Mark III Electron Linear Accelerator
INSTITUTION: High Energy Physics Lab.
LOCATION: Stanford University, Stanford, Calif. 94305

PERSON IN CHARGE: Professor R. Hofstadter
DATA SUPPLIED BY: Professor M. R. Yearian
DATE: March 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): 1949
FIRST BEAM OBTAINED, OR GOAL (date): 1953(280'); 1964(310')
TOTAL COST OF FACILITY: $3.5 M (Accel. only)
FUNDED BY: 1956-69; ONR, AEC, AFOSR*
TOTAL ACCELERATOR STAFF (now): See Note A
ANNUAL OPERATING BUDGET: See Note A

ACCELERATOR PARAMETERS

Physical Dimensions
ACCELERATOR LENGTH: 100 m, DIAM. 10 cm
TUNNEL SIZE (L×H×W): 150 m (variable H&W) m³

Injection System
TYPE: Oxide cathode gun
OUTPUT: 300 mA AT 80 keV MeV
BEAM EMITTANCE: mm-mrad
INJECTION PERIOD: 1.5 μs RF cycles

Acceleration System
No. SECTIONS: 31 length (ea): 3.0m
FIELD MODE: 2π/3 FREQUENCY: 2856 MHz
GROUP VELOCITY: .01c; Phase Vel.: 1.00 c
WAVE TYPE: TM 01 FILLING TIME: 0.83 μsec
SHUNT IMPEDANCE (MΩ/cm): 560
ATTENUATION (Np/m): 0.19
IRIS, aperture: 1.9-2.6 cm, thickness: 5.8 mm
IRIS SPACING (cm): 3.50
Q: 13 500
POWER UNITS, No.: 31 TYPE: Klystrons
POWER RATING (MW/unit): 20
FEED SPACING (m): 3
RF POWER DEMAND (MW) PEAK: 600 MEAN: 0.1

Focusing System
QUADRUPOLES, No.: 4 pairs, SPACING: variable
GRADIENTS: plus magnetic lenses

Other Relevant Parameters or Notable Features

Note A: Mark III in process of phasing out; staff and operating budget minimal.

*1969 - present - NSF

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
electrons		
ENERGY (GeV)		1.2
ENERGY GAIN (MeV/m)		
RESOLUTION ΔE/E (%)		0.4 - 1.0
REPET. RATE (pulse/sec)		0.1 - 120
PULSE WIDTH		0.8 - 1.3 μsec
DUTY FACTOR, macroscopic (%)		1.6×10^{-2}
BEAM CURRENT (μA)		5
BEAM EMITTANCE (mm-mrad)		
positrons		
ENERGY (GeV)		1
ENERGY GAIN (MeV/m)		
RESOLUTION ΔE/E (%)		1
REPET. RATE (pulse/sec)		60
PULSE WIDTH		1 μ sec
DUTY FACTOR, macroscopic (%)		0.6×10^{-2}
BEAM CURRENT (μA)		0.2×10^{-3}
BEAM EMITTANCE (mm-mrad)		

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm²)	ENERGY (GeV)	ΔE/E (%)
e^-	3×10^{13}	0.3	1	0.1
e^+	10^9	0.3	0.8	0.5
γ	Depends on radiation thickness			

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA: 1760 m²
BEAM LINES TO: 5 Stations
STATIONS SERVED AT SAME TIME: 1
BEAM SEPARATORS: None SPECTROMETERS: 4
ON-LINE COMPUTERS WITH: 3 Inputs
BUBBLE CHAMBERS, in-house: None outside:
TOTAL POWER INSTALLED FOR RESEARCH: 3 MW
No. USER GROUPS, in-house: outside:
TOTAL RESEARCH STAFF, in-house: outside:
ANNUAL RESEARCH BUDGET, in-house:
SCHEDULED RESEARCH TIME, hours/week:

See Note A

Recent or Planned Modifications to Machine

Published Articles Describing Machine

1. General Description: M. Chodorow et al., Rev. Sci. Instr. 26, 134 (1955).

NAME OF MACHINE Superconducting Mark III Electron Linac
INSTITUTION High Energy Physics Lab.
LOCATION Stanford Univ., Stanford, Ca 94305

PERSON IN CHARGE Mason R. Yearian, Acting Director
DATA SUPPLIED BY R. E. Rand
DATE March 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1969
FIRST BEAM OBTAINED, OR GOAL (date) 1976
TOTAL COST OF FACILITY $10 M
FUNDED BY ONR & NSF
TOTAL ACCELERATOR STAFF (now) 57 + 13 students
ANNUAL OPERATING BUDGET $ 1 M

ACCELERATOR PARAMETERS

Physical Dimensions
ACCELERATOR LENGTH 150 m, DIAM. Dewar 90 cm
TUNNEL SIZE (L×H×W) 180 x 4 x 4 m³

Injection System
TYPE Superconducting Buncher & Pre-accelerator
OUTPUT 0.1 mA AT 8 MeV
BEAM EMITTANCE 0.5π mm-mrad
INJECTION PERIOD CW μs RF cycles

Acceleration System
No. SECTIONS 8 length (ea) 6 m
FIELD MODE π 12 FREQUENCY 1300 MHz
GROUP VELOCITY 1 c; Phase Vel. 1 c
WAVE TYPE TM-01 FILLING TIME μsec
SHUNT IMPEDANCE (MΩ/cm)
ATTENUATION (Np/m)
IRIS, aperture cm, thickness mm
IRIS SPACING (cm)
Q $10^{10} - 10^{11}$
POWER UNITS, No. 8 TYPE Klystron
POWER RATING (MW/unit) 0.015
FEED SPACING (m) 6
RF POWER DEMAND (MW) PEAK 0.36 MEAN 0.36

Focusing System
QUADRUPOLES, No. , SPACING
GRADIENTS

Other Relevant Parameters or Notable Features

Operating temperature = 1.85°K

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
electrons		
ENERGY (GeV)	0.7 - 2	
ENERGY GAIN (MeV/m)	12.3	
RESOLUTION ΔE/E (%)	0.01	
REPET. RATE (pulse/sec)		
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)	100	
BEAM CURRENT (μA)	100	
BEAM EMITTANCE (mm-mrad)	0.1	
positrons		
ENERGY (GeV)		
ENERGY GAIN (MeV/m)		
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)		
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)		
BEAM CURRENT (μA)		
BEAM EMITTANCE (mm-mrad)		

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm²)	ENERGY (GeV)	ΔE/E (%)
e^-	10^{9}	0.05	2	0.01

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 3000 m²
BEAM LINES TO 5 Stations
STATIONS SERVED AT SAME TIME 1
BEAM SEPARATORS SPECTROMETERS 2
ON-LINE COMPUTERS WITH Inputs
BUBBLE CHAMBERS, in-house outside
TOTAL POWER INSTALLED FOR RESEARCH 6 MW
No. USER GROUPS, in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week

Recent or Planned Modifications to Machine

Published Articles Describing Machine

Suelzle, L. R., IEEE Trans., June 1971, to be published.

NAME OF MACHINE Stanford Linear Accelerator Center
INSTITUTION Stanford University
LOCATION Stanford, California, USA

PERSON IN CHARGE W.K.H.Panofsky
DATA SUPPLIED BY R. B. Neal
DATE March 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1962
FIRST BEAM OBTAINED, OR GOAL (date) May 21, 1966
TOTAL COST OF FACILITY $114M
FUNDED BY USAEC
TOTAL ACCELERATOR STAFF (now) ~1093
ANNUAL OPERATING BUDGET FY 75: $28.65 M

ACCELERATOR PARAMETERS

Physical Dimensions
ACCELERATOR LENGTH 3050 m, DIAM. 10 cm
TUNNEL SIZE (L×H×W) 3350x3.05x3.35 m³

Injection System
TYPE Linac with two off-axis guns.
OUTPUT 100 peak mA AT 35 MeV
BEAM EMITTANCE 1.2π mm-mrad
INJECTION PERIOD ~1.6 μs ~5,000 RF cycles

Acceleration System
No. SECTIONS 960 length (ea) 3.05m
FIELD MODE 2π/3 FREQUENCY 2856 MHz
GROUP VELOCITY 1/ c; Phase Vel. v_p =c c
WAVE TYPE TM-01 FILLING TIME 0.83 μsec
SHUNT IMPEDANCE (MΩ/cm) 0.53
ATTENUATION (Np/m) 0.57 Np/section
IRIS, aperture 2.62-1.92 cm, thickness 5.84 mm
IRIS SPACING (cm) 3.5
Q 13,000
POWER UNITS, No. 244 TYPE Klystron
POWER RATING (MW/unit) 20-30 MW
FEED SPACING (m) 3
RF POWER DEMAND (MW) PEAK 5,600 MEAN 5.6 at 360 pps and 20 GeV.
Focusing System: 43 sets of doublets and triplets
QUADRUPOLES, No. _____, SPACING ~100 m
42 singlets at 12m spacing.

Other Relevant Parameters or Notable Features
1.5 GeV $e^{\pm}$ beams are available on a pulse-to-pulse basis interlaced with all e^- beams up to ~ ~21 GeV.

Beam break-up limit :
85 mA at 20 GeV, 1.6 μsec.

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
electrons		
ENERGY (GeV)	20	22.28
ENERGY GAIN (MeV/m)	6.5	7.5
RESOLUTION ΔE/E (%)	0.5-1	.1
REPET. RATE (pulse/sec)	360	360
PULSE WIDTH	1.6	1.6
DUTY FACTOR, macroscopic (%)	0.06	0.06
BEAM CURRENT (μA)	30	48
BEAM EMITTANCE (mm-mrad)	5π×10⁻²	
positrons		
ENERGY (GeV)	1.5-13.5	13.5
ENERGY GAIN (MeV/m)	6.5	6.5
RESOLUTION ΔE/E (%)	1	0.5
REPET. RATE (pulse/sec)	180	360
PULSE WIDTH	1.6	1.6
DUTY FACTOR, macroscopic (%)	0.03	0.06
BEAM CURRENT (μA)	1.2	1.2
BEAM EMITTANCE (mm-mrad)	.1π	

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm²)	ENERGY (GeV)	ΔE/E (%)
γBrems.	2/	0.15cm²	5-20	
$K^{\pm}$	10/pulse	2 cm²	7-13	4% max.
γCoherent	10^9 eq	0.15cm²	1-15	
K^0	150/pulse	2	1-10	
3/ K^0	15/pulse	.3m²	1-6	
$\pi^{\pm}$	10^3/pulse	2cm²	1-16	4% max.
p	30/pulse	2cm²	1-14	2% max.
μ^+	500/pulse	1cm²	14	2% max.

RESEARCH PROGRAM
TOTAL EXPERIMENTAL AREA 2650 and 1100 m²
BEAM LINES TO 10 experimental Stations
STATIONS SERVED AT SAME TIME 6
BEAM SEPARATORS 4 SPECTROMETERS 7 4/
ON-LINE COMPUTERS WITH 5/ 6/ 9 Inputs
BUBBLE CHAMBERS, in-house ____ outside ____
TOTAL POWER INSTALLED FOR RESEARCH 43MW MW
No. USER GROUPS, in-house 7 outside 40
TOTAL RESEARCH STAFF, in-house 55 7/ outside 60 to date
ANNUAL RESEARCH BUDGET, in-house 8.6 M$ (FY 74)
SCHEDULED RESEARCH TIME, hours/week 168 8/

Published Articles Describing Machine

R.B.Neal (Editor), "The Stanford Two-Mile Accelerator," W.A.Benjamin, Inc. 1968.

R.H.Miller, et al, "Recent Ideas on Upgrading the SLAC Accelerator," p.604, Proceedings of the 1971 Particle Accelerator Conference, Chicago, Illinois.

Recent or Planned Modifications to Machine

"SLED: A Method of Doubling SLAC's Energy," Z.D.Farkas, et al., paper to be presented at IXth International Conference on High Energy Accel.

4/ 3 focused magnetic spectrometers, 2 wire chambers 1 under construction, 2 solenoid spect.(1 in SPEAR.)

5/ 1 streamer chamber operating

6/ 1 rapid cycle bubble chamber and 1-40" conventional chamber.

7/ Plus 12 theoreticians

8/ During running time, 1-6 beams may be used simultaneously (interlaced)

1/ $v_{g/c}$ = 0.0204 to 0.0065

2/ 3×10^9 eq.

3/ Time of Flight

NAME OF MACHINE LAMPF
INSTITUTION Los Alamos Scientific Lab.
LOCATION Los Alamos, NM, USA

PERSON IN CHARGE Louis Rosen
DATA SUPPLIED BY Edward A. Knapp
DATE January 21, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) October 1968
FIRST BEAM OBTAINED, OR GOAL (date) 7/4/72
TOTAL COST OF FACILITY $57M
FUNDED BY U. S. Atomic Energy Commission
TOTAL ACCELERATOR STAFF (now) 70
ANNUAL OPERATING BUDGET $6M

ACCELERATOR PARAMETERS

Physical Dimensions

ACCELERATOR LENGTH 795 m, DIAM.
TUNNEL SIZE (L×H×W) 800 x 4 x 4 m³

Injection System

ION SOURCE Duoplasmatron
OUTPUT 48 mA EMITTANCE 1.5 mm-mrad
INJECTOR TYPE Cockcroft-Walton (3)
OUTPUT 48 mA EMITTANCE 1.5 mm-mrad
BUNCHER #1 (4kV, 7m), Buncher #2 (16kV, 1.5m)

Acceleration System

	I	II
TYPE	LINAC	Drift tube Side Coupled
BEAM ENERGY MeV	100	800
TOTAL LENGTH (m)	63	727
ENERGY GAIN (MeV/m)	1-1.9	1.1
RF FREQ. (MHz)	201.25	805
FIELD MODE	TM010	TM010
Q ($\times 10^3$)	60-75	18-25
EQUIL. PHASE (°)	-26	-30
SHUNT IMPED. (MΩ/m)	50-70	25-40
FILLING TIME (μsec)	150	15
No. TANKS	4	44
TANK DIAM. (cm)	94-90	26
No. DRIFT TUBES	165	--
DRIFT TUBE LENGTH (cm)	4.9-37	--
DRIFT TUBE DIAM. (cm)	18-16	--
GAP/CELL LENGTH RATIO	.21-.42	--
IRIS THICKNESS	--	--
IRIS SPACING	--	--
APERTURE (cm)	1.5-3.0	4
No. QUADS	135	104 doublets
GRADIENT (kG/cm)	8.4-.82	3.0
No. RF POWER UNITS	4	44
POWER INPUT, PEAK (MW)	3.0	1.25
MEAN (MW)	0.258	0.090

Other Relevant Parameters or Notable Features

Simultaneous acceleration of + and - proton beams to full energy and at full duty. Intensities of H^- beam restricted to 100 μA average current. Negative polarized proton source in preparation.

Emittance quoted as (Area * βγ)

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	0.800	.800
ENERGY GAIN (MeV/m)	1.0	1.0
RESOLUTION ΔE/E (%)	.5	.2%
REPET. RATE (pulse/sec)	120	120 pps
PULSE WIDTH	500μsec	500 μsec
DUTY FACTOR, macroscopic (%)	.6	6%
INTERNAL BEAM (part/pulse)	5×10^{13}	5×10^{13}
(part/sec)	6×10^{15}	--
CURRENT (μA)	1000	30μA
BEAM EMITTANCE (mm-mrad)	< 5	--
SCHEDULED OPERATION (hr/wk)	120	88

"ON BEAM" 65% % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
π^+	10^9	4	.5	10
π^+	2×10^8	160	.2	.05
μ^+	5×10^7	50	.04	5
p	10^{14}	20	.8	.01
n	2×10^8	10	.8	.5
ν_e	5×10^7	--	.03	--

π^- and μ^- beams at reduced intensities.

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA 4400 m²
BEAM LINES 4 STATIONS 10
STATIONS SERVED AT SAME TIME 10
BEAM SEPARATORS 1 SPECTROMETERS 2
ON-LINE COMPUTERS WITH 4 INPUTS 4
BUBBLE CHAMBERS, in-house 0 outside 0
TOTAL POWER INSTALLED FOR RESEARCH 12 MW
No. USER GROUPS: in-house 5 outside 40
TOTAL RESEARCH STAFF, in-house 20 outside 200
ANNUAL RESEARCH BUDGET, in-house $2M
SCHEDULED RESEARCH TIME, hours/week 120

Published Articles Describing Machine

D. E. Nagle, E. A. Knapp and B. C. Knapp, "Coupled Resonator Model for Standing Wave Accelerator Tanks," Rev. Sci. Instr., Vol. 38, No. 11, pp. 1583-87, Nov. 1967.

E. A. Knapp, B. C. Knapp, J. M. Potter, "Standing Wave High Energy Linear Accelerator Structures," Rev. of Sci. Instr. Vol 39, No. 7, 979-91, July 1968.

D. C. Hagerman, "805 MHz Power Sources for the LAMPF Accelerator," Proc. 1968 Proton Linear Accel. Conf., BNL-59120 (C-54), BNL

H. S. Butler, "A Computer-Based Accelerator Control System," to be published Proc. Inst. Soc. of Am. Conf., Philadelphia, PA (Oct. 1970)

INJECTOR FOR SATURNE
INSTITUTION C.E.A.
LOCATION Saclay - France

IN OPERATION SINCE Août 1969
DATA SUPPLIED BY Rommel
DATE Janv. 1974

PARAMETERS

Physical Dimensions
TOTAL LENGTH 10,47 m; No. TANKS 1
TANK DIAM. 1, — m; No. DRIFT TUBES 58
DRIFT TUBE LENGTHS 4,53 to 20,73 cm
DRIFT TUBE DIAMETERS 18 to 15 cm
GAP/CELL LENGTH 0,26 to 0,32
APERTURE 0,79 cm to 1,25 cm

Ion Source
TYPE Duoplasmatron
OUTPUT 40 mA at 30 keV
BEAM EMITTANCE (mm-mrad) 0,31 π normalised

Injector
TYPE Pressurized Cockroft - Walton
OUTPUT 50 mA at 750 keV
BEAM EMITTANCE (mm-mrad) 0,5π normalised

Buncher
TYPE Double cavity (harmonic)
POTENTIAL 27 kV, DRIFT LENGTH 84 cm

Acceleration System
RF FREQ. 200 MHz, Field mode TM010 ; 80,000
EQUIL. PHASE 45 to 20 deg., Accel. rate 1,84 MeV/m
DUTY FACTOR 0,1 %, Pulse length 600 µsec
SHUNT RESIST. 63 MΩ/m, Filling time 400 µsec
RF POWER INPUT (kW) PEAK 2 MW MEAN 3 kW

Focusing System
No. QUADS 58 TYPE magnetique ORDER ++ --
GRADIENTS 5,3 to 0,64 kG/cm
OTHER

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	20	
ENERGY SPREAD ΔE/E (%)	0,8	
CURRENT (mA)	20	40
BEAM EMITTANCE (mm-mrad)	normalised 2,8π	

Other Parameters or Notable Features
- performance maximum of preinjector 120 mA at 1,1 MeV
- acceleration of deuterons 7 mA at 10 MeV
- acceleration of α 2 mA at 19,4

Published Articles Describing Machine
Proceedings of 1968 proton linear accelerator "Brookhaven"

The new Saturne injector

Status on the 20 MeV Linac - JM. Lefèbvre
- M. Promé

Status on the 750 KeV preinjector
- J. Faure

Proceedings of 1972 protons linar accelerator conference

Deuterons acceleration with the Saturne linac

Saturne linac three years operation report

- additionel ramping energy cavity
  phase variation 90 ° in 600 us
  energy modulation 600 keV in 600 µs
  peak power 100 kW potential - 430 kV

- debuncher cavity
  drift length 8,50 m
  phase variation 160° in 600 us
  peak power 55 kW potential 230 kV

INJECTOR FOR 10 GeV Proton Synchrotron
INSTITUTION Nat.Lab.for High Energy Phys.
LOCATION Tsukuba, Japan

IN OPERATION SINCE
DATA SUPPLIED BY T. Nishikawa
DATE March, 1974

PARAMETERS

Physical Dimensions

TOTAL LENGTH 15.5 m; No. TANKS 1
TANK DIAM. 94 m; No. DRIFT TUBES 90
DRIFT TUBE LENGTHS 4.8 ~ 20.6 cm
DRIFT TUBE DIAMETERS 18 cm
GAP/CELL LENGTH 1/5 ~ 1/3
APERTURE 2.0 cm to 2.5 cm

Ion Source

TYPE Mofidified Duoplasmatron
OUTPUT 300 mA at 750 keV
BEAM EMITTANCE (mm-mrad) 5π (norm)

Injector

TYPE Open type Cockcroft-Walton
OUTPUT 250 mA at 750 keV
BEAM EMITTANCE (mm-mrad) 10π (norm)

Buncher

TYPE Single
POTENTIAL 10 kV, DRIFT LENGTH 100 cm

Acceleration System

RF FREQ. 201 MHz, Field mode 0-mode Q >60,000
EQUIL. PHASE 25 deg., Accel. rate 1.3 MeV/m
DUTY FACTOR 0.5 %, Pulse length 250 μsec
SHUNT RESIST. ~70 MΩ/m, Filling time 150 μsec
RF POWER INPUT (kW) PEAK 3000 MEAN 15

Focusing System

No. QUADS 90 TYPE Magnet ORDER FDFD
GRADIENTS 11 to 4 kG/cm
OTHER

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	(20)	
ENERGY SPREAD ΔE/E (%)	(±1)	
CURRENT (mA)	(100)	
BEAM EMITTANCE (mm-mrad)	[10π (norm)]	

Other Parameters or Notable Features

Published Articles Describing Machine

INJECTOR FOR NIMROD
INSTITUTION Rutherford Laboratory
LOCATION Chilton, Didcot, Berks., UK

IN OPERATION SINCE August 1961
DATA SUPPLIED BY D A Gray
DATE January 1974

PARAMETERS

Physical Dimensions

TOTAL LENGTH 13.45 m; No. TANKS 1
TANK DIAM. 1.69 m; No. DRIFT TUBES 48 + 2 x ½
DRIFT TUBE LENGTHS 8.05 to 32.0 cm
DRIFT TUBE DIAMETERS 28.15
GAP/CELL LENGTH 0.194
APERTURE 2.1 cm to 4.9 cm

Ion Source

TYPE RF, Thonemann-Harrison type
OUTPUT 120 mA at 24 keV
BEAM EMITTANCE (mm-mrad) 95 π for 50 mA at 15 kV

Injector

TYPE Conventional, low gradient column
OUTPUT 120 mA at 600 keV
BEAM EMITTANCE (mm-mrad) 73π for 100% of 44 mA

Buncher

TYPE Single gap. Re-entrant
POTENTIAL 23 kV, DRIFT LENGTH 1.44 m

Acceleration System

RF FREQ. 115 MHz, Field mode E-010 Q 80,000
EQUIL. PHASE 30 deg., Accel. rate 1.06 MeV/m
DUTY FACTOR 0.5 %, Pulse length 2500 μsec max
SHUNT RESIST. 19 MΩ/m, Filling time 400 μsec to stabilisation
RF POWER INPUT (kW) PEAK 1300 MEAN 6.5

Focusing System

No. QUADS 48 TYPE DC ORDER + − + −
GRADIENTS 3.70 to 0.64 kG/cm
OTHER -

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	14.9	
ENERGY SPREAD ΔE/E (%)	0.67	
CURRENT (mA)	18	45
BEAM EMITTANCE (mm-mrad)	50	

Other Parameters or Notable Features

Linac is a cavity inside a separate vacuum tank.
RF system operates as a self oscillator.
Multipactor in linac overcome by carbon blank on drift tube faces.
Ramped debuncher giving energy shift during injection into Nimrod.

Published Articles Describing Machine

Nimrod - A 7 GeV Proton Synchrotron (Part I)
Ruth. Lab. Report NIRL/R/44 (1965).

It is planned to replace this injector by a 70 MeV injector in 1975. (See separate data sheet).

INJECTOR FOR NIMROD (7 GeV P.S.)
INSTITUTION Rutherford Laboratory
LOCATION Chilton, Didcot, Berks., UK

IN OPERATION SINCE Under construction, completion due 1975
DATA SUPPLIED BY N D West
DATE January 1974

PARAMETERS

Physical Dimensions

TOTAL LENGTH 43.8 m; No. TANKS 4
TANK DIAM. .81-.94 m; No. DRIFT TUBES 144 + 8 halves
DRIFT TUBE LENGTHS 0.045 - 0.341 m
DRIFT TUBE DIAMETERS 0.16 - 0.18 m
GAP/CELL LENGTH 0.21 - 0.37
APERTURE 2.00 cm to 3.81 - 2.50 cm

Ion Source

TYPE Duoplasmatron
OUTPUT 200 mA at 42 keV
BEAM EMITTANCE (mm-mrad) ~ 0.9 $\pi/\beta\gamma$

Injector

TYPE Cockcroft-Walton
OUTPUT 200 mA at 665 keV
BEAM EMITTANCE (mm-mrad) -

Buncher

TYPE $\lambda/2$ co-axial line
POTENTIAL ~ 27 kV, DRIFT LENGTH 80 cm

Acceleration System

RF FREQ. 202 MHz, Field mode E010 Q ~ 60,000
EQUIL. PHASE 30 deg., Accel. rate 1.64 MeV/m (1)
DUTY FACTOR 0.07 %, Pulse length 700 μsec
SHUNT RESIST. - MΩ/m, Filling time - μsec
RF POWER INPUT (kW) PEAK ~ 11,000 MEAN 7.7 (2)

Focusing System

No. QUADS 152 TYPE Pulsed DC ORDER N = 1 (Tank 1), N = 2 (Tanks 2-4)
GRADIENTS 10.1 to 0.4 kG/cm
OTHER Quadrupole triplets used in low and high energy beam transport.

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	70.4	-
ENERGY SPREAD ΔE/E (%)	-	-
CURRENT (mA)	75	-
BEAM EMITTANCE (mm-mrad)	-	-

Other Parameters or Notable Features

Tanks 2 and 3 were previously part of the Rutherford Laboratory 50 MeV PLA.

Published Articles Describing Machine

(1) Average over 4 tanks.
(2) Includes beam loading (75 mA)

INJECTOR FOR ZGS - Polarized Protons
INSTITUTION Argonne National Laboratory
LOCATION Argonne, Illinois

IN OPERATION SINCE January 1963
DATA SUPPLIED BY E. F. Parker
DATE February 1974

PARAMETERS

Physical Dimensions
TOTAL LENGTH 33.28 m; No. TANKS 1
TANK DIAM. 0.95 m; No. DRIFT TUBES 124
DRIFT TUBE LENGTHS 4.9 to 35.46 cm
DRIFT TUBE DIAMETERS 24.9 to 14.7
GAP/CELL LENGTH 0.225 to 0.250
APERTURE 1.270 cm to 3.175 cm

Ion Source
TYPE Ground State
OUTPUT 2×10^{-2} mA at 20 keV
BEAM EMITTANCE (mm-mrad) 425

Injector
TYPE Cockcroft-Walton
OUTPUT ____ mA at 750 keV
BEAM EMITTANCE (mm-mrad) Unmeasured

Buncher
TYPE One-gap re-entrant cavity
POTENTIAL 15 kV, DRIFT LENGTH 220 cm

Acceleration System
RF FREQ 220 MHz, Field mode TM-010 60,000
EQUIL. PHASE -26 deg., Accel. rate 1.89 MeV/m
DUTY FACTOR 0.1 %, Pulse length 0-1000 μsec
SHUNT RESIST. 39 MΩ/m, Filling time 150 μsec
RF POWER INPUT (kW) PEAK 3500 MEAN 3.5

Focusing System
No. QUADS 124 TYPE magnetic ORDER +-+-
GRADIENTS 8.0 to 1.4 kG/cm
OTHER

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	50	50
ENERGY SPREAD ΔE/E (%)	0.6	0.6
CURRENT (mA)	6×10^{-3}	9×10^{-3}
BEAM EMITTANCE (mm-mrad)	Unmeasured	

Other Parameters or Notable Features

50 MeV Polarization = 75%
Polarized deutrons can also be produced.

Published Articles Describing Machine

"Zero Gradient Synchrotron (ZGS) High Energy Polarized Proton Beam Program - Injector System" E. F. Parker, et al., 1973 Particle Accelerator Conference, March 5-7, 1973, page 395.

"Acceleration of Polarized Protons to 8.5 GeV" T. K. Khoe, et al., (to be published)

INJECTOR FOR ZGS - Unpolarized Protons
INSTITUTION Argonne National Laboratory
LOCATION Argonne, Illinois

IN OPERATION SINCE January 1963
DATA SUPPLIED BY E. F. Parker
DATE February 1974

PARAMETERS

Physical Dimensions
TOTAL LENGTH 33.28 m; No. TANKS 1
TANK DIAM. 0.95 m; No. DRIFT TUBES 124
DRIFT TUBE LENGTHS 4.9 to 35.46 cm
DRIFT TUBE DIAMETERS 24.9 to 14.7
GAP/CELL LENGTH 0.225 to 0.250
APERTURE 1.270 cm to 3.175 cm

Ion Source
TYPE Duoplasmatron
OUTPUT 160 mA at ____ keV
BEAM EMITTANCE (mm-mrad) ____

Injector
TYPE Cockcroft-Walton
OUTPUT 160 mA at 750 keV
BEAM EMITTANCE (mm-mrad) 80 π (90%)

Buncher
TYPE One-gap re-entrant cavity
POTENTIAL 15 kV, DRIFT LENGTH 220 cm

Acceleration System
RF FREQ. 220 MHz, Field mode $TM\text{-}010_Q$ 60,000
EQUIL. PHASE -26 deg., Accel. rate 1.89 MeV/m
DUTY FACTOR 0.1 %, Pulse length 0-1000 μsec
SHUNT RESIST. 39 MΩ/m, Filling time 150 μsec
RF POWER INPUT (kW) PEAK 3500 MEAN 3.5

Focusing System
No. QUADS 124 TYPE magnetic ORDER +-+-
GRADIENTS 8.0 to 1.4 kG/cm
OTHER ____

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)*	50	50
ENERGY SPREAD ΔE/E (%)	0.6	0.6
CURRENT (mA)	40	42
BEAM EMITTANCE (mm-mrad)	____	20 π (90%)

Other Parameters or Notable Features

*See "Recent Measurement of the ZGS Injector Beam Characteristics" E. F. Parker, Proceedings of the 1972 Proton Linear Acc. Conf. Oct. 10-13, 1972

Published Articles Describing Machine

See Synchrotron Sheet.

INJECTOR FOR Alternating Gradient Synchrotron — IN OPERATION SINCE November 1970
INSTITUTION Brookhaven Nat'l. Laboratory — DATA SUPPLIED BY George W. Wheeler
LOCATION Upton, New York — DATE January 28, 1974

PARAMETERS

Physical Dimensions
TOTAL LENGTH 145 m; No. TANKS 9
TANK DIAM. 0.89 m; No. DRIFT TUBES 286
DRIFT TUBE LENGTHS 4.74 cm to 44.6 cm
DRIFT TUBE DIAMETERS 18 cm(Tank 1)16 cm(others)
GAP/CELL LENGTH 0.20 to 0.47
APERTURE 2.0 cm to 4.0 cm

Ion Source
TYPE Duoplasmatron
OUTPUT 400 mA at --- keV
BEAM EMITTANCE (mm-mrad) ---

Injector
TYPE Cockcroft-Walton
OUTPUT 400 mA at 780 keV
BEAM EMITTANCE (mm-mrad) 500 π

Buncher
TYPE 2 Fundamental Frequency Units
POTENTIAL 10/20 kV, DRIFT LENGTH 100/75 cm

Acceleration System
RF FREQ. 201 MHz, Field mode TM_{010} Q ~ 50000
EQUIL. PHASE -32 deg., Accel. rate 1.45 MeV/m
DUTY FACTOR 0.2 %, Pulse length Beam 200 μsec
SHUNT RESIST. 20 MΩ/m, Filling time 80 μsec
RF POWER INPUT (kW) PEAK 45000 MEAN 180

Focusing System Pulsed
No. QUADS 295 TYPE Mag. ORDER +-+-
GRADIENTS 10 to 1 kG/cm
OTHER

PERFORMANCE

	Normal (for Geo+)	Maximum Achieved
OUTPUT ENERGY (MeV)	200.3	206
ENERGY SPREAD ΔE/E (%)	0.5	0.6
CURRENT (mA)	70	100
BEAM EMITTANCE (mm-mrad) (80%)	5π	10π

Other Parameters or Notable Features

Pulse rate of 10 pulses/s allows Linac Beam to be used for about 9 pulses/s for Radio Chemistry, radio-biology and Isotope production. The beam is deflected into a special side tunnel for this purpose.

Published Articles Describing Machine

G.W. Wheeler, "The AGS Conversion Project" IEEE Trans. Nucl. Sci. NS-18, No. 3, 515 (1971).

G.W. Wheeler, VIII International Conf. on High Energy Accelerators, CERN, 531-39, Sept. 1971.

Tanks stabilized by the multi-stem method in tanks #2-9.

INJECTOR FOR 200/500 GeV Synchrotron
INSTITUTION National Accelerator Lab.
LOCATION Batavia, Ill. USA

IN OPERATION SINCE November 30, 1970
DATA SUPPLIED BY C. W. Owen
DATE March 8, 1974

PARAMETERS

Physical Dimensions
TOTAL LENGTH 144.8 m; No. TANKS 9
TANK DIAM. 0.84 / 0.94 m; No. DRIFT TUBES 286
DRIFT TUBE LENGTHS 4.7 - 44.6 cm
DRIFT TUBE DIAMETERS 16-18 cm
GAP/CELL LENGTH 0.21 - 0.47
APERTURE 2.0 cm to 4.0 cm

Ion Source
TYPE Duoplasmatron
OUTPUT ____ mA at ____ keV
BEAM EMITTANCE (mm-mrad) ____

Injector
TYPE Cockcroft-Walton
OUTPUT 200 / 320 max mA at 750 keV
BEAM EMITTANCE (mm-mrad) 50π

Buncher
TYPE Single cavity
POTENTIAL 25 kV, DRIFT LENGTH 75 cm

Acceleration System
RF FREQ. 201.25 MHz, Field mode $TM010_0$ 50-60,000
EQUIL. PHASE 32 deg., Accel. rate 1.4 MeV/m
DUTY FACTOR 0.5 %, Pulse length (max) 400 μsec
SHUNT RESIST. 27-15 MΩ/m, Filling time 75 μsec
RF POWER INPUT (kW) PEAK 37.10^3 MEAN 110

Focusing System
No. QUADS 295 TYPE pulsed ORDER NSNS
GRADIENTS 6.9 to 0.68 kG/cm
OTHER ____

PERFORMANCE

	* Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	205 (200.3)	
ENERGY SPREAD ΔE/E (%)	*0.4 (0.6)	
CURRENT (mA)	90 (75)	110
BEAM EMITTANCE (mm-mrad)	10π	(5π-10π)

Other Parameters or Notable Features

A three-cell debuncher to reduce further the energy spread is under construction.

Published Articles Describing Machine

Initial Performance of the NAL 200-MeV Linear Accelerator, D. E. Young et al, IEEE Transactions on Nuclear Science NS-18, June 1971, p. 517.

Operation of the First Section of the NAL Linear Accelerator, C. D. Curtis et al, Particle Accelerators 1, 51, (1970)

Operating experience with the NAL 200-MeV Linac, C. D. Curtis et. al. Proc. of the 1972 Proton Linear Accelerator Conf., LA-5115, p. 17 (1972)

*Typical operating values with design goals in parentheses. Measurements of energy spread and emittance are for 95% and 90% of the beam respectively at 100 mA.

INJECTOR FOR Bevatron
INSTITUTION Lawrence Berkeley Laboratory
LOCATION Univ. of Calif., Berkeley, CA

IN OPERATION SINCE 1963 (1971)
DATA SUPPLIED BY Kenneth C. Crebbin
DATE February 1974

PARAMETERS

Physical Dimensions

TOTAL LENGTH 11 m; No. TANKS 1
TANK DIAM. 1 m; No. DRIFT TUBES 75
DRIFT TUBE LENGTHS 2.5 - 22.5 cm
DRIFT TUBE DIAMETERS 20 - 22.0 cm
GAP/CELL LENGTH 0.23
APERTURE 1.25 cm to 3.27 cm

* **Ion Source**
TYPE Von-Ardenne duo plasmatron
OUTPUT 150 mA at 60 keV
BEAM EMITTANCE (mm-mrad) ------
* See below for heavy-ion source.

Injector
TYPE Cockroft-Walton
OUTPUT 100 mA at 480 keV
BEAM EMITTANCE (mm-mrad) 179

Buncher
TYPE Single-cavity re-entrant
POTENTIAL 10 kV, DRIFT LENGTH 100 cm

Acceleration System
RF FREQ. 199.3 MHz, Field mode TM-010 Q 70,000
EQUIL. PHASE 260 deg., Accel. rate 2(0.5) MeV/m
DUTY FACTOR 0.12 %, Pulse length 600 μsec
SHUNT RESIST. 2 MΩ/m, Filling time 200 μsec
RF POWER INPUT (kW) PEAK 2500 MEAN 5

Focusing System
No. QUADS 75 TYPE Magnet, ORDER CCDD
GRADIENTS ____ to ~20 kG-cm/cm kG/cm
OTHER ____

( ) value for heavy-ion operation.

Ion Source for Heavy-Ion Operation

Type - PIG

Ion	Output	Exit of C-W
H^+	10 ma	480 kV
$^2H^+$	8	253
$^4He^{++}$	1.5	251
$^{12}C^{4+}$	0.1	376
$^{14}N^{5+}$	0.04	350
$^{16}O^{5+}$	0.05	402
$^{20}Ne^{6+}$	0.0001	418

PERFORMANCE

	Normal (or Goal)	Maximum Achieved	
OUTPUT ENERGY (MeV)	19.0	19.27	(4.8/Amu)
ENERGY SPREAD ΔE/E (%)	1.5	1	(.8)
CURRENT (mA)	50	40	(*)
BEAM EMITTANCE (mm-mrad)	20	25	

* Approximately 20% of C-W output.

Other Parameters or Notable Features

Provides heavy-ion acceleration in the 2 βλ mode.
Cavity is pre-pulse excited and driven with ten main oscillators.

Published Articles Describing Machine

1. R. W. Allison, et al, Rev. Sci. Instr. 32, 1331 (1961).
2. R. W. Allison et al, Measurements of The Linear-Accelerator Exit Beam of the Bevatron Injector, UCRL-17001 (1966), Proc. 1966 Linear Accel. Conf., Los Alamos.

INJECTOR FOR Bevatron
INSTITUTION Lawrence Berkeley Laboratory
LOCATION Univ. of Calif., Berkeley, CA

IN OPERATION SINCE Preliminary tests (1973-1974)
DATA SUPPLIED BY John Staples
DATE February 1974

PARAMETERS

Physical Dimensions
TOTAL LENGTH 33 m; No. TANKS 1
TANK DIAM. 0.97 m; No. DRIFT TUBES 124
DRIFT TUBE LENGTHS 4.91 to 35.46 cm
DRIFT TUBE DIAMETERS 25.02 to 14.71 cm
GAP/CELL LENGTH 0.231 to 0.249
APERTURE 1.90 cm to 3.17 cm

Ion Source
TYPE Von-Ardenne-duo plasmatron
OUTPUT ~200 mA at ----- keV
BEAM EMITTANCE (mm-mrad) -----

Injector
TYPE Cockroft-Walton
OUTPUT 180 mA at 750 keV
BEAM EMITTANCE (mm-mrad) 25.5 π

Buncher
TYPE Single gap
POTENTIAL 22 kV, DRIFT LENGTH 135 cm

Acceleration System
RF FREQ. 201.6 MHz, Field mode: TM-010 Q: 60,000
EQUIL. PHASE 26 deg., Accel. rate 2.0 MeV/m
DUTY FACTOR .12 %, Pulse length 600 usec
SHUNT RESIST. 39 MΩ/m, Filling time 150 usec
RF POWER INPUT (kW) PEAK 9,000 MEAN 11

Focusing System
No. QUADS 124 TYPE Mag. ORDER ++ - -
GRADIENTS 4.5 to 0.91 kG/cm
OTHER

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	50.8	--
ENERGY SPREAD ΔE/E (%)	0.5	0.8
CURRENT (mA)	80	--
BEAM EMITTANCE (mm-mrad)	20π	--

Other Parameters or Notable Features

Formerly the injector for the AGS at Brookhaven National Laboratory.

Published Articles Describing Machine

1. D. Brodzik, et al, The 50 MeV Bevatron Injection Linac, Vol. NS-20, Number 3, June 1973, pp 923-927.

SuperHILAC, a heavy-ion
INJECTOR FOR the Bevatron
INSTITUTION Lawrence Berkeley Laboratory
LOCATION Univ. of California, Berkeley, CA

IN OPERATION SINCE April, 1972
DATA SUPPLIED BY F. Selph
DATE 3/5/74

PARAMETERS

Physical Dimensions

TOTAL LENGTH 73.3 m; No. TANKS 8
TANK DIAM. 3.05 m; No. DRIFT TUBES 214
DRIFT TUBE LENGTHS 4.9 to 38.5 cm
DRIFT TUBE DIAMETERS 25.4 to 17.2 cm
GAP/CELL LENGTH 0.26 to 0.32
APERTURE 1.2 cm to 4.2 cm

Ion Source

TYPE PIG
OUTPUT --- mA at --- keV
BEAM EMITTANCE (mm-mrad) 240π

Injector

TYPE 2.5 MV press. C.W./750 kV C.W.
OUTPUT --- mA at ------ keV
BEAM EMITTANCE (mm-mrad) 30π/70π

Buncher (750 kV C.W.)

TYPE two gap
POTENTIAL 7.5 kV, DRIFT LENGTH 224 cm

Acceleration System

RF FREQ. 70 MHz, Field mode 010 Q 100,000
EQUIL. PHASE 20 deg., Accel. rate 1.35 q* MeV/m
DUTY FACTOR 30-50%, Pulse length 8-14 msec
SHUNT RESIST. 22 MΩ/m, Filling time 500 usec
RF POWER INPUT (kW) PEAK 7,500 MEAN 2,500

Focusing System

No. QUADS 209 TYPE D.C. ORDER NSNS prestripper NNSS poststripper
GRADIENTS 14.5 to 1.3 kG/cm
OTHER

* q equals charge state of ion.

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	8.5	7.2
ENERGY SPREAD ΔE/E (%)	0.5	0.3
CURRENT (mA) **		
BEAM EMITTANCE (mm-mrad)	10π	10π

Other Parameters or Notable Features

The SuperHILAC is capable of accelerating beams of heavy ions from Helium (mass 4) through Uranium (mass 238). Injection to the Bevatron is possible, using the Bevalac transfer line, for ions as heavy as Argon (mass 40).

Published Articles Describing Machine

1) R. M. Main, Modification of the Berkeley Hilac, Nuclear Instruments and Methods 97, 51-64 (1971).
2) A. Ghiorso, Progress with the SuperHILAC, Vol. NS-20, Number 3, June 1973.
3) A. Ghiorso, et al, The Bevalac--An Economical Facility for Very Energetic Heavy Particle Research, Vol. NS-20, Number 3, June 1973.

** Current (particle μA)

	Goal	Achieved
Carbon (A=12)	80	1.6
Argon (40)	8	0.8
Krypton (84)	0.8	0.1

INJECTOR FOR 76GeV Proton-Synchrotron
INSTITUTION I H E P
LOCATION Serpukhov, USSR

IN OPERATION SINCE 1967
DATA SUPPLIED BY V.A.Tepljakov
DATE February, 1974

PARAMETERS

Physical Dimensions

TOTAL LENGTH 80 m; No. TANKS 3
TANK DIAM. 1.8*m; No. DRIFT TUBES 160+6x1/2
DRIFT TUBE LENGTHS 6.2cm to 62.4cm
DRIFT TUBE DIAMETERS 23.2-10cm(Tl)and10cm
GAP/CELL LENGTH 0.185 to 0.284
APERTURE 2 cm to 4 cm

Ion Source **

TYPE Duoplasmatron
OUTPUT 1000 mA at 35 keV
BEAM EMITTANCE (mm-mrad) -

Injector

TYPE pulse transformer
OUTPUT 450 mA at 700 keV
BEAM EMITTANCE (mm-mrad) 8π (norm)

Buncher

TYPE single-gap
POTENTIAL 30 kV, DRIFT LENGTH ~ 85 cm

Acceleration System

RF FREQ 1485 MHz, Field mode TM 010 67,000-46,000
EQUIL. PHASE 38 deg., Accel. rate 1.2 MeV/m
DUTY FACTOR 0.004, Pulse length 300 μsec
SHUNT RESIST to 15 MΩ/m, Filling time 150 μsec
RF POWER INPUT (kW) PEAK 15,000 MEAN 0.6

Focusing System

No. QUADS 160 TYPE mag. ORDER FODO
GRADIENTS 6.0 to 0.399 kG/cm
OTHER -

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	100	100
ENERGY SPREAD ΔE/E (%)	±0.5 (with debuncher)	
CURRENT (mA)	90	180
BEAM EMITTANCE (mm-mrad)	10π (90% current) (norm)	

Other Parameters or Notable Features

*for vacuum tank. 1cavity diam=1.32m
11 " " =1.22m
111 " " =1.09m

**with plasma-cathode and pulse gas filling

Published Articles Describing Machine

INJECTOR FOR 10 Gev PS
INSTITUTION ITEP
LOCATION Moscow USSR

IN OPERATION SINCE November 1966
DATA SUPPLIED BY N.V. Lasarev
DATE February, 1974

PARAMETERS

Physical Dimensions
TOTAL LENGTH 18.4 m; No. TANKS 2
TANK DIAM. 1.9 m; No. DRIFT TUBES 20 + 35
DRIFT TUBE LENGTHS 13.7-31.3; 19.7-31.4 cm
DRIFT TUBE DIAMETERS 19 - 15; 15 cm
GAP/CELL LENGTH 0.2-0.3; 0.16-0.30
APERTURE 2.0 cm to 2.5 cm

Ion Source
TYPE Cold cathode duoplasmatron
OUTPUT - mA at 40 keV
BEAM EMITTANCE (mm-mrad) -

Injector
TYPE Pulse transformer
OUTPUT 1000 mA at 700 keV
BEAM EMITTANCE (mm-mrad) 150 - 300

Buncher
TYPE One gap
POTENTIAL 30 kV, DRIFT LENGTH 85 cm

Acceleration System
RF FREQ. 148.5 MHz, Field mode E010 Q 70000
EQUIL. PHASE 37 deg., Accel. rate 1.3 MeV/m
DUTY FACTOR 0.03 %, Pulse length 300 μsec
SHUNT RESIST. 22 MΩ/m, filling time 150 μsec
RF POWER INPUT (kW) PEAK 1000+2000 MEAN 0.3+0.6

Focusing System
No. QUADS 38+68 TYPE d.c. ORDER FOD;FOFDOD
GRADIENTS 5.5 to 1.8 kG/cm
OTHER each drift tube contains 2 lenses of opposite signs.

PERFORMANCE

	Normal (or Goal)	Maximum Achieved
OUTPUT ENERGY (MeV)	24.6	24.6
ENERGY SPREAD ΔE/E (%)	0.6	0.5
CURRENT (mA)	160	200
BEAM EMITTANCE (mm-mrad)	60	60

Other Parameters or Notable Features

The length of accel. period is $2\beta\lambda$ in 1st, $\beta\lambda$ in the second tanks.
The vacuum chamber is pumped out to 2×10^{-6} torr by ion vacuum pumps of total rate 8000 l/sec.

Published Articles Describing Machine

1. Prib. Tech. Eksp. N5, p.9-70, 1967
2. Prib. Tech. Eksp. N6, p.14, 1969
3. Proc. of the 6th Int. Conf. on High Energy Accelerators, Cambridge, Mass., 1967, p.A1-7,; A30-31
4. Proc. of the Los-Alamos Linac Conf. 1972, p.275.

NAME OF STORAGE RINGS: CERN Intersecting Storage Rings (ISR)
INSTITUTION: C.E.R.N.
LOCATION: Geneva, Switzerland

PERSON IN CHARGE: K. Johnsen
DATA SUPPLIED BY: M.H. Blewett, W. Schnell
DATE: February, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): 1966
FIRST COLLISIONS, OR GOAL (date): January, 1971
TOTAL COST OF FACILITY: ~326 million Sw.Fr.
FUNDED BY: CERN Supplementary Programme
TOTAL MACHINE STAFF (now): 330
ANNUAL OPERATING BUDGET: ~40 million Sw.Fr.

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES: protons ENERGY: 11 to 31 GeV
APPROX. SHAPE: circular DIMENSIONS: 300 m diam
ORBIT: length: 942.6 m, time: 3.2 μs
No. INTERSECTS: 8 CROSSING ANGLE: 14.77 deg.

Injector System

TYPE: CERN Proton Synchrotron
INJ. ENERGY: to 28 GeV OUTPUT: 2 × 10^{12} p/pulse
EMITTANCE: ____ mm-mrad
FILLING SPEED: approx. 1 pulse/2.5 s
TOTAL FILLING TIME: ~ 1000 s/ring

Magnet System

FOCUSING TYPE: comb.fn BEND. RAD.: 78.590 m
LATTICE ORDER: F O D O
No. MAGNETS: 2 × 132 Length (ea): 2.44; 4.88 m
No. QUADS: ____ Length (ea): ____ m
MAX BEND. FIELD: 12 kG; MAX. GRAD.: 0.478 kG/cm
OTHER MAGNETS: Rad.field, sext., spec.quads.
TOTAL WEIGHT (tons) Fe: 2 × 5360 Cu: 2 × 560
BETATRON OSC. FREQ. ν_H: 8.793 ν_V: 8.700
AMPL. FUNCT. AT INTERSECT, (H): 21 m (V): 13.86 m

Acceleration System

centre
HARMONIC No.: 30 FREQUENCY: 9.5 MHz
No. TRANSMITTERS: 6/ring No. CAVITIES: 6/ring + 1 spare
BUNCH TO BUNCH TIME: 105 ns + 1 spare
BUNCH SIZE (L×W×H): ____
PEAK RF VOLTAGE PER BEAM: 20 kV per turn
MAX RF POWER: ____ ON BEAMS: see note 1

Vacuum System

PRESSURE IN RINGS, NO BEAM: 2×10^{-11} (N_2eq.) Torr
WITH BEAM: ____ Torr
PRESSURE AT INTERSECTIONS: ~ 3 × 10^{-12} Torr
PUMPS (no., type, speed): 2 × 144, 400 ℓ/s sputter ion; 2 × 7, 100 ℓ/s sputter ion; 2 × 250 tit. sublim.

Other Relevant Parameters or Notable Features

ISR are two identical interlaced rings intersecting at 8 points

Note 1: RF system is used for stacking and for phase-displacement acceleration from 26 to 31.4 GeV/c

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV/c)	10 to 28	31.4
RESOLUTION ΔE/E (%)	2%	
LUMINOSITY (cm^{-2} sec^{-1})	4 × 10^{30}	6.7×10^{30}
BEAM SIZE, horizontal		
vertical	effective height ~3mm	
CURRENT, PER BEAM	20 A	22 A
BEAM LIFE, AT 20 A	12 hr	*
typical loss rates A		0.1%/hr
SCHEDULED OPERATION	3000 hr/year	

"ON BEAM": > 90 % OF SCHEDULED TIME

*longest life to date: 58 hr, 12 A.

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA: ~ 6000 m²
No. EXPERIMENTAL INTERSECTS: 6; 6 now in use
No. EXPERIMENTS/INTERSECT: 1 to 4

SPECIAL RESEARCH EQUIPMENT OR FACILITIES:
3 magnetic spectrometers
Split-field analyzing magnet of 28 m^3 field volume.
Thin-walled (down to 0.15 mm), specially shaped vacuum chambers at intersection regions.

TOTAL POWER INSTALLED FOR RESEARCH: 14.5 MVA
USER GROUPS: in-house: 0; mixed + outside: 12 to 15
TOTAL RESEARCH STAFF, in-house: ~ 40 outside: ~ 230
ANNUAL RESEARCH BUDGET: ____
SCHEDULED RESEARCH TIME: ~2200 hr/year

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

High-luminosity insertions (low-beta) at intersections; first stage (steel-copper quadrupoles) at one intersection in 1974.

Published Articles Describing Machine

Contributions in Proc. of Int. Conf. on High-Energy Accelerators for 1967, 1969 and 1971.

E. Keil, "Intersecting Storage Rings", CERN report 72-14, 1972.

W. Schnell, IEEE Trans. Nucl. Sci., NS-20 no. 3, p. 747, 1973.

K. Johnsen, Nucl. Instr. and Methods, 108, p. 205, 1973.

NAME OF STORAGE RINGS D.C.I. *)
INSTITUTION Lab. Accélérateur Linéaire
LOCATION ORSAY (France)

PERSON IN CHARGE P. MARIN
DATA SUPPLIED BY M. SOMMER
DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) March 1971
FIRST COLLISIONS, OR GOAL (date) 1975
TOTAL COST OF FACILITY 41.5 MF (October 1970)
FUNDED BY National Ministry of Education
TOTAL MACHINE STAFF (now) 150
ANNUAL OPERATING BUDGET Not evaluated yet

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES $2(e^+e^-)$ ENERGY 1.8 GeV
APPROX. SHAPE Race track DIMENSIONS 33 × 21 m^2
ORBIT: length 94.6 m, time 316 ns
No. INTERSECTS 2 CROSSING ANGLE 0

Injector System

TYPE Linac
INJ. ENERGY 1.2 GeV OUTPUT $3.6\times10^8 e^+$/20ns pulse
EMITTANCE, for e^+ : 5 mm-mrad
FILLING SPEED (e^+) 3 to 9 A/h 1 beam
TOTAL FILLING TIME ≤ 1 hour

Magnet System

FOCUSING TYPE Strong BEND. RAD. H:3.82, V:4 m
LATTICE ORDER 2
No. MAGNETS 2 × 12 Length (ea) 2 m
No. QUADS 2 × 48 Length (ea) .45 m
MAX BEND. FIELD 16 kG; MAX. GRAD. 1.2 kG/cm
OTHER MAGNETS 2 × 16 sextupoles
TOTAL WEIGHT (tons) Fe 800 Cu 80
BETATRON OSC. FREQ. ν_H 3.5-4.9 ν_V 1.5 - 2.9
AMPL. FUNCT. AT INTERSECT, (H) 2 m (V) 2 m

Acceleration System

HARMONIC No. 8 FREQUENCY 25.352 MHz
No. TRANSMITTERS 2 No. CAVITIES 2 × 1
BUNCH TO BUNCH TIME 316 ns
BUNCH SIZE (L×W×H) 300 × 1.6 × 1.8 mm^3
PEAK RF VOLTAGE PER BEAM 450 kV (max)
MAX RF POWER 2 × 350 kW BEAMS 125 kW per beam

Vacuum System

PRESSURE IN RINGS, NO BEAM < 10^{-9} Torr
WITH BEAM < 10^{-8} Torr
PRESSURE AT INTERSECTIONS Torr
PUMPS (no., type, speed) 2 × 24 Ionic
2 × 50 Sublimation

Other Relevant Parameters or Notable Features

- Space charge compensation.
- 2 rings, with two beams in each.
- One bunch per beam.
- Possibility of e^-e^- mode with 8 bunches /beam.

STORAGE RINGS PERFORMANCE

		(Goal)	Maximum Achieved
ENERGY (GeV)	1.3	1.6	1.8
RESOLUTION ΔE/E (%)		0.06	
LUMINOSITY (cm^{-2} sec^{-1})	2.5	1	0.4×10^{32}
BEAM SIZE, horizontal	1.4	0.7	0.8 (mm): σ_x
vertical	1.3	0.8	0.9 (mm): σ_z
CURRENT, PER BEAM (A)	1.5	0.6	0.4
BEAM LIFE, AT 1 A		> 5 h	
A			
SCHEDULED OPERATION (hr/wk)			

"ON BEAM" % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA m^2
No. EXPERIMENTAL INTERSECTS 1
No. EXPERIMENTS/INTERSECT 1
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

2 synchrotron radiation external beams (LURE)

TOTAL POWER INSTALLED FOR RESEARCH MW
USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET
SCHEDULED RESEARCH TIME, hours/week

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

- Proceedings of the 8th International Conference on High Energy Accelerators, CERN, Geneva (1971)

* Université PARIS-SUD
Dependent on I.N.2.P.3 (Institut National de Physique Nucléaire et de Physique des Particules).

NAME OF STORAGE RINGS ACO
INSTITUTION Lab. Accélérateur Linéaire *)
LOCATION ORSAY (France)

PERSON IN CHARGE P. MARIN
DATA SUPPLIED BY M. SOMMER
DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1962
FIRST COLLISIONS, OR GOAL (date) June 1966
TOTAL COST OF FACILITY 15 MF
FUNDED BY National Ministry of Education
TOTAL MACHINE STAFF (now) 13
ANNUAL OPERATING BUDGET 0.35 MF + Elect. Cost

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES e^+e^- ENERGY max 0.54 GeV
APPROX. SHAPE circular DIMENSIONS Ø = 7 m
ORBIT: length 22 m, time 73 ns
No. INTERSECTS 2 CROSSING ANGLE 0

Injector System

TYPE Linac
INJ. ENERGY 0.24 GeV OUTPUT 3.10^9 e^+/1µs pulse
EMITTANCE, for e^+ : 6 π mm-mrad
FILLING SPEED 0.5 A/hour for e^+
TOTAL FILLING TIME 3/4 hour (e^+, e^-)

Magnet System

FOCUSING TYPE Strong BEND. RAD. 1.11 m
LATTICE ORDER 4
No. MAGNETS 8 Length (ea) 0.87 m
No. QUADS 12 Length (ea) 0.33 m
MAX BEND. FIELD 16 kG; MAX. GRAD. 1.45 kG/cm
OTHER MAGNETS 12 sextupoles, 2 octupoles
TOTAL WEIGHT (tons) Fe 90 Cu 13
BETATRON OSC. FREQ. ν_H 2.845 ν_V 0.833
AMPL. FUNCT. AT INTERSECT, (H) 1.8 m (V) 4 m

Acceleration System

HARMONIC No. 2 FREQUENCY 27.236 MHz
No. TRANSMITTERS 1 No. CAVITIES 1
BUNCH TO BUNCH TIME 73 ns
BUNCH SIZE (L×W×H) 300 × 1.3 × 1.3 mm^3 at 0.5 GeV
PEAK RF VOLTAGE PER BEAM 17.5 kV at 0.5 GeV
MAX RF POWER 10 kW ON BEAMS 0.5 kW

Vacuum System

PRESSURE IN RINGS, NO BEAM few 10^{-10} Torr
WITH BEAM < 10^{-9} Torr
PRESSURE AT INTERSECTIONS $4×10^{-10}$ with beam Torr
PUMPS (no., type, speed) 3 ionic
6 sublimation
2 distributed

Other Relevant Parameters or Notable Features

- One bunch mode operation.
- Possibility of modification of the lattice order in order to obtain higher luminosities.

STORAGE RINGS PERFORMANCE

	Normal (max max)	Maximum Achieved
ENERGY (GeV)	.51	.54
RESOLUTION ΔE/E (%)	.05	
LUMINOSITY (cm^{-2} sec^{-1})	10^{29}	
BEAM SIZE, horizontal σ_x^* =	0.5 mm	
vertical σ_z^* =	0.5 mm	
CURRENT, PER BEAM	35 mA	
BEAM LIFE, AT .035 A	5 h	
.030 A	10 h	

SCHEDULED OPERATION (hr/wk) 168 h/wk 3 wk our of 4
"ON BEAM" 75 % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA ____ m^2
No. EXPERIMENTAL INTERSECTS 1
No. EXPERIMENTS/INTERSECT 1
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

- cylindrical (spark and wire) chambers
- magnetic detector
- 1 synchrotron radiation external beam (LURE)

TOTAL POWER INSTALLED FOR RESEARCH 1.9 MW
USER GROUPS: in-house 2 outside 1
TOTAL RESEARCH STAFF, in-house 25 outside 15
ANNUAL RESEARCH BUDGET LAL (2.0 MF), LURE (1 MF)
SCHEDULED RESEARCH TIME, hours/week 135

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

- Proceedings of the Dubna Conference (1963)
- Proceedings of the Frascati Conference (1965)
- Proceedings of the CERN Conference (1971)

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* Université PARIS-SUD
Dependent on I.N.2.P.3. (Institut National de Physique Nucléaire et de Physique des Particules).

NAME OF STORAGE RINGS: DORIS
INSTITUTION: DESY
LOCATION: Hamburg

PERSON IN CHARGE: H. Schopper
DATA SUPPLIED BY: D. Degèle, K. Steffen
DATE: 17.1.1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): 1969
FIRST COLLISIONS, OR GOAL (date): 1974
TOTAL COST OF FACILITY: 10^8 DM
FUNDED BY: Government
TOTAL MACHINE STAFF (now): 80
ANNUAL OPERATING BUDGET: -

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES: $e^- e^+ (e^- e^-)$ ENERGY: 3,6 GeV
APPROX. SHAPE: oval DIMENSIONS: 110m x 55m
ORBIT: length 2x288 m, time 0,96 μsec
No. INTERSECTS: 2 CROSSING ANGLE: 2x12 mrad

Injector System

TYPE: 40/400 MeV Linac + Synchrotron
INJ. ENERGY: ≤ 2.2 GeV OUTPUT: e^- :15mA e^+:0,5mA
EMITTANCE, e^-: 1πmmmrad, e^+: 5 π mm-mrad
FILLING SPEED: e^-: 100mA/s e^+: 20mA/s
TOTAL FILLING TIME: approx. 5 min for 0,9A

Magnet System

FOCUSING TYPE: sep.fct BEND. RAD.: 12.19 m
LATTICE ORDER: Q/2 Q Q Q B B Q Q Q Q/2
No. MAGNETS: 2 x 24 Length (ea): 3,19 m
No. QUADS: 2x56 + 13 Length (ea): 0,6m resp.1,1
MAX BEND. FIELD: 9,7 kG; MAX. GRAD.: 0,9 kG/cm
OTHER MAGNETS: 2x12vert.bend;2x12sext;2x2oct
TOTAL WEIGHT (tons) Fe: 800 t Cu: 70 t
BETATRON OSC. FREQ. ν_H: 7...8 ν_V: 4...5,5
AMPL. FUNCT. AT INTERSECT, (H): 0,5m (V): 0,1m

Acceleration System

HARMONIC No.: 480 FREQUENCY: 499,67 MHz
No. TRANSMITTERS: 2 x 3 No. CAVITIES: 2 x 12
BUNCH TO BUNCH TIME: 2 nsec
BUNCH SIZE (L×W×H): 40mmx6,0mmx0,3mm
PEAK RF VOLTAGE PER BEAM: 6,5 MV
MAX RF POWER: 2x750 KW ON BEAMS: 2x580 KW

Vacuum System

PRESSURE IN RINGS, NO BEAM: $1 \cdot 10^{-9}$ Torr
WITH BEAM: $2 \cdot 10^{-8}$ Torr
PRESSURE AT INTERSECTIONS: $< 10^{-9}$ Torr
PUMPS (no., type, speed): 84 ion sput.p.450 1/sec
48 distr.ion sput.p.2000 1/sec

Other Relevant Parameters or Notable Features

Double ring with vertical crossing

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	3 GeV	
RESOLUTION ΔE/E (%)	7×10^{-4}	
LUMINOSITY (cm^{-2} sec^{-1})	10^{32}	
BEAM SIZE, horizontal mm	0,6	
vertical mm	0,03	
CURRENT, PER BEAM	0.9A	
BEAM LIFE, AT 0.9 A	6 h	
- A		
SCHEDULED OPERATION (hr/wk)	140	

"ON BEAM": ____ % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA: 2 x 300 m^2
No. EXPERIMENTAL INTERSECTS: 2
No. EXPERIMENTS/INTERSECT: 1 - 2

SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

1.4 m Ø superconducting solenoid magnet of 1.15 m length. B_{max} = 20 KΓ

500 tons doublearm spectrometer magnets
B·ℓ = 18 KΓ·m gapwidth = 0,90 m

TOTAL POWER INSTALLED FOR RESEARCH: 6 MW
USER GROUPS: in-house ____ outside ____
TOTAL RESEARCH STAFF, in-house ____ outside ____
ANNUAL RESEARCH BUDGET ____
SCHEDULED RESEARCH TIME, hours/week ____

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Max. Energy: 2x5,0 GeV

Max. Injection energy: 5,0 GeV

Injection of protons for e-p-collisions

Published Articles Describing Machine

-K.Steffen, DESY Int.Report H/18 (Sept.69)
-K.Steffen, DESY Report 70/24 (June 70)
-Kerntechnik 12 (1970) 526, 536

NAME OF STORAGE RINGS: ADONE
INSTITUTION: Laboratori Naz.del CNEN
LOCATION: Frascati - Italy

PERSON IN CHARGE: Sergio TAZZARI
DATA SUPPLIED BY: " "
DATE: February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date): 1964
FIRST COLLISIONS, OR GOAL (date): 1969
TOTAL COST OF FACILITY: $ 9 millions
FUNDED BY: CNEN (2/3); CNR (1/3)
TOTAL MACHINE STAFF (now): 54
ANNUAL OPERATING BUDGET: $ 7 millions

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES: e^+ e^- ENERGY: 1.5 GeV
APPROX. SHAPE: circular DIMENSIONS: 16.4m radius
ORBIT: length 104 m, time .35 μs
No. INTERSECTS: 6 CROSSING ANGLE: 0

Injector System

TYPE: Linac
INJ. ENERGY: 320 MeV OUTPUT: 1A e^-; 6mA e^+
EMITTANCE: ≃ 2π e^-; ≃ 10π e^+ mm-mrad
FILLING SPEED: 10 mA/s e^-; 5 mA/s e^+
TOTAL FILLING TIME: ~ 20 m

Magnet System

FOCUSING TYPE: AG SF BEND. RAD.: 5.00 m
LATTICE ORDER: 0/2 Qf Qd B Qd Qf 0/2
No. MAGNETS: 12 Length (ea): 2.61 m
No. QUADS: 48 Length (ea): .5 m
MAX BEND. FIELD: 10 kG; MAX. GRAD.: .5 kG/cm
OTHER MAGNETS:
TOTAL WEIGHT (tons) Fe: 350 Cu: 30
BETATRON OSC. FREQ. ν_H: 3.0÷3.5 ν_V: 3.0÷3.5
AMPL. FUNCT. AT INTERSECT, (H): 9 m (V): 3.2 m

Acceleration System

HARMONIC No.: 3 FREQUENCY: 8.568 MHz
No. TRANSMITTERS: 4 No. CAVITIES: 2 x 2
BUNCH TO BUNCH TIME: 117 ns
BUNCH SIZE (L×W×H): ~600 x 3.5 x 2 mm³
PEAK RF VOLTAGE PER BEAM: 160 KV/turn
MAX RF POWER: 190 KW ON BEAMS: 20 KW

Vacuum System

PRESSURE IN RINGS, NO BEAM: ~ 10^{-10} Torr
WITH BEAM: ~ 10^{-9} Torr
PRESSURE AT INTERSECTIONS: ≤ 10^{-9} Torr
PUMPS (no., type, speed): 28x500 lt/s + distributed pumps (~6x200 lt/s)

Other Relevant Parameters or Notable Features

STORAGE RINGS PERFORMANCE

	Normal (~~Design~~)	Maximum Achieved
ENERGY (GeV)	1.5	
RESOLUTION ΔE/E (%)	~5.10⁻⁴	
LUMINOSITY (cm^{-2} sec^{-1})	6 10^{29}	@1.5 GeV
BEAM SIZE, horizontal	~3.5 mm	
vertical	~2 mm	
CURRENT, PER BEAM	60 mA	
BEAM LIFE, AT .1 A	~10 h	
AT A		
SCHEDULED OPERATION (hr/wk)	143	

"ON BEAM" 55 % OF SCHEDULED TIME ("two beams on" time)

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA: m²
No. EXPERIMENTAL INTERSECTS: 4
No. EXPERIMENTS/INTERSECT: 1
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

Magnetic detector

TOTAL POWER INSTALLED FOR RESEARCH: 2.7 MW
USER GROUPS: in-house mixed outside 4
TOTAL RESEARCH STAFF, in-house 21 outside 34
ANNUAL RESEARCH BUDGET: average $ ~ .7 millions
SCHEDULED RESEARCH TIME, hours/week: 100 average

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

50 MHz RF system (1975)

Published Articles Describing Machine

- ADONE Status Report - Proc.of the Int. Conf.on high Energy Acc. - Dubna (1963)
- F.Amman et al. Lettere al Nuovo Cimento (1969)
- Status Report on the e^+ e^- storage ring ADONE - Proc.of the 1971 Particle Acc. Conf. - Geneva, p. 132

NAME OF STORAGE RINGS SPEAR
INSTITUTION Stanford Lin. Accel. Ctr.
LOCATION Stanford, California, USA

PERSON IN CHARGE B. Richter
DATA SUPPLIED BY E. Paterson, G. Fischer
DATE 20 February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) August 1970
FIRST COLLISIONS, OR GOAL (date) April 1972
TOTAL COST OF FACILITY $5 million
FUNDED BY USAEC
TOTAL MACHINE STAFF (now) 44
ANNUAL OPERATING BUDGET $1 million

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES $e^+ e^-$ ENERGY each beam 2.5 GeV
APPROX. SHAPE Racetrack DIMENSIONS 40 x 32 m
ORBIT: length 234 m, time per rev 0.78 μsec
No. INTERSECTS 2 CROSSING ANGLE 0

Injector System

TYPE Stanford Linear Accelerator
INJ. ENERGY 1.5 GeV OUTPUT 7 mA e^+ in 7-ns pulse
EMITTANCE, π x 1 mm x 0.4 mm-mrad
FILLING SPEED ≈ 10 mA/min
TOTAL FILLING TIME 20 min for both beams

Magnet System

FOCUSING TYPE Sep funct NO. RAD. 12.7 m
LATTICE ORDER QFBDBFO
No. MAGNETS 36 B Length (ea) 2.35/1.75 m
No. QUADS 46 Q Length (ea) 0.5 m
MAX BEND. FIELD 6.5 kG; MAX. GRAD. 0.4 at 2.5 GeV kG/cm
OTHER MAGNETS 8 Int Reg Q, 52 Sext, 4 Oct
TOTAL WEIGHT (tons) Fe ~220 tons Cu Al ~ 10 tons
BETATRON OSC. FREQ. ν_H 5.0 - 5.25 ν_V 5.0 - 5.25
AMPL. FUNCT. AT INTERSECT, (H) 1.25 m (V) 0.05 variable

Acceleration System

HARMONIC No. 40 FREQUENCY 40 x 1.28 MHz
No. TRANSMITTERS 8 No. CAVITIES 2
BUNCH TO BUNCH TIME 1 bunch in each beam = 780 ns
BUNCH SIZE (L×W×H) L = 30 cm
PEAK RF VOLTAGE PER BEAM 500 kV
MAX RF POWER 160 kW ON BEAMS 110 kW (typ.)

Vacuum System

PRESSURE IN RINGS, NO BEAM 10^{-9} Torr
WITH BEAM 3×10^{-9} Torr
PRESSURE AT INTERSECTIONS $\sim 1 \times 10^{-9}$ Torr
PUMPS (no., type, speed) 20, Ion, 400 ℓ/sec
36m Dist Ion 600 ℓ/sec

Other Relevant Parameters or Notable Features

Two low-beta interaction regions having 5 meters clear for experimental apparatus. The machine is computer-controlled.

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	2.5 GeV	
RESOLUTION ΔE/E (%)	0.06%	
LUMINOSITY (cm^{-2} sec^{-1})	6×10^{30} at 2.6 GeV	
BEAM SIZE, horizontal	3 mm	
vertical	0.08 mm at Int	
CURRENT, PER BEAM	0.22 A	
BEAM LIFE, AT 60 m A and 2.5 GeV	3 hrs	
SCHEDULED OPERATION (hr/yr, ~~xxyr~~)	4000	

"ON BEAM" 75 % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA 2 areas ea 120 m²
No. EXPERIMENTAL INTERSECTS 2
No. EXPERIMENTS/INTERSECT 1
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

(1) One large magnetic detector--with spark chamber readout, shower counters, muon identifier, and time-of-flight system.
(2) Time-shared on-line data acquisition and remote terminals.

TOTAL POWER INSTALLED FOR RESEARCH 4.0 MW
USER GROUPS: in-house 2 outside 7
TOTAL RESEARCH STAFF, in-house 12 outside 11
ANNUAL RESEARCH BUDGET $1 million
SCHEDULED RESEARCH TIME, hours/year 3,000

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Energy increase to 4.0 to 4.5 GeV per beam, scheduled for completion October 1974.

Published Articles Describing Machine

(1) Colliding Beams - Present Status and the SLAC Project, B. Richter, invited paper presented at 1971 Accelerator Conference, Chicago, Illinois, March 1-3, 1971.

(2) The SLAC Storage Ring Project - SPEAR, presented at VIIIth Accelerator Conference, CERN, 1971.

NAME OF STORAGE RINGS Tantalus I
INSTITUTION
LOCATION Wisconsin

PERSON IN CHARGE E. M. Rowe
DATA SUPPLIED BY E. M. Rowe
DATE January 21, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) August 1965
FIRST COLLISIONS, OR GOAL (date) February 1968
TOTAL COST OF FACILITY
FUNDED BY NSF beginning Sept. 1, 1974
TOTAL MACHINE STAFF (now) 12
ANNUAL OPERATING BUDGET $350,000

STORAGE RINGS PARAMETERS

General

~~XXXXXXX~~ PARTICLES electrons ENERGY .240 GeV
APPROX. SHAPE octagon DIMENSIONS $\bar{R} \simeq 1.5$ meters
ORBIT: length 9.4 m, time 3.12×10^{-8}
No. INTERSECTS CROSSING ANGLE

Injector System

TYPE microtron
INJ. ENERGY 44 MeV OUTPUT 2×10^{11} per pulse
EMITTANCE, $2\pi \times .5\pi$ mm-mrad
FILLING SPEED single pulse, 5 turn inj.
TOTAL FILLING TIME

Magnet System

FOCUSING TYPE AG BEND. RAD. .65 m
LATTICE ORDER 0/2 DDFDD 0/2
No. MAGNETS 8 Length (ea) .68 m
No. QUADS 4 Length (ea) .10 m
MAX BEND. FIELD 12.3 kG; MAX. GRAD. 1.2 kG/cm
OTHER MAGNETS
TOTAL WEIGHT (tons) Fe 10 Cu 1.2
BETATRON OSC. FREQ. ν_H 1.18 ν_V 1.14
AMPL. FUNCT. AT INTERSECT, (H) (V)

Acceleration System

HARMONIC No. 1 FREQUENCY 31.955 MHz
No. TRANSMITTERS 1 No. CAVITIES 1
BUNCH TO BUNCH TIME 3.2×10^{-8} sec
BUNCH SIZE (L×W×H) variable, 600 x 1.5 x .5 nominal
PEAK RF VOLTAGE PER BEAM 20 kV
MAX RF POWER 20 kW ON BEAMS

Vacuum System

PRESSURE IN RINGS, NO BEAM 5×10^{-10} Torr
WITH BEAM 2×10^{-9} Torr
PRESSURE AT INTERSECTIONS Torr
PUMPS (no., type, speed) internal, 200 ℓ/sec per magnet

Other Relevant Parameters or Notable Features

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	.240	.240
RESOLUTION ΔE/E (%)	6.25×10^{-3}	
LUMINOSITY (cm^{-2} sec^{-1})		
BEAM SIZE, horizontal		
vertical		
CURRENT, PER BEAM	20	30
BEAM LIFE, AT 20 m A	3 hours	
A		
SCHEDULED OPERATION (hr/wk)	46	

"ON BEAM" 100 % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA 400 m^2
No. EXPERIMENTAL INTERSECTS see below
No. EXPERIMENTS/INTERSECT
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

The storage ring is used exclusively as a source of synchrotron radiation for solid state physics, atomic physics, and chemistry. There are, at present, 9 radiation ports installed for this.

TOTAL POWER INSTALLED FOR RESEARCH 150 kVA MW
USER GROUPS: in-house 3 outside 18
TOTAL RESEARCH STAFF, in-house 6 outside 60
ANNUAL RESEARCH BUDGET > 750,000
SCHEDULED RESEARCH TIME, hours/week 46 at present, 72 at end of year

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

Tantalus I: A Dedicated Storage Ring Synchrotron Radiation Source. E. M. Rowe & F. E. Mills. Particle Accelerators 1973, Vol. 4, pp. 211-227.

NAME OF STORAGE RINGS SUPER ADONE
INSTITUTION Laboratori Nazionali del CNEN
LOCATION Frascati

PERSON IN CHARGE
DATA SUPPLIED BY S. TAZZARI
DATE Feb. 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) Prel. Project
FIRST COLLISIONS, OR GOAL (date)
TOTAL COST OF FACILITY ~ $ 27 millions (1973)
FUNDED BY Not Yet Funded
TOTAL MACHINE STAFF (now) /
ANNUAL OPERATING BUDGET /

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES e^+ e^- ENERGY 10 + 12 GeV
APPROX. SHAPE Race Track DIMENSIONS Av.rad. 136 m
ORBIT: length 857 m, time 2.86 μs
No. INTERSECTS 2 CROSSING ANGLE 0

Injector System

TYPE LINAC + ADONE
INJ. ENERGY 1.5 GeV OUTPUT /
EMITTANCE, 5 RAD 3 VERT mm-mrad
FILLING SPEED e^+: ~4.5 mA/m; e^-: ~20 mA/m
TOTAL FILLING TIME ~ 1 h

Magnet System

FOCUSING TYPE S.F. BEND. RAD. 64 m
LATTICE ORDER standard cell: 0/2-F-B-D-0-D-B-F-0/2
No. MAGNETS 48 + 16 Length (ea) 6.28 m
No. QUADS 96 (st.cell) Length (ea) .5 m
MAX BEND. FIELD 5.2 kG; MAX. GRAD. ~ .5 kG/cm
OTHER MAGNETS 40 insert. quads; sextupoles
TOTAL WEIGHT (tons) Fe ~ 1100 Cu ~ 160
BETATRON OSC. FREQ. ν_H 9.2 ν_V 7.2
AMPL. FUNCT. AT INTERSECT, (H) 1÷2.2 m (V) .2 m

Acceleration System

HARMONIC No. 294 FREQUENCY 103 MHz
No. TRANSMITTERS 56 No. CAVITIES 56
BUNCH TO BUNCH TIME (one bunch) 2.86 μs
BUNCH SIZE (L×W×H) ~ 75x.3x.6 mm^3 at X-ing
PEAK RF VOLTAGE PER BEAM 20 MV
MAX RF POWER 2.6 MW ON BEAMS 1.4 MW

Vacuum System

PRESSURE IN RINGS, NO BEAM ~ 10^{-10} Torr
WITH BEAM ~ 10^{-9} Torr
PRESSURE AT INTERSECTIONS ~ 10^{-10} Torr
PUMPS (no., type, speed) 120 x 200 l/s + distributed pumps (~64 x 6000 l/s)

Other Relevant Parameters or Notable Features

STORAGE RINGS PERFORMANCE

	~~XXXXX~~ (or Goal)	~~XXXXX~~ ~~XXXXX~~
ENERGY (GeV)	10 + 12	
RESOLUTION ΔE/E (%)	~ 10^{-3}	
LUMINOSITY (cm^{-2} sec^{-1})	~ 10^{32}	
BEAM SIZE, horizontal	.6 mm	
vertical	.3 mm	
CURRENT, PER BEAM	200 mA max	
BEAM LIFE, AT / A	~ 9 h	
/ A		
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA / m^2
No. EXPERIMENTAL INTERSECTS 2
No. EXPERIMENTS/INTERSECT 1
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

TOTAL POWER INSTALLED FOR RESEARCH ~ 5 MW
USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET
SCHEDULED RESEARCH TIME, hours/week

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

SUPERADONE
(Special Document of INFN & CNEN)

SYNCHROTRON RADIATION SOURCE

NAME OF MACHINE (Electron-storage ring) PERSON IN CHARGE PROFESSOR A. ASHMORE
INSTITUTION DARESBURY LABORATORY DATA SUPPLIED BY D.J. THOMPSON
LOCATION DARESBURY, NR. WARRINGTON, U.K. DATE 22ND JANUARY, 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) Not yet funded
FIRST BEAM OBTAINED, OR GOAL (date) December 1978
TOTAL COST OF FACILITY £2M approx (capital)
FUNDED BY Science Research Council
TOTAL ACCELERATOR STAFF (now) -
ANNUAL OPERATING BUDGET -

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 30.1 m; Tunnel sect. _____ _____ m
MAGNET ___ x ___ m; Mag. Gap 6.5 x vert cm
"DONUT" 19 x 4.5 cm; Aperture 15 x 4 cm

Injector System
TYPE 10 MeV linac + 600 MeV synchrotron
OUTPUT (max) 10^{10} e⁻/pulse at 600 MeV
BEAM EMITTANCE _____ mm-mrad
INJECTION PERIOD 0.315 μsec, or 1 turns
INFLECTOR TYPE Pulsed magnetic. Multicycle accumulation

Magnet System
FOCUSING TYPE Separated Function
No. MAG. UNITS 16 Length (ea) dipoles 2.18m
STRAIGHT SECT. 16 Total S.S. Length 60 m
FOCUSING ORDER FBODBO
BETATRON OSC. FREQ. ν_H Both in ν_V range 2 to 3.5
FIELD, AT INJ. 3600 G, at max 12 kG
RISE TIME - sec; Flat-top time - sec
MAG. WEIGHT (tons) Fe _____, Cu _____
POWER INPUT (MW) PEAK _____ MEAN ~ 0.4

Acceleration System
HARMONIC No. 135 No. Cavities 4
RF RANGE _____ 428 MHz
ORBIT FREQ. _____ 3.17 MHz
ENERGY GAIN -
RADIATION LOSS 255 keV/turn
RF POWER INPUT (kW) PEAK 430 _____

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	2	
RESOLUTION ΔE/E (%)		
REPET. RATE (pulse/sec)		
Storage time	8 hours at full	intensity
DUTY FACTOR, macroscopic (%)		
INTERNAL BEAM (part/pulse)		
(part/sec)		
CURRENT (mA)	1000	
BEAM EMITTANCE (mm-mrad)		
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" _____ % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)	
1) Synchrotron Radiation, characteristic wavelength 3.9 Å.					
5 x 10^{13} photons/s/mr					in 0.1% bandwidth at peak
2 x 10^{12}	"	" "	"	"	at 1Å
10^{13}	"	" "	"	"	at 4000 Å
2) Test beam from synchrotron injector					

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA ~ 2000 m²
BEAM LINES TO ~ 20 Stations
STATIONS SERVED AT SAME TIME All
BEAM SEPARATORS _____ SPECTROMETERS _____
ON-LINE COMPUTERS WITH _____ Inputs
BUBBLE CHAMBERS, in-house _____ Users' _____
TOTAL POWER INSTALLED FOR RESEARCH _____ MW
No. USER GROUPS: in-house _____ outside _____
TOTAL RESEARCH STAFF, in-house _____ outside _____
ANNUAL RESEARCH BUDGET, in-house _____
SCHEDULED RESEARCH TIME, hours/week _____

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

This electron storage ring is proposed as a dedicated source of synchrotron radiation at Daresbury Laboratory after the closure of NINA.

Published Articles Describing Machine

Daresbury Laboratory Internal Technical Memorandum T/M 105 (D.J. Thompson).

NAME OF STORAGE RINGS EPIC
INSTITUTION Rutherford and Daresbury
LOCATION Ruth.Lab., Chilton, Didcot, Berks., UK

PERSON IN CHARGE D A Gray
DATA SUPPLIED BY G H Rees
DATE January 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) 1976
FIRST COLLISIONS, OR GOAL (date) 1981
TOTAL COST OF FACILITY ~ £20M (excl.staff costs)
FUNDED BY Science Research Council, UK
TOTAL MACHINE STAFF (now)
ANNUAL OPERATING BUDGET

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES $e^{\pm}$ ENERGY 14 GeV
APPROX. SHAPE symm. race-track DIMENSIONS 349m radius
ORBIT: length 2200 m, time $7.33\ 10^{-6}$ secs
No. INTERSECTS 4 CROSSING ANGLE Collinear

Injector System

TYPE Linacs + Booster Synchrotron
INJ. ENERGY 5 GeV OUTPUT $10^{9}\ e^{\pm}$/pulse
EMITTANCE, 3π (H) π (V) mm-mrad
FILLING SPEED ~ 2 x 10^{9} e+ or e^{-}/sec
TOTAL FILLING TIME <1000 sec

Magnet System

FOCUSING TYPE Sep.FN BEND. RAD. 171.89 m
LATTICE ORDER (14,FBDB) + (FODBOFDOFDO Insert + Insert Reversed)
No. MAGNETS 240 Length (ea) 4.5 m
No. QUADS 132 + 32 Length (ea) 1.0 m
MAX BEND. FIELD 4.27 kG; MAX. GRAD. 0.95 kG/cm
OTHER MAGNETS 160 sext, 4 oct, 4 sk.quad
TOTAL WEIGHT (tons) Fe Cu
BETATRON OSC. FREQ. ν_H 19.1/18.1/15.1 ν_V 19.1/18.1/15.1
AMPL. FUNCT. AT INTERSECT, (H) .4-1.2m (V) .1-.3m

Acceleration System

HARMONIC No. 2880 FREQUENCY 394 MHz
No. TRANSMITTERS 16 No. CAVITIES 16 x 10
BUNCH TO BUNCH TIME $1.83\ 10^{-6}$ sec
BUNCH SIZE (L×W×H) 70mm x 1.2mm x 0.3mm at X_n
PEAK RF VOLTAGE PER BEAM 30 MV
MAX RF POWER 2-2.6 MW ON BEAMS 2 x 0.7 MW

Vacuum System

PRESSURE IN RINGS, NO BEAM 10^{-9} Torr
WITH BEAM Torr
PRESSURE AT INTERSECTIONS <10^{-9} Torr
PUMPS (no., type, speed)

Other Relevant Parameters or Notable Features

Single ring, long insertions.

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)		
RESOLUTION $\Delta E/E$ (%)		
LUMINOSITY ($cm^{-2}\ sec^{-1}$)		
BEAM SIZE, horizontal		
vertical		
CURRENT, PER BEAM		
BEAM LIFE, AT A		
A		
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA m^2
No. EXPERIMENTAL INTERSECTS 4
No. EXPERIMENTS/INTERSECT 1
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

TOTAL POWER INSTALLED FOR RESEARCH MW
USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET
SCHEDULED RESEARCH TIME, hours/week

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

1. Series of R.L. internal reports EPIC/MC/1-40 (1973/74)
2. A description is to be given by G H Rees in the 1974 International Accelerator Conference Proceedings.

NAME OF MACHINE Superconducting Stretcher Ring (ZGS-SSR)
INSTITUTION Argonne National Laboratory
LOCATION Argonne, Illinois USA

PERSON IN CHARGE Ronald L. Martin
DATA SUPPLIED BY Edwin A. Crosbie
DATE February 1974

HISTORY AND STATUS

CONSTRUCTION STARTED (date) January 1976
FIRST BEAM OBTAINED, OR GOAL (date) January 1978
TOTAL COST OF FACILITY $4 M
FUNDED BY US AEC (proposed)
TOTAL ACCELERATOR STAFF (now)
ANNUAL OPERATING BUDGET

ACCELERATOR PARAMETERS

Physical Dimensions (Mean)
RING DIAM. 63.66 m; Tunnel sect. ZGS ring building
MAGNET 46 diam m; Mag. Gap 10 diam cm
"DONUT" x cm; Aperture 9 diam cm

Injector System
TYPE ZGS
OUTPUT (max) 10^{13} pulse at 12.0 GeV
BEAM EMITTANCE 25 π mm-mrad
INJECTION PERIOD 30 μsec, or 50 turns
INFLECTOR TYPE Resonance Injection

Magnet System
FOCUSING TYPE Separated Function
No. MAG. UNITS 24 Length (ea) 6.25 m
STRAIGHT SECT. 6.25 Total S.S. Length 50 m
FOCUSING ORDER FODO
BETATRON OSC. FREQ. ν_H 5.3-5.1 ν_V 5.26
FIELD, AT INJ. G, at max 30 kG
RISE TIME sec; Flat-top time sec
MAG. WEIGHT (tons) Fe , Cu
POWER INPUT (MW) PEAK 0.3 MEAN 0.3

Acceleration System
HARMONIC No. 8 No. Cavities 1
RF RANGE 12 MHz
ORBIT FREQ. 1.5 MHz
ENERGY GAIN
RADIATION LOSS keV/turn
RF POWER INPUT (kW) PEAK

Other Relevant Parameters or Notable Features

ACCELERATOR PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	12.0	
RESOLUTION ΔE/E (%)	±0.01	
REPET. RATE (pulse/sec)	dc	
PULSE WIDTH		
DUTY FACTOR, macroscopic (%)	100	
INTERNAL BEAM (part/pulse)	10^{13}	
(part/sec)	Variable	
CURRENT (mA)	250	
BEAM EMITTANCE (mm-mrad)	25 π	
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" % OF SCHEDULED TIME

Some Typical External and Secondary Beams

PARTICLE	FLUX (part/sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
See Zero Gradient Synchrotron				

RESEARCH PROGRAM

TOTAL EXPERIMENTAL AREA m^2
BEAM LINES TO Stations
STATIONS SERVED AT SAME TIME
BEAM SEPARATORS SPECTROMETERS
ON-LINE COMPUTERS WITH Inputs
BUBBLE CHAMBERS, in-house Users'
TOTAL POWER INSTALLED FOR RESEARCH MW
No. USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET, in-house
SCHEDULED RESEARCH TIME, hours/week

RECENT IMPROVEMENTS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

NAME OF STORAGE RINGS ISABELLE
INSTITUTION Brookhaven National Lab.
LOCATION Upton, New York

PERSON IN CHARGE R. R. Rau
DATA SUPPLIED BY H. Hahn
DATE January 18, 1974

HISTORY AND STATUS in design stage
CONSTRUCTION STARTED (date) 1976
FIRST COLLISIONS, OR GOAL (date) 1981
TOTAL COST OF FACILITY
FUNDED BY U.S. AEC
TOTAL MACHINE STAFF (now) ---
ANNUAL OPERATING BUDGET ---

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES p-p ENERGY 200 GeV
APPROX. SHAPE circular DIMENSIONS 428 m radius
ORBIT: length 2690 m, time 9 μsec
No. INTERSECTS 4 CROSSING ANGLE 0 ÷ 6 mrad

Injector System

TYPE Synchrotron (AGS)
INJ. ENERGY 200 MeV OUTPUT 28.5 GeV
EMITTANCE, 0.4 π mm-mrad
FILLING SPEED 250 AGS pulses
TOTAL FILLING TIME 60 minutes

Magnet System

FOCUSING TYPE AG BEND. RAD. 266 m
LATTICE ORDER Q_FBB Q_DBB
No. MAGNETS 256 Length (ea) 4.25 m
No. QUADS 96 Length (ea) 1.30 m
MAX BEND. FIELD 40 kG; MAX. GRAD. 6.7 kG/cm
OTHER MAGNETS
TOTAL WEIGHT (tons) Fe Cu
BETATRON OSC. FREQ. ν_H 23.4 ν_V 19.4
AMPL. FUNCT. AT INTERSECT, (H) 2.2 (V) 6.7

Acceleration System

HARMONIC No. 2 FREQUENCY 0.223 MHz
No. TRANSMITTERS 1/ring No. CAVITIES 1/ring
BUNCH TO BUNCH TIME 4.5 μsec
BUNCH SIZE (L×W×H) 600m x 8mm x 3mm
PEAK RF VOLTAGE PER BEAM 40 kV
MAX RF POWER 550 kW ON BEAMS 180 kW

Vacuum System

PRESSURE IN RINGS, NO BEAM $\approx 10^{-10}$ Torr
WITH BEAM Torr
PRESSURE AT INTERSECTIONS $\approx 10^{-11}$ Torr
PUMPS (no., type, speed) sputter ion
Ti sublimation

Other Relevant Parameters or Notable Features

Superconducting magnets

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)	200	
RESOLUTION ΔE/E (%)	0.3	
LUMINOSITY (cm^{-2} sec^{-1})	10^{33}	
BEAM SIZE, horizontal	0.6 mm	
vertical	0.4 mm	
CURRENT, PER BEAM	10 A	
BEAM LIFE, AT A		
A		
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA 7200 m^2
No. EXPERIMENTAL INTERSECTS 4
No. EXPERIMENTS/INTERSECT
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

TOTAL POWER INSTALLED FOR RESEARCH MW
USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET
SCHEDULED RESEARCH TIME, hours/week

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

15 GeV electron ring

Published Articles Describing Machine

J.P. Blewett, Proc. 8th Int. Conf. High-Energy Accelerators, CERN, 1971, p. 501.

F.E. Mills, IEEE Trans. NS-20, No. 3, 1036 (1973).

R.R. Rau, Comments Nucl. & Part. Phys. (to be published).

NAME OF STORAGE RINGS PEP - Stage I
INSTITUTION SLAC-LBL
LOCATION SLAC

PERSON IN CHARGE J. Rees, T. Elioff
DATA SUPPLIED BY R. H. Helm
DATE

HISTORY AND STATUS

CONSTRUCTION STARTED (date) Oct. '75 (proposed)
FIRST COLLISIONS, OR GOAL (date) 1979
TOTAL COST OF FACILITY $60M
FUNDED BY U.S.A.E.C.
TOTAL MACHINE STAFF (now)
ANNUAL OPERATING BUDGET

STORAGE RINGS PARAMETERS

General

COLLIDING PARTICLES e^+e^- ENERGY 5 to 15 GeV
APPROX. SHAPE hexagon DIMENSIONS 700 m diam.
ORBIT: length 2167 m, time 7.23 μsec
No. INTERSECTS 6 CROSSING ANGLE 0

Injector System

TYPE Linac (SLAC)
INJ. ENERGY 10-15GeV OUTPUT 20mA e^+, 1.4 ns pulse
EMITTANCE, $\pi \times 10^{-1}$ mm-mrad
FILLING SPEED .17 to .1 mA/sec, ea. beam
TOTAL FILLING TIME 10 to 15 min., both beams

Magnet System

FOCUSING TYPE strong BEND. RAD. 170 m
LATTICE ORDER (F/2)BBDBB(F/2) cell
No. MAGNETS 192 Length (ea) 5.56 m
No. QUADS 90 Length (ea) 0.78 m
MAX BEND. FIELD 2.94 kG; MAX. GRAD. 0.80 kG/cm
OTHER MAGNETS 48 str.sect.quads; 84 sextupoles
TOTAL WEIGHT (tons) Fe 3100 Al. 130
BETATRON OSC. FREQ. ν_H 12 to 22 ν_V 12 to 22
AMPL. FUNCT. AT INTERSECT, (H) 5 m (V) 0.2 m

Acceleration System

HARMONIC No. 2592 FREQUENCY 358.6 MHz
No. TRANSMITTERS 24 No. CAVITIES 24
BUNCH TO BUNCH TIME 2.4 μsec (3 bunches)
BUNCH SIZE (L×W×H) 46 x 2 x 1 mm rms
PEAK RF VOLTAGE PER BEAM 44 MV
MAX RF POWER 7.2 MW ON BEAMS 5 MW

Vacuum System

PRESSURE IN RINGS, NO BEAM $<10^{-9}$ Torr
WITH BEAM $<2.5 \times 10^{-8}$ Torr
PRESSURE AT INTERSECTIONS 5×10^{-9} Torr
PUMPS (no., type, speed) 192, Distrib, 400 ℓ/sec;
96, Ion, 100 ℓ/sec(holding);
120, Ion, 260 ℓ/sec(I.R.)

Other Relevant Parameters or Notable Features

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved	
ENERGY (GeV)	15		
RESOLUTION ΔE/E (%)	0.1		
LUMINOSITY (cm^{-2} sec^{-1})	10^{32}		@15 GeV
BEAM SIZE, horizontal	1.2 mm		
vertical	0.06mm		
CURRENT, PER BEAM e^+	100 mA		
e^-	~~100 mA~~		
BEAM LIFE, AT 0.1 A	>2 hr		
A			
SCHEDULED OPERATION (hr/wk)			

"ON BEAM" % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA 5 areas; 100-200 m^2
No. EXPERIMENTAL INTERSECTS 6*
No. EXPERIMENTS/INTERSECT
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:
*5 intersections for H.-E. Physics
1 intersection for Accel. Physics Studies

TOTAL POWER INSTALLED FOR RESEARCH MW
USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET
SCHEDULED RESEARCH TIME, hours/week

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

1. Addition of superconducting proton ring for 200 GeV p on $e^{\pm}$.
2. Addition of 2nd electron ring.

Published Articles Describing Machine

1. "The PEP Electron-Positron Ring", J. Rees, to be presented at IXth International Accelerator Conference, SLAC, 1974.
2. "Preliminary Design Considerations for the PEP Lattice", R. H. Helm, and M. J. Lee, to be published in Proceedings of IXth Int. Acc. Conf., SLAC, 1974.

NAME OF STORAGE RINGS Tantalus II
INSTITUTION
LOCATION Wisconsin

PERSON IN CHARGE E. M. Rowe
DATA SUPPLIED BY E. M. Rowe
DATE January 21, 1974

HISTORY AND STATUS

Design ~~CONSTRUCTION~~ STARTED (date) January 1971
FIRST COLLISIONS, OR GOAL (date)
TOTAL COST OF FACILITY 2.5×10^6 est.
FUNDED BY
TOTAL MACHINE STAFF (now)
ANNUAL OPERATING BUDGET

STORAGE RINGS PARAMETERS

General

~~COLLIDING~~ PARTICLES electrons ENERGY 1.76 GeV
APPROX. SHAPE Race Track DIMENSIONS 10.9×13.1 m
ORBIT: length 82 m, time 2.73×10^{-7}
No. INTERSECTS CROSSING ANGLE

Injector System

TYPE see below
INJ. ENERGY 44 MeV OUTPUT 3×10^{11}/pulse
EMITTANCE, $2\pi \times .5\pi$ mm-mrad
FILLING SPEED single pulse, multiturn
TOTAL FILLING TIME

Magnet System

FOCUSING TYPE AG BEND. RAD. 4.5 m
LATTICE ORDER 0/2 DFD 0/2
No. MAGNETS 16 Length (ea) 1.8 m
No. QUADS 24 Length (ea) .20 m
MAX BEND. FIELD 12.3 kG; MAX. GRAD. 1.2 kG/cm
OTHER MAGNETS 4 sextupoles
TOTAL WEIGHT (tons) Fe 100 Cu 7.5
BETATRON OSC. FREQ. ν_H 2.18 ν_V 2.14
AMPL. FUNCT. AT INTERSECT, (H) (V)

Acceleration System

HARMONIC No. 9 FREQUENCY 33 MHz
No. TRANSMITTERS 1 No. CAVITIES 1
BUNCH TO BUNCH TIME 3×10^{-8}
BUNCH SIZE (L×W×H)
PEAK RF VOLTAGE PER BEAM 250 kV
MAX RF POWER 100 kW ON BEAMS 60 kW

Vacuum System

PRESSURE IN RINGS, NO BEAM 1×10^{-9} Torr
WITH BEAM 5×10^{-9} Torr
PRESSURE AT INTERSECTIONS Torr
PUMPS (no., type, speed) internal, 800 ℓ/sec per magnet

Other Relevant Parameters or Notable Features

Injector machine would be a 44 MeV microtron initially, as experimental program needs lead to increased stored beam current, Tantalus I would be installed as a booster to raise the injection energy to 240 MeV.

STORAGE RINGS PERFORMANCE

	Normal (or Goal)	Maximum Achieved
ENERGY (GeV)		
RESOLUTION ΔE/E (%)		
LUMINOSITY (cm^{-2} sec^{-1})		
BEAM SIZE, horizontal		
vertical		
CURRENT, PER BEAM	100 mA	
BEAM LIFE, AT A		
A		
SCHEDULED OPERATION (hr/wk)		

"ON BEAM" % OF SCHEDULED TIME

RESEARCH PROGRAM

APPROX. EXPERIMENTAL AREA 1800 m^2
No. EXPERIMENTAL INTERSECTS
No. EXPERIMENTS/INTERSECT
SPECIAL RESEARCH EQUIPMENT OR FACILITIES:

This storage ring is designed to be used exclusively as a synchrotron radiation source. Sixteen beam ports are planned initially. Several photon beam lines may be served by each port.

TOTAL POWER INSTALLED FOR RESEARCH MW
USER GROUPS: in-house outside
TOTAL RESEARCH STAFF, in-house outside
ANNUAL RESEARCH BUDGET
SCHEDULED RESEARCH TIME, hours/week

PLANNED EXTENSIONS OR MODIFICATIONS TO MACHINE

Published Articles Describing Machine

Tantalus II: An Electron Storage Ring for Vacuum Ultraviolet Research. Ednor Rowe. Proceedings of the Brookhaven Synchrotron Radiation Study Symposium BNL 50381, pp. 1-27, June 1973.