AECL-5615

ATOMIC ENERGY OF CANADA LIMITED

L'ÉNERGIE ATOMIQUE DU CANADA LIMITÉE

COMPENDIUM OF LINEAR ACCELERATORS - 1976

Compiled by

J.S. FRASER and S.O. SCHRIBER

Chalk River Nuclear Laboratories

Chalk River, Ontario

September 1976

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J.S. Fraser and S.O. Schriber

for the 1976 Proton Linear Accelerator Conference,
Chalk River, Ontario

Atomic Energy of Canada Limited
Chalk River Nuclear Laboratories
Chalk River, Ontario
September 1976

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Inventaire des accélérateurs linéaires - 1976

préparé par

J. S. Fraser et S. O. Schriber

Résumé

Cet inventaire comprend la plupart des accélérateurs linéaires d'ions et d'électrons actuellement employés comme instruments de recherche. Les nombreux accélérateurs linéaires employés à des fins médicales et industrielles ne figurent pas sur la liste. Cet inventaire a été préparé en vue de sa présentation au Congrès sur les accélérateurs linéaires de protons, tenu en 1976 dans les Laboratoires Nucléaires de Chalk River, Chalk River, Ontario.

L'Energie Atomique du Canada, Limitée
Laboratoires Nucléaires de Chalk River
Chalk River, Ontario

Septembre 1976

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COMPENDIUM OF LINEAR ACCELERATORS - 1976

Compiled by

J.S. Fraser and S.O. Schriber

ABSTRACT

This compendium lists most of the ion and electron linear accelerators now in operation as research tools. Not included are the numerous electron linacs used in industry and in medicine. The information was prepared for presentation at the 1976 Proton Linear Accelerator Conference, held at the Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada.

Atomic Energy of Canada Limited
Chalk River Nuclear Laboratories
Chalk River, Ontario
September 1976

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FOREWORD

This compendium lists most of the ion and electron linear accelerators now in operation as research tools. Not included are the numerous electron linacs used in industry and in medicine. Requests for information were sent out to about 60 installations; 41 were returned. We are grateful to the many people who filled out the data sheets.

We recommend that any future compendium should include entries for the maximum current and the duty factor for each section of the linac and that provision be made for a consistent notation for heavy ion energies.

We are indebted to F.T. Howard of ORNL who, has over the years, established the format of these compendia.

J.S. Fraser

S.O. Schriber

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Linear Accelerators

THE COMPENDIUM

ENTRY NO. 1

NAME OF MACHINE GELINA (GEEL ELECTON LINEAR ACCELERATOR)
INSTITUTION EURATOM, Central Bureau for Nuclear Measurements
LOCATION B-2440 Geel, Belgium DATE 23.2.76
IN CHARGE European Commission REPORTED BY ---

HISTORY AND STATUS

DESIGN, date 1962 MODEL tests --
ENG. DESIGN, date 1963
CONSTRUCTION, date 1964
FIRST BEAM date (or goal) 1965
MAJOR ALTERATIONS presently being upgraded *
OPERATION hr/wk; On Target hr/wk
TIME DIST., in house %, outside %
USERS' SCHEDULING CYCLE weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS ENGINEERS
TECHNICIANS CRAFTS
ADMIN & CLER TOTAL
GRAD. STUDENTS involved during year
OPERATED BY Res staff or Sp op.
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USER GROUPS, in house outside
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 70 m^2
movable m^2
TARGET STATIONS 1 in ROOMS
STATIONS SERVED AT THE SAME TIME, max. 18
MAG SPECTROGRAPH, type -
ON-LINE COMPUTER, model -
TOTAL POWER INSTALLED FOR RESEARCH -
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study yes
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length 20 m, X-sec(hXw) X m
ACCELERATOR, length 14 m, dia. - cm
BEAM, DIA. 1.5 cm; ENERGY GAIN 10 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Neutron	6.10^{13} into	4π	keV-MeV	-

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 10 %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research %
Applied neutron physics 90 %
%

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: Guaranteed performance of upgraded machine

	Short pulses (1)			Long pulses (2)	
T	4 ns	10 ns	100 ns	1 μs	2 μs
I	9 A	9 A	1.5 A	0.22 A	0.22 A
F	900 Hz	900 Hz	880 Hz	380 Hz	250 Hz
E	120 MeV	105 MeV	87 MeV	100 MeV	100 MeV
P	3.9 kW	8.5 kW	11.5 kW	8.3 kW	11 kW

(1) For short pulses, the energy at zero current will be 130 MeV
(2) For long pulses, the energy at zero current will be 150 MeV

* All figures quoted refer to the upgraded machine.

ENTRY NO. 1

INJECTOR SYSTEM

TYPE OF SOURCE	Electron Triode Gun					
OUTPUT, max	18 000	*mA, at*	80	*keV, at*	-	*π mm-mrad*
INJECTION PERIOD	4 ns - 2 μs	*μsec, at*	900	*Hz*		
HIGH VOLTAGE STAGE						
Output, max	18 000	*mA, at*	80	*keV, at*	-	*π mm-mrad*
BUNCHER	Standing wave					
Potential	10 000	*keV, Drift Length*	2	*m*		
Potential		*keV, Drift Length*		*m*		

ACCELERATION SYSTEM

	I	*II*	*III*
TYPE	Disk-loaded		
BEAM EN. (IN-OUT), MeV	160		
TOTAL LENGTH, m	14		
RADIO FREQUENCY, MHz	2998		
FIELD MODE	2 π/3		
Q(x 10^3)	8		
FILLING TIME, μs	1.1		
NO. OF TANKS	3		
DIAMETER, cm	-		
DRIFT TUBES, number	-		
LENGTH, cm	-		
DIAMETER, cm	-		
GAP/CELL LENGTH RATIO	-		
IRIS APERTURE, cm	2.5		
THICKNESS, cm	-		
SPACING, cm	2.5		
GROUP VELOCITY	c/55		
PHASE VELOCITY	c		
WAVE TYPE	travelling		
SHUNT IMPEDANCE, MΩ/m	45		
ATTENUATION, Np/TANK	-		
EQUILIBRIUM PHASE, deg.	-		
RF POWER UNITS, type	F 2042 klystron		
RF POWER UNITS, number	3		
RF POWER DEMAND, peak, MW	25 x 3		
RF POWER DEMAND, mean, MW	70		
RF POWER RATING, MW/unit	25		
RF POWER FEED SPACING, m	6		
QUADRUPOLES, number	3 X 3		
GRADIENT, ~~kG/cm~~ T/m	4		
SPACING, m	2		
OTHER	-		

ENTRY NO. 2

NAME OF MACHINE Linear Electron Accelerator - Ghent
INSTITUTION Nuclear Physics Laboratory - Ghent State University
LOCATION Proeftuinstr.86 - B 9000 Ghent, Belgium DATE 15th July 1976

IN CHARGE Prof. Dr. A. Deruytter
REPORTED BY Ir. K. Kiesel

HISTORY AND STATUS

DESIGN, date 1960 MODEL tests
ENG. DESIGN, date 1961
CONSTRUCTION, date 1964
FIRST BEAM date (or goal) 1965
MAJOR ALTERATIONS New sections and modulators 1975
OPERATION 80 hr/wk; On Target 75 hr/wk
TIME DIST., in house 95 %, outside 5 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR ~ 1 mil. $
COST, FACILITY, total -
FUNDED BY Interuniv. Inst. for Nucl. Sc. - Belgium
Ghent State University

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2 ENGINEERS 4
TECHNICIANS 4 CRAFTS 2
ADMIN & CLER 1/2 TOTAL 12-1/2
GRAD. STUDENTS involved during year 1
OPERATED BY 1 Res staff or 1 Sp op.
BUDGET, op & dev ~ 150,000 $
FUNDED BY Interuniv. Inst. for Nucl. Sc. Belgium

RESEARCH STAFF, not included above

USER GROUPS, in house 5 outside
STAFF SCIENTISTS, in house 12 outside
TOTAL RES STAFF, in house 16 outside 4
GRAD STUDENTS involved during year 6
RES. BUDGET, in house 250,000 $
FUNDED BY Interuniv. Inst. for Nucl. Sc. Belgium
Ghent State University

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 600 m^2
movable - m^2
TARGET STATIONS 4 in 4 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type No
ON-LINE COMPUTER, model PDP 15/20 PDP 11E
TOTAL POWER INSTALLED FOR RESEARCH 700 kVA
FACILITIES for:
Isotope production Yes
Irradiation, Solid State Yes
Biological Yes
Time-of-Flight Study No
On-Line Mass Separation No
Other No

PHYSICAL DIMENSIONS

TUNNEL, length 15 m, X-sec(hXw) 2 X 2.5 m
ACCELERATOR, length 2 x 3 m, dia. cm
BEAM, DIA. 0.4 cm; ENERGY GAIN 15 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	6.10^{17} puls	0.07	0.07	1%
e^-	$1.5.10^{17}$ puls	0.2	0.07	0.3%

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	80	%
Solid State Physics	2	%
Bio-Medical Applications	3	%
Isotope Production	5	%
Machine Research	10	%
		%
		%

SELECTED REFERENCES DESCRIBING MACHINE

Intern. Rep.

OTHER NOTABLE FEATURES:

ENTRY NO. 2

INJECTOR SYSTEM

TYPE OF SOURCE Indir. Heated Cathode
OUTPUT, max 400 *mA, at* 180 *keV, at* ______ π *mm-mrad*
INJECTION PERIOD 1 - 10 μ*sec, at* 300 *Hz*
HIGH VOLTAGE STAGE -
Output, max - *mA, at* ______ *keV, at* ______ π *mm-mrad*
BUNCHER 1 Pre-Buncher
Potential ______ *keV, Drift Length* ______ *m*
Potential ______ *keV, Drift Length* ______ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Linear		
BEAM EN. (IN-OUT), MeV	0.2 - 90		
TOTAL LENGTH, m	2 x 3		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	2π/3		
Q(x 10^3)	-		
FILLING TIME, μs	0.6		
NO. OF TANKS	2 x 84		
DIAMETER, cm	-		
DRIFT TUBES, number	-		
LENGTH, cm	-		
DIAMETER, cm	-		
GAP/CELL LENGTH RATIO	-		
IRIS APERTURE, cm	-		
THICKNESS, cm	-		
SPACING, cm	-		
GROUP VELOCITY	0.037-0.013		
PHASE VELOCITY	-		
WAVE TYPE	TW		
SHUNT IMPEDANCE, MΩ/m	33		
ATTENUATION, Np/TANK	-		
EQUILIBRIUM PHASE, deg.	-		
RF POWER UNITS, type	Klystron		
RF POWER UNITS, number	2		
RF POWER DEMAND, peak, MW	2 x 20		
RF POWER DEMAND, mean, MW	2 x 0.025		
RF POWER RATING, MW/unit	20		
RF POWER FEED SPACING, m	3		
QUADRUPOLES, number	2		
GRADIENT, kG/m	48/65.6		
SPACING, m	6		
OTHER	-		

ENTRY NO. 3

NAME OF MACHINE Saskatchewan Electron Linear Accelerator
INSTITUTION University of Saskatchewan
LOCATION Saskatoon, Saskatchewan DATE March 1, 1976
IN CHARGE Y. M. Shin REPORTED BY Y. M. Shin

HISTORY AND STATUS

DESIGN, date 1961 MODEL tests ____
ENG. DESIGN, date 1961
CONSTRUCTION, date 1962
FIRST BEAM date (or goal) 1964
MAJOR ALTERATIONS Change no. RF sources to get 250 MeV
OPERATION 100 hr/wk; On Target 90 hr/wk
TIME DIST., in house 100 %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR $750,000 +
COST, FACILITY, total $300,000 x 12 yrs. + $2,000,000
FUNDED BY Atomic Energy Control Bd./National Research Council

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 14 ENGINEERS 2
TECHNICIANS 4 CRAFTS 2
ADMIN & CLER 2 TOTAL 24
GRAD. STUDENTS involved during year 2
OPERATED BY X Res staff or ____ Sp op.
BUDGET, op & dev ∿ $150,000
FUNDED BY Atomic Energy Control Bd./Nat.Res.Council (Canada)

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house 14 outside 2
TOTAL RES STAFF, in house 14 outside 2
GRAD STUDENTS involved during year 2
RES. BUDGET, in house ∿ $150,000
FUNDED BY Atomic Energy Control Bd./Nat.Res.Council (Canada)

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 350 m^2
movable --- m^2
TARGET STATIONS 4 in 5 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type 50 cm-250 MeV/c, 75 cm-450 MeV/c
ON-LINE COMPUTER, model SDS 920, PDP 15
TOTAL POWER INSTALLED FOR RESEARCH 0.75 MW
FACILITIES for:
Isotope production none
Irradiation, Solid State none
Biological none
Time-of-Flight Study dormant
On-Line Mass Separation none
Other ____

PHYSICAL DIMENSIONS

TUNNEL, length ____ m, X-sec(hXw) 10 X 10 m
ACCELERATOR, length 24 m, dia. 2 cm
BEAM, DIA. 0.5 cm; ENERGY GAIN 11 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	1.2×10^{14}	0.01	0.25	≤ 1%
γ	1.2×10^{12}	< 21	--	Brems.
n	$\sim 10^9$	3	--	Cont.

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 80-85 %
Solid State Physics ----- %
Bio-Medical Applications (Chemical) 15-20 %
Isotope Production ____ %
Machine Research < 2 %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: ____

ENTRY NO. 3

INJECTOR SYSTEM

TYPE OF SOURCE Electron gun
OUTPUT, max > 1000 mA, at 105 keV, at ____ π mm-mrad
INJECTION PERIOD 1. μsec, at 360 Hz
HIGH VOLTAGE STAGE ____
Output, max ____ mA, at ____ keV, at ____ π mm-mrad
BUNCHER ____
Potential ∿ 25 kV/cm keV, Drift Length 0 m
Potential ____ keV, Drift Length ____ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Const Z		
BEAM EN. (IN-OUT), MeV	0.1 - 250		
TOTAL LENGTH, m	24		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	$2\pi/3$		
$Q(x\ 10^3)$	13		
FILLING TIME, μs	0.8		
NO. OF TANKS	6		
DIAMETER, cm	2		
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2.5		
THICKNESS, cm	0.58		
SPACING, cm	3.4		
GROUP VELOCITY	0.01		
PHASE VELOCITY	C		
WAVE TYPE	travelling		
SHUNT IMPEDANCE, MΩ/m	53		
ATTENUATION, Np/TANK	0.57		
EQUILIBRIUM PHASE, deg.	--		
RF POWER UNITS, type	klystron		
RF POWER UNITS, number	6		
RF POWER XXXXXX, peak, MW	122		
RF POWER XXXXXX, mean, MW	∿ 100		
RF POWER RATING, MW/unit	22 MW		
RF POWER FEED SPACING, m	5		
QUADRUPOLES, number	5		
GRADIENT, kG/m	0.8 kG		
SPACING, m	0.3		
OTHER			

ENTRY NO. 4

NAME OF MACHINE 35 MEV ELECTRON LINAC

INSTITUTION Physics Division, National Research Council of Canada

LOCATION Montreal Road, Ottawa, Canada — DATE 20-2-76

IN CHARGE K.H. Lokan — REPORTED BY K.H. Lokan

HISTORY AND STATUS (manufactured by Vickers Ltd.)

DESIGN, date 1960-66 MODEL tests

ENG. DESIGN, date 1960-66

CONSTRUCTION, date 1965-1968

FIRST BEAM date (or goal) 1968

MAJOR ALTERATIONS -

OPERATION 80 hr/wk; On Target 60-80 hr/wk

TIME DIST., in house 85 %, outside 15 %

USERS' SCHEDULING CYCLE 1 weeks

COST, ACCELERATOR $500,000

COST, FACILITY, total 2,300,000

FUNDED BY NATIONAL RESEARCH COUNCIL

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 0.5 ENGINEERS 1

TECHNICIANS 2 x 0.5 CRAFTS

ADMIN & CLER 0.3 TOTAL 2.8

GRAD. STUDENTS involved during year 0

OPERATED BY x Res staff or Sp op.

BUDGET, op & dev $27,000 (excluding salaries, power)

FUNDED BY NATIONAL RESEARCH COUNCIL

RESEARCH STAFF, not included above

USER GROUPS, in house 3 outside 3*

STAFF SCIENTISTS, in house 7 outside

TOTAL RES STAFF, in house 9 outside 2*

GRAD STUDENTS involved during year 2

RES. BUDGET, in house $60,000 (excluding salaries)

FUNDED BY NATIONAL RESEARCH COUNCIL

*in collaboration with in-house scientists

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ~125 m^2

movable m^2

TARGET STATIONS 4 in 1 ROOMS

STATIONS SERVED AT THE SAME TIME, max. 1

MAG SPECTROGRAPH, type -

ON-LINE COMPUTER, model Digital Equip. Cor. 2 PDP-9s

TOTAL POWER INSTALLED FOR RESEARCH 75 kwatt

FACILITIES for:

Isotope production

Irradiation, Solid State

Biological

Time-of-Flight Study (Photoneutron, energy + angle)

On-Line Mass Separation

Other pulse radiolysis (radiation chemistry)

radiation dosimetry, shielding, bremsstrahlung spectroscopy

PHYSICAL DIMENSIONS

TUNNEL, length 28 m, X-sec(hXw) 5.5 X 4.5 m

ACCELERATOR, length 8 m, dia. 25 cm

BEAM, DIA. 1 cm; ENERGY GAIN 4.5 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
ELECTRONS	$\sim 10^{15}$ (160μA)	1	.035	2(3.2μsec pulses
ELECTRONS	$\sim 10^{14}$ (15μA)	1	.045	4(.01μsec pulses

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	(photonuclear)	30 %
Solid State Physics		%
Bio-Medical Applications		%
Isotope Production		%
Machine Research		10 %
radiation chemistry		30 %
radiation dosimetry, shielding, bremsstrahlung spectroscopy		30 %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES:

a pretzel magnet placed half way along the accelerator permits the extraction of a lower energy (2-12MeV) electron beam at full rated current (0.25 A per pulse)

ENTRY NO. 4

INJECTOR SYSTEM

TYPE OF SOURCE Indirectly heated cathode ($5\ cm^2$) triode assembly
OUTPUT, max 10000 mA, at 60 keV, at N A π mm-mrad
INJECTION PERIOD .005 to 3.3 μsec, at single shot to 720 Hz
HIGH VOLTAGE STAGE N A
Output,max ___ mA, at ___ keV, at ___ π mm-mrad
BUNCHER N A
Potential ___ keV, Drift Length ___ m
Potential ___ keV, Drift Length ___ m

ACCELERATION SYSTEM

	Section 1	Section 2-4	
	I	II	III
TYPE	travelling wave	travelling wave	
BEAM EN. (IN-OUT), MeV	9		
TOTAL LENGTH, m	2		
RADIO FREQUENCY, MHz	2856	2856	
FIELD MODE	π/2	2π/3	
Q(x 10^3)			
FILLING TIME, μs	0.8	0.5	
NO. OF TANKS			
DIAMETER, cm			
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	1	1	
THICKNESS, cm			
SPACING, cm	4 cells/wavelength	3 cells/wavelength	
GROUP VELOCITY	0.008c	0.013	
PHASE VELOCITY	variable - c	c	
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m		30	
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type } RF POWER UNITS, number	One 20 Mw klystron, output shared by all sections		
RF POWER DEMAND, peak, MW	5	5 each	
RF POWER DEMAND, mean, MW	.005	.005 each	
RF POWER RATING, MW/unit	10	10	
RF POWER FEED SPACING, m	2m	2m	
QUADRUPOLES, number	none	none	
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 5

NAME OF MACHINE lo MeV Electron Linac Model HRC-712
INSTITUTION Research Establishment Risø
LOCATION DK-4ooo Roskilde, Denmark
DATE
IN CHARGE Knud Sehested
REPORTED BY Jørgen Fenger

HISTORY AND STATUS

DESIGN, date primo 1973 MODEL tests
ENG. DESIGN, date
CONSTRUCTION, date
FIRST BEAM date (or goal) primo 1975
MAJOR ALTERATIONS none
OPERATION 3o hr/wk; On Target hr/wk
TIME DIST., in house 75 %, outside 25 %
USERS' SCHEDULING CYCLE 3/4 weeks
COST, ACCELERATOR $ 500.000
COST, FACILITY, total $ 200.000
FUNDED BY Danish Atomic Energy Commission

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2 ENGINEERS 2
TECHNICIANS 2 CRAFTS 1
ADMIN & CLER 1 TOTAL 8
GRAD. STUDENTS involved during year
OPERATED BY 2 Res staff or o Sp op.
BUDGET, op & dev $ 30.000
FUNDED BY Research Establishment Risø

RESEARCH STAFF, not included above

USER GROUPS, in house 3 outside 3
STAFF SCIENTISTS, in house 6 outside 15
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year 3
RES. BUDGET, in house $ 30.000
FUNDED BY Research Establishment Risø

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 7o m^2
movable none m^2
TARGET STATIONS 7 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model PDP8/I
TOTAL POWER INSTALLED FOR RESEARCH lo kW
FACILITIES for:
Isotope production none
Irradiation, Solid State none
Biological one
Time-of-Flight Study none
On-Line Mass Separation none
Other Chemical and physical

PHYSICAL DIMENSIONS

TUNNEL, length m, X-sec(hXw) X m
ACCELERATOR, length 1,6 m, dia. cm
BEAM, DIA. o.5 cm; ENERGY GAIN 8.75 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	$\Delta E/E$ (%)
electron	1.3×10^{14}	o.1	o.ol	$\pm$ 2 1/2

OPERATING PROGRAMS, time dist

Basic Nuclear Physics %
Solid State Physics %
Bio-Medical Applications 2o %
Isotope Production %
Machine Research lo %
Chemical " 5o %
Physical " 2o %

SELECTED REFERENCES DESCRIBING MACHINE

A Wide Dynamic Range lo MeV High Current Electron Linear Accelerator. J. Haimson, B. Mecklenburg and V. Valencia. IEEE Transactions on Nuclear Science, Vol. NS-22, No. 3, June 1975.

OTHER NOTABLE FEATURES:

ENTRY NO. 5

INJECTOR SYSTEM (HRC Model 275/2250)

TYPE OF SOURCE Dispenser Cathode
OUTPUT, max 2500 mA, at 275 keV, at $2.2 \times 10^{-3}\pi\ m_0c$-cm $\cong 20$ π mm-mrad
INJECTION PERIOD 8 μsec, at 200 Hz
HIGH VOLTAGE STAGE
Output, max ____ mA, at ____ keV, at ____ π mm-mrad
BUNCHER
Potential ____ keV, Drift Length ____ m
Potential ____ keV, Drift Length ____ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Electron Linac		
BEAM EN. (IN-OUT), MeV	0.25-15		
TOTAL LENGTH, m	1.6		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	2π/3		
Q(x 10^3)	13		
FILLING TIME, μs	0.19		
NO. OF TANKS	1		
DIAMETER, cm			
DRIFT TUBES, number	-		
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	Not Constant		
THICKNESS, cm	0.58		
SPACING, cm	Not Constant		
GROUP VELOCITY	0.023c		
PHASE VELOCITY	Tapered upto c		
WAVE TYPE	Travelling		
SHUNT IMPEDANCE, MΩ/m	51		
ATTENUATION, Np/TANK	0.128		
EQUILIBRIUM PHASE, deg.	85		
RF POWER UNITS, type	ITT/RCA8568 Klystron		
RF POWER UNITS, number	1		
RF POWER DEMAND, peak, MW	18		
RF POWER DEMAND, mean, MW	0.018		
RF POWER RATING, MW/unit	-		
RF POWER FEED SPACING, m	-		
QUADRUPOLES, number	-		
GRADIENT, kG/m			
SPACING, m			
OTHER	Solenoid		

ENTRY NO. 6

NAME OF MACHINE Accélérateur Linéaire d'ORSAY
INSTITUTION Laboratoire de l'Accélérateur Linéaire (1) (L.A.L.) part of IN2P3 (2) : C.N.R.S.
LOCATION 91400 - ORSAY (France) DATE 1959
IN CHARGE P. BRUNET REPORTED BY P. BRUNET

HISTORY AND STATUS

DESIGN, date 1956 MODEL tests
ENG. DESIGN, date
CONSTRUCTION, date 1956-61 and 65-68 (3)
FIRST BEAM date (or goal) 1959
MAJOR ALTERATIONS Positron beam
OPERATION 60 hr/wk; On Target / hr/wk
TIME DIST., in house / %, outside / %
USERS' SCHEDULING CYCLE / weeks
COST, ACCELERATOR } 10^8 F
COST, FACILITY, total }
FUNDED BY Ministry of Education

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 0 ENGINEERS 4
TECHNICIANS 30 CRAFTS 13
ADMIN & CLER 3 TOTAL 50
GRAD. STUDENTS involved during year 0
OPERATED BY Res staff or 17 Sp op.
BUDGET, op & dev 1.8 x 10^6 F
FUNDED BY IN2P3 CNRS

(4)

RESEARCH STAFF, not included above

USER GROUPS, in house outside
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS (Linac Only)

SHIELDED AREA, fixed 250 m^2
movable m^2
TARGET STATIONS 1 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 2 (ACO)
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length 360 m, X-sec(hXw) X m ?
ACCELERATOR, length 230 m, dia. 180 cm
BEAM, DIA.(e^-): .5 cm; ENERGY GAIN 10 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)	
e^-	2.10^{13} (1,5 μs)	Ajustable	2	1	
e^+	5.10^{10} (300ns)	Ajustable	0,25	2	(ACO)
e^+	$1,5.10^9$ (20 ns)	Ajustable	1,2	1	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine ~~Research~~ development 5 %
%
%

SELECTED REFERENCES DESCRIBING MACHINE

- Onde Electrique (Juillet 1969)
- L.A.L. - Rapport d'Activité 1976

OTHER NOTABLE FEATURES: (1) Université PARIS-SUD
(2) Institut National de Physique Nucléaire et de Physique des Particules
(3) First was built a 1,3 GeV Linac then an extra 1 GeV one ahead making a total of 2,3 GeV.
(4) Linac beams are not directly used for physics experiments any more but only for injection in storage rings ACO and DCI (Elementary particule and synchrotron radiation physics). The last experimental remaining room can handle a 500 MeV e^- or e^+ beam and is used for testing equipments.

ERRATA

AECL-5615

TITLE: Compendium of Linear Accelerators - 1976.

AUTHORS: Compiled by J.S. Fraser and S.O. Schriber.

Please insert corrected page 13 into your copy.

October 1976.

ENTRY NO. 6

INJECTOR SYSTEM

Gun:
- *TYPE OF SOURCE* Diode electron gun
- *OUTPUT, max* 3000 *mA, at* 110 *keV, at* ? *π mm-mrad*
- *INJECTION PERIOD* 2,5 (1) *μsec, at* 50 *Hz*
- *HIGH VOLTAGE STAGE* Pulse forming network and pulse transformer

Injector *Output, max* 1000 *mA, at* 20.000 *keV, at* ~ 10^{-2} *π mm-mrad*

PRE-*BUNCHER* RF Cavity

Potential ~ 5 *keV, Drift Length* 0,31 *m*

Potential ___ *keV, Drift Length* ___ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	per.structure		
BEAM EN. (IN-OUT), MeV	20/2300		
TOTAL LENGTH, m (accélération)	230 m		
RADIO FREQUENCY, MHz	3000 (S.band)		
FIELD MODE	π/2		
Q(x 10³)	11		
FILLING TIME, μs	0.7 & 1.0		
NO. OF TANKS (acc. sections)	38		
DIAMETER, cm	18.0		
DRIFT TUBES, number (between sect.)	13		
TOTAL *LENGTH,* ~~cm~~ meter	55		
DIAMETER, cm	~ 4		
GAP/CELL LENGTH RATIO	1		
IRIS APERTURE, cm	29 → 18 mm		
THICKNESS, cm	3 mm		
SPACING, cm	2.5 cm		
GROUP VELOCITY C/vg	20 → 100		
PHASE VELOCITY	C		
WAVE TYPE	Travel. wave		
SHUNT IMPEDANCE, MΩ/m	50		
ATTENUATION, Np/TANK	0.55 → 0.9		
EQUILIBRIUM PHASE, deg.	π/2 (Max.field)		
RF POWER UNITS, type	Klystrons		
RF POWER UNITS, number	39		
RF POWER DEMAND, peak, MW	860		
RF POWER DEMAND, mean, MW	0,13		
RF POWER RATING, MW/unit	25 & 20		
RF POWER FEED SPACING, m	6		
QUADRUPOLES, number (multiplets)	13 Sets		
GRADIENT, kG/m	11 T/m		
SPACING, m	6 → 25 m		
OTHER			

(1) Pulse duration may be continuously ajusted from 0,010 to 2,0 μs
typical duration :

LINAC : 1,5 μs
ACO : 0,3 μs
DCI : 20 nanosecondes.

$e^- \leftrightarrow e^+$ converter after 16 sections e.g. ≅ 1.0 GeV

ENTRY NO. 7

NAME OF MACHINE UNILAC
INSTITUTION Gesellschaft für Schwerionenforschung mbH
LOCATION Darmstadt/Fed.Rep.Germany *DATE* July 21th, 1976

IN CHARGE N.Angert/ D.Böhne/ P.Strehl *REPORTED BY* D. Böhne

HISTORY AND STATUS

DESIGN, date 1968 *MODEL tests* since 1963
ENG. DESIGN, date 1966 - 1971
CONSTRUCTION, date 1971
FIRST BEAM date (or goal) 1975
MAJOR ALTERATIONS no
OPERATION 148 *hr/wk; On Target* 75 *hr/wk*
TIME DIST., in house 50 *%, outside* 50 *%*
USERS' SCHEDULING CYCLE 4 *weeks*
COST, ACCELERATOR 53 MDM
COST, FACILITY, total 165 MDM
FUNDED BY Federal Republic of Germany and State of Hessen

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 11 *ENGINEERS* 13
TECHNICIANS 28 *CRAFTS* 5
ADMIN & CLER 1 *TOTAL*
GRAD. STUDENTS involved during year -
OPERATED BY *Res staff or* *Sp op.*
BUDGET, op & dev 5 MDM personnel excluded
FUNDED BY Fed. Rep. of Germany and State of Hessen

RESEARCH STAFF, not included above

USER GROUPS, in house 12 *outside* 30
STAFF SCIENTISTS, in house 30 *outside* 150
TOTAL RES STAFF, in house 40 *outside* 170
GRAD STUDENTS involved during year 20
RES. BUDGET, in house 4 MDM
FUNDED BY Fed. Rep. of Germany and State of Hessen

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed m^2
movable 45 x 56 m^2
TARGET STATIONS 20 *in* 2 *ROOMS*
STATIONS SERVED AT THE SAME TIME, max. 2
MAG SPECTROGRAPH, type Berkeley Spectrometer
ON-LINE COMPUTER, model PDP11/45
TOTAL POWER INSTALLED FOR RESEARCH 2 MW
FACILITIES for:
Isotope production -
Irradiation, Solid State +
Biological +
Time-of-Flight Study +
On-Line Mass Separation +
Other

PHYSICAL DIMENSIONS

TUNNEL, length 120 *m, X-sec(hXw)* 6 x 8 *m*
ACCELERATOR, length 100 *m, dia.* 200 *cm*
BEAM, DIA. 0.5 *cm; ENERGY GAIN* 1 *MeV/m*

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	*FLUX* *) *(part./sec)*	*BEAM AREA* (cm^2)	*ENERGY* *) *(GeV)*	$\Delta E/E$ *(%)*
^{40}Ar	$6 \cdot 10^{12}$	0.5	0.52	0.5
^{84}Kr +)	10^{12}	"	0.9	"
^{132}Xe +)	$3 \cdot 10^{11}$	"	1.3	"
^{238}U	10^{10}	"	2	"
^{50}Ti +)	10^{10}	"	0.6	"

*) for gas stripper

+) from natural isotopic mixture in source

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 80 %
Solid State Physics 4 %
Bio-Medical Applications 1 %
Isotope Production %
Machine Research 5 %
Atomic Physics 10 %
%

SELECTED REFERENCES DESCRIBING MACHINE

Proceedings of the 1972 Proton Linear Acc. Conf.

OTHER NOTABLE FEATURES: continous energy variation
parasitic beam at 1.4 MeV/u

ENTRY NO. 7

INJECTOR SYSTEM

TYPE OF SOURCE Duoplasmatron and PIG
OUTPUT, max 0.2 for one charge state mA, at 30 kV, at 100 π mm-mrad
INJECTION PERIOD ______ µsec, at ______ Hz
HIGH VOLTAGE STAGE oil insulated rectifier, open air terminal single gap acc. tube
Output, max 40 mA, at 320 kV, at ______ π mm-mrad
BUNCHER double drift buncher with drift tube
Potential 3 kV, Drift Length 1.5 m
Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Wideröe	Alvarez	20 single gap cavities
BEAM EN. (IN-OUT), MeV	0.011	1.4	8.5
TOTAL LENGTH, m	28	26	20
RADIO FREQUENCY, MHz	27.1	108.4	108.4
FIELD MODE	coaxial π	TM 010	TM 010
$Q(x\ 10^3)$	12	110	44
FILLING TIME, µs	100	500	200
NO. OF TANKS	4	2	20
DIAMETER, cm	120	210	160
DRIFT TUBES, number	128	118	-
LENGTH, cm	1 - 30	13 - 28	-
DIAMETER, cm	13 and 20	20	16
GAP/CELL LENGTH RATIO	0.25	0.25	0.1
IRIS APERTURE, cm	2 - 3	3 - 3.5	4
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE	stand. wave	stand. wave	stand. wave
SHUNT IMPEDANCE, MΩ/m	90 - 30	45	12.5
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	30	30	30
RF POWER UNITS, type	tetrode amp.	tetrode amp.	tetrode amp.
RF POWER UNITS, number	4	4	20
RF POWER DEMAND, peak, MW	1.2	2.8	3.6
RF POWER DEMAND, mean, MW	0.3	0.7	0.9
RF POWER RATING, MW/unit	0.12 - 0.52	1.4	0.18
RF POWER FEED SPACING, m	28	28	28
QUADRUPOLES, number	64	120	22
GRADIENT, kG/cm	12 - 3.6	5.8 - 2.8	1.3
SPACING, m			
OTHER			

ENTRY NO. 8

NAME OF MACHINE Linac II Electron-Positron Injector
INSTITUTION DESY
LOCATION Hamburg, Germany
DATE 17-3-76
IN CHARGE H. Kumpfert
REPORTED BY A. Febel, G. Stange

HISTORY AND STATUS

DESIGN, date 1967 MODEL tests 1968/1969
ENG. DESIGN, date
CONSTRUCTION, date 1970
FIRST BEAM date (or goal) Dec. 1970
MAJOR ALTERATIONS
OPERATION 150 hr/wk; On Target ____ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR 12 MDM
COST, FACILITY, total 25 MDM
FUNDED BY Federal Government, City of Hamburg

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2
TECHNICIANS 5 CRAFTS
ADMIN & CLER TOTAL 8
GRAD. STUDENTS involved during year
OPERATED BY ____ Res staff or ____ Sp op.
BUDGET, op & dev ~ 1.25 MDM/year
FUNDED BY DESY

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house ____ outside ____
TOTAL RES STAFF, in house ____ outside ____
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS * 1 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model ARGUS 500**
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other Injector for synchrotron

PHYSICAL DIMENSIONS

TUNNEL, length 103 m, X-sec(hXw) 3 X 3 m
ACCELERATOR, length 82 m, dia. ~ 10 cm
BEAM, DIA. e^-: 0.2 cm; e^+: 1.5 ENERGY GAIN 11 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	$\Delta E/E$ (%)
e^-	2.10^{14}	0.03	0.56	0.3
e^+	2.10^{12}	1.8	0.38	2.0***

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %
Solid State Physics ____ %
Bio-Medical Applications ____ %
Isotope Production ____ %
Machine Research ____ %
____ %
e^+/e^- Injector for Synchrotron, ~7000h/a ≙ 100 %

SELECTED REFERENCES DESCRIBING MACHINE

1) N.C. Pering et al., "General Description and performance Measurements on DESY Linac II..." Proc. 1971 Particle Acc. Conf., p.579, Chicago 1971.
2) A. Febel, G. Stange, "Linac II", Int. Bericht DESY SI-72/3, 1972.
3) G. Stange, "A Pulsed Magnetic Lens for Positron Focusing ...", Int. Bericht DESY SI-73/4, 1973.

OTHER NOTABLE FEATURES: * not in permanent use; ** for linac operation; *** Energy of e^- on converter target: 320 MeV. Energy of e^+ out of linac: ~ 380 MeV; all positrons in $\Delta E/E$ = 2%.

Chopper devices (incorporated in new injection system) for 500 MHz (Synchrotron RF), or single buncher, or 1 out of 4, or 1 out of 16 bunches in 500 MHz.

ENTRY NO. 8

INJECTOR SYSTEM

TYPE OF SOURCE Electron Gun

OUTPUT, max 13 A ~~mA~~, at 150 keV, at 21 π mm-mrad

INJECTION PERIOD 3 μsec, at 50 Hz

HIGH VOLTAGE STAGE

Output,max ______ mA, at ______ keV, at ______ π mm-mrad

BUNCHER integrated in first section

~~Potential~~Field strength 163 kV/cm keV, ~~Drift~~ Length 0.6 m

Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Travelling Wave Structure		
BEAM EN. (IN-OUT), MeV	0.15 - 640		
TOTAL LENGTH, m	14 x 5.2		
RADIO FREQUENCY, MHz	3000		
FIELD MODE	$2\pi/3$		
$Q(x\ 10^3)$	14		
FILLING TIME, μs	0.74		
NO. OF ~~TANKS~~ Sections	14		
DIAMETER, cm	~ 10		
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2 - 2.5		
THICKNESS, cm			
SPACING, cm	3.33		
GROUP VELOCITY , average	0.0234 c		
PHASE VELOCITY	c		
WAVE TYPE	TM01		
SHUNT IMPEDANCE, MΩ/m	51.5		
ATTENUATION, Np/~~TANK~~Section	0.5		
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Klystron TV2002 DOD, Thomson CSF		
RF POWER UNITS, number	14		
RF POWER DEMAND, peak, MW	25 per unit		
RF POWER DEMAND, mean, ~~MW~~ kW	7.5 per unit		
RF POWER RATING, MW/unit			
RF POWER FEED SPACING, m			
QUADRUPOLES, number	25 on sections 10-14 (FODO channel)		
GRADIENT, kG/m	0.2		
SPACING, m			
OTHER			

Solenoids: 800 G on sections No. 1-5

Solenoids: 4 kG on sections No. 8-9

Positron pulsed focusing lens: 18 kG over 4.5 cm length

Fixed positron target: Tungsten, 0.5 cm thick, in front of section No. 8

ENTRY NO. 9

NAME OF MACHINE: MUELL (MAINZ UNIVERSITY ELECTRON LINAC)
INSTITUTION: INSTITUT FÜR KERNPHYSIK, JOHANNES GUTENBERG-UNIVERSITÄT
LOCATION: MAINZ, W-GERMANY — DATE: 20.2.1976
IN CHARGE: R. HERR — REPORTED BY:

HISTORY AND STATUS

DESIGN, date: 1962 — MODEL tests:
ENG. DESIGN, date:
CONSTRUCTION, date: 1964-1965
FIRST BEAM date (or goal): 1966
MAJOR ALTERATIONS:
OPERATION 100-120 hr/wk; On Target ~ 110 hr/wk
TIME DIST., in house 50 %, outside 50 %
USERS' SCHEDULING CYCLE 1 .. 2 weeks
COST, ACCELERATOR ~ $5 \cdot 10^6$ DM
COST, FACILITY, total ~ $12 \cdot 10^6$ DM 1962/65
FUNDED BY:

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 — ENGINEERS 2
TECHNICIANS 5 — CRAFTS 12
ADMIN & CLER — TOTAL 23
GRAD. STUDENTS involved during year 3
OPERATED BY — Res staff or — Sp op.
BUDGET, op & dev ~ $1 \cdot 10^6$ DM
FUNDED BY: GOVERMENT (UNIVERSITY)

RESEARCH STAFF, not included above

USER GROUPS, in house 6 outside 4
STAFF SCIENTISTS, in house 20 outside 5
TOTAL RES STAFF, in house — outside
GRAD STUDENTS involved during year 15-20
RES. BUDGET, in house ~ 500 000 DM
FUNDED BY: GOVERMENT (UNIVERSITY)

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 1200 m^2
movable m^2
TARGET STATIONS 4 in 4 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type 180^0 DOUBLE FOCUSSING + ENERGY LOSS FACILITY
ON-LINE COMPUTER, model CD 1700 + DDP 516
TOTAL POWER INSTALLED FOR RESEARCH 1200 KVA
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other E-SCATTERING, MONOCHROMATIC PHOTONS, PHOTON ABSORPT. + SCATTERING

PHYSICAL DIMENSIONS

TUNNEL, length 50 m, X-sec(hXw) 3.2x2.5 m
ACCELERATOR, length 36 m, dia. 30 cm
BEAM, DIA. 0.3 cm; ENERGY GAIN — MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
E^-	MAX $3 \cdot 10^{14}$	0.1	0.1-0.3	0.1
E^+	10^{10}	1	0.05	2
γ-BREMS	10^9	(MeV^{-1}, SEC^{-1}) AT 20 MEV		
γ-MONO	10^6	10	0.02	2

OPERATING PROGRAMS, time dist

Basic Nuclear Physics > 99 %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research < 1 %

SELECTED REFERENCES DESCRIBING MACHINE

H.EHRENBERG ET AL.: DIE ELEKTRONENSTREU-APPARATUR AM MAINZER 300 MEV-ELEKTRONEN-LINEARBESCHLEUNIGER NUCL.INSTR. & METH. 105 (1972) 253

H.HERMINGHAUS, K.H.KAISER: DESIGN, CONSTRUCTION AND PERFORMANCE OF THE ENERGY COMPRESSING SYSTEM OF THE MAINZ 300 MEV ELECTRON LINAC; NUCL.INSTR. & METH. 113 (1973) 189

OTHER NOTABLE FEATURES:

ENERGY COMPRESSING SYSTEM (SEE REF.)

ENTRY NO. 9

INJECTOR SYSTEM

TYPE OF SOURCE PIERCE GUN

OUTPUT, max 1000 *mA, at* 50 *keV, at* ____ *π mm-mrad*

INJECTION PERIOD 5 *μsec, at* 150 *Hz*

HIGH VOLTAGE STAGE CONVENTIONEL STABILIZED POWER SUPPLY

Output,max 3 *mA, at* 50 *keV, at* ____ *π mm-mrad*

PRE *BUNCHER*

Potential 0 *keV, Drift Length* 0.25 *m*

BUNCHER *Potential* 0 *keV,* ~~*Drift*~~ *Length* 1 *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	IRIS		
BEAM EN. (IN-OUT), MeV	350 MAX		
TOTAL LENGTH, m	38		
RADIO FREQUENCY, MHz	2998.5		
FIELD MODE	$\pi/2$		
Q(x 10^3*)*	12		
FILLING TIME, μs	0.5		
NO. OF TANKS	8		
DIAMETER, cm	22		
DRIFT TUBES, number	--		
LENGTH, cm	--		
DIAMETER, cm	--		
GAP/CELL LENGTH RATIO	--		
IRIS APERTURE, cm	2.85..1.95		
THICKNESS, cm	0.3		
SPACING, cm	2.5		
GROUP VELOCITY	1/20..1/70c		
PHASE VELOCITY	c		
WAVE TYPE	E_{01}		
SHUNT IMPEDANCE, MΩ/m	50		
ATTENUATION, Np/TANK	1		
EQUILIBRIUM PHASE, deg.	--		
RF POWER UNITS, type	KLYSTRON TH 2042		
RF POWER UNITS, number	8		
RF POWER DEMAND, peak, MW	8 x 20		
RF POWER DEMAND, mean, MW	8 x 0.005		
RF POWER RATING, MW/unit			
RF POWER FEED SPACING, m	4.5		
QUADRUPOLES, number	2 TRIPLETTS		
GRADIENT, kG/m	50		
SPACING, m	9		
OTHER			

ENTRY NO. 10

NAME OF MACHINE DARMSTADT ELECTRON LINEAR ACCELERATOR (DALINAC)
INSTITUTION INSTITUT FUER KERNPHYSIK, TECHNISCHE HOCHSCHULE DARMSTADT
LOCATION DARMSTADT, GERMANY — DATE FEBRUARY 1976
IN CHARGE PROF. A. RICHTER - DR. E. SPAMER — REPORTED BY PROF. A. RICHTER

HISTORY AND STATUS

DESIGN, date 1960 MODEL tests 1960-62
ENG. DESIGN, date --
CONSTRUCTION, date 1960-1961
FIRST BEAM date (or goal) FEBRUARY 10, 1962
MAJOR ALTERATIONS NEW INJECTOR 1971
OPERATION 120 hr/wk; On Target 110 hr/wk
TIME DIST., in house 97 %, outside 3 %
USERS' SCHEDULING CYCLE 2 - 3 weeks
COST, ACCELERATOR ~ DM 1 MILLION IN 1960
COST, FACILITY, total ~ DM 4.5 MILLIONS
FUNDED BY STATE, FEDERAL GOVERNMENT AND GERMAN NATIONAL SCIENCE FOUNDATION (DFG)

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2 ENGINEERS 1
TECHNICIANS 4 CRAFTS 2
ADMIN & CLER - TOTAL 9
GRAD. STUDENTS involved during year 7
OPERATED BY 7 Res staff or 7 Sp op.
BUDGET, op & dev DM 200.000,-- per year
FUNDED BY STATE (WITHOUT SALARIES)

RESEARCH STAFF, not included above

USER GROUPS, in house 13 outside -
STAFF SCIENTISTS, in house 5 outside -
TOTAL RES STAFF, in house 13 outside -
GRAD STUDENTS involved during year 10
RES. BUDGET, in house 250.000,-- per year
FUNDED BY STATE AND DFG (WITHOUT SALARIES)

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 593 m^2
movable same m^2
TARGET STATIONS 4 in 3 ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type N=1/2, 120° AND N=1/2, 169°
ON-LINE COMPUTER, model H116, PDP 11/20, PDP 11/45
TOTAL POWER INSTALLED FOR RESEARCH 100 KVA
FACILITIES for:
Isotope production 1
Irradiation, Solid State 1
Biological
Time-of-Flight Study -
On-Line Mass Separation -
Other ELECTRON SCATTERING AND ATOMIC PHYSICS

PHYSICAL DIMENSIONS

TUNNEL, length 16 m, X-sec(hXw) 2.4 X 3 m
ACCELERATOR, length 6.60 m, dia. ~40 cm
BEAM, DIA. 0.8 cm; ENERGY GAIN ~10 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	$\sim 2\times10^{14}$ (≙ 30μA averaged)	0.2x0.2	0.07	≤.5

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 75 %
Solid State Physics - %
Bio-Medical Applications 2 %
Isotope Production 3 %
Machine Research 5 %
ATOMIC PHYSICS 15 %
%

SELECTED REFERENCES DESCRIBING MACHINE

F. Gudden, G. Fricke, H.-G. Clerc und P. Brix, Z. Physik 181, 453 (1964).

H. Miska, H.D. Gräf, A. Richter, R. Schneider, D. Schüll, E. Spamer, H. Theissen, O. Titze and Th. Walcher, Phys. Lett. 58B, 155 (1975).

R.W. Frey, et al., Nucl. Instr. Meth., to be submitted

OTHER NOTABLE FEATURES:

HIGH RESOLUTION BEAM HANDLING SYSTEM AND ENERGY LOSS SPECTROMETER WITH OVERALL ENERGY RESOLUTION OF ΔE ≃ 30 keV AT INCIDENT ELECTRON ENERGIES BETWEEN 20 AND 70 MeV

ENTRY NO. 10

INJECTOR SYSTEM

TYPE OF SOURCE ELECTRON GUN
OUTPUT, max 250 *mA, at* 150 *keV, at* -- *π mm-mrad*
INJECTION PERIOD 5 - 10 μsec *μsec, at* 150 *Hz*
HIGH VOLTAGE STAGE -
Output,max - *mA, at* - *keV, at* -- *π mm-mrad*
BUNCHER RF-PREBUNCHER
Potential - *keV, Drift Length* 0.30 *m*
Potential - *keV, Drift Length* - *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	S- BANDLINAC		
BEAM EN. (IN-OUT), MeV	70		
TOTAL LENGTH, m	6.6		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	2π/3		
$Q (x\ 10^3)$	13		
FILLING TIME, μs	1.2		
NO. OF TANKS	-		
DIAMETER, cm	-		
DRIFT TUBES, number	-		
LENGTH, cm	-		
DIAMETER, cm	-		
GAP/CELL LENGTH RATIO	-		
IRIS APERTURE, cm	-		
THICKNESS, cm	-		
SPACING, cm	-		
GROUP VELOCITY	2.75×10^6 m/s		
PHASE VELOCITY	c		
WAVE TYPE	TRAVELLING		
SHUNT IMPEDANCE, MΩ/m	57		
ATTENUATION, Np/TANK	-		
EQUILIBRIUM PHASE, deg.	-		
RF POWER UNITS, type	TV2011 KLYSTRON		
RF POWER UNITS, number	1		
RF POWER DEMAND, peak, MW	20		
RF POWER DEMAND, mean, MW	0.020		
RF POWER RATING, MW/unit	-		
RF POWER FEED SPACING, m	3.30		
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 11

NAME OF MACHINE GILB (GIESSEN ELECTRON LINEAR BESCHLEUNIGER)
INSTITUTION STRAHLENZENTRUM DER UNIVERSITAET
LOCATION 63 GIESSEN, LEIHGESTERNERWEG 2A
DATE AUGUST 9, 1976
IN CHARGE W. ARNOLD
REPORTED BY W. ARNOLD

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests 1966
ENG. DESIGN, date 1966/67
CONSTRUCTION, date 1966/67
FIRST BEAM date (or goal) 1967
MAJOR ALTERATIONS 1972
OPERATION 100 hr/wk; On Target 90 hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE 1-2 weeks
COST, ACCELERATOR $600,000
COST, FACILITY, total $900,000 excl. building
FUNDED BY STATE

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 5 CRAFTS 1
ADMIN & CLER 0.2 TOTAL 8.2
GRAD. STUDENTS involved during year -
OPERATED BY 50% Res staff or 50% Sp op.
BUDGET, op & dev $60,000/year
FUNDED BY STATE

RESEARCH STAFF, not included above

USER GROUPS, in house 4 outside 2
STAFF SCIENTISTS, in house 6 outside 2
TOTAL RES STAFF, in house 15 outside 5
GRAD STUDENTS involved during year 10
RES. BUDGET, in house $20,000
FUNDED BY 30% State, 70% Federal

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 300 m^2
movable - m^2
TARGET STATIONS 3 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max. -
MAG SPECTROGRAPH, type -
ON-LINE COMPUTER, model TELEFUNKEN TR86
TOTAL POWER INSTALLED FOR RESEARCH 2 MW
FACILITIES for:
Isotope production x
Irradiation, Solid State -
Biological x
Time-of-Flight Study -
On-Line Mass Separation -
Other Nuclear Physics

PHYSICAL DIMENSIONS

TUNNEL, length 20 m, X-sec(hXw) X m
ACCELERATOR, length 9 m, dia. 15 cm
BEAM, DIA. 1 cm; ENERGY GAIN 8 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	10^{15}	1	0.03	3
e^+	10^9	1	0.02	3
γ	10^{13}	10	0.03	cont.

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 75 %
Solid State Physics 10 %
Bio-Medical Applications 5 %
Isotope Production 5 %
Machine Research 5 %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: $e^\pm$ converter in between sections, mono-energetic γ-facility (beryllium target)

ENTRY NO. 11

INJECTOR SYSTEM

TYPE OF SOURCE Triode
OUTPUT, max 1 *mA, at* 40 *keV, at* ______ *π mm-mrad*
INJECTION PERIOD 0.01/0.1/2 *μsec, at* 800/800/200 *Hz*
HIGH VOLTAGE STAGE ______
Output,max ______ *mA, at* ______ *keV, at* ______ *π mm-mrad*
BUNCHER for electrons
Potential earth *keV, Drift Length* ______ *m*
Potential ______ *keV, Drift Length* ______ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	travelling wave (two section)		
BEAM EN. (IN-OUT), MeV	0.04 - (10 -65)		
TOTAL LENGTH, m	9		
RADIO FREQUENCY, MHz	3000		
FIELD MODE			
$Q(x\ 10^3)$	10		
FILLING TIME, μs	0.5		
NO. OF TANKS	2		
DIAMETER, cm	15		
DRIFT TUBES, number	-		
LENGTH, cm	-		
DIAMETER, cm	-		
GAP/CELL LENGTH RATIO	-		
IRIS APERTURE, cm	~ 2.5		
THICKNESS, cm			
SPACING, cm	π/2		
GROUP VELOCITY	0.04 - 0.015		
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	40		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	klystron F2042		
RF POWER UNITS, number	1		
RF POWER DEMAND, peak, MW	30		
RF POWER DEMAND, mean, MW	0.03		
RF POWER RATING, MW/unit	-		
RF POWER FEED SPACING, m	-		
QUADRUPOLES, number	1		
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 12

NAME OF MACHINE Linac I Electron-Injector
INSTITUTION DESY
LOCATION Hamburg, Germany
DATE 29-3-76
IN CHARGE H. Kumpfert
REPORTED BY R. Waldhausen

HISTORY AND STATUS

DESIGN, date 1959 MODEL tests 1961/62
ENG. DESIGN, date
CONSTRUCTION, date
FIRST BEAM date (or goal) May 1961
MAJOR ALTERATIONS 1968 (inj., Vac.), 1975 (Energy)
OPERATION 168 hr/wk; On Target ______ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ______ weeks
COST, ACCELERATOR 2 MDM
COST, FACILITY, total 4 MDM
FUNDED BY Federal Government, City of Hamburg

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS - ENGINEERS 1
TECHNICIANS 5 CRAFTS
ADMIN & CLER TOTAL 6
GRAD. STUDENTS involved during year
OPERATED BY ____ Res staff or ____ Sp op.
BUDGET, op & dev ~ 0.5 MDM/year
FUNDED BY DESY

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house ____ outside ____
TOTAL RES STAFF, in house ____ outside ____
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 10 m^2
movable ______ m^2
TARGET STATIONS 1 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model* PDP 15
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other Injector for Synchrotron

PHYSICAL DIMENSIONS

TUNNEL, length 20 m, X-sec(hXw) ____ X ____ m
ACCELERATOR, length 7.5 m, dia. 10 cm
BEAM, DIA. 1 cm; ENERGY GAIN 8 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	$\Delta E/E$ (%)
e^-	1.6×10^{13}	0.8	0.06	1

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %
Solid State Physics ____ %
Bio-Medical Applications ____ %
Isotope Production ____ %
Machine Research ____ %

SELECTED REFERENCES DESCRIBING MACHINE

A 40 MeV electron-accelerator for Germany by M.C. Crowley-Milling

OTHER NOTABLE FEATURES: * for linac operation (remote control).

Prebuncher for 500 MHz (Synchrotron rf - frequency)

Chopper for single bunch, or 1 out of 4, or 1 out of 16 bunches in 500 MHz, adjustable pulse length.

ENTRY NO. 12

INJECTOR SYSTEM

TYPE OF SOURCE Electron Gun
OUTPUT, max 400 mA, at 50 keV, at ______ π mm-mrad
INJECTION PERIOD 1.5 μsec, at 50 Hz
HIGH VOLTAGE STAGE ______
Output,max ______ mA, at ______ keV, at ______ π mm-mrad
BUNCHER integrated in first section
Potential ______ keV, ~~Drift~~ Length ~ 0.4 m
Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Travelling Wave Structure		
BEAM EN. (IN-OUT), MeV	0.05 - 60		
TOTAL LENGTH, m	5 x 1.5		
RADIO FREQUENCY, MHz	3000		
FIELD MODE	2π/3		
Q(x 10^3)			
FILLING TIME, μs	0.5		
NO. OF TANKS	5		
DIAMETER, cm	7.8		
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2		
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY	10^{-2} c		
PHASE VELOCITY	c		
WAVE TYPE	TM01		
SHUNT IMPEDANCE, MΩ/m	33		
ATTENUATION, Np/TANK	0.28		
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Klystron K211 EEV; Yk1110 Valvo		
RF POWER UNITS, number	5		
RF POWER DEMAND, peak, MW	6.5 per unit		
RF POWER DEMAND, mean, ~~MW~~ kW	1 per unit		
RF POWER RATING, MW/unit			
RF POWER FEED SPACING, m			
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

Solenoid focusing

ENTRY NO. 13

NAME OF MACHINE BAM-Linac
INSTITUTION Bundesanstalt für Materialprüfung
LOCATION 1000 Berlin 45 DATE 28.6.76
IN CHARGE P. Jost REPORTED BY P. Jost

HISTORY AND STATUS

DESIGN, date 1970 MODEL tests 1972
ENG. DESIGN, date 1970
CONSTRUCTION, date 1971
FIRST BEAM date (or goal) 1973
MAJOR ALTERATIONS
OPERATION 5 hr/wk; On Target 4 hr/wk
TIME DIST., in house 100 %, outside %
USERS' SCHEDULING CYCLE 52 weeks
COST, ACCELERATOR 1.5 · 10 mill. DM
COST, FACILITY, total 2.5 · 10 mill. DM
FUNDED BY Government

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 3 ENGINEERS
TECHNICIANS 1 CRAFTS
ADMIN & CLER TOTAL 4
GRAD. STUDENTS involved during year
OPERATED BY Res staff or Sp op.
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USER GROUPS, in house outside
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 40 m^2
movable 4 m^2
TARGET STATIONS 1 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH 1
FACILITIES for:
Isotope production 1
Irradiation, Solid State 1
Biological 1
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length m, X-sec(hXw) X m
ACCELERATOR, length 4 m, dia. 30 cm
BEAM, DIA. 0.3 cm; ENERGY GAIN 9 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	400 μA	0.08	0.035	5

OPERATING PROGRAMS, time dist

Basic Nuclear Physics %
Solid State Physics %
Bio-Medical Applications %
Isotope Production 10 %
Machine Research %
γ-Activation analysis 80 %
n-radiography 10 %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES:

ENTRY NO. 13

INJECTOR SYSTEM

TYPE OF SOURCE indirect heated tantalum disc (Pierce)
OUTPUT, max 0.400 *mA, at* 40 *keV, at* ______ *π mm-mrad*
INJECTION PERIOD 4 *μsec, at* 300 *Hz*
HIGH VOLTAGE STAGE ______
Output, max ______ *mA, at* ______ *keV, at* ______ *π mm-mrad*
BUNCHER ______
Potential ______ *keV, Drift Length* ______ *m*
Potential ______ *keV, Drift Length* ______ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	trav. wave		
BEAM EN. (IN-OUT), MeV	40 keV 35 MeV		
TOTAL LENGTH, m	4		
RADIO FREQUENCY, MHz	28560		
FIELD MODE	$2\pi/3$		
$Q(x\ 10^3)$	12		
FILLING TIME, μs	0.6		
NO. OF TANKS			
DIAMETER, cm			
DRIFT TUBES, number	2		
LENGTH, cm	200		
DIAMETER, cm	1.8		
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	1.8		
THICKNESS, cm	0.6		
SPACING, cm	0.3 - 0.6		
GROUP VELOCITY			
PHASE VELOCITY	0.4·c-0.99·c		
WAVE TYPE	E_{01}		
SHUNT IMPEDANCE, MΩ/m	50		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Klystron		
RF POWER UNITS, number	1		
RF POWER DEMAND, peak, MW	2 X 10		
RF POWER DEMAND, mean, MW	2 X 0.02		
RF POWER RATING, MW/unit	10		
RF POWER FEED SPACING, m	2		
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 14

NAME OF MACHINE FRASCATI LINAC (INJECTOR TO ADONE)
INSTITUTION C N E N
LOCATION Frascati
DATE 8/March/1976
IN CHARGE S. TAZZARI
REPORTED BY Scrimaglio, Tazzari

HISTORY AND STATUS

DESIGN, date 62 *MODEL teste*
ENG. DESIGN, date 63
CONSTRUCTION, date 64
FIRST BEAM date (or goal) 66
MAJOR ALTERATIONS
OPERATION 120 *hr/wk; On Target* *hr/wk*
TIME DIST., in house *%, outside* *%*
USERS' SCHEDULING CYCLE *weeks*
COST, ACCELERATOR 2 M$ (64)
COST, FACILITY, total 3.3 M$ (64)
FUNDED BY CNR, CNEN

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT
Linac + Storage Ring
SCIENTISTS 5 *ENGINEERS* 4
TECHNICIANS 15 *CRAFTS* 25
ADMIN & CLER *TOTAL* 49
GRAD. STUDENTS involved during year ~ 2
OPERATED BY *Res staff or* X *Sp op.*
BUDGET, op & dev ~ 250.000 $ /year
FUNDED BY INFN

RESEARCH STAFF, not included above

USER GROUPS, in house 3 *outside* 3(5)
STAFF SCIENTISTS, in house 7 *outside* 12(18)
TOTAL RES STAFF, in house 14 *outside* 20(23)
GRAD STUDENTS involved during year 6
RES. BUDGET, in house ~ 50000 $ /year
FUNDED BY INFN

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 50 m^2
movable 70 m^2
TARGET STATIONS 2 *in* 2 *ROOMS*
STATIONS SERVED AT THE SAME TIME, max. 1÷2
MAG SPECTROGRAPH, type pair, compton, energy loss, 180°, large angle
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH 1 MW
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological in project
Time-of-Flight Study
On-Line Mass Separation
Other Nuclear Physics with π and γ beams

PHYSICAL DIMENSIONS

TUNNEL, length 80 *m, X-sec(hXw)* 4 X 3 *m*
ACCELERATOR, length 60 *m, dia.* *cm*
BEAM, DIA. 1.5 *cm; ENERGY GAIN* 8÷9 *MeV/m* Av.

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	*FLUX (part./sec)*	*BEAM AREA (cm^2)*	*ENERGY (GeV)*	*ΔE/E (%)*
e^+	9.10^{11}max	2 cm.mrad	.34	±1
±	10^6max	10 x 10	0.03÷0.15	±10
	10^8*		0.08÷0.3	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 30 %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research %

SELECTED REFERENCES DESCRIBING MACHINE

F.Amman, R.Andreani: L'acceleratore lineare per elettroni e positroni - LNF Int.Report LNF 63/46, 1963.

F.Amman, R.Andreani, J.Haimson, C.Nunan: Positron acceleration in the Frascati 450 MeV Linear Accelerator - Proc.Lin.Acc.Conference, Los Alamos (1966).

OTHER NOTABLE FEATURES: * Angular acceptance 6 mrad. around 0°

ENTRY NO. 14

INJECTOR SYSTEM

TYPE OF SOURCE Indirect heating, 3 KV bombarder, Pierce geometry
OUTPUT, max 4000 *mA, at* 120 *keV, at* ~ 10^2 π *mm-mrad*
INJECTION PERIOD 4 *μsec, at* 200 *Hz*
HIGH VOLTAGE STAGE
Output, max ____ *mA, at* ____ *keV, at* ____ π *mm-mrad*
RAS *BUNCHER* circular RF cavity TM010
Potential ____ *keV, Drift Length* .25 *m*
Potential ____ *keV, Drift Length* ____ *m*

ACCELERATION SYSTEM

	I High current	*II* High energy	*III*
TYPE	constant gradient	constant gradient	
BEAM EN. (IN-OUT), MeV	.12÷105 @ i=0	105÷440 @ i=0	
TOTAL LENGTH, m	4x2.94	8x5.04	
RADIO FREQUENCY, MHz	2856	2856	
FIELD MODE	TM_{01}, 2π/3	TM_{01}, 2π/3	
Q(x 10^3)	13000	13000	
FILLING TIME, μs	.57	1.19	
NO. OF TANKS	4	8	
DIAMETER, cm			
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2 ÷ 3	2 ÷ 3	
THICKNESS, cm	.62	.62	
SPACING, cm	3.5 cm	3.5 cm	
GROUP VELOCITY	5.16 10^6m/s	4.24 10^6m/s	
PHASE VELOCITY	→ ~ C	~ C	
WAVE TYPE	travelling	travelling	
SHUNT IMPEDANCE, MΩ/m	50.7	51.5	
ATTENUATION, Np/TANK	.08÷.220	.07÷.255	
EQUILIBRIUM PHASE, deg.	~ 90	~ 90	
RF POWER UNITS, type	KLY TV2015 Th CSF	KLY TV2015 Th CSF	
RF POWER UNITS, number	2	4	
RF POWER DEMAND, peak, MW	2x25	4x25	
RF POWER DEMAND, mean, MW	2x.025	4x.025	
RF POWER RATING, MW/unit	25 peak	25 peak	
RF POWER FEED SPACING, m	1 x section	1 x section	
QUADRUPOLES, number		8 solenoids	
GRADIENT, kG/m		(2400 Gaussx5 m each)	
SPACING, m			
OTHER			

ENTRY NO. 15

NAME OF MACHINE RILAC (Riken Ion Linear Accelerator)
INSTITUTION The Institute of Physical and Chemical Research (Riken)
LOCATION Wako-shi, Saitama, 351 Japan
DATE Feb. 25 1976
IN CHARGE M. Odera
REPORTED BY M. Odera

HISTORY AND STATUS

DESIGN, date 1971 MODEL tests 1972-1974
ENG. DESIGN, date 1974-1975
CONSTRUCTION, date 1975-1979
FIRST BEAM date (or goal) 1980
MAJOR ALTERATIONS
OPERATION ___ hr/wk; On Target ___ hr/wk
TIME DIST., in house ___ %, outside ___ %
USERS' SCHEDULING CYCLE ___ weeks
COST, ACCELERATOR $ 4,200,000
COST, FACILITY, total $ 7,830,000
FUNDED BY Science and Technology Agency

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2 ENGINEERS 6
TECHNICIANS 3 CRAFTS
ADMIN & CLER TOTAL
GRAD. STUDENTS involved during year
OPERATED BY ___ Res staff or ___ Sp op.
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USER GROUPS, in house ___ outside ___
STAFF SCIENTISTS, in house ___ outside ___
TOTAL RES STAFF, in house ___ outside ___
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 1500 m^2
movable ___ m^2
TARGET STATIONS 6 in 3 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type none
ON-LINE COMPUTER, model not determined yet
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length 46 m, X-sec(hXw) 8.3 X 9 m
ACCELERATOR, length 20 m, dia. ___ cm
BEAM, DIA. ___ cm; ENERGY GAIN 1×charge MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Kr	5×10^{11}		0.16	
Xe	1×10^{11}		0.18	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	30	%
Solid State Physics	20	%
Bio-Medical Applications	10	%
Isotope Production		%
Machine Research	20	%
Other Fields and		%
Maintenance work	20	%

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: A Wideröe-type low energy accelerator for very heavy elements. A quarter-wave coaxial resonator is used as an accelerating structure. Resonant frequency is adjustable according to charge to mass ratio of ions.

ENTRY NO.15

INJECTOR SYSTEM

TYPE OF SOURCE Indirectly-heated PIG for multiply-charged ions
OUTPUT, max 10 mA, at 50 q keV, at ______ π mm-mrad
INJECTION PERIOD continuous μsec, at ______ Hz
HIGH VOLTAGE STAGE Cockcroft-Walton
Output,max 5 mA, at 500 q keV, at ______ π mm-mrad
BUNCHER A quarter-wave coaxial
Potential 3 keV, Drift Length 2 m
Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Combination of quarter wave resonators		
BEAM EN. (IN-OUT), MeV	0.5q-20q		
TOTAL LENGTH, m	20		
RADIO FREQUENCY, MHz	20 ∿ 40		
FIELD MODE	π		
$Q (x 10^3)$	10 ∿ 20		
FILLING TIME, μs			
NO. OF TANKS	6		
DIAMETER, cm			
DRIFT TUBES, number	80		
LENGTH, cm	2.6 ∿ 16.4		
DIAMETER, cm	16		
GAP/CELL LENGTH RATIO	0.6 ∿ 0.33		
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	25 ∿ 80		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Grounded Cathode		
RF POWER UNITS, number	6		
RF POWER DEMAND, peak, MW	0.6		
RF POWER DEMAND, mean, MW	0.6		
RF POWER RATING, MW/unit	0.1		
RF POWER FEED SPACING, m	1 for each tank		
QUADRUPOLES, number	40		
GRADIENT, kG/m	100 ∿ 700		
SPACING, m			
OTHER			

ENTRY NO. 16

NAME OF MACHINE Injector Linac for KEK 12 GEV PS
INSTITUTION National Laboratory for High Energy Physics
LOCATION Oho-machi, Tsukuba, Ibaraki, Japan DATE February 20, 1976

IN CHARGE J. Tanaka REPORTED BY J. Tanaka

HISTORY AND STATUS

DESIGN, date 1966 MODEL tests 1967
ENG. DESIGN, date 1970
CONSTRUCTION, date April 1971
FIRST BEAM date (or goal) August 1, 1974
MAJOR ALTERATIONS
OPERATION ____ hr/wk; On Target ____ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE (~30) weeks
COST, ACCELERATOR 2.8 M$
COST, FACILITY, total
FUNDED BY Ministry of Education

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 11 ENGINEERS —
TECHNICIANS 5 CRAFTS —
ADMIN & CLER — TOTAL 16
GRAD. STUDENTS involved during year none
OPERATED BY ____ Res staff or ____ Sp op.
BUDGET, op & dev 1.1 M$
FUNDED BY Ministry of Education

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house ____ outside ____
TOTAL RES STAFF, in house ____ outside ____
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS ____ in ____ ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length 50 m, X-sec(hXw) 4.7 X 5.5 m
ACCELERATOR, length 15.5 m, dia. 94 cm
BEAM, DIA. 1.0 cm; ENERGY GAIN 1.3 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

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

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %
Solid State Physics ____ %
Bio-Medical Applications ____ %
Isotope Production ____ %
Machine Research ____ %
____ %
____ %

SELECTED REFERENCES DESCRIBING MACHINE

1. Proc. U.S.-Japan Seminar on High Energy Accelerator Science, p.279 (1973)
2. KEK Annual Report 1971-1974

OTHER NOTABLE FEATURES: This machine is an injector for the KEK 12 GeV Proton Synchrotron. Therefore the organization is also a part of KEK 12 GeV PS department, and the linac does not have its own research facilities.

ENTRY NO. 16

INJECTOR SYSTEM

TYPE OF SOURCE Duoplasmatron
OUTPUT, max 260 *mA, at* 50 *keV, at* 2.0 (normalized) *π mm-mrad*
INJECTION PERIOD 20 *μsec, at* 20 *Hz*
HIGH VOLTAGE STAGE Cockcroft-Walton
Output,max 160 *mA, at* 750 *keV, at* ~4 (normalized) *π mm-mrad*
BUNCHER COAXIAL (TWO GAPS)
Potential 20 *keV, Drift Length* 0.8 *m*
Potential *keV, Drift Length* *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Drift tube Linac		
BEAM EN. (IN-OUT), MeV	0.75(IN) 20.3(OUT)		
TOTAL LENGTH, m	15.5		
RADIO FREQUENCY, MHz	200		
FIELD MODE	TM_{010}		
$Q(x\ 10^3)$	>64		
FILLING TIME, μs	>65 (=Q/W)		
NO. OF TANKS	1		
DIAMETER, cm	94		
DRIFT TUBES, number	88 + 1/2 × 2		
LENGTH, cm	4.8 - 20.7		
DIAMETER, cm	18		
GAP/CELL LENGTH RATIO	0.21 - 0.32		
IRIS APERTURE, cm	-		
THICKNESS, cm	-		
SPACING, cm	-		
GROUP VELOCITY	-		
PHASE VELOCITY	-		
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	65 - 78		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	26.5		
RF POWER UNITS, type	TH516 Triode		
RF POWER UNITS, number	2		
RF POWER DEMAND, peak, MW	3		
RF POWER DEMAND, mean, MW	0.018		
RF POWER RATING, MW/unit	1.5		
RF POWER FEED SPACING, m	7.5		
QUADRUPOLES, number	90		
GRADIENT, kG/m	8 - 2		
SPACING, m			
OTHER			

BEAM OUTPUT, max.> 100 mA, at <4.0 πmm-mrad
BEAM PULSE WIDTH 0.5 - 30 μs
REPETITION RATE max. 20 Hz
ENERGY SPREAD ΔE/E (%) ±0.3 WITH DEBUNCHER

ENTRY NO. 17

NAME OF MACHINE TOHOKU 300 MeV ELECTRON LINEAR ACCELERATOR
INSTITUTION LABORATORY OF NUCLEAR SCIENCE, TOHOKU UNIVERSITY
LOCATION SENDAI, JAPAN — DATE July 29, 1976
IN CHARGE Y. TORIZUKA — REPORTED BY M. OYAMADA

HISTORY AND STATUS

DESIGN, date 1963 MODEL tests 1964-1965
ENG. DESIGN, date 1964-1965
CONSTRUCTION, date 1965-1967
FIRST BEAM date (or goal) May 24, 1967
MAJOR ALTERATIONS ENERGY COMPRESSING SYSTEM 1976
OPERATION 120 hr/wk; On Target 105 hr/wk
TIME DIST., in house 50 %, outside 50 %
USERS' SCHEDULING CYCLE 27 weeks
COST, ACCELERATOR U.S.$1.7M (¥500M)
COST, FACILITY, total U.S.$1.7M(¥500M integrated)
FUNDED BY Government (Ministry of Education)

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 5 ENGINEERS 2
TECHNICIANS 4 CRAFTS 0
ADMIN & CLER 1 TOTAL 12
GRAD. STUDENTS involved during year 1
OPERATED BY many Res staff or 6 Sp op.
BUDGET, op & dev U.S.$0.4M (¥120M)
FUNDED BY Government (Ministry of Education)

RESEARCH STAFF, not included above

USER GROUPS, in house 6 outside 40
STAFF SCIENTISTS, in house 6 outside 70
TOTAL RES STAFF, in house 6 outside 120
GRAD STUDENTS involved during year 50
RES. BUDGET, in house U.S.$0.2M (¥60M)
FUNDED BY Government (Ministry of Education)

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 1300 m^2
movable 0 m^2
TARGET STATIONS 8 in 4 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type Magic angle,Brown-Buchner
ON-LINE COMPUTER, model OKITAC-4500
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production pneumatic tubes
Irradiation, Solid State pulsed neutron source
Biological defocusing magnet
Time-of-Flight Study 125m and 25m flight tubes
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length 55 m, X-sec(hXw) 3.5 X 3 m
ACCELERATOR, length 45 m, dia. 8 cm
BEAM, DIA. 0.5 cm; ENERGY GAIN 9 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
electron	20 μA	0.1	250 MeV	0.2
electron	120 μA	1	60 MeV	5
thermal neutron	10^{12} n/cm^{2}s	3cmϕx9	meV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 60 %
Solid State Physics 15 %
Bio-Medical Applications 5 %
Isotope Production 15 %
Machine Research 5 %

SELECTED REFERENCES DESCRIBING MACHINE

Y. Torizuka et al.,"A 300 MeV Electron Linear Accelerator of Tohoku University" Oyobutsuri 37 (1968) 690 (in Japanese)

M. Oyamada,"Tohoku 300 MeV Electron Linac as a Pulsed Neutron Source", Proceedings for the Symposium on Intense Pulsed Neutron Sources in Japan, Tokai. (March 1975) 91

OTHER NOTABLE FEATURES:

1. The detector systems which have been adopted for the two magnetic spectrometers are consist of 100 SSD (Si(Li)) respectively.
2. The pulsed neutron source was installed in the reactor-like shielding around which various neutron facilities are distributed. Eight user's groupes can execute thier experiments simultaneously and all data are processed by a small on-line computer.
3. Energy Compressing System (ECS) was installed and very successfully set into operation in July 1976.

ENTRY NO. 17

INJECTOR SYSTEM

TYPE OF SOURCE Impregnated cathod type electron gun (triode)
OUTPUT, max 1500 mA, at 80 keV, at ____ π mm-mrad
INJECTION PERIOD 4 μsec, at 300 Hz
HIGH VOLTAGE STAGE ____
Output,max ____ mA, at ____ keV, at ____ π mm-mrad
BUNCHER ____
Potential ____ keV, Drift Length ____ m
Potential ____ keV, Drift Length ____ m

ACCELERATION SYSTEM

	I	II	III
TYPE	uniform structure	uniform structure	
BEAM EN. (IN-OUT), MeV	0.4-80	80-250	
TOTAL LENGTH, m	8.4	25.2	
RADIO FREQUENCY, MHz	2856	2856	
FIELD MODE	TM_{01}	TM_{01}	
$Q(x\ 10^3)$	13	13	
FILLING TIME, μs	0.4	0.8	
NO. OF TANKS	8	12	
DIAMETER, cm	8.2	8.2	
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2.09	2.09	
THICKNESS, cm	0.5842	0.5842	
SPACING, cm	3.499	3.499	
GROUP VELOCITY	0.0088c	0.0088c	
PHASE VELOCITY	c	c	
WAVE TYPE	traveling wave 2π/3	traveling wave 2π/3	
SHUNT IMPEDANCE, MΩ/m	58	58	
ATTENUATION, Np/TANK	0.275	0.55	
EQUILIBRIUM PHASE, deg.	-90°	-90°	
RF POWER UNITS, type	klystron	klystron	
RF POWER UNITS, number	2	3	
RF POWER DEMAND, peak, MW	40	60	
RF POWER DEMAND, mean, MW	0.048	0.072	
RF POWER RATING, MW/unit	20	20	
RF POWER FEED SPACING, m	1.5	2.5	
QUADRUPOLES, number	3	5	
GRADIENT, kG/m	24	24	
SPACING, m			
OTHER			

ENTRY NO. 18

NAME OF MACHINE JAERI Linac
INSTITUTION Japan Atomic Energy Research Institute
LOCATION Tokai-mura, Ibaraki-ken, Japan *DATE* June 7, 1976
IN CHARGE A.Asami *REPORTED BY* A.Asami

HISTORY AND STATUS

DESIGN, date 1970 *MODEL tests* ______
ENG. DESIGN, date April 1970
CONSTRUCTION, date April 1070 - March 1972
FIRST BEAM date (or goal) April 1972
MAJOR ALTERATIONS ______
OPERATION 40 *hr/wk; On Target* 30 *hr/wk*
TIME DIST., in house 80 *%, outside* 20 *%*
USERS' SCHEDULING CYCLE 2 *weeks*
COST, ACCELERATOR ¥ 245 Million
COST, FACILITY, total ¥ 390 Million
FUNDED BY Science and Technology Agency

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 *ENGINEERS* ______
TECHNICIANS 4 *CRAFTS* ______
ADMIN & CLER ______ *TOTAL* 5
GRAD. STUDENTS involved during year ______
OPERATED BY ______ *Res staff or* ______ *Sp op.*
BUDGET, op & dev ¥ 33Million (1975)
FUNDED BY Science and Technology Agency

RESEARCH STAFF, not included above

USER GROUPS, in house 2 *outside* 2
STAFF SCIENTISTS, in house 8 *outside* 3
TOTAL RES STAFF, in house 8 *outside* 3
GRAD STUDENTS involved during year 1
RES. BUDGET, in house ¥ 10 Million
FUNDED BY Science and Technology Agency

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ______ m^2
movable ______ m^2
TARGET STATIONS 4 *in* 3 *ROOMS*
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type ______
ON-LINE COMPUTER, model ______
TOTAL POWER INSTALLED FOR RESEARCH ______
FACILITIES for:
Isotope production one
Irradiation, Solid State one for solid state
Biological ______
Time-of-Flight Study 7 neutron TOF tubes
On-Line Mass Separation ______
Other ______

PHYSICAL DIMENSIONS

TUNNEL, length ______ *m, X-sec(hXw)* ______ *X* ______ *m*
ACCELERATOR, length 13 *m, dia.* ~ 10 *cm*
BEAM, DIA. ~ 0.7 *cm; ENERGY GAIN* ______ *MeV/m*

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	*FLUX (part./sec)*	*BEAM AREA* (cm^2)	*ENERGY (GeV)*	$\Delta E/E$ (%)
Electron	105 μA	0.7	0.1	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 75 %
Solid State Physics 10 %
Bio-Medical Applications ______ %
Isotope Production 5 %
Machine Research 5 %
Reactor Physics 5 %
______ %

SELECTED REFERENCES DESCRIBING MACHINE

H.Takekoshi et al : "Design, Construction and operation of JAERI — Linac", JAERI Report 1238 (1975) (in Japanese)

OTHER NOTABLE FEATURES: ______

ENTRY NO. 18

INJECTOR SYSTEM

TYPE OF SOURCE Triode electron gun
OUTPUT, max ______ mA, at 100 keV, at ______ π mm-mrad
INJECTION PERIOD 0.03 ~ 2 μsec, at 150 Hz
HIGH VOLTAGE STAGE 1
Output,max ______ mA, at ______ keV, at ______ π mm-mrad
BUNCHER βw = 0.95c , 2λ long
Potential ______ keV, Drift Length ______ m
Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE			
BEAM EN. (IN-OUT), MeV	0.1 ~ 30	30 ~ 100	
TOTAL LENGTH, m	7.4	11.6	
RADIO FREQUENCY, MHz	2856		
FIELD MODE	TM 01		
Q(x 10^3)	13000	13000	
FILLING TIME, μs	0.32		
NO. OF TANKS			
DIAMETER, cm			
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2.62		
THICKNESS, cm	0.584		
SPACING, cm			
GROUP VELOCITY	0.021		
PHASE VELOCITY	1.0	1.0	
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	49	53	
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Klystron	Klystron	
RF POWER UNITS, number	2	3	
RF POWER DEMAND, peak, MW	40	60	
RF POWER DEMAND, mean, MW			
RF POWER RATING, MW/unit	20	20	
RF POWER FEED SPACING, m	3.2	3.6	
QUADRUPOLES, number	2	3	
GRADIENT, kG/m	7 (max)	7 (max)	
SPACING, m	3.1	3.6	
OTHER			

ENTRY NO. 19

NAME OF MACHINE 33 MeV ETL Electron Linear Accelerator
INSTITUTION Electrotechnical Laboratory, Agency of Industrial Science and Technology
LOCATION Tanashi, Tokyo, Japan   DATE March 3, 1976
IN CHARGE T. Tomimasu   REPORTED BY T. Tomimasu

HISTORY AND STATUS

DESIGN, date ____ MODEL tests ____
ENG. DESIGN, date ____
CONSTRUCTION, date March, 1963
FIRST BEAM date (or goal) September, 1963
MAJOR ALTERATIONS June, 1969
OPERATION 30 hr/wk; On Target 25 hr/wk
TIME DIST., in house 70 %, outside 30 %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY Japanese Government

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS ____ CRAFTS ____
ADMIN & CLER ____ TOTAL 2
GRAD. STUDENTS involved during year ____
OPERATED BY ____ Res staff or no Sp op.
BUDGET, op & dev ____
FUNDED BY Japanese Government

RESEARCH STAFF, not included above

USER GROUPS, in house 3 outside 3
STAFF SCIENTISTS, in house 6 outside 5
TOTAL RES STAFF, in house 6 outside 5
GRAD STUDENTS involved during year 1
RES. BUDGET, in house ____
FUNDED BY Japanese Government

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 332 m^2
movable ____ m^2
TARGET STATIONS two in two ROOMS
STATIONS SERVED AT THE SAME TIME, max. one
MAG SPECTROGRAPH, type 180° double focusing
ON-LINE COMPUTER, model ____
TOTAL POWER INSTALLED FOR RESEARCH 500 KW
FACILITIES for:
Isotope production Yes
Irradiation, Solid State Yes
Biological ____
Time-of-Flight Study ~~Yes~~
On-Line Mass Separation ____
Other ____

PHYSICAL DIMENSIONS

TUNNEL, length ____ m, X-sec(hXw) ____ X ____ m
ACCELERATOR, length 1.2x3 m, dia. ____ cm
BEAM, DIA. 0.35 cm; ENERGY GAIN 10 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
electrons	3×10^{15}	0.1	0.030	7
neutrons				
X-rays				

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 30 %
Solid State Physics 30 %
Bio-Medical Applications ____ %
Isotope Production 5 %
Machine Research 5 %
Nuclear Engineering 25 %
____ %

SELECTED REFERENCES DESCRIBING MACHINE

M. Nakamura, A New Method of Computing RF Properties of Disk-Loaded Wave Guides of Electron Linear Accelerator, DPNU 38 (Nagoya University, 1969)

T. Tomimasu, T. Mikado, and Y. Tsuchiya, The 33 MeV ETL Electron Linear Accelerator, Bul. Electrotech. Lab., Vol. 35, No. 1, P. 2 (1971)

OTHER NOTABLE FEATURES: ____

ENTRY NO. 19

INJECTOR SYSTEM

TYPE OF SOURCE
OUTPUT, max 1000 mA, at 100 keV, at π mm-mrad
INJECTION PERIOD 4 μsec, at 300 Hz
HIGH VOLTAGE STAGE
Output, max 400 mA, at 100 keV, at π mm-mrad
BUNCHER constant phase-velocity structure (0.958c)
Potential keV, Drift Length m
Potential keV, Drift Length m

ACCELERATION SYSTEM

	I	II	III
TYPE	Electron Linac		
BEAM EN. (IN-OUT), MeV	0.1 - 33		
TOTAL LENGTH, m	1.2 x 3		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	2 /3		
Q(x 10^3)	11		
FILLING TIME, μs	0.44		
NO. OF TANKS			
DIAMETER, cm			
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2.0		
THICKNESS, cm	0.5		
SPACING, cm	3.5		
GROUP VELOCITY	0.0087		
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	50		
ATTENUATION, Np/TANK	0.312 Np/m		
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Klystron		
RF POWER UNITS, number	2		
RF POWER DEMAND, peak, MW	14		
RF POWER DEMAND, mean, MW	0.017		
RF POWER RATING, MW/unit			
RF POWER FEED SPACING, m	5		
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 20

NAME OF MACHINE Electron linear accelerator
INSTITUTION Research Reactor Institute , Kyoto University
LOCATION Kumatori,Sennan-gun,Osaka,Japan DATE Feb. 24, 1976
IN CHARGE Toshikazu Shibata REPORTED BY Yoshiaki Fujita

HISTORY AND STATUS

DESIGN, date ____ MODEL tests ____
ENG. DESIGN, date L-1512-G of Applied Radiation Corp.
CONSTRUCTION, date 1966
FIRST BEAM date (or goal) 1966
MAJOR ALTERATIONS graded up to 2-section in 1972
OPERATION 30 hr/wk; On Target 30 hr/wk
TIME DIST., in house 40 %, outside 60 %
USERS' SCHEDULING CYCLE 1 or 1/2 weeks
COST, ACCELERATOR $ 600,000
COST, FACILITY, total $ 200,000
FUNDED BY Ministry of Education

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2 ENGINEERS 0
TECHNICIANS 4 CRAFTS 0
ADMIN & CLER 0 TOTAL 6
GRAD. STUDENTS involved during year 0
OPERATED BY ✓ Res staff or ____ Sp op.
BUDGET, op & dev $ 50,000
FUNDED BY Ministry of Education

RESEARCH STAFF, not included above

USER GROUPS, in house 4 outside 10
STAFF SCIENTISTS, in house 4 outside ____
TOTAL RES STAFF, in house 6 outside 20
GRAD STUDENTS involved during year 2
RES. BUDGET, in house $ 10,000
FUNDED BY Ministry of Education

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 400 m^2
movable 0 m^2
TARGET STATIONS 1 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type ____
ON-LINE COMPUTER, model ____
TOTAL POWER INSTALLED FOR RESEARCH 50 kVA
FACILITIES for:
Isotope production, Irradiation, Solid State, Biological } One irradiation facility
Time-of-Flight Study 5 flight tubes (5~40 m)
On-Line Mass Separation ____
Other ____

PHYSICAL DIMENSIONS

TUNNEL, length 25 m, X-sec (hXw) 4 X 4 m
ACCELERATOR, length 4.3 m, dia. 40 cm
BEAM, DIA. 1 cm; ENERGY GAIN 10 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	$\Delta E/E$ (%)
Electron	2A x 10 nsec	1	46 MeV	
	0.5A x 4 μsec (av. 360 μA)	1	28 MeV	
Neutron	10^{13} n/sec	Photo neutrons		

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 20 %
Solid State Physics 20 %
Bio-Medical Applications ____ %
Isotope Production ____ %
Machine Research ____ %
Neutron and Reactor Physics 60 %
____ %

SELECTED REFERENCES DESCRIBING MACHINE

" Proc. for Symp. on Intense Pulsed Neutron Sources in Japan " p.77, 1975. edited by Nuclear Engineering Research Laboratory, the Faculty of Engineering University of Tokyo.

OTHER NOTABLE FEATURES: This machine was established as a common use of universities and public research organizations in Japan.

ENTRY NO. 20

INJECTOR SYSTEM

TYPE OF SOURCE Grid-controlled electron gun with an oxide cathode accelerated by a 100 kV DC generator

OUTPUT, max 10 A (at peak) mA, at ______ keV, at ______ π mm-mrad

INJECTION PERIOD 0.01~4 μsec, at 180 Hz

HIGH VOLTAGE STAGE ______

Output,max ______ mA, at ______ keV, at ______ π mm-mrad

BUNCHER ______

Potential ______ keV, Drift Length ______ m

Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	constant impedance	constant gradient	
BEAM EN. (IN-OUT), MeV	23	23	
TOTAL LENGTH, m	2.5	1.845	
RADIO FREQUENCY, MHz	1300.7	1300.7	
FIELD MODE	2/3	2/3	
$Q(x\ 10^3)$	19.2	19.4	
FILLING TIME, μs	1.8	1.73	
NO. OF TANKS	1	1	
DIAMETER, cm	40	40	
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY	1.4×10^6 cm/sec	1.1×10^6 cm/sec	
PHASE VELOCITY	3×10^{10} cm/sec	3×10^{10} cm/sec	
WAVE TYPE	travelling wave	travelling wave	
SHUNT IMPEDANCE, MΩ/m	41	41	
ATTENUATION, Np/TANK	0.37	0.37	
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	klystron	klystron	
RF POWER UNITS, number	1	1	
RF POWER DEMAND, peak, MW	15	15	
RF POWER DEMAND, mean, MW	0.02	0.02	
RF POWER RATING, MW/unit	15	15	
RF POWER FEED SPACING, m			
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 21

NAME OF MACHINE PROTON LINEAR ACCELERATOR "ANDRZEJ"
INSTITUTION INSTITUTE OF NUCLEAR RESEARCH
LOCATION ŚWIERK near OTWOCK POLAND
DATE
IN CHARGE
REPORTED BY

HISTORY AND STATUS

DESIGN, date 1959 MODEL tests 1963
ENG. DESIGN, date 1965
CONSTRUCTION, date 1969
FIRST BEAM date (or goal) 15 January 1970
MAJOR ALTERATIONS
OPERATION 60 hr/wk; On Target 50 hr/wk
TIME DIST., in house 64 %, outside 36 %
USERS' SCHEDULING CYCLE 4 weeks
COST, ACCELERATOR 1,5 mil. $
COST, FACILITY, total
FUNDED BY Institute of Nuclear Research

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2 ENGINEERS 3
TECHNICIANS 13 CRAFTS 1
ADMIN & CLER 1 TOTAL 20
GRAD. STUDENTS involved during year 2
OPERATED BY 10 Res staff or ___ Sp op.
BUDGET, op & dev 110 000 $
FUNDED BY Atomic Energy Office

RESEARCH STAFF, not included above

USER GROUPS, in house 5 outside 4
STAFF SCIENTISTS, in house 14 outside 14
TOTAL RES STAFF, in house 22 outside 24
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY Atomic Energy Office

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 250 m^2
movable - m^2
TARGET STATIONS 5 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type Buechner
ON-LINE COMPUTER, model -
TOTAL POWER INSTALLED FOR RESEARCH 20 kW
FACILITIES for:
Isotope production no
Irradiation, Solid State yes
Biological yes
Time-of-Flight Study no
On-Line Mass Separation no
Other Scattering chamber

PHYSICAL DIMENSIONS

TUNNEL, length - m, X-sec(hXw) - X - m
ACCELERATOR, length 6 m, dia. 132 cm
BEAM, DIA. 0,3-2cm; ENERGY GAIN 1,6 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
protons	$1,9 \cdot 10^{13}$	0,3-3	0,0096	0,26-1,5

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 75 %
Solid State Physics %
Bio-Medical Applications 1 %
Isotope Production %
Machine Research 8 %
Industrial Applications 16 %
%

SELECTED REFERENCES DESCRIBING MACHINE

Collective work "Liniowy akcelerator protonów 10 MeV "Andrzej" w Świerku INR Raport Nr 1187/FLAP Warszawa 1970
J.Sura-"Dynamika wiązki w liniowym akceleratorze protonów 10 MeV Andrzej " INR Raport Nr 1369/SLLAP Warszawa 1972
M.Pachan-LCO-050 p.67 Proceedings of the 1970 Proton Linear Accelerator Conference, September 28-October 2, 1970/Batavia,Illinois/
T.Niewodniczański-LCO-049 p.77 ibid
St.Kuliński- LCO-051 p.353 ibid

OTHER NOTABLE FEATURES:

ENTRY NO. 21

INJECTOR SYSTEM

TYPE OF SOURCE radio frequency ion source
OUTPUT, max 10 mA, at 515 keV, at 7,7 π mm-mrad
INJECTION PERIOD 200-900 μsec, at up to 12,5 Hz
HIGH VOLTAGE STAGE Cockroft-Walton type
Output,max 5 DC mA, at 515 keV, at 7,7 π mm-mrad
BUNCHER one gap type
Potential 515 ± 17,5 keV, Drift Length 1,15 m
Potential keV, Drift Length m

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	0,515-9,6		
TOTAL LENGTH, m	5,524		
RADIO FREQUENCY, MHz	193,251		
FIELD MODE	E_{olo}		
Q(x 10^3)	$58 \cdot 10^3$		
FILLING TIME, μs			
NO. OF TANKS	1		
DIAMETER, cm	132		
DRIFT TUBES, number	40 + 2·1/2		
LENGTH, cm	5,3 ÷ 22,0		
DIAMETER, cm	15,3 ÷ 10,2		
GAP/CELL LENGTH RATIO	0,25		
IRIS APERTURE, cm	-		
THICKNESS, cm	-		
SPACING, cm	-		
GROUP VELOCITY	-		
PHASE VELOCITY	-		
WAVE TYPE	-		
SHUNT IMPEDANCE, MΩ/m	23		
ATTENUATION, Np/TANK	-		
EQUILIBRIUM PHASE, deg.	30^0		
RF POWER UNITS, type	tetrode generators		
RF POWER UNITS, number	3		
RF POWER DEMAND, peak, MW	0,750		
RF POWER DEMAND, mean, MW	$4,7 \cdot 10^{-3}$		
RF POWER RATING, MW/unit	0,250		
RF POWER FEED SPACING, m	1,54		
QUADRUPOLES, number	40		
GRADIENT, kG/m	498,5 ÷ 92,8		
SPACING, m			
OTHER			

ENTRY NO. 22

NAME OF MACHINE 50 MeV Linac Injector for CERN PS ("Old Linac")
INSTITUTION C E R N
LOCATION 1211 - GENEVA 23, Switzerland
DATE March 1976
IN CHARGE G. Plass
REPORTED BY D. Warner

HISTORY AND STATUS

DESIGN, date 1955 MODEL tests 1955
ENG. DESIGN, date 1955-1956
CONSTRUCTION, date 1956-1959
FIRST BEAM date (or goal) 1959
MAJOR ALTERATIONS 1966 1) 1971 2)
OPERATION*) 168 hr/wk; On Target - hr/wk
TIME DIST., in house - %, outside - %
USERS' SCHEDULING CYCLE 4 or 5 weeks
COST, ACCELERATOR -
COST, FACILITY, total -
FUNDED BY Member states of CERN

*) During scheduled periods (ignoring ≈ 1%)

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT
See details under "New 50 MeV Linac"
SCIENTISTS - ENGINEERS -
TECHNICIANS - CRAFTS -
ADMIN & CLER - TOTAL -
GRAD. STUDENTS involved during year -
OPERATED BY - Res staff or Sp op.
BUDGET, op & dev -
FUNDED BY -

RESEARCH STAFF, not included above

USER GROUPS, in house - outside -
STAFF SCIENTISTS, in house - outside -
TOTAL RES STAFF, in house - outside -
GRAD STUDENTS involved during year -
RES. BUDGET, in house -
FUNDED BY -

FACILITIES FOR ~~RESEARCH PROGRAMS~~ Beam studies at 50 MeV

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS in ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type sector magnet for ~~single pulse~~ energy ~~spectrum~~
ON-LINE COMPUTER, model IBM 1800
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production -
Irradiation, Solid State -
Biological -
Time-of-Flight Study -
On-Line Mass Separation -
Other Single pulse emittance measurement at 50 MeV

PHYSICAL DIMENSIONS

TUNNEL, length 33 m, X-sec(hXw) 8 X 8 m
ACCELERATOR*) length 29 m, dia. 1.08 to 0.81 m
BEAM, DIA. 1.0 cm; ENERGY GAIN 1.7 MeV/m
*) Alvarez section only

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
See following for details of proton beam				

OPERATING PROGRAMS, time dist

Basic Nuclear Physics - %
Solid State Physics - %
Bio-Medical Applications - %
Isotope Production - %
Machine Research 2%
Injection 98%

SELECTED REFERENCES DESCRIBING MACHINE

E. Regenstreif "The CERN Proton Synchrotron" Ch V "Injection" CERN 60-26

Improvements and Performance reported at Linac Conferences e.g.,

a) MURA (1964), p. 353
b) LOS ALAMOS (1966), p. 48
c) BROOKHAVEN (1968), p. 694

OTHER NOTABLE FEATURES:

i) 50 MeV injection can be made on alternate pulses :
a) to the 28 GeV proton synchrotron
or b) to the 800 MeV booster proton synchrotron
ii) A deuteron beam of 12 mA (1976) at 22.3 MeV has been obtained by acceleration in the 2Bλ mode through the three tanks.
iii) Mercury diffusion pumps on tanks have been replaced by turbomolecular pumps.

MAJOR ALTERATIONS

1) Duoplasmatron source and high gradient column installed (1966)
2) Beam pulse length increased to 100 μS and programmed rf compensation (1971).

ENTRY NO. 22

INJECTOR SYSTEM 1)

TYPE OF SOURCE Duoplasmatron (with plasma expansion cup)
OUTPUT, ~~max~~ (Nominal) 330 *mA, at* - *keV, at* - *π mm-mrad*
INJECTION PERIOD (Normal) 110 *μsec, at* 1 *Hz*
HIGH VOLTAGE STAGE High gradient accelerating column (double gap) - 43 kV cm^{-1}
Output, ~~max~~ 330 *mA, at* 515 *keV, at* 2Πmm mrad (Norm[d])
BUNCHER Single gap reentrant cavity; TM 010 Mode
Potential 17 *keV, Drift Length* 0.70 *m*
Potential - *keV, Drift Length* - *m*

ACCELERATION SYSTEM

	TANK *I*	TANK *II*	TANK *III*
TYPE	Alvarez	Alvarez	Alvarez
BEAM EN. (IN-OUT), MeV	0.52 - 9.9	9.9 - 30.4	30.4 - 49.7
TOTAL LENGTH, m (inside dimensions)	5.49	11.96	11.24
RADIO FREQUENCY, MHz	202.56	202.56	202.56
FIELD MODE	TM 010	TM 010	TM 010
Q(x 10^3) (unloaded)	65	57	53
FILLING TIME, μs	--	--	--
NO. OF TANKS	--	--	--
DIAMETER, cm	107.6	92.8	81.2
DRIFT TUBES, number	41 + 2(½)	40 + 2(½)	26 + 2(½)
LENGTH, cm	3.96 - 15.70	16.22 - 23.79	27.67 - 32.08
DIAMETER, cm	14.03 - 6.16	17.78	17.78
GAP/CELL LENGTH RATIO	0.25 (constant)	0.244-0.351	0.248-0.305
IRIS APERTURE, cm	-	-	-
THICKNESS, cm	-	-	-
SPACING, cm	-	-	-
GROUP VELOCITY	unstabilised	unstabilised	unstabilised
PHASE VELOCITY	-	-	-
WAVE TYPE	standing wave	standing wave	standing wave
SHUNT IMPEDANCE, MΩ/m	50	45	41
ATTENUATION, Np/TANK	-	-	-
EQUILIBRIUM PHASE, deg.	- 30	- 30	- 30
RF POWER UNITS, type	FTH 470 and 516	FTH 470 and 516	FTH 470 and 516
RF POWER UNITS, number	2	2	2
RF POWER DEMAND, peak, MW 2)	0.7 + 0.8	1.5 + 1.6	1.4 + 1.5
RF POWER DEMAND, mean, ~~MW~~ kW	0.21 + 0.08	0.45 + 0.16	0.42 + 0.15
RF POWER RATING, MW/unit	2.5-3.5	2.5 - 3.5	2.5 - 3.5
RF POWER FEED SPACING, m	-	-	-
QUADRUPOLES, number	42	42	28
GRADIENT, kG/cm	7.5 - 1.3	1.1 - 0.6	0.4
SPACING, m	1 per drift tube (++--)	1 per drift tube (++--)	1 per drift tube
OTHER			

NOTES : 1) Normal operating currents quoted (with beams of lower quality up to 500 mA obtainable).

2) Figures quoted for r.f. power are based on two r.f. feeds per tank. One feed supplies power for cavity losses (300 μS) and the other supplies extra power during 100 μS to compensate beam loading. The repetition rate is 1 p.pS and normal beam current (March 1976) = 80 mA.

ENTRY NO. 23

NAME OF MACHINE New 50 MeV Linac Injector for CERN PS ("New Linac")
INSTITUTION CERN
LOCATION CH-1211 - Geneva (Switzerland)
DATE March 1976
IN CHARGE G. Plass
REPORTED BY D. Warner

HISTORY AND STATUS

DESIGN, date 1973-1974 MODEL tests 1974-1975
ENG. DESIGN, date 1974-1976
CONSTRUCTION, date 1975-1977
FIRST BEAM date (or goal) mid 1977 (50 MeV)
MAJOR ALTERATIONS -
OPERATION*) 168 hr/wk; On Target - hr/wk
TIME DIST., in house - %, outside - %
USERS' SCHEDULING CYCLE - weeks
COST, ACCELERATOR 21.3 M SF (1973)
COST, FACILITY, total -
FUNDED BY Member states of CERN

*) during scheduled periods

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT 1)

SCIENTISTS and ENGINEERS 19
TECHNICIANS and CRAFTS 33
ADMIN & CLER - TOTAL 52
GRAD. STUDENTS involved during year
OPERATED BY - Res staff or - Sp op.
BUDGET, op & dev -
FUNDED BY -

RESEARCH STAFF, not included above

USER GROUPS, in house ___ outside ___
STAFF SCIENTISTS, in house ___ outside ___
TOTAL RES STAFF, in house ___ outside ___
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR [struck-out text] BEAM STUDIES AT 50 MeV

SHIELDED AREA, fixed 50 m^2
movable m^2
TARGET STATIONS in ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type sector magnet for single pulse energy spectrum
ON-LINE COMPUTER, model PDP 11/45
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other Single pulse emittance measurement at 50 MeV

PHYSICAL DIMENSIONS

TUNNEL, length 70 m, X-sec(hXw) 3.5 X 3.7 m
ACCELERATOR*) length 33.6 m, dia. 0.94-0.86 m
BEAM, DIA. 0.8 cm; ENERGY GAIN 1.47 MeV/m
*) Alvarez section only

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
See following for details of proton beam				

OPERATING PROGRAMS, time dist

Basic Nuclear Physics %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research %
Injection 100 %

SELECTED REFERENCES DESCRIBING MACHINE

"Project study for a new 50 MeV linear accelerator for the CPS" - CERN/MPS/LINP 73-1

B. Bru, M. Weiss "Design of the low energy beam transport system for the new 50 MeV Linac", CERN/MPS/LIN 74-1

OTHER NOTABLE FEATURES:

1) Total staff numbers are given for "new linac" (design and commissioning) and "old linac" (operation and maintenance). Estimated effort (1974-1977) for "new linac" is 150 man-years.

ENTRY NO. 23

INJECTOR SYSTEM

TYPE OF SOURCE 1) Duoplasmatron (with plasma expansion cup)
OUTPUT, ~~max~~ nominal 250 *mA, at* - *keV, at* - *π mm-mrad*
INJECTION PERIOD 70 - 230 *μsec, at* 2 *Hz*
HIGH VOLTAGE STAGE High gradient accelerating column (double gap) - 53 kV cm^{-1}
Output, ~~max~~ nominal 250 *mA, at* 750 *keV, at* 2Πmm mrad (normalised)
BUNCHER Double drift harmonic buncher and energy corrector (single gap TM010 cavities) 2)
B1 *Potential* 36 37 *keV, Drift Length* 0.95m, frequency 202.56 MHz
B2 *Potential* 15 16 *keV, Drift Length* 0.80m, frequency 405.12 MHz
B3 potential 20 41 keV, drift length 0.15m, frequency 202.56 MHz

ACCELERATION SYSTEM

	TANK *I*	TANK *II*	TANK *III*
TYPE	Post coupled Alvarez	Post coupled Alvarez	Post coupled Alvarez
BEAM EN. (IN-OUT), MeV	0.75 - 10.4	10.4 - 30.5	30.5 - 50.0
TOTAL LENGTH, m	6.94	12.96	13.36
RADIO FREQUENCY, MHz	202.56	202.56	202.56
FIELD MODE	TM 010	TM 010	TM 010
Q(x 10^3)	56	54	50
FILLING TIME, μs	-	-	-
NO. OF TANKS			
DIAMETER, cm	94.0	90.0	86.0
DRIFT TUBES, number	51 + 2(½)	43 + 2(½)	31 + 2(½)
LENGTH, cm	4.76 - 14.69	17.68 - 25.83	27.36 - 31.61
DIAMETER, cm	18.0	16.0	16.0
GAP/CELL LENGTH RATIO	0.22 - 0.31	0.20 - 0.29	0.26 - 0.32
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY	> 0.05c	> 0.05c	> 0.09c
PHASE VELOCITY			
WAVE TYPE	standing wave	standing wave	standing wave
SHUNT IMPEDANCE, MΩ/m	45	46	42
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	-35 - -25	-25	-25
RF POWER UNITS, type	FTH 470 (516)	FTH 470 (516)	FTH 470 (516)
RF POWER UNITS, number	1	2	2
RF POWER DEMAND, peak, MW 3)	0.6 + 1.4	1.1 + 3.0	1.2 + 2.9
RF POWER DEMAND, mean, ~~MW~~ kW 3)	0.36 + 0.28	0.67+0.60	0.70+0.59
RF POWER RATING, MW/unit	3 - 4	3 - 4	3 - 4
RF POWER FEED SPACING, m	-	-	-
QUADRUPOLES, number	53	45	33
GRADIENT, kG/cm (for 150 mA beam)	9.3 - 3.1	2.3 - 2.0	2.0 - 1.9
SPACING, m	1 per drift tube (+-)	1 per drift tube(+-)	1 per drift tube (+-)
OTHER			

NOTES :

1) Nominal operating currents quoted (up to 500 mA obtainable)
2) Bunching parameters given for accelerated currents 50 mA and 150 mA respectively
3) Accelerator is designed to operate over range of output currents 50 mA to 150 mA. Peak r.f. demand quoted in form "cavity losses" + "beam power for 150 mA". Mean power based on repetition rate of 2 p.p S, r.f. pulse length = 300 μS and 150 mA beam during 100 μS. In contrast to the "old linac" each amplifier provides power for cavity and beam.

ENTRY NO. 24

NAME OF MACHINE: NEW NIMROD INJECTOR
INSTITUTION: RUTHERFORD LABORATORY, SCIENCE RESEARCH COUNCIL
LOCATION: CHILTON, DIDCOT, OXFORDSHIRE — DATE: MARCH 1976
IN CHARGE: G N VENN — REPORTED BY: N D WEST

HISTORY AND STATUS

DESIGN, date 1973 MODEL tests ____
ENG. DESIGN, date ____
CONSTRUCTION, date Jan 1976
FIRST BEAM date (or goal) Feb 76 - 10 MeV, Apr 76 - 70 MeV
MAJOR ALTERATIONS ____
OPERATION ____ hr/wk; On Target ____ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY SCIENCE RESEARCH COUNCIL

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS ____ ENGINEERS ____
TECHNICIANS ____ CRAFTS ____
ADMIN & CLER ____ TOTAL ____
GRAD. STUDENTS involved during year ____
OPERATED BY ____ Res staff or ____ Sp op.
BUDGET, op & dev ____
FUNDED BY ____

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house ____ outside ____
TOTAL RES STAFF, in house ____ outside ____
GRAD STUDENTS involved during year ____
RES. BUDGET, in house ____
FUNDED BY ____

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS ____ in ____ ROOMS
STATIONS SERVED AT THE SAME TIME, max. ____
MAG SPECTROGRAPH, type ____
ON-LINE COMPUTER, model ____
TOTAL POWER INSTALLED FOR RESEARCH ____
FACILITIES for:
Isotope production ____
Irradiation, Solid State ____
Biological ____
Time-of-Flight Study ____
On-Line Mass Separation ____
Other ____

PHYSICAL DIMENSIONS

TUNNEL, length ____ m, X-sec(hXw) ____ X ____ m
ACCELERATOR, length ____ m, dia. ____ cm
BEAM, DIA. ____ cm; ENERGY GAIN ____ MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Proton	Target, 50-75 mA 500 μs, 1 Hz		0.070	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %
Solid State Physics ____ %
Bio-Medical Applications ____ %
Isotope Production ____ %
Machine Research ____ %
____ %
____ %

SELECTED REFERENCES DESCRIBING MACHINE

The Work of the Rutherford Laboratory 1972, RHEL/R270 (1973).

OTHER NOTABLE FEATURES: Four tank Alvarez linac, 665 keV - 10 MeV; 10 - 30 MeV; 30 - 50 MeV; 50 - 70 MeV. Tanks 2 and 3 are from the Rutherford Laboratory's original 50 MeV Proton Linac. Tanks 1 and 4 are based on the design of the NAL injector line.

Machine currently being commissioned. 28 mA so far obtained from tank 1 without buncher cavity.

ENTRY NO. 24

INJECTOR SYSTEM

TYPE OF SOURCE Duoplasmatron
OUTPUT, max > 250 mA, at 45 keV, at 110 π mm-mrad
INJECTION PERIOD 500 μsec, at 1 Hz
HIGH VOLTAGE STAGE Medium gradient column, 16 kV/cm
Output,max 200 mA, at 665 keV, at π mm-mrad
BUNCHER Twin gap, coaxial line type cavity
Potential 23 keV, Drift Length 0.8 m
Potential keV, Drift Length m

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	0.665-70.4		
TOTAL LENGTH, m	43.85		
RADIO FREQUENCY, MHz	202.5		
FIELD MODE	E 010		
Q(x 10^3)			
FILLING TIME, μs			
NO. OF TANKS	4		
DIAMETER, cm			
DRIFT TUBES, number	144 + 8 x ½		
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m			
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	30		
RF POWER UNITS, type	FTH 116		
RF POWER UNITS, number	4		
RF POWER DEMAND, peak, MW	11		
RF POWER DEMAND, mean, MW	0.0077		
RF POWER RATING, MW/unit	4.25		
RF POWER FEED SPACING, m			
QUADRUPOLES, number	152		
GRADIENT, kG/m	8.5-0.6		
SPACING, m			
OTHER			

ENTRY NO. 25

NAME OF MACHINE	NIMROD INJECTOR
INSTITUTION	RUTHERFORD LABORATORY, SCIENCE RESEARCH COUNCIL
LOCATION	CHILTON, DIDCOT, OXFORDSHIRE
DATE	MARCH 1976
IN CHARGE	G N VENN
REPORTED BY	N D WEST

HISTORY AND STATUS

DESIGN, date ~ 1957 MODEL tests ______
ENG. DESIGN, date ______
CONSTRUCTION, date ______
FIRST BEAM date (or goal) Aug 1961
MAJOR ALTERATIONS ______
OPERATION ____ hr/wk; On Target ____ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ______
COST, FACILITY, total ______
FUNDED BY Science Research Council

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS ____ ENGINEERS ____
TECHNICIANS ____ CRAFTS ____
ADMIN & CLER ____ TOTAL ____
GRAD. STUDENTS involved during year ____
OPERATED BY ____ Res staff or ____ Sp op.
BUDGET, op & dev ______
FUNDED BY ______

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house ____ outside ____
TOTAL RES STAFF, in house ____ outside ____
GRAD STUDENTS involved during year ____
RES. BUDGET, in house ______
FUNDED BY ______

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS ____ in ____ ROOMS
STATIONS SERVED AT THE SAME TIME, max. ____
MAG SPECTROGRAPH, type ____
ON-LINE COMPUTER, model ____
TOTAL POWER INSTALLED FOR RESEARCH ____
FACILITIES for:
Isotope production ____
Irradiation, Solid State ____
Biological ____
Time-of-Flight Study ____
On-Line Mass Separation ____
Other ____

PHYSICAL DIMENSIONS

TUNNEL, length ____ m, X-sec(hXw) ____ X ____ m
ACCELERATOR, length 13.45 m, dia. 169 cm
BEAM, DIA. ____ cm; ENERGY GAIN ____ MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Proton	Typically, 18 mA 300 μs, 0.5 Hz		0.015	0.67

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %
Solid State Physics ____ %
Bio-Medical Applications ____ %
Isotope Production ____ %
Machine Research ____ %
____ %
____ %

SELECTED REFERENCES DESCRIBING MACHINE

Nimrod - A 7 GeV Proton Synchrotron (Part 1), Rutherford Lab Report NIRL/R/44 (1965).
Machine Physics Experiments on the Nimrod Injector, NIRL/R/84 (1965).

OTHER NOTABLE FEATURES: Linac constructed as a copper cavity inside a separate vacuum vessel. RF system operates as a self oscillator with feedback provided by a second loop coupled to the cavity. A fast phase ramped Debuncher cavity provides energy shift during injection into Nimrod.

ENTRY NO. 25

INJECTOR SYSTEM

TYPE OF SOURCE RF Thonemann-Harrison type
OUTPUT, max 120 *mA, at* 24 *keV,(at* 15 keV, 50 mA) 95 π *mm-mrad*
INJECTION PERIOD up to 2000 *μsec, at* up to 1 *Hz*
HIGH VOLTAGE STAGE Conventional, low gradient column, with es lens input focusing
Output,max 60 *mA, at* 600 *keV, at* (44 mA) 73 π *mm-mrad*
BUNCHER Single gap, re-entrant cavity
Potential 23 *keV, Drift Length* 1.44 *m*
Potential ______ *keV, Drift Length* ______ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	0.6-14.9		
TOTAL LENGTH, m	13.45		
RADIO FREQUENCY, MHz	115		
FIELD MODE	E 010		
Q(x 10^3)	80,000		
FILLING TIME, μs			
NO. OF TANKS	1		
DIAMETER, cm	1.69		
DRIFT TUBES, number	48 + 2 x ½		
LENGTH, cm	8.05 to 32.0		
DIAMETER, cm	28.15		
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m			
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	30		
RF POWER UNITS, type	RS 1041		
RF POWER UNITS, number	1		
RF POWER DEMAND, peak, MW	1.3		
RF POWER DEMAND, mean, MW	0.0065		
RF POWER RATING, MW/unit			
RF POWER FEED SPACING, m			
QUADRUPOLES, number	50		
GRADIENT, kG/m	3.70 to 0.64		
SPACING, m			
OTHER			

ENTRY NO. 26

NAME OF MACHINE 140 MeV
INSTITUTION UNIVERSITY OF GLASGOW, KELVIN LABORATORY
LOCATION EAST KILBRIDE DATE
IN CHARGE Prof. J.M. Reid. REPORTED BY DR. R.O. OWENS AND MR. M.G. KELLIHER

HISTORY AND STATUS

DESIGN, date 1964 MODEL tests
ENG. DESIGN, date 1964-65
CONSTRUCTION, date 1965
FIRST BEAM date (or goal) 1966
MAJOR ALTERATIONS NONE TO DATE. SEE BELOW
OPERATION 65 hr/wk; On Target 64 hr/wk
TIME DIST., in house 100 %, outside 0 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR £400,000
COST, FACILITY, total £1.2 million
FUNDED BY Science Research Council

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2 ENGINEERS
TECHNICIANS 3 CRAFTS
ADMIN & CLER TOTAL
GRAD. STUDENTS involved during year 0
OPERATED BY Res staff or 3 Sp op.
BUDGET, op & dev £160,000
FUNDED BY Science Research Council

RESEARCH STAFF, not included above

USER GROUPS, in house 4 outside 1
STAFF SCIENTISTS, in house 8 outside 2
TOTAL RES STAFF, in house 11 outside 3
GRAD STUDENTS involved during year 6
RES. BUDGET, in house £80,000
FUNDED BY Science Research Council

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed None m^2
movable 500 m^2
TARGET STATIONS 4 in 3 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type 80cm radius, n=½, 350 MeV/c max
ON-LINE COMPUTER, model PDP8, 8I, 7
TOTAL POWER INSTALLED FOR RESEARCH 500KVA
FACILITIES for:
Isotope production 5%
Irradiation, Solid State 0
Biological
Time-of-Flight Study 7 flight paths, 100 metres
On-Line Mass Separation None
Other

PHYSICAL DIMENSIONS

TUNNEL, length 30 m, X-sec(hXw) 2.5 X 3.5 m
ACCELERATOR, length 18 m, dia. cm
BEAM, DIA. 0.5 cm; ENERGY GAIN 7.5 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	10^{14}	(2mm.mrad)	0.120	0.6%
	10^{13}		0.020	0.3%
n	2.5×10^4 (in 3ns pulse)	1000	.0003 -.010	white spectrum

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	98	%
Solid State Physics	0	%
Bio-Medical Applications	0	%
Isotope Production	0	%
Machine Research	2	%

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: An energy compressor resigned to improve the energy spectrum by a factor of 10 is under construction and will be fitted during summer 1976.

Energy is being increased to 180 MeV by using higher power klystrons and by increasing the active length of the linac from 18 to 22 metres with 8M of the length having higher series impedance.

ENTRY NO. 26

INJECTOR SYSTEM

TYPE OF SOURCE Indirectly heated tantalum button
OUTPUT, max 600 mA, at 32 keV, at ______ π mm-mrad
INJECTION PERIOD 5 μsec, at UP TO 600 Hz
HIGH VOLTAGE STAGE
Output, max ______ mA, at ______ keV, at ______ π mm-mrad
PRE BUNCHER No longer used
Potential ______ keV, Drift Length ______ m
Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Travelling wave	Same	Same
BEAM EN. (IN-OUT), MeV	140		
TOTAL LENGTH, m	18		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	TM01		
$Q(x\ 10^3)$	9		
FILLING TIME, μs	0.4		
NO. OF TANKS	12		
DIAMETER, cm	10		
DRIFT TUBES, number	}		
LENGTH, cm	} NA		
DIAMETER, cm	}		
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2.32 to 2.50		
THICKNESS, cm	0625		
SPACING, cm	262 λ/4		
GROUP VELOCITY	0.0115 to 0.0152 c		
PHASE VELOCITY	In buncher 0.3 to 1 c then v = c		
WAVE TYPE	TM01		
SHUNT IMPEDANCE, MΩ/m	40		
ATTENUATION, Np/TANK	0.38		
EQUILIBRIUM PHASE, deg.	0^o		
RF POWER UNITS, type	TV2011		
RF POWER UNITS, number	3		
RF POWER DEMAND, peak, MW	}		
RF POWER DEMAND, mean, MW	} .3		
RF POWER RATING, MW/unit	20		
RF POWER FEED SPACING, m	5MW into each 1.5 metre section		
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 27

NAME OF MACHINE	NPL 15 MeV Electron Linear Accelerator
INSTITUTION	National Physical Laboratory
LOCATION	Teddington, U.K.
DATE	2 June 1976
IN CHARGE	J E Burns
REPORTED BY	J E Burns

HISTORY AND STATUS

DESIGN, date 1965 & 1970 MODEL tests -
ENG. DESIGN, date -
CONSTRUCTION, date 1967 and 1971
FIRST BEAM date (or goal) 1968 and 1974
MAJOR ALTERATIONS 1971
OPERATION - hr/wk; On Target - hr/wk
TIME DIST., in house 100 %, outside 0 %
USERS' SCHEDULING CYCLE - weeks
COST, ACCELERATOR $ 300K
COST, FACILITY, total $ 700K
FUNDED BY Government

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 0
TECHNICIANS 1 CRAFTS 0
ADMIN & CLER 0 TOTAL 2
GRAD. STUDENTS involved during year 0
OPERATED BY - Res staff or - Sp op.
BUDGET, op & dev $ 12K
FUNDED BY Government

RESEARCH STAFF, not included above

USER GROUPS, in house 1 outside 0
STAFF SCIENTISTS, in house 2 outside 0
TOTAL RES STAFF, in house 2 outside 0
GRAD STUDENTS involved during year 0
RES. BUDGET, in house No separate budget
FUNDED BY Government

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 60 m^2
movable None m^2
TARGET STATIONS 2 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max. None
MAG SPECTROGRAPH, type Pretzel
ON-LINE COMPUTER, model None
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production None
Irradiation, Solid State None
Biological None
Time-of-Flight Study None
On-Line Mass Separation None
Other Radiation metrology

PHYSICAL DIMENSIONS

TUNNEL, length 16.5 m, X-sec(hXw) 3 X 3 m
ACCELERATOR, length 2 m, dia. 10 cm
BEAM, DIA. 1 cm; ENERGY GAIN 11 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

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

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	0 %
Solid State Physics	0 %
Bio-Medical Applications	0 %
Isotope Production	0 %
Machine Research	0 %
Radiation metrology	95 %
Pulse radiolysis	5 %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: The main purpose of the machine is to develop a facility for calibrating radiation dosemeters using high-energy photons and electrons over the range of intensities from health physics monitors, through the types of dosemeters used for clinical radiotherapy, to industrial megarad dosemeters.

ENTRY NO. 27

INJECTOR SYSTEM

TYPE OF SOURCE Oxide coated cathode
OUTPUT, max 5000 *mA, at* 80 *keV, at* ______ *π mm-mrad*
INJECTION PERIOD 3 *μsec, at* 240 *Hz*
HIGH VOLTAGE STAGE ______
Output,max ______ *mA, at* ______ *keV, at* ______ *π mm-mrad*
BUNCHER ______
Potential ______ *keV, Drift Length* ______ *m*
Potential ______ *keV, Drift Length* ______ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE			
BEAM EN. (IN-OUT), MeV	22		
TOTAL LENGTH, m	2		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	Solenoidal		
Q(x 10^3)			
FILLING TIME, μs	0.5		
NO. OF TANKS	2		
DIAMETER, cm	8.2		
DRIFT TUBES, number	-		
LENGTH, cm	-		
DIAMETER, cm	-		
GAP/CELL LENGTH RATIO	-		
IRIS APERTURE, cm	2.3 to 2.0		
THICKNESS, cm	0.62		
SPACING, cm			
GROUP VELOCITY	0.01 to 0.005 vg/c		
PHASE VELOCITY	v = c		
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	12		
ATTENUATION, Np/TANK	0.58		
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	klystron		
RF POWER UNITS, number	1		
RF POWER DEMAND, peak, MW	20		
RF POWER DEMAND, mean, MW	0.02		
RF POWER RATING, MW/unit	20		
RF POWER FEED SPACING, m	1		
QUADRUPOLES, number	2		
GRADIENT, kG/m			
SPACING, m	2.4		
OTHER	-		

Brief specification:

1. Energy range of analysed beam, 2 to 22 MeV.
2. Beam peak current range, < 0.1 μA to 700 mA for long pulses and 5A for short pulses.
3. Pulse length range, 5ns to 3μs.
4. Pulse repetition frequencies, 1.5 to 480 p.p.s, with single shot facility

Manufacturers: Radiation Dynamics Ltd., U.K.

ENTRY NO. 28

NAME OF MACHINE SuperHILAC
INSTITUTION Lawrence Berkeley Laboratory
LOCATION Berkeley, California DATE 4/22/76
IN CHARGE H. Grunder REPORTED BY F. Selph

HISTORY AND STATUS

DESIGN, date 1969 MODEL tests --
ENG. DESIGN, date 1970
CONSTRUCTION, date 1971 - 1972
FIRST BEAM date (or goal) April 1972
MAJOR ALTERATIONS 1975-76
OPERATION 128 hr/wk; On Target 120 hr/wk*
TIME DIST., in house 50 %, outside 50 %
USERS' SCHEDULING CYCLE 26 weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY ERDA

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 6 ENGINEERS 9
TECHNICIANS 26 CRAFTS 6
ADMIN & CLER 3 TOTAL 50
GRAD. STUDENTS involved during year
OPERATED BY ____ Res staff or ____ Sp op.
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house ____ outside ____
TOTAL RES STAFF, in house ____ outside ____
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS ____ in ____ ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length ____ m, X-sec(hXw) ____ X ____ m
ACCELERATOR, length ____ m, dia. ____ cm
BEAM, DIA. ____ cm; ENERGY GAIN ____ MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part. μA)	BEAM AREA (cm^2)	ENERGY (Mev/u)	ΔE/E (%)
Ne(A=20)	2		1.2-8.5	0.5
Ar(A=40)	0.8		"	"
Kr(A=84)	0.1		"	"
Xe(A=136)	0.02		"	"

OPERATING PROGRAMS, time dist of pulses

Basic Nuclear Physics 90 %
Solid State Physics - %
Bio-Medical Applications 5 %
Isotope Production - %
Machine Research 5 %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: *Usually two beams are being run concurrently with timesharing.

ENTRY NO. 28

INJECTOR SYSTEM

TYPE OF SOURCE PIG
OUTPUT, max 0.01 to 1 *mA, at* 17 *keV, at* 240 *π mm-mrad*
INJECTION PERIOD 1000-8000 *μsec, at* 1 to 36 *Hz*
HIGH VOLTAGE STAGE Cockcroft Walton and Dynamatron
Output,max ______ *mA, at* 750/2500 *keV, at* 70/30 *π mm-mrad*
BUNCHER
Potential 7.5 kV double gap *keV, Drift Length* 2.12 *m*
Potential 25 kV double gap *keV, Drift Length* 2.19 *m*

ACCELERATION SYSTEM

	Prestripper I	Poststripper II	III
TYPE	Alvarez	Alvarez	
BEAM EN. (IN-OUT), MeV/μ	0.13 - 1.2	1.2 - 8.5 (variable)	
TOTAL LENGTH, m	18.5	30.9	
RADIO FREQUENCY, MHz	70	70	
FIELD MODE	TM010	TM010	
Q(x 10^3)	100	100	
FILLING TIME, μs	500	500	
NO. OF TANKS	2	6	
DIAMETER, cm	305	305	
DRIFT TUBES, number	135	77	
LENGTH, cm	4.9 to 21.5	21.8 to 56.8	
DIAMETER, cm	25	22-17	
GAP/CELL LENGTH RATIO	.27 - .31	.26 - .32	
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	22	22	
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	-20	-20	
RF POWER UNITS, type	RCA 6949	RCA 6949	
RF POWER UNITS, number	4	6	
RF POWER DEMAND, peak, MW	4	6	
RF POWER DEMAND, mean, MW	1	1.5	
RF POWER RATING, MW/unit	0.75	0.75	
RF POWER FEED SPACING, m			
QUADRUPOLES, number	135	70	
GRADIENT, kG/m	1450-620	192-140	
SPACING, m			
OTHER			

ENTRY NO. 29

NAME OF MACHINE Bevatron Injector
INSTITUTION Lawrence Berkeley Laboratory Univ. of Calif.
LOCATION Berkeley, California USA DATE 24 March 1976
IN CHARGE E. J. Lofgren REPORTED BY K. C. Crebbin, E. Zajec

HISTORY AND STATUS

DESIGN, date 1959 MODEL tests
ENG. DESIGN, date
CONSTRUCTION, date 1960 - 1962
FIRST BEAM date (or goal) June, 1962
MAJOR ALTERATIONS
OPERATION hr/wk; On Target hr/wk
TIME DIST., in house %, outside %
USERS' SCHEDULING CYCLE weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY ERDA

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS ENGINEERS
TECHNICIANS CRAFTS
ADMIN & CLER TOTAL
GRAD. STUDENTS involved during year
OPERATED BY Res staff or Sp op.
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USER GROUPS, in house outside
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS in ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length m, X-sec(hXw) X m
ACCELERATOR, length m, dia. cm
BEAM, DIA. cm; ENERGY GAIN MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

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

OPERATING PROGRAMS, time dist

Basic Nuclear Physics %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research %
%
%

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES:

ENTRY NO. 29

INJECTOR SYSTEM For Bevatron

TYPE OF SOURCE Von-Ardenne duo plasmatron*
OUTPUT, max 150 *mA, at* 60 *keV, at* ______ *π mm-mrad*
INJECTION PERIOD 600 *μsec, at* DC *Hz*
HIGH VOLTAGE STAGE Cockroft-Walton
Output, max 100 *mA, at* 480 *keV, at* 179 *π mm-mrad*
BUNCHER Single Cavity-re-entrant
Potential 10 *keV, Drift Length* 1 *m*
Potential - *keV, Drift Length* - *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	19.2 (4.8/amu)		
TOTAL LENGTH, m	12.80		
RADIO FREQUENCY, MHz	199.3		
FIELD MODE	TM-010		
Q(x 10^3)	70		
FILLING TIME, μs	200		
NO. OF TANKS	1		
DIAMETER, cm	99		
DRIFT TUBES, number	75		
LENGTH, cm	3.8 to 22.3		
DIAMETER, cm	1.9 to 3.18		
GAP/CELL LENGTH RATIO	.23		
IRIS APERTURE, cm	-		
THICKNESS, cm	-		
SPACING, cm	-		
GROUP VELOCITY	-		
PHASE VELOCITY	-		
WAVE TYPE	Standing		
SHUNT IMPEDANCE, MΩ/m	2		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	26°		
RF POWER UNITS, type	Y219		
RF POWER UNITS, number	10		
RF POWER DEMAND, peak, MW	2.5		
RF POWER DEMAND, mean, MW	0.005		
RF POWER RATING, MW/unit	0.25		
RF POWER FEED SPACING, m	.685		
QUADRUPOLES, number	75		
GRADIENT, kG/m	∿20kG-cm/cm		
SPACING, m	in each drift tube		
OTHER			

* Ion sourc for heavy ion operation

Type of source - PIG

Ion output Exit C-W

H^+	10 ma	480KV
$^2H^+$	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

Provides heavy-ion acceleration in the 2βλ mode.
Cavity is pre-pulse excited and driven with 10 main oscillators.

ENTRY NO. 30

NAME OF MACHINE: Clinton P. Anderson Meson Physics Facility
INSTITUTION: Los Alamos Scientific Laboratory
LOCATION: Los Alamos, New Mexico
DATE: April 1976
IN CHARGE: L. Rosen
REPORTED BY: D. C. Hagerman

HISTORY AND STATUS

DESIGN, date 1968 MODEL tests 1964-1968
ENG. DESIGN, date 1968-1970
CONSTRUCTION, date 1968-1972
FIRST BEAM date (or goal) June 1972
MAJOR ALTERATIONS 1975
OPERATION 160 hr/wk; On Target 110 hr/wk
TIME DIST., in house 50 %, outside 50 %
USERS' SCHEDULING CYCLE 3 weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY ERDA

LASL STAFF, OPERATION, DEVELOPMENT AND RESEARCH

SCIENTISTS 68 ENGINEERS 47
TECHNICIANS 249 CRAFTS 35
ADMIN & CLER 36 TOTAL
GRAD. STUDENTS involved during year
OPERATED BY ___ Res staff or x Sp op.
BUDGET, op & dev
FUNDED BY ERDA

RESEARCH STAFF, not included above

USERS ORGANIZATION, 840 outside members
STAFF SCIENTISTS, in house ___ outside ___
TOTAL RES STAFF, in house ___ outside ___
GRAD STUDENTS involved during year 31
RES. BUDGET, in house
FUNDED BY ERDA

FACILITIES FOR RESEARCH PROGRAMS

EXPERIMENTAL AREA, 4600 m^2
m^2
TARGET STATIONS 10 in 4 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 12
MAG SPECTROGRAPH, type π and p
ON-LINE COMPUTER, model SEL840,PDP 11/45, etc.
TOTAL POWER INSTALLED FOR FACILITY 50 MW
FACILITIES for:
- Isotope production: yes
- Irradiation, Solid State: yes
- Biological: yes
- Time-of-Flight Study: yes
- On-Line Mass Separation: no
- Other:

PHYSICAL DIMENSIONS

TUNNEL, length 900 m, X-sec(hXw) 4 X 4 m
ACCELERATOR, length 785 m, dia. 91, 28 cm
BEAM, DIA. 0.3 cm; ENERGY GAIN 1 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS (Normalized to 100-μA proton beam)

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (MeV)	ΔE/E (%)
π^+	2×10^8	6	20-300	$\pm 2 \frac{\Delta p}{p}$
π^+	5×10^8	30 mr-cm	100-600	$\pm 5 \frac{\Delta p}{p}$
π^+	4×10^7	5 msr	50-300	$\pm 2 \frac{\Delta p}{p}$
μ^-	4×10^6	100	for stopped muons	
π^-	3×10^7	10-100	80-100	
νe	5×10^6	1	20-50	
p	10 nA	<1 cm^2	800	±0.25
n	6×10^5	10	800	±5

(neutrons from 1-μA proton beam)

OPERATING PROGRAMS, time dist

- Basic Nuclear Physics ___ %
- Solid State Physics 70 %
- Bio-Medical Applications ___ %
- Isotope Production ___ %
- Facility Development 30 %

SELECTED REFERENCES DESCRIBING MACHINE

See proceedings of recent accelerator conferences and LAMPF Users Handbook.

OTHER NOTABLE FEATURES:

ENTRY NO. 30

INJECTOR SYSTEM (See below.)

TYPE OF SOURCE Duoplasmatron
OUTPUT, max 50 *mA, at* 27 *keV, at* 2.0 *π mm-mrad*
INJECTION PERIOD 500 *μsec, at* 120 *Hz*
HIGH VOLTAGE STAGE Cockcroft-Walton Generator
Output, max 50 *mA, at* 750 *keV, at* 2.0 *π mm-mrad*
BUNCHER Double Drift, Single Frequency (201.25 MHz)
Potential 4 keV *keV, Drift Length* 6.0 *m*
Potential 18 keV *keV, Drift Length* 1.5 *m*

ACCELERATION SYSTEM

	I	*II*	*III*
TYPE	Drift Tube	Side Coupled	
BEAM EN. (IN-OUT), MeV	0.750-100	100-800	
TOTAL LENGTH, m	61.74	726.95	
RADIO FREQUENCY, MHz	201.25	805	
FIELD MODE	TM_{010}	TM_{010}	
Q(x 10^3)	50	10	
FILLING TIME, μs	150	10	
NO. OF TANKS	4	44	
DIAMETER, cm	94,90,88,88	25.7-25.9	
DRIFT TUBES, number	161	4960 (cells)	
LENGTH, cm	4.9-37.3	8.03-15.66(cell length)	
DIAMETER, cm	18,16,16,16		
GAP/CELL LENGTH RATIO	0.21-0.41	0.32-0.43	
IRIS APERTURE, cm	1.5,2-3,3,3	3.18-3.81 (cell bore)	
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY	N.M.F.	N.M.F.	
PHASE VELOCITY	β	β	
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	70,70,63,60	38.3-46.7 (zT^2)	
ATTENUATION, Np/TANK	N.M.F.	N.M.F.	
EQUILIBRIUM PHASE, deg.	-26°	-30°	
RF POWER UNITS, type	Triode-cavity	Klystron	
RF POWER UNITS, number	4	44	
RF POWER DEMAND, peak, MW	0.5,3.3.3	0.8	
RF POWER DEMAND, mean, MW	0.043,0.258,0.258,0.258	50	
RF POWER RATING, MW/unit	N.M.F.	1.25	
RF POWER FEED SPACING, m	11.4-20.4	15.1-17.2	
QUADRUPOLES, number	134	104	
GRADIENT, kG/m	0.0766-0.0053	0.023-0.030	
SPACING, m	0.063-1.091	3.25-8.06	
OTHER			

INJECTOR SYSTEMS

H^+ INJECTOR:
Type of source - Duoplasmatron
Output, Max - 50 mA at 27 keV at 1.6 π mm-mrad
Injection period - 500 μs at 120 Hz
High-voltage stage - Cockcroft-Walton generator (750 keV)

H^- INJECTOR:
Type of source - Charge exchange (protons in hydrogen gas)
Output, Max - 1 mA at 20 keV, at 2.0 π mm-mrad
Injection period - 500 μs at 120 Hz
High-voltage stage - Cockcroft-Walton generator (750 keV)

POLARIZED ION INJECTOR:
Type of source - Lamb-shift H^- polarized source
Output Max - 0.5 μA at 8 keV at 0.4 π mm-mrad
Injection period - 500 μs at 120 Hz
High-voltage stage - Cockcroft-Walton generator (750 keV)

NOTE: All emittance are normalized E = βγ (phase space area of 99% of beam).

ENTRY NO. 31

NAME OF MACHINE 200-MeV Proton-Linac Injector
INSTITUTION Fermi National Accelerator Laboratory
LOCATION Batavia, Illinois 60510 DATE July 6, 1976
IN CHARGE C. W. Owen/C. D. Curtis REPORTED BY C. D. Curtis

HISTORY AND STATUS

DESIGN, date 1961-1967 MODEL tests 1963-1968
ENG. DESIGN, date Complete July 1969
CONSTRUCTION, date Dec 1968 to Nov 1970
FIRST BEAM date (or goal) Nov 30, 1970
MAJOR ALTERATIONS None
OPERATION 158 hr/wk; On Target N.A. hr/wk
TIME DIST., in house 100 %, outside %
USERS' SCHEDULING CYCLE N.A. weeks
COST, ACCELERATOR 10.6M $
COST, FACILITY, total 12.7M $
FUNDED BY US AEC

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 3 ENGINEERS 2
TECHNICIANS 8 CRAFTS
ADMIN & CLER 1/2 TOTAL 13 1/2
GRAD. STUDENTS involved during year
OPERATED BY Res staff or 2 1/2 Sp op.
BUDGET, op & dev 0.9M $
FUNDED BY ERDA

RESEARCH STAFF, not included above

USER GROUPS, in house outside
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 13.4 m^2
movable m^2
TARGET STATIONS 1 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological X
Time-of-Flight Study
On-Line Mass Separation
Other Neutron Cancer Therapy

OTHER NOTABLE FEATURES:
* Normalized emittance (area x $\beta\gamma$) for 90% of beam at beam currents in the range of 20-230 mA peak.
** Measured for 95% of beam at 100 mA
† Tissue Dose Rate at a distance of 153 cm from a 2.2-cm-thick beryllium target for a 66-MeV proton beam current of 9 μA average.

PHYSICAL DIMENSIONS

TUNNEL, length 156 m, X-sec(hXw) 4.0X4.3 m
ACCELERATOR, length 144.8 m, dia. .84-.94 cm
BEAM, DIA. cm; ENERGY GAIN 1.4 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Protons	1-10x10^{13}	*E=5π-11π mm-mrad	.20	**0.4
Neutrons	†20 Rad/min			

OPERATING PROGRAMS, time dist

Basic Nuclear Physics %
Solid State Physics %
Bio-Medical Applications Parasitic %
Isotope Production %
Machine Research (Linac) <1 %
Injector for Synchroton Studies 9 %
Injector for High Energy Physics 90 %

SELECTED REFERENCES 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)

Operation of the Fermilab 200-MeV Proton Linac, C. D. Curtis and C. W. Owen. Proc. of the Fourth All-Union National Conference on Particle Accelerators, Vol. I, p. 136 (Moscow, 1974)

ENTRY NO. 31

INJECTOR SYSTEM

TYPE OF SOURCE Duoplasmatron

OUTPUT, max ______ mA, at ______ keV, at ______ π mm-mrad

INJECTION PERIOD 4 - 15 μsec, at 15 Hz

HIGH VOLTAGE STAGE Cockcroft Walton

Output, XXXX *300 mA, at 750 keV, at (90%) 80 π mm-mrad

BUNCHER Single Gap

Potential ~25 keV, Drift Length 0.75 m

Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	0.750-200		
TOTAL LENGTH, m	144.8		
RADIO FREQUENCY, MHz	201.25		
FIELD MODE	TM010		
Q(x 10^3)	50-60		
FILLING TIME, μs	90		
NO. OF TANKS	**9		
DIAMETER, cm	84-94		
DRIFT TUBES, number	286		
LENGTH, cm	4.7-44.6		
DIAMETER, cm	16-18		
GAP/CELL LENGTH RATIO	0.21-0.47		
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE	standing		
SHUNT IMPEDANCE, MΩ/m	27-15		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	-32°		
RF POWER UNITS, type	Triode		
RF POWER UNITS, number	9		
RF POWER DEMAND, peak, MW	†37		
RF POWER DEMAND, mean, MW	†.11		
RF POWER RATING, MW/unit	6		
RF POWER FEED SPACING, m	one feed/tank		
QUADRUPOLES, number	295		
GRADIENT, kG/m	7-0.7		
SPACING, m			
OTHER (order)	+-+-		

* Maximum current achieved, 675 mA

** In addition, a three-cell debuncher reduces the energy spread at the input of the booster synchrotron.

† For design beam current of 75 mA peak

ENTRY NO. 32

NAME OF MACHINE: 200 MeV Proton Linear Accelerator
INSTITUTION: Brookhaven National Laboratory
LOCATION: Upton, New York
DATE: March 1, 1976
IN CHARGE: Y.Y. Lee
REPORTED BY: K. Batchelor

HISTORY AND STATUS

DESIGN, date Early 1965 MODEL tests 1965 to 1966
ENG. DESIGN, date 1966 - 1969
CONSTRUCTION, date 1968 - 1970
FIRST BEAM date (or goal) November 1970
MAJOR ALTERATIONS Changes in electric field distribution and parasitic use of beam
OPERATION 156 hr/wk; On Target ~144 hr/wk
TIME DIST., in house ~95 %, outside ~5 %
USERS' SCHEDULING CYCLE one weeks
COST, ACCELERATOR $11 million
COST, FACILITY, total $22.5 million
FUNDED BY U.S. Atomic Energy Commission

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 3
TECHNICIANS 10 CRAFTS 1
ADMIN & CLER 1 TOTAL 16
GRAD. STUDENTS involved during year 1
OPERATED BY 20 Res staff or ____ Sp op.
BUDGET, op & dev $1.3 million
FUNDED BY Energy Research and Development Administration

RESEARCH STAFF, not included above

USER GROUPS, in house 3 outside 1
STAFF SCIENTISTS, in house 2 outside 2
TOTAL RES STAFF, in house 8 outside 6
GRAD STUDENTS involved during year 1
RES. BUDGET, in house $600,000
FUNDED BY ERDA and N.I.H.

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 55 m^2
movable 40 m^2
TARGET STATIONS 4 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 2
MAG SPECTROGRAPH, type none
ON-LINE COMPUTER, model PDP-8 connected to PDP-10
TOTAL POWER INSTALLED FOR RESEARCH 250 KVA
FACILITIES for:
Isotope production 1
Irradiation, Solid State 1
Biological 1
Time-of-Flight Study Zero
On-Line Mass Separation Zero
Other nuclear chemistry

PHYSICAL DIMENSIONS

TUNNEL, length 250 m, X-sec(hXw) 4.3m X 5.7 m
ACCELERATOR, length 200 m, dia. 84 to 94 cm
BEAM, DIA. 1.5 cm; ENERGY GAIN 1 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Protons	5×10^{13}	2.0	0.2	0.6
Neutrons	5×10^{11}	4.0	.025 to .2	Very large

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	95 %
Solid State Physics	0 %
Bio-Medical Applications	1 %
Isotope Production	90 %
Machine Research	5 %
Nuclear Chemistry	3 %
Special Irradiation	1 %

SELECTED REFERENCES DESCRIBING MACHINE

1966 Linear Accelerator Conf. Proceedings LA-3609
1968 " BNL-50120
1970 Linear Accelerator Conf.
1972 " LA-5115

OTHER NOTABLE FEATURES:

ENTRY NO. 32

INJECTOR SYSTEM

TYPE OF SOURCE Duoplasmatron
OUTPUT, max ____ mA, at ____ keV, at ____ π mm-mrad
INJECTION PERIOD 250 μsec μsec, at 10 Hz
HIGH VOLTAGE STAGE Cockroft Walton
Output, max 300 mA, at 750 keV, at 200 π mm-mrad
BUNCHER 2 double gap fundamental frequency
Potential 10 keV, Drift Length 1 m
Potential 17 keV, Drift Length 0.72 m

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	0.75 - 200 MeV		
TOTAL LENGTH, m	200 m		
RADIO FREQUENCY, MHz	201.25 MHZ		
FIELD MODE	TM010		
$Q(x\ 10^3)$	50 to 70		
FILLING TIME, μs	50 to 70		
NO. OF TANKS	9		
DIAMETER, cm	94 to 84 cm		
DRIFT TUBES, number	286(including ½ drift tubes)		
LENGTH, cm	4.8 cm to 44.7 cm		
DIAMETER, cm	18 cm to 16 cm		
GAP/CELL LENGTH RATIO	0.21 to 0.47		
IRIS APERTURE, cm	N.A.		
THICKNESS, cm	N.A.		
SPACING, cm	N.A.		
GROUP VELOCITY	N.A.		
PHASE VELOCITY	N.A.		
WAVE TYPE	Standing		
SHUNT IMPEDANCE, MΩ/m	53.5 to 14.9		
ATTENUATION, Np/TANK	N.A.		
EQUILIBRIUM PHASE, deg.	32°		
RF POWER UNITS, type	RCA 7835		
RF POWER UNITS, number	9 + operating spare		
RF POWER DEMAND, peak, MW	40 MW		
RF POWER DEMAND, mean, MW	0.16 MW		
RF POWER RATING, MW/unit	5 MW/unit		
RF POWER FEED SPACING, m	20 to 30 m		
QUADRUPOLES, number	287		
GRADIENT, kG/m	9.2 KG/cm to 0.56 KG/cm		
SPACING, m	6 cm to 84 cm		
OTHER			

ENTRY NO. 33

NAME OF MACHINE Zero Gradient Synchrotron Injector Linac
INSTITUTION Argonne National Laboratory
LOCATION Argonne, Illinois, USA
DATE February 27, 1976
IN CHARGE R.L. Martin
REPORTED BY E.F. Parker

HISTORY AND STATUS

DESIGN, date ______ MODEL tests ______
ENG. DESIGN, date ______
CONSTRUCTION, date 1962
FIRST BEAM date (or goal) ______
MAJOR ALTERATIONS Polarized Proton Preinjector and Source
OPERATION 168 hr/wk; On Target ______ hr/wk
TIME DIST., in house ______ %, outside ______ %
USERS' SCHEDULING CYCLE ______ weeks
COST, ACCELERATOR 5×10^6
COST, FACILITY, total ______
FUNDED BY ERDA

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 4
TECHNICIANS 5 CRAFTS ______
ADMIN & CLER ______ TOTAL ______
GRAD. STUDENTS involved during year 0
OPERATED BY x Res staff or ______ Sp op.
BUDGET, op & dev ~ $\$10^5$
FUNDED BY ERDA

RESEARCH STAFF, not included above NA

USER GROUPS, in house ______ outside ______
STAFF SCIENTISTS, in house ______ outside ______
TOTAL RES STAFF, in house ______ outside ______
GRAD STUDENTS involved during year ______
RES. BUDGET, in house ______
FUNDED BY ______

FACILITIES FOR RESEARCH PROGRAMS NA

SHIELDED AREA, fixed ______ m^2
movable ______ m^2
TARGET STATIONS ______ in ______ ROOMS
STATIONS SERVED AT THE SAME TIME, max. ______
MAG SPECTROGRAPH, type ______
ON-LINE COMPUTER, model ______
TOTAL POWER INSTALLED FOR RESEARCH ______
FACILITIES for:
Isotope production ______
Irradiation, Solid State ______
Biological ______
Time-of-Flight Study ______
On-Line Mass Separation ______
Other ______

PHYSICAL DIMENSIONS

TUNNEL, length ______ m, X-sec(hXw) ______ X ______ m
ACCELERATOR, length 33.28 m, dia. 95 cm
BEAM, DIA. ______ cm; ENERGY GAIN 1.9 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
Proton (Unpolarized)	40 MA-pulsed		0.050	0.5
Proton (Polarized)	20 μA-pulsed		0.050	0.75

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ______ %
Solid State Physics ______ %
Bio-Medical Applications ______ %
Isotope Production ______ %
Machine Research ______ %
ZGS Injector 100%
______ %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: ______

ENTRY NO. 33

INJECTOR SYSTEM

TYPE OF SOURCE Duoplasmatron/Atomic Beam Polarized Ion Source
OUTPUT, max 160/0.024 *mA, at* 750 *keV, at* 80 *π mm-mrad*
INJECTION PERIOD 250 *μsec, at* up to 30 *Hz*
HIGH VOLTAGE STAGE Cockcroft-Walton
Output, max _____ *mA, at* 750 *keV, at* 80 *π mm-mrad*
BUNCHER One-gap re-entrant cavity-first harmonic
Potential ~ 15 *keV, Drift Length* 2.2 *m*
Potential _____ *keV, Drift Length* _____ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	0.75-50		
TOTAL LENGTH, m	33.28		
RADIO FREQUENCY, MHz	200		
FIELD MODE	TM-010		
$Q (x\ 10^3)$	60		
FILLING TIME, μs	150		
NO. OF TANKS	1		
DIAMETER, cm	95		
DRIFT TUBES, number	124		
LENGTH, cm	4.9-35.46		
DIAMETER, cm	24.9-14.7		
GAP/CELL LENGTH RATIO	0.225-0.250		
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	39		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	-26^{o}		
RF POWER UNITS, type	Triode		
RF POWER UNITS, number	1		
RF POWER DEMAND, peak, MW	4.5		
RF POWER DEMAND, mean, MW			
RF POWER RATING, MW/unit			
RF POWER FEED SPACING, m	Single feed		
QUADRUPOLES, number	124		
GRADIENT, kG/m	8.0 to 1.4		
SPACING, m	1 per drift tube		
OTHER			

Polarization at 50 MeV is 75%, and the polarity can be alternated each machine cycle.

ENTRY NO. 34

NAME OF MACHINE 50 MeV ESCAR Injector
INSTITUTION Lawrence Berkeley Laboratory
LOCATION Berkeley, California
DATE March, 1976
IN CHARGE John Staples
REPORTED BY John Staples

HISTORY AND STATUS - LBL dates

DESIGN, date 1960/1972 MODEL tests
ENG. DESIGN, date 1972
CONSTRUCTION, date 1972-3
FIRST BEAM date (or goal) 1973
MAJOR ALTERATIONS rf manifold system
OPERATION 0 hr/wk; On Target hr/wk
TIME DIST., in house %, outside %
USERS' SCHEDULING CYCLE weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY AEC

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS
ADMIN & CLER TOTAL
GRAD. STUDENTS involved during year
OPERATED BY X Res staff or Sp op.
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USER GROUPS, in house outside
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS in ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model PDP-8
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length m, X-sec(hXw) X m
ACCELERATOR, length 33 m, dia. 97 cm
BEAM, DIA. 2 cm; ENERGY GAIN 1.4 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
p^+	30 ma peak		0.05	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research 100 %

SELECTED REFERENCES DESCRIBING MACHINE

D. Brodzik et al, NS-20, No. 3 (1973) pp. 923-927

OTHER NOTABLE FEATURES: This machine formally served as the injector to the Brookhaven Alternating Gradient Synchrotron. It was brought to LBL and installed in 1971-73. Presently shut down, it will serve as the injector to the Experimental Superconducting Accelerator Ring (ESCAR) in 1977, at which time the performance will be optimized.

ENTRY NO. 34

INJECTOR SYSTEM

TYPE OF SOURCE: Duo plasmatron
OUTPUT, max ____ mA, at ____ keV, at ____ π mm-mrad
INJECTION PERIOD 600 μsec, at 2 Hz
HIGH VOLTAGE STAGE: Cockcroft-Walton Generator
Output, max 180 mA, at 750 keV, at 25 π mm-mrad
BUNCHER: Single-gap fundamental
Potential 22 keV, Drift Length 1.33 m
Potential ____ keV, Drift Length ____ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez		
BEAM EN. (IN-OUT), MeV	50		
TOTAL LENGTH, m	33		
RADIO FREQUENCY, MHz	201.6		
FIELD MODE	TM 010		
Q(x 10^3)	60000		
FILLING TIME, μs	150		
NO. OF TANKS	1		
DIAMETER, cm	97		
DRIFT TUBES, number	124		
LENGTH, cm	4.91 - 35.46		
DIAMETER, cm	25.02 - 14.71		
GAP/CELL LENGTH RATIO	0.231 - 0.249		
IRIS APERTURE, cm	1.9 - 3.2		
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	39		
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	-30^o		
RF POWER UNITS, type	Triode		
RF POWER UNITS, number	3		
RF POWER DEMAND, peak, MW	9		
RF POWER DEMAND, mean, MW	0.011		
RF POWER RATING, MW/unit	3		
RF POWER FEED SPACING, m			
QUADRUPOLES, number	124		
GRADIENT, kG/m	4.5 - 0.9		
SPACING, m			
OTHER	++--		

ENTRY NO. 35

NAME OF MACHINE Stanford Linear Accelerator Center
INSTITUTION Stanford University
LOCATION Stanford, California
DATE April 2, 1976
IN CHARGE W. K. H. Panofsky
REPORTED BY G. A. Loew

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests 1961
ENG. DESIGN, date 1961
CONSTRUCTION, date Started 1962
FIRST BEAM date (or goal) May 21, 1966
MAJOR ALTERATIONS SPEAR 1/, SLED 2/, PEP 3/, SSRP 4/
OPERATION 5/ hr/wk; On Target 5/ hr/wk
TIME DIST., in house 55 %, outside 45 % 6/
USERS' SCHEDULING CYCLE 6 - 12 weeks
COST, ACCELERATOR + Facilities : $114 M
COST, FACILITY, total
FUNDED BY USAEC, Now ERDA

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 28 ENGINEERS 97
TECHNICIANS 290 CRAFTS 105
ADMIN & CLER 33 TOTAL 553
GRAD. STUDENTS involved during year 5
OPERATED BY ______ Res staff or _____ Sp op.
BUDGET, op & dev FY1976 $20,730,000
FUNDED BY USAEC, Now ERDA

RESEARCH STAFF, not included above

USER GROUPS, in house 7 outside 20
STAFF SCIENTISTS, in house 78 outside
TOTAL RES STAFF, in house 318 outside
GRAD STUDENTS involved during year 18
RES. BUDGET, in house FY1976 $6,770,000
FUNDED BY USAEC, Now ERDA

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 4000 m^2
movable 100 m^2
TARGET STATIONS 5 in 3 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 8
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model IBM 370/168
TOTAL POWER INSTALLED FOR RESEARCH ∿30 MW
FACILITIES for:
Isotope production None
Irradiation, Solid State 4/
Biological 4/
Time-of-Flight Study Yes
On-Line Mass Separation Yes
Other

PHYSICAL DIMENSIONS

TUNNEL, length 3090 m, X-sec(hXw) 3.05X3.35 m
ACCELERATOR, length 3050 m, dia. 10 cm
BEAM, DIA. 0.2 cm; ENERGY GAIN 8 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./pulse)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
γ	2×10^{10} eq	0.15	1 - 21	
$K^{\pm}$	10	2	7 - 13	4% max
γCoherent	10^9 eq	0.15 cm^2	5 - 15	
K°	150	3000	1 - 10	
$\pi^{\pm}$	10^3	2	1 - 16	4% max
p	30	2 cm^2	1 - 14	2% max
μ^+	500	1	14	2% max

OPERATING PROGRAMS, time dist

Basic High Energy Physics FY 1975 96 %
Solid State Physics 0 % 4/
Bio-Medical Applications 0 % 4/
Isotope Production 0 %
Machine Research FY 1975 4 %

SELECTED REFERENCES DESCRIBING MACHINE

The Stanford Two-Mile Accelerator, R.B.Neal, Editor, W.A.Benjamin, Inc., New York, Amsterdam, 1968.

SLED: A Method of Doubling SLAC's Energy, Z.D.Farkas, et al, Proc. 9th Int. Conf. on High Energy Accel., SLAC, Stanford, CA., May 2-7, 1974, pp. 576-583.

Recent Progress on SLED, The SLAC Energy Doubler, Z.D.Farkas, et al, IEEE Trans. on Nu. Sci., Vol.NS-22, No. 3, June 1975, pp. 1299-1302.

OTHER NOTABLE FEATURES:

1/ SPEAR, the SLAC positron-electron storage ring, was first put into operation in April, 1972. It now can store beams up to 3.9 GeV/beam.

2/ SLED, the SLAC energy development project, is being installed, starting January, 1976 with completion of installation presently contemplated for September, 1978. The linac energy will then be increased up to ∿33 GeV.

3/ PEP, the SLAC-LBL positron-electron project, is presently scheduled for start of construction in Fall 1976 with completion sometime in 1980. The energy per beam should initially reach 18 GeV.

4/ Solid-state Physics and Bio-Medical research are not performed with the linac itself but are done indirectly at SPEAR with the facility called SSRP (Stanford Synchrotron Radiation Project) which extracts and uses the X-rays radiated by the stored electrons over the entire spectrum from infrared to 1/4 Angstrom.

5/ FY 1976 (Projected) : Number of eight-hour shifts for accelerator : 658
Average pulse rate : 180 pps
Average number of simultaneous beams : 3
Maximum number of simultaneous beams : 8

6/ The percentages shown refer to hours for electronic counting experiments. For bubble chamber pictures, the numbers are : in house : 12 %, outside : 80%, combined : 8%.

ENTRY NO. 35

INJECTOR SYSTEM 1/

TYPE OF SOURCE Oxide Cathode (2 off-axis guns) 2/

OUTPUT, max 1000 *mA, at* 70 *keV, at* ____ π *mm-mrad*

INJECTION PERIOD ∿1.6 *μsec, at* 360 3/ *Hz*

HIGH VOLTAGE STAGE 3 m LINAC

Output,max 500 (short pulse) *mA, at* 35,000 *keV, at* 1.2 π *mm-mrad*

BUNCHER Cavity followed by travelling-wave buncher

Potential 70 *keV, Drift Length* .3 *m*

Potential 70 keV in, 250 keV out *keV, Drift Length* .1 *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Travelling wave		
BEAM EN. (IN-OUT), MeV	70 keV-23 GeV 4/ 5/		
TOTAL LENGTH, m	3050		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	$2\pi/3$		
Q($x\ 10^3$)	13		
FILLING TIME, μs	.83		
NO. OF TANKS	960		
DIAMETER, cm	8.34 → 8.17		
DRIFT TUBES, number	--		
LENGTH, cm	--		
DIAMETER, cm	--		
GAP/CELL LENGTH RATIO	--		
IRIS APERTURE, cm	2.62 - 1.92		
THICKNESS, cm	.584		
SPACING, cm	3.5		
GROUP VELOCITY v_g/c	0.0204 → 0.0065		
PHASE VELOCITY	c		
WAVE TYPE	TM_{01}		
SHUNT IMPEDANCE, MΩ/m	57		
ATTENUATION, Np/TANK	.57		
EQUILIBRIUM PHASE, deg.	0		
RF POWER UNITS, type	Klystron		
RF POWER UNITS, number	244		
RF POWER DEMAND, peak, MW	5,900		
RF POWER DEMAND, mean, MW	5.9		
RF POWER RATING, MW/unit	20 - 40 MW		
RF POWER FEED SPACING, m	3.05		
QUADRUPOLES, number	43 doublets		
GRADIENT, kG/m	10 - 200		
SPACING, m	100 m		
OTHER	42 singlets at 12 m spacing		

1/ For recent information on injector innovations, see R.F.Koontz, R.H.Miller, IEEE Trans. Nu. Sci., Vol NS-22, No. 3, Jun. 75.

2/ In addition to these two off-axis guns, there is a third source giving longitudinally polarized electrons obtained by photo-ionization of a beam of polarized Lithium atoms. The output energy of this source is also 70 KeV, the current is of the order of 0.300 mA pk (∿3 x 10^9 electrons per pulse with a polarization of 0.6) with a maximum repetition rate of 180 pps and a pulse length of 1.5 μs.

3/ The maximum RF and beam repetition rate is 360 pps. The RF pulse length is 2.5 μs, the maximum beam pulse length is 1.6 μs. Shorter beam bursts down to ∿1 ns can be generated by fast grid pulsers and/or beam choppers described in detail under 1/ above.

4/ The energy of the output electron beam is programmable from about 1 to 23 GeV on a pulse-to-pulse basis. The electron current, likewise, is programmable in the range of ∿10^5 to 8 x 10^{11} electrons per pulse. The maximum peak current of 80 mA for a 1.6 μs pulse is determined by the beam breakup threshold.

5/ The SLAC linac can also produce positron beams in the energy range of 1 to 14 GeV. The positron current at the end of the accelerator can reach about 10 mA peak. This corresponds to an overall positron yield of about 10%. For injection into SPEAR, 2.25 GeV $e^{\pm}$ beams are used. The number of positrons per pair of 1 ns bursts is ∿2.5 x 10^8.

ENTRY NO. 36

NAME OF MACHINE: William H. Bates Linear Accelerator
INSTITUTION: Massachusetts Institute Of Technology
LOCATION: Middleton, Massachusetts
DATE: August 16, 1976
IN CHARGE: Dr. Peter Demos
REPORTED BY: W. Lobar

HISTORY AND STATUS

DESIGN, date 1964 MODEL tests -
ENG. DESIGN, date 1966-69
CONSTRUCTION, date 1972 Completed
FIRST BEAM date (or goal) 1973
MAJOR ALTERATIONS -
OPERATION 65 hr/wk; On Target 45 hr/wk
TIME DIST., in house 50 %, outside 50 %
USERS' SCHEDULING CYCLE 12 weeks
COST, ACCELERATOR ~ $5 Million
COST, FACILITY, total ~ $13 Million
FUNDED BY ERDA

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 15 ENGINEERS 17
TECHNICIANS 26 CRAFTS 5
ADMIN & CLER 4 TOTAL 67
GRAD. STUDENTS involved during year 9
OPERATED BY ___ Res staff or ✓ Sp op.
BUDGET, op & dev $3M FY/76
FUNDED BY ERDA

RESEARCH STAFF, not included above

USER GROUPS, in house - outside 18
STAFF SCIENTISTS, in house - outside 33
TOTAL RES STAFF, in house - outside ?
GRAD STUDENTS involved during year ?
RES. BUDGET, in house -
FUNDED BY Responsibility of each group

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 375 m^2
movable 100 m^2
TARGET STATIONS 2 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type Split poles ρ=2.2 M, $\theta=90^\circ$
ON-LINE COMPUTER, model PDP 11/45
TOTAL POWER INSTALLED FOR RESEARCH -
FACILITIES for:
Isotope production -
Irradiation, Solid State -
Biological -
Time-of-Flight Study -
On-Line Mass Separation -
Other High resolution e^- scattering

PHYSICAL DIMENSIONS

TUNNEL, length 200 m, X-sec(hXw) 3 X 3 m
ACCELERATOR, length 150 m, dia. ~ 15 cm O.D.
BEAM, DIA. < 1.2 cm; ENERGY GAIN 2.67 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	6×10^{14}	See note*	0.4	$\tilde{<}$0.3
γ Brem.	Radiators ~	.02 R.L.		

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 100 %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research %
%
%

SELECTED REFERENCES DESCRIBING MACHINE

Medium Energy Nuclear Physics With Electron Linear Accelerators MIT 1967 Summer Study
Edited By: W. Bertozzi, S. Kowalski
Laboratory For Nuclear Science, Cambridge, Mass.

OTHER NOTABLE FEATURES: *Beam emittance $r p_r \sim 10^{-3}$ mc-cm. When used in high resolution e^- scattering dispersion matching between spectrometer and beam switchyard - beam dispersed on target with space focus - dispersion ~ 7 cm/%.

ENTRY NO. 36

INJECTOR SYSTEM

TYPE OF SOURCE High Voltage Eng. Corp. - Insulated Core Transf.
OUTPUT, max ~ 20 mA, at 400 keV, at ~ 10 π mm-mrad
INJECTION PERIOD 15 μsec, at 5000 Hz Max.
HIGH VOLTAGE STAGE -
Output,max ____ mA, at ____ keV, at ____ π mm-mrad
BUNCHER
Pre-Buncher Power 5 kW Peak, Drift Length 1.2 m
Buncher Power 3 MW Peak, Drift Length ____ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Disc-Loaded		
BEAM EN. (IN-OUT), MeV	6-400		
TOTAL LENGTH, m	150		
RADIO FREQUENCY, MHz	2856		
FIELD MODE	TM 010		
Q(x 10^3)	13.4 - 13.75		
FILLING TIME, μs	1.12 - 1.27		
NO. OF TANKS	23		
DIAMETER, cm	-		
DRIFT TUBES, number	-		
LENGTH, cm	-		
DIAMETER, cm	-		
GAP/CELL LENGTH RATIO	-		
IRIS APERTURE, cm	1.9 - 3.7		
THICKNESS, cm	0.594		
SPACING, cm	3.5		
GROUP VELOCITY	.0389 - .007C		
PHASE VELOCITY	C		
WAVE TYPE	T.W.		
SHUNT IMPEDANCE, MΩ/m	48 - 57.7		
ATTENUATION, Np/TANK	0.75 - 0.825		
EQUILIBRIUM PHASE, deg.	-		
RF POWER UNITS, type	VA938 Klystron		
RF POWER UNITS, number	10		
RF POWER DEMAND, peak, MW	4 MW/Klystron		
RF POWER DEMAND, mean, MW	75 kW/Klystron		
RF POWER RATING, MW/unit	4 MW/Klystron		
RF POWER FEED SPACING, m	3.7 - 7.35		
QUADRUPOLES, number	5 Doublets		
GRADIENT, kG/m	40		
SPACING, m	30 Average		
OTHER (Solenoids)	1 kG for 50 ft		

ENTRY NO. 37

NAME OF MACHINE Oak Ridge Electron Linear Accelerator (ORELA)
INSTITUTION Oak Ridge National Laboratory
LOCATION Oak Ridge, Tennessee — *DATE* August 16, 1976
IN CHARGE J. A. Harvey and R. W. Peelle — *REPORTED BY* J. A. Harvey & R. W. Peelle

HISTORY AND STATUS

DESIGN, date March 1966 *MODEL tests* 1967
ENG. DESIGN, date 1966
CONSTRUCTION, date 1967
FIRST BEAM date (or goal) 1969
MAJOR ALTERATIONS None
OPERATION 120 *hr/wk; On Target* 120 *hr/wk*
TIME DIST., in house 96 *%, outside* 4 *%*
USERS' SCHEDULING CYCLE 2 *weeks*
COST, ACCELERATOR 1.8 M
COST, FACILITY, total 4.8 M
FUNDED BY USAEC (USERDA)

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 0 *ENGINEERS* 3
TECHNICIANS 4 *CRAFTS* 4
ADMIN & CLER 1 *TOTAL* 12
GRAD. STUDENTS involved during year
OPERATED BY ___ *Res staff or* 4 *Sp op.*
BUDGET, op & dev $750 K
FUNDED BY USERDA

RESEARCH STAFF, not included above

USER GROUPS, in house ___ *outside* 1
STAFF SCIENTISTS, in house 20 *outside* ∿4 MY
TOTAL RES STAFF, in house 24 *outside* ∿5 MY
GRAD STUDENTS involved during year 1
RES. BUDGET, in house $1.7 M
FUNDED BY USERDA

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ___ m^2
movable ___ m^2
TARGET STATIONS 17 *in* 9 *ROOMS*
STATIONS SERVED AT THE SAME TIME, max. 10
MAG SPECTROGRAPH, type NA
ON-LINE COMPUTER, model 3 SEL 810 B + 4 PDP computers
TOTAL POWER INSTALLED FOR RESEARCH 500 KW
FACILITIES for:
Isotope production 2 rabbits
Irradiation, Solid State None
Biological None
Time-of-Flight Study Neutron
On-Line Mass Separation None
Other None

PHYSICAL DIMENSIONS

TUNNEL, length 37.8 *m, X-sec(hXw)* 3.35 x 4.6 *m*
ACCELERATOR, length 25 *m, dia.* 25 *cm*
BEAM, DIA. ∿1.3 *cm; ENERGY GAIN* 10 *MeV/m*

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	*FLUX (part./sec)*	*BEAM AREA (cm^2)*	*ENERGY (GeV)*	*ΔE/E (%)*
Electrons	20 amps in pulses	1	0.14	40
Neutrons	10^{14} into 4π steradian		10 keV-40 MeV (Evaporation spectrum)	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	94 %
Solid State Physics	2 %
Bio-Medical Applications	0 %
Isotope Production	0 %
Machine Research	4 %

SELECTED REFERENCES DESCRIBING MACHINE

ORNL-TM-5112, Performance of 140-MeV High-Current Short-Pulse Linac at ORNL, IEEE Trans. Nucl. Sci. NS-16 (3), 316 (1969), by T. A. Lewis and N. C. Pering

OTHER NOTABLE FEATURES:

ENTRY NO. 37

INJECTOR SYSTEM

TYPE OF SOURCE Gridded gun with oxide cathode
OUTPUT, max 50 A *mA, at* 150 *keV, at* ____ π *mm-mrad*
INJECTION PERIOD 0.002 to 1.0 *μsec, at* o to 1000 *Hz*
HIGH VOLTAGE STAGE NA
Output, max ____ *mA, at* ____ *keV, at* ____ π *mm-mrad*
BUNCHER Pancake type
Potential 50 *keV, Drift Length* 30 cm *m*
Potential ____ *keV, Drift Length* ____ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Traveling wave		
BEAM EN. (IN-OUT), MeV	0.15 - 140		
TOTAL LENGTH, m	16.5		
RADIO FREQUENCY, MHz	1300		
FIELD MODE	$2\pi/3$		
$Q(x\ 10^3)$	18		
FILLING TIME, μs	1.85		
NO. OF TXXXX Sections	4		
DIAMETER, cm			
DRIFT TUBES, number	None		
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm	2-4		
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY	.007 c		
PHASE VELOCITY	1.0 c		
WAVE TYPE	SINE		
SHUNT IMPEDANCE, MΩ/m	35		
ATTENUATION, Np/TANK	0.41 per section		
EQUILIBRIUM PHASE, deg.	90°		
RF POWER UNITS, type	Klystron		
RF POWER UNITS, number	4		
RF POWER DEMAND, peak, MW	30 each Kly		
RF POWER DEMAND, mean, MW	0.075 each kly		
RF POWER RATING, MW/unit	NA		
RF POWER FEED SPACING, m	4.3		
QUADRUPOLES, number	None		
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 38

NAME OF MACHINE Gaerttner Electron Linac
INSTITUTION Rensselaer Polytechnic Institute
LOCATION Troy, New York DATE May, 1976
IN CHARGE R. C. Block REPORTED BY R. C. Block & W. McRoberts

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests ____
ENG. DESIGN, date 1958
CONSTRUCTION, date 1959
FIRST BEAM date (or goal) 1962
MAJOR ALTERATIONS New Electron Gun, Injector
OPERATION 20 hr/wk; On Target 20 hr/wk
TIME DIST., in house 60 %, outside 40 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR ~ $2 x 10^6
COST, FACILITY, total ~ $4 x 10^6
FUNDED BY USAEC

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 0
TECHNICIANS 3 CRAFTS 1
ADMIN & CLER 2 TOTAL 7
GRAD. STUDENTS involved during year 6
OPERATED BY ____ Res staff or X Sp op.
BUDGET, op & dev ____
FUNDED BY ____

RESEARCH STAFF, not included above

USER GROUPS, in house ____ outside ____
STAFF SCIENTISTS, in house ____ outside ____
TOTAL RES STAFF, in house ____ outside ____
GRAD STUDENTS involved during year ____
RES. BUDGET, in house ____
FUNDED BY ____

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 230 m^2
movable ____ m^2
TARGET STATIONS 4 in 4 ROOMS
STATIONS SERVED AT THE SAME TIME, max. ____
MAG SPECTROGRAPH, type ____
ON-LINE COMPUTER, model PDP-7, PDP-9
TOTAL POWER INSTALLED FOR RESEARCH ~ 1 MW
FACILITIES for:
Isotope production ____
Irradiation, Solid State X
Biological ____
Time-of-Flight Study X
On-Line Mass Separation ____
Other ____

PHYSICAL DIMENSIONS

TUNNEL, length 20 m, X-sec(hXw) 3 X 3 m
ACCELERATOR, length 10 m, dia. ____ cm
BEAM, DIA. 1 cm; ENERGY GAIN 10 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
e^-	6 amp. peak 1 ma. average	~2	0.1	10
n	10^{12}			white source

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 80 %
Solid State Physics ____ %
Bio-Medical Applications ____ %
Isotope Production ____ %
Machine Research ____ %
Radiography 30 %
____ %

SELECTED REFERENCES DESCRIBING MACHINE

E. R. Gaerttner, M. L. Yeater and R. R. Fullwood "Rensselaer Polytechnic Institute Linac Facility, Neutron Physics" edited by M. L. Yeater, Academic Press, N.Y. pp. 263-287, 1962.

E. R. Gaerttner, M. L. Yeater, R. R. Fullwood, "Operation Experience with the RPI Linac", IRE Trans. on Nuc. Sci. NS9 pp 23-26, Nov. 1962

OTHER NOTABLE FEATURES: ____

ENTRY NO. 38

INJECTOR SYSTEM

TYPE OF SOURCE Cockcroft Walton plus Triode Gun
OUTPUT, max 40,000 mA, at 100 keV, at ______ π mm-mrad
INJECTION PERIOD ~1 μsec, at 720 Hz
HIGH VOLTAGE STAGE ______
Output,max ______ mA, at ______ keV, at ______ π mm-mrad
BUNCHER ______
Potential ______ keV, Drift Length 0.4 m
Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Travelling Wave		
BEAM EN. (IN-OUT), MeV	0.1 (in) 100 (out)		
TOTAL LENGTH, m	10		
RADIO FREQUENCY, MHz	1300		
FIELD MODE			
$Q(x\ 10^3)$			
FILLING TIME, μs	1.5		
NO. OF TANKS			
DIAMETER, cm			
DRIFT TUBES, number	9		
LENGTH, cm	100		
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m			
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Klystron		
RF POWER UNITS, number	9		
RF POWER DEMAND, peak, MW	90		
RF POWER DEMAND, mean, MW	.135		
RF POWER RATING, MW/unit	10		
RF POWER FEED SPACING, m			
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 39

NAME OF MACHINE Microwave electron linear accelerator.
INSTITUTION Yale University
LOCATION New Haven, Conn.
DATE March 8, 1976
IN CHARGE H. L. Schultz
REPORTED BY H. L. Schultz

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests ______
ENG. DESIGN, date ______
CONSTRUCTION, date 1958-1961
FIRST BEAM date (or goal) Aug. 21, 1961
MAJOR ALTERATIONS None
OPERATION 110 hr/wk; On Target 110 hr/wk
TIME DIST., in house 100 %, outside ______ %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR $900,000
COST, FACILITY, total 1,500,000 approx.
FUNDED BY Atomic Energy Commission

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 0 ENGINEERS 1/3
TECHNICIANS 3 CRAFTS ______
ADMIN & CLER 1/2 TOTAL ______
GRAD. STUDENTS involved during year 3
OPERATED BY ______ Res staff or 3 Sp op.
BUDGET, op & dev See below.
FUNDED BY ERDA

RESEARCH STAFF, not included above

USER GROUPS, in house 0 outside 0
STAFF SCIENTISTS, in house 4 outside 0
TOTAL RES STAFF, in house 4 outside 0
GRAD STUDENTS involved during year 3
RES. BUDGET, in house 180,000 (Research & operation combined)
FUNDED BY ERDA

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed ______ m^2
movable ______ m^2
TARGET STATIONS 2 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type ______
ON-LINE COMPUTER, model PDP/7 coupled to PDP/8
TOTAL POWER INSTALLED FOR RESEARCH ______
FACILITIES for:
Isotope production ______
Irradiation, Solid State ______
Biological ______
Time-of-Flight Study (fast neutron)
On-Line Mass Separation ______
Other ______

PHYSICAL DIMENSIONS

TUNNEL, length 50 m, X-sec(hXw) ______ X ______ m
ACCELERATOR, length 15 m, dia. ______ cm
BEAM, DIA. < 0.5 cm; ENERGY GAIN ~10 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
electron	10 amp in 20ns pulse, 200 pps		10-60 MeV	≤ 5% direct beam, 1-0.2% after beam analyzer.
X-ray				
neutrons				

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 100 %
Solid State Physics ______ %
Bio-Medical Applications ______ %
Isotope Production ______ %
Machine Research ______ %
______ %
______ %

SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: ______

ENTRY NO. 39

INJECTOR SYSTEM

TYPE OF SOURCE pulsed electron gun
OUTPUT, max 20 amp ~~mA~~, at 120 keV, at ______ π mm-mrad
INJECTION PERIOD 20 ns ~~μsec~~, at 200 Hz
HIGH VOLTAGE STAGE ______
Output,max ______ mA, at ______ keV, at ______ π mm-mrad
BUNCHER ______
Potential ______ keV, Drift Length ______ m
Potential ______ keV, Drift Length ______ m

ACCELERATION SYSTEM

	I	II	III
TYPE	Traveling Wave		
BEAM EN. (IN-OUT), MeV	10-60		
TOTAL LENGTH, m	15		
RADIO FREQUENCY, MHz	1300		
FIELD MODE	π/2		
Q(x 10^3)			
FILLING TIME, μs	1.5		
NO. OF ~~TANKS~~ Sections	5		
DIAMETER, cm			
DRIFT TUBES, number			
LENGTH, cm			
DIAMETER, cm			
GAP/CELL LENGTH RATIO			
IRIS APERTURE, cm			
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE	Traveling		
SHUNT IMPEDANCE, MΩ/m			
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.			
RF POWER UNITS, type	Klystron		
RF POWER UNITS, number	5		
RF POWER DEMAND, peak, MW	5-8		
RF POWER DEMAND, mean, ~~MW~~ KW	5		
RF POWER RATING, MW/unit	10		
RF POWER FEED SPACING, m			
QUADRUPOLES, number			
GRADIENT, kG/m			
SPACING, m			
OTHER			

ENTRY NO. 40

NAME OF MACHINE: High Current Electron Linac (L-Band)
INSTITUTION: Chemistry Division - Argonne National Laboratory
LOCATION: Bldg. 211 DATE: 2/25/76
IN CHARGE: G. Mavrogenes REPORTED BY: G. Mavrogenes

HISTORY AND STATUS

DESIGN, date 1968 MODEL tests -
ENG. DESIGN, date -
CONSTRUCTION, date 1969
FIRST BEAM date (or goal) 1970
MAJOR ALTERATIONS 1972; picosecond pulses
OPERATION 80 hr/wk; On Target varies hr/wk
TIME DIST., in house 95 %, outside 5 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR ∿ $1 Million
COST, FACILITY, total ∿ $1.7 Million
FUNDED BY A.E.C.

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS - ENGINEERS 3
TECHNICIANS 2 CRAFTS -
ADMIN & CLER - TOTAL 5
GRAD. STUDENTS involved during year 0
OPERATED BY - Res staff or 2 Sp op.
BUDGET, op & dev 414
FUNDED BY E.R.D.A.

RESEARCH STAFF, not included above

USER GROUPS, in house 0 outside 0
STAFF SCIENTISTS, in house 20 outside 10
TOTAL RES STAFF, in house 20 outside 10
GRAD STUDENTS involved during year 2
RES. BUDGET, in house 735
FUNDED BY E.R.D.A.

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 307 m^2
movable - m^2
TARGET STATIONS 12 in 3 ROOMS
STATIONS SERVED AT THE SAME TIME, max. 1
MAG SPECTROGRAPH, type 90° : N=1
ON-LINE COMPUTER, model Sigma V
TOTAL POWER INSTALLED FOR RESEARCH -
FACILITIES for:
Isotope production X
Irradiation, Solid State X
Biological
Time-of-Flight Study X
On-Line Mass Separation X
Other Radiation Chemistry; X

PHYSICAL DIMENSIONS

TUNNEL, length 13.7 m, X-sec(hXw) 2.6 X 4.6 m
ACCELERATOR, length 7.3 m, dia. 70 cm
BEAM, DIA. 1 cm; ENERGY GAIN 13 MeV/m, No load

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS, Electrons Only:

~~XXXXXXX~~ PULSE WIDTH	CURRENT ~~XXXX~~ (~~XXX~~./~~XXX~~) AMP./PULSE	BEAM AREA (cm^2)	ENERGY (~~GeV~~) MEV	ΔE/E (%)
10μs	2.5A	1	14	5 (90% of part)
10ns	22A	0.5	19	10 (80% of part)
30ps	250A	0.3	20	∿1 (100% of part)

OPERATING PROGRAMS, time dist

Basic Nuclear Physics 30 %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research and Maint. 6 %
Radiation Chemistry 64 %

* SELECTED REFERENCES DESCRIBING MACHINE

OTHER NOTABLE FEATURES: Capable of producing a 35 ps. pulse containing 8μc of charge at 20 MEV. Repetition rate is adjustable from 1 to 800 pps with a $\frac{\Delta E}{E}$ of 1%.

* Ref.

1. W. Gallagher, K. Johnson, G. Mavrogenes, W. Ramler, "A High Current Electron Linac," IEEE Trans. Nuc. Sci. NS-18, 584 (1971)

2. G. Mavrogenes, W. Ramler, W. Wesolowski, K. Johnson, B. Clifft, "Subnanosecond High-Intensity Beam Pulse," IEEE Trans. Nuc. Sci. NS-20, 919 (1973)

ENTRY NO. 40

INJECTOR SYSTEM

TYPE OF SOURCE Triode Electron Gun (ARCO N-12)
OUTPUT, max 30 Amp ~~xx~~, at 135 keV, at Not Measured π mm-mrad
INJECTION PERIOD 13 to 3 x 10^{-3} μsec, ~~xxx~~ Duty Cycle Dependent Hz
HIGH VOLTAGE STAGE N.A.
Output, max - mA, at - keV, at - π mm-mrad
BUNCHER
#1; Potential Single Gap; 20 keV, Drift Length 1.57 m; (216.7 MHz)
#2; Potential 5 T.W. Cavities; 400 keV, Drift Length 0.8 m; (1300 MHz)
#3; Potential 10 T.W. Cavities; 400 keV, Drift Length 0.1 m; (1300 MHz)

ACCELERATION SYSTEM

	I	II	III
TYPE	Buncher	Accelerating W.G.	
BEAM EN. (IN-OUT), MeV	0.135 to 2.0	2-12	
TOTAL LENGTH, m	0.72	0.845	
RADIO FREQUENCY, MHz	1300	1300	
FIELD MODE	2π/3	2π/3	
Q(x 10^3)	Diff. for ea. cavity	19.4	
FILLING TIME, μs	-	0.62	
NO. OF TANKS	1	2	
DIAMETER, cm	21.9	21.9	
DRIFT TUBES, number	-	1	
LENGTH, cm	-	25	
DIAMETER, cm	-	5	
GAP/CELL LENGTH RATIO	-	-	
DISC ~~xxxx~~ APERTURE, cm	Varies	≈3.8	
THICKNESS, cm	1.40	1.40	
SPACING, cm	-	6.403	
GROUP VELOCITY	0.0089 C	0.0052 C	
PHASE VELOCITY	0.6 to 1C	1.0C	
WAVE TYPE	TM_{01}	TM_{01}	
SHUNT IMPEDANCE, MΩ/m	Varies	40	
ATTENUATION, Np/TANK	0.1	0.252	
EQUILIBRIUM PHASE, deg.	-	-	
RF POWER UNITS, type	-	KLY; type L3661	
RF POWER UNITS, number	-	2	
RF POWER DEMAND, peak, MW	5	16 x 2	
RF POWER DEMAND, mean, MW	7.5 x 10^{-3}	24 x 2 x 10^{-3}	
RF POWER RATING, MW/unit	-	20	
RF POWER FEED SPACING, m	-	-	
QUADRUPOLES, number	None	None	
GRADIENT, kG/m	-	-	
SPACING, m	-	-	
OTHER Helmholtz Coils along axis	400G	400G	

ENTRY NO. 41

NAME OF MACHINE LINAC I-2
INSTITUTION ITEP
LOCATION Moscow, USSR
DATE March 1976
IN CHARGE I.M.Kapchinskij
REPORTED BY N.V.Lazarev

HISTORY AND STATUS

DESIGN, date 1959 MODEL tests
ENG. DESIGN, date 1962
CONSTRUCTION, date 1966
FIRST BEAM date (or goal) Nov. 1966
MAJOR ALTERATIONS 1974
OPERATION 168 hr/wk; On Target 160 hr/wk
TIME DIST., in house %, outside %
USERS' SCHEDULING CYCLE 4 - 6 weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS ENGINEERS
TECHNICIANS CRAFTS
ADMIN & CLER TOTAL
GRAD. STUDENTS involved during year
OPERATED BY Res staff or Sp op.
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USER GROUPS, in house outside
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS in ROOMS
STATIONS SERVED AT THE SAME TIME, max.
MAG SPECTROGRAPH, type
ON-LINE COMPUTER, model
TOTAL POWER INSTALLED FOR RESEARCH
FACILITIES for:
Isotope production
Irradiation, Solid State
Biological
Time-of-Flight Study
On-Line Mass Separation
Other

PHYSICAL DIMENSIONS

TUNNEL, length 30 m, X-sec(hXw) X m
ACCELERATOR, length 18 m, dia. 200 cm
BEAM, DIA. 2 cm; ENERGY GAIN 1.37 MeV/m

SOME TYPICAL PRIMARY EXTERNAL AND SECONDARY BEAMS

PARTICLE	FLUX (part./sec)	BEAM AREA (cm^2)	ENERGY (GeV)	ΔE/E (%)
protons	$2.5\cdot10^{13}$	3.5	0.025	±0.5%
protons	$1\cdot10^{13}$	3.5	0.025	±0.15%

OPERATING PROGRAMS, time dist

Basic Nuclear Physics as injector PS 80 %
Solid State Physics %
Bio-Medical Applications %
Isotope Production %
Machine Research 10 %
Other uses beam of the LINAC 10 %
%

SELECTED REFERENCES DESCRIBING MACHINE

Pribory i technika experimenta N5, p.9-70, 1967
Cambridge - 1967 Proceedings p.A1-7, A30-31.
Proc. 1972 Linear Accel. Conf. Los Alamos, p.275

OTHER NOTABLE FEATURES:

Output pulsed current (max) 200 mA
Output beam emittance (non-normalized):
180 mA 60 mm·mrad
135 mA 20 mm·mrad

ENTRY NO. 41

INJECTOR SYSTEM

TYPE OF SOURCE Duoplasmatron
OUTPUT, max 2000 *mA, at* 70 *keV, at* ______ *π mm-mrad*
INJECTION PERIOD 30 *μsec, at* 0.4 - 1 *Hz*
HIGH VOLTAGE STAGE Pulse transformer
Output, max 500 *mA, at* 700 *keV, at* norm. 10 *π mm-mrad*
BUNCHER Single gap cavity
Potential 35 *keV, Drift Length* 0.85 *m*
Potential ______ *keV, Drift Length* ______ *m*

ACCELERATION SYSTEM

	I	II	III
TYPE	Alvarez	Alvarez	
BEAM EN. (IN-OUT), MeV	0.7-6.11	6.11-24.6	
TOTAL LENGTH, m	6	11.7	
RADIO FREQUENCY, MHz	148.5	148.5	
FIELD MODE	E_{010}	E_{010}	
$Q (x\ 10^3)$	60	65	
FILLING TIME, μs			
NO. OF TANKS			
DIAMETER, cm	137	137	
DRIFT TUBES, number	1/2+18+1/2	1/2+33+1/2	
LENGTH, cm	13.7-31.3	19.6-31.4	
DIAMETER, cm	19-15	15	
GAP/CELL LENGTH RATIO	0.2-0.3	0.16-0.3	
IRIS APERTURE, cm	2.0	2.5	
THICKNESS, cm			
SPACING, cm			
GROUP VELOCITY			
PHASE VELOCITY			
WAVE TYPE			
SHUNT IMPEDANCE, MΩ/m	27	31	
ATTENUATION, Np/TANK			
EQUILIBRIUM PHASE, deg.	-37°	-37°	
RF POWER UNITS, type	GI-27A	GI-27A	
RF POWER UNITS, number	1	1	
RF POWER DEMAND, peak, MW	0.9	2.0	
RF POWER DEMAND, mean, MW			
RF POWER RATING, MW/unit			
RF POWER FEED SPACING, m			
QUADRUPOLES, number	38	68	
GRADIENT, kG/m	427-173	205-116	
SPACING, m			
OTHER			

Each drift tube contains 2 lenses of opposite signs. The length of accelerating period is $2\beta\lambda$ in the first cavity and $\beta\lambda$ in the second.

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