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CYCLOTRONS – 1978

Compiled by

John A. Martin

Holifield Heavy Ion Research Facility
Oak Ridge National Laboratory

Eighth International Conference on Cyclotrons and Their Applications
Indiana University, Bloomington, Indiana
September 18-21, 1978

To be published in IEEE Trans. Nucl. Sci. NS-26. No. 2 (1979)

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Eighth International Conference on Cyclotrons and Their Applications
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*Operated by Union Carbide Corporation for the U.S. Department of Energy under contract W-7405-eng-26.

NOTICE

[illegible]

To be published in IEEE Trans. Nucl. Sci. NS-26. No. 2 (1979)

Cyclotrons - 1978

Compiled by John A. Martin

This 1978 compilation of the world's cyclotrons is dedicated to the memory of Dr. F. T. Howard to honor his many years of contribution to accelerator science and technology. Dr. Robert S. Livingston, one of the leaders in the development of the isochronous cyclotron and a friend of Dr. Howard's over a span of three decades wrote the following:

> "On the evening of April 1, 1976, death came quietly to Dr. Frederick Thomas Howard. Culminating a lifetime of productive scientific work, much of it in the accelerator information category, *Cyclotrons - 1975*, prepared for the Seventh International Conference on Cyclotrons, was one of his last accomplishments.
>
> Starting in the mid-1950s, Dr. Howard originated a series of inquiry forms covering various types of accelerators. He proceeded to communicate diligently with the scientists responsible for the many accelerator installations and he succeeded over the years in developing authoritative compilations of characteristics of cyclotrons, synchrotrons, linear accelerators and electrostatic accelerators. Dr. Howard's forms and survey techniques were copied officially and unofficially all over the world. His summaries of isochronous cyclotrons followed that field from its beginning in the early 1960s through the completion of the 1975 survey.
>
> One of Dr. Howard's most ambitious projects was the collection and analysis of the accelerator data contained in the National Academy of Science volume *Perspectives in Physics*, headed by D. Alan Bromley and developed by a large group of scientists in 1969.
>
> Dr. Howard had a consuming interest in the details of accelerators and the patience and persistence to cajole the hundreds of respondents to his intricate information requests to provide consistent and accurate data. He made endless telephone calls to track down seeming inconsistencies or to locate missing pieces of information.
>
> The summaries and varied accelerator data compilations produced by Dr. Howard will remain a fitting tribute and memorial portraying appropriately his love for the big and little machines of science and testifying to his patience, diligence and skill in producing a quarter century record of accelerator high technology."

The cooperation of all who participated in this present survey is sincerely appreciated.

J.A.M.

TABLE OF CONTENTS

Cyclotrons

Location	Description	First Beam	Entry No.
Australia			
Canberra, ANU	26 MeV H^- injector [CNI-22]	Shut down	1[d]
Belgium			
Ghent, INW	24 MeV p etc; 4-sec [CGR-MeV]	1972	2
Louvain-la-Neuve,UCL	95 MeV p etc; 4-sec; [CGR-MeV]	1972	3
Liege, UL	22 MeV p etc; 4-sec [CGR-MeV]	1975	4
Brazil			
Rio de Janeiro,	24 MeV p etc; 3-sec; [CV-28]	1974	5[a]
Sao Paulo, IEA	24 MeV p etc; 3-sec; [CV-28]	(1979)	6
Canada			
Chalk River	Heavy i; K=500; 4-sec supercond.	(1981)	7
Vancouver, TRIUMF	520 MeV H^-; 6-sec; Meson Factory	1974	8
Winnipeg, UM	50 MeV $H^{\pm}$; 4-sec	1965	9
Czechoslovakia			
Prague	41 MeV p etc; 3-sec; U-120 M	1976	10
Chile			
Santiago, UC	10 MeV p etc; 3-sec; Davis Conv	1967	11[a]
Finland			
Åbo, AÅA	19 MeV p etc; 3-sec [MGC]	1974	12
Jyväskylä, UJ	20 MeV p etc; 4-sec; MC-20	1974	13
France			
Caen, GANIL	Heavy i, 2xK=400; sep sec 4x51°	(1982)	14
Grenoble, ISN	60 MeV p, etc; 4-sec [CGR-MeV]	1968	15
Grenoble, ISN	Heavy i; K=240; sep sec 4x48°	(1980)	16
Orleans, CNRS	33 MeV p etc; 4-sec [CGR-MeV]	1974	17
Orsay, AEC-Biol	24 MeV p etc; 4-sec [CGR-MeV]	1975	18
Orsay, IPN	Heavy i; K=75; 3-sec; ALICE-CEVIL	1965	19
Saclay, CEN	20 MeV $^3He^{++}$; 3-sec [Philips]	Shut down - 1975	20[d]

[a] Listing from previous surveys; no new data sheet.
[b] Listing from The Cyclotron Corporation, no data sheet.
[c] Listing based on literature; no data sheet.
[d] Shut down; no data sheet.

Cyclotrons (continued)

Location	Description	First Beam	Entry No.
Germany, West			
Berlin, HMIKB	Heavy i, etc.; K=128; VICKSI	1977	21
Bonn, UB	30 MeV d etc; 3-sec	1968	22
Braunschweig, PTB	24 MeV p etc; 3-sec [CV-28]	1974	23
Essen, KGE	24 MeV p etc; 3-sec [CV-28]	1975	24
Hamburg, UH	30 MeV p etc; 3-sec; HAIZY	1968	25[a]
Hannover Medical Hochschule	30 MeV p etc; 3-sec [MC-30]	1975	26[c]
Heidelberg, INM	22 MeV p etc; 3-sec [AEG compact]	1972	27
Jülich, IFK-KFA	90 MeV d etc; 3-sec; JULIC	1968	28
Jülich, IFF-KFA	24 MeV p etc; 3-sec [CV-28]	1975	29
Karlsruhe, KFK	52 MeV d etc; 3-sec [AEG]	1962	30
Munich	22 MeV p etc; 3-sec [AEG compact]	1973	31
India			
Calcutta, BARC	60 MeV d etc; 3-sec	1977	32
Chandigahr, Panjab U	5 MeV p; classical	1971	33
Italy			
Milan, UM	45 MeV $H^{\pm}$; 3-sec	1965	34
Japan			
Chiba, NIRS	70 MeV p etc; 4-sec; [CGR-MeV]	1973	35
Hyogo, Medi-Physics	26 MeV p etc; 3-sec [CS-30]	1974	36
Osaka, RCNP	75 MeV p etc; 3-sec	1974	37
Sendai, TU	40 MeV p etc; 4-sec; [CGR-MeV]	1977	38
Tokyo, IMS	26 MeV p etc; 3-sec; [CS-30]	1973	39
Tokyo, INS	70 MeV α etc; 3-sec	1974	40
Netherlands			
Amsterdam, VU	30 MeV p etc; 3-sec [Philips]	1965	41
Delft, TUD	12 MeV p; 4-sec (1st AVF)	1957	42
Eindhoven, EUT	30 MeV p etc; 3-sec [Philips]	1963	43
Groningen, UG	140 MeV α etc; 3-sec [Philips]	1970	44
Petten, Philips	30 MeV p etc; 3-sec; [Philips]	1964	45
Poland			
Warsaw, IEP	Heavy i, K = 180; 4 sec	-	46[c]
South Africa			
Pretoria, CSIR	17 MeV d etc; 3-sec	1958	47
Stellenbosch, NAC	(200) MeV p etc; sep sec 4x34°	(1983)	48
Stellenbosch, NAC	(8) MeV p etc; 4-sec; spec. inj.	(1984)	49
Saudi Arabia			
Riyadh, King Faisal Research Center	26 MeV p etc.; 3-sec [CS-30]	(1979)	50[b]

Cyclotrons (continued

Location	Description	First Beam	Entry No.
Sweden			
Stockholm, RIP	30 MeV d etc; classical	1951	51
Uppsala, AB Scand.	40 MeV p etc; 4-sec [MC-40]	1976	52
Switzerland			
Villigen, SIN	72 MeV p etc; inj; 4-sec	1973	53
Villigen, SIN	72 MeV p; sep sec 4x28°; injector II	(1982)	54
Villigen, SIN	590 MeV p; 8-sec; Meson Factory	1974	55
United Kingdom			
Amersham, RCL	27 MeV p etc; 3-sec	1965	56
Birmingham, UB	24 MeV α etc; 3-sec	1961	57
Edinburgh, MRC-WGH	15 MeV d; 3-sec [CS-30]	1976	58
Harwell, AERE	50 MeV p etc; 3-sec	1965	59
United States			
Argonne	22 MeV d etc; classical	1952	60
Brookhaven	36 MeV p etc; 3-sec	1968	61
Duke U, TUNL	15 MeV H^- inj; 3-sec [CNI-15]	1968	62
Indiana U, IUCF	200 MeV p etc; sep sec 4x36°	1975	63
Medi-Physics, CA	22 MeV p etc; 3-sec [CS-22]	1970	64
Medi-Physics, NJ	22 MeV p etc; 3-sec [CS-22]	1973	65
Michigan SU	56 MeV p etc; 3-sec	1965	66
Michigan SU	Heavy i; K=500; 3-sec supercond.	(1979)	67
Mt. Sinai Med. C.	27 MeV p etc; 3-sec [CS-30]	1972	68
NASA-Lewis	46 MeV p; 3-sec	1972	69
Naval Res Lab	50 MeV p etc; 3-sec	1967	70
New Eng Nuc	22 MeV p etc; 3-sec [CS-22]	1970	71
New Eng Nuc	26 MeV p etc; 3-sec [CS-30]	1976	72
New Eng Nuc	26 MeV p etc; 3-sec [CS-30]	1978	73
New Eng Nuc	26 MeV p etc; 3-sec [CS-30]	(1980)	74
Oak Ridge, ORNL	67 MeV p etc; 3-sec; ORIC	1962	75
Princeton U	50 MeV p etc; 3-sec	1968	76
Sloan-Kettering	15 MeV p etc; [CS-15]	1967	77[a]
Texas A&M	50 MeV p etc; 3-sec; TAMVEC	1967	78
UC-Berkeley	60 MeV p etc; 3-sec	1961	79
UC-Davis	65 MeV p etc; 3-sec	1966	80
UC-Livermore	15 MeV H^- inj; 3-sec [CNI-15]	1969	81
UCLA-Med	22 MeV p etc; 3-sec [CS-22]	1971	82
U Chicago, Med	15 MeV p etc; 3-sec [CS-15]	1969	83[a]
U Colorado	28 MeV p etc; 4-sec	1962	84
U Maryland	100 MeV p etc; 4-sec	1970	85
U Michigan	30 MeV p etc; 3-sec	Shut down 1977	86[d]
U Washington	21 MeV d etc; classical	1951	87
Washington U	30 MeV α etc; 3-sec	1965	88
Washington U	15 MeV p etc; 3-sec [CS-15]	1978	89

Cyclotrons (continued)

Location	Description	First Beam	Entry No.
USSR			
Alma Ata	30 MeV d etc; 3-sec	1971	90[a]
Dubna, LNP-JINR	e-model 400 keV; 8-sec	1967	91
Dubna, LNR-JINR	Heavy i; U-200	1968	92[a]
Dubna, LNR-JINR *	Heavy i; U-300	1960	93[a] *
Moscow, Kurchatov I	30 MeV d etc; 3-sec	-	94[c]
Kiev, INR	100 MeV p etc; 3-sec	1976	95

Frequency Modulated Cyclotrons

Argentina			
Buenos Aires	28 MeV d; standard FM	1954	FM-1
Canada			
Montreal, McGill	100 MeV p; standard FM	1949	FM-2
CERN			
Geneva	600 MeV p etc.; modified 1973/1974	1957	FM-3
France			
Lyon, UCB	28 MeV d; standard FM	1963	FM-4
Orsay, IPN	200 MeV p etc; modified 1975/1977	1958(77)	FM-5
Germany			
Goettingen, UG	28 MeV d; standard FM	1962	FM-6
Sweden			
Uppsala, GWI	200 MeV p; major modifications 1977	1951	FM-7
United Kingdom			
Harwell, AERE	160 p etc; new RF 1969	1949	FM-8
USA			
Columbia U**	570 MeV p; 3-sec FM Conv 1970/1975	1950(75)	FM-9**
Harvard U	160 MeV p; standard FM	1949	FM-10
NASA-SREL**	300/600 MeV p; std FM; mods. 1972	1965	FM-11**
UC-Berkeley	740 MeV p etc; std FM; mods. 1955/1957	1946/57	FM-12
USSR			
Dubna, JINR	700 MeV p; 4-sec FM Conv 1979/1980	1949/(80)	FM-13
Gatchina, PTI	1000 MeV p; standard FM	1967	FM-14[c]

*Being converted to U-400, K = 625; operation expected 1979.

**Shut down 1978.

ENTRY NO. 2

NAME OF MACHINE Ghent University isochronous cyclotron DATE 15.1.1979

INSTITUTION Institute for Nuclear Sciences, Rijksuniversiteit Gent

ADDRESS Proeftuinstraat 86, B-9000 Gent, Belgium

IN CHARGE J.Hoste ; C. Vandecasteele REPORTED by C. Vandecasteele

HISTORY AND STATUS

DESIGN, date 1974 MODEL tests

ENG. DESIGN, date 1975

CONSTRUCTION, date 1976-77

FIRST BEAM date (or goal) 17 June 1977

MAJOR ALTERATIONS

OPERATION, 40 hr/wk; On Target 30 hr/wk

TIME DIST., in house %, outside %

USERS' SCHEDULING CYCLE weeks

COST, ACCELERATOR

COST, FACILITY, total

FUNDED BY NFWO a) and University

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1

TECHNICIANS 2 CRAFTS 1

GRAD STUDENTS involved during year

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY IIKW b) and University

RESEARCH STAFF, not included above

USERS, in house 10 outside

GRAD STUDENTS involved during year 2

RES. BUDGET, in house

FUNDED BY IIKW

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 85 m^2

movable m^2

TARGET STATIONS 3 in 3 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type

COMPUTER, model

OTHER FACILITIES Hot chemistry laborat., measuring room with 2 Ge(Li)detect. + IN-90 γ-spectrometer, pneumatic transfer system for activation analysis, PIXE set-up

REFERENCES/NOTES

a) Nationaal Fonds voor Wetenschappelijk Onderzoek

b) Interuniversitair Instituut voor Kernwetenschappen

c) max = 150 000 ampere turns

d) without gas supply : 1 μ Torr

MAGNET

POLE FACE diameter 120 cm; R extraction 52.5 cm

GAP, min 8.6 cm; Field 17.5 kG
max 14 cm; Field 11.0 kG
AVERAGE FIELD at R ext 14.8 kG
} at 150 X 10^6 ampere turns c)

CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$ 1.18

NUMBER OF SECTORS 4 ; SPIRAL, max 34 deg

POLE FACE COIL PAIRS: AVF /sec;

Harmonic correction 4 coils

Rad grad /sec or Circ coils 7

WEIGHT: Fe 28 tons; Coils tons

CONDUCTOR, Material and type Cu

STORED ENERGY MJ

COOLING SYSTEM demineralised water

POWER: Main coils 65 max, kW

Trimming coils 10 max, kW

YOKE/POLE AREA %

SECTOR ANGLE (Sep Sec) deg

ION ENERGY (Bending limit) E/A = 29 q^2/A^2 MeV

(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 50 deg

BEAM APERTURE 2.5 cm; DC BIAS kV

TUNED by, coarse piston fine panel

RF 20 to 41 mHz, stable ± 1 /10^6

Orb F 5.1 to 20.2 mHz; GAIN, max 100 kV/turn

HARMONICS, RF/Orb F used 2 - 3 - 4

DEE-Gnd, max 30 kV, min gap 2 cm

STABILITY, (pk-pk noise)/(pk RF volt) $5\ 10^{-4}$

RF PHASE stable to ± 0.2 deg

RF POWER input, max 30 kW

RF PROTECT circuit, speed μsec

Type

FREQUENCY MODULATION, rate /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size Balzers BP 800 011
PF 7310 DIF 320 3000 l/s

OPERATING PRESSURE 20 μTorr d)

PUMPDOWN TIME 2.5 hrs

ION SOURCES/INJECTION SYSTEM

Livingston-Jones ; axial

EXTRACTION SYSTEM

Electrostatic deflector; V_{max} = 50 kV

CONTROL SYSTEM

conventional

typing limit

ENTRY NO. 2 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	6-21	2.5-24
	d	3-13.5	3-14.5
	^{3}He	6-31	6-32
	α	10-27	10-29
CURRENT		(μA)	(μA)
Internal			
External	p	50	100
	d	70	100
	^{3}He	30	60
	α	50 (part/s)	60 (part/s)
Secondary			

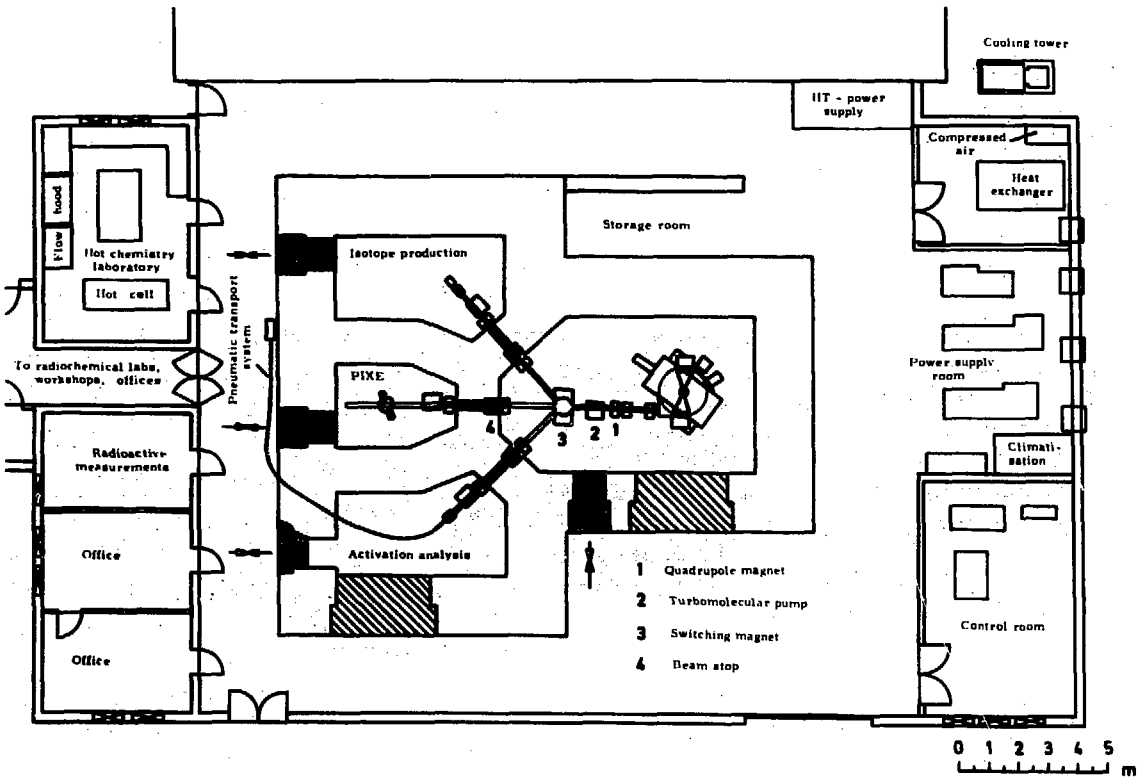
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	60-70 %	25 μA of 7 MeV d
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	25 %
Development	%
Activation analysis	50 %
PIXE	25 %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

ENTRY NO. 3

NAME OF MACHINE CYCLONE DATE JAN 79

INSTITUTION Université Catholique de Louvain

ADDRESS Chemin du Cyclotron, 2 - B - 1348 LOUVAIN-LA-NEUVE, Belgium

IN CHARGE Y. JONGEN, C. PIRART, G. RYCKEWAERT REPORTED by C. PIRART

HISTORY AND STATUS

DESIGN, date 1969 MODEL tests 1969

ENG. DESIGN, date 1968-1969

CONSTRUCTION, date 1969-1971

FIRST BEAM date (or goal) 1972

MAJOR ALTERATIONS -

OPERATION, 168 hr/wk; On Target 140 hr/wk

TIME DIST., in house ___ %, outside ___ %

USERS' SCHEDULING CYCLE 8 weeks

COST, ACCELERATOR 3 10^6 $

COST, FACILITY, total 6.5 10^6 $

FUNDED BY University of Louvain, State

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS - ENGINEERS 3

TECHNICIANS 9 CRAFTS 3

GRAD STUDENTS involved during year -

OPERATED BY ___ Res staff or 4 Operators

BUDGET, op & dev 900.000 $ with salaries

FUNDED BY I.I.S.N., U.C.L.

RESEARCH STAFF, *not included above*

USERS, in house 38 outside 45

GRAD STUDENTS involved during year 10

RES. BUDGET, in house 450.000 $ without salaries

FUNDED BY I.I.S.N., U.C.L.

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 390 m^2

movable 1300 m^2

TARGET STATIONS 14 in 8 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type -

COMPUTER, model PDP 8-9-11/20-11/34

OTHER FACILITIES remote target handling - hot chemistry - neutron beam (radiotherapy-biology) - neutron beam (polarized-unpolarized) - On-Line-Mass Separators (LISOL) - External ECR Ion Source (Atomic beam) (1979)

REFERENCES/NOTES

MAGNET

POLE FACE diameter 215.6 cm; R extraction 9.3 cm

GAP, min 16.6 cm; Field 21 kG
max 40.5 cm; Field 11.5 kG
AVERAGE FIELD at R ext 16 kG
} at .4 X 10^6 ampere turns

CURRENT STABILITY ± 20 parts/10^6; $B_{max}/\langle B\rangle$ 1.25

NUMBER OF SECTORS 4 ; SPIRAL, max 53 deg

POLE FACE COIL PAIRS: AVF - /sec;

Harmonic correction 2 x 4 pairs

Rad grad ___ /sec or Circ coils 12

WEIGHT: Fe 200 tons; Coils 6 tons

CONDUCTOR, Material and type Cu (20x20 ϕ 13 mm)

STORED ENERGY ___ MJ

COOLING SYSTEM desionized water

POWER: Main coils 300 max, kW

Trimming coils 100 max, kW

YOKE/POLE AREA 115 %

SECTOR ANGLE (Sep Sec) ___ deg

ION ENERGY (Bending limit) E/A = 110 q^2/A^2 MeV

(Focusing limit) E/A = 93 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 86 deg

BEAM APERTURE 38 cm; DC BIAS 0 kV

TUNED by, coarse MP fine MP auto

RF 10.6 to 23 mHz, stable ± 0.1 /10^6

Orb F 3.6 to 23 mHz; GAIN, max 200 kV/turn

HARMONICS, RF/Orb F, used 1-2-3

DEE-Gnd, max 50 kV, min gap 0.4 cm

STABILITY, (pk-pk noise)/(pk RF volt) 10^{-4}

RF PHASE stable to ± 0.1 deg

RF POWER input, max 240 kW

RF PROTECT circuit, speed 4 μsec

Type crowbar

FREQUENCY MODULATION, rate - /sec

MODULATOR, type -

BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 2x (OIL diff. 12000 l/s) 1 cryopanel 10000 l/s 15°K

OPERATING PRESSURE 2 μTorr,

PUMPDOWN TIME 4 hrs

ION SOURCES/INJECTION SYSTEM

Livingston-Jones-Internal Hot Cathode Pig External ECR Source (1979)

EXTRACTION SYSTEM

DC electrostatic + Weak Magn. Chan. +

CONTROL SYSTEM Positive grad corr.

Manual

typing limit

ENTRY NO. 3 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	80	95
	α	80	110
	Heavy Ions		110 Q^2/A
CURRENT		(μA)	(μA)
Internal	p	100	> 2000
	α	20	> 200
External	p 40 MeV	20	50
	d 50 MeV	20	66
	α 60 MeV	20	45
	Ar^{8+} (Pig)		100 en A
		(part/s)	(part/s)
Secondary	n		10^{14}
	from d+Be 50 MeV		

BEAM PROPERTIES

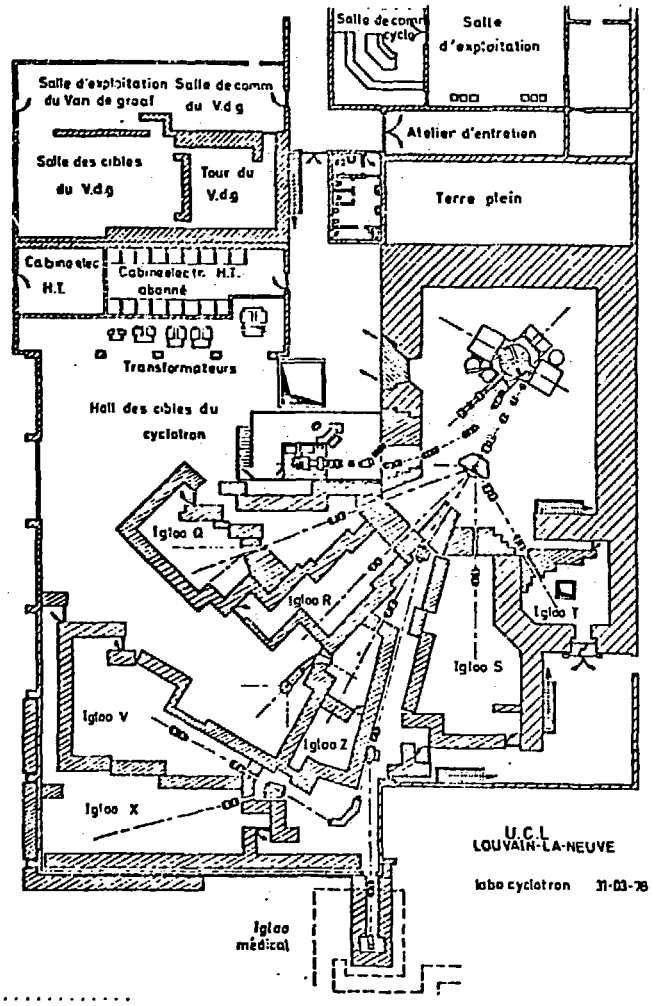
	Measured		Conditions			
Pulse Width	10/30	RF deg	20	μA of	33	MeV d
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	95	%	20	μA of	50	MeV d
Res, ΔE/E	.3	%	1	μA of	40	MeV α
Emittance (mm-mrad)	30 axial / 70 radial		50	μA of	50	MeV d

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	51	%
Solid State Physics	–	%
Bio-Medical Applications	20	%
Isotope Production	10	%
Development	7.5	%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

An external Electron Cyclotron Resonance (ECR) Ion Source is under construction : it will provide heavy ions beams up to ^{84}Kr ; fully stripped ions up to ^{16}O and ions like $^{40}A^{14+}$ could be accelerated.



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ENTRY NO. 4

NAME OF MACHINE AVF Cyclotron - CGR-MeV 520 DATE 20.7.78
INSTITUTION Université de Liège - Bât B30 - Sart Tilman
ADDRESS 4000 LIEGE - Belgique

IN CHARGE L. WINAND - D. LAMOTTE REPORTED by D. LAMOTTE

HISTORY AND STATUS

DESIGN, date 1972 MODEL tests 1973
ENG. DESIGN, date 1973
CONSTRUCTION, date 1973-1975
FIRST BEAM date (or goal) 21.3.1975
MAJOR ALTERATIONS

OPERATION, 40 hr/wk; On Target 30 hr/wk
TIME DIST., in house %, outside %
USERS' SCHEDULING CYCLE weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY Government and University

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS 1
GRAD STUDENTS involved during year 2
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY University

RESEARCH STAFF, not included above

USERS, in house 10 outside 10
GRAD STUDENTS involved during year 3
RES. BUDGET, in house
FUNDED BY IISN-FNRS-FRSM-UNIVERSITY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 680 m^2
movable - m^2
TARGET STATIONS 8 in 5 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model NORD 10S
OTHER FACILITIES hot chemistry, biological and medical laboratories, workshops, animal house.

REFERENCES/NOTES

MAGNET

POLE FACE diameter 120 cm; R extraction 52.5 cm
GAP, min 8.6 cm; Field 17.0 kG
max 14.0 cm; Field 10.6 kG
AVERAGE FIELD at R ext 14.0 kG
} at .136 x 10^6 ampere turns
CURRENT STABILITY ± 20 parts/10^6; $B_{max}/\langle B\rangle$ 1.20
NUMBER OF SECTORS 4 ; SPIRAL, max 34 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 4 coils
Rad grad /sec or Circ coils 7
WEIGHT: Fe 29 tons; Coils tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM demineralized water
POWER: Main coils 60 max, kW
Trimming coils 10 max, kW
YOKE/POLE AREA 48 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 26.7 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 50 deg
BEAM APERTURE 2.5 cm; DC BIAS kV
TUNED by, coarse s.c.piston fine panel
RF 19.5 to 40.5 mHz, stable ± 1 /10^6
Orb F 4.9 to 20.2 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 2-3-4
DEE-Gnd, max 35 kV, min gap .25 cm
STABILITY, (pk-pk noise)/(pk RF volt) .002
RF PHASE stable to ± .1 deg
RF POWER input, max 25 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size diffusion Balzers 3200l /sec, DA 60 m^3/h
OPERATING PRESSURE 1 μTorr,
PUMPDOWN TIME 2.5 hrs

ION SOURCES/INJECTION SYSTEM

Livingston-Jones; axial

EXTRACTION SYSTEM

Electrostatic deflector, passive corrector

CONTROL SYSTEM

in progress

typing limit

ENTRY NO. 4 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	6-20	3-22
	d	3-11.5	3-13.5
	^{3}He	6-29	6-30
CURRENT		(μA)	(μA)
Internal	p	300	
	d	200	
External	p	70	100
	d	70	100
	^{4}He	50	60
		(part/s)	(part/s)
Secondary			

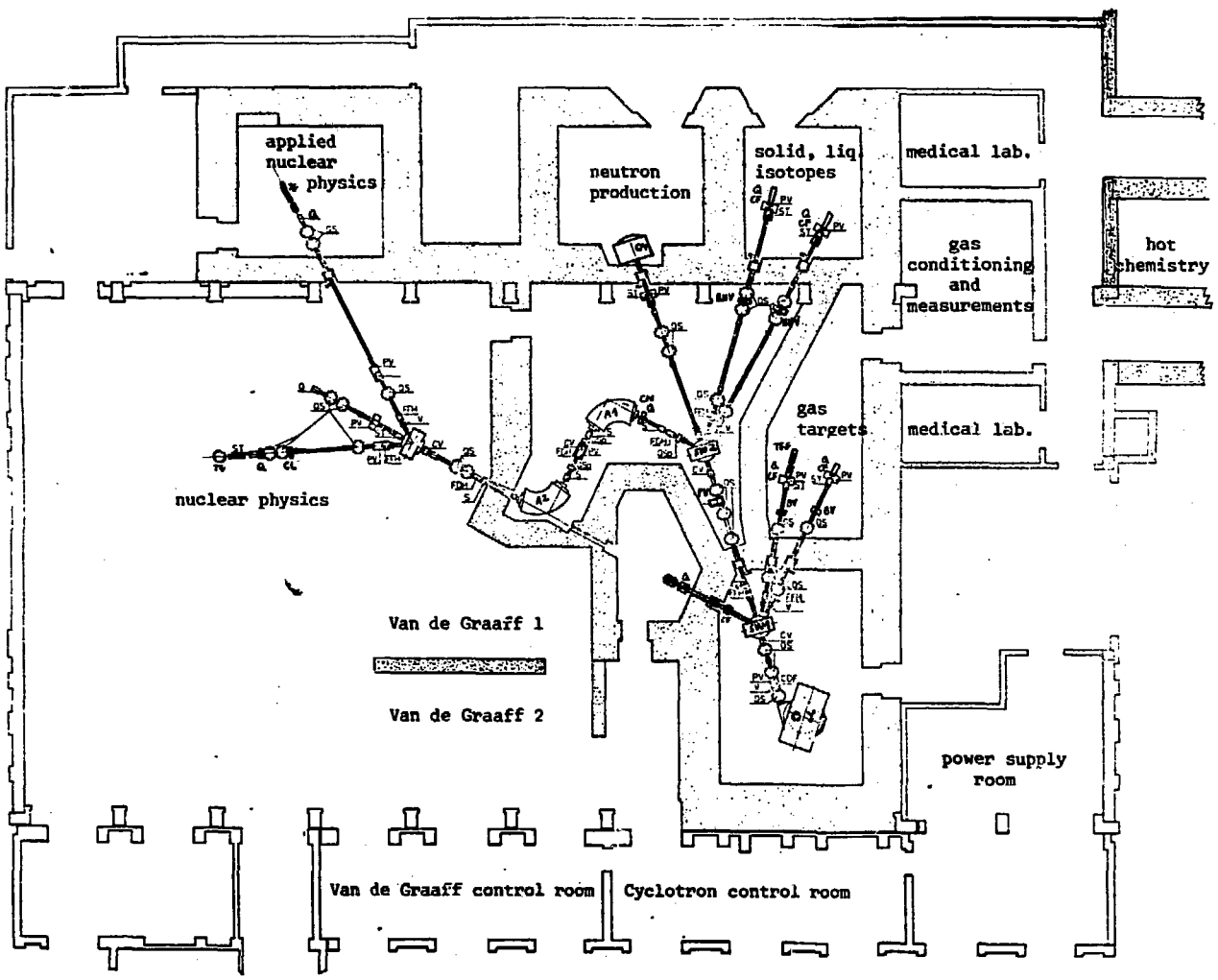
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	60-70 %	30 μA of 10 MeV d
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

ENTRY NO. 5

NAME OF MACHINE Ciclotron de Energia Variável
INSTITUTION Instituto de Engenharia Nuclear
LOCATION C.Universitária - I. do Fundão BRASIL DATE 5.5.75
IN CHARGE _____ REPORTED by Arthur Gerbasi da Silva

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date Cyclotron Corp. CV-28
CONSTRUCTION, date '71 - '74
FIRST BEAM date (or goal) Dec. '74
MAJOR ALTERATIONS None
OPERATION, _____ hr/wk; On Target _____ hr/wk
TIME DIST., in house _____ %, outside _____ %
USERS' SCHEDULING CYCLE _____ weeks
COST, ACCELERATOR US$ 500,000
COST, FACILITY, total US$ 1 200,000
FUNDED BY CNEN - Brazil

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2
TECHNICIANS 3 CRAFTS _____
ADMIN & CLER 1 TOTAL 7
GRAD. STUDENTS involved during year _____
OPERATED BY ✓ Res staff or ✓ Sp operators
BUDGET, op & dev _____
FUNDED BY CNEN - Brazil

RESEARCH STAFF, not included above

USER GROUPS, in house 2 outside _____
STAFF SCIENTISTS, in house 6 outside _____
TOTAL RES STAFF, in house 4 outside _____
GRAD STUDENTS involved during year 2
RES. BUDGET, in house _____
FUNDED BY CNEN - Brazil

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 50 m^2
movable 25 m^2
TARGET STATIONS 1 in 1 ROOMS
STATIONS SERVED AT THE SAME TIME, max 1
MAG SPECTROGRAPH, type ---
ON-LINE COMPUTER, model ---
FACILITIES for:
Isotope production in preparation
Irradiation, Solid State ---
Biological ---
Time-of-Flight Study ---
On-Line Mass Separation ---

NOTATIONS

MAGNET

POLE FACE dia 96 cm; R ext 42 cm
GAP, min 5.6 cm; Field 21 kG
max _____ cm; Field 14.5 kG } at _____ x 10^6 A·turns
AVE FIELD at R max 18.5 kG
CURRENT, STABILITY ± 10 parts/10^6
B max/<B> = _____
AVF SECTORS 3 SPIRAL, max 50 deg
POLE FACE coil pairs, AVF _____ /sec
Harmonic _____ /sec; Rad Grad _____ /sec, or
_____ circular; HEAVY ION, Ξ max = 28 q^2/A
WEIGHT, Fe 23 ton, Cu, or Al _____ tons
POWER, main coils 60 kw, pole tips 7
total 67 kW; cooled by water
YOKE/POLE area _____ %; θ sec (Sect Mag) _____ deg
TOTAL POWER, installed 0.9 MW
normal load _____ MW

ION SOURCE, int PIG
ext _____

ACCELERATION SYSTEM

DEES, number 2, width 90 deg
BEAM APERTURE 2 cm; DC BIAS 2.5 kV
TUNED by, coarse MSP, fine V.C.
RF 6.0 to 25.5 MHz, stable ± 40 /10^6
Orb F _____ to _____ Mc/s; GAIN (max) 100 kV/t
HARMONICS, RF/OF, used _____
DEE-Gnd, max _____ kV, x/field, min _____ cm,
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max 75 kW
RF PROTECT curcuit, speed 5 μs
type Series Mod. Tube
EXTRACT System electrostatic, mag. channel

FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____ nsec
FM only

SELECTED REFERENCES

Typing limit

ENTRY NO.5 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	24	24
	d	14	14
	α	28	28
CURRENT		(μA)	(μA)
Internal	p		
	d		145
	α		87
External	p	70	8.4
	d	100	100
	α	55	55
		(part/s)	(part/s)
Secondary			
HEAVIEST ion			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width		RF deg		μA of		MeV	
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	82	%	6.6	μA of	19	MeV	p
Res, ΔE/E		%		μA of		MeV	
Emittance (mm·mrad)	axial / radial			μA of		MeV	

VACUUM norm 50 μtorr; PUMPDOWN time 1 hr

OPERATING PROGRAMS, time dist

Basic Nuclear Physics/Chemistry	some	%
Solid State Physics		%
Bio-Medical Applications		%
Isotope Production	some	%
Materials Science		%
Test	100	%

OTHER FEATURES and OPERATION SUMMARY

Typing limit

ENTRY NO. 6

NAME OF MACHINE IEA Isochronons, Variable Energy Cyclotron DATE 1/5/79
INSTITUTION Instituto de Energia Atômica
ADDRESS C.P. - 11.049 - Pinheiros CEP-05508 - SÃO PAULO - BRASIL

IN CHARGE Prof. Dr. R.R. Pieroni REPORTED by Dr. G. Lucki

HISTORY AND STATUS

DESIGN, date before 70 MODEL tests July 1977
ENG. DESIGN, date 1971
CONSTRUCTION, date 1976 - 1977
FIRST BEAM date (or goal) Sept. 1979 (goal)
MAJOR ALTERATIONS none

OPERATION, 40(*) hr/wk; On Target 20-30(*) hr/wk
TIME DIST., in house 100 %, outside ___ %
USERS' SCHEDULING CYCLE 12 weeks
COST, ACCELERATOR $ 1.1 x 10^6
COST, FACILITY, total $ 2.0 x 10^6
FUNDED BY São Paulo State Government Brasil

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 2
TECHNICIANS 4 CRAFTS -
GRAD STUDENTS involved during year ___
OPERATED BY ___ Res staff or 2 Operators
BUDGET, op & dev ___
FUNDED BY São Paulo State Government Brasil

RESEARCH STAFF, not included above

USERS, in house 8 outside -
GRAD STUDENTS involved during year 2 - 4
RES. BUDGET, in house ___
FUNDED BY São Paulo State Government Brasil

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 84 m^2
movable 158 m^2
TARGET STATIONS 3 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type ___
COMPUTER, model ___
OTHER FACILITIES 1 Sample holder for radioisotope production - In project stage: 1 irradiation device for Radiation Damage Studies in Metals and Alloys.

REFERENCES/NOTES

(=) - programmed operation time

MAGNET

POLE FACE diameter 96 cm; R extraction 42 cm
GAP, min 5.6 cm; Field 21 kG } at ___ X 10^6 ampere turns
max ___ cm; Field ___ kG
AVERAGE FIELD at R ext 18.5 kG
CURRENT STABILITY 10 parts/10^6; $B_{mean}/(B)$ ___
NUMBER OF SECTORS 3 ; SPIRAL, max 50 deg
POLE FACE COIL PAIRS: AVF ___ /sec;
Harmonic correction 3
Rad grad 120 /sec or Circ coils ___
WEIGHT: Fe 23 tons; Coils 1.14 tons
CONDUCTOR, Material and type Cu
STORED ENERGY ___ MJ
COOLING SYSTEM Demineralized Water
POWER: Main coils 60 max, kW
Trimming coils ___ max, kW
YOKE/POLE AREA ___ %
SECTOR ANGLE (Sep Sec) ___ deg
ION ENERGY (Bending limit) E/A = ___ q^2/A^2 MeV
(Focusing limit) E/A = ___ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg
BEAM APERTURE 2 cm; DC BIAS 2.5 kV
TUNED by, coarse MSP fine V C
RF 6.0 to 25.5 mHz, stable ± 40 /10^6
Orb F ___ to ___ mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used ___
DEE-Gnd, max ___ kV, min gap ___ cm
STABILITY, (pk-pk noise)/(pk RF volt) ___
RF PHASE stable to ± ___ deg
RF POWER input, max 75 kW
RF PROTECT circuit, speed 5 μsec
Type Series Mod. Tube
FREQUENCY MODULATION, rate ___ /sec
MODULATOR, type ___
BEAM PULSE, width ___

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Diff. Pumps

OPERATING PRESSURE 50 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM

Electrostatic Injector

EXTRACTION SYSTEM

Electrostatic Deflector + electrostatic channel

CONTROL SYSTEM

typing limit

ENTRY NO. 6 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	protons	24	
	deuterons	14	
	He_3^{++}	36	
	He_4^{++}	28	
CURRENT		(μA)	(μA)
Internal			
External	protons	60	
	deuterons	100	
	He_3^{++}	50	
	He_4^{++}	40	
		(part/s)	(part/s)
Secondary			

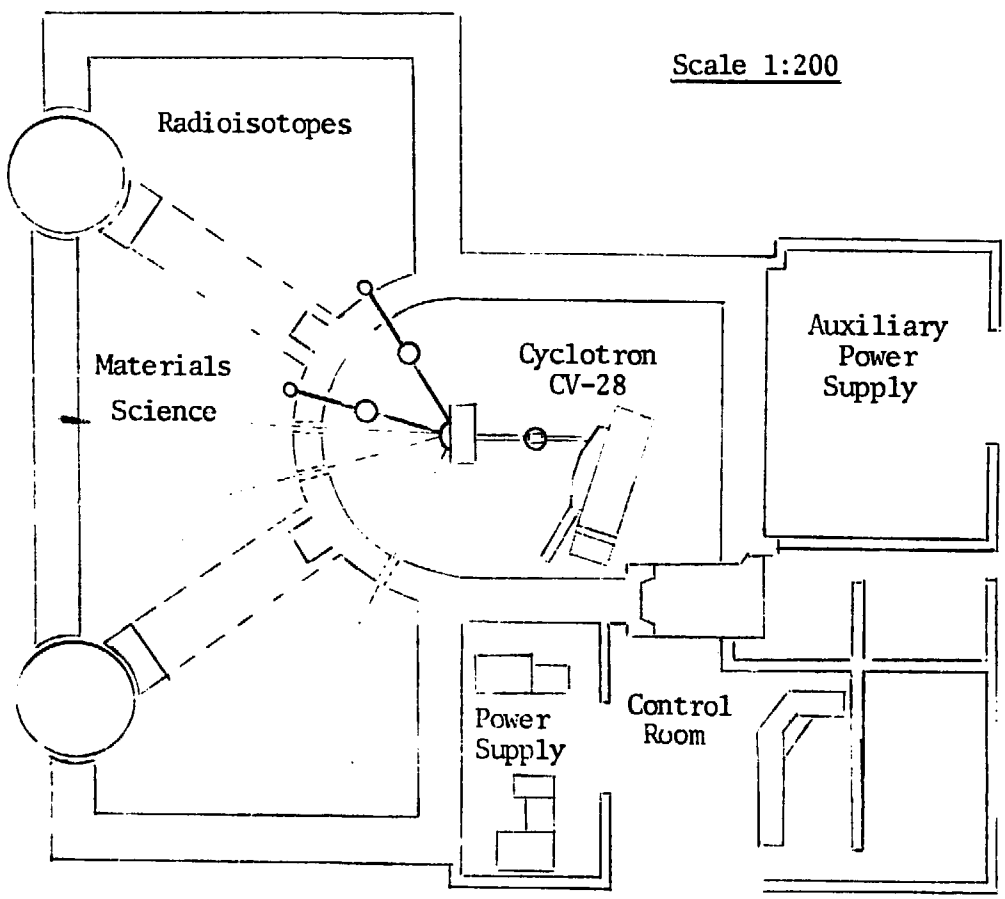
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	10 %
Solid State Physics	-- %
Bio-Medical Applications	-- %
Isotope Production	40 %
Development	10 %
Materials Science	40 %
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



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ENTRY NO. 7

NAME OF MACHINE Chalk River Superconducting Cyclotron DATE 1978 Aug 15

INSTITUTION Atomic Energy of Canada Limited

ADDRESS CHALK RIVER, Ontario

IN CHARGE J.H. Ormrod REPORTED by J.H. Ormrod

HISTORY AND STATUS

DESIGN, date 1973 MODEL tests 1974-78

ENG. DESIGN, date 1974-77

CONSTRUCTION, date 1978 (Magnet & RF structure)

FIRST BEAM date (or goal) 1981

MAJOR ALTERATIONS

OPERATION, hr/wk; On Target hr/wk

TIME DIST., in house %, outside %

USERS' SCHEDULING CYCLE weeks

COST, ACCELERATOR $2.4 M

COST, FACILITY, total

FUNDED BY

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS and ENGINEERS 7

TECHNICIANS 5 CRAFTS

GRAD STUDENTS involved during year

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside

GRAD STUDENTS involved during year

RES. BUDGET, in house

FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2

movable m^2

TARGET STATIONS in rooms

STATIONS served at same time, max

MAG SPECTROGRAPH, type

COMPUTER, model

OTHER FACILITIES

REFERENCES/NOTES

J.H. Ormrod et al (these Proceedings)

MAGNET

POLE FACE diameter 138.6 cm; R extraction 65 cm

GAP, min 4 cm; Field 60 kG } at 5 X 10^6 ampere turns

max 64 cm; Field 43 kG

AVERAGE FIELD at R ext 50 kG

CURRENT STABILITY 10 parts/10^6; B_{max}/(B 1.2-1.7

NUMBER OF SECTORS 4 ; SPIRAL, max 50 deg

POLE FACE COIL PAIRS: AVF /sec;

Harmonic correction

Rad grad /sec or Circ coils

WEIGHT: Fe 170 tons; Coils 10 tons

CONDUCTOR, Material and type Nb Ti

STORED ENERGY ∿25 MJ

COOLING SYSTEM Liquid helium

POWER: Main coils max, kW

Trimming coils max, kW

YOKE/POLE AREA %

SECTOR ANGLE (Sep Sec) deg

ION ENERGY (Bending limit) E/A = 520 q^2/A^2 MeV

(Focusing limit) E/A = 100 q/A MeV

ACCELERATION SYSTEM

DEES, number 4 angle ∿40 deg

BEAM APERTURE 3.2 cm; DC BIAS kV

TUNED by, coarse fine

RF 31 to 62 mHz, stable ± 1 /10^6

Orb F 5.9 to 23.4 mHz; GAIN, max 800 Q kV/turn

HARMONICS, RF/Orb F, used 2, 4, 6

DEE-Gnd, max 100 kV, min gap 3 cm

STABILITY, (pk-pk noise)/(pk RF volt) 1:10^4

RF PHASE stable to ± deg

RF POWER input, max 100 kW

RF PROTECT circuit, speed μsec

Type

FREQUENCY MODULATION, rate /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 2 cryo panels

OPERATING PRESSURE 0.5 μTorr,

PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

13 mV Tandem Van de Graaff

EXTRACTION SYSTEM

Orbit perturbation, electrostatic

CONTROL SYSTEM deflector, magnetic channel

typing limit

ENTRY NO. 7 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	C^{12}	600	
	U^{238}	2380	
CURRENT		(μA)	(μA)
Internal			
External	C^{12}	.200	
	U^{238}	.004	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	____	RF deg	____ μA of	____ MeV	____
Phase Exc, max	____	RF deg	____ μA of	____ MeV	____
Extract Eff	____	%	____ μA of	____ MeV	____
Res, ΔE/E	____	%	____ μA of	____ MeV	____

Emittance

(mm-mrad) { ____ axial / ____ radial } ____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %

Solid State Physics ____ %

Bio-Medical Applications ____ %

Isotope Production ____ %

Development ____ %

____ %

____ %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 8

NAME OF MACHINE TRIUMF DATE 8/28/78

INSTITUTION Universities of Alberta, British Columbia, Victoria, and Simon Fraser University

ADDRESS UBC, Vancouver, B.C., Canada V6T 1W5

IN CHARGE J.T. Sample REPORTED by M.K. Craddock, G. Dutto

HISTORY AND STATUS

DESIGN, date July 1966 MODEL tests Dec. 1966

ENG. DESIGN, date October 1968

CONSTRUCTION, date January 1970

FIRST BEAM date (or goal) December 1974

MAJOR ALTERATIONS

OPERATION, 144 hr/wk; On Target 100 hr/wk

TIME DIST., in house ____ %, outside ____ %

USERS' SCHEDULING CYCLE ~12 weeks

COST, ACCELERATOR Can$12,000,000

COST, FACILITY, total Can$36,000,000

FUNDED BY Atomic Energy Control Board and TRIUMF universities

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 13 ENGINEERS 15

TECHNICIANS 70 CRAFTS 50

GRAD STUDENTS involved during year 0

OPERATED BY ____ Res staff or x Operators

BUDGET, op & dev Can$8,700,000

FUNDED BY National Research Council

RESEARCH STAFF, not included above

USERS, in house 70* outside 60

GRAD STUDENTS involved during year 25*

RES. BUDGET, in house Can$1,800,000

FUNDED BY National Research Council

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 2350 m^2

~~movable~~ (incl shielding within area) m^2

TARGET STATIONS 10 in 2 rooms

STATIONS served at same time, max 9

MAG SPECTROGRAPH, type MRS spectrometer

COMPUTER, model

OTHER FACILITIES

Polarized fast neutron beam

Thermal neutron source

Biomedical irradiation

REFERENCES/NOTES

*includes users from the four founding universities

typing limit

MAGNET

POLE FACE diameter 1717.0 cm; R extraction 780 cm

GAP, min 52.8 cm; Field 5.8 kG } at 0.72 x 10^6 ampere turns

max ____ cm; Field 2.0 kG

AVERAGE FIELD at R ext 4.6 kG

CURRENT STABILITY ±5 parts/10^6; $B_{max}/\langle B\rangle$ 1.25

NUMBER OF SECTORS 6 ; SPIRAL, max 70 deg

POLE FACE COIL PAIRS: AVF ____ /sec;

Harmonic correction 13/sec

Rad grad ____ /sec or Circ coils 55

WEIGHT: Fe 4000 tons; Coils 170 tons

CONDUCTOR, Material and type Al

STORED ENERGY ____ MJ

COOLING SYSTEM water

POWER: Main coils 1270 normal, 3160 max, kW

Trimming coils 68 max, kW

YOKE/POLE AREA 18 %

SECTOR ANGLE (Sep Sec) - deg

ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV

(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg

BEAM APERTURE 8 cm; DC BIAS 0 kV

TUNED by, coarse panels fine panels

RF ____ to 23.055 mHz, stable ± 1 /10^6

Orb F ____ to 4.61 mHz; GAIN, max 340 kV/turn

HARMONICS, RF/Orb F, used fifth

DEE-Gnd, max 85 kV, min gap 2.5 cm

STABILITY, (pk-pk noise)/(pk RF volt) $1/10^4$

RF PHASE stable to ± 0.5 deg

RF POWER input, max 1650 kW

RF PROTECT circuit, speed 20 μsec

Type Screen input. In emergency, crowbar

FREQUENCY MODULATION, rate - /sec

MODULATOR, type -

BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size

2 He-cooled 20 K cryopanels, 1.2 m^2

OPERATING PRESSURE 0.06 μTorr,

PUMPDOWN TIME 24 hrs

ION SOURCES/INJECTION SYSTEM

1. "Ehlers" Hot Filament Arc (H^-)
2. "Lamb Shift" Polarized H^-

EXTRACTION SYSTEM

Electron stripping in Al or C foil

CONTROL SYSTEM

3 minicomputers with CAMAC

ENTRY NO. 8 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	165-500	180-520
	p	65-100	
CURRENT Internal	H^-	100 (500MeV) (μA)	120 (μA)
		150 (450MeV)	
External	p	100 (500MeV)	120
		400 (450MeV)	
Secondary	π^+	20-120 (MeV ~~(part/s)~~)	$>10^8$ (part/s)
	μ^+	20-75	$\sim 10^7$
polarized n		75% @ 200	$\sim 6\times10^7$
		40% @ 500	

BEAM PROPERTIES

	Measured	Conditions	
Pulse Width	45 RF deg	100 μA of 500 MeV	p
Phase Exc, max	20 RF deg	100 μA of 500 MeV	
Extract Eff	99.95%	100 μA of 500 MeV	
Res, ΔE/E	0.3 %	100 μA of 500 MeV	
Emittance (mm-mrad)	3π axial, 3π radial	100 μA of 500 MeV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	Simultaneous	90 %
Solid State Physics	at various	%
Bio-Medical Applications	target	%
Isotope Production	stations	%
Development		10 %
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

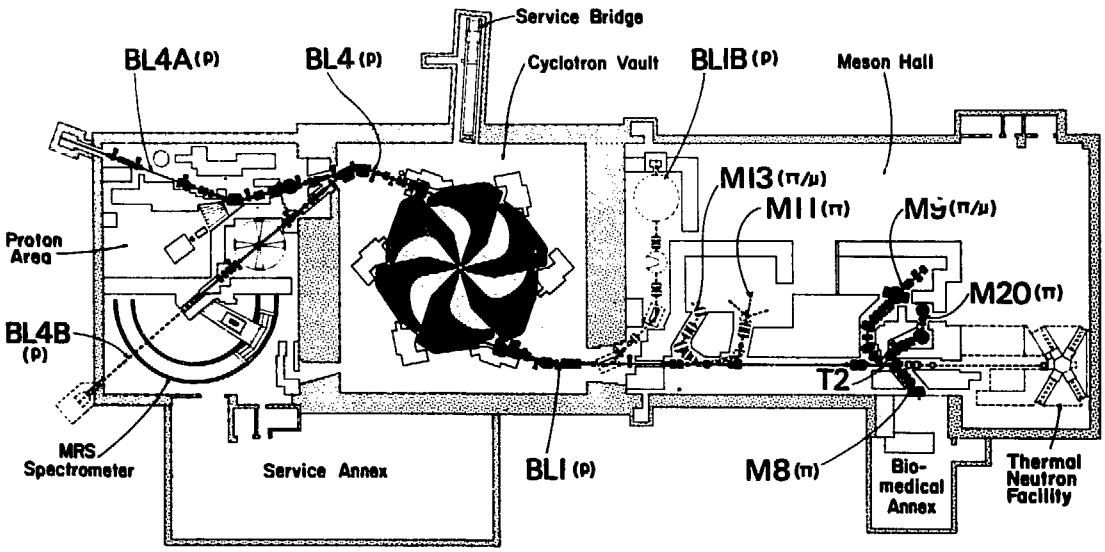


Fig. 1 Layout of the facility. Existing beam lines are indicated by solid lines, beam lines planned for future installation by dashed lines (see text).

REFERENCES

J.J. Burgerjon, O.K. Fredriksson, A.J. Otter, W.A. Grundman, B.C. Stonehill, Construction details of the TRIUMF H^- cyclotron, IEEE Trans. NS-20(3), 243 (1973).

J.B. Warren, TRIUMF, March 1971, IEEE Trans. NS-18(3), 272 (1971).

J.R. Richardson, The Status of TRIUMF, Proc. 7th Int. Conf. on Cyclotrons and their Applications (Birkhäuser, Basel, 1975), p. 41.

G. Dutto, J.L. Beveridge, E.W. Blackmore, M.K. Craddock, K.L. Erdman, D.P. Gurd, C.J. Kost, G.H. Mackenzie, P.A. Reeve, J.R. Richardson, J.T. Sample, P. Schmor, M. Zach, Developments at TRIUMF, IEEE Trans. NS-24(3), 1653 (1977).

typing limit

ENTRY NO. 9

NAME OF MACHINE University of Manitoba Cyclotron DATE 7/14/78
INSTITUTION Cyclotron Laboratory, University of Manitoba
ADDRESS Winnipeg, Manitoba, R3T 2N2, Canada

IN CHARGE J.S.C. McKee REPORTED by S. Oh

HISTORY AND STATUS

DESIGN, date 1959 MODEL tests 1959-61
ENG. DESIGN, date 1960-63
CONSTRUCTION, date 1960-64
FIRST BEAM date (or goal) 1965
MAJOR ALTERATIONS 100% external injection of beam (1975)
OPERATION, 168 hr/wk; On Target ∿150 hr/wk
TIME DIST., in house 95 %, outside 5 %
USERS' SCHEDULING CYCLE 5 weeks
COST, ACCELERATOR $600,000
COST, FACILITY, total $1,500,000
FUNDED BY University & AECB (Canada)

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 3
TECHNICIANS 3 CRAFTS 8
GRAD STUDENTS involved during year 1
OPERATED BY x Res staff or Operators
BUDGET, op & dev $333,000
FUNDED BY NRC (Canada)

RESEARCH STAFF, not included above

USERS, in house 14 outside 6
GRAD STUDENTS involved during year 10
RES. BUDGET, in house $125,000
FUNDED BY NRC (Canada)

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ____ m^2
movable ∿300 m^2
TARGET STATIONS 6 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type ____
COMPUTER, model PDP15/40 & 15/20
OTHER FACILITIES P.I.X.E. analysis
High resolution spectroscopy
Fast neutron time of flight
Polarized ^{3}He target
Isotope production (^{123}I, ^{84}Rb)

REFERENCES/NOTES

1) IEEE Trans.Nucl.Sci.NS-13 No. 4 422 (1966)
2) Proc. 8th Int. Conf. on Cycl. & Appl. Bloomington (1978)

* Magnetic field shaped by 64 invar shims(8 under each hill) and a pair of movable centre plugs.

MAGNET

POLE FACE diameter 117 cm; R extraction 26-53 cm
GAP, min 3.6 cm; Field 26 kG
max 15 cm; Field 16 kG
AVERAGE FIELD at R ext 19.1-19.7 kG
} at 3.1 X 10^6 ampere turns
CURRENT STABILITY 100 parts/10^6; $B_{max}/\langle B\rangle$ 1.32
NUMBER OF SECTORS 4 ; SPIRAL, max 47.5 deg
POLE FACE COIL PAIRS: AVF 8 invar blocks*/sec;
Harmonic correction 8 per sector*
Rad grad 8* /sec or Circ coils ____
WEIGHT: Fe 38 tons; Coils 4 tons
CONDUCTOR, Material and type Water cooled copper
STORED ENERGY ____ MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 113 max, kW
Trimming coils * max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ∿52 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 45 deg
BEAM APERTURE 1.8 cm; DC BIAS 1.5 kV
TUNED by, coarse M.S fine ____
RF 14.24 & 28.48 mHz, stable ± 10 /10^6
Orb F 14.24 & 28.48 mHz; GAIN, max 45 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 30 kV, min gap 0.3 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± 2 deg
RF POWER input, max 15 kW
RF PROTECT circuit, speed 10 μsec
Type H thratron crowbar
FREQUENCY MODULATION, rate - /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 3 diffusion pumps (46cmx2, 15cmx1) cryopumping of injection system
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 12 hrs

ION SOURCES/INJECTION SYSTEM

Duoplasmatron & Lamb-shift nuclear spin-filter source/axial injection

EXTRACTION SYSTEM

Stripping of electrons from H^- & D^-

CONTROL SYSTEM

conventional

typing limit

ENTRY NO. 9 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	H^-		22-50
	D^-	24	11-21
	$\vec{p}$		28.6
CURRENT		(μA)	(μA)
Internal	p	10	5(30 MeV)
	p	3	1(48 MeV)
	$\vec{p}$		3×10^{-6}†
External	D	10	3(12 MeV)
		(part/s)	(part/s)
Secondary	n		$\sim4\times10^{9}$ Sr^{-1}

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	6	RF deg	0.1	μA of	25-45 MeV	p
Phase Exc, max		RF deg		μA of	MeV	
Extract Eff	100	%		μA of	MeV	
Res, ΔE/E	∿1.0	%	0.1	μA of	45 MeV	p
Emittance (mm-mrad) axial / radial				μA of	MeV	

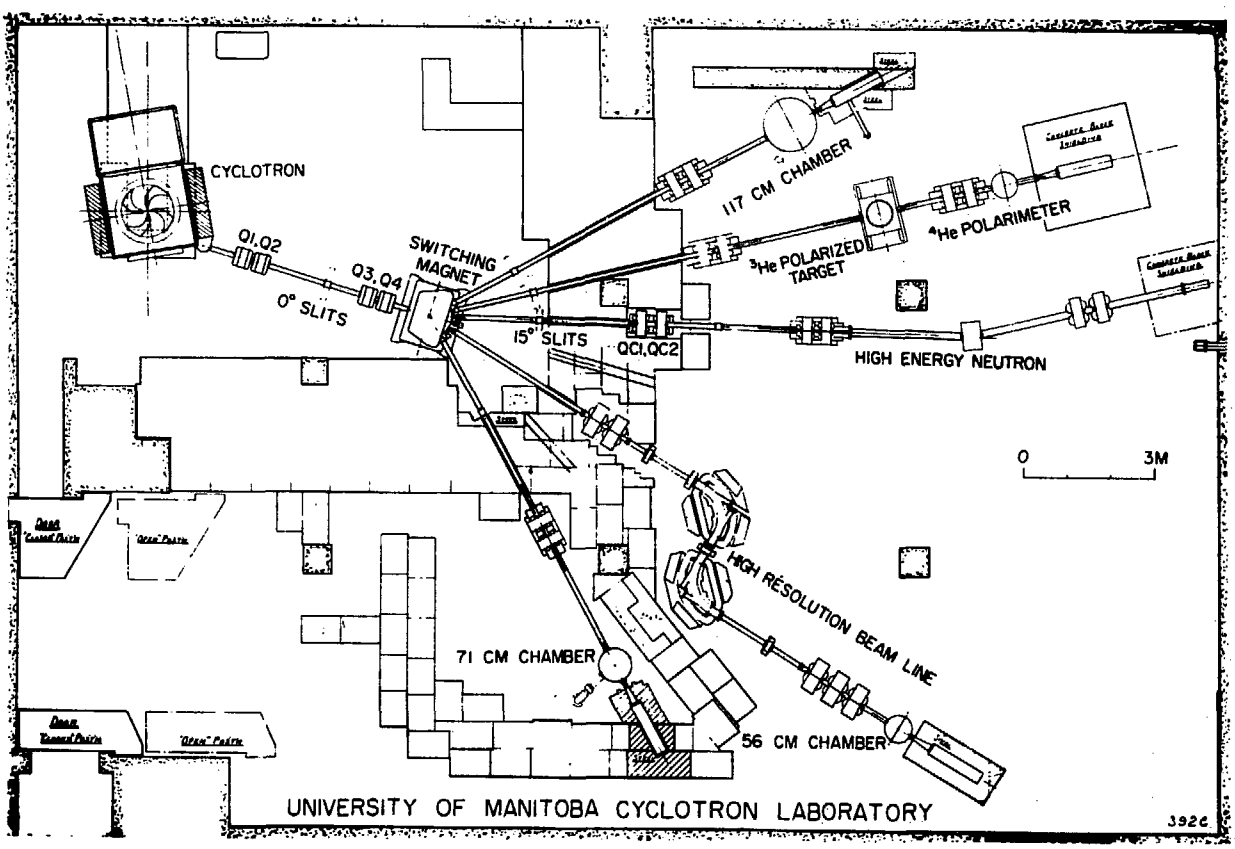
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	85 %
Solid State Physics/Atomic Physics	5 %
Bio-Medical Applications	3 %
Isotope Production	5 %
Development	2 %
	%
	%

† This was obtained using the proto-type TRIUMF Sona source as a test facility.

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The cyclotron was converted entirely to operation using axially injected H^- beam in 1975. An ion source hall was built 3m above the cyclotron vault in 1976 and accommodates a duoplasmatron and a Lamb-shift source. Construction of the Lamb-shift source is expected to be completed in 1978. A polarized ^{3}He target is under construction and is also expected to come into operation in 1978.



typing lim

ENTRY NO. 10

NAME OF MACHINE Isochronous Cyclot on U-120 M DATE

INSTITUTION Institute of Nuclear Physics

ADDRESS Praha, CzSSR

IN CHARGE REPORTED by Prof. V.P.DZHELEPOV

HISTORY AND STATUS

DESIGN, date 1969-71 MODEL tests 1971-75

ENG. DESIGN, date

CONSTRUCTION, date 1972-1975

FIRST BEAM date (or goal) 1976

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

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS

TECHNICIANS CRAFTS

GRAD STUDENTS involved during year

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside

GRAD STUDENTS involved during year

RES. BUDGET, in house

FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2

movable m^2

TARGET STATIONS in rooms

STATIONS served at same time, max

MAG SPECTROGRAPH, type

COMPUTER, model

OTHER FACILITIES

REFERENCES/NOTES

MAGNET

POLE FACE diameter 120 cm; R extraction 52 cm

GAP, min 3.2 cm; Field 20 kG
max 22 cm; Field 16 kG
} at 0.4 X 10^6 ampere turns

AVERAGE FIELD at R ext kG

CURRENT STABILITY parts/10^6; $B_{max}/\langle B\rangle$ 1.12

NUMBER OF SECTORS 4 ; SPIRAL, max 70 deg

POLE FACE COIL PAIRS: AVF /sec;

Harmonic correction

Rad grad /sec or Circ coils

WEIGHT: Fe 117.5 tons; Coils 15 tons

CONDUCTOR, Material and type Cu,

STORED ENERGY MJ

COOLING SYSTEM H_2O

POWER: Main coils 130 max, kW

Trimming coils 60 max, kW

YOKE/POLE AREA %

SECTOR ANGLE (Sep Sec) deg

ION ENERGY (Bending limit) E/A = q^2/A^2 MeV

(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg

BEAM APERTURE 2 cm; DC BIAS 0 kV

TUNED by, coarse MP fine VC, auto

RF 3.6 to 26.5 mHz, stable ± 0.1 /10^6

Orb F 3.3 to 26.3 mHz; GAIN, max 100 kV/turn

HARMONICS, RF/Orb F, used 1

DEE-Gnd, max 50 kV, min gap 3 cm

STABILITY, (pk-pk noise)/(pk RF volt) 1.10^{-3}

RF PHASE stable to ± deg

RF POWER input, max 150 kW

RF PROTECT circuit, speed μsec

Type

FREQUENCY MODULATION, rate /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 diffusion pumps

OPERATING PRESSURE 10 μTorr,

PUMPDOWN TIME 6 hrs

ION SOURCES/INJECTION SYSTEM

Oak Ridge type

EXTRACTION SYSTEM

Electrostatic

CONTROL SYSTEM

typing limit

ENTRY NO. 10 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	10.0	
	d	20.3	
	alpha	11.6	
	He-3	50	
CURRENT		(μA)	(μA)
Internal	20-50		
External	15-35		
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	____	RF deg	____ μA of	____	MeV	____
Phase Exc, max	____	RF deg	____ μA of	____	MeV	____
Extract Eff	____	%	____ μA of	____	MeV	____
Res, ΔE/E	____	%	____ μA of	____	MeV	____

Emittance

(mm-mrad) { ____ axial / ____ radial } ____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %

Solid State Physics ____ %

Bio-Medical Applications ____ %

Isotope Production ____ %

Development ____ %

____ %

____ %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 11

NAME OF MACHINE Ciclotron de la Universidad de Chile
INSTITUTION Facultad de Ciencias Físicas y Matemáticas de Chile
LOCATION Santiago-Chile DATE Apr. 1975

IN CHARGE H. Izquierdo A. REPORTED by J. L. Morales

HISTORY AND STATUS

DESIGN, date 1960 MODEL tests 1962
ENG. DESIGN, date 1960-1964
CONSTRUCTION, date 1960-1964
FIRST BEAM date (or goal) 1962 (Davis) 1967 (Eggy)
MAJOR ALTERATIONS New design MS and
OPERATION, 40 hr/wk; On Target 24 hr/wk
TIME DIST., in house 100 %, outside ___ %
USERS' SCHEDULING CYCLE ___ weeks
COST, ACCELERATOR $ 500 000
COST, FACILITY, total $ 300 000
FUNDED BY U. of Chile and U. of Chile-U. of Cal. Coop. program (operation)

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 1
TECHNICIANS 1 CRAFTS -
ADMIN & CLER - TOTAL 4
GRAD. STUDENTS involved during year 2
OPERATED BY 1 Res staff or 1 Sp operators
BUDGET, op & dev aprox. $ 2,000
FUNDED BY U. of Chile and convenio U. Chile - U. California

RESEARCH STAFF, not included above

USER GROUPS, in house 1 outside ___
STAFF SCIENTISTS, in house 2 outside ___
TOTAL RES STAFF, in house 2 outside ___
GRAD STUDENTS involved during year 2
RES. BUDGET, in house non fixed
FUNDED BY U. of Chile

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 150 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 ___
FACILITIES for:
Isotope production ___
Irradiation, Solid State ___
Biological ___
Time-of-Flight Study up to 10m flight path
On-Line Mass Separation ___

MAGNET

POLE FACE dia 60 cm; R ext 25 cm
GAP, min ___ cm; Field ___ kG
max 4.4 cm; Field 19.7 kG } at 0.2 x 10^6 A-turns
AVE FIELD at R max 19.7 kG
CURRENT, STABILITY ± 100 (Goal) parts/10^6
B max/<B> = ___
AVF SECTORS 3 SPIRAL, max 45 deg
POLE FACE coil pairs, AVF ___ /sec
Harmonic 1 /sec; Rad Grad ___ /sec, or
___ circular; HEAVY ION, E max = ___ q^2/A
WEIGHT, Fe ___, Cu, or Al ___ tons
POWER, main coils 40 KW, pole tips 34 KW
total 74 kW; cooled by water
YOKE/POLE area 100 %; θ sec (Sect Mag) ___ deg
TOTAL POWER, installed 0.3 MW
normal load 0.12 MW

ION SOURCE, int Hot Cathode
ext ___

ACCELERATION SYSTEM

DEES, number 2, width 110 deg
BEAM APERTURE 1.5 cm; DC BIAS ___ kV
TUNED by, coarse MS, fine MC
RF 15 to 30 MHz, stable ± 1 /10^6
Orb F ___ to ___ Mc/s; GAIN 100 kV/t
HARMONICS, RF/OF, used ___
DEE-Gnd, max 60 kV, x/field, min ___ cm,
STABILITY, (pk-pk noise)/(pk RF volt) 0.05
RF PHASE stable to ± ___ deg
RF POWER input, max 15 kW
RF PROTECT curcuit, speed 1000 μs
type Relay
EXTRACT System DC Electrostatic

FREQUENCY MODULATION, rate ___ /sec
MODULATOR, type ___
BEAM PULSE, width ___ nsec
(FM only)

SELECTED REFERENCES

Nucl. Inst. Meth. 18,19, 120-124 and 125-128 (1962)
UCD-CNL 56 Report (1970)

NOTATIONS # This Cyclotron was transfered from UC Davis through the U. of Chile - U. of California Cooperative Program, financed by Ford Foundation.

Typing limit

ENTRY NO. 11 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	12	10
	d	6	5
	.1e-4	12	10
CURRENT		(μA)	(μA)
Internal	p		1
	d		10
	.1e-4		0.5
External	p		0.3
	d		3
		(part/s)	(part/s)
Secondary	20Mev n		10^5
HEAVIEST ion			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	30	%	2	μA of	5	MeV d
Res, ΔE/E	1	%	2	μA of	5	MeV d
Emittance (mm-mrad)	axial / radial			μA of		MeV

VACUUM norm 40 μtorr; PUMPDOWN time 1-2 hr

OPERATING PROGRAMS, time dist

Basic Nuclear Physics/Chemistry	20%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	%
Materials Science	%
Machine Research	20%
Maintenance	60

OTHER FEATURES and OPERATION SUMMARY

1.- The beam is pulsed with a variable duty cycle up to 50% through the RF system
2.- The facilities include a spherical neutron pit with a radius of aprox. 5 m and with a centered target holder
3.- A new ion-source was developed and tested

Typing limit

ENTRY NO. 12

NAME OF MACHINE MGC DATE 78-09-21

INSTITUTION Acceleratorlaboratoriet vid Åbo Akademi

ADDRESS Porthansgatan 3-5 20500 Åbo 50 FINNLAND

IN CHARGE Mårten Brenner REPORTED by Jan Arhippainen

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____

ENG. DESIGN, date _____

CONSTRUCTION, date Dec.1973 to Oct.1974

FIRST BEAM date (or goal) July 1974 Int/Ext

MAJOR ALTERATIONS _____

OPERATION, 30 hr/wk; On Target _____ hr/wk

TIME DIST., in house _____ %, outside _____ %

USERS' SCHEDULING CYCLE 6 weeks

COST, ACCELERATOR 4×10^6 Fmk

COST, FACILITY, total _____

FUNDED BY Finnish Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS _____ ENGINEERS 1

TECHNICIANS 1 CRAFTS _____

GRAD STUDENTS involved during year 2

OPERATED BY _____ Res staff or 4 Operators

BUDGET, op & dev 40.000 Fmk

FUNDED BY Government 75%

Privat funds 25%

RESEARCH STAFF, not included above

USERS, in house 8 outside 13

GRAD STUDENTS involved during year 7

RES. BUDGET, in house 54.000 Fmk

FUNDED BY Government 85%

Privat funds15%

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 50 m^2

movable 140 m^2

TARGET STATIONS 4 in 2 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type _____

COMPUTER, model PDP 11/10

OTHER FACILITIES _____

Scattering Chamber

REFERENCES/NOTES

Basargin, Bogdanov, Finkelstein, Galeev, Galchuk, Glukhikh, Gusev, Malishev, Popov, Stepanov, Stogov Proc. 6th Intern.Cycl.Conf. Vancouver (1972), Am.Inst.Phys. (1972) 102

*MP -movable panels

VC -variable capacitors

TC -trim capacitors

typing limit

MAGNET

POLE FACE diameter 103 cm; R extraction 45 cm

GAP, min 7,2 cm; Field 16,5 kG

max 12 cm; Field 12,5 kG

AVERAGE FIELD at R ext 14,5 kG

at. 12 $\times10^6$ ampere turns

CURRENT STABILITY 100 parts/10^6; $B_{max}/(B)$ 1,13

NUMBER OF SECTORS 3 ; SPIRAL, max 35 deg

POLE FACE COIL PAIRS: AVF _____ /sec;

Harmonic correction 2per sector

Rad grad _____ /sec or Circ coils 4

WEIGHT: Fe 24 tons; Coils 1,2 tons

CONDUCTOR, Material and type Cu tube

STORED ENERGY _____ MJ

COOLING SYSTEM Demineralised water

POWER: Main coils 35 max, kW

Trimming coils 1 max, kW

YOKE/POLE AREA 100 %

SECTOR ANGLE (Sep Sec) _____ deg

ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV

(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 140 deg

BEAM APERTURE 1,9 cm; DC BIAS -- kV

TUNED by, coarse HP * fine VCman/TCauto

RF 8,5 to 25,5 mHz, stable ± 10 /10^6

Orb F (to _____ mHz; GAIN, max 120 kV/turn

HARMONICS, RF/Orb F, used 1, 3

DEE-Gnd, max 35 kV, min gap 0,4 cm

STABILITY, (pk-pk noise)/(pk RF volt) 0,001

RF PHASE stable to ± 5 deg

RF POWER input, max 180 kW

RF PROTECT circuit, speed 5 μsec

Type Thyratron

FREQUENCY MODULATION, rate _____ /sec

MODULATOR, type _____

BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 2 diffusion pumps 35 cm

OPERATING PRESSURE 5 μTorr,

PUMPDOWN TIME 6 hrs

ION SOURCES/INJECTION SYSTEM

Hot-Filament Livingston

EXTRACTION SYSTEM

Electrostatic deflector+mag.chan.

CONTROL SYSTEM

conventional

ENTRY NO. 12 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	18	19
	d	10	10
	α	20	21
	^{3}He	24	29
CURRENT		(μA)	(μA)
Internal	p, d	300	120
	α	50	100
	^{3}He	50	90
External	p, d	50	60
	α	25	40
	^{3}He	25	37
		(part/s)	(part/s)
Secondary			

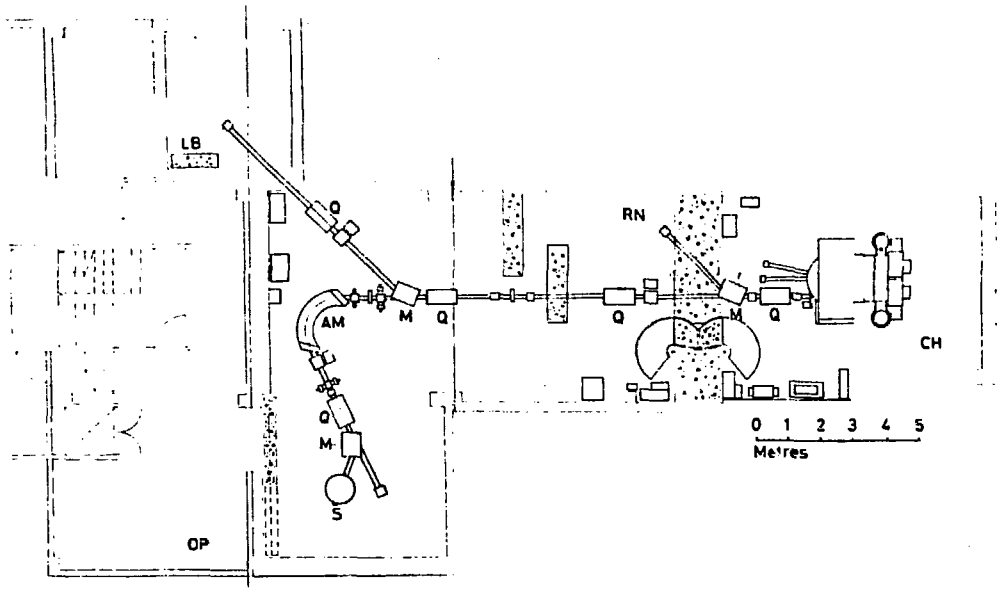
BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	RF deg		μA of	MeV		
Phase Exc, max	RF deg		μA of	MeV		
Extract Eff	50 %		20 μA of	α	MeV	21
Res, ΔE/E	0,3 %		0,4 μA of	p	MeV	18
Emittance (mm-mrad)	axial / radial		μA of	MeV		

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	20 %
Solid State Physics	%
Bio-Medical Applications	30 %
Isotope Production	40 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



The layout of the compact cyclotron at Åbo Akademi(Finland): Q = quadropole lens, M = bending magnet, AM = analysing magnet, S = Scattering Chamber, LB = low background area, OP = controlroom, CH = cyclotron vault, RN = position for isotop production.

typing limit

ENTRY NO. 13

NAME OF MACHINE Minicyclotron MC-20 DATE 7/25/78
INSTITUTION Department of Physics, University of Jyväskylä
ADDRESS Nisulankatu 78, SF-40720 Jyväskylä 72, Finland

IN CHARGE Teuvo Poikolainen REPORTED by Teuvo Poikolainen

HISTORY AND STATUS

DESIGN, date 1968-69 MODEL tests 1968-69
ENG. DESIGN, date 1969-71
CONSTRUCTION, date 1969-73
FIRST BEAM date (or goal) 1974
MAJOR ALTERATIONS

OPERATION, ~70 hr/wk; On Target ~60 hr/wk
TIME DIST., in house † %, outside † %
USERS' SCHEDULING CYCLE ~5 weeks
COST, ACCELERATOR $ 550 000
COST, FACILITY, total $1000 000
FUNDED BY Government of Finland

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS 3
TECHNICIANS 1 CRAFTS 4
GRAD STUDENTS involved during year 2
OPERATED BY x Res staff or Operators
BUDGET, op & dev $ 250 000
FUNDED BY Government of Finland

RESEARCH STAFF, not included above

USERS, in house 20 outside 15
GRAD STUDENTS involved during year 10
RES. BUDGET, in house $ 200 000
FUNDED BY Government of Finland

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 100 m^2
movable - m^2
TARGET STATIONS 5 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model PDP 11/45
OTHER FACILITIES In-beam Gamma Ray and Electron spectrometers.
On-Line Mass Spectrometer
Helium-Jet Recoil Transport

REFERENCES/NOTES

†No distinction has been made between "In-house" and "outside" users.

MAGNET

POLE FACE diameter 90 cm; R extraction 38-39 cm
GAP, min 6.5 cm; Field 20.5 kG
max 16.5 cm; Field 13.7 kG
AVERAGE FIELD at R ext 17.1 kG
} at 0.3 x 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B \rangle$ 1.2
NUMBER OF SECTORS 4 ; SPIRAL, max 48 deg
POLE FACE COIL PAIRS: AVF 2 /sec;
Harmonic correction 2/sector
Rad grad /sec or Circ coils 8
WEIGHT: Fe 19.5 tons; Coils 1 tons
CONDUCTOR, Material and type Copper
STORED ENERGY MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 90 max, kW
Trimming coils 6 max, kW
YOKE/POLE AREA 112 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 20 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg
BEAM APERTURE 1.8 cm; DC BIAS 0 kV
TUNED by, coarse MS fine VC
RF 10.5 to 25.6 mHz, stable ± /10^6
Orb F 5.3 to 25.6 mHz; GAIN, max 120 kV/turn
HARMONICS, RF/Orb F, used 1,2
DEE-Gnd, max 30 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± 0.5 deg
RF POWER input, max 50 kW
RF PROTECT circuit, speed 1 μsec
Type Series tube
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 2 oil diffusion pumps (2x2500 l/s; with baffles)
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 5-7 hrs

ION SOURCES/INJECTION SYSTEM

Internal cold cathode penning, biased

EXTRACTION SYSTEM

Electrostatic defl.+magn.channel

CONTROL SYSTEM

Conventional.

typing limit

ENTRY NO. 13 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	2.5-20	4.8-20.2
	d	1.5-10	6-10
	^{3}He	2.5-27	12-27.5
	α	2.5-20	6-20.5
CURRENT		e (μA)	e (μA)
Internal	p	200	100
	d	200	300
	α	100	10
External	p	100	4
	d	100	10
	α	50	1.5
		(part/s)	(part/s)
Secondary			

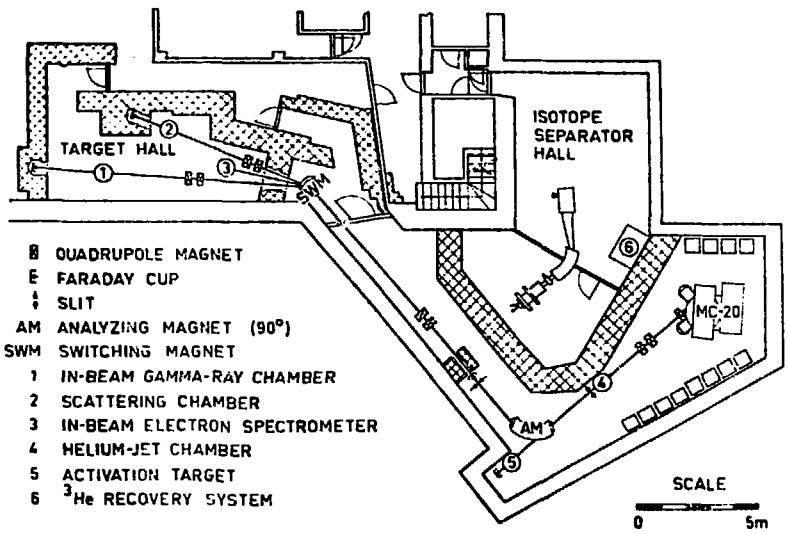
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	35 %	4 μA of 13 MeV p
Res, ΔE/E	0.5 %	2 μA of 20 MeV α
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



The control room of the cyclotron and the measuring room are placed above the target hall.

typing limit

ENTRY NO. 14

NAME OF MACHINE GANIL DATE 1978

INSTITUTION Grand Accélérateur National d'Ions Lourds (GANIL)

ADDRESS B. P. 5027, 14021 CAEN CEDEX - FRANCE

IN CHARGE M. GOUTTEFANGEAS REPORTED by GANIL STAFF

HISTORY AND STATUS

DESIGN, date 1973 MODEL tests 1976

ENG. DESIGN, date 1975 - 1976

CONSTRUCTION, date 1977 - 1982

FIRST BEAM date (or goal) 1982

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 French AEC and I N2 P3

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS and ENGINEERS 44

TECHNICIANS 50 CRAFTS 10

GRAD STUDENTS involved during year

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY French AEC and I N2 P3

RESEARCH STAFF, not included above

USERS, in house outside

GRAD STUDENTS involved during year

RES. BUDGET, in house

FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2

movable 4 000 m^2

TARGET STATIONS 8 in 8 rooms

STATIONS served at same time, max

MAG SPECTROGRAPH, type

COMPUTER, model

OTHER FACILITIES

REFERENCES/NOTES

- GANIL Group : these proceedings
- BIETH, Journées GANIL, Internal report, nov 1977.

MAGNET (SSC 2)

POLE FACE diameter 690 cm; R extraction 300 cm

GAP, min 10 cm; Field 16.4 kG
max 10 cm; Field 16.4 kG
AVERAGE FIELD at R ext 9.65 kG
} at 205 x 10^6 ampere turns

CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$ 1.7

NUMBER OF SECTORS 4 ; SPIRAL, max 0 deg

POLE FACE COIL PAIRS: XXFX 15 /sec;

Harmonic correction

Rad grad /sec or Circ coils

WEIGHT: Fe 1 700 tons; Coils 14 tons

CONDUCTOR, Material and type Copper

STORED ENERGY 2 MJ

COOLING SYSTEM Demineralized water

POWER: Main coils 950 max, kW

Trimming coils 140 max, kW

YOKE/POLE AREA 100 %

SECTOR ANGLE (Sep Sec) 51 deg

ION ENERGY (Bending limit) E/A = 400 q^2/A^2 MeV

(Focusing limit) E/A = > 200 q/A MeV

ACCELERATION SYSTEM (SSC 2)

DEES, number 2 angle 34 deg

BEAM APERTURE 5 cm; DC BIAS kV

TUNED by, coarse panel fine plunger

RF 6.5 to 14 mHz, stable ± 0.1 /10^6

Orb F 1.6 to 7 mHz; GAIN, max 4 x 250 kV/turn

HARMONICS, RF/Orb F, used 2 - 4

DEE-Gnd, max 250 kV, min gap 5 cm

STABILITY, (pk-pk noise)/(pk RF volt) 5 10^{-4}

RF PHASE stable to ± .5 deg

RF POWER input, max 100 / cavity kW

RF PROTECT circuit, speed μsec

Type

FREQUENCY MODULATION, rate 0 /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM (SSC 1)

PUMPS, No., Type, Size 8 cryo pumps 20 000 l/s
4 turbo pumps 3 500 l/s

OPERATING PRESSURE .05 μTorr,

PUMPDOWN TIME 24 hrs

ION SOURCES/INJECTION SYSTEM

PIG at the center of the C0 injector

EXTRACTION SYSTEM (SSC 2)

Electrostatic deflector + mag. channel

CONTROL SYSTEM

Computer MITRA 125

typing limit

ENTRY NO. 14 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV/A)	Achieved (MeV)
ENERGY	C	100	
	Kr	50	
	U	8	
CURRENT		XXX (part/s)	XX
Internal			
		13	
External	C	10^{10}	
	Kr	$3\ 10^{10}$	
	U	$3\ 10^{9}$	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

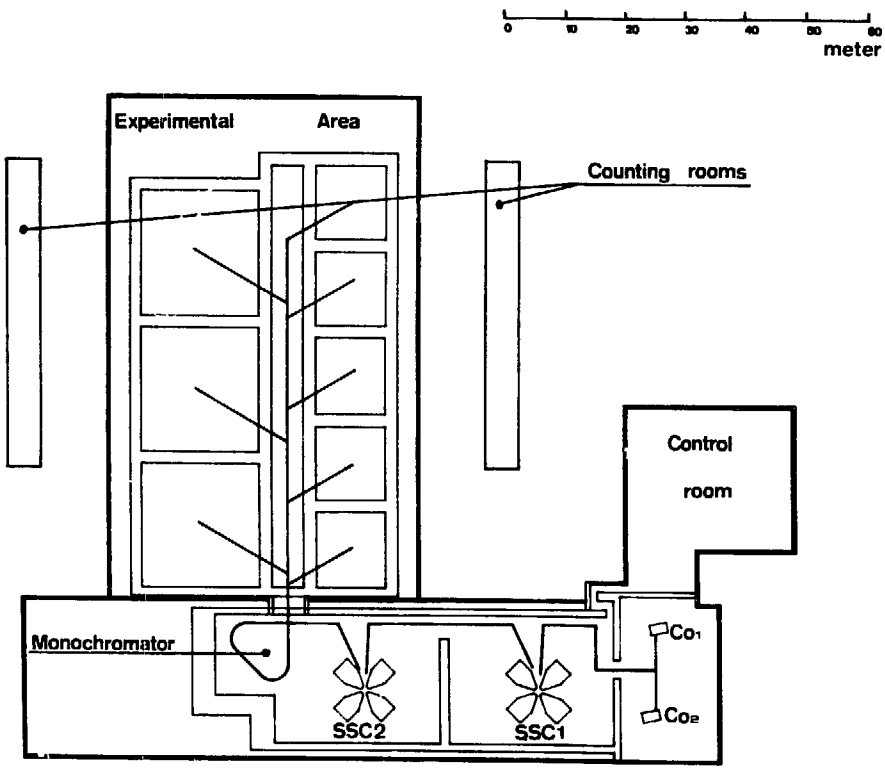
	Measured		Conditions				
Pulse Width	6	RF deg	0.2p	μA of	100	MeV/A	C
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	90	%	"	μA of	"	MeV	"
Res, ΔE/E	0.2	%	"	μA of	"	MeV	"
Emittance (mm-mrad)	25 axial / 15 radial		"	μA of	"	MeV	"

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The heart of the GANIL accelerator consists of two identical separated-sector cyclotrons (SSC 1, SSC 2). The injector is a compact cyclotron (C01 or C02). Ions extracted from SSC 1 are stripped by a factor of 3.5 before being injected in SSC 2.



typing limit

ENTRY NO. 15

NAME OF MACHINE Grenoble Isochronous cyclotron DATE July 78

INSTITUTION Institut des Sciences Nucléaires

ADDRESS 53 avenue des Martyrs 38026 Grenoble Cedex

IN CHARGE J M LOISEAUX REPORTED by J M LOISEAUX and M. FRUNEAU

HISTORY AND STATUS

DESIGN, date 1962 MODEL tests 1963

ENG. DESIGN, date 1963 - 1965

CONSTRUCTION, date 1963 - 1967

FIRST BEAM date (or goal) July 1968

MAJOR ALTERATIONS None

OPERATION, 120 hr/wk; On Target 100 hr/wk

TIME DIST., in house 70 %, outside 30 %

USERS' SCHEDULING CYCLE 4 weeks

COST, ACCELERATOR $ 2.0 10^6

COST, FACILITY, total $ 6 10^6

FUNDED BY I N2 P3 - CNRS

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 7

TECHNICIANS 20 CRAFTS 5

GRAD STUDENTS involved during year ✓

OPERATED BY ✓ Res staff or 9 Operators

BUDGET, op & dev $. 3 Millions

FUNDED BY ✓

RESEARCH STAFF, not included above

USERS, in house 40 outside 20

GRAD STUDENTS involved during year ✓

RES. BUDGET, in house $. 5 Millions

FUNDED BY CNRS and I N2 P3

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 300 m^2

movable 500 m^2

TARGET STATIONS 7 in 5 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type Q1 D

COMPUTER, model PDP9 and PDP 15

OTHER FACILITIES

on line mass spectrometer (test)

REFERENCES/NOTES

Annales de Radioélectricité XX1 n° 84

J.L. Belmont Rapport interne 75-06

XIème Europ. Cycl. Prog. Meeting. Lieuvin

typing limit

MAGNET

POLE FACE diameter 212 cm; R extraction 88 cm

GAP, min 16 cm; Field 19 kG

max 36 cm; Field 12 kG

AVERAGE FIELD at R ext 16 kG

at 360 x 10^6 ampere turns

CURRENT STABILITY 5 parts/10^6; $B_{max}/(B)$ 1.2

NUMBER OF SECTORS 4 ; SPIRAL, max 40 deg

POLE FACE COIL PAIRS: AVF ✓ /sec;

Harmonic correction 1/sector

Rad grad ✓ /sec or Circ coils 11

WEIGHT: Fe 200 tons; Coils 8 tons

CONDUCTOR, Material and type copper

STORED ENERGY ✓ MJ

COOLING SYSTEM Demineralized Water

POWER: Main coils 270 max, kW

Trimming coils 100 max, kW

YOKE/POLE AREA 100 % %

SECTOR ANGLE (Sep Sec) ✓ deg

ION ENERGY (Bending limit) E/A = 90 q^2/A^2 MeV

(Focusing limit) E/A = ~70 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 80° deg

BEAM APERTURE 4 cm; DC BIAS ✓ kV

TUNED by, coarse Mov.Panels fine ✓

RF 10.7 to 21.5 mHz, stable ± .1 /10^6

Orb F 3.6 to 21.5 mHz; GAIN, max 140 kV/turn

HARMONICS, RF/Orb F, used 1-2-3-

DEE-Gnd, max 70 kV, min gap ~ 1 cm

STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}

RF PHASE stable to ± .2 deg

RF POWER input, max ✓ kW

RF PROTECT circuit, speed 60 10.000 μsec

Type Relay

FREQUENCY MODULATION, rate ✓ /sec

MODULATOR, type ✓

BEAM PULSE, width 2-4 ns

VACUUM SYSTEM

PUMPS, No., Type, Size Diffusion pumps (80 cm)

OPERATING PRESSURE 1.5 μTorr,

PUMPDOWN TIME 5 hrs

ION SOURCES/INJECTION SYSTEM

Internal PIG source.

External PIG source with axial injection

EXTRACTION SYSTEM

Electrostatic + magnetic channel

CONTROL SYSTEM

Conventional and computer for checking and recording parameters.

ENTRY NO. 15 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	60	60
	d, ^{3}He α		~~80 q²/A~~
	Heavy ions		90 q²/A
CURRENT		(μA)	(μA)
Internal			eμA
	$^{14}N^{5+}$		2
	$^{16}O^{6+}$		.1
External	$^{20}Ne^{6+}$		.1
	^{8+}Ar		.05
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	10° RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	60 %	μA of MeV
Res, ΔE/E	.4 %	μA of MeV
Emittance (mm-mrad)	15 axial, 50 radial	μA of MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	86 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	4 %
Development	~~8 %~~ %
~~Nuclear Accelerator spectrometer~~	%
~~(^{10}Be)~~	2 %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The Grenoble cyclotron in able to accelerate both light and heavy ions. More than 60 % of the running time is now used with heavy ions beams from Li to Ar.

The external source installed in July 1976 is now operating with a rather good transmission. This cyclotron is planned to be the injector of a postaccelerator (separated sector cyclotron with K = 120) see SARA Accelerator.

typing limit

ENTRY NO. 16

NAME OF MACHINE SARA Rhone-Alpes Accelerator System DATE July 78

INSTITUTION Institut des Sciences Nucléaires Grenoble and Inst.Phys.Nucl. (Lyon)

ADDRESS 53 Avenue des Martyrs 38026 GRENOBLE CEDEX

IN CHARGE J.M. LOISEAUX REPORTED by M. LIEUVIN, J.M. LOISEAUX

HISTORY AND STATUS

DESIGN, date 1976 MODEL tests 1977

ENG. DESIGN, date 1976 - 1977

CONSTRUCTION, date beginning 1977

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 $1.5 \cdot 10^6$ (1976)

COST, FACILITY, total Existing

FUNDED BY I N2 P3 - CNRS

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS

TECHNICIANS CRAFTS

GRAD STUDENTS involved during year

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside

GRAD STUDENTS involved during year

RES. BUDGET, in house

FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2

movable m^2

TARGET STATIONS in rooms

STATIONS served at same time, max

MAG SPECTROGRAPH, type

COMPUTER, model

OTHER FACILITIES

REFERENCES/NOTES

- Projet Post Accelerateur Grenoble Int. Report. March 76
- Rhône Alpes Acceleration System Berlin Conference April 76

MAGNET 4 x 48° sectors

POLE FACE diameter cm; R extraction 2108 cm

GAP, min 6 cm; Field 14.5 kG
max cm; Field kG
AVERAGE FIELD at R ext kG
} at 89.6×10^3 ampere turns

CURRENT STABILITY parts/10^6; $B_{max}/\langle B \rangle$

NUMBER OF SECTORS ; SPIRAL, max deg

POLE FACE COIL PAIRS: AVF /sec;

Harmonic correction

Rad grad /sec or Circ coils

WEIGHT: Fe 100 tons; Coils 1 tons

CONDUCTOR, Material and type Cu 14 x 14 mm^2

STORED ENERGY MJ

COOLING SYSTEM Water

POWER: Main coils 46/Sector max, kW

Trimming coils 2.5/Sector max, kW

YOKE/POLE AREA %

SECTOR ANGLE (Sep Sec) 48 deg

ION ENERGY (Bending limit) E/A = 120 q^2/A^2 MeV

(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 34 deg

BEAM APERTURE 3 cm; DC BIAS 0 kV

TUNED by, coarse Mov. Pan. fine Mov. Pan

RF 15 to 25 mHz, stable ± /10^6

Orb F 3.5 to 6.1 mHz; GAIN, max 400 kV/turn

HARMONICS, RF/Orb F, used 3, 4, 5, 6

DEE-Gnd, max 100 kV, min gap cm

STABILITY, (pk-pk noise)/(pk RF volt)

RF PHASE stable to ± deg

RF POWER input, max kW

RF PROTECT circuit, speed μsec

Type CROWBAR

FREQUENCY MODULATION, rate /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 4 Dif. Pumps

OPERATING PRESSURE 1 μTorr,

PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

Stripping in the first orbit

EXTRACTION SYSTEM

Elect. Deflec + Mag. channels

CONTROL SYSTEM

typing limit

ENTRY NO. 16 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	^{12}C	360	
	^{20}Ne	600	
	^{40}Ar	600	
CURRENT		(μA)	(μA)
Internal			
External	$^{12}C^{6+}$	4 eμA	
	$^{20}Ne^{10+}$	1.6eμA	
	^{40}Ar	.5eμA	
		(part/s)	(part/s)
Secondary			

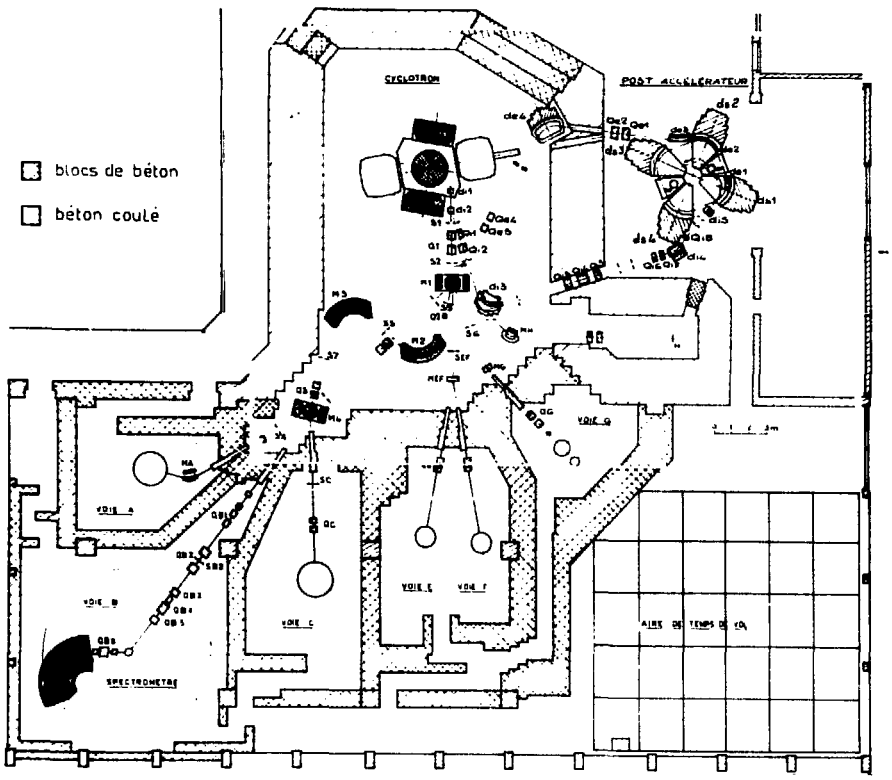
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

ENTRY NO. 17

NAME OF MACHINE ORLEANS ISOCHRONOUS CYCLOTRON DATE 19/01/79
INSTITUTION CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
ADDRESS SERVICE DU CYCLOTRON 3A, rue de la Férollerie 45045 ORLEANS CEDEX

IN CHARGE G. GOIN REPORTED by

HISTORY AND STATUS

DESIGN, date 1971 MODEL tests 1971
ENG. DESIGN, date 1971
CONSTRUCTION, date 1972-1973
FIRST BEAM date (or goal) 1974
MAJOR ALTERATIONS

OPERATION, ∿ 45 hr/wk; On Target 20 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 2
TECHNICIANS 5 CRAFTS
GRAD STUDENTS involved during year
OPERATED BY Res staff or 2 Operators
BUDGET, op & dev
FUNDED BY C N R S

RESEARCH STAFF, not included above

USERS, in house 6 outside 12
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY C N R S

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable 3 x 10 m^2
TARGET STATIONS 2 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES Isotope production
Irradiation, solid state

REFERENCES/NOTES

MAGNET

POLE FACE diameter 160 cm; R extraction 67 cm
GAP, min 13 cm; Field 19 kG
max 27 cm; Field kG
AVERAGE FIELD at R ext 15 kG
} at 0.25 x 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B \rangle$
NUMBER OF SECTORS 4 ; SPIRAL, max deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 4
Rad grad /sec or Circ coils 8
WEIGHT: Fe 100 tons; Coils tons
CONDUCTOR, Material and type
STORED ENERGY MJ
COOLING SYSTEM
POWER: Main coils 100 max, kW
Trimming coils 26 max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 60 deg
BEAM APERTURE 3 cm; DC BIAS kV
TUNED by, coarse M. PANEL fine Moving Panel
RF 20 to 40 mHz, stable ± 1 /10^6
Orb F 5 to 20 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 2, 3, 4
DEE-Gnd, max 50 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.01
RF PHASE stable to ± 0.1 deg
RF POWER input, max 110 kW
RF PROTECT circuit, speed 10 μsec
Type Ignitron
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size

OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 1.5 hrs

ION SOURCES/INJECTION SYSTEM

Internal axial Livingstone type

EXTRACTION SYSTEM

Deflector + focusing magnet

CONTROL SYSTEM

typing limit

ENTRY NO. 17 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P	5 38	5 33
	d	5 24	5 25
	α	10 48	10 50
CURRENT		(μA)	(μA)
Internal	P	200	200
	d	200	200
	α	100	60
External	P	100	80
	d		80
	α	40	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance		
(mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Machine being constructed by CGR-MeV FRANCE

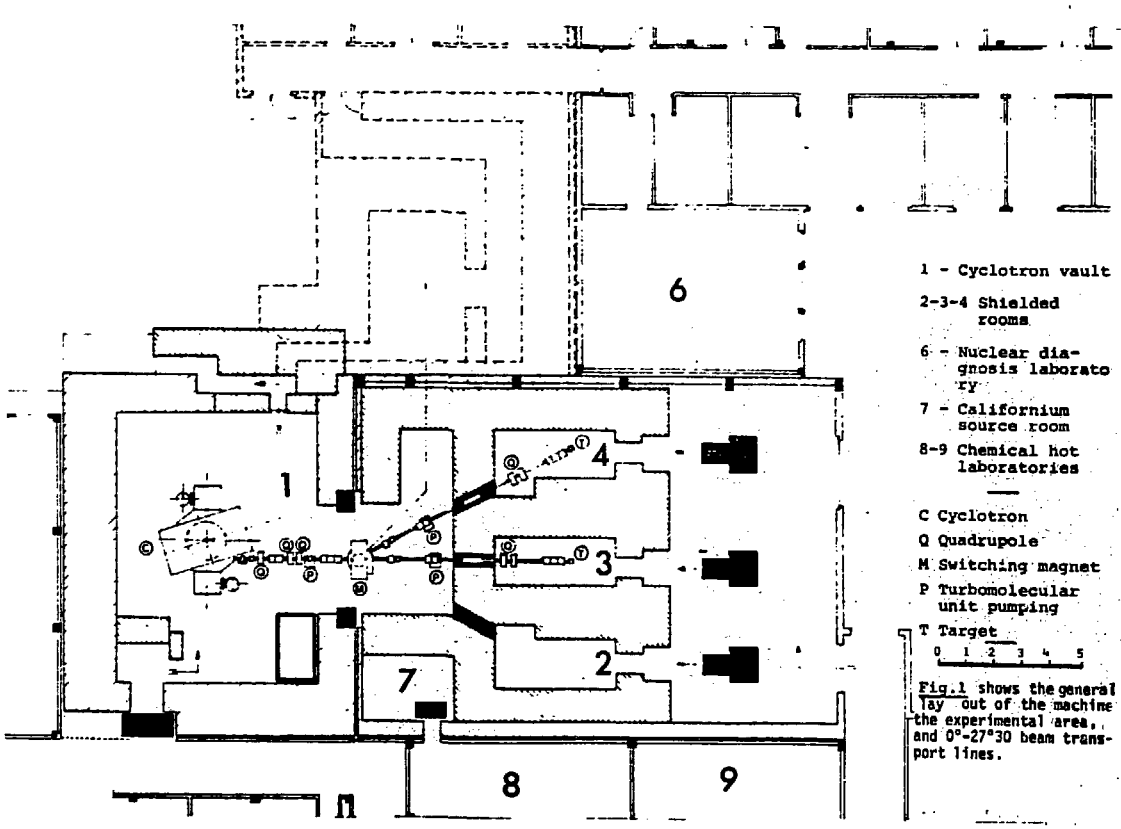


Fig.1 shows the general lay out of the machine the experimental area, and 0°-27°30 beam transport lines.

typing limit

ENTRY NO. 18

NAME OF MACHINE Cyclotron 520 DATE 1.3.1979
INSTITUTION Atomic Energy Commission - Department of Biology
ADDRESS Hôpital d'Orsay, 91406 Orsay, France

IN CHARGE Kellershohn C. REPORTED by Crouzel C.

HISTORY AND STATUS

DESIGN, date 1973 MODEL tests
ENG. DESIGN, date 1973
CONSTRUCTION, date 1974
FIRST BEAM date (or goal) May 1975
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

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS
TECHNICIANS CRAFTS
GRAD STUDENTS involved during year
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, *not included above*

USERS, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS 3 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES
Isotope production

REFERENCES/NOTES

MAGNET

POLE FACE diameter 120 cm; R extraction 52 cm
GAP, min 8.6 cm; Field 17 kG
max 14 cm; Field 10.6 kG
AVERAGE FIELD at R ext 14 kG
} at 136 x 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B\rangle$ 1.21
NUMBER OF SECTORS 4 ; SPIRAL, max 34 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 4
Rad grad /sec or Circ coils
WEIGHT: Fe 28 tons; Coils tons
CONDUCTOR, Material and type
STORED ENERGY MJ
COOLING SYSTEM Water
POWER: Main coils 65 max, kW
Trimming coils 10 max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 50 deg
BEAM APERTURE 2 cm; DC BIAS 1 kV
TUNED by, coarse yes fine yes
RF 20 to 62 mHz, stable ± 1 /10^6
Orb F 6 to 20 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 2, 3, 6
DEE-Gnd, max 35 kV, min gap 2 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± 0.1 deg
RF POWER input, max 20 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size Diffusion pump

OPERATING PRESSURE μTorr,
PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

Levingston

EXTRACTION SYSTEM

electrostatic deflector

CONTROL SYSTEM

typing limit

ENTRY NO. 18 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	24	
	d	13	
	α	26	
	^{3}He	33	
CURRENT		(μA)	(μA)
Internal	p	200	
	d	400	
	α - ^{3}He	100	
External	p	70	
	d	70	
	α - ^{3}He	50	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

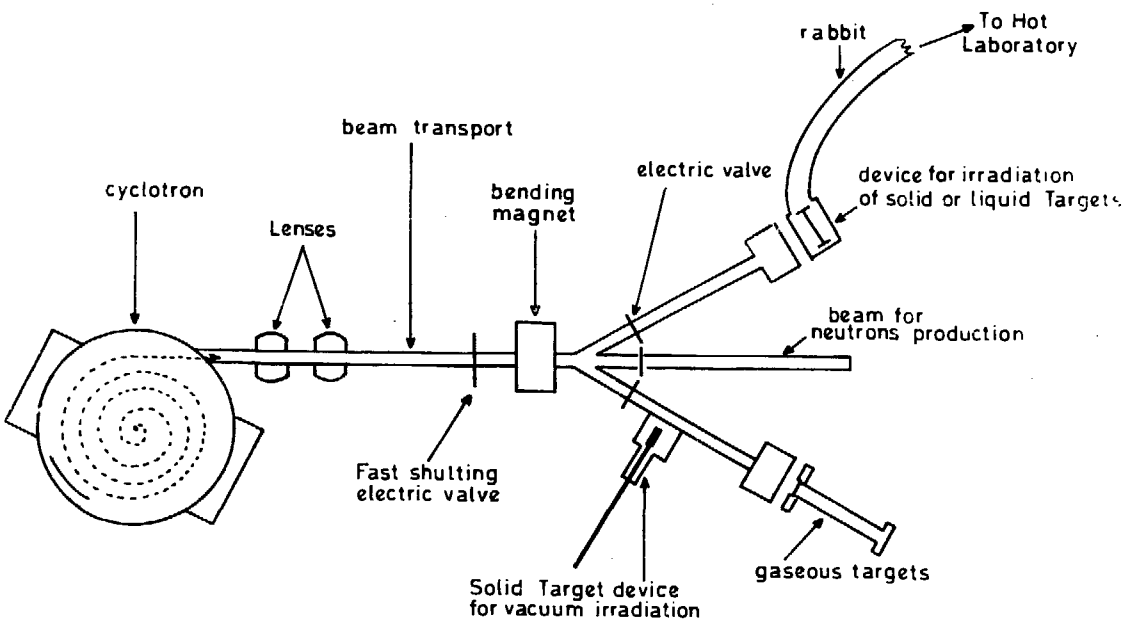
OPERATING PROGRAMS, time dist

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

100

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Machine constructed by CGR-MeV



Plan of irradiation devices at the SHFJ Cyclotron - fig 1

typing limit

ENTRY NO. 19

NAME OF MACHINE ALICE - CEVIL DATE 05.07.78
INSTITUTION INSTITUT DE PHYSIQUE NUCLEAIRE
ADDRESS B.P. N° 1 91406 ORSAY FRANCE

IN CHARGE LUC C.B. MARTIAL REPORTED by L. MARTIAL

HISTORY AND STATUS

DESIGN, date 1959 MODEL tests 1958 - 59
ENG. DESIGN, date 1959 - 1962
CONSTRUCTION, date 1960 - 64
FIRST BEAM date (or goal) 1965 APRIL
MAJOR ALTERATIONS LINAC INJECTOR 1968
new beams area 1972
OPERATION, 120 hr/wk; On Target 100 hr/wk
X TIME DIST., in house 59 %, outside 49 %
USERS' SCHEDULING CYCLE 12 weeks
COST, ACCELERATOR 5.106 F
COST, FACILITY, total 12.10^6 F
FUNDED BY Ministère National de la Recherche Scientifique

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 0 ENGINEERS 2
TECHNICIANS 24 CRAFTS 7
GRAD STUDENTS involved during year
OPERATED BY Res staff or 13 Operators
BUDGET, op & dev 10^6 F
FUNDED BY Centre National de la Recherche Scientifique

RESEARCH STAFF, not included above

USERS, in house 44 outside 52
GRAD STUDENTS involved during year 5
RES. BUDGET, in house 0.9 10^6 F
FUNDED BY CNRS - IN2P3

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 290 m^2
movable m^2
TARGET STATIONS 9 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type 120° n = 1/2
COMPUTER, model IBM 360 - 70
OTHER FACILITIES PDP 11/05
PDP 11/34

REFERENCES/NOTES

X - Time is assigned by Program Committee.

MAGNET

POLE FACE diameter 200 cm; R extraction 85 cm
GAP, min 21 cm; Field 18 kG
max 47 cm; Field 12.4 kG
AVERAGE FIELD at R ext 15 kG
} at 0.75 X 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B \rangle$ 1.2
NUMBER OF SECTORS 3 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF 0 /sec;
Harmonic correction
Rad grad /sec or Circ coils
WEIGHT: Fe 260 tons; Coils 20 tons
CONDUCTOR, Material and type Aluminium
STORED ENERGY MJ
COOLING SYSTEM oil and demineralized water
POWER: Main coils 490 max, kW
Trimming coils 72 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) 50 deg
ION ENERGY (Bending limit) E/A = 75 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 5 cm; DC BIAS 0 kV
TUNED by, coarse fine Trim - Cap
RF 5 to 10.2 mHz, stable ± 7 /10^6
Orb F 1.7 to 10.2 mHz; GAIN, max 150 kV/turn
HARMONICS, RF/Orb F, used 1 - 3
DEE-Gnd, max 75 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.01
RF PHASE stable to ± deg
RF POWER input, max 100 kW
RF PROTECT circuit, speed 1 μsec
Type Thyratron crowbar
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 4 diffusion pumps one 80 cm three 60 cm
OPERATING PRESSURE LINAC 0.3 CEVI μTorr,
PUMPDOWN TIME 10 hrs

ION SOURCES/INJECTION SYSTEM

Internal penning and LINAC with internal stripping in the cyclotron

EXTRACTION SYSTEM

Electrostatic deflector + magnetic channels

CONTROL SYSTEM

PDP 11/05

typing limit

ENTRY NO. 19 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	$^{14}N^{7}$		210
	$^{40}Ca^{15}$		400
	$^{63}Cu^{20}$		450
	$^{84}Kr^{25}$		520
CURRENT		(μA)	(μA)
Internal			
External	$^{14}N^{7}$		0.05
	$^{40}Ca^{15}$		0.15
	$^{84}Kr^{25}$		0.015
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

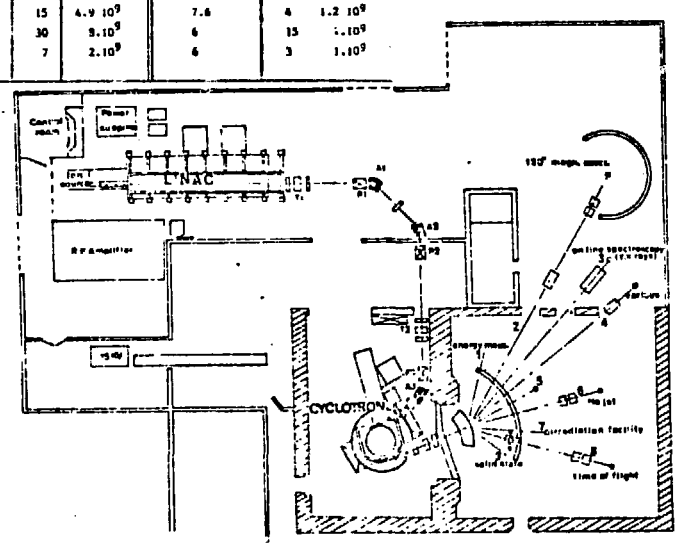
	Measured		Conditions				
Pulse Width	11	RF deg	1	μA of	$^{16}O^{5}$	MeV	106
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	40	%		μA of		MeV	
Res, ΔE/E	1	%		μA of		MeV	
Emittance (mm-mrad)	axial / radial			μA of		MeV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	80 %
Solid State Physics	+ atomic physics 10 %
Bio-Medical Applications	%
Isotope Production	%
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Particule	E min MeV/Uma	Intensité nA	Intensité PPS	E moy MeV/Uma	Intensité nA	Intensité PPS	E max MeV/Uma	Intensité nA	Intensité PPS
B_{10}	9	50	8.10^{10}	10	50	10^{10}	14.5	50	3.10^{10}
B_{11}	7			8.5			14.		
N_{14}	9.2	200	2.10^{11}	12	200	2.10^{11}	15	40	3.10^{10}
O_{16}	7	300	$5.2\ 10^{11}$	10	500	$5.2\ 10^{11}$	13.5	300	$2.6\ 10^{11}$
F_{19}	5	250	$2.6\ 10^{11}$	8.8	500	$4.4\ 10^{11}$	12.5	200	$1.6\ 10^{11}$
Ne_{20}	5	100	1.10^{11}	10	800	$6.2\ 10^{11}$	14.3	150	1.10^{11}
Ne_{22}	5	10	1.10^{10}	8.5	15	1.10^{10}	11.8	15	1.10^{10}
Mg_{24}	5	30	$2.6\ 10^{10}$	10	100	$6.9\ 10^{10}$	15	20	1.10^{10}
Mg_{26}	5	15	$1.3\ 10^{10}$	9	30	2.10^{10}	12.6	15	1.10^{10}
Al_{27}	5	100	8.10^{10}	8.5	300	2.10^{11}	11.7	200	$1.1\ 10^{11}$
S_{32}	5	500	3.10^{11}	8.5	1μA	5.10^{11}	11.7	250	$1.2.10^{11}$
Cl_{35}	5	100	6.10^{10}	8	300	$1.5\ 10^{11}$	11.3	30	$1.3\ 10^{10}$
Ar_{40}	4	100	$6.2\ 10^{10}$	6	1μA	$5.2\ 10^{11}$	8.6	500	$2.2\ 10^{11}$
Ca_{40}	4	100	$5.6\ 10^{10}$	7	400	2.10^{11}	10	150	$6.2\ 10^{10}$
Ti_{48}	4	20	1.10^{10}	6	60	$2.5\ 10^{10}$	8.8	20	$7.3\ 10^{9}$
Ti_{51}	3.6	40	2.10^{10}	5.6	80	$3.3\ 10^{10}$	7.7	40	$1.5\ 10^{10}$
Cr_{52}	3.6	40	$1.9\ 10^{10}$	6	100	$3.9\ 10^{10}$	8.5	40	$1.4\ 10^{10}$
Fe_{56}	3.6	30	$1.2\ 10^{10}$	5.8	50	2.10^{10}	8	30	1.10^{10}
Co_{59}	3.6	10	4.10^{9}	5.5	30	$1.1\ 10^{10}$	7.3	15	5.10^{9}
Ni_{58}	3.6	20	1.10^{10}	6	30	1.10^{10}	8.4	20	6.10^{9}
Cu_{63}	3.6	60	$2.4\ 10^{10}$	5.3	80	$2.6\ 10^{10}$	7	50	$1.5\ 10^{10}$
Cu_{65}	3.6	10	$6.3\ 10^{9}$	5.3	15	$5.2\ 10^{9}$	7	10	$3.1\ 10^{9}$
Zn_{64}	3.6	5	$1.9\ 10^{9}$	5.3	30	$9.8\ 10^{9}$	7.6	10	$2.9\ 10^{9}$
Zn_{66}	3.6	3	$1.1\ 10^{9}$	5.3	20	$6.6\ 10^{9}$	7.6	5	$1.5\ 10^{9}$
Zn_{68}	3.6	2	$7.8\ 10^{8}$	5.3	15	$4.9\ 10^{9}$	7.6	4	$1.2\ 10^{9}$
Kr_{84}	3.6	30	1.10^{10}	4.8	30	9.10^{9}	6	15	5.10^{9}
Kr_{86}	3.6	6	2.10^{9}	4.8	7	2.10^{9}	6	3	1.10^{9}



ALICE plan view

typing limit

ENTRY NO. 21

NAME OF MACHINE VICKSI (Separated-Sector Cyclotron)+ DATE July 78
INSTITUTION Hahn-Meitner-Institut für Kernforschung Berlin GmbH
ADDRESS 1000 Berlin 39, Glienicker Straße 100

IN CHARGE K. Ziegler REPORTED by K. Ziegler

HISTORY AND STATUS

DESIGN, date 1973-74 MODEL tests 1973-74
ENG. DESIGN, date 1973-75
CONSTRUCTION, date 1974-76
FIRST BEAM date (or goal) June 77
MAJOR ALTERATIONS none

OPERATION, -- hr/wk; On Target -- hr/wk
TIME DIST., in house -- %, outside -- %
USERS' SCHEDULING CYCLE no reg. schedule yet weeks
COST, ACCELERATOR
COST, FACILITY, total DM 40 Million
FUNDED BY Hahn-Meitner-Institut

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 6 ENGINEERS 6
TECHNICIANS 7 CRAFTS 30
GRAD STUDENTS involved during year
OPERATED BY -- Res staff or X Operators
BUDGET, op & dev DM 5.5 million
FUNDED BY Hahn-Meitner-Institut

RESEARCH STAFF, not included above

USERS, in house ~40 outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY Hahn-Meitner-Institut

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 800 m^2
movable m^2
TARGET STATIONS 14 in 6 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type Q3D
COMPUTER, model PDP 11/70
OTHER FACILITIES External pulsing system

REFERENCES/NOTES

+The Cyclotron was designed and built under contract with Scanditronix, Uppsala, Sweden. Scanditronix notation for the Cyclotron is SPC 120 refering to the energy constant $E=120q^2/A$. The cyclotron was accepted in March 78.

typing limit

MAGNET

POLE FACE diameter 380 cm; R extraction 171 cm
GAP, min 6 cm; Field 15.7 kG } at .98 x 10^6 ampere turns
max open cm; Field ~1 kG
AVERAGE FIELD at R ext 8.9 kG
CURRENT STABILITY 5 parts/10^6; $B_{max}/\langle B\rangle$ 1.74
NUMBER OF SECTORS 4 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 3/sector
Rad grad 12 /sec or Circ coils --
WEIGHT: Fe 360 tons; Coils 6 tons
CONDUCTOR, Material and type Hollow Copper
STORED ENERGY ~ 0.5 MJ
COOLING SYSTEM Demineralized Water
POWER: Main coils 300 max, kW
Trimming coils 50 max, kW
YOKE/POLE AREA 108 %
SECTOR ANGLE (Sep Sec) 50 deg
ION ENERGY (Bending limit) E/A = 128 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 36 deg
BEAM APERTURE 4 cm; DC BIAS 0 kV
TUNED by, coarse Piston fine Flaps
RF 10 to 20 mHz, stable ± 0.05 /10^6
Orb F 1.43 to 8.9 mHz; GAIN, max 400 kV/turn
HARMONICS, RF/Orb F, used 2-6
DEE-Gnd, max 100 kV, min gap 3.7 cm
STABILITY, (pk-pk noise)/(pk RF volt) <10^{-3}
RF PHASE stable to ± <0.05 deg
RF POWER input, max 90 kW
RF PROTECT circuit, speed 5 μsec
Type RF-turn off
FREQUENCY MODULATION, rate -- /sec
MODULATOR, type --
BEAM PULSE, width --

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Kryopumps (4.2° K)
2 Turbopumps (1450 l/sec)
OPERATING PRESSURE 0.1 - 0.5 μTorr,
PUMPDOWN TIME 8 hrs

ION SOURCES/INJECTION SYSTEM

Axial Penning source in 6MV Van de Graaff, Stripper between Injector and Cyclotron

EXTRACTION SYSTEM El.stat. deflector, current septum, bending magnet

CONTROL SYSTEM

Computer Control System, PDP 11/40 2)

ENTRY NO. 21 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	50	--
	^{12}C	200	--
	^{20}Ne	200	280
	to ^{40}Ar	200	205
CURRENT		(μA)	(μA)
Internal			
External	^{3}He		0.06pμA
	^{20}Ne	0.1pμA	0.01pμA
	^{40}Ar		0.01pμA
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions
Pulse Width	<9	RF deg	008p μA of 180 MeV ^{20}Ne
Phase Exc, max	± 1	RF deg	008p μA of 180 MeV ^{20}Ne
Extract Eff	96	%	002p μA of 220 MeV ^{20}Ne
Res, ΔE/E	<10^{-3}	%	008p μA of 180 MeV ^{20}Ne
Emittance (mm-mrad)	6.3	axial / radial	008p μA of 180 MeV ^{20}Ne

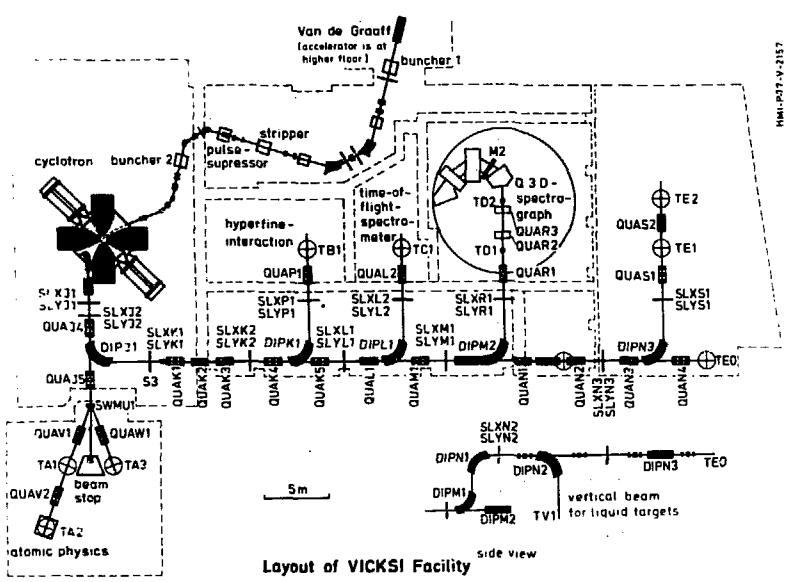
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	~40	%
Solid State Physics	~40	%
Bio-Medical Applications		%
Isotope Production		%
Development	~20	%
No reg. schedule yet. Data are estimated from short test periods. 1)		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The accelerator facility consists of a 6 MV Van de Graaff as injector for a 4-fold symmetric separated sector cyclotron. Mostly 2^+ ions from an axial penning ion source are accelerated to a maximum energy of 12 MeV and after stripping injected into the cyclotron. Before injection the beam is bunched into a phase width of ~5°. The energy of the extracted beam is 17 times that of injection. Single turn extraction with $\Delta E/E \approx 10^{-3}$ and sharp time structure is the normal mode of operation. The main target positions are reached via a double monochromator that allows for very flexible beam preparation. Beam has been delivered to target stations TB1, TC1 and TD1, the other stations are under construction.

Ref: 1) Running in of VICKSI and first operating experience, this conference
2) The computer aided Control-System of the VICKSI Accelerators, this conference



Layout of VICKSI Facility

typing limit

ENTRY NO. 22

NAME OF MACHINE Bonn Isochronous Cyclotron DATE July 78

INSTITUTION University of Bonn, Institut für Strahlen-u. Kernphysik

ADDRESS Nussallee 14-16, D-5300 Bonn, Germany

IN CHARGE T. Mayer-Kuckuk REPORTED by H. Wahl

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests 1966-67

ENG. DESIGN, date 1966-67

CONSTRUCTION, date 1967-69

FIRST BEAM date (or goal) Dec. 1968

MAJOR ALTERATIONS none

OPERATION, 160 hr/wk; On Target ~140 hr/wk

TIME DIST., in house 98 %, outside 2 %

USERS' SCHEDULING CYCLE ~1 weeks

COST, ACCELERATOR ~5 · 10^6 DM

COST, FACILITY, total ~8 · 10^6 DM

FUNDED BY Bundesministerfür Bildung und Wissenschaft

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS 3

TECHNICIANS 5 CRAFTS 1

GRAD STUDENTS involved during year 15

OPERATED BY Res staff or x Operators

BUDGET, op & dev 1,8 · 10^6 DM

FUNDED BY Land NRW

RESEARCH STAFF, not included above

USERS, in house ~80 outside ~2

GRAD STUDENTS involved during year ~20

RES. BUDGET, in house 4,5 · 10^5 DM

FUNDED BY Land NRW und Bundesministerfür Forschung und Technologie

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 415 m^2

movable -- m^2

TARGET STATIONS 12 in 4 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type split pole (Scanditronix)

COMPUTER, model PDP9 (on line), PDP9L,

OTHER FACILITIES PDP15, XVM200

Isotope production

Orange spectrometer

Time-of-flight-study

off-line mass separation

REFERENCES/NOTES

Jahresberichte ISKP 1965-1977

IEEE Trans. Nucl. Sci., 18(1971)319

K. Euler et al., 7th Int. Conf. on Cyclotrons and their applications (1975)92

further references see 2nd sheet

MAGNET

POLE FACE diameter 200 cm; R extraction 91 cm

GAP, min 8,4 cm; Field 18,5 kG

max 24 cm; Field 7,0 kG

} at 0,14 x 10^6 ampere turns

AVERAGE FIELD at R ext 12,7 kG

CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$ 1,46

NUMBER OF SECTORS 3 ; SPIRAL, max 0 deg

POLE FACE COIL PAIRS: AVF ____ /sec;

Harmonic correction ____

Rad grad 7 /sec or Circ coils ____

WEIGHT: Fe ~200 tons; Coils ~5 tons

CONDUCTOR, Material and type copper

STORED ENERGY ~0,3 MJ

COOLING SYSTEM demineralized water

POWER: Main coils 40 max, kW

Trimming coils 5 max, kW

YOKE/POLE AREA 100 %

SECTOR ANGLE (Sep Sec) - deg

ION ENERGY (Bending limit) E/A = 60 q^2/A^2 MeV

(Focusing limit) E/A = ~30 q/A MeV

ACCELERATION SYSTEM

DEES, number 3 angle 40 deg

BEAM APERTURE 2,4 cm; DC BIAS 0 kV

TUNED by, coarse capacity fine loops

RF 20,4 to 28,5 mHz, stable ± 10 /10^6

Orb F 6,4 to 9,5 mHz; GAIN, max 200 kV/turn

HARMONICS, RF/Orb F, used 3 (9)

DEE-Gnd, max 45 kV, min gap 2,3 cm

STABILITY, (pk-pk noise)/(pk RF volt) ~5 · 10^{-4}

RF PHASE stable to ± <3 deg

RF POWER input, max 30 kW

RF PROTECT circuit, speed 1 μsec

Type ignitron

FREQUENCY MODULATION, rate ____ /sec

MODULATOR, type ____

BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size 1 diffusion pump 60 cm

OPERATING PRESSURE 2 μTorr,

PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM :int.:Penning

ext.:Penning for ions $e/m \geq 1/3$;

I.S. for polarized p, d; electrostat. inj. syst.

EXTRACTION SYSTEM

electrostat. deflector, 2 magn. channels

CONTROL SYSTEM

conventional

typing limit

ENTRY NO. 22 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	d	14–28	14–30
	α	28–56	28–60
	$^{12}C^{4+}$	85	85
	$^{14}N^{5+}$	100	100
CURRENT		(μA)	(μA)
Internal	d	50	50
	α	10	20
	$^{14}N^{5+}$	4	0,2
External	d	40	50
	α	8	15
	$^{14}N^{5+}$	2	0,1
		(part/s)	(part/s)
Secondary			

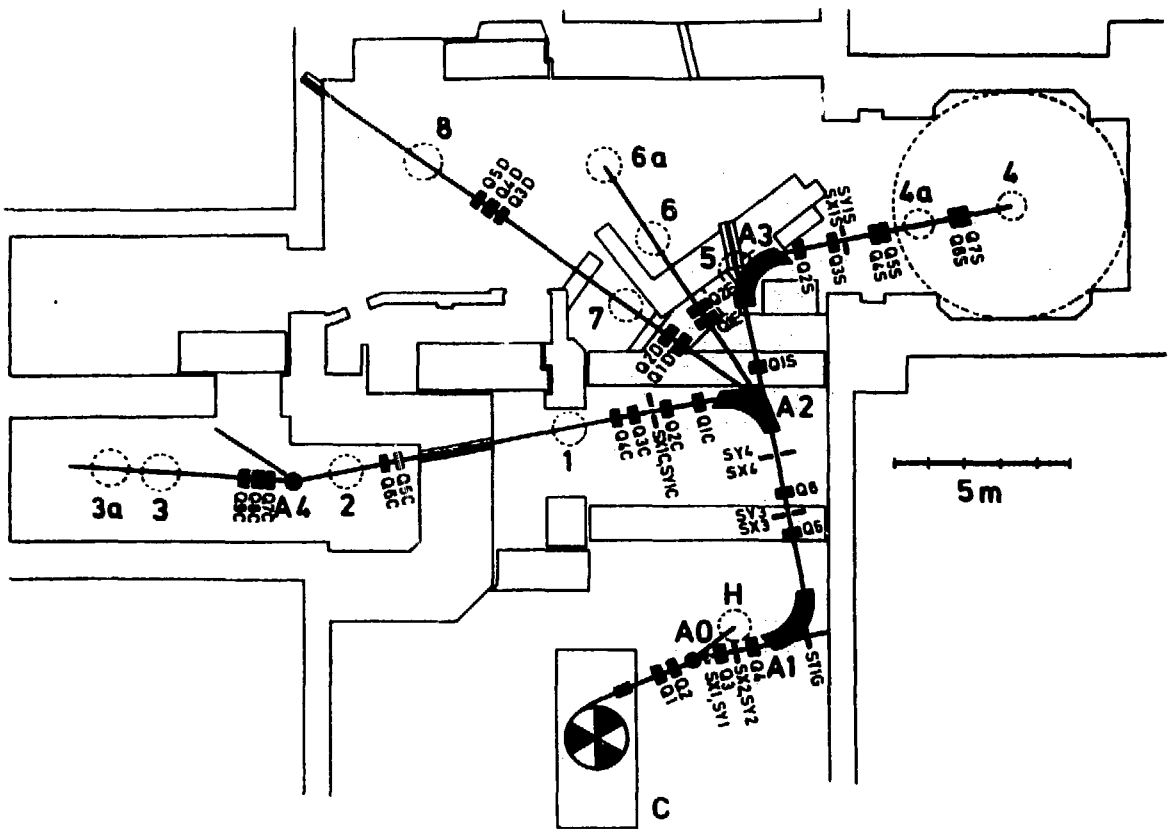
BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	~5	RF deg	~1	μA of	21-28	MeV d
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	90	%	25	μA of	28	MeV d
Res, ΔE/E	0,1	%	5	μA of	25	MeV d
Emittance (mm-mrad)	<10 axial, <10 radial		10	μA of	14-30	MeV d

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	70 %
Solid State Physics	4 %
Bio-Medical Applications	– %
Isotope Production	8 %
Development	16 %
archeometric applications	2 %
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



References: A.Scholzen et al., Nucl.Instr. 123 (1975) 327
H.Hinterberger et al., Nucl.Instr. 130 (1975) 335
" " " " " " " 130 (1975) 347
" " " " " " " 133 (1976) 1
M.Agena et al., these Proceedings

typing limit

ENTRY NO. 23

NAME OF MACHINE Isochronous Cyclotron CV 28 DATE 8/30/78

INSTITUTION Physikalisch-Technische Bundesanstalt

ADDRESS Bundesallee 100, 3300 Braunschweig, W.Germany

IN CHARGE Hein JÜrgen Brede REPORTED by H.J. Brede

HISTORY AND STATUS

DESIGN, date ____ MODEL tests ____
ENG. DESIGN, date ____ } The Cyclotron Corp.
CONSTRUCTION, date ____
FIRST BEAM date (or goal) 1974
MAJOR ALTERATIONS New pumping system 1977

OPERATION, ____ hr/wk; On Target ____ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR $ 1.5 x 10^6
COST, FACILITY, total $ 1.4 x 10^7
FUNDED BY Bundeswirtschaftsministerium

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 1 CRAFTS 1
GRAD STUDENTS involved during year 0
OPERATED BY ____ Res staff or X Operators
BUDGET, op & dev ____
FUNDED BY Bundeswirtschaftsministerium

RESEARCH STAFF, not included above

USERS, in house 9 outside 3
GRAD STUDENTS involved during year 0
RES. BUDGET, in house $ 300 000/year
FUNDED BY Bundeswirtschaftsministerium

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 24 x 30 m^2
movable ____ m^2
TARGET STATIONS 5 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type ____
COMPUTER, model PDP 15-, PDP 11-
OTHER FACILITIES Time-of-Flight-Spectrometer, 3.75 MV Van de Graaff Generator with internal pulsing system

REFERENCES/NOTES

H.J. Brede et al., Nucl. Instr. & Meth. to be published

MAGNET

POLE FACE diameter 96.5 cm; R extraction 41 cm
GAP, min 5.08 cm; Field 22.1 kG
max 11.64 cm; Field 14.2 kG
AVERAGE FIELD at R ext 17.5 kG
} at 0.23 x 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ ____
NUMBER OF SECTORS 3 ; SPIRAL, max ____ deg
POLE FACE COIL PAIRS: AVF ____ /sec;
Harmonic correction 1 per sector
Rad grad ____ /sec or Circ coils 3
WEIGHT: Fe 22 tons; Coils ____ tons
CONDUCTOR, Material and type ____
STORED ENERGY ____ MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 60 max, kW
Trimming coils 15 max, kW
YOKE/POLE AREA ____ %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 82 deg
BEAM APERTURE 2.04 cm; DC BIAS 0.7 kV
TUNED by, coarse Short. Pl. fine Trim Cap.
RF 6.5 to 26 mHz, stable ± 30 /10^6
Orb F 6.5 to 26 mHz; GAIN, max 110 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 35 kV, min gap 1.5 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± ____ deg
RF POWER input, max 40 kW
RF PROTECT circuit, speed ____ μsec
Type Ignitron crowbar
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Turbomolecular pumps, Refrigerator cryopump
OPERATING PRESSURE 15 μTorr
PUMPDOWN TIME 0.5 hrs

ION SOURCES/INJECTION SYSTEM

Internal Penning

EXTRACTION SYSTEM

Electrost. deflector + mag. channel

CONTROL SYSTEM

Manual control

typing limit

ENTRY NO. 23 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	24	24
	d^+	14	14
	$^3He^{++}$	36	36
	$^4He^{++}$	28	28
CURRENT		(μA)	(μA)
Internal	p		500
	d		450
	He		300
External	p		100
	d		100
	He		60
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff		%		μA of		MeV
Res, ΔE/E		%		μA of		MeV

Emittance (mm-mrad) { 6 axial, 9 radial } 10 μA of 6 MeV d^+

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	%
Development	%
Production of monoenergetic neutrons	100 %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The Van de Graaff generator and the energy variable cyclotron are used to produce "monoenergetic" neutrons with continuously variable energy between about 10 keV and 31.5 MeV. Both accelerators can be operated in a nanosecond pulsed beam mode, as needed for time-of-flight spectroscopy. The building comprises a low backscatter experimental hall and a set-up for a fast neutron scattering experiment with five flight paths in fixed positions and a cyclotron moving on a swivel arm.

typing limit

ENTRY NO. 24

NAME OF MACHINE Isochronous variable energy cyclotron CV 28 PAGE TCC, Berkeley

INSTITUTION Institute Med. Rad. Physics and Biology, Div. Rad. Physics (20.8.78)

ADDRESS Hufelandstr. 55, D 4300 Essen 1, Western Germany

IN CHARGE Prof. Dr. J. Rassow REPORTED by Rassow

HISTORY AND STATUS

DESIGN, date 1973 MODEL tests 1974

ENG. DESIGN, date 1972

CONSTRUCTION, date 1974

FIRST BEAM date (or goal) Sept.1975 (in Essen)

MAJOR ALTERATIONS

OPERATION, 40 hr/wk; On Target 20 hr/wk

TIME DIST., in house * %, outside * %

USERS' SCHEDULING CYCLE weeks

COST, ACCELERATOR $ 0.9 x 10^6

COST, FACILITY, total $ 1.6 x 10^6

FUNDED BY Land Nordrhein-Westfalen (University)

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 7 ENGINEERS 5

TECHNICIANS 3 CRAFTS 1

GRAD STUDENTS involved during year 0

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY Land Nordrhein-Westfalen (University)

RESEARCH STAFF, not included above

USERS, in house 3 groups outside

GRAD STUDENTS involved during year

RES. BUDGET, in house

FUNDED BY University

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 138 m^2

movable m^2

TARGET STATIONS 7 in 4 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type --

COMPUTER, model --

OTHER FACILITIES isocentric neutron facility 5 external and 1 internal target stations, 1 neutron activation station

REFERENCES/NOTES Rassow, J.: Planning of a Cyclotron Facility within a Radiological Centre. In: Kormano,M., Stieve, F.: Planning of Radiological Departments. Thieme Publisher, Stuttgart, 1974.

Rassow, J., Hüdepohl, G., Maier, E., Meissner, P.: CIRCE - Cyclotron Isocentric Neutron Therapy Facility, Radiation Physics Essen. In: Burger, G., Ebert, H.G.: Proceedings Third Symposium on Neutron Dosimetry in Biology and Medicine. Neuherberg May 1977. EURATOM EUR 5848 DE/EN/FR 1978

typing limit

MAGNET

POLE FACE diameter 96 cm; R extraction 42 cm

GAP, min 5.0 cm; Field 14 kG } at 0.25 x 10^6 ampere turns

max 10.1 cm; Field 20 kG

AVERAGE FIELD at R ext 17 kG

CURRENT STABILITY 300 parts/10^6; $B_{max}/\langle B \rangle$

NUMBER OF SECTORS 3 ; SPIRAL, max 47 deg

POLE FACE COIL PAIRS: AVF none /sec;

Harmonic correction 2 sets

Rad grad -- /sec or Circ coils --

WEIGHT: Fe 21 tons; Coils 2 tons

CONDUCTOR, Material and type Cu tubes

STORED ENERGY -- MJ

COOLING SYSTEM water

POWER: Main coils 70 max, kW

Trimming coils 20 max, kW

YOKE/POLE AREA 110 %

SECTOR ANGLE (Sep Sec) 120 deg

ION ENERGY (Bending limit) E/A = 28* q^2/A MeV

(Focusing limit) E/A = q/A MeV

* 24 (H^+)

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg

BEAM APERTURE 2.0 cm; DC BIAS 1 kV

TUNED by, coarse Short.Plane fine Trim Capacitor

RF 6.5 to 25.5 MHz, stable ± 100 /10^6

Orb F 6.5 to 26.5 MHz; GAIN, max 80 kV/turn

HARMONICS, RF/Orb F, used fundamental

DEE-Gnd, max 30 kV, min gap 1.3 cm

STABILITY, (pk-pk noise)/(pk RF volt)

RF PHASE stable to ± deg

RF POWER input, max 40 kW

RF PROTECT circuit, speed 0.05 μsec

Type crowbar - series tube

FREQUENCY MODULATION, rate 0 /sec

MODULATOR, type --

BEAM PULSE, width --

VACUUM SYSTEM Oil diffusion pump

PUMPS, No., Type, Size NRC 1 x 25 cm

8 x 5 cm

OPERATING PRESSURE 10 μTorr,

PUMPDOWN TIME 0.3 hrs

ION SOURCES/INJECTION SYSTEM

EXTRACTION SYSTEM Electrostatic deflector and magnetic channel

CONTROL SYSTEM

ENTRY NO. 24 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	protons	2 - 24	2 - 24
	deuterons	3 - 14	3 - 14
	Helium3++	5 - 38	5 - 38
	Helium4++	6 - 28	6 - 28
CURRENT		(μA)	(μA)
Internal	protons	500	300
	deuterons	500	400
	He-3	150	150
External	He-4	100	100
	protons	70	85
	deuterons	100	120
	He-3	70	80
	He-4	50 (part/s)	50 (part/s)
Secondary			

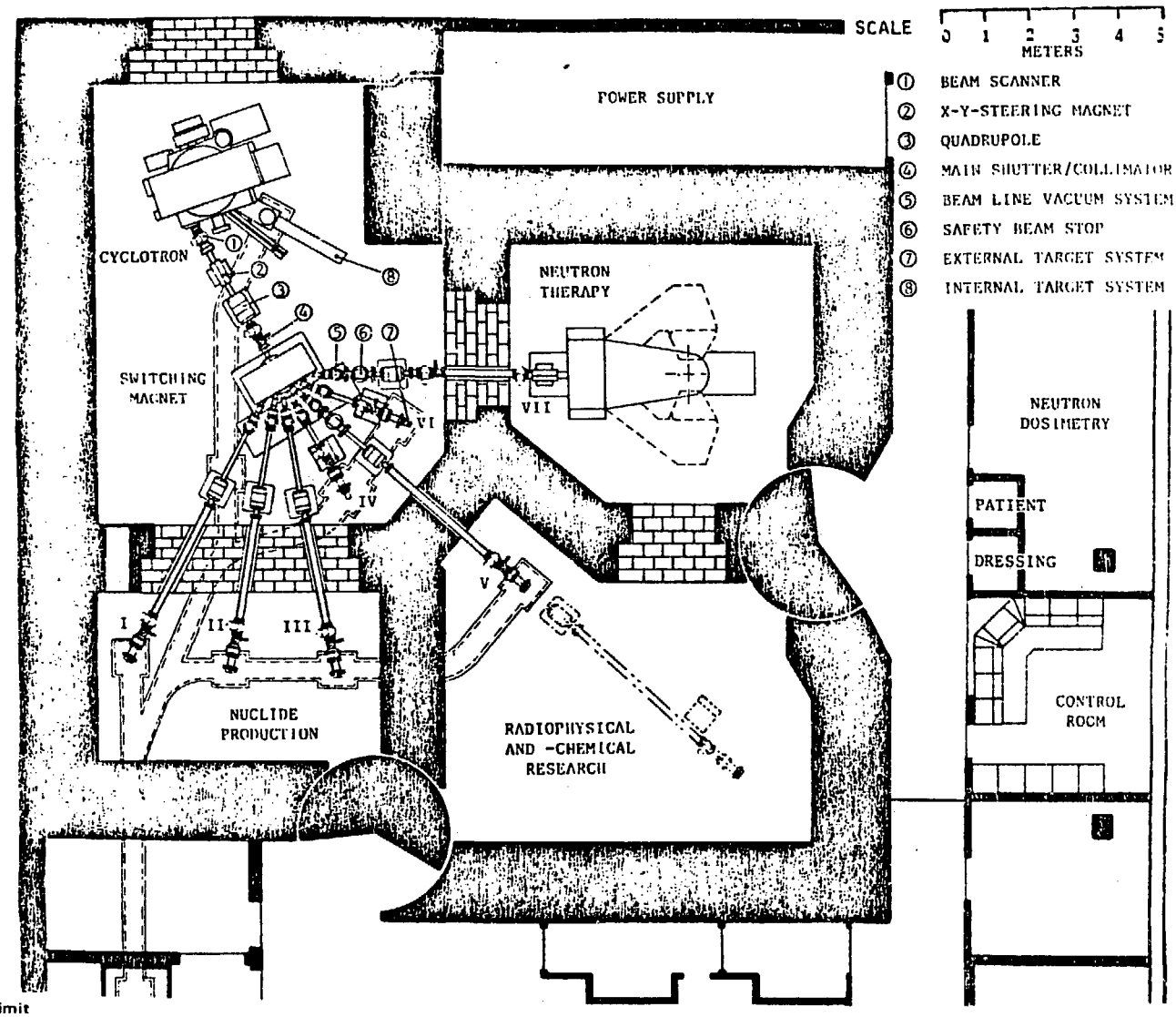
BEAM PROPERTIES

	Measured		Conditions
Pulse Width	____ RF deg	____ μA of	____ MeV ____
Phase Exc, max	____ RF deg	____ μA of	____ MeV ____
Extract Eff	70 %	100 μA of	14 MeV deuterons
Res, ΔE/E	____ %	____ μA of	____ MeV ____
Emittance (mm-mrad)	250 axial, 250 radial	100 μA of	14 MeV deuterons

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	33 %
Solid State Physics	%
Bio-Medical Applications	33 %
Isotope Production	33 %
Development	included above %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

ENTRY NO. 25

NAME OF MACHINE Hamburger Isochron-Zyklotron - HAIZY DATE 1972

INSTITUTION I. Institut f. Experimentalphysik, University of Hamburg

ADDRESS Hamburg, Germany

IN CHARGE Board of the Institute REPORTED by M. Bormann, R. Langkau

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests 1966

ENG. DESIGN, date 1966

CONSTRUCTION, date 1966-1968

FIRST BEAM date (or goal) 1968

MAJOR ALTERATIONS none

OPERATION, 140 hr/wk; On Target 70 hr/wk

TIME DIST., in house 70 %, outside 30 %

USERS' SCHEDULING CYCLE weeks

COST, ACCELERATOR $ 1.1 x 10^6

COST, FACILITY, total

FUNDED BY State of Hamburg and BMBW of Fed. Rep.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 2

TECHNICIANS 6 CRAFTS 4

GRAD STUDENTS involved during year 4

OPERATED BY Res staff or Operators

BUDGET, op & dev $200,000

FUNDED BY

RESEARCH STAFF, not included above

USERS, in house 12 outside 6

GRAD STUDENTS involved during year 12

RES. BUDGET, in house

FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed - m^2

movable 600 m^2

TARGET STATIONS 6 in 4 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type -

COMPUTER, model PDP 9

OTHER FACILITIES

Isotope production

Time-of-flight

REFERENCES/NOTES

Nucl. Inst. and Meth. 18, 19 (1962) pp. 88, 201, 327, 336

Nucl. Inst. and Meth. 68 (1969), p. 135

Nucl. Inst. and Meth. 94 (1971) p. 391

MS - Movable short

VC - Variable capacitor

MAGNET

POLE FACE diameter 140 cm; R extraction 57 cm

GAP, min 16 cm; Field kG } at X 10^6 ampere turns

max 32 cm; Field kG

AVERAGE FIELD at R ext 15 kG

CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B\rangle$ 1.33

NUMBER OF SECTORS 3 ; SPIRAL, max 37 deg

POLE FACE COIL PAIRS: AVF - /sec;

Harmonic correction 3

Rad grad - /sec or Circ coils 10

WEIGHT: Fe 80 tons; Coils 8 tons

CONDUCTOR, Material and type

STORED ENERGY MJ

COOLING SYSTEM water

POWER: Main coils 100 max, kW

Trimming coils 40 max, kW

YOKE/POLE AREA - %

SECTOR ANGLE (Sep Sec) - deg

ION ENERGY (Bending limit) E/A = 30 q^2/A^2 MeV

(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg

BEAM APERTURE 2.8 cm; DC BIAS 1 kV

TUNED by, coarse MS fine VC, auto

RF 5 to 23 mHz, stable ± 20 /10^6

Orb F 5 to 23 mHz; GAIN, max 100 kV/turn

HARMONICS, RF/Orb F, used

DEE-Gnd, max 50 kV, min gap cm

STABILITY, (pk-pk noise)/(pk RF volt) 2 x 10^{-4}

RF PHASE stable to ± - deg

RF POWER input, max 100 kW

RF PROTECT circuit, speed μsec

Type Capacitive pickup

FREQUENCY MODULATION, rate /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size

OPERATING PRESSURE 3 μTorr,

PUMPDOWN TIME < 2 hrs

ION SOURCES/INJECTION SYSTEM

Livingston type

EXTRACTION SYSTEM

DC-electrostatic def. + 2 compensating iron channels

CONTROL SYSTEM

typing limit

ENTRY NO. 25 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	α	10-32	10-34
	p	3-30	6-30
	d	5-16	5-17
	τ	13-44	15-40
CURRENT		(μA)	(μA)
Internal	p	> 100	300
	τ	-	10
	α	50	20
External	p	100	100
	τ	-	6
	α	30	10
		(part/s)	(part/s)
Secondary	-		
	-		

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	30	RF deg	10	μA of	15	MeV	p
Phase Exc, max	5	RF deg	5	μA of	15	MeV	p
Extract Eff	75	%	10	μA of	24	MeV	p
Res, ΔE/E	0.3	%	5	μA of	15	MeV	p
Emittance (mm-mrad)	16 axial / 20 radial		5	μA of	15	MeV	p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	95 %
Solid State Physics	- %
Bio-Medical Applications	- %
Isotope Production	5 %
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

1) Beam pulsing system under construction

2) Beam transport system sec: Nucl. Inst. & Meth. 99, 557 (1972)

typing limit

ENTRY NO. 27

NAME OF MACHINE Heidelberg Compact Cyclotron DATE July 1978
INSTITUTION German Cancer Research Center-Inst.for Nuclear Medicine
ADDRESS Heidelberg-West Germany

IN CHARGE Prof.Dr.W.J. Lorenz/ Dr. G. Wolber REPORTED by Dr. G. Wolber

HISTORY AND STATUS

DESIGN, date 1967 MODEL tests 1968-69
ENG. DESIGN, date
CONSTRUCTION, date Oct.1971-May 1972
FIRST BEAM date (or goal) June 14th, 1972+)
MAJOR ALTERATIONS

OPERATION, min.35 hr/wk; On Target 20 hr/wk
TIME DIST., in house 80 %, outside 20 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR $1,5 \times 10^6$ DM
COST, FACILITY, total 10^7 DM
FUNDED BY Volkswagenwerk Foundation

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 6 CRAFTS
GRAD STUDENTS involved during year 1
OPERATED BY Res staff or 2 Operators
BUDGET, op & dev
FUNDED BY Federal Government 90%
Government of State 10%

RESEARCH STAFF, not included above

USERS, in house 4 outside 3
GRAD STUDENTS involved during year 2
RES. BUDGET, in house
FUNDED BY Federal Government > 90%

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 16 x 18 m^2
movable m^2
TARGET STATIONS 6 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type -
COMPUTER, model -
OTHER FACILITIES
fast neutron target for radiation therapy

REFERENCES/NOTES

+) End of tests:April 30th,1973. Fixed schedule for experiments since 1975

1) Liesem,H.:Nucl.Instr.Meth.105, 1972, 329-332
2) Wolber,G.et al.: 7th Int.Conf.on Cyclotrons and their Applications, Zurich,Switzerland, Aug. 19-22, 1975

typing limit

MAGNET 1)

POLE FACE diameter 109 cm; R extraction 49 cm
GAP, min 5,4 cm; Field 20 kG
max 17,5 cm; Field 8 kG
AVERAGE FIELD at R ext kG
} at 0,175 $\times 10^6$ ampere turns
CURRENT STABILITY ± 50 parts/10^6; $B_{max}/(B)$ 1,43
NUMBER OF SECTORS 4 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF 4 /sec;
Harmonic correction -
Rad grad - /sec or Circ coils
WEIGHT: Fe 24 tons; Coils 2 tons
CONDUCTOR, Material and type Cu pipes
STORED ENERGY ~0,1 MJ
COOLING SYSTEM Water
POWER: Main coils 40 max, kW
Trimming coils 0,8 max, kW
YOKE/POLE AREA 102 %
SECTOR ANGLE (Sep Sec) 45 deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM 1)

DEES, number 2 angle 43 deg
BEAM APERTURE 2,3 cm; DC BIAS - kV
TUNED by, coarse Manual fine VC (Auto)
RF 28,6 to 43 mHz, stable ± 50 /10^6
Orb F 10 to mHz; GAIN, max 165 kV/turn
HARMONICS, RF/Orb F, used 2/4
DEE-Gnd, max 50 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 5×10^{-3}
RF PHASE stable to ± not measured deg
RF POWER input, max 60 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 2 x 450 ltrs/sec VERTICAL TURBO PUMPS
OPERATING PRESSURE 20 μTorr,
PUMPDOWN TIME 0,5 hrs

ION SOURCES/INJECTION SYSTEM

Livingstone Type

EXTRACTION SYSTEM DC Electrostatic Defelctor and Focusing Magnet Channel

CONTROL SYSTEM

ENTRY NO. 27 (cont.)

CHARACTERISTIC BEAMS 2)

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p/^{4}He		21,5
	d		10,6
	^{3}He		28
CURRENT		(μA)	(μA)
Internal	p,d		1000
	^{3}He, ^{4}He		50
External	p		53,5
	d		100
	^{3}He, ^{4}He		16
		(part/s)	(part/s)
Secondary	n		6x10^7 3)

BEAM PROPERTIES

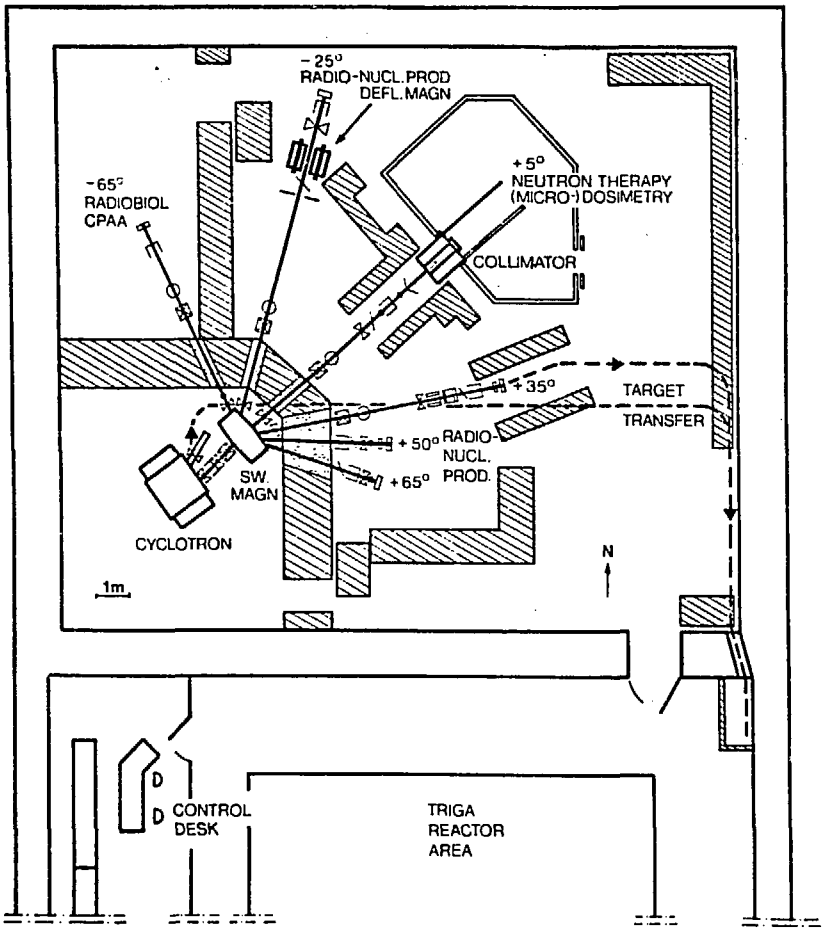
	Measured		Conditions
Pulse Width		RF deg	μA of MeV
Phase Exc, max	±30	RF deg 45	μA of 10,6 MeV d
Extract Eff	50–70 %		μA of 10,6 MeV d
Res, ΔE/E	0,5 %		μA of MeV
Emittance	not measured		
(mm-mrad)	axial / radial		μA of MeV

OPERATING PROGRAMS, time dist 2)

Basic Nuclear Physics	– %
Solid State Physics	– %
Bio-Medical Applications	40 %
Isotope Production	60 %
Development	%
	%
	%

3) $\bar{E}_n$=8,5 MeV, dose rate ~20 rad/min at FSD=120 cm and 50 μA d

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



THE
HEIDELBERG
COMPACT CYCLOTRON
LABORATORY

typing limit

ENTRY NO. 28

NAME OF MACHINE Jülich Isochronous Cyclotron (JULIC) DATE Aug. 1978
INSTITUTION Institut für Kernphysik der Kernforschungsanlage (KFA) Jülich
ADDRESS D-5170 Jülich, W. Germany

IN CHARGE C.U. Mayer-Böricke REPORTED by C.U.Mayer-Böricke, J.Reich

HISTORY AND STATUS

DESIGN, date 1963 MODEL tests 1963-1965
ENG. DESIGN, date 1964/1965
CONSTRUCTION, date 1966-1969
FIRST BEAM date (or goal) int.1968; ext.1969
MAJOR ALTERATIONS none

OPERATION, 168 hr/wk; On Target 140 hr/wk
TIME DIST., in house 61* %, outside 39** %
USERS' SCHEDULING CYCLE 5 weeks
COST, ACCELERATOR 14×10^6 DM
COST, FACILITY, total 24×10^6 DM (cycl.&bldg.)
FUNDED BY Kernforschungsanlage Jülich

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS 2
TECHNICIANS 13 CRAFTS 5
GRAD STUDENTS involved during year --
OPERATED BY -- Res staff or 8 Operators
BUDGET, op & dev
FUNDED BY Kernforschungsanlage Jülich

RESEARCH STAFF, not included above

USERS, in house 30* outside 75**
GRAD STUDENTS involved during year 5
RES. BUDGET, in house
FUNDED BY Kernforschungsanlage Jülich

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 210 (cycl.vault) m^2
movable 915 (exper.rooms) m^2
TARGET STATIONS 11 in 6 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type QQDDQ
COMPUTER, model PDP15, PDP11
OTHER FACILITIES In-Beam Gamma Ray Facilities; Bent Crystal Gamma Ray Spectrometer; Orange Type Beta Ray Spectrometer; Facilities for Isotope Production and Chemistry

REFERENCES/NOTES

H.Thimmel, Kerntechnik 12(1968)663
W.Kuhlmann, J.Bojowald, C.Mayer-Böricke, J.Reich, Proc.Fifth Int.Cycl. Conf., Oxford, 1969, p.190
C.Mayer-Böricke, JÜL-665 KP (1970)

*Institut f. Kernphysik of KFA
**Other institutes of KFA, foreign and German universities

typing limit

MAGNET

POLE FACE diameter 330 cm; R extraction 154 cm
GAP, min 8.4 cm; Field 19.2 kG
max 24 cm; Field 7.0 kG
AVERAGE FIELD at R ext 13.5 kG
} at 0.18×10^6 ampere turns
CURRENT STABILITY ±10 parts/10^6; $B_{max}/\langle B \rangle$ 1.47
NUMBER OF SECTORS 3 ; SPIRAL, max 20 deg
POLE FACE COIL PAIRS: AVF -- /sec;
Harmonic correction 13/sec
Rad grad 12 /sec or Circ coils
WEIGHT: Fe ~700 tons; Coils 12 tons
CONDUCTOR, Material and type copper, square hollow
STORED ENERGY MJ
COOLING SYSTEM demineralized water
POWER: Main coils - 50 max, kW
Trimming coils 12 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) -- deg
ION ENERGY (Bending limit) E/A = 180 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 3 angle 40 deg
BEAM APERTURE 2.4 cm; DC BIAS 0 kV
TUNED by, coarse panels fine rot. loops
RF 20 to 30 mHz, stable ± 13 /10^6
Orb F 6.3 to 10 mHz; GAIN, max 240 kV/turn
HARMONICS, RF/Orb F, used 3
DEE-Gnd, max 45 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) $8 \cdot 10^{-4}$
RF PHASE stable to ± deg
RF POWER input, max 60 kW
RF PROTECT circuit, speed 1 μsec
Type ignitron
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 2, oil diffusion 80 cm diameter, 30 000 l/sec
OPERATING PRESSURE 5 μTorr,
PUMPDOWN TIME between 2 and 4 hrs

ION SOURCES/INJECTION SYSTEM

Livingstone type

EXTRACTION SYSTEM

El.defl., screen chann., foc.chann.

CONTROL SYSTEM

conventional

ENTRY NO. 28 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		22.5-45
	d		45-90
	^{3}He		67-185
	α		90-180
CURRENT		(μA)	(μA)
Internal	p		>100
	d		>100
	^{3}He, α		> 30
External	p		> 30
	d		> 15
	^{3}He, α		> 8
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES*

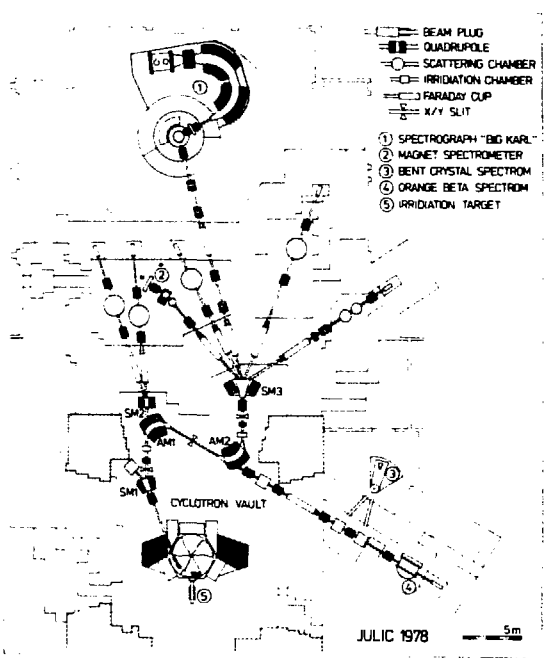
	Measured		Conditions				
Pulse Width	15/7	RF deg	100/10	μA of	60	MeV	d
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	50/75	%	10/4	μA of	60	MeV	d
Res, ΔE/E	0.3/0.15	%	10/4	μA of	60	MeV	d
Emittance (mm-mrad)	20 axial / 20,10 radial		10/4	μA of	60	MeV	d

OPERATING PROGRAMS, time dist (1977)

Basic Nuclear Physics	79.5	%
Solid State Physics Mater. Science	3.5	%
Bio-Medical Applications		%
Isotope Production	9.0	%
Development of Accelerator	3.8	%
of Experiments	2.9	%
Miscellaneous	1.3	%

*second number refers to inserted axial phase slits

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



OPERATION SUMMARY 1977:

Beam Time for Exper.	6313h	85.0 %
Scheduled Mainten.	254h	3.4 %
System Failures	858h	11.6 %
Scheduled Oper. Time	7425h	100.0 %

OTHER FEATURES

Emittance Measuring Device[1)]

Double Monochromator[2)]
Momentum resolution p/Δp(FWHM)> 20000, transmission ∿2 %

Beam Pulsing[3)]
Microscopic: 1 out of 3 beam pulses
Macroscopic: Beam-fall-off time ∿1μsec

Axial Phase Slits[4)]
7°RF, transmission 10 %

12 Beam Phase Probes
Detection on first harmonic with fixed intermediate frequency

REFERENCES:

1) J.Bojowald,H.Borsch,W.Kuhlmann,J.Reich,A.Retz, AIP Conference Proceedings No.9(1972),p.399
2) J.Reich,C.Mayer-Böricke,S.Martin,K.L.Brown,F.E.Johnson AIP Conference Proceedings No.9(1972),p.401
3) R.Brings,G.Lürken,P.Wucherer,Annual Report 1975,KFA-IKP 10/76,p.248
4) J.Reich,R.Brings,J.Linz,P.Wucherer, these proceedings

typing limit

ENTRY NO. 29

NAME OF MACHINE Juelich Compact Cyclotron (CV 28) DATE July 78
INSTITUTION Kernforschungsanlage Juelich - IFF
ADDRESS Postfach 1913, D-5170 Juelich Germany

IN CHARGE J. L. Hemmerich REPORTED by J. L. Hemmerich

HISTORY AND STATUS

DESIGN, date 1969 MODEL tests 1973
ENG. DESIGN, date 1970
CONSTRUCTION, date 1973 - 1975
FIRST BEAM date (or goal) Oct. 1975
MAJOR ALTERATIONS none

OPERATION, 80 hr/wk; On Target 72 hr/wk
TIME DIST., in house 40 %, outside 60 %
USERS' SCHEDULING CYCLE 5 weeks
COST, ACCELERATOR $ 1 Mio.
COST, FACILITY, total $ 2 Mio.
FUNDED BY German Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2
TECHNICIANS 4 CRAFTS -
GRAD STUDENTS involved during year -
OPERATED BY - Res staff or 4 Operators
BUDGET, op & dev $ 100,000 per year
FUNDED BY German Government

RESEARCH STAFF, not included above

USERS, in house 6 outside 20
GRAD STUDENTS involved during year -
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ∿ 200 m^2
movable - m^2
TARGET STATIONS 8 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type none
COMPUTER, model PDP 11-40 (1979)
OTHER FACILITIES Pneumatic transfer for internal and 1 external target

REFERENCES/NOTES

J. Hemmerich, R. Hölzle, W. Kogler, Kerntechnik 19 (1977) p.67to70

MAGNET

POLE FACE diameter 96 cm; R extraction 42 cm
GAP, min 5 cm; Field kG
max 10 cm; Field kG
AVERAGE FIELD at R ext 18.5 kG
} at 2 X 10^6 ampere turns
CURRENT STABILITY 5 parts/10^6; $B_{max}/\langle B \rangle$
NUMBER OF SECTORS 3 ; SPIRAL, max 60 deg
POLE FACE COIL PAIRS: AVF none /sec;
Harmonic correction 2 coils/sector
Rad grad - /sec or Circ coils 4
WEIGHT: ~~Fe~~ total 23 tons; Coils tons
CONDUCTOR, Material and type Cu-foil
STORED ENERGY MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 60 max, kW
Trimming coils 50 max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 28 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg
BEAM APERTURE 2.5 cm; DC BIAS .5-2 kV
TUNED by, coarse Short, plane fine Var. cap.
RF 6 to 26 mHz, stable ± 1 /10^6
Orb F 6 to 26 mHz; GAIN, max kV/turn
HARMONICS, RF/Orb F, used fundamental
DEE-Gnd, max 30 kV, min gap 1.27 cm
STABILITY, (pk-pk noise)/(pk RF volt) 1×10^{-3}
RF PHASE stable to ± deg
RF POWER input, max 75 kW
RF PROTECT circuit, speed 1 μsec
Type Series pass tube
FREQUENCY MODULATION, rate - /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 1 Diff. p. 12"
OPERATING PRESSURE 50 μTorr,
PUMPDOWN TIME 1/2 hrs

ION SOURCES/INJECTION SYSTEM

"cold cathode" Penning or thermionic mode

EXTRACTION SYSTEM

d c electrostatic + mag. channel

CONTROL SYSTEM

typing limit

ENTRY NO. 29 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	2-24	2-24
	d	3-14	3-14
	3 He^{++}	5-36	5-36
	α	6-28	6-28
CURRENT		(μA)	(μA)
Internal	p	500	250
	d	500	250
	α	100	200
External	p	70	90
	d	100	110
	α	50	70
		(part/s)	(part/s)
Secondary	n	$3x10^{12}$	$3x10^{12}$

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	____	RF deg	____ μA of	____ MeV	____
Phase Exc, max	____	RF deg	____ μA of	____ MeV	____
Extract Eff	____	%	____ μA of	____ MeV	____
Res, ΔE/E	____	%	____ μA of	____ MeV	____

Emittance

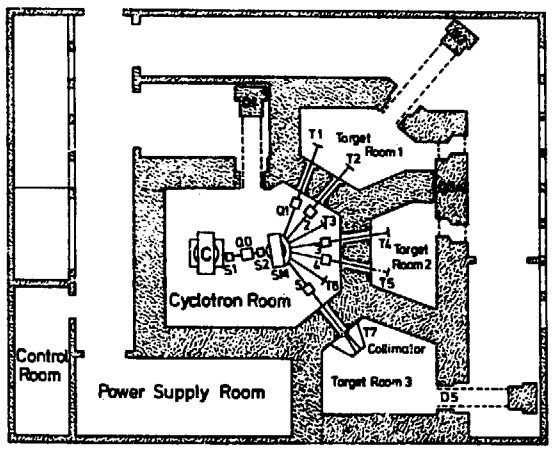
(mm-mrad) { 15 axial / 15 radial } 5 μA of 24 MeV p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics		%
Solid State Physics	40 %	%
Bio-Medical Applications	20 %	%
Isotope Production	40 %	%
Development		%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Originally designed for manual control, all cyclotron and peripheral power supplies are presently redesigned (partly in cooperation with The Cyclotron Corp.) for computer control. System will be installed starting end of 78 parallel to normal cyclotron operation and should be operational (preset and monitor operating parameters, correct longterm drifts etc.) by the end of 1979.



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ENTRY NO. 30

NAME OF MACHINE Karlsruhe Isochronous Cyclotron DATE 1.8.1978
INSTITUTION Kernforschungszentrum, Zyklotronlaboratorium
ADDRESS D-7500 Karlsruhe, Postfach 3640, Germany

IN CHARGE H. Schweickert REPORTED by H. Schweickert

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests 1958-60
ENG. DESIGN, date
CONSTRUCTION, date 1960-1962
FIRST BEAM date (or goal) int.1962,ext.1964
MAJOR ALTERATIONS axial injection 1971

OPERATION, 168 hr/wk: On Target ~135 hr/wk
TIME DIST., in house x %, outside x %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR 4.6 x 10^6 DM
COST, FACILITY, total 20 x 10^6 DM/to date
FUNDED BY Federal Government & State of Baden-Württemberg

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 5
TECHNICIANS 10 CRAFTS 20
GRAD STUDENTS involved during year
OPERATED BY Res staff or 10 Operators
BUDGET, op & dev 2 x 10^6 DM
FUNDED BY Federal Government & State of Baden-Württemberg

RESEARCH STAFF, not included above

USERS, in house 40x outside 90
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 225 m^2
movable m^2
TARGET STATIONS 8 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model 3-NOVA 2
OTHER FACILITIES
Time-of-Flight Spectrometer (190 m)
Isotope production
Beam pulsing systems

REFERENCES/NOTES

Proc. Int. Conf. SF Cyclotrons
CERN 63-19, p. 24
Nucl. Inst. Meth. 13, 55 (1961)
KFK 754 (1968)

x In house refers to users from KFK

MAGNET

POLE FACE diameter 225 cm; R extraction 105 cm
GAP, min 8 cm; Field 19.5 kG
max 16 cm; Field 19.5 kG
at 0.16x 10^6 ampere turns
AVERAGE FIELD at R ext 14.7 kG
CURRENT STABILITY 5 parts/10^6; $B_{max}/\langle B\rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max – deg
POLE FACE COIL PAIRS: AVF – /sec;
Harmonic correction
Rad grad 5 /sec or Circ coils
WEIGHT: Fe 280 tons; Coils 8.5 tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM water
POWER: Main coils 32 max, kW
Trimming coils 1 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) – deg
ION ENERGY (Bending limit) E/A = 104 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 3 angle 60 deg
BEAM APERTURE 3.5 cm; DC BIAS 0 kV
TUNED by, coarse – fine rotating loop
RF – to 33 mHz, stable ± 5 /10^6
Orb F – to 11 mHz; GAIN, max 240 kV/turn
HARMONICS, RF/Orb F, used 3 only
DEE-Gnd, max 40 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± deg
RF POWER input, max 50 kW
RF PROTECT circuit, speed 1 μsec
Type Ignitron
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type –
BEAM PULSE, width –

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Diffusion pumps (8000 l/sec + 12000 l/sec)
OPERATING PRESSURE 4 μTorr,
PUMPDOWN TIME 1/2 hrs

ION SOURCES/INJECTION SYSTEM

Internal Penning, External: Penning, Lambshift, Axial Injection (10 keV)

EXTRACTION SYSTEM

Two electrostatic deflectors+magn.iron channel

CONTROL SYSTEM

Two NOVA-2 computers plus conventional

typing limit

ENTRY NO. 30 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	$p(H_2^+)$		26(52)
	d		52
	α		104
	$^6Li^{3+}$		156
CURRENT		(μA)	(μA)
Internal	p		50
	d		>1000
	α		100
External	p,d,α		>10
	$^6Li^{3+}$		0.1
	pol.d.		0.1
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	10	RF deg	1	μA of	52	MeV	d
Phase Exc. max	20	RF deg	1	μA of	52	MeV	d
Extract Eff	>70	%	1	μA of	52	MeV	d
Res. ΔE/E	0.3	%	1	μA of	52	MeV	d
Emittance (mm-mrad)	9 axial, 6 radial		5	μA of	52	MeV	d

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	42	%
Solid State Physics	24	%
Bio-Medical Applications	1	
Isotope Production	3	
Development	5	%
Neutron Physics	10	%
Engineering	15	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The Karlsruhe Cyclotron was originally designed for internal isotope production for radiochemistry. After the implementation of the extraction system im 1964 the machine was used by more than 90 % of all operation for basic nuclear physics with light ions (protons, deuterons, alphas). More recently, experimental program has shifted to application oriented research projects (wear studies of machine parts[1)], radiation damage[1)], routine produciton of iodine-123[2)], etc.)with about 50 % of all operation.At present a large amount of the basic nuclear physics experimental program is performed using the polarized deuteron- and the $^6Li^{3+}$-beams injected by the axial injection system[3)].The actual beam currents available in the scattering chamber for both particles are in the range of 50-100 enA.
In 1978 it was decided to build up a MAFIOS-ion source at the axial injection system.With this type of ion source completely stripped "light heavy ions" can be produced. Examples of beams to be available in late 1981: ^{12}C, ^{14}N, ^{16}O, ^{20}Ne(?) with a fixed energy of 26 MeV/A.

Neutron time-of-facility: 190 m flight path, neutron pulse length <1 nsec; neutron flux at detector position $>10^3$ n/cm^2 sec
Rev. Sci. Instr. 39 (1968) 1279; KFK 2298 (1976)

Beam analyzing magnet: double focussing (n=0.5), deflection radius 130 cm, deflection angle 150°; resolution at 1 mm slits 5×10^{-4}.

Computer aided operation:
W.R. Kappel, W. Kneis, J. Möllenbeck, H. Schweickert,these Proceedings.

1) Applications of cyclotrons in technical and analytical studies:
A. Gervé, G. Schatz; Proc. 7th Int. Conf. on Cyclotrons and their Applications (Birkhäuser, Basel, 1975) p. 496-502.

2) Routine production of iodine-123:
K.H. Assmus, K. Jäger, R. Schütz, F. Schulz,H.Schweickert,these Proc.

3) Axial injection system:
G. Haushahn, J. Möllenbeck, G. Schatz,F.Schulz, H. Schweickert; Proc. 7th Int. Conf. on Cyclotrons and their Applications (Birkhäuser Basel, 1975). p. 376-380.

typing limit

ENTRY NO. 31

NAME OF MACHINE A.G. Compact Cyclotron Munich DATE 11/15/73
INSTITUTION Fachbereich Physik Technical University Munich BRD
ADDRESS D 8046 Garching James Franckstr.

IN CHARGE H. Morinaga REPORTED by G. Muenges

HISTORY AND STATUS

DESIGN, date 1968 MODEL tests 1970
ENG. DESIGN, date 1970
CONSTRUCTION, date 1972
FIRST BEAM date (or goal) 1973
MAJOR ALTERATIONS Tritium ion source system
OPERATION, 100 hr/wk; On Target 80 hr/wk
TIME DIST., in house 80 %, outside 20 %
USERS' SCHEDULING CYCLE / weeks
COST, ACCELERATOR 1.5×10^5 DM
COST, FACILITY, total 3×10^6 DM
FUNDED BY Bavarian Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS 1
GRAD STUDENTS involved during year
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY Bavarian Government

RESEARCH STAFF, not included above

USERS, in house 5 outside 8
GRAD STUDENTS involved during year 3
RES. BUDGET, in house 150.000 DM
FUNDED BY Bavarian Government

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 100 m^2
movable m^2
TARGET STATIONS 1 in 1 rooms
STATIONS served at same time, max –
MAG SPECTROGRAPH, type –
COMPUTER, model –
OTHER FACILITIES Rotating internal target for beam intensities up to 1mA for 22MeV protons

REFERENCES/NOTES

MAGNET

POLE FACE diameter 109 cm; R extraction 48 cm
GAP, min 5.4 cm; Field 19 kG
max 17.5 cm; Field 8 kG
AVERAGE FIELD at R ext 14 kG
at X 10^6 ampere turns
CURRENT STABILITY 50 parts/10^6; $B_{max}/\langle B \rangle$ 1.35
NUMBER OF SECTORS 4 ; SPIRAL, max – deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction 4 per sector
Rad grad /sec or Circ coils
WEIGHT: Fe 25 tons; Coils 5 tons
CONDUCTOR, Material and type Copper
STORED ENERGY MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 40 max, kW
Trimming coils 2 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 25 q^2/A^2 MeV
(Focusing limit) E/A = 22 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 63 deg
BEAM APERTURE 2.3 cm; DC BIAS 0 kV
TUNED by, coarse Short st. fine Trim. cap.
RF 28 to 42.5 mHz, stable ± 1 part /10^6
Orb F 7 to 21.3 mHz; GAIN, max 130 kV/turn
HARMONICS, RF/Orb F, used 2, 4
DEE-Gnd, max 50 kV, min gap 2.3 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.0007
RF PHASE stable to ± deg
RF POWER input, max 40 kW
RF PROTECT circuit, speed – μsec
Type
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type –
BEAM PULSE, width –

VACUUM SYSTEM

PUMPS, No., Type, Size 2 diffusion oil pumps or 1 ion getter p. 2000
OPERATING PRESSURE 7 μTorr,
PUMPDOWN TIME 10 hrs

ION SOURCES/INJECTION SYSTEM

Internal Livingstone type

EXTRACTION SYSTEM

Electrost. deflector + mag.ch.

CONTROL SYSTEM

Conventional system

typing limit

ENTRY NO. 31 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p, ^{4}He		22
	d		11
	^{3}He		22
	t		7.3
CURRENT		(μA)	(μA)
Internal	p, d	1000	400
	t		45
	He	80	40
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	____	RF deg	____	μA of	____	MeV ____
Phase Exc, max	____	RF deg	____	μA of	____	MeV ____
Extract Eff	____	%	____	μA of	____	MeV ____
Res, ΔE/E	____	%	____	μA of	____	MeV ____
Emittance (mm-mrad)	____ axial / ____ radial		____	μA of	____	MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	5 %
Bio-Medical Applications	%
Isotope Production	85 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The AMG isocharonous compact cyclotron is an energy fixed machine for light particles with rather high beam intensities. It is used nearly exclusively for isotope production. The main purpuse is the production of strong 57Co - sources for Mössbauer experiments and the production of various short-lived isotopes usefull in biological research by means of the the tritium beam.

typing limit

ENTRY NO. 32

NAME OF MACHINE Variable Energy Cyclotron DATE Aug. 78
INSTITUTION Bhabha Atomic Research Centre
ADDRESS I-AF Bidhan Nagar, Calcutta 700064, India.

IN CHARGE C. Ambasankaran REPORTED by A.S. Divatia and Santimay Chatterjee

HISTORY AND STATUS

DESIGN, date 1967 MODEL tests -
ENG. DESIGN, date 1968-69
CONSTRUCTION, date 1969-77
FIRST BEAM date (or goal) Jun '77(Int);Jul'78 (Ext)
MAJOR ALTERATIONS -

OPERATION, - hr/wk; On Target - hr/wk
TIME DIST., in house - %, outside - %
USERS' SCHEDULING CYCLE - weeks
COST, ACCELERATOR $3.03 x 10^6
COST, FACILITY, total $10.67 x 10^6
FUNDED BY Dept. of Atomic Energy

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 11 ENGINEERS 37
TECHNICIANS 58 CRAFTS 122
GRAD STUDENTS involved during year -
OPERATED BY - Res staff or - Operators
BUDGET, op & dev $ 1.05 x 10^6(1978-79)
FUNDED BY Dept. of Atomic Energy

RESEARCH STAFF, not included above

USERS, in house 17 outside -
GRAD STUDENTS involved during year -
RES. BUDGET, in house $0.70 x 10^6(1978-79)
FUNDED BY Dept. of Atomic Energy

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 226 m^2
movable 535 m^2
TARGET STATIONS 9 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type QSD
COMPUTER, model Unichannel-15
OTHER FACILITIES Target, Detector, Electronics, Radio-chemistry, Irradiation.

REFERENCES/NOTES

1. C. Ambasankaran and D.Y. Phadke, Proc.Particle Accl. Conf., San Fransisco: IEEE Trans. Nucl. Sc., NS-20, No.3(June 1973) p.236.

MAGNET

POLE FACE diameter 224 cm; R extraction 99 cm
GAP, min 19 cm; Field 21 kG
max 30 cm; Field 14.1 kG
AVERAGE FIELD at R ext 17.1 kG
} at 0.56 x 10^6 ampere turns
CURRENT STABILITY ±10 parts/10^6; $B_{max}/\langle B\rangle$ 1.22
NUMBER OF SECTORS 3 ; SPIRAL, max 55 deg
POLE FACE COIL PAIRS: AVF - /sec;
Harmonic correction 5
Rad grad - /sec or Circ coils 17
WEIGHT: Fe 275 tons; Coils 10 tons
CONDUCTOR, Material and type Cu
STORED ENERGY - MJ
COOLING SYSTEM LCW
POWER: Main coils 525 max, kW
Trimming coils 460 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 140 q^2/A^2 MeV
(Focusing limit) E/A = 70 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3.5 cm; DC BIAS - kV
TUNED by, coarse MP fine VC
RF 5.5 to 16.5 mHz, stable ± 1 /10^6
Orb F - to - mHz; GAIN, max ≤ 140 kV/turn
HARMONICS, RF/Orb F, used -
DEE-Gnd, max 70 kV, min gap 6.19 cm
STABILITY, (pk-pk noise)/(pk RF volt) -
RF PHASE stable to ± - deg
RF POWER input, max 400 (DC) kW
RF PROTECT circuit, speed 2 μsec
Type Ignitron crowbar
FREQUENCY MODULATION, rate - /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size Two 89 cm. dia and one 30 cm dia
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 3-4 hrs

ION SOURCES/INJECTION SYSTEM

PIG

EXTRACTION SYSTEM

DC Electrostatic Deflector

CONTROL SYSTEM

Manual

typing limit

ENTRY NO. 32 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	6-60	
	d	12-65	
	α	25-130	50
CURRENT		(μA)	(μA)
Internal	α	1000	2
External	α	100	Nominal
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial, ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Fabrication of all components of the Variable Energy Cyclotron was completed and internal beam obtained on June 16, 1977. Studies on beam diagnostics were conducted till August, 1977. The deflector was assembled, tested, installed and commissioned. External beam was obtained on July 8, 1978.

One switching magnet and two quadrupole magnets have been installed. 160° analysing magnet is under construction. 915 mm diameter scattering chamber is ready. Unichannel-15 computer for on-line data acquisition has been commissioned and is under operation. One IRIS-80 computer system is also planned to be installed within the next year. Other facilities for research like target, detector and electronics have been started. Fabrication of magnetic spectrometer has started. The Variable Energy Cyclotron will operate as a national facility available to all scientists all over India.

REFERENCES/NOTES (Contd...)

2. C. Ambasankaran, et al., Proc. 7th Int.Conf. on Cyclotrons and their Applications (Birkhauser, Basel, 1975), p.84-87.
3. A.S. Divatia, Proc. VII Int.Conf. on Few Body Problems in Nucl. and Part.Phys, Delhi,1976(North-Holland)p.1-13.
4. VEC Staff (Presented by A.S. Divatia): Int. Conf. on Nucl. Phys. at Cyclotron Energies, Calcutta 1977 Proc. to be published.

typing limit

ENTRY NO. 33

NAME OF MACHINE Chandigarh Variable Energy Cyclotron* DATE 8/21/78
INSTITUTION Physics Department, Panjab University, Chandigarh.
ADDRESS Physics Department, Panjab University, Chandigarh-160014 (India)

IN CHARGE Prof. U.S. Hans, REPORTED by Dr. I.M. Govil/Dr. T.S. Cheema.

HISTORY AND STATUS

DESIGN, date 1953 MODEL tests
ENG. DESIGN, date 1953
CONSTRUCTION, date 1965-70
FIRST BEAM date (or goal) 1971
MAJOR ALTERATIONS

OPERATION, 40 hr/wk; On Target 20 hr/wk
TIME DIST., in house %, outside %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR $100,000
COST, FACILITY, total $200,000
FUNDED BY UGC, New Delhi-India and Panjab University, Chandigarh

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 2
TECHNICIANS 4 CRAFTS 4
GRAD STUDENTS involved during year
OPERATED BY Res staff or Operators
BUDGET, op & dev $20,000 per annum
FUNDED BY UGC New Delhi and Panjab University, Chandigarh-India

RESEARCH STAFF, not included above

USERS, in house 6 outside 8
GRAD STUDENTS involved during year 4
RES. BUDGET, in house $15,000
FUNDED BY UGC, New Delhi and Panjab University, Chandigarh-India

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 230 m^2
movable 400 m^2
TARGET STATIONS 2 in 1 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES

REFERENCES/NOTES

* This is one of the earlier cyclotron built around 1953-54 at Univ. of Rochester, Rochester, U.S.A. This has been shifted to, modified and reinstalled at Chandigarh in 1971. Ref. Sector focussed Cyclotron Conference 1959.

MAGNET

POLE FACE diameter 66 cm; R extraction 28 cm
GAP, min 16 cm; Field 14 kG
max 16 cm; Field 14 kG
AVERAGE FIELD at R ext 13 kG
at X 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; B_{max}/(B) 14 Kg.
NUMBER OF SECTORS ; SPIRAL, max deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction
Rad grad /sec or Circ coils
WEIGHT: Fe 20 tons; Coils tons
CONDUCTOR, Material and type Copper
STORED ENERGY MJ
COOLING SYSTEM Chilling Plant.
POWER: Main coils 40 max, kW
Trimming coils max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 7 q^2/A^2 MeV
(Focusing limit) E/A = 7 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 2.54 cm; DC BIAS kV
TUNED by, coarse fine
RF 10 to 20 mHz, stable ± 10 /10^6
Orb F to mHz; GAIN, max kV/turn
HARMONICS, RF/Orb F, used
DEE-Gnd, max kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max 25 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 4 Diffusion pumps (15.3 cm) 1 Diff. Pump 23 cm, 2 Kinney Rotary pumps.
OPERATING PRESSURE 2.10^{-5} mm of Hg Torr,
PUMPDOWN TIME 12 hrs

ION SOURCES/INJECTION SYSTEM

Hooded Arc Type

EXTRACTION SYSTEM

Electrostatic Deflector

CONTROL SYSTEM

Semi-manual

typing limit

ENTRY NO. 33 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	1 [illegible]+	7	4-5
	2 [illegible]+	4	4
	3 [illegible]++	11	5-9
	4 [illegible]++	1-8	1-8
CURRENT		(μA)	(μA)
Internal			15
External	[illegible]		1.5-2
		(part/s)	(part/s)
Secondary			

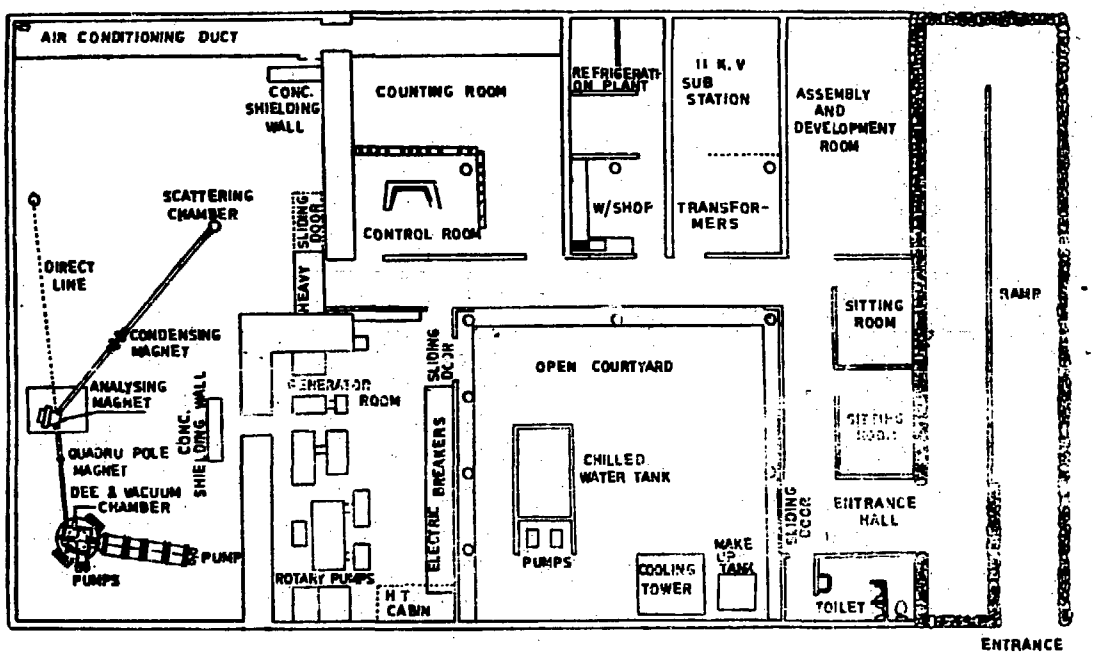
BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	40	%		μA of		MeV
Res, ΔE/E	0.2	%	0.1	μA of	4	MeV Proton
Emittance (mm-mrad)	axial / radial			μA of		MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	40 %
Solid State Physics	20 %
Bio-Medical Applications	5 %
Isotope Production	10 %
Development	25 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



LAY OUT PLAN

typing limit

ENTRY NO. 34

NAME OF MACHINE AVF CYCLOTRON - MILAN DATE Sept. 78
INSTITUTION UNIVERSITY OF MILAN - PHYSICS DEPARTMENT
ADDRESS VIA CELORIA, 16

IN CHARGE F. Resmini REPORTED by M. Castiglioni & F. Resmini

HISTORY AND STATUS

DESIGN, date 1961 MODEL tests 1961-62
ENG. DESIGN, date 1961-62
CONSTRUCTION, date 1961-62
FIRST BEAM date (or goal) int. 1965/ext. 1965
MAJOR ALTERATIONS new dee 1967

OPERATION, 120 hr/wk; On Target 100 hr/wk
TIME DIST., in house 50 %, outside 50 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR 7.10^5
COST, FACILITY, total $1x10^6$
FUNDED BY Ministry of Education - Ist. Nazionale di Fisica Nucl.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 5 ENGINEERS 2
TECHNICIANS 5 CRAFTS 7
GRAD STUDENTS involved during year 3
OPERATED BY Res staff or 4 Operators
BUDGET, op & dev 10^5
FUNDED BY Ministry of Education and Istituto Nazionale de Fisica Nucl.

RESEARCH STAFF, not included above

USERS, in house 5 outside 7
GRAD STUDENTS involved during year 6
RES. BUDGET, in house 2.0×10^5
FUNDED BY Istituto Nazionale de Fisica Nucl. and Cons Naz. Ricerche

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ____ m^2
movable 600° m^2
TARGET STATIONS 7 in 6 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model LABEN 70 - PDP 11/45
OTHER FACILITIES
Isotope production--one high level vault
Biological--1 shared beam line

REFERENCES/NOTES

1) Nucl. Instr. and Meth. 18.19 (1962)
2) IEEE Trans. Nucl. Sci. NS-13 (1966)

These are really undergraduates; no graduates (U.S. - like) are provided in Italy's university system.

MAGNET

POLE FACE diameter 166 cm; R extraction 72 cm
GAP, min 11 cm; Field 19.5 kG
max 31 cm; Field 8 kG
AVERAGE FIELD at R ext 13.9 kG
} at 36 X 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B\rangle$ 1.47
NUMBER OF SECTORS 3 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF none /sec;
Harmonic correction none
Rad grad none /sec or Circ coils 8
WEIGHT: Fe 181 tons; Coils ____ tons
CONDUCTOR, Material and type
STORED ENERGY MJ
COOLING SYSTEM water
POWER: Main coils 80 max, kW
Trimming coils max, kW
YOKE/POLE AREA 127 %
SECTOR ANGLE (Sep Sec) 1 deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 170 deg
BEAM APERTURE 4 cm; DC BIAS 0 kV
TUNED by, coarse MP auto fine VC auto
RF 15 to 22 mHz, stable ± 1 /10^6
Orb F 19 to 21 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used first
DEE-Gnd, max 60 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 003
RF PHASE stable to ± 12 deg
RF POWER input, max 30 kW
RF PROTECT circuit, speed 5 μsec
Type rectifier cut off
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 - 10.000 liter/sec diffusion pumps
OPERATING PRESSURE 1×10^{-6} Torr,
PUMPDOWN TIME 12 hrs

ION SOURCES/INJECTION SYSTEM

H^- internal ion source

EXTRACTION SYSTEM

stripping foil for H^-

CONTROL SYSTEM

typing limit

ENTRY NO. 34 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	H^-	18-45	18-45
	P	40-45	45
CURRENT		(μA)	(μA)
Internal	H^-	40-30	20-15
	P	100	100
External	H^-	40-30	20-15
	P	60	CO
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	7.25	RF deg	10^{-3}	μA of	18-45	MeV H^-
Phase Exc, max	70	RF deg	10^{-3}	μA of	30	MeV H^-
Extract Eff	100	%	1	μA of	18-45	MeV H^-
Res, ΔE/E	8	%	1	μA of	30	MeV H^-

Emittance

(mm-mrad) { 40 axial, 35 radial } 1 μA of 30 MeV H^-

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	70 %
Solid State Physics	5 %
Bio-Medical Applications	%
Isotope Production	20 %
Development	%
machine development	5 %
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

- Beam pulsing device (external) for on-line spectroscopy being built (selection of 1 out of 2, 3, 4, 5 pulses allowed) - Installation anticipated by early 1979.

- New operating console built - installed

- Accelerator research concentrated on design of a K600 superconducting cyclotron, construction and operation of a 1:6 superconducting model magnet, 1:1 R.F. cavity model.

typing limit

ENTRY NO. 35

NAME OF MACHINE NIRS Isochronous Cyclotron DATE 7/21/78

INSTITUTION National Institute of Radiological Sciences

ADDRESS 4-9-1, Anagawa, Chiba, JAPAN

IN CHARGE T.Hiramoto REPORTED by H. Ogawa

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____

ENG. DESIGN, date _____

CONSTRUCTION, date _____

FIRST BEAM date (or goal) Dec. 1973

MAJOR ALTERATIONS _____

OPERATION, 44 hr/wk; On Target _____ hr/wk

TIME DIST., in house _____ %, outside _____ %

USERS' SCHEDULING CYCLE _____ weeks

COST, ACCELERATOR _____

COST, FACILITY, total _____

FUNDED BY Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 3

TECHNICIANS 6 CRAFTS _____

GRAD STUDENTS involved during year _____

OPERATED BY _____ Res staff or _____ Operators

BUDGET, op & dev _____

FUNDED BY _____

RESEARCH STAFF, not included above

USERS, in house _____ outside _____

GRAD STUDENTS involved during year _____

RES. BUDGET, in house _____

FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 376 m^2

movable _____ m^2

TARGET STATIONS 7 in 4 rooms

STATIONS served at same time, max _____

MAG SPECTROGRAPH, type _____

COMPUTER, model _____

OTHER FACILITIES Isotope production
Neutron Therapy

REFERENCES/NOTES

Commercial: CGR-MEV
Model-930

MAGNET

POLE FACE diameter 215 cm; R extraction 92 cm

GAP, min 16.6 cm; Field 16.5 kG
max 40.5 cm; Field 8.6 kG
AVERAGE FIELD at R ext 14 kG
} at 0.28X 10^6 ampere turns

CURRENT STABILITY ± 20 parts/10^6; $B_{max}/\langle B \rangle$ _____

NUMBER OF SECTORS 4 ; SPIRAL, max 53 deg

POLE FACE COIL PAIRS: AVF _____ /sec;

Harmonic correction 2 per sector

Rad grad _____ /sec or Circ coils 12

WEIGHT: Fe 200 tons; Coils _____ tons

CONDUCTOR, Material and type Cu, hollow

STORED ENERGY _____ MJ

COOLING SYSTEM Demineralized water

POWER: Main coils 225 max, kW

Trimming coils 75 max, kW

YOKE/POLE AREA 115 %

SECTOR ANGLE (Sep Sec) _____ deg

ION ENERGY (Bending limit) E/A = ~90 q^2/A^2 MeV

(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 86 deg

BEAM APERTURE 3.8 cm; DC BIAS 0 kV

TUNED by, coarse MP fine MP

RF 10.6 to 22.0 mHz, stable ± ≤ 1 /10^6

Orb F 5.3 to 22.0 mHz; GAIN, max 140 kV/turn

HARMONICS, RF/Orb F, used 1, 2

DEE-Gnd, max 50 kV, min gap _____ cm

STABILITY, (pk-pk noise)/(pk RF volt) 0.001

RF PHASE stable to ± 0.5 deg

RF POWER input, max 160 kW

RF PROTECT circuit, speed ~1 μsec

Type Ignitron crowbar

FREQUENCY MODULATION, rate _____ /sec

MODULATOR, type _____

BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size _____

2 x 22" Diffusion pumps

OPERATING PRESSURE 1~2 μTorr,

PUMPDOWN TIME _____ hrs

ION SOURCES/INJECTION SYSTEM

Hot filament for light ions,
Penning for heavy ions

EXTRACTION SYSTEM

Electrostatic deflector, magnetic channel

CONTROL SYSTEM

typing limit

ENTRY NO. 35 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		9-70
	d		16-43
	$^4He^{++}$		32-86
	$^3He^{++}$		66-100
CURRENT		(μA)	(μA)
Internal			
External	p		20
	d		40
	$^4He^{++}$		20
	$^3He^{++}$		20
		(part/s)	(part/s)
Secondary			

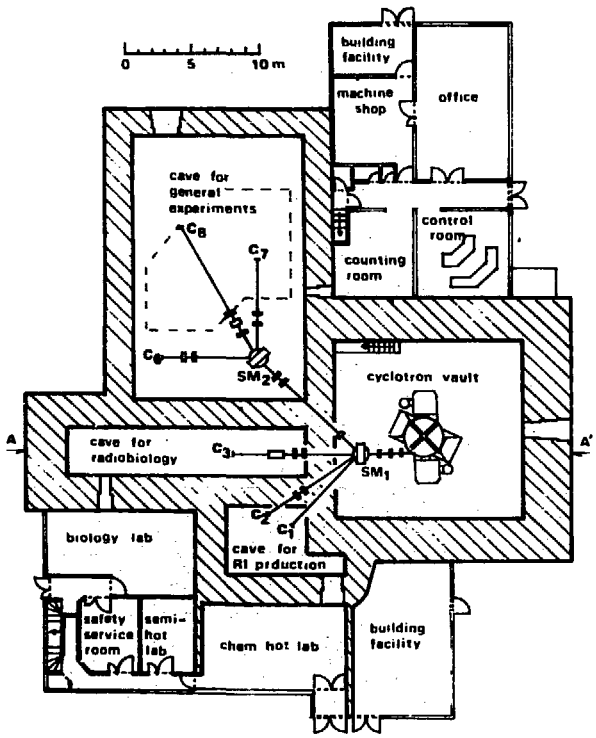
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	80 %	35 μA of 30 MeV d
Res, ΔE/E	%	μA of MeV
Emittance (mm-mrad)	axial / radial	μA of MeV

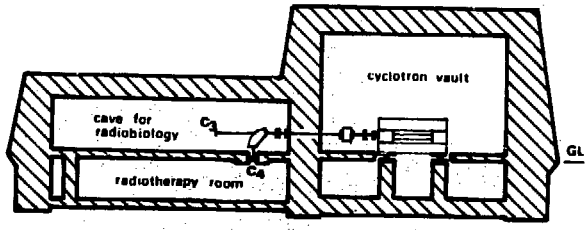
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	67 %
Isotope Production	33 %
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



1st floor



cross section (A-A')

typing limit

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ENTRY NO. 36

NAME OF MACHINE CS-30 (TCC) DATE 8/20/78

INSTITUTION Nihon Medi-Physics Co., Ltd.

ADDRESS 4, 2-1, Takatsukasa, Takarazuka, Hyogo, Japan

IN CHARGE M. Hazue REPORTED by S. Nakamoto

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____

ENG. DESIGN, date _____

CONSTRUCTION, date 1974 Aug.-Nov.

FIRST BEAM date (or goal) Nov., 1974

MAJOR ALTERATIONS Addition of yoke iron, Dec., 1976

OPERATION, _____ hr/wk; On Target _____ hr/wk

TIME DIST., in house 100 %, outside 0 %

USERS' SCHEDULING CYCLE 0 weeks

COST, ACCELERATOR -

COST, FACILITY, total -

FUNDED BY in house

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS _____ ENGINEERS 3

TECHNICIANS 2 CRAFTS _____

GRAD STUDENTS involved during year _____

OPERATED BY _____ Res staff or x Operators

BUDGET, op & dev _____

FUNDED BY in house

RESEARCH STAFF, not included above

USERS, in house _____ outside _____

GRAD STUDENTS involved during year _____

RES. BUDGET, in house _____

FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 87 m^2

movable _____ m^2

TARGET STATIONS 3 in 1 rooms

STATIONS served at same time, max 0

MAG SPECTROGRAPH, type _____

COMPUTER, model _____

OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 96 cm; R extraction 42 cm

GAP, min _____ cm; Field _____ kG } at _____ X 10^6 ampere turns

max _____ cm; Field _____ kG

AVERAGE FIELD at R ext 17.5 kG

CURRENT STABILITY _____ parts/10^6; $B_{max}/\langle B \rangle$ _____

NUMBER OF SECTORS 3 ; SPIRAL, max _____ deg

POLE FACE COIL PAIRS: AVF _____ /sec;

Harmonic correction _____

Rad grad _____ /sec or Circ coils 6

WEIGHT: Fe ~20 tons; Coils _____ tons

CONDUCTOR, Material and type Alminum

STORED ENERGY _____ MJ

COOLING SYSTEM Circulated demineralized water

POWER: Main coils ~40 max, kW

Trimming coils ~1 max, kW

YOKE/POLE AREA _____ %

SECTOR ANGLE (Sep Sec) _____ deg

ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV

(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg

BEAM APERTURE _____ cm; DC BIAS _____ kV

TUNED by, coarse _____ fine _____

RF _____ to _____ mHz, stable ± _____ /10^6

Orb F _____ to _____ mHz; GAIN, max _____ kV/turn

HARMONICS, RF/Orb F, used _____

DEE-Gnd, max 25 kV, min gap _____ cm

STABILITY, (pk-pk noise)/(pk RF volt) _____

RF PHASE stable to ± _____ deg

RF POWER input, max ~25 kW

RF PROTECT circuit, speed _____ μsec

Type gap tube shortening

FREQUENCY MODULATION, rate _____ /sec

MODULATOR, type _____

BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size one 25cm, one 10cm diffusion pump

OPERATING PRESSURE 10 μTorr,

PUMPDOWN TIME 0.5 hrs

ION SOURCES/INJECTION SYSTEM

PIG type

EXTRACTION SYSTEM

Electrostatic deflector + mag. channel

CONTROL SYSTEM

manual

typing limit

ENTRY NO. 36 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		26
	d		15
	He-3		38
	He-4		30
CURRENT		(μA)	(μA)
Internal	p	200	200
	d	200	200
External	p	50	50
	d	50	50
		(part/s)	(part/s)
Secondary			

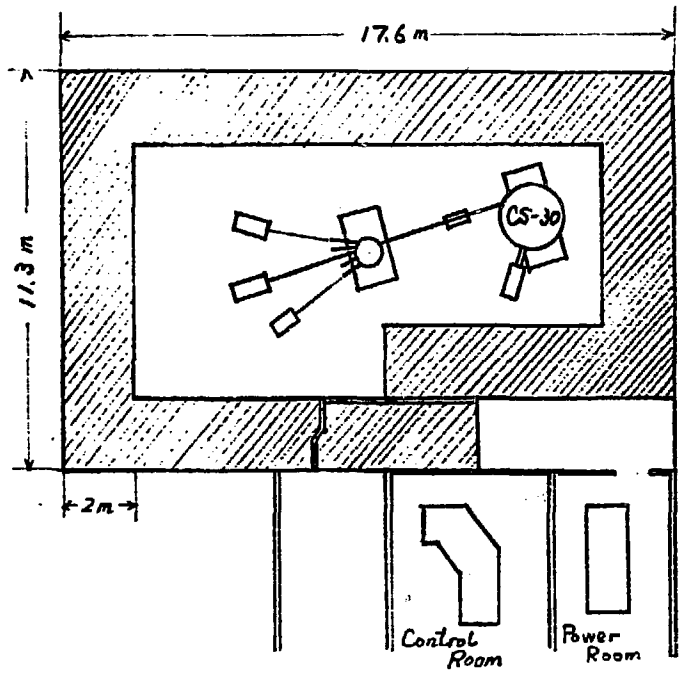
BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of	MeV	
Phase Exc, max		RF deg		μA of	MeV	
Extract Eff	60	%	60	μA of	26 MeV	p
Res, ΔE/E		%		μA of	MeV	
Emittance (mm-mrad)	axial / radial			μA of	MeV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	95 %
Development	5 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

ENTRY NO. 37

NAME OF MACHINE Osaka University RCNP Isochronous Cyclotron DATE 7/22/78
INSTITUTION Research Center for Nuclear Physics, Osaka University
ADDRESS Suita, Osaka 565, Japan

IN CHARGE M. Kondo REPORTED by M. Kondo

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests 1966 - 69
ENG. DESIGN, date 1970 - 1972
CONSTRUCTION, date 1971 - 1973
FIRST BEAM date (or goal) 1974
MAJOR ALTERATIONS None

OPERATION, 120 hr/wk; On Target ∿ 100 hr/wk
TIME DIST., in house * %, outside * %
USERS' SCHEDULING CYCLE ∿ 12 weeks
COST, ACCELERATOR $ 3.5 × 10^6
COST, FACILITY, total $ 9 × 10^6
FUNDED BY Ministry of Education, Japan

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ∿ 8 ENGINEERS -
TECHNICIANS 8 CRAFTS -
GRAD STUDENTS involved during year -
OPERATED BY × Res staff or × Operators
BUDGET, op & dev ∿ $ 1 × 10^6
FUNDED BY Ministry of Education

RESEARCH STAFF, not included above

USERS, in house ∿ 8 outside ∿ 200
GRAD STUDENTS involved during year 2
RES. BUDGET, in house ∿ $ 1 × 10^6
FUNDED BY Ministry of Education

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 1130 m^2
movable - m^2
TARGET STATIONS 11 in 5 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type QDDQ
COMPUTER, model TOSBAC 5600, PDP 11/40 & 70
OTHER FACILITIES Scattering Chamber
Scattering Chember with Polarization Monitor
In-Beam Gamma Ray Facility
Irradiation Facility with Rabbit System

REFERENCES/NOTES

M. Kondo, et al., Seventh Internat. Conf. on Cyclotrons and their Applications, Zürich (1975), pp 95 - 98.
M. Kondo, these Proceedings

* Time is assigned by Programme Committee. No distinction is made between "In-house" and "Outside" proposal.

typing limit

MAGNET

POLE FACE diameter 230 cm; R extraction 100 cm
GAP, min 20.7 cm; Field 19.5 kG
max 34.7 cm; Field 12.0 kG
AVERAGE FIELD at R ext 16.0 kG
} at 0.4 × 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ 1.2
NUMBER OF SECTORS 3 ; SPIRAL, max 52 deg
POLE FACE COIL PAIRS: AVF - /sec;
Harmonic correction 5/sec
Rad grad /sec or Circ coils 16
WEIGHT: Fe 400 tons; Coils 13 tons
CONDUCTOR, Material and type Copper, Hollow
STORED ENERGY ∿ 3 MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 450 max, kW
Trimming coils 265 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 120 q^2/A^2 MeV
(Focusing limit) E/A = ∿ 80 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 4.4 cm; DC BIAS 0 kV
TUNED by, coarse MS fine VC. auto
RF 6 to 18 mHz, stable ± 0.005 /10^6
Orb F 1.2 to 18 mHz; GAIN, max 160 kV/turn
HARMONICS, RF/Orb F, used 1, 3
DEE-Gnd, max 80 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 1 × 10^{-4}
RF PHASE stable to ± 1 deg
RF POWER input, max 430 kW
RF PROTECT circuit, speed 1 μsec
Type Ignitron Crowbar
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion Pumps (one 55 cm, two 90 cm)
OPERATING PRESSURE 1 μTorr,
PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM

Oak Ridge Type & Penning
Polarized p and d

EXTRACTION SYSTEM

DC Electrostatic with Magnetic Channel

CONTROL SYSTEM

Digital Control System Plus PDP 11/40

ENTRY NO. 37 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	≤ 75	≤ 75
	α	≤ 120	≤ 120
	$^{14}N^{5+}$		215
CURRENT		(μA)	(μA)
Internal	p	500	50
	$\vec{p}$		0.2
	$^{14}N^{5+}$		1.2
External	p	50	20
	$\vec{p}$		0.1
	$^{14}N^{5+}$		0.8
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	12	RF deg	0.1 μA of	40	MeV	p
Phase Exc, max	5	RF deg	1∿2 μA of	90	MeV	α
Extract Eff	90	%	1∿2 μA of	65	MeV	p
Res, ΔE/E	0.2	%	1∿2 μA of	90	MeV	α
Emittance (mm-mrad)	10 axial, 20 radial		1∿2 μA of	90	MeV	α

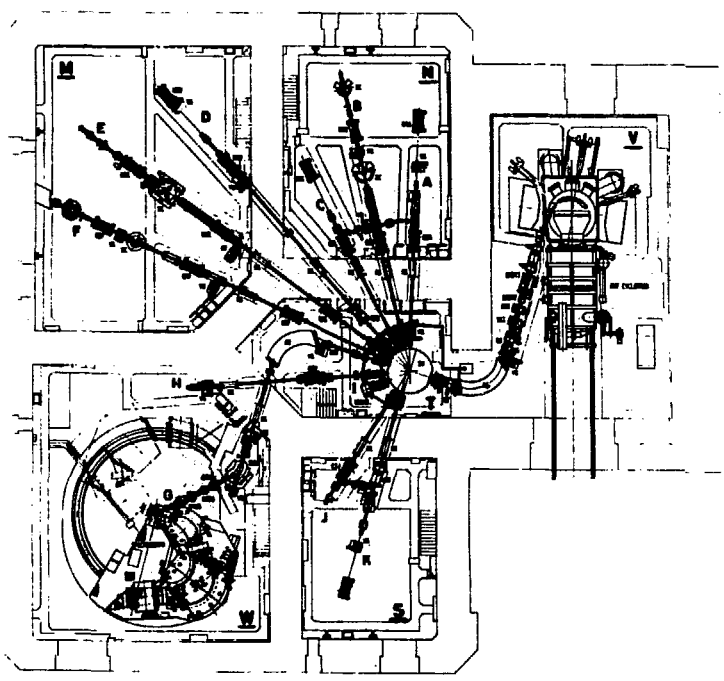
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	∿80 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	∿2 %
Development	∿18 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

All research facilities in the Research Center for Nuclear Physics (RCNP) are open to all nuclear scientists in Japan. Beams of p, d, ^{3}He, ^{4}He, $\vec{p}$, $\vec{d}$, $^{12}C^{4+}$, $^{14}N^{4+,5+}$, $^{16}O^{5+}$ and $^{20}Ne^{4+,5+}$ have been used for many kinds of experiments. The B-beam line is mainly used for polarization experiments. The E-line is equipped with a large scattering chamber. The F-line is for an in-beam spectroscopy. A reaction particle analyzer (230t, ρ = 1500 mm) of QDDQ-type[1], whose momentum resolution is 20,000 is located in room W.

1) H. Ikegami et al, RCNP Annual Report (1976)



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ENTRY NO. 38

NAME OF MACHINE Tohoku University Cyclotron DATE July, 1978
INSTITUTION Cyclotron and Radioisotope Center, Tohoku University
ADDRESS Aramaki-Aoba, 980 Sendai, Japan

IN CHARGE S. Morita REPORTED by S. Morita

HISTORY AND STATUS CGR-MeV Model 680

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date 1975 – 1977
FIRST BEAM date (or goal) December, 1977
MAJOR ALTERATIONS none

OPERATION, _____ hr/wk; On Target _____ hr/wk
TIME DIST., in house _____ %, outside _____ %
USERS' SCHEDULING CYCLE _____ weeks
COST, ACCELERATOR _____
COST, FACILITY, total $ 14×10^6
FUNDED BY Japan Ministry of Education

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS _____
TECHNICIANS 3 CRAFTS 1
GRAD STUDENTS involved during year ~6
OPERATED BY 3 Res staff or _____ Operators
BUDGET, op & dev $ 1.0×10^6
FUNDED BY Japan Ministry of Education

RESEARCH STAFF, not included above

USERS, in house _____ outside ~20
GRAD STUDENTS involved during year ~10
RES. BUDGET, in house $ 0.3×10^6
FUNDED BY Japan Ministry of Education

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 800 m^2
movable _____ m^2
TARGET STATIONS 8 in 5 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type _____
COMPUTER, model MELCOM COSMO500 + MELCOM70/35
OTHER FACILITIES Isotope production, Irradiation of solid, Time-of-flight study (40 m flight path), Mass separator, Beam choppers.

REFERENCES/NOTES

MAGNET

POLE FACE diameter 160 cm; R extraction 68 cm
GAP, min 13 cm; Field 19.0 kG
max 28 cm; Field 10.7 kG
AVERAGE FIELD at R ext 15.6 kG
} at 0.26×10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B \rangle$ 1.22
NUMBER OF SECTORS 4 ; SPIRAL, max 50 deg
POLE FACE COIL PAIRS: AVF _____ /sec;
Harmonic correction 4
Rad grad _____ /sec or Circ coils 8
WEIGHT: Fe 100 tons; Coils _____ tons
CONDUCTOR, Material and type _____
STORED ENERGY _____ MJ
COOLING SYSTEM Deionized water
POWER: Main coils 100 max, kW
Trimming coils 26 max, kW
YOKE/POLE AREA _____ %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = 50 q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 60 deg
BEAM APERTURE 3 cm; DC BIAS 0 kV
TUNED by, coarse M.P. fine M.P.
RF 20 to 40 mHz, stable ± < 1 x /10^6
Orb F 5 to 20 mHz; GAIN, max 200 kV/turn
HARMONICS, RF/Orb F, used 2, 3 and 4
DEE-Gnd, max 50 kV, min gap _____ cm
STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}
RF PHASE stable to ± 0.5 deg
RF POWER input, max 120 kW
RF PROTECT circuit, speed 10 μsec
Type Ignitron
FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 2 x 8000 l/s
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME _____ hrs

ION SOURCES/INJECTION SYSTEM

Internal axial Livingstone-type

EXTRACTION SYSTEM

Deflector + two magnetic channels

CONTROL SYSTEM

typing limit

ENTRY NO. 38 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	3~39.5	same
	d	5~25	"
	^{3}He	7~65	"
	α	10~50	"
CURRENT		(μA)	(μA)
Internal			
External	p	50 (max)	100
	d	50 (max)	60
	^{3}He	40 (max)	40
		(part/s)	(part/s)
Secondary			

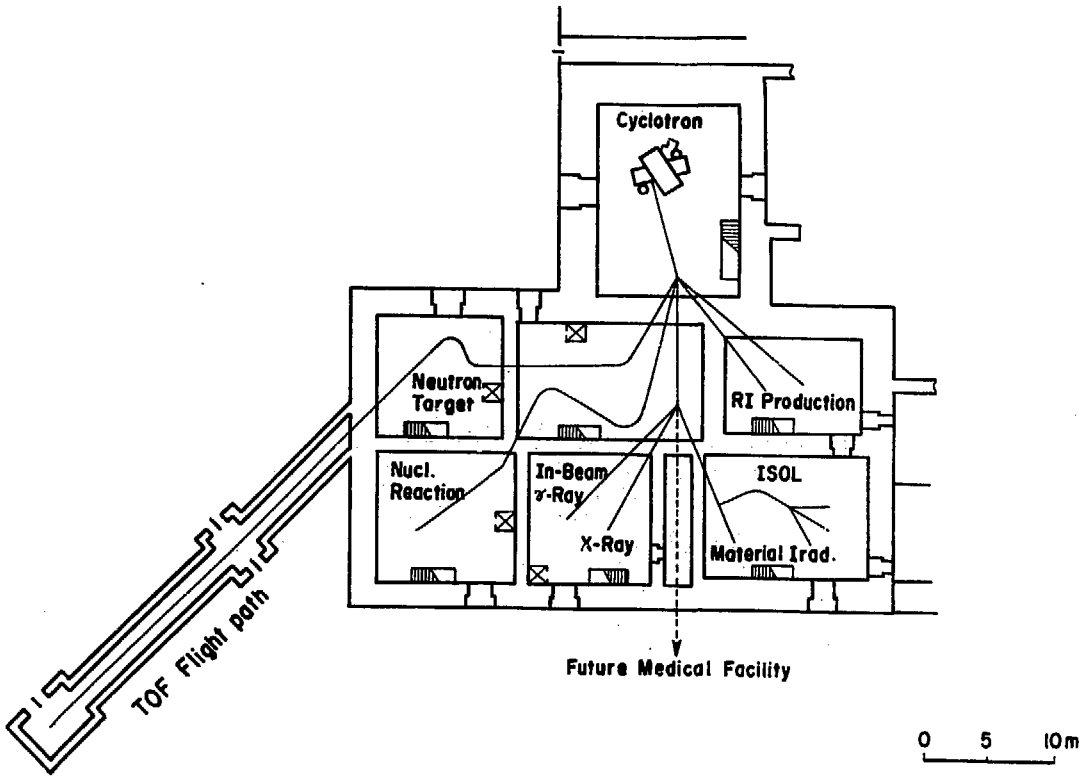
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	72 %	50 μA of 40 MeV p
Res, ΔE/E	0.5 %	20 μA of 35 MeV α
Emittance (mm-mrad)	21 axial, 30 radial	40 μA of 40 MeV p

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



Cyclotron-Radioisotope Center Shielded Area

typing limit

ENTRY NO. 39

NAME OF MACHINE IMS (IKAKEN) Cyclotron DATE 7/31/78
INSTITUTION The Institute of Medical Science, The Univ. of Tokyo
ADDRESS Minato-ku, Tokyo 108, JAPAN

IN CHARGE Akira ITO REPORTED by Akira ITO

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date TCC model CS-30
CONSTRUCTION, date 1971-1973
FIRST BEAM date (or goal) Aug. 1973
MAJOR ALTERATIONS replacement of magnet coils (1976)
OPERATION, 50 hr/wk; On Target 40 hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR about $1M (1973)
COST, FACILITY, total about $1M (1973)
FUNDED BY Japanese Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS _____
TECHNICIANS 3 CRAFTS _____
GRAD STUDENTS involved during year _____
OPERATED BY X Res staff or X Operators
BUDGET, op & dev $0.4M (1978)
FUNDED BY Japanese Government

RESEARCH STAFF, not included above

USERS, in house 6 outside 10
GRAD STUDENTS involved during year 2
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 330 m^2
movable 0 m^2
TARGET STATIONS 6 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type _____
COMPUTER, model PDP-8L, PDP-11/40
OTHER FACILITIES
Isotopes production
Neutron therapy
Neutron TOF
In beam X & gamma spectroscopy

REFERENCES/NOTES

Y.Yoshida et al., Nucl. Instr. & Meth., Vol.138,pp.579-788(1976).

MAGNET

POLE FACE diameter 96 cm; R extraction 42 cm
GAP, min 5 cm; Field 20 kG
max 10 cm; Field 12 kG
AVERAGE FIELD at R ext 16 kG
} at 0.2 x 10^6 ampere turns
CURRENT STABILITY 100 parts/10^6; $B_{max}/\langle B \rangle$ 1.25
NUMBER OF SECTORS 3 ; SPIRAL, max 60 deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction 2(inner&outer)/sec.
Rad grad _____ /sec or Circ coils _____
WEIGHT: Fe 23 tons; Coils 1 tons
CONDUCTOR, Material and type Cu hollow
STORED ENERGY _____ MJ
COOLING SYSTEM demineralized water
POWER: Main coils 60 max, kW
Trimming coils _____ max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = 30 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg
BEAM APERTURE 4 cm; DC BIAS -1.5 kV
TUNED by, coarse short bar fine V.C.
RF 14 to 26 mHz, stable ± 10 /10^6
Orb F _____ to _____ mHz; GAIN, max 40 kV/turn
HARMONICS, RF/Orb F, used _____
DEE-Gnd, max 30 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.1%
RF PHASE stable to ± 5 deg
RF POWER input, max 75 kW
RF PROTECT circuit, speed 50 μsec
Type driver tube crowbar
FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size one diffusion pump (30cm dia.)
OPERATING PRESSURE less than 10 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM

PIG type (internal only)

EXTRACTION SYSTEM

DC deflector + mag. channel

CONTROL SYSTEM

manual

typing limit

ENTRY NO. 39 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		26
	d		14
	^{3}He		38
	α		28
CURRENT		(μA)	(μA)
Internal	p, d		500
	^{3}He		150
	α		100
External	p		70
	d		150
	^{3}He		70
	α		50
		(part/s)	(part/s)
Secondary	Be(d,n) $\bar{E}$n=6MeV		5×10^{12}

BEAM PROPERTIES

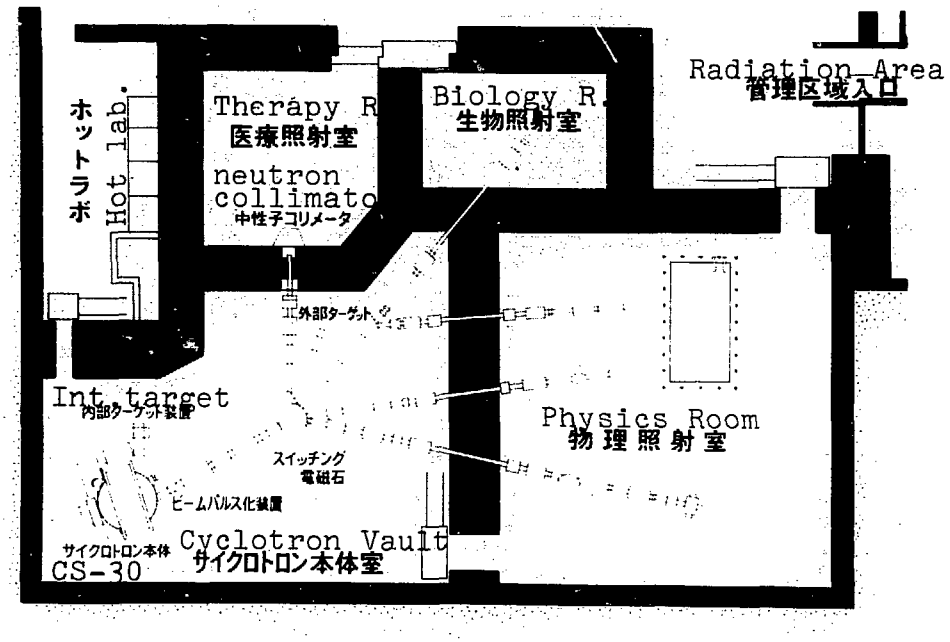
	Measured		Conditions			
Pulse Width	10	RF deg	1	μA of	28	MeV α
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	60	%	100	μA of	14	MeV d
Res, ΔE/E	1	%	1	μA of	14	MeV d
Emittance (mm-mrad)	10 axial / 14 radial		1	μA of	14	MeV d

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	20 %
Bio-Medical Applications	60 %
Isotope Production	10 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

1) Plan view of IMS cyclotron



2) External beam pulsing system Using horizontal and vertical RF deflector system, beam period can be selected from 160 ns(p), 200ns(^{3}He) and 280 ns(d&α) to infinite.

3) Fast neutron irradiation facility For medical and biological study, the neutron target and collimator system is facilitated, which yields the neutron dose of about 40 rad/min./100μAd at 125 cm SSD.

typing limit

ENTRY NO. 40

NAME OF MACHINE INS Sector Focusing Cyclotron(INS-SF) DATE 7/14/78
INSTITUTION Institute for Nuclear Study, University of Tokyo
ADDRESS 3-2-1, Tanashi, Tokyo, Japan

IN CHARGE Y. Hirao REPORTED by M. Sekiguchi

HISTORY AND STATUS

DESIGN, date 1968 MODEL tests 1968-1970
ENG. DESIGN, date 1969-1970
CONSTRUCTION, date 1969-1973
FIRST BEAM date (or goal) Extracted, 1974
MAJOR ALTERATIONS New deflector system, 2nd on-line computer
OPERATION, 132 hr/wk; On Target ∿100 hr/wk
TIME DIST., in house (*) %, outside (*) %
USERS' SCHEDULING CYCLE ∿4 weeks
COST, ACCELERATOR 3×10^8 yen(†)
COST, FACILITY, total 7×10^8 yen(†)
FUNDED BY Japan Ministry of Education

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS 3
TECHNICIANS 2 CRAFTS 2
GRAD STUDENTS involved during year 0
OPERATED BY 1/2 Res staff or 1/2 Operators
BUDGET, op & dev 4×10^7 yen(†)
FUNDED BY Japan Ministry of Education

RESEARCH STAFF, not included above

USERS, in house 9 outside ∿20
GRAD STUDENTS involved during year ∿ 5
RES. BUDGET, in house 5×10^7 yen(†)
FUNDED BY Japan Ministry of Education

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 530 m^2
movable 0 m^2
TARGET STATIONS 11 in 5 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type QDD(original design)
COMPUTER, model TOSBAC 40C and FACOM U400
OTHER FACILITIES 80cm dia. scatt. chamber, Semi-circular scatt. chamber for pγ correl., In Beam γ ray facility, Water-cooled target station for RI production, On-line mass separator

REFERENCES/NOTES

INS Internal Reports, INS-J-131(1971), INS-J-133(1972), INS-J-138(1972), INS-J-139(1972), INS-J-154(1975), Proceedings of the 7th Cyclotron Conf., p.103 and p.312(1975)
*Time is assigned by Program Committee. No distinction is made between inhouse and outside proposals.
†Salaries are not included.

typing limit

MAGNET

POLE FACE diameter 168 cm; R extraction 73 cm
GAP, min 14.6 cm; Field 19.5 kG
max 22.8 cm; Field 13.2 kG
AVERAGE FIELD at R ext 16.4 kG
} at 0.38×10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ 1.19
NUMBER OF SECTORS 3 ; SPIRAL, max 55 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 7/3
Rad grad /sec or Circ coils 11
WEIGHT: Fe 130 tons; Coils 5 tons
CONDUCTOR, Material and type Copper and MI cable
STORED ENERGY ∿4 MJ
COOLING SYSTEM Oil and demineralized water
POWER: Main coils 260 max, kW
Trimming coils 60 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 68 q^2/A^2 MeV
(Focusing limit) E/A = 48 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 4 cm; DC BIAS 0 kV
TUNED by, coarse Short. Pl. fine 2 Trim. Cap.
RF 7.5 to 22.5 mHz, stable ± < 10 /10^6
Orb F 2.5 to 22.5 mHz; GAIN, max 160 kV/turn
HARMONICS, RF/Orb F, used 1 , 3
DEE-Gnd, max 80 kV, min gap 0.7 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± deg
RF POWER input, max 360 kW
RF PROTECT circuit, speed ∿1 μsec
Type Ignitron crowbar
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 36 inch and 10 inch oil diffusion pumps
OPERATING PRESSURE 1 μTorr,
PUMPDOWN TIME 8 hrs

ION SOURCES/INJECTION SYSTEM

Hot cathode (A≤4) and cold cathode (A>4) PIG, Vert. Inj. for $\vec{p}$ and $\vec{d}$

EXTRACTION SYSTEM

2 channel dc deflector

CONTROL SYSTEM

Conventional

ENTRY NO. 40 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	48	35
	α	68	68
	$^{14}N^{5+}$	118	115
	$^{20}Ne^{6+}$	119	115
CURRENT		(μA)	(μA)
Internal	p		>500
	α		>200
External	p		∿10
	$^{14}N^{5+}$		4.3
	$^{20}Ne^{6+}$		1.5
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

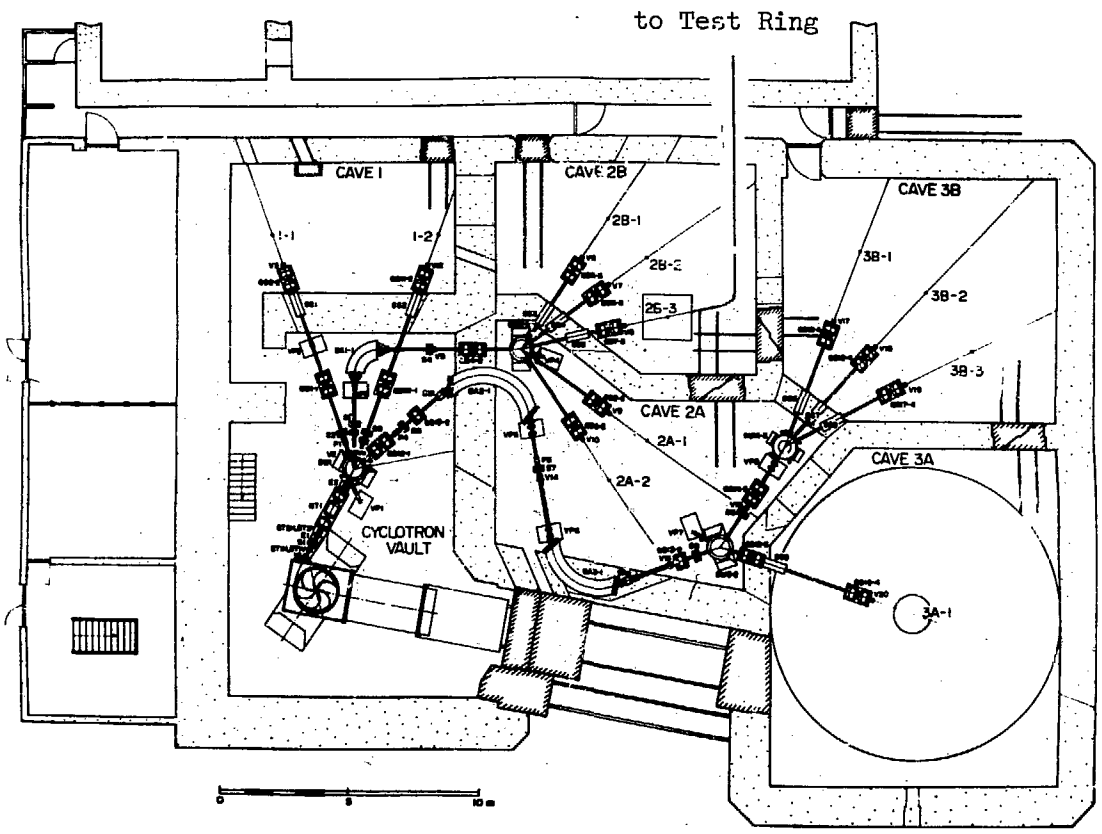
	Measured		Conditions				
Pulse Width	15	RF deg	1	μA of	60	MeV	α
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	60	%	8	μA of	82	MeV	^3He
Res, ΔE/E	0.3	%	1	μA of	67	MeV	α
Emittance (mm-mrad)	25 axial / 18 radial		5	μA of	14	MeV	p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	∿ 90 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	%
Development	∿ 10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

. storage ring of heavy ion beams will be installed in a room adjacent to the SF cyclotron facility by the end of 1978. The ring is used to solve technical problems encountered in constructing a big synchrotron for heavy ions, the NUMATRON (cf."NUMATRON" published by The Study Group of Numatron, INS, 1977). Some kinds of heavy ions are planned to be injected into the test ring from the SF cyclotron through the beam line 2B-3.



typing limit

ENTRY NO. 41

NAME OF MACHINE Isochronous Cyclotron Free University Amsterdam DATE Jan. 1979
INSTITUTION Natuurkundig Laboratorium van de Vrije Universiteit
ADDRESS De Boelelaan 1081, Amsterdam-Buitenveldert, The Netherlands

IN CHARGE J. Blok REPORTED by J. Rethmeier

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date _____
FIRST BEAM date (or goal) April 1965
MAJOR ALTERATIONS _____

OPERATION, 100 hr/wk; On Target 40 hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR _____
COST, FACILITY, total Dfl. 6 10^6 (1965)
FUNDED BY Free University

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 1
TECHNICIANS 3 CRAFTS 5
GRAD STUDENTS involved during year 1
OPERATED BY night Res staff or day Operators
BUDGET, op & dev Dfl. 100.000,-
FUNDED BY Free Unsiversity

RESEARCH STAFF, not included above

USERS, in house 15 outside 2
GRAD STUDENTS involved during year 15
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 235 m^2
movable _____ m^2
TARGET STATIONS 7 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type ENGE-SPLIT POLE
COMPUTER, model HP-3000
OTHER FACILITIES Rabbit-system for on-line Mass-separation
PIXE-facility
Momentum analyzing system $\Delta E/E$
Burst-suppression 3 10^{-4}

REFERENCES/NOTES

Los Angelos Cycl. Conf. '62 p. 88
CERN Cycl. Conf. '63 p 43, 214
Nucl.Instr.Meth. '68 (1969)135

MAGNET

POLE FACE diameter 140 cm; R extraction 57 cm
GAP, min 16 cm; Field 20 kG
max 32 cm; Field 10 kG
AVERAGE FIELD at R ext 15 kG
} at 0,2 x 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/(B)$ 1.33
NUMBER OF SECTORS 3 ; SPIRAL, max 37 deg
POLE FACE COIL PAIRS: AVF 3 /sec;
Harmonic correction _____
Rad grad _____ /sec or Circ coils 10
WEIGHT: Fe 100 tons; Coils 20 tons
CONDUCTOR, Material and type Aluminium
STORED ENERGY _____ MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 140 max, kW
Trimming coils 32.5 max, kW
YOKE/POLE AREA 106 %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 2,8 cm; DC BIAS 0,3 VAR. kV
TUNED by, coarse short.Pl. fine VAR.CAP.
RF 5 to 22 mHz, stable ± 1 /10^6
Orb F 5 to 22 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 1,3
DEE-Gnd, max 50 kV, min gap 2 cm
STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}
RF PHASE stable to ± 1,5 deg
RF POWER input, max 85 kW
RF PROTECT circuit, speed _____ μsec
Type _____
FREQUENCY MODULATION, rate – /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 3 H.V. Oil Diff. 10.000L/sec. roots 400 m^3/hr. M.V. Pump 170 m^3/Hr.
OPERATING PRESSURE 1,5 μTorr,
PUMPDOWN TIME 1,5 hrs

ION SOURCES/INJECTION SYSTEM

Internal Livingston

EXTRACTION SYSTEM

Electrostatic + magnetic channel

CONTROL SYSTEM HARDWARE

typing limit

ENTRY NO. 41 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	33	30
	d	16	16,7
	α	33	33
CURRENT		(μA)	(μA)
Internal	p		>300
	d		300
	He^3, He^4		8
External	p		50
	d		30
	He^3, He^4		5
		(part/s)	(part/s)
Secondary			

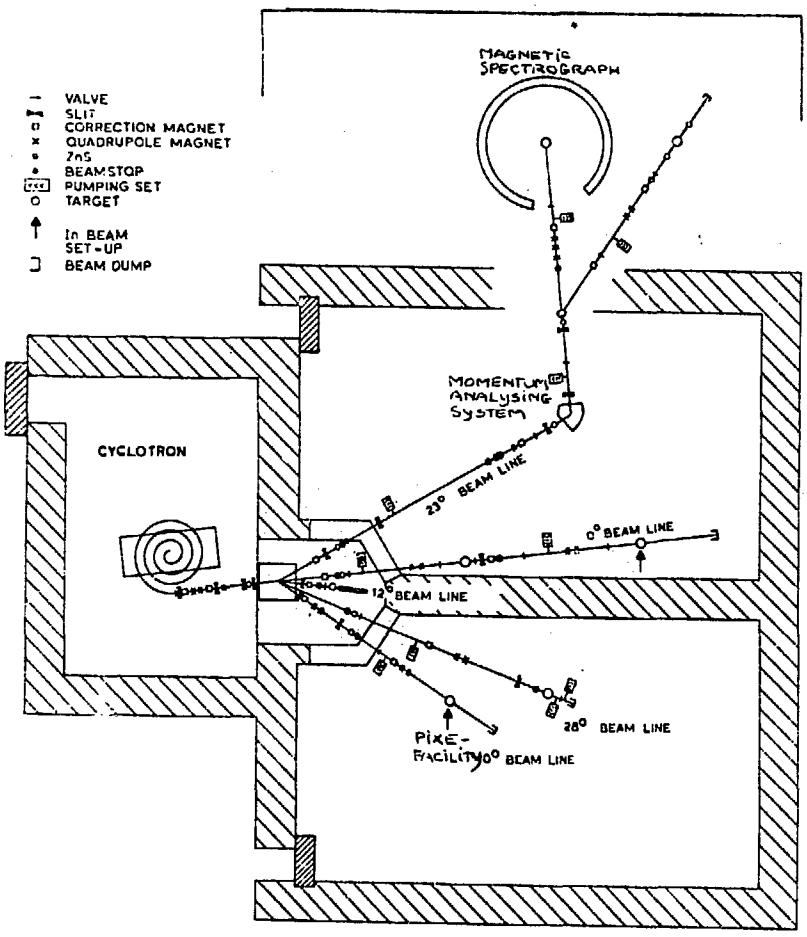
BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	30-2	RF deg	5	μA of	12	MeV	d
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	70 %		10	μA of	12	MeV	p
Res, ΔE/E	0.3 %			μA of	20	MeV	p
Emittance (mm-mrad)	15 axial / 15 radial			μA of	12	MeV	p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	80 %
Solid State Physics	0 %
Bio-Medical Applications	5 %
Isotope Production	5 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

ENTRY NO. 42

NAME OF MACHINE Delft Isochronous Cyclotron DATE 7/31/78
INSTITUTION Delft University of Technology, Dept. of Electrical Eng.
ADDRESS Kanaalweg 2B, Delft

IN CHARGE W.A. van Kampen REPORTED by J.Liedorp

HISTORY AND STATUS

DESIGN, date 1955 MODEL tests none
ENG. DESIGN, date 1955-57 1966-68
CONSTRUCTION, date 1955-57 1967-69
FIRST BEAM date (or goal) 1957 1969
MAJOR ALTERATIONS 1966 1974

OPERATION, ____ hr/wk; On Target ____ hr/wk
TIME DIST., in house 100 %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS ____
TECHNICIANS 2 CRAFTS ____
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or ____ Operators
BUDGET, op & dev ____
FUNDED BY ____

RESEARCH STAFF, not included above

USERS, in house ____ outside ____
GRAD STUDENTS involved during year ____
RES. BUDGET, in house ____
FUNDED BY ____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS ____ in ____ rooms
STATIONS served at same time, max ____
MAG SPECTROGRAPH, type ____
COMPUTER, model ____
OTHER FACILITIES ____

REFERENCES/NOTES

W.A.van Kampen and J.Liedorp, Experientia Suppl.(Zürich)24 (1975)254.
W.A.van Kampen and J.Liedorp, Nucl.Instr.and Meth.140(1977) 219.

MAGNET

POLE FACE diameter 85 cm; R extraction 38 cm
GAP, min 9 cm; Field 10 kG
max 15 cm; Field 16 kG
AVERAGE FIELD at R ext 13.5 kG
(at .156 X 10^6 ampere turns)
CURRENT STABILITY 100 parts/10^6; $B_{max}/(B)$ 1.12
NUMBER OF SECTORS 4 ; SPIRAL, max 37 deg
POLE FACE COIL PAIRS: AVF ____ /sec;
Harmonic correction 3
Rad grad ____ /sec or Circ coils 3
WEIGHT: Fe 26 tons; Coils 1.65 tons
CONDUCTOR, Material and type Al
STORED ENERGY ____ MJ
COOLING SYSTEM water
POWER: Main coils 24 max, kW
Trimming coils 1 max, kW
YOKE/POLE AREA ____ %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 2 cm; DC BIAS 0-.3 kV
TUNED by, coarse short fine moving panel
RF 20.2 to 20.9 mHz, stable ± 10 /10^6
Orb F 20.6 to ____ mHz; GAIN, max 60 kV/turn
HARMONICS, RF/Orb F, used ____
DEE-Gnd, max 30 kV, min gap ____ cm
STABILITY, (pk-pk noise)/(pk RF volt) ____
RF PHASE stable to ± ____ deg
RF POWER input, max 50 kW
RF PROTECT circuit, speed ____ μsec
Type ____
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size oil diffusionpump
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

~~duoplasmatron, precession injection~~

EXTRACTION SYSTEM

CONTROL SYSTEM

typing limit

ENTRY NO. 42 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	~~p~~	~~12.7~~	~~12.7~~
CURRENT		(μA)	(μA)
Internal	p	100	110
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff		%		μA of		MeV
Res, ΔE/E		%		μA of		MeV
Emittance (mm-mrad)	axial / radial			μA of		MeV

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

1966: the magnet field and the r.f. system redesigned to incorporate spiral ridge magnet poles and externally excited r.f. system

1974: cyclotron magnet central region and dee at the central region modified for precession injection,
a 200 keV proton injector giving 10mA protons in operation.

july 1975: 110 μA protons accelerated up to 12MeV with external ion source and precession injection.

1976-78: beam line between preaccelerator and cyclotron equipped with slits and a chopping system to inject beampulses,small in time and space,at various places and times into the cyclotron. Measuring the resultant betatronmotions in the main mode of the cyclotron.

notes:

1 from the original cyclotron,which was the first AVF proton cyclotron to operate,the magnet yoke,magnet excitation and windings and the vacuum chamber are still the same.

2 data given refer to the cyclotron with precession injection

typing limit

ENTRY NO. 43

NAME OF MACHINE philips Variable Energy AVF cyclotron DATE july 1987
INSTITUTION Eindhoven University of Technology (EUT)
ADDRESS Eindhoven, The Netherlands

IN CHARGE H.L. Hagedoorn REPORTED by J.I.M. Botman

HISTORY AND STATUS

DESIGN, date 1960 MODEL tests 1960
ENG. DESIGN, date 1961-1962
CONSTRUCTION, date 1962-1963
FIRST BEAM date (or goal) April 1963
MAJOR ALTERATIONS moved to Eut 1968

OPERATION, 70 hr/wk; On Target 50 hr/wk
TIME DIST., in house 100 %, outside %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR gift from Philips
COST, FACILITY, total M$3 (1968)
FUNDED BY EUT

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2
TECHNICIANS 2 CRAFTS
GRAD STUDENTS involved during year 1
OPERATED BY Res staff or 1 Operators
BUDGET, op & dev k$50
FUNDED BY EUT

RESEARCH STAFF, not included above

USERS, in house 10 outside
GRAD STUDENTS involved during year 20
RES. BUDGET, in house k$80
FUNDED BY EUT

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 120 m^2
movable 230 m^2
TARGET STATIONS 4 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model PDP 11
OTHER FACILITIES isotope production
time of flight study
PIXE analyses facility
microbeam (under developpment)

REFERENCES/NOTES

MAGNET

POLE FACE diameter 130 cm; R extraction 51 cm
GAP, min 15 cm; Field 20 kG
max 30 cm; Field 10 kG
AVERAGE FIELD at R ext 15 kG
} at 0.4 X 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B \rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max 35 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction
Rad grad 3 /sec or Circ coils 10
WEIGHT: Fe 80 tons; Coils 10 tons
CONDUCTOR, Material and type Al
STORED ENERGY MJ
COOLING SYSTEM water
POWER: Main coils 130 max, kW
Trimming coils 20 max, kW
YOKE/POLE AREA 115 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 30 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 2.0 cm; DC BIAS 0.7 kV
TUNED by, coarse MS fine VC
RF 5 to 23.3 mHz, stable ± 20 /10^6
Orb F 5 to 23.3 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 50 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}
RF PHASE stable to ± 1 deg
RF POWER input, max 100 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size oil diffusion,1,8000 1/sec
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

internal: Livingston type
external: polarised,trochoidal injection

EXTRACTION SYSTEM

electrostatic,80deg,60kV/4mm, followed by magnetic channel

CONTROL SYSTEM

conventional, plus computer control

typing limit

ENTRY NO. 43 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		2.5-29.5
	d		3-15
	^{4}He		6-30
	^{3}He		5-40
CURRENT		(μA)	(μA)
Internal	p, d		1000
	^{4}He, ^{3}He		50
	pol. p		0.05
External	p, d		100
	^{4}He, ^{3}He		30
	pol. p		0.03
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	36	RF deg		μA of		MeV
Phase Exc, max	5	RF deg		μA of		MeV
Extract Eff	80	%		μA of		MeV
Res, ΔE/E	0.3	%		μA of		MeV

Emittance (mm-mrad) {10-20 axial, 10-20 radial} 5 μA of 20 MeV p

OPERATING PROGRAMS, time dist

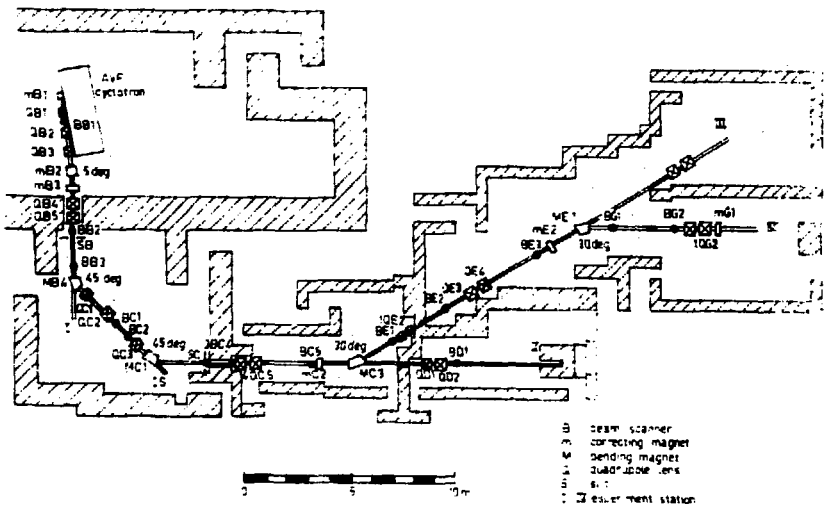
Basic Nuclear Physics	50 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production for medical appl	10 %
Development and machine research	20 %
Pixe	20 %
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Automatic control project (with CAMAC and PDP 11)

1. Internal beam
   Computer control of HF phase, measured with capacitive phase probes, using 3 concentric correction coils. Maximum phase deviation from the desired phase is 2 degrees; control action every 6 sec.
2. Extraction efficiency
   Measured by applying small disturbances of the currents through 4 harmonic coils and the outermost circular coil; optimisation by computer control.
3. External beam
   Control of both analysing magnets by a NMR measuring and control unit.
   Control of beam position, measured by beam scanners, by computer setting of steering magnets.
   Determination of emittances at several places.

Ref. Van Heusden, EUT thesis 1976.



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ENTRY NO. 44

NAME OF MACHINE Groningen Isochronous Cyclotron DATE Aug. '78
INSTITUTION Kernfysisch Versneller Instituut
ADDRESS Zernikelaan 25, Groningen, The Netherlands.

IN CHARGE R.H. Siemssen REPORTED by H.W. Schreuder

HISTORY AND STATUS

DESIGN, date 1963 MODEL tests 1964-1966
ENG. DESIGN, date 1966-1968
CONSTRUCTION, date 1968-1970
FIRST BEAM date (or goal) 1970
MAJOR ALTERATIONS central region (1972)

OPERATION, 126 hr/wk; On Target 84% hr/wk
TIME DIST., in house 80 %, outside 20 %
USERS' SCHEDULING CYCLE – weeks
COST, ACCELERATOR $ 4 * 10^6
COST, FACILITY, total
FUNDED BY Groningen University

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 1
TECHNICIANS 10 CRAFTS 2
GRAD STUDENTS involved during year 1
OPERATED BY ✓ Res staff or 8 Operators 4)
BUDGET, op & dev
FUNDED BY Groningen University and Foundation F.O.M.

RESEARCH STAFF, not included above

USERS, in house 20 outside 8
GRAD STUDENTS involved during year 11
RES. BUDGET, in house
FUNDED BY Groningen University and Foundation F.O.M.

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable 450 m^2
TARGET STATIONS 8 in 6 rooms 1)
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type Q3D
COMPUTER, model 3 PDP 15
OTHER FACILITIES
In-beam gamma ray facility
Gamma multiplicity set-up
Scattering chambers
Beam pulser

REFERENCES/NOTES

1) 3 more target stations and one more room in 1979.
2) axial injection in design stage.
3) computer control: start in 1979.
4) 8 half-time operators.

MAGNET

POLE FACE diameter 280 cm; R extraction 121 cm
GAP, min 22.4 cm; Field 20 kG
max 45 cm; Field 10 kG
AVERAGE FIELD at R ext 16 kG
at X 10^6 ampere turns
CURRENT STABILITY ± 5 parts/10^6; $B_{max}/(B)$ 1.25
NUMBER OF SECTORS 3 ; SPIRAL, max 56 deg
POLE FACE COIL PAIRS: AVF – /sec;
Harmonic correction 5 / sector
Rad grad – /sec or Circ coils 12
WEIGHT: Fe 650 tons; Coils 29 tons
CONDUCTOR, Material and type aluminum
STORED ENERGY MJ
COOLING SYSTEM demin. water
POWER: Main coils 360 max, kW
Trimming coils 100 max, kW
YOKE/POLE AREA 113 %
SECTOR ANGLE (Sep Sec) – deg
ION ENERGY (Bending limit) E/A = 160 q^2/A^2 MeV
(Focusing limit) E/A = 80 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 2.5 cm; DC BIAS 0.5 kV
TUNED by, coarse mov. short fine trim. cap.
RF 4.7 to 13.9 mHz, stable ± 5 /10^6
Orb F to mHz; GAIN, max 140 kV/turn
HARMONICS, RF/Orb F, used 1, 3
DEE-Gnd, max 70 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 3.10^{-4}
RF PHASE stable to ± deg
RF POWER input, max 150 kW
RF PROTECT circuit, speed μsec
Type series tube
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 2 diffusion pumps Ø 50 cm, one 3000ℓ/s cryopump
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

Livingston (2 types)
PIG (in development) 2)

EXTRACTION SYSTEM

electrostatic 55°

CONTROL SYSTEM

manual 3)

typing limit

ENTRY NO. 44 (cont.)

CHARACTERISTIC BEAMS

	Particle	[redacted] (MeV)		Achieved (MeV)
ENERGY	α	25	-	140
	$^{12}C^{3+,4+}$	50	-	200
	$^{16}O^{4+}$		160	
CURRENT [redacted] *)		(μA)		(μA)
External				
		(part/s)		(part/s)
Secondary				

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	5-40	RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	50	%		μA of		MeV
Res, ΔE/E	0.3	%		μA of		MeV
Emittance (mm-mrad)	30 axial / 20 radial			μA of		MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	80 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	7 %
Development	10 %
radiation damage studies	3 %
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

plan view and status report: Dermois et al., these Proceedings.

*) beam currents for light ions limited by septum dissipation.
300 nA analysed beam on target typical
beam currents for C and O beams limited by Livingston source:
5-400 en A external.

typing limit

ENTRY NO. 45

NAME OF MACHINE _____ DATE 12/7/75

INSTITUTION Cyclotron and Isotope Lab., Philips-Duphar B.V.

ADDRESS 1755 LE PETTEN, The Netherlands

IN CHARGE I.F. van den Bosch REPORTED by I.G. van der Bean

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____

ENG. DESIGN, date _____

CONSTRUCTION, date 1963-1964

FIRST BEAM date (or goal) protons, june '64

MAJOR ALTERATIONS 1966

Multi-particle machine

OPERATION, 80 hr/wk; On Target 75 hr/wk

TIME DIST., in house 100 %, outside - %

USERS' SCHEDULING CYCLE -- weeks

COST, ACCELERATOR $1 x 10^6

COST, FACILITY, total _____

FUNDED BY privately, Philips-Duphar B.V.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1

TECHNICIANS 5 CRAFTS 4

GRAD STUDENTS involved during year --

OPERATED BY -- Res staff or 3 Operators

BUDGET, op & dev --

FUNDED BY privately, Philips-Duphar B.V.

RESEARCH STAFF, not included above

USERS, in house -- outside none

GRAD STUDENTS involved during year --

RES. BUDGET, in house --

FUNDED BY privately, Philips-Duphar B.V.

FACILITIES

SHIELDED AREA, fixed 130 m^2

movable -- m^2

TARGET STATIONS 1 in ternal

STATIONS served at same time, max --

MAG SPECTROGRAPH, type --

COMPUTER, model Philips P855M

OTHER FACILITIES

Radionuclide production

REFERENCES/NOTES

Hagedoorn, H.L. and Verster, M.F.C., report 63-19 (1963), p. 228-235

MAGNET

POLE FACE diameter 140 cm; R extraction 57 cm

GAP, min 16 cm; Field _____ kG
max 30 cm; Field _____ kG
AVERAGE FIELD at R ext 15.3 kG
} at 505 x 10^6 ampere turns

CURRENT STABILITY 50 parts/10^6; $B_{max}/\langle B \rangle$ _____

NUMBER OF SECTORS 3 ; SPIRAL, max 18 deg

POLE FACE COIL PAIRS: AVF -- /sec;

Harmonic correction _____

Rad grad _____ /sec or Circ coils 2

WEIGHT: Fe 90 tons; Coils 5 tons

CONDUCTOR, Material and type Al

STORED ENERGY _____ MJ

COOLING SYSTEM water

POWER: Main coils 160 max, kW

Trimming coils _____ max, kW

YOKE/POLE AREA 106 %

SECTOR ANGLE (Sep Sec) _____ deg

ION ENERGY (Bending limit) E/A = 30 q^2/A^2 MeV

(Focusing limit) E/A = 30 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg

BEAM APERTURE 3.5 cm; DC BIAS 0.75 kV

TUNED by, coarse MS fine trim cap.

RF 10 to 31 mHz, stable ± 50 /10^6

Orb F 7 to 21 mHz; GAIN, max 100 kV/turn

HARMONICS, RF/Orb F, used 1 st or 3 rd

DEE-Gnd, max 50 kV, min gap _____ cm

STABILITY, (pk-pk noise)/(pk RF volt) 0.001

RF PHASE stable to ± _____ deg

RF POWER input, max 90 kW

RF PROTECT circuit, speed _____ μsec

Type Series Triode

FREQUENCY MODULATION, rate _____ /sec

MODULATOR, type _____

BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 1 Oil Diff. 5000 l/sec, 1 Roots p., 1 Backing p. 100 m^3/h

OPERATING PRESSURE 5-10 μTorr,

PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM

Internal, hooded arc, 800 V, 8 A

EXTRACTION SYSTEM

electrostatic

CONTROL SYSTEM

typing limit

ENTRY NO. 45 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	H1	29	29
	H2	15	16
	He3	15	18
	He4	30	32
CURRENT		(μA)	(μA)
Internal	H1	300	100
	H2	200	100
	He3	--	--
External	He4	200	--
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width		RF deg		μA of		MeV	
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	80	%	25	μA of	30	MeV	p
Res, ΔE/E		%		μA of		MeV	
Emittance (mm-mrad)	axial / radial			μA of		MeV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	--	%
Solid State Physics	--	%
Bio-Medical Applications	--	%
Isotope Production	95	%
Development	5	%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 47

NAME OF MACHINE: CSIR Pretoria Cyclotron — DATE: July 24,78

INSTITUTION: Council for Scientific and Industrial Research (CSIR)

ADDRESS: P O Box 395, Pretoria 0001, Republic of South Africa

IN CHARGE: S J Mills — REPORTED by: A A Cowley

HISTORY AND STATUS

DESIGN, date 1950 MODEL tests -

ENG. DESIGN, date 1951 - 1953

CONSTRUCTION, date 1953 - 1958

FIRST BEAM date (for goal) 1958

MAJOR ALTERATIONS (See below)

OPERATION, 136 hr/wk; On Target 110 hr/wk

TIME DIST., in house 100 %, outside 0 %

USERS' SCHEDULING CYCLE 4 weeks

COST, ACCELERATOR

COST, FACILITY, total R200 000 (1958)

FUNDED BY CSIR

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1

TECHNICIANS 5 CRAFTS ~ 2

GRAD STUDENTS involved during year 0

OPERATED BY Res staff or 5 Operators

BUDGET, op & dev

FUNDED BY CSIR

RESEARCH STAFF, not included above

USERS, in house 7 outside 0

GRAD STUDENTS involved during year 1

RES. BUDGET, in house -

FUNDED BY CSIR

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 150 m^2

movable None m^2

TARGET STATIONS 4 in 2 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type -

COMPUTER, model Varian V 73

OTHER FACILITIES Facility for Isotope Production

REFERENCES/NOTES

Nucl. Inst. & Meth., 3,323 (1958)
Nucl. Inst. & Meth., 8,261 (1960)

MAGNET

POLE FACE diameter 112 cm, R extraction 49.5 cm

GAP, min 14.7 cm, Field 17.7 kG
max 15.9 cm, Field 16.4 kG
AVERAGE FIELD at R ext 17.7 kG
} at 0.32 x 10^6 ampere turns

CURRENT STABILITY 200 parts/10^6, B_{max}/(B)

NUMBER OF SECTORS 3, SPIRAL, max 0 deg

POLE FACE COIL PAIRS AVF /sec.

Harmonic correction 3

Rad grad /sec or Circ coils 2

WEIGHT Fe 73.8 tons; Coils 5.4 tons

CONDUCTOR, Material and type Aluminium

STORED ENERGY 0.2 MJ

COOLING SYSTEM Water

POWER Main coils 70 max, kW

Trimming coils 2 max, kW

YOKE/POLE AREA 115 %

SECTOR ANGLE (Sep Sec) - deg

ION ENERGY (Bending limit) E/A ~ 32 q^2/A^2 MeV

(Focusing limit) E/A ~ ~ 15 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 140 deg

BEAM APERTURE 5 cm; DC BIAS - kV

TUNED by, coarse MS fine VC, AUTO

RF 10.8 to 17.4 mHz, stable ± 10 /10^6

Orb F 10.8 to 17.4 mHz; GAIN, max 280 kV/turn

HARMONICS, RF/Orb F, used 1

DEE-Gnd, max 72 kV, min gap 1 cm

STABILITY, (pk-pk noise)/(pk RF volt) -

RF PHASE stable to ± - deg

RF POWER input, max 40 kW

RF PROTECT circuit, speed 1000 μsec

Type Rectifier Cut-off

FREQUENCY MODULATION, rate - /sec

MODULATOR, type -

BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Diffusion HV, 2 Roughing

OPERATING PRESSURE 50 μTorr,

PUMPDOWN TIME 5 hrs

ION SOURCES/INJECTION SYSTEM

Internal hot cathode ion source.

EXTRACTION SYSTEM

D C Electrostatic with 1st harmonic bump

CONTROL SYSTEM

Manual

typing limit

ENTRY NO. 47 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	8	5.8-15.3
	d	16	11.5-17.3
	^{3}He		18-38
	^{4}He	32	23-34.6
CURRENT		(μA)	(μA)
Internal	p		700
	d		700
	^{3}He, ^{4}He		150
External	p		60
	d		60
	^{3}He, ^{4}He		50
		(part/s)	(part/s)
Secondary	-	-	-

BEAM PROPERTIES

	Measured			Conditions				
Pulse Width	-	RF deg	-	μA of	-	MeV	-	
Phase Exc. max	-	RF deg	-	μA of	-	MeV	-	
Extract Eff	30	%	60	μA of	16	MeV	d	
Res. ΔE/E		%		μA of		MeV		
Emittance (mm-mrad)	- axial / - radial		-	μA of	-	MeV	-	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	20	%
Solid State Physics	0	%
Bio-Medical Applications		%
Isotope Production	70	%
Development	10	%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

During 1960 Thomas shims were installed in order to improve the vertical focussing.

The cyclotron has been modified for variable-energy operation and for acceleration of ^{3}He-ions during 1969. A ^{3}He-recovering system has been installed.

typing limit

ENTRY NO. 48

NAME OF MACHINE: NAC Separated-sector Cyclotron — DATE: 24 July 1978

INSTITUTION: National Accelerator Centre

ADDRESS: P O Box 320, Stellenbosch, 7600, South Africa.

IN CHARGE: G Heymann — REPORTED by: A H Botha

HISTORY AND STATUS

DESIGN, date 1975 MODEL tests 1975

ENG. DESIGN, date 1978

CONSTRUCTION, date 1979

FIRST BEAM date (or goal) Dec. 1983

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

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 7 ENGINEERS 10

TECHNICIANS 18 CRAFTS

GRAD STUDENTS involved during year

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside

GRAD STUDENTS involved during year

RES. BUDGET, in house

FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 700 m^2

movable 900 m^2

TARGET STATIONS ~25 in 10 rooms

STATIONS served at same time, max One

MAG SPECTROGRAPH, type

COMPUTER, model

OTHER FACILITIES

REFERENCES/NOTES

1. W L Rautenbach, A H Botha, Seventh Int. Conf. on Cyclotrons and their Applications, Zürich(1975)pp.117-122
2. A H Botha et al., IEEE Trans.Nucl. Sci. NS-24,No.3(1977),pp 1118 - 1120.
3. National Accelerator Project, Technical Report of the Accelerator Task Group, (1976)

typing limit

MAGNET

POLE FACE diameter 909 cm. R extraction 443 cm

GAP, min 6 cm. Field 12.7 kG } at 0.105 x 10^6 ampere turns

max - cm. Field - kG

AVERAGE FIELD at R ext 5.2 kG

CURRENT STABILITY 10 parts/10^6 B_{max}/B 2.4

NUMBER OF SECTORS 4 , SPIRAL, max 0 deg

POLE FACE COIL PAIRS AVF - /sec

Harmonic correction -

Rad grad ~27 /sec or Circ coils -

WEIGHT Fe 1400 tons, Coils ~5.8 tons

CONDUCTOR, Material and type Copper HC

STORED ENERGY 1 MJ

COOLING SYSTEM demineralized water

POWER Main coils 700 max. kW

Trimming coils 150 max. kW

YOKE/POLE AREA 74 %

SECTOR ANGLE (Sep Sec) 34 deg

ION ENERGY (Bending limit) E/A = 200 q^2/A^2 MeV

(Focusing limit) E/A = 200 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 51° deg

BEAM APERTURE 3 cm. DC BIAS 0 kV

TUNED by, coarse MS, VC fine VC

RF 5 to 26 mHz, stable ± 1 part /10^6

Orb F 0.5 to 6.5 mHz, GAIN, max 1000 kV/turn

HARMONICS, RF/Orb F, used 4, 12

DEE-Gnd, max 250 kV, min gap 10 cm

STABILITY, (pk-pk noise)/(pk RF volt)

RF PHASE stable to ± deg

RF POWER input, max 2 × 150 kW

RF PROTECT circuit, speed μsec

Type

FREQUENCY MODULATION, rate 0 /sec

MODULATOR, type -

BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 4 Rotary vane (200 m^3/hr), 4 Turbo molecular (4000 l/s), 8 cryopumps.

OPERATING PRESSURE 0.1 μTorr,

PUMPDOWN TIME 20 hrs

ION SOURCES/INJECTION SYSTEM

Two bending magnets in central region and a magnetic infiection channel in one pole-tip

EXTRACTION SYSTEM Electrostatic channel and two septum magnets.

CONTROL SYSTEM

Multi-minicomputer system with CAMAC interfacing. The system has a hierarchial structure: 2 senior-level and 3 junior-level computers.

ENTRY NO. 48 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	$^{1}H^{1+}$	20-200	
	$^{20}Ne^{8+}$	358	
	$^{40}Ar^{13+}$	660	
CURRENT		(μA)	(μA)
Internal			
External	$^{1}H^{1+}$(200MeV)	10	
	$^{1}H^{1+}$(80MeV)	100	
	Heavy ions	1 pμA	
		(part/s)	(part/s)
Secondary	–	–	–
	–	–	–

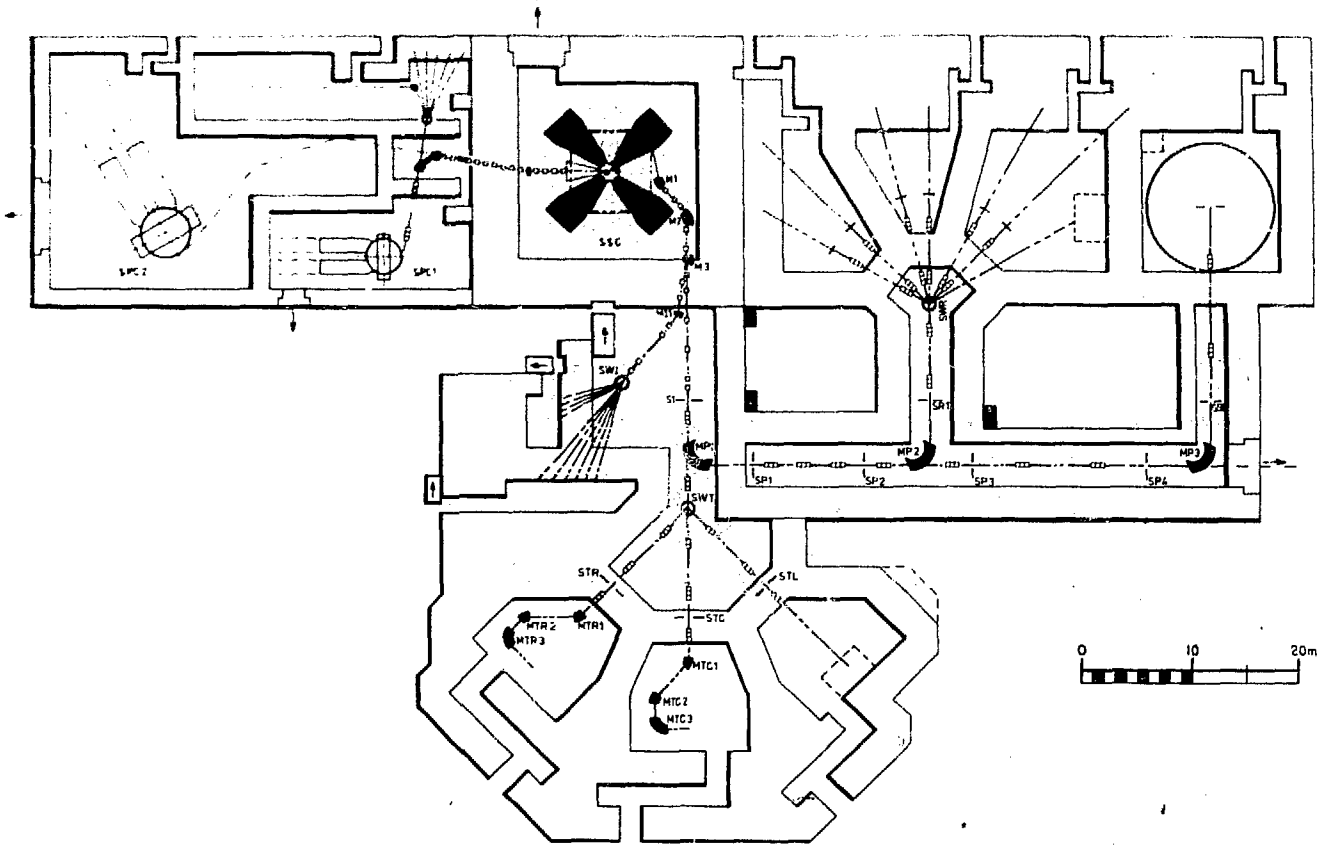
BEAM PROPERTIES

	Measured		Conditions	
Pulse Width	RF deg		μA of	MeV
Phase Exc. max	RF deg		μA of	MeV
Extract Eff	%		μA of	MeV
Res. ΔE/E	%		μA of	MeV
Emittance (mm-mrad)	axial / radial		μA of	MeV

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

Layout of Facility

ENTRY NO. 49

NAME OF MACHINE NAC Light-ion Injector DATE 24/7/78

INSTITUTION National Accelerator Centre

ADDRESS P O Box 320, Stellenbosch 7600, South Africa

IN CHARGE G Heymann REPORTED by A H Botha

HISTORY AND STATUS

DESIGN, date 1978 MODEL tests

ENG. DESIGN, date 1978 - 1982

CONSTRUCTION, date 1980 - 1983

FIRST BEAM date (or goal) Goal - Jan. 1984

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 CSIR

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 2

TECHNICIANS CRAFTS

GRAD STUDENTS involved during year

OPERATED BY Res staff or Operators

BUDGET, op & dev

FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside

GRAD STUDENTS involved during year

RES. BUDGET, in house

FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2

movable m^2

TARGET STATIONS in rooms

STATIONS served at same time, max

MAG SPECTROGRAPH, type

COMPUTER, model

OTHER FACILITIES

REFERENCES/NOTES

MAGNET

POLE FACE diameter 112 cm; R extraction 47,6 cm

GAP, min 15 cm; Field 10,4 kG
max 25 cm; Field 6,24 kG
AVERAGE FIELD at R ext 8,6 kG
} at 0,128 x 10^6 ampere turns

CURRENT STABILITY 100 parts/10^6; $B_{max}/\langle B \rangle$ 1,21

NUMBER OF SECTORS 4 ; SPIRAL, max 0 deg

POLE FACE COIL PAIRS: AVF 0 /sec;

Harmonic correction 4

Rad grad /sec or Circ coils 1

WEIGHT: Fe 32 tons; Coils 1,97 tons

CONDUCTOR, Material and type Copper

STORED ENERGY 0,06 MJ

COOLING SYSTEM Demineralized water

POWER: Main coils 17,4 max, kW

Trimming coils max, kW

YOKE/POLE AREA 90 %

SECTOR ANGLE (Sep Sec) - deg

ION ENERGY (Bending limit) E/A = 8 q^2/A^2 MeV

(Focusing limit) E/A = 8 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg

BEAM APERTURE 4 cm; DC BIAS 0 kV

TUNED by, coarse Short.Pl. fine Trim. Cap.

RF 7.5 to 26 mHz, stable ± 10 /10^6

Orb F 1,25 to 13 mHz; GAIN, max 280 kV/turn

HARMONICS, RF/Orb F, used 2,6

DEE-Gnd, max 70 kV, min gap cm

STABILITY, (pk-pk noise)/(pk RF volt)

RF PHASE stable to ± deg

RF POWER input, max 40 kW

RF PROTECT circuit, speed μsec

Type

FREQUENCY MODULATION, rate 0 /sec

MODULATOR, type -

BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size

OPERATING PRESSURE μTorr,

PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

EXTRACTION SYSTEM

CONTROL SYSTEM

typing limit

ENTRY NO. 49 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	0,8-8	
	d	0,4-4	
	α	0,8-8	
	N^{3+}	1-5	
CURRENT		(μA)	(μA)
Internal			
External	p	100	
	d	100	
	^3He, ^4He	50	
		(part/s)	(part/s)
Secondary	-	-	-

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	____ RF deg	____	μA of ____	MeV	____
Phase Exc, max	____ RF deg	____	μA of ____	MeV	____
Extract Eff	____ %	____	μA of ____	MeV	____
Res, ΔE/E	____ %	____	μA of ____	MeV	____
Emittance (mm-mrad)	____ axial / ____ radial	____	μA of ____	MeV	____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Will be used as an injector for 200 MeV separated-sector cyclotron of the South African National Accelerator Centre.

typing limit

ENTRY NO. 51

NAME OF MACHINE Stockholm 225-cm Cyclotron DATE Oct. 1978
INSTITUTION Research Institute of Physics
ADDRESS S-104 05 Stockholm 50, Sweden

IN CHARGE C.J. Herrlander REPORTED by H. Atterling

HISTORY AND STATUS

DESIGN, date 1946 MODEL tests 1946 (RF)
ENG. DESIGN, date 1946 (start)
CONSTRUCTION, date 1946 (start)
FIRST BEAM date (or goal) at full radius 1951
MAJOR ALTERATIONS New RF system in operation since 1973
OPERATION, ____ hr/wk; On Target ≈ 40 (a) hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY Sw.Govt., Sw.Atom.Committee, Wallenberg Foundation and other funds

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS and
TECHNICIANS 12-14 CRAFTS 1
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or x Operators
BUDGET, op & dev ____
FUNDED BY Sw. Govt., Sw. Nat. Sci. Res. Council, and Wallenberg Foundation

RESEARCH STAFF, not included above

USERS, in house and outside ≈ 50
GRAD STUDENTS involved during year ____
RES. BUDGET, in house ____
FUNDED BY Sw. Govt., Sw. Nat. Sci. Res. Council, and private funds

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ____ m^2
movable 5 caves (see Fig.) 175 m^2
TARGET STATIONS ____ in ____ rooms
STATIONS served at same time, max 1 (cf. Fig.)
MAG SPECTROGRAPH, type ____
COMPUTER, model PDP 11/70 + PDP 11/55
OTHER FACILITIES Ref. to the Institute's Annual Reports

REFERENCES/NOTES

(a) Operation recently resumed after a long-lasting shutdown, necessitated by construction and installation work. The beam-on-target time given was recorded prior to mid-March 1977.
(b) The poles are extended by steel discs tapered to a diam. of 211 cm.
(c) Max. field used; max. attainable field about 20 kG.

typing limit

MAGNET

POLE FACE dia 225 (b) cm; R extraction 90 cm
GAP, ~~min~~ 33 cm; Field 16 (c) kG } at ____ × 10^6 ampere turns
~~max~~ ____ cm; Field ____ kG
AVERAGE FIELD at R ext ____ kG
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$ ____
NUMBER OF SECTORS -- ; SPIRAL, max ____ deg
POLE FACE COIL PAIRS: AVF -- /sec;
Harmonic correction ____
Rad grad ____ /sec or Circ coils ____
WEIGHT: Fe 370 tons; Coils 27 tons
CONDUCTOR, Material and type Cu bars, hollow
STORED ENERGY ____ MJ
COOLING SYSTEM deionized water
POWER: Main coils at 16 kG 125 ~~max~~ kW
~~Trimming coils~~ ____ max, kW
YOKE/POLE AREA ____ %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg
BEAM APERTURE 12-5 cm; DC BIAS 0 kV
TUNED by, coarse short. pl. fine trim. cap.
RF 7.8 to 10 mHz, stable ± 0.01 /10^6
Orb F ____ to ____ mHz; GAIN, max ____ kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 120 kV, min gap 8 cm
STABILITY, (pk-pk noise)/(pk RF volt) ≤ 0.2 %
RF PHASE stable to ± ____ deg
RF POWER input, max 250 kW
RF PROTECT circuit, speed ____ μsec
Type ignitron crowbar
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size 3 oil diffusion pumps (one 50 cm, two 40 cm)
OPERATING PRESSURE ≈ 5 μTorr,
PUMPDOWN TIME 8-10 hrs

ION SOURCES/INJECTION SYSTEM

internal PIG source; for heavy ions indirectly heated cathode

EXTRACTION SYSTEM

electrostatic deflector

CONTROL SYSTEM

ENTRY NO. 51 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		10-15
	d		20-30
	α		40-60
	$^{12}C^{4+}$ (d)		120
CURRENT		(μA)	(μA)
Internal			
External	α		0.1nA - ≈5μA
at target in exp. area	$^{12}C^{4+}$		0.1-10 nA
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	%	μA of MeV
Res, ΔE/E	%	μA of MeV
Emittance (mm-mrad)	axial / radial	μA of MeV

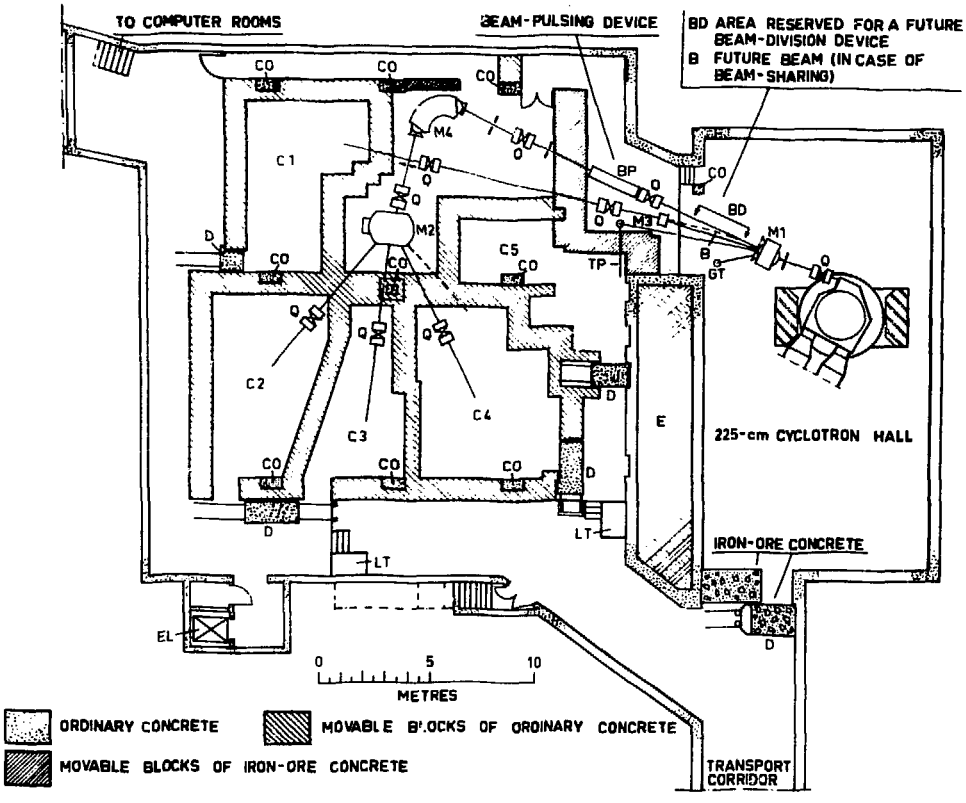
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	mainly %
Solid State Physics	%
Bio-Medical Applications	yes %
Isotope Production	yes %
Development	%
	%
	%

(d) External beams of other heavy ions to be developed.

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

REFERENCE: H. Atterling and G. Lindström, Arkiv för Fysik 15 (1959) 483. Major modifications are described in the Annual Reports.



The Fig. shows the lower floor of the recently built 2-story experimental hall. The first beam line to the new area (to C 1) was tested in June 1978. Two more beam lines are scheduled for completion before mid-1979. Cave C 5 is being equipped for processing of bombarded target material. On the upper floor a shielded area is being arranged for bio-medical synthesis work. On this floor is also the counting laboratory. For details, reference is made to the 1977 Annual Report.

typing limit

ENTRY NO. 52

NAME OF MACHINE Minicyclotron MC-40 DATE 1978-08-08
INSTITUTION Instrument AB Scanditronix
ADDRESS Husbyborg, S-755 90 Uppsala, Sweden

IN CHARGE Stig Lindbäck REPORTED by Stig Lindbäck

HISTORY AND STATUS

DESIGN, date 1974 MODEL tests 1974
ENG. DESIGN, date 1974-1975
CONSTRUCTION, date 1974-1975
FIRST BEAM date (or goal) 1976
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

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS
TECHNICIANS CRAFTS
GRAD STUDENTS involved during year
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS in rooms
STATIONS served at same time, max
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES

REFERENCES/NOTES

x) Data refer to original model MC-35, which has now been boosted to the MC-40 version.

MAGNET

POLE FACE diameter 130 cm; R extraction 50 cm
GAP, min 10 cm; Field 21.3 kG
max 18 cm; Field 13.2 kG
AVERAGE FIELD at R ext 17.9 kG
} at X 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$ 1.19
NUMBER OF SECTORS 3 ; SPIRAL, max 45 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 4 per valley
Rad grad /sec or Circ coils 10
WEIGHT: Fe 57 tons; Coils 2.5 tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 120 max, kW
Trimming coils 10 max, kW
YOKE/POLE AREA 106 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 40 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg
BEAM APERTURE 2 cm; DC BIAS 0 kV
TUNED by, coarse Mov. short fine Var. cond.
RF 12 to 27 mHz, stable ± 1 /10^6
Orb F 6 to 26.8 mHz; GAIN, max 176 kV/turn
HARMONICS, RF/Orb F, used 1,2
DEE-Gnd, max 44 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) < 1/1000
RF PHASE stable to ± 0.5 deg
RF POWER input, max 60 kW
RF PROTECT circuit, speed 5 μsec
Type Crowbar
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Diffusion pumps, each 40 cm, 1 rough pump
OPERATING PRESSURE 5 μTorr,
PUMPDOWN TIME 0.5-1 hrs

ION SOURCES/INJECTION SYSTEM

Internal, cold cathode

EXTRACTION SYSTEM

Electrostatic deflector + mag. foc. channel

CONTROL SYSTEM

Conventional

typing limit

ENTRY NO. 52 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	9-40	
	d	4.5-20	
	He-3	7-53	
	α	9-40	
CURRENT		(μA)	(μA)
Internal	p	>500	
	d	>500	
	α	>100	
External	p	100	
	d	100	
	α	50	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Changing of operation mode (first or second harmonic) is done completely from control desk without mechanical movements of the ion source. The ion source cathodes are exchangeable without breaking the main vacuum.

Highly automated and stable RF-system with an extensive interlock system providing detailed indications on system status.

Remotely adjustable deflector with temperature monitored septum to avoid overheating.

The first MC-40 cyclotron will be shipped late fall 1978 from the factory in Uppsala and installed at the Medi-Physics Inc. plant close to Chicago in the U.S.A.

A second MC-40 will be installed at the EURATOM research laboratory in Ispra, Italy in the beginning of 1980.

typing limit

ENTRY NO. 53

NAME OF MACHINE S. I. N. Injector Cyclotron DATE Aug. 78
INSTITUTION Swiss Institute for Nuclear Research (S. I. N.)
ADDRESS CH - 5234 Villigen, Switzerland

IN CHARGE J. -P. Blaser REPORTED by H. A. Willax

HISTORY AND STATUS

DESIGN, date 67/69 MODEL tests 1968/71
ENG. DESIGN, date 1969/73
CONSTRUCTION, date 1970/73
FIRST BEAM date (or goal)
Aug. 1, 1973 int.
Jan. 1, 1974 ext.
OPERATION, 150 hr/wk; On Target 120 hr/wk
TIME DIST. as Inject. 75 %, outside 25 %
USERS' SCHEDULING CYCLE 2 to 3 weeks
COST, ACCELERATOR 14 MSw. Fr. (1975)
COST, FACILITY, total 134 MSw. Fr. (1975)
FUNDED BY Swiss Federal Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

Design and construction:
Philips Company, Eindhoven, Netherlands

OPERATED BY S. I. N. Operators
BUDGET, op & dev see S. I. N. Isochronous Ring Cyclotron

RESEARCH STAFF, not included above

USERS, in house - outside 14 groups
GRAD STUDENTS involved during year approx. 15
RES. BUDGET, in house -
FUNDED BY Swiss National Science Foundation

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed - m^2
movable approx. 400 m^2
TARGET STATIONS 5 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type 110° analyz. magnet
COMPUTER, model PDP 11/40
OTHER FACILITIES
Isotope production 1
Irradiation 1

REFERENCES/NOTES

- A. Baan et al., IEEE Trans. Nucl. Sci. NS 20, No. 3 (1973) 257
- N. Hazewindus et al., Nucl. Instr. + Meth. 118 (1974) 125
- J. M. v. Nieuwland, N. Hazewindus, Philips Res. Rep. 29 (1974) 528

MAGNET

POLE FACE diameter 250 cm; R extraction 105 cm
GAP, min 24 cm; Field ___ kG
max 45 cm; Field ___ kG
AVERAGE FIELD at R ext 16.5 kG
(at .6 X 10^6 ampere turns)
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$ 1.25
NUMBER OF SECTORS 4 ; SPIRAL, max 55 deg
POLE FACE COIL PAIRS: AVF - /sec;
Harmonic correction 4
Rad grad ___ /sec or Circ coils 12
WEIGHT: Fe 470 tons; Coils 20 tons
CONDUCTOR, Material and type Al
STORED ENERGY ___ MJ
COOLING SYSTEM ___
POWER: Main coils 400 max, kW
Trimming coils 100 max, kW
YOKE/POLE AREA 105 %
SECTOR ANGLE (Sep Sec) ___ deg
ION ENERGY (Bending limit) E/A = 135 q^2/A^2 MeV
(Focusing limit) E/A = ___ q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3 cm; DC BIAS .5 kV
TUNED by, coarse MS fine VC, auto
RF 4.7 to 17.5 mHz, stable ± 1 /10^6
Orb F 4.7 to 17 mHz; GAIN, max 140 kV/turn
HARMONICS, RF/Orb F, used 3 (injector mode)
DEE-Gnd, max 80 kV, min gap 25 cm
STABILITY, (pk-pk noise)/(pk RF volt) 1/1000
RF PHASE stable to ± .5 deg
RF POWER input, max 80 kW
RF PROTECT circuit, speed 100 to 1000 μsec
Type low level amplifier clamp + series tube mod.
BEAM PULSE, width (1 ns (injector mode) ca. 20° (V. C. mode)

VACUUM SYSTEM

PUMPS, No., Type, Size Oil diffusion pumps (Balzers) 20 000 + 12 000 l/s + Philips Cryo-pump
OPERATING PRESSURE 1 μTorr,
PUMPDOWN TIME 8 hrs

ION SOURCES/INJECTION SYSTEM Livingstone-type + axial injection. Ortec Duo-plasmatron + polarized p, d

EXTRACTION SYSTEM electrostatic + electro-magnetic + magnetic channel

CONTROL SYSTEM
with computer access

typing limit

ENTRY NO. 53 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	10-75	14-72
	d	10-65	10-65
	heavy ions	< 10 MeV/ nucl.	-
CURRENT		(μA)	(μA)
Internal	p	300	160
	d	50-100	70
	heavy ions	3-5	-
External	p	120	~120
	d	30	25
	polarized p+d		
		(part/s)	(part/s)
Secondary	-	-	-

BEAM PROPERTIES (typical for (injector mode

	Measured		Conditions				
Pulse Width	8°*	RF deg	80	μA of	72	MeV	p
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	90	%	80	μA of	72	MeV	p
Res, ΔE/E	.2	%	80	μA of	72	MeV	p
Emittance (mm-mrad)	2π axial / 2π radial		80	μA of	72	MeV	p

*fwhm

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	see below %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	%
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

S.I.N. Injector Cyclotron - Operational time distribution 1977 (shutdown of 105 shifts not included)

Total operation time of 990 shifts (7920 hours) = 100 %

Cyclotron in operation with beam	81 %	
Standby	5.6 %	
Regular service	6.7 %	
Component failures	6.7 %	= 100 %

Distribution of effective beam time (6415 hours = 100 %)

A.1 Experimental beams from Injector cyclotron only:			
variable energy, α, p, d	12.5 %		
polarized d, p	5.5 %		
72 MeV p for isotope production	2.6 %	= 20.6 %	
A.2 Injection beams for high-energy beam production			
high-intensity c.w. 72 MeV p	30.6 %	(150 000	
pulsed, 400 kHz, 40 % d.f.	19.6 %	(μAh	
polarized p	1.4 %	= 51.6 %	
B. Beam development (both operational modes)		12.4 %	
C. Overhead (setup, tuning, etc.)		15.4 %	= 100 %

Injector Cyclotron: Philips design. Mainly used as injector for the S.I.N. Ring Cyclotron (72 MeV p at 50.7 Mc/s, 3rd harmonic mode), variable energy operation 1/4 of scheduled time.

Axial injection system and source for polarized p and d operational.

typing limit

ENTRY NO. 54

NAME OF MACHINE S. I. N. Injector Cyclotron II 1) DATE Aug. 78
INSTITUTION Swiss Institute for Nuclear Research (S. I. N.)
ADDRESS CH - 5234 Villigen, Switzerland

IN CHARGE J. -P. Blaser REPORTED by U. Schryber/W. Joho

HISTORY AND STATUS

DESIGN, date 1972 MODEL tests 1973/78
ENG. DESIGN, date 1973 - 1978
CONSTRUCTION, date 1978 -
FIRST BEAM date (or goal) 1982
MAJOR ALTERATIONS Cyclotron under construction
OPERATION, ____ hr/wk; On Target ____ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR approx. 18 MSw. Fr.
COST, FACILITY, total ____
FUNDED BY Swiss Federal Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ____ ENGINEERS ____
TECHNICIANS ____ CRAFTS ____
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or ____ Operators
BUDGET, op & dev ____
FUNDED BY ____

RESEARCH STAFF, not included above 2)

FACILITIES FOR RESEARCH 2)

REFERENCES/NOTES

1) Isochronous ring cyclotron for fixed frequency, under construction. (See Proc. 7th Int. Conf. on Cycl. and their Applications, Birkhäuser, Basel, p. 123)

2) See S. I. N. Isochronous Ring Cyclotron (this compilation)

3) Design values

4) Special coils outside vacuum chamber for correction of isochronism and vertical steering

MAGNET 4 separated sector magnets

POLE FACE diameter 760 cm; R extraction 370 cm
GAP, min 3.5 cm; Field 10.0 kG
max 3.5 cm; Field 10.4 kG
AVERAGE FIELD at R ext 3.5 kG
} at .03 hill x 10^6 ampere turns per magn.
CURRENT STABILITY 2 parts/10^6; $B_{max}/\langle B \rangle$ 3.0
NUMBER OF SECTORS 4 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction 4)
Rad grad ____ /sec or Circ coils -
WEIGHT: Fe 4x180=720 tons; Coils 4x. 96 tons
CONDUCTOR, Material and type OFHC-copper
STORED ENERGY 4 x .12 MJ
COOLING SYSTEM demin. water
POWER: Main coils 4 x 35 max, kW
Trimming coils approx. 2 kW/mag max, kW
YOKE/POLE AREA 80 %
SECTOR ANGLE (Sep Sec) approx. 28 deg
ION ENERGY (Bending limit) E/A = 72 q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM 3)

$\lambda/2$ Resonator 2 angle 18° (RF) deg
BEAM APERTURE 4 cm; DC BIAS - kV
TUNED by, coarse - fine Trim. Cap.
RF ____ 50.6 mHz, stable ± ____ /10^6
Orb F ____ to 5.06 mHz; GAIN 400 ÷ 1000 kV/turn
HARMONICS, RF/Orb F, used 10
DEE-Gnd, max 250 kV, min gap ~ 3.0 cm
STABILITY, (pk-pk noise)/(pk RF volt) $3 \cdot 10^{-4}$
RF PHASE stable to ± 1 deg
RF POWER input, max 2 x 170 kW
RF PROTECT circuit, speed ____ μsec
Type ____
FREQUENCY MODULATION, rate - /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 6 x 2000 l/s turbo-molecular pumps
OPERATING PRESSURE $5 \cdot 10^{-6}$ μTorr,
PUMPDOWN TIME ____ hrs

ION SOURCES/INJECTION SYSTEM

EXTRACTION SYSTEM

2 septum magnets 5° and 40°

CONTROL SYSTEM

existing, access to two computers (PDP 11/40 and PDP 11/60)

ENTRY NO. 54 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	72	
CURRENT		(μA)	(μA)
Internal	p	≥1000	
External	p	≥1000	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

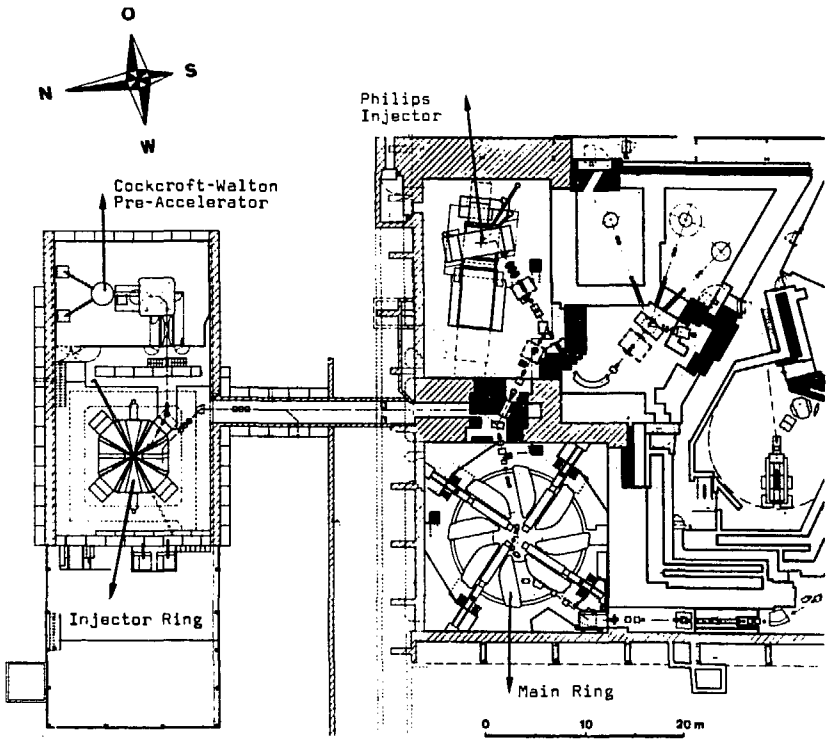
	Goal		Conditions
Pulse Width	15 RF deg	μA of	MeV
Phase Exc, max	RF deg	μA of	MeV
Extract Eff	%	μA of	MeV
Res, ΔE/E	%	μA of	MeV
Emittance (mm-mrad)	π • 2 axial, π • 2 radial	1000 μA of	72 MeV p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %
Solid State Physics ____ %
Bio-Medical Applications under investigation
Isotope Production parasitic ~50 %
Development Injection into 600 MeV - ring 100 %
____ %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The S. I. N. Injector Cyclotron II has two stages. The first stage is a 800 keV DC accelerator with a Cockcroft-Walton type high voltage generator. The 40 keV beam from the ion source is analyzed in a beam transport-system prior to injection into the accelerating column.



typing limit

ENTRY NO. 55

NAME OF MACHINE S. I. N. Isochronous Ring Cyclotron DATE Aug. 78
INSTITUTION Swiss Institute for Nuclear Research (S. I. N.)
ADDRESS CH - 5234 Villigen, Switzerland

IN CHARGE J. P. Blaser REPORTED by H. A. Willax

HISTORY AND STATUS

DESIGN, date 1962 MODEL tests 1962/68
ENG. DESIGN, date 1967/71
CONSTRUCTION, date 1969/74
FIRST BEAM date (or goal) Jan. 18, 1974
MAJOR ALTERATIONS energy from 520 to 590 MeV
OPERATION, 120 hr/wk; On Target 90 to 100 hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE 2 to 3 weeks
COST, ACCELERATOR 35 MSw. Fr. (1974)
COST, FACILITY, total 134 MSw. Fr. (1975)
FUNDED BY Swiss Federal Government

ACCELERATOR STAFF, OPERATION and DEVELOPMENT (1975)

SCIENTISTS 14 ENGINEERS 12
TECHNICIANS and CRAFTS : 20
GRAD STUDENTS involved during year -
OPERATED BY 6 Res staff or 15 Operators
BUDGET, op & dev 6 MSw. Fr. (w.o. salaries)
FUNDED BY Swiss Federal Government

RESEARCH STAFF, not included above

USERS, in house ____ outside approx. 50
GRAD STUDENTS involved during year approx. 50
RES. BUDGET, in house 50 MSw. Fr. (w.o. sal.)
FUNDED BY Swiss Federal Government

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed - m^2
movable total 2700 m^2
TARGET STATIONS 3* in 2 rooms
STATIONS served at same time, max 10
MAG SPECTROGRAPH, type pion spectrometer
COMPUTER, model several PDP 11 /QDD
OTHER FACILITIES
2 superconducting muon channels, superconducting medical pion channel under construction

REFERENCES/NOTES

*two meson production targets in one beam line, one p-target (scattered polarized p parasitic)

MAGNET (8 separate magnets)

POLE FACE diameter 360-930 cm; R extraction 445 cm
GAP, min 5 cm; Field 20.9 kG
max ____ cm; Field ____ kG
AVERAGE FIELD at R ext 8.7 kG
} at .15 X 10^6 ampere turns
CURRENT STABILITY 5 parts/10^6; $B_{max}/\langle B\rangle$ 2.4
NUMBER OF SECTORS 8 ; SPIRAL, max 35 deg
POLE FACE COIL PAIRS: AVF 18(9) correction /sec;
Harmonic correction ____
Rad grad ____ /sec or Circ coils ____
WEIGHT: Fe 1960 total tons; Coils 28 tons
CONDUCTOR, Material and type ____
STORED ENERGY ____ MJ
COOLING SYSTEM demin. water
POWER: Main coils ~ 650 max, kW
Trimming coils ____ max, kW
YOKE/POLE AREA 120 %
SECTOR ANGLE (Sep Sec) 20 deg
ION ENERGY (Bending limit) E/A = - q^2/A^2 MeV
(Focusing limit) E/A = - q/A MeV

ACCELERATION SYSTEM

Cavities: 4
BEAM APERTURE 4 cm; DC BIAS ____ kV
TUNED by, coarse - fine change dimen.
RF 50.63 to - mHz, stable ± 1 /10^6
Orb F 8.41 to - mHz; GAIN, max 2000 kV/turn
HARMONICS, RF/Orb F, used 6th
DEE-Gnd, max 600 kV, min gap 15 cm
STABILITY, (pk-pk noise)/(pk RF volt) 3 x 10^{-4}
RF PHASE stable to ± < 1 deg
RF POWER input, max 4 x 200 kW
RF PROTECT circuit, speed 100 μsec
Type low level amplifier clamp
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 4 titanium-sublimators, 12000 l/s
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 5 hrs

ION SOURCES/INJECTION SYSTEM 72 MeV p beam injected at 200 cm radius, pulse rate 50.63 or 16.88 Mc/s

EXTRACTION SYSTEM electrostat. deflector, magn. focusing channel, extr. magnet

CONTROL SYSTEM

computer-aided

typing limit

ENTRY NO. 55 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	590	588 ± 1
CURRENT		(μA)	(μA)
Internal	p	>100	110
External	p	~100	110
		("routine"	60-80)
		(part/s)	(part/s)
Secondary	$\pi^+(-)$	10^9	10^8(30msr)
	$\mu^+(-)$	10^8	10^7(30 cm^2)

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	∿ 6°* RF deg	80 μA of 588 MeV p
Phase Exc, max	RF deg	μA of MeV
Extract Eff	> 99.5%	80 μA of 588 MeV p
Res, ΔE/E	~ .1* %	80 μA of 588 MeV p
Emittance (mm-mrad)	2π axial, 2π radial	80 μA of 588 MeV p

*fwhm

OPERATING PROGRAMS, time dist see below

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

S. I. N. Isochronous Ring Cyclotron - Operational time distribution 1977 (shutdown of 105 shifts and separate Injector operation of 270 shifts not included)

Total operation time of 720 shifts (5760 hours)		= 100 %
Ring in operation with beam	78 %	
Standby	10.6 %	
Regular service	7.6 %	
Component failures	3.8 %	= 100 %

Distribution of effective beam time (4490 hours = 100 %)

A. Experimental beams			
High intensity c.w. 590 MeVp	43.5 %) 137000		
Pulsed 400 kHz, 40 % d.f.	28.0 %) μAh		
Polarized p	2.0 %	= 73.5 %	
B. Beam development		= 12.0 %	
C. Overhead (setup, tuning, etc.)		= 14.5 %	= 100 %

Isochronous ring cyclotron with eight separated small gap magnets, four high voltage TE-cavities. Large ΔE/turn, extraction near $\nu_r \approx 1.5$ → Large ΔR/turn → Extraction efficiency over 99 %.

Design of components for easy access and repair. Power consumption total 4.5 MW (including injector and beam lines up to 2 π-production targets).

Transmission through ring cyclotron of 99 % (at 80 μA level) achieved.

Essential use of beam: π-production.

typing limit

ENTRY NO. 56

NAME OF MACHINE The Amersham Cyclotron DATE 20th July 1978

INSTITUTION The Radiochemical Centre Ltd

ADDRESS Amersham, Bucks, England.

IN CHARGE M.F. Finlan REPORTED by M.F. Finlan

HISTORY AND STATUS

DESIGN, date 1962 MODEL tests

ENG. DESIGN, date

CONSTRUCTION, date 1963-1965

FIRST BEAM date (or goal) 1965

MAJOR ALTERATIONS Computer control 1975

OPERATION, hr/wk; On Target >150 hr/wk

TIME DIST., in house 100 %, outside %

USERS' SCHEDULING CYCLE weeks

COST, ACCELERATOR approx. £3.5 x 10^5

COST, FACILITY, total approx. £5 x 10^5

FUNDED BY United Kingdom Atomic Energy Authority

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS -

TECHNICIANS 4 CRAFTS -

GRAD STUDENTS involved during year -

OPERATED BY - Res staff or - Operators

BUDGET, op & dev

FUNDED BY

RESEARCH STAFF, not included above

USERS, in house - outside -

GRAD STUDENTS involved during year -

RES. BUDGET, in house

FUNDED BY -

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed - m^2

movable - m^2

TARGET STATIONS - in - rooms

STATIONS served at same time, max -

MAG SPECTROGRAPH, type -

COMPUTER, model -

OTHER FACILITIES

Isotope production - Quick change water

Irradiation, Solid State - Yes cooled target

Biological -

Time-of-Flight Study -

On-Line Mass Separation -

REFERENCES/NOTES

NOTATIONS M.S.- movable start
M.P.- movable panel

MAGNET

POLE FACE diameter 140 cm; R extraction - cm

GAP, min 16 cm; Field 18 kG
max 30 cm; Field 12 kG
AVERAGE FIELD at R ext 15 kG
} at X 10^6 ampere turns

CURRENT STABILITY 50 parts/10^6; $B_{max}/\langle B\rangle$ 1.5

NUMBER OF SECTORS 3 ; SPIRAL, max 48 deg

POLE FACE COIL PAIRS: AVF None /sec;

Harmonic correction -

Rad grad - /sec or Circ coils -

WEIGHT: Fe 73.6 tons; Coils 6.4 tons

CONDUCTOR, Material and type Aluminium

STORED ENERGY MJ

COOLING SYSTEM Water

POWER: Main coils 140 max, kW

Trimming coils - max, kW

YOKE/POLE AREA 106 %

SECTOR ANGLE (Sep Sec) - deg

ION ENERGY (Bending limit) E/A = q^2/A^2 MeV

(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg

BEAM APERTURE 3.5 cm; DC BIAS 0.5 kV

TUNED by, coarse M.S. fine M.P.

RF 10 to 21 mHz, stable ± 10 /10^6

Orb F to 21 mHz; GAIN, max 100 kV/turn

HARMONICS, RF/Orb F, used

DEE-Gnd, max 50 kV, min gap cm

STABILITY, (pk-pk noise)/(pk RF volt) 0.01

RF PHASE stable to ± - deg

RF POWER input, max 100 kW

RF PROTECT circuit, speed 6000 μsec

Type Thyratron crowbar

FREQUENCY MODULATION, rate /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size

OPERATING PRESSURE μTorr,

PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

EXTRACTION SYSTEM None

CONTROL SYSTEM

typing limit

SELECTED REFERENCES

CERN - Report 63-19, (1963) 286

ENTRY NO. 56 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	27	27
	d	16	15
CURRENT		(μA)	(μA)
Internal	p	1000	> 500
	d	1000	> 400
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance		
(mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Isotope production machine, mini-computer controlled since 1974 to operate for periods of up to 100 hours with no operator in attendance. Mini-computer controlled automatic target change with no operator in attendance since 1977.

typing limit

ENTRY NO. 57

NAME OF MACHINE 1m RADIAL RIDGE CYCLOTRON DATE JULY 1978
INSTITUTION UNIVERSITY OF BIRMINGHAM
ADDRESS BIRMINGHAM B15 2TT ENGLAND

IN CHARGE G.C. MORRISON REPORTED by W.C. HARDY

HISTORY AND STATUS

DESIGN, date 1957 MODEL tests NONE
ENG. DESIGN, date 1957-63
CONSTRUCTION, date 1958-63
FIRST BEAM date (or goal) INT 1961 EXT 1963
MAJOR ALTERATIONS

OPERATION, 100 hr/wk; On Target 90 hr/wk
TIME DIST., in house 100 %, outside 0 %
USERS' SCHEDULING CYCLE 12 weeks
COST, ACCELERATOR £30,000
COST, FACILITY, total
FUNDED BY O.S.I.R. (NOW S.R.C.)

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 0 ENGINEERS 1
TECHNICIANS 6 CRAFTS 0
GRAD STUDENTS involved during year 0
OPERATED BY 0 Res staff or 4 Operators
BUDGET, op & dev £15,000
FUNDED BY UNIVERSITY OF BIRMINGHAM AND SCIENCE RESEARCH COUNCIL

RESEARCH STAFF, not included above

USERS, in house 16 outside 0
GRAD STUDENTS involved during year 8
RES. BUDGET, in house £40,000
FUNDED BY UNIVERSITY OF BIRMINGHAM AND SCIENCE RESEARCH COUNCIL

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 90 m^2
movable 0 m^2
TARGET STATIONS 6 in 1 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type NONE
COMPUTER, model IBM 11300 + GEC 4080
OTHER FACILITIES
10 MASS IDENTIFICATION SYSTEM USING COUNTER TELESCOPES

REFERENCES/NOTES

NUCL.INST.METH. 18/19, 25, 1962

NUCL.INST.METH. 32, 325, 1965

MAGNET

POLE FACE diameter 102 cm; R extraction 46 cm
GAP, min 7-6 cm; Field 19 kG
max 14.5 cm; Field 13 kG
AVERAGE FIELD at R ext 16 kG
} at ____ X 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/(B)$ 1.2
NUMBER OF SECTORS 3 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF 0 /sec;
Harmonic correction 2
Rad grad /sec or Circ coils 8
WEIGHT: Fe 50 tons; Coils 8 tons
CONDUCTOR, Material and type Cu. STRIP
STORED ENERGY MJ
COOLING SYSTEM WATER
POWER: Main coils 40 max, kW
Trimming coils max, kW
YOKE/POLE AREA 115 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 2.3 cm; DC BIAS 0 kV
TUNED by, coarse M.S. fine M.S.
RF 12 to 16 mHz, stable ± 5 /10^6
Orb F 12 to 16 mHz; GAIN, max 50 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 27 kV, min gap 0.3 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± 3 deg
RF POWER input, max 45 kW
RF PROTECT circuit, speed 1000 μsec
Type CIRCUIT BREAKER
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 DIFFUSION PUMPS
1 x 40 cm. 2 x 22 cm.
OPERATING PRESSURE 3 μTorr,
PUMPDOWN TIME 4 hrs

ION SOURCES/INJECTION SYSTEM

INTERNAL (OAK RIDGE TYPE)
EXTERNAL POLARISED D^+ AND ^3He

EXTRACTION SYSTEM SOURCE
MAG/ELECTRO REGENERATOR & ELECT. DEF.

CONTROL SYSTEM

CONVENTIONAL

typing limit

ENTRY NO. 57 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	d	12	12.5
	^{4}He	24	25.1
	^{3}He	32	34.0
CURRENT		(μA)	(μA)
Internal	d	1000	1000
	^{4}He		1000
	^{3}He		500
External	^{4}He		200
	^{3}He		50
POLARISED	d		0.2
POLARISED	^{3}He		0.001
		(part/s)	(part/s)
Secondary POLARISED, n			6 x 10^7/μA

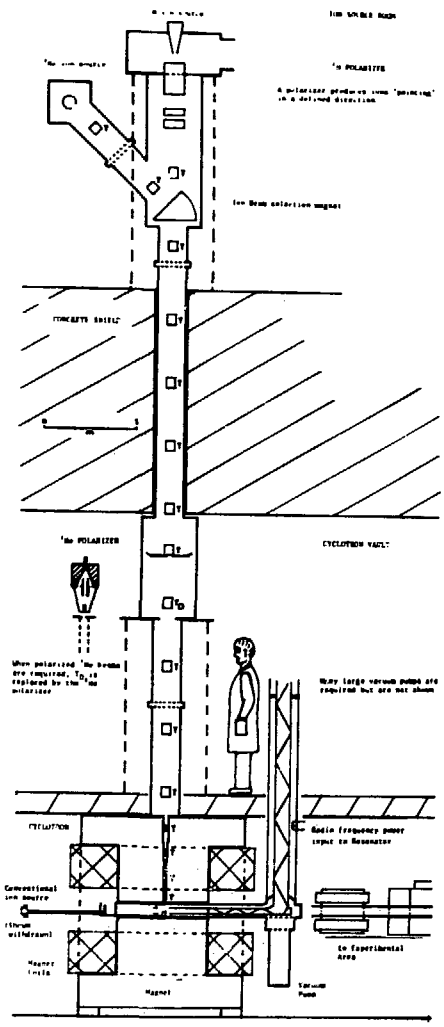
BEAM PROPERTIES

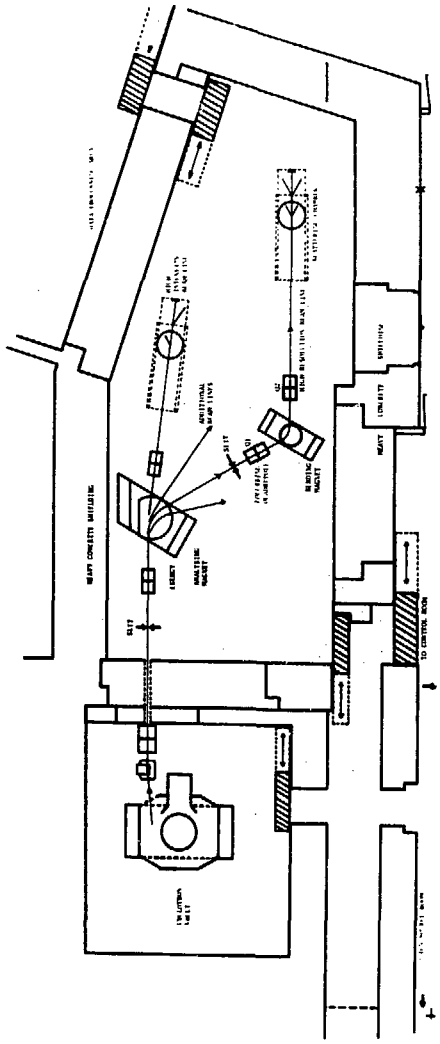
	Measured		Conditions				
Pulse Width	30	RF deg	10	μA of	34	MeV	^{3}He
Phase Exc, max	15	RF deg	"	μA of	"	MeV	"
Extract Eff	60	%	"	μA of	"	MeV	"
Res, ΔE/E	0.4	%	"	μA of	"	MeV	"
Emittance (mm-mrad)	40 axial / 40 radial		"	μA of	"	MeV	"

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	80 %
Solid State Physics	0 %
Bio-Medical Applications	0 %
Isotope Production	0 %
Development	20 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES





typing limit

ENTRY NO. 58

NAME OF MACHINE The Edinburgh Cyclotron DATE 7th July, 1978.
INSTITUTION Medical Research Council,
ADDRESS Cyclotron Unit, Western General Hospital, Edinburgh.

IN CHARGE T.E. Saxton REPORTED by T.E. Saxton

HISTORY AND STATUS Commercial Design - The Cyclotron Corporation model CS30 to standard specification

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date _____
FIRST BEAM date (or goal) Middle 1976
MAJOR ALTERATIONS _____

OPERATION, 40 hr/wk; On Target 15 hr/wk
TIME DIST., in house 100 %, outside _____ %
USERS' SCHEDULING CYCLE _____ weeks
COST, ACCELERATOR $ 850,000
COST, FACILITY, total $ 2,400,000
FUNDED BY Medical Research Council
Cancer Research Council
Scottish Home and Health Department

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 2
TECHNICIANS 3 CRAFTS 2
GRAD STUDENTS involved during year _____
OPERATED BY _____ Res staff or _____ Operators
BUDGET, op & dev _____
FUNDED BY Medical Research Council

RESEARCH STAFF, not included above

USERS, in house _____ outside _____
GRAD STUDENTS involved during year 1
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 80 m^2
movable _____ m^2
TARGET STATIONS 2 in 2 rooms
STATIONS served at same time, max _____
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES Short-lived gas isotope production proposed.

2 Neutron Therapy Rooms

REFERENCES/NOTES

MAGNET

POLE FACE diameter _____ cm; R extraction _____ cm
GAP, min _____ cm; Field _____ kG
max _____ cm; Field _____ kG
AVERAGE FIELD at R ext _____ kG
} at _____ X 10^6 ampere turns
CURRENT STABILITY _____ parts/10^6; $B_{max}/\langle B \rangle$ _____
NUMBER OF SECTORS _____ ; SPIRAL, max _____ deg
POLE FACE COIL PAIRS: AVF _____ /sec;
Harmonic correction _____
Rad grad _____ /sec or Circ coils _____
WEIGHT: Fe _____ tons; Coils _____ tons
CONDUCTOR, Material and type _____
STORED ENERGY _____ MJ
COOLING SYSTEM _____
POWER: Main coils _____ max, kW
Trimming coils _____ max, kW
YOKE/POLE AREA _____ %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number _____ angle _____ deg
BEAM APERTURE _____ cm; DC BIAS _____ kV
TUNED by, coarse _____ fine _____
RF _____ to _____ mHz, stable ± _____ /10^6
Orb F _____ to _____ mHz; GAIN, max _____ kV/turn
HARMONICS, RF/Orb F, used _____
DEE-Gnd, max _____ kV, min gap _____ cm
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max _____ kW
RF PROTECT circuit, speed _____ μsec
Type _____
FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size _____

OPERATING PRESSURE _____ μTorr,
PUMPDOWN TIME _____ hrs

ION SOURCES/INJECTION SYSTEM

EXTRACTION SYSTEM

CONTROL SYSTEM

typing limit

ENTRY NO. 58 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	d		15
CURRENT		(μA)	(μA)
Internal			
External	d	100 routine	100 70
Secondary		(part/s) 6.3 MeV	(part/s)

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	%	μA of MeV
Res, ΔE/E	%	μA of MeV
Emittance (mm-mrad)	axial / radial	μA of MeV

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Used for Fast Neutron Therapy

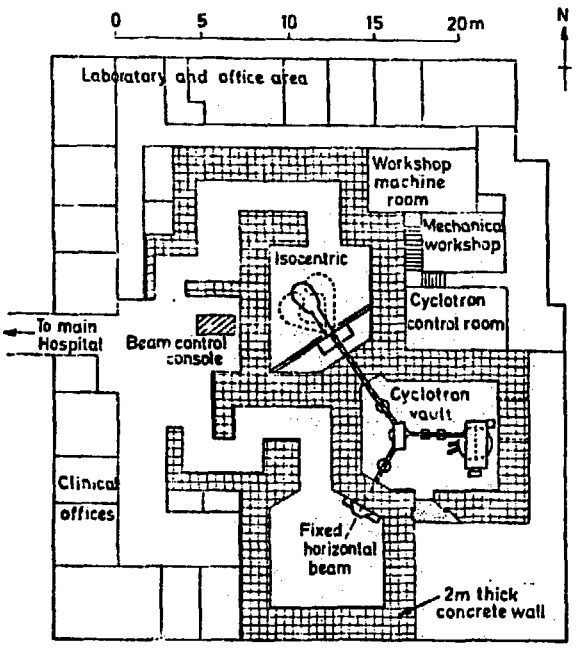
Two beams into separate treatment rooms

One beam fixed horizontal, with fixed beryllium target

One beam Isocentric, with beryllium target in rotating gantry

Target - Patient distance 125cm.

Patient dose rate 25 rads/min.



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ENTRY NO. 59

NAME OF MACHINE Harwell Variable Energy Cyclotron - VEC DATE July 78
INSTITUTION Atomic Energy Research Establishment
ADDRESS Harwell, Nr. Didcot, Oxon, OX11 ORA, England

IN CHARGE R. W. McIlroy REPORTED by E. J. Jones

HISTORY AND STATUS

DESIGN, date 1961-62 MODEL tests 1961-63
ENG. DESIGN, date 1962-64
CONSTRUCTION, date 1962-65
FIRST BEAM date (or goal) int.1965 : ext.1966
MAJOR ALTERATIONS None

OPERATION, 120 hr/wk; On Target 77 hr/wk
TIME DIST., in house 79 %, outside 21 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR £1.2 x 10^6
COST, FACILITY, total £1.6 x 10^6
FUNDED BY U.K.A.E.A.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 1
TECHNICIANS 9 CRAFTS 10
GRAD STUDENTS involved during year -
OPERATED BY Res staff or X Operators
BUDGET, op & dev £600K
FUNDED BY U.K.A.E.A.

RESEARCH STAFF, not included above

USERS, in house 13 outside 20
GRAD STUDENTS involved during year 10
RES. BUDGET, in house -
FUNDED BY U.K.A.E.A.

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 360 m^2
movable 0 m^2
TARGET STATIONS 7 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type -
COMPUTER, model PDP8
OTHER FACILITIES 1. Isotope Production Rig with variable target assemblies. 2. Irradiation facility for damage studies - programmed beam scanning and target rocking.

REFERENCES/NOTES

RHEL report NIRL/R/85.
Harwell Report - R5744 (pp 5-9).
Proc. Fifth Int.Cycl.Conf., 200, 318 (1969).
IEEE Trans. Nucl. Sci. NS-19, no. 2, 101 (1972).

MAGNET

POLE FACE diameter 178 cm; R extraction 80 cm
GAP, min 19 cm; Field 21.6 kG
max 43 cm; Field 13.1 kG
AVERAGE FIELD at R ext 17 kG
} at 0.55 x 10^6 ampere turns
CURRENT STABILITY 100 parts/10^6; $B_{max}/\langle B\rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max 48 deg
POLE FACE COIL PAIRS: AVF Nil /sec;
Harmonic correction 3 per sector
Rad grad Nil /sec or Circ coils 12
WEIGHT: Fe 170 tons; Coils 10 tons
CONDUCTOR, Material and type Copper
STORED ENERGY 2 MJ
COOLING SYSTEM Demineralised water
POWER: Main coils 300 max, kW
Trimming coils 650 max, kW
YOKE/POLE AREA 120 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 86 q^2/A^2 MeV
(Focusing limit) E/A = ~ 65 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 4.5 cm; DC BIAS 0 kV
TUNED by, coarse Short Pl. fine Trim. Cap.
RF 7.5 to 23 mHz, stable ± 0.01 /10^6
Orb F 1.1 to ____ mHz; GAIN, max 160 kV/turn
HARMONICS, RF/Orb F, used 1, 3, 5, 7, 9
DEE-Gnd, max 80 kV, min gap 0.7 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± - deg
RF POWER input, max 200 kW
RF PROTECT circuit, speed - μsec
Type Reflectometer
FREQUENCY MODULATION, rate - /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion pumps (one 60 cm, two 76 cm): Liq. N_2 cryopanels
OPERATING PRESSURE 1.2 μTorr,
PUMPDOWN TIME 6 hrs

ION SOURCES/INJECTION SYSTEM

Internal Penning

EXTRACTION SYSTEM

Electrostatic deflector + mag.channel

CONTROL SYSTEM

Conventional

typing limit

ENTRY NO. 59 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		59
	$^{6}Li^{3+}$		80
	$^{20}Ne^{6+,7+}$		150, 202
	$^{58}Ni^{6+,10+}$		48, 150
CURRENT		(μA)	(μA)
Internal			
External	p		25
	$^{6}Li^{3+}$		1
	$^{20}Ne^{6+,7+}$		2, .3
	$^{58}Ni^{6+,10+}$		30, .04
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	20-40	RF deg		μA of		MeV	
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	75	%	10	μA of	48	MeV	p
Res, ΔE/E	0.35	%	20	μA of	27	MeV	p
Emittance (mm-mrad)	20 axial, 20 radial		10	μA of	59	MeV	p

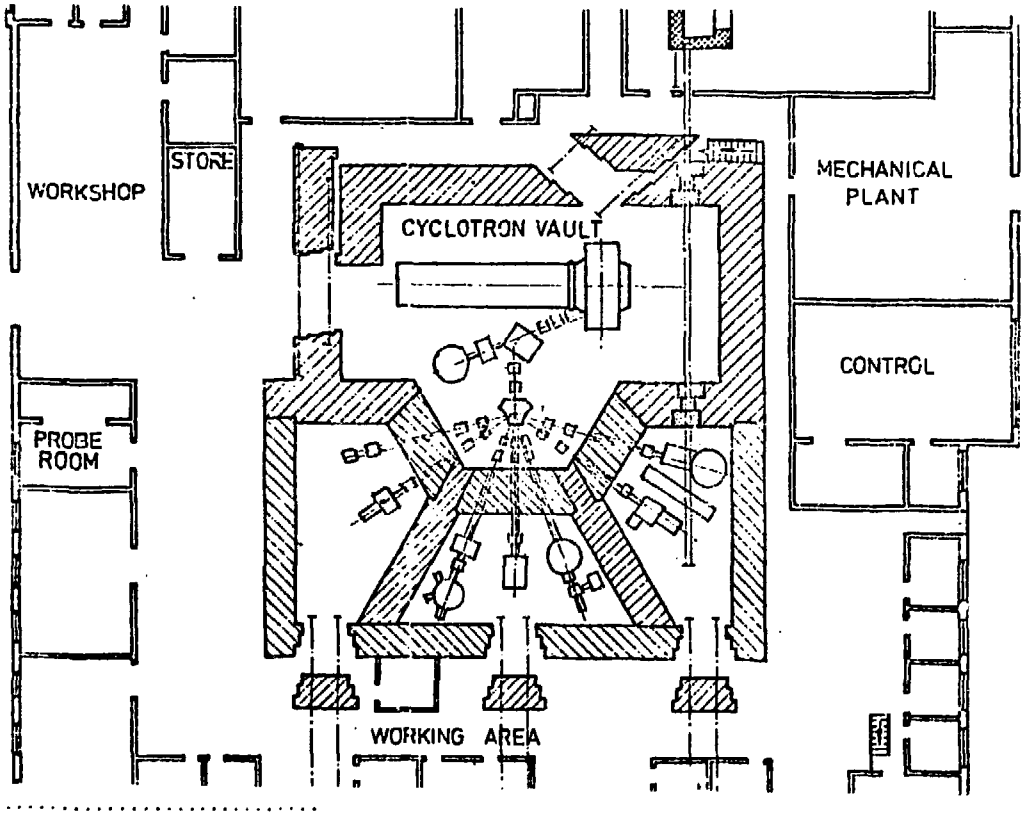
OPERATING PROGRAMS, time dist

Basic Nuclear Physics		27 %
Solid State Physics	Metallurgy	37 %
Bio-Medical Applications	)	16 %
Isotope Production	)	
Development		20 %
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Despite a reduction over the past two years in the machine time required by users, beam requirements are still very varied, ranging from light ions for isotope production, medium heavy ions such as Li, B, C, O, N and Ne for nuclear physics and the heavier metal ions Co, Cr, Fe and Ni for radiation damage work.

Diversification into the nuclear medicine field has been increasing and has now reached the stage where (a) production of the medical isotope ^{123}I is now on a routine basis and (b) plans are being prepared for the establishment of a limited neutron therapy facility.



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ENTRY NO. 60

NAME OF MACHINE Argonne National Laboratory 60-inch Cyclotron DATE 1/17/79
INSTITUTION Chemistry Division, Argonne National Laboratory
ADDRESS 9700 S. Cass Avenue, Argonne, ILL. 60439 U.S.A.

IN CHARGE J. Aron REPORTED by M. C. Oselka

HISTORY AND STATUS

DESIGN, date 1949 MODEL tests 1951-1952
ENG. DESIGN, date 1949-1951
CONSTRUCTION, date 1949-1952
FIRST BEAM date (or goal) 1952
MAJOR ALTERATIONS Magnet Trim Coils added 1964. New Dees - 1974.
OPERATION, ~35 hr/wk; On Target ~30 hr/wk
TIME DIST., in house 95+ %, outside < 5 %
USERS' SCHEDULING CYCLE ~4 weeks
COST, ACCELERATOR $950,000
COST, FACILITY, total $2.2 x 10^6
FUNDED BY AEC, ERDA

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 1 CRAFTS
GRAD STUDENTS involved during year
OPERATED BY Res staff or X Operators
BUDGET, op & dev
FUNDED BY US DOE

RESEARCH STAFF, not included above

USERS, in house 6 outside 3
GRAD STUDENTS involved during year 0
RES. BUDGET, in house -
FUNDED BY DOE

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 350 m^2
movable m^2
TARGET STATIONS 11 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type -
COMPUTER, model -
OTHER FACILITIES Hot Lab, with Caves

REFERENCES/NOTES

W.J.Ramler & G.W.Parker, The Argonne 60-inch Cyclotron ANL-5907.
W.J.Ramler et.al.,Argonne Cyclotron-Helium 3 Conversion ANL-7171.
W.J.Ramler et.al.,Energy-Analyzing System for the Argonne 60-inch Cyclotron ANL-7251.

MAGNET

POLE FACE diameter 152 cm; R extraction 68 cm
GAP, min 30.5 cm; Field kG
max cm; Field kG
AVERAGE FIELD at R ext 15 kG
} at .44 X 10^6 ampere turns
CURRENT STABILITY 16 parts/10^6; $B_{max}/\langle B \rangle$ 1.3
NUMBER OF SECTORS ; SPIRAL, max deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction
Rad grad /sec or Circ coils
WEIGHT: Fe 265 tons; Coils 26 tons
CONDUCTOR, Material and type Aluminum
STORED ENERGY MJ
COOLING SYSTEM Demineralized Water
POWER: Main coils 200 max, kW
Trimming coils max, kW
YOKE/POLE AREA 153 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg
BEAM APERTURE cm; DC BIAS 0 kV
TUNED by, coarse fine Trim Cap
RF 11.2 to 11.5 mHz, stable ± 5 parts /10^6
Orb F 11.2 to 11.5 mHz; GAIN, max 240 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 120 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max 150 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Diffusion Pumps 16 inch
OPERATING PRESSURE 5 μTorr,
PUMPDOWN TIME 6 hrs

ION SOURCES/INJECTION SYSTEM

DC-type hooded arc

EXTRACTION SYSTEM

Electrostatic Deflector

CONTROL SYSTEM

Manual

typing limit

ENTRY NO. 60 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	H_2^+		10.7
	D^+		21.4
	$^3He^{++}$		33.0
	α^{++}		43.0
CURRENT		(μA)	(μA)
Internal			
External	D^+		150
	$^3He^{++}$		100
	α^{++}		90
		(part/s)	(part/s)
Secondary			

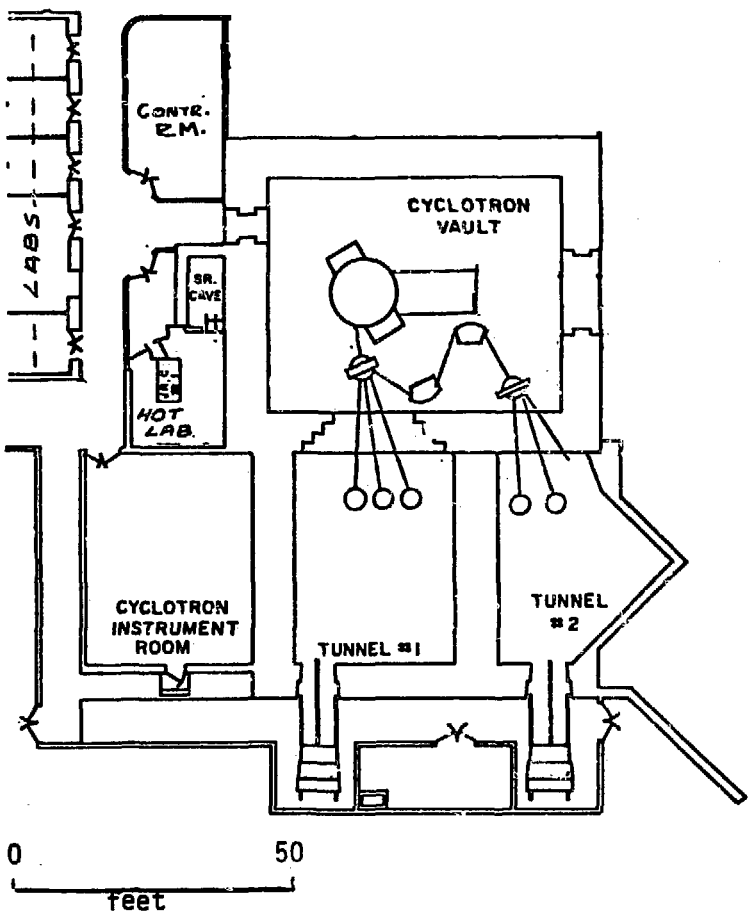
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	10 %
Isotope Production	70 %
Development	10 %
Materials Science	10 %
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



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ENTRY NO. 61

NAME OF MACHINE Brookhaven Cyclotron DATE 8/15/78
INSTITUTION Brookhaven National Laboratory
ADDRESS Upton, New York 11973

IN CHARGE W. B. Jones REPORTED by W. B. Jones

HISTORY AND STATUS

DESIGN, date 1963 MODEL tests 1963
ENG. DESIGN, date 1964
CONSTRUCTION, date 1965-1967
FIRST BEAM date (or goal) 1968
MAJOR ALTERATIONS none

OPERATION, 50 hr/wk; On Target varies hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR 400,000 (conversion)
COST, FACILITY, total
FUNDED BY US-DOE

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 0
TECHNICIANS 3 CRAFTS 0
GRAD STUDENTS involved during year 0
OPERATED BY Res staff or x Operators
BUDGET, op & dev 103,000
FUNDED BY US-DOE

RESEARCH STAFF, not included above

USERS, in house 4 outside 1
GRAD STUDENTS involved during year varies
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 100 m^2
movable m^2
TARGET STATIONS 3 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES

REFERENCES/NOTES

MS Movable Short
MP Movable Panels

MAGNET

POLE FACE diameter 152 cm; R extraction 65 cm
GAP, min 19 cm; Field 18 kG
max 34.5 cm; Field 12 kG
AVERAGE FIELD at R ext 15.4 kG
} at X 10^6 ampere turns
CURRENT STABILITY parts/10^6; $B_{max}/\langle B \rangle$
NUMBER OF SECTORS 3 ; SPIRAL, max 50 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 5
Rad grad /sec or Circ coils 8
WEIGHT: Fe tons; Coils tons
CONDUCTOR, Material and type
STORED ENERGY MJ
COOLING SYSTEM
POWER: Main coils 200 max, kW
Trimming coils max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3.5 cm; DC BIAS 0 kV
TUNED by, coarse MS fine panels
RF 9 to 21 mHz, stable ± /10^6
Orb F 3 to 22 mHz; GAIN, max 120 kV/turn
HARMONICS, RF/Orb F, used 3
DEE-Gnd, max 70 kV, min gap .7 cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max 100 kW
RF PROTECT circuit, speed μsec
Type Constant current supply
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size

OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

Hooded hot filament

EXTRACTION SYSTEM

electrostatic deflector

CONTROL SYSTEM

typing limit

ENTRY NO. 61 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P_4	40	36
	He_3	40	48
	He	53	66.5
CURRENT		(μA)	(μA)
Internal	over	200	
External	10	to 50	
	MAX.	POWER	1 KW
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	5	RF deg	___	μA of	___	MeV ___
Phase Exc, max	___	RF deg	___	μA of	___	MeV ___
Extract Eff	20	%	___	μA of	___	MeV ___
Res, ΔE/E	.6	%	___	μA of	___	MeV ___

Emittance

(mm-mrad) { ___ axial / ___ radial } ___ μA of ___ MeV ___

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	variable	%
Solid State Physics	"	%
Bio-Medical Applications	"	%
Isotope Production	"	%
Development		%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 62

NAME OF MACHINE Cyclo-Graaff Injector, Triangle Universities Nuclear Laboratory (TUNL) DATE 1/8/79
INSTITUTION Duke University, UNC-CH, NCSU
ADDRESS Durham, N. C.

IN CHARGE E. G. Bilpuch REPORTED by F. O. Purser

HISTORY AND STATUS

DESIGN, date 1964* MODEL tests ---
ENG. DESIGN, date 1965
CONSTRUCTION, date
FIRST BEAM date (or goal) Factory 1966, Site 1968
MAJOR ALTERATIONS Harmonic Coil Sets

OPERATION, 50 hr/wk; On Target 50 hr/wk
TIME DIST., in house 100 %, outside %
USERS' SCHEDULING CYCLE 4 weeks
COST, ACCELERATOR Cyclotron $360,000.00
COST, FACILITY, total Tandem $1,250,000.00 $3,945,000.00
FUNDED BY ~~AEC, NSF, HEW, N.C., Duke Univ.~~

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS Part time ENGINEERS 0
TECHNICIANS 4 CRAFTS 1-4
GRAD STUDENTS involved during year Part Time
OPERATED BY X. Res staff or Operators
BUDGET, op & dev
FUNDED BY US DOE and Universities

RESEARCH STAFF, not included above

USERS, in house -- outside --
GRAD STUDENTS involved during year 26
RES. BUDGET, in house $800,000.00
FUNDED BY US DOE

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 1000 m^2
movable m^2
TARGET STATIONS 11 in 3 rooms
STATIONS served at same time, max 2
MAG SPECTROGRAPH, type ---
COMPUTER, model DDP-224
OTHER FACILITIES

REFERENCES/NOTES

*Invention of Cyclo-Graaff by H. W. Newson

The Cyclo-Graaff, Concept and Practice, F.O. Purser, H.W. Newson, N.R. Roberson, E.G. Bilpuch and R.L. Walter, Proceedings of the Fifth International Cyclotron Conference, Oxford, Eng., 1969

MAGNET

POLE FACE diameter 80 cm; R extraction 33.5 cm
GAP, min 5 cm; Field 20 kG
max 10 cm; Field 12 kG
AVERAGE FIELD at R ext 16.4 kG
at X 10^6 ampere turns
CURRENT STABILITY parts/10^6; $B_{max}/\langle B \rangle$ 1.25
NUMBER OF SECTORS 3 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 2
Rad grad 0 /sec or Circ coils
WEIGHT: Fe tons; Coils tons
CONDUCTOR, Material and type
STORED ENERGY MJ
COOLING SYSTEM Hollow core copper H_2O
POWER: Main coils 30 KW max, kW
Trimming coils max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 120 deg
BEAM APERTURE 2 cm; DC BIAS 1.0 kV
TUNED by, coarse R.F. Strap fine movable strap
RF 12 to 25.5 mHz, stable ± 50 /10^6
Orb F 12 to 25.5 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 35 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.002
RF PHASE stable to ± 5 deg
RF POWER input, max 40 kW
RF PROTECT circuit, speed 1.0 μsec
Type Ignition Crowbar
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion Pumps, 2 12", 1 4".
OPERATING PRESSURE μTorr,
PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

PIG, Axial Injection

EXTRACTION SYSTEM D.C. Electrostatic with 1st harmonic bump and magnetic channel.

CONTROL SYSTEM

typing limit

ENTRY NO. 62 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	H^-	15	15
	D^-	8	8
CURRENT		(μA)	(μA)
Internal	H^-	50	100
	D^-	20	50
External	H^-	10	25
	D^-	2	10
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions			
Pulse Width	18 RF deg	20 μA of	15 MeV	H^-
Phase Exc, max	RF deg	μA of	MeV	
Extract Eff	30.50%	15 μA of	15 MeV	H^-
Res, ΔE/E	0.3%	15 μA of	15 MeV	H^-
Emittance (mm-mrad)	20 axial, 20 radial	10 μA of	15 MeV	H^-

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Beam Properties with Internal Phase Limiting Slits

Pulse Width 3.2 RF Deg. 1.5 μA of 15 MeV H^-

Extract Eff. 60 % 2.0 " 15 " H^-

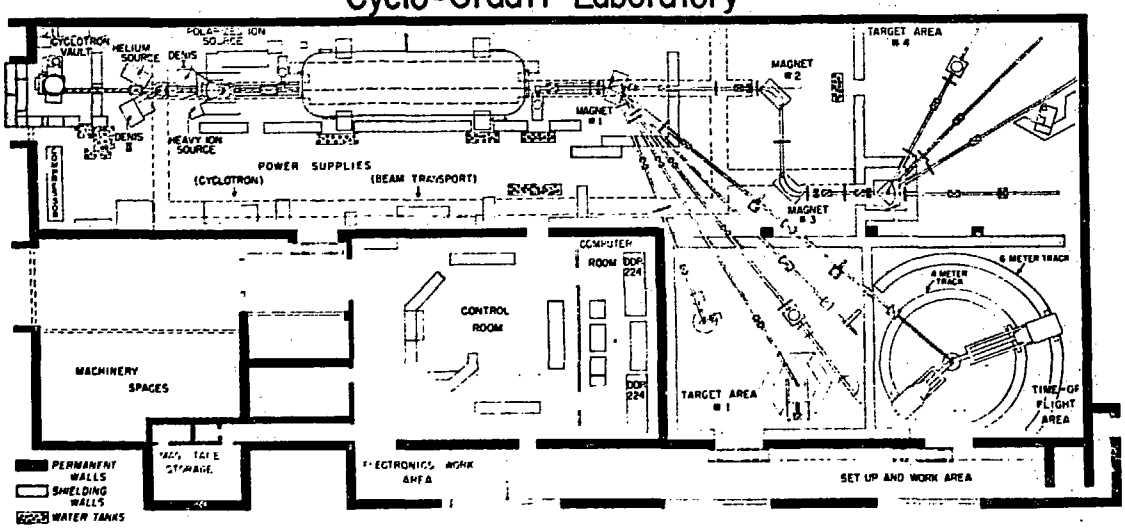
Res. ΔE/E 0.1 % 2.0 " 15 " H^-

Burst Length ≤ 0.5 ns

SELECTED REFERENCES (Cont)

An Operational Review of the TUNL Cyclo-Graaff, H.W. Newson, E.G. Bilpuch, F.O. Purser, J.R. Boyce, Duke University and TUNL and T.B. Clegg, University of North Carolina at Chapel Hill and TUNL, Nucl. Instr. and Meth. 122 (1974) 99.

Cyclo-Graaff Laboratory



ENTRY NO. 63

NAME OF MACHINE Indiana University Cyclotron Facility DATE August 1978
INSTITUTION Indiana University
ADDRESS Milo B. Sampson Lane, Bloomington IN 47401

IN CHARGE R. E. Pollock REPORTED by R. E. Pollock

HISTORY AND STATUS

DESIGN, date 1966 MODEL tests 1967-1972
ENG. DESIGN, date 1968-1973
CONSTRUCTION, date 1968-1974
FIRST BEAM date (or goal) August 1975
MAJOR ALTERATIONS New DC ion source terminal 1977, polarized source 1978
OPERATION, 120 hr/wk; On Target 80 hr/wk
TIME DIST., in house 50 %, outside 50 %
USERS' SCHEDULING CYCLE 10 weeks
COST, ACCELERATOR $5.6 10^6
COST, FACILITY, total $12.5 10^6
FUNDED BY National Science Foundation and IU

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS 6
TECHNICIANS 14 CRAFTS 14
GRAD STUDENTS involved during year 0
OPERATED BY ____ Res staff or x Operators
BUDGET, op & dev & user services $2.4 10^6
FUNDED BY NSF

RESEARCH STAFF, not included above

USERS, in house 20 outside >100
GRAD STUDENTS involved during year 10
RES. BUDGET, in house $0.6 10^6
FUNDED BY NSF

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 300 m^2
movable 800 m^2
TARGET STATIONS 6 in 5 rooms
STATIONS served at same time, max 1 (later 2)
MAG SPECTROGRAPH, type QDDM 250 MeV
COMPUTER, model 3 Harris Slash 4
OTHER FACILITIES In Beam Gamma Ray
160 cm Scatter Chamber
Isotope Production Station
100 m Neutron Time-of-Flight
(Pion Spectrograph)

REFERENCES/NOTES

IEEE Trans Nucl Sci NS-22 1975 (9 papers)

MAGNET

POLE FACE diameter 692 cm; R extraction 330 cm
GAP, min 7.6 cm; Field 16 kG
max ∞ cm; Field <0.2 kG
AVERAGE FIELD at R ext 6.4 kG
} at 0.15 x 10^6 ampere turns
CURRENT STABILITY ±10 parts/10^6; $B_{max}/\langle B\rangle$ 2.50
NUMBER OF SECTORS 4 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF 0 /sec;
Harmonic correction 0
Rad grad 21 /sec or Circ coils 0
WEIGHT: Fe 2000 tons; Coils 10 tons
CONDUCTOR, Material and type Hollow Copper
STORED ENERGY ____ MJ
COOLING SYSTEM Deionized water
POWER: Main coils 400 max, kW
Trimming coils 120 max, kW
YOKE/POLE AREA 125 %
SECTOR ANGLE (Sep Sec) 36 deg
ION ENERGY (Bending limit) E/A = 215 q^2/A^2 MeV
(Focusing limit) E/A = >200 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 38 deg
BEAM APERTURE 4 cm; DC BIAS 0 kV
TUNED by, coarse Hinged Panels fine x
RF 25 to 35 mHz, stable ± 1 /10^6
Orb F 1.5 to 9.0 mHz; GAIN, max 1000 kV/turn
HARMONICS, RF/Orb F, used 3 - 8 12 - 17
DEE-Gnd, max 25° kV, min gap 3 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.03%
RF PHASE stable to ± ____ deg
RF POWER input, max 200 kW
RF PROTECT circuit, speed ____ μsec
Type Crowbar
FREQUENCY MODULATION, rate x /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size Diffusion plus cryopanel
OPERATING PRESSURE 5 μTorr,
PUMPDOWN TIME 8 hrs

ION SOURCES/INJECTION SYSTEM DC terminal/Injector Cyclotron, External Duoplasmatron, Lithium Self-ionizing plus polarized source and arc source in development

EXTRACTION SYSTEM non-resonant electric-magnetic

CONTROL SYSTEM Sigma 2 computer control exclusively

typing limit

ENTRY NO. 63 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	225	199
	d,α	105Q	75Q
	^{6}Li	300	154
	H.I	210 Q^2/A	-
CURRENT		e(μA)	e(μA)
Internal	p d	3	2
	α	2	1
	^{6}Li	1	.5
External	p d	2	1
	α	1.	.5
	^{6}Li	0.5	0.2
		(part/s)	(part/s)
Secondary	$\vec{n}$	2 10^6	-

BEAM PROPERTIES

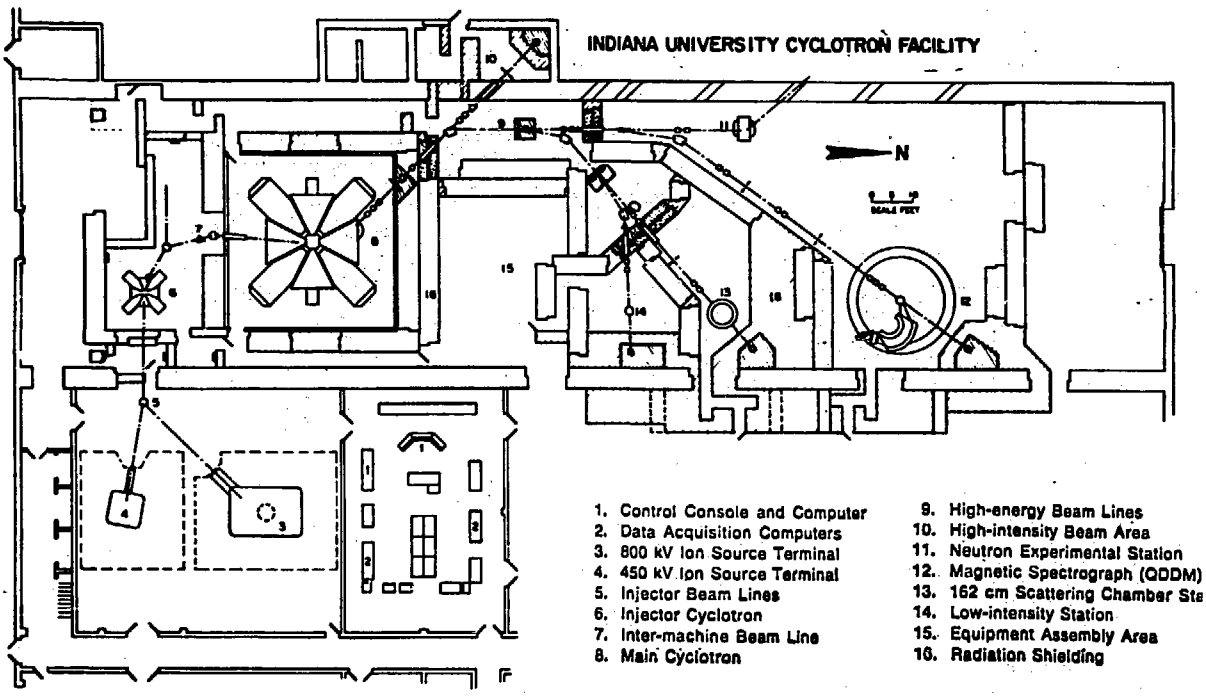
	Measured	Conditions (Vary)
Pulse Width	6 RF deg	____ μA of ____ MeV ____
Phase Exc, max	7 RF deg	____ μA of ____ MeV ____
Extract Eff	85 %	____ μA of ____ MeV ____
Res, ΔE/E	0.05 %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	85 %
Solid State Physics	%
Bio-Medical Applications	< 5 %
Isotope Production	%
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Noteworthy Features
- beam klystrom-bunched and chopped before injection
- low orbit frequency exploited for clean (>2000:1) pulse suppression for time-of-flight
- main stage can function with one dee shut off
- extensive user program
- spectrograph resolution 30 keV fwhm at 100 MeV has been achieved



typing limit

ENTRY NO. 64

NAME OF MACHINE Medi-Physics Cyclotron DATE 8/30/78
INSTITUTION Medi-Physics, Inc.
ADDRESS 5855 Christie Ave., Emeryville, CA 94608

IN CHARGE D.K. Wells REPORTED by D.K. Wells

HISTORY AND STATUS

DESIGN, date ____ MODEL tests Designed by the Cyclotron Corp.
ENG. DESIGN, date ____
CONSTRUCTION, date ____
FIRST BEAM date (or goal) Accepted 12/70
MAJOR ALTERATIONS None

OPERATION, 168 hr/wk; On Target 120 hr/wk
TIME DIST., in house 99 %, outside 1 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY Medi-Physics, Inc.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS ____
TECHNICIANS 5 CRAFTS ____
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or X Operators
BUDGET, op & dev ____
FUNDED BY Medi-Physics, Inc.

RESEARCH STAFF, not included above

USERS, in house ____ outside ____
GRAD STUDENTS involved during year ____
RES. BUDGET, in house ____
FUNDED BY ____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ~100 m^2
movable ____ m^2
TARGET STATIONS 8 in 1 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type None
COMPUTER, model None
OTHER FACILITIES ____

REFERENCES/NOTES

(1) IEEE Trans. Nucl. Sci. NS-14 70-71 (1967)

(2) IEEE Trans. Nucl. Sci. NS-16 500-503 (1969)

MAGNET

POLE FACE diameter 97 cm; R extraction 42.4 cm
GAP, min 5 cm; Field 21 kG
max 10 cm; Field 13.5 kG
AVERAGE FIELD at R ext 16.5 kG
} at 2 X 10^6 ampere turns
CURRENT STABILITY 30 parts/10^6; $B_{max}/\langle B\rangle$ 1.22
NUMBER OF SECTORS ____ ; SPIRAL, max 45 deg
POLE FACE COIL PAIRS: AVF None /sec;
Harmonic correction 1
Rad grad None /sec or Circ coils None
WEIGHT: Fe 19.5 tons; Coils ____ tons
CONDUCTOR, Material and type ____
STORED ENERGY ____ MJ
COOLING SYSTEM ____
POWER: Main coils ____ max, kW
Trimming coils ____ max, kW
YOKE/POLE AREA ____ %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90° deg
BEAM APERTURE 2 cm; DC BIAS 1.5 kV
TUNED by, coarse straps fine panel
RF 12 to 25 mHz, stable ± ____ /10^6
Orb F ____ to ____ mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used None
DEE-Gnd, max 30 kV, min gap ____ cm
STABILITY, (pk-pk noise)/(pk RF volt) ____
RF PHASE stable to ± ____ deg
RF POWER input, max 70 kW
RF PROTECT circuit, speed ____ μsec
Type Series tube
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size ____
OPERATING PRESSURE ____ μTorr,
PUMPDOWN TIME ____ hrs

ION SOURCES/INJECTION SYSTEM

Internal - "Cold Cathode" (1)

EXTRACTION SYSTEM

Electrostatic and magnetic channel

CONTROL SYSTEM

typing limit

ENTRY NO. 64 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		22
	d		12
	He^3		32
CURRENT		(μA)	(μA)
Internal	p		400
	d		400
	He^3		100
External	p		60
	d		100
	He^3		50
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial, ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	~100 %
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 65

CS-22

NAME OF MACHINE Medi-Physics Cyclotron (The Cyclotron Corp.) DATE 7-10-78
INSTITUTION Medi-Physics, Inc.
ADDRESS 900 Durham Avenue, South Plainfield, New Jersey

IN CHARGE R.E. Hubbard REPORTED by R.E. Hubbard

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date _____
FIRST BEAM date (or goal) Accepted Feb. 1973
MAJOR ALTERATIONS None

OPERATION, 168 hr/wk; On Target 120 hr/wk
TIME DIST., in house 100 %, outside 0 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR _____
COST, FACILITY, total _____
FUNDED BY Medi-Physics, Inc.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS _____
TECHNICIANS 5 CRAFTS _____
GRAD STUDENTS involved during year _____
OPERATED BY _____ Res staff or X Operators
BUDGET, op & dev _____
FUNDED BY Medi-Physics, Inc.

RESEARCH STAFF, not included above

USERS, in house _____ outside _____
GRAD STUDENTS involved during year _____
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ~100 m^2
movable _____ m^2
TARGET STATIONS 8 in 1 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type None
COMPUTER, model None
OTHER FACILITIES None

REFERENCES/NOTES

(1) IEEE Trans.Nucl.Sci. NS-14 70-71 (1967)
(2) IEEE Trans.Nucl.Sci. NS-16 500-503 (1969)

MAGNET

POLE FACE diameter 97 cm; R extraction 42.4 cm
GAP, min 5 cm; Field 21 kG
max 10 cm; Field 13.5 kG
AVERAGE FIELD at R ext 16.5 kG
} at 2 X 10^6 ampere turns
CURRENT STABILITY ± 30 parts/10^6; $B_{max}/\langle B\rangle$ 1.22
NUMBER OF SECTORS 3 ; SPIRAL, max 45 deg
POLE FACE COIL PAIRS: AVF None /sec;
Harmonic correction 3 Sets
Rad grad _____ /sec or Circ coils X
WEIGHT: Fe 19.5 tons; Coils 2.5 tons
CONDUCTOR, Material and type Cu Strap
STORED ENERGY _____ MJ
COOLING SYSTEM De-ionized water
POWER: Main coils 40 max, kW
Trimming coils 0 max,
YOKE/POLE AREA _____ %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg
BEAM APERTURE 2 cm; DC BIAS 1.5 kV
TUNED by, coarse straps fine panel
RF 12 to 25 mHz, stable ± _____ /10^6
Orb F _____ to _____ mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used None
DEE-Gnd, max 30 kV, min gap 5 cm
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max 70 kW
RF PROTECT circuit, speed _____ μsec
Type Series tube
FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 1 Diffusion Pump 10"
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM

"Cold Cathode" (1)

EXTRACTION SYSTEM

Electrostatic and Magnetic Channel (2)

CONTROL SYSTEM

typing limit

ENTRY NO. 65 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		22
	d		12
	He^3		32
CURRENT		(μA)	(μA)
Internal	p		400
	d		400
	He^3		100
External	p		60
	d		100
	He^3		50
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res. ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial, ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 66

NAME OF MACHINE MSU 50 MeV Cyclotron DATE 8/11/78
INSTITUTION Michigan State University
ADDRESS East Lansing, Michigan 48823

IN CHARGE H. G. Blosser REPORTED by P. S. Miller

HISTORY AND STATUS

DESIGN, date 1958-63 MODEL tests 1959-64
ENG. DESIGN, date 1961-63
CONSTRUCTION, date 1963-65
FIRST BEAM date (or goal) Feb. 1965
MAJOR ALTERATIONS ---

OPERATION, 168 hr/wk; On Target 140 hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE 4 weeks
COST, ACCELERATOR $940,000
COST, FACILITY, total $ 3,900,000
FUNDED BY NSF & MSU

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS 3
TECHNICIANS 5 CRAFTS 5
GRAD STUDENTS involved during year 2
OPERATED BY X Res staff or Operators
BUDGET, op & dev
FUNDED BY NSF

RESEARCH STAFF, not included above

USERS, in house 22 outside 10
GRAD STUDENTS involved during year 15
RES. BUDGET, in house
FUNDED BY NSF

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable 900 m^2
TARGET STATIONS 9 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type Enge Split-pole
COMPUTER, model XDS-Sigma 7; PDP 11/45,11/20
OTHER FACILITIES pneumatic rabbit, He jet recoil thermalizer with recoil mass analyzer (Siegfried). 0.3 nsec TOF with selectable rep. rate. G-factors of excited states (21 kg).

REFERENCES/NOTES γ-γ coincidence in beam.

MAGNET

POLE FACE diameter 170 cm; R extraction 73 cm
GAP, min 16.8 cm; Field 19.3 kG
max cm; Field 8.5 kG
AVERAGE FIELD at R ext 15 kG
at 475 x 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$
NUMBER OF SECTORS 3 ; SPIRAL, max small deg
POLE FACE COIL PAIRS: AVF 0 /sec;
Harmonic correction 2
Rad grad 0 /sec or Circ coils 8
WEIGHT: Fe 103 US tons; Coils 13 US tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM Water
POWER: Main coils 140 max, kW
Trimming coils 15 max, kW
YOKE/POLE AREA 70 %
SECTOR ANGLE (Sep Sec) --- deg
ION ENERGY (Bending limit) E/A = 58 q^2/A^2 MeV
(Focusing limit) E/A = 45 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 134 deg
BEAM APERTURE 2.5 cm; DC BIAS 0 kV
TUNED by, coarse panels fine capacitor
RF 14.3 to 21.5 mHz, stable ± 0.5 /10^6
Orb F 3.53 to 21.5 mHz; GAIN, max 250 kV/turn
HARMONICS, RF/Orb F, used 1,2,4
DEE-Gnd, max 70 kV, min gap 0.9 cm
STABILITY, (pk-pk noise)/(pk RF volt) 6/10,000
RF PHASE stable to ± deg
RF POWER input, max 250 kW
RF PROTECT circuit, speed few μsec
Type grid clamp
FREQUENCY MODULATION, rate --- /sec
MODULATOR, type ---
BEAM PULSE, width ---

VACUUM SYSTEM

PUMPS, No., Type, Size One 36" oil diffusion pump, freon baffle
OPERATING PRESSURE 8 μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

Hooded filament arc for H, He. PIG for heavy ions

EXTRACTION SYSTEM Precessional into 60° elect. defl. into 45° iron-free channel

CONTROL SYSTEM

direct and computer control

typing limit

ENTRY NO. 66 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	56	56
	d	26	26
	^{3}He	76	76
	^{12}C^{4+}	77	77
CURRENT		(μA)	(μA)
Internal	p		3000*
External	p		20
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	1.5	RF deg	14	μA of	40	MeV p
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	100	%	15	μA of	40	MeV p
Res, ΔE/E	.06	%		μA of	40	MeV p
Emittance (mm-mrad)	5.0 axial, 0.4* radial		1.0	μA of	40	MeV p

*incoherent

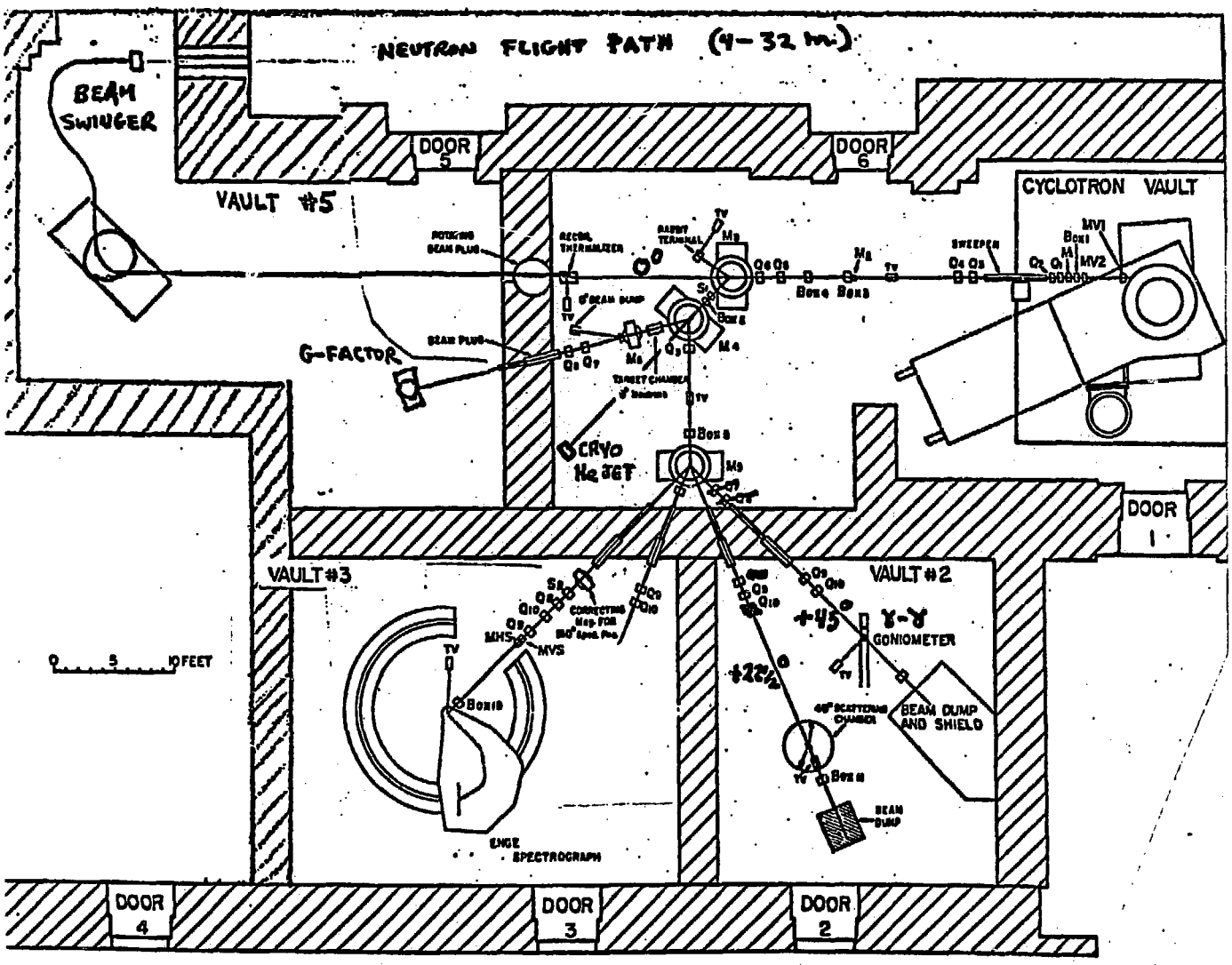
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	& Chemistry	80 %
Solid State Physics		%
Bio-Medical Applications		10 %
Isotope Production		%
Development	of accelerators	10 %
		%
		%

* to 1/3 radius only (probe power limit)

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Proc. 7th Int. Cyc. Conf. Zurich (1975) 249; Nucl. Inst. & Meth. 143 (1977) 63



ENTRY NO. 67

NAME OF MACHINE K500 DATE 8/78
INSTITUTION Michigan State University
ADDRESS Cyclotron Laboratory, East Lansing, MI 48824

IN CHARGE H. Blosser REPORTED by H. Blosser

HISTORY AND STATUS

DESIGN, date 75 MODEL tests 6/75-6/77
ENG. DESIGN, date
CONSTRUCTION, date 8/77 (magnet 6/75)
FIRST BEAM date (or goal) 10/79
MAJOR ALTERATIONS

OPERATION, hr/wk; On Target hr/wk
TIME DIST., in house %, outside %
USERS' SCHEDULING CYCLE weeks
COST, ACCELERATOR $1,740,000
COST, FACILITY, total
FUNDED BY National Science Foundation

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS
TECHNICIANS CRAFTS
GRAD STUDENTS involved during year
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS in rooms
STATIONS served at same time, max
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES

REFERENCES/NOTES

Blosser, et al., Proc. VII Int. Conf. on Cyclotrons and their Applications
MSU Cyc. Lab. annual report 1974-76
MSU Cyc. Lab. annual report 1976-77
MSU Cyc. Lab. annual report 1977-78

MAGNET

POLE ~~FACE~~ Base diameter 142 cm; P extraction 67 cm
GAP, min 6.35 cm; Field 58 kG
max 91.4 cm; Field 43 kG
AVERAGE FIELD at R ext 49 kG
} at X 10^6 ampere turns
CURRENT STABILITY parts/10^6; $B_{max}/\langle B\rangle$
NUMBER OF SECTORS 3 ; SPIRAL, max 113.5 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction
Rad grad 13 /sec or Circ coils
WEIGHT: Fe 100 tons; Coils 8 tons
CONDUCTOR, Material and type NbTi in Cu
STORED ENERGY 18 MJ
COOLING SYSTEM He bath
POWER: Main coils 0 max, kW
Trimming coils 50 max, kW
YOKE/POLE AREA 200 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 500 q^2/A^2 MeV
(Focusing limit) E/A = 160 q/A MeV

ACCELERATION SYSTEM

DEES, number 3 angle 53 deg
BEAM APERTURE 2.5 cm; DC BIAS 0 kV
TUNED by, coarse sliding short fine variable cap.
RF 9 to 32 mHz, stable ± 0.1 /10^6
Orb F 1.3 to 32 mHz; GAIN, max 600 kV/turn
HARMONICS, RF/Orb F, used 1,2,3,4,5,7
DEE-Gnd, max 100 kV, min gap 1.0 cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size

OPERATING PRESSURE μTorr,
PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

Penning

EXTRACTION SYSTEM

3 electrostatic deflectors @90kv/cm

CONTROL SYSTEM

computerized with conventional console

typing limit

ENTRY NO. 67 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	$^{12}C^{5+}$	800	
	$^{20}Ne^{6+}$	900	
	$^{40}Ar^{8+}$	800	
	$^{78}Kr^{8+}$	410	
CURRENT		(μA)	(μA)
Internal			
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

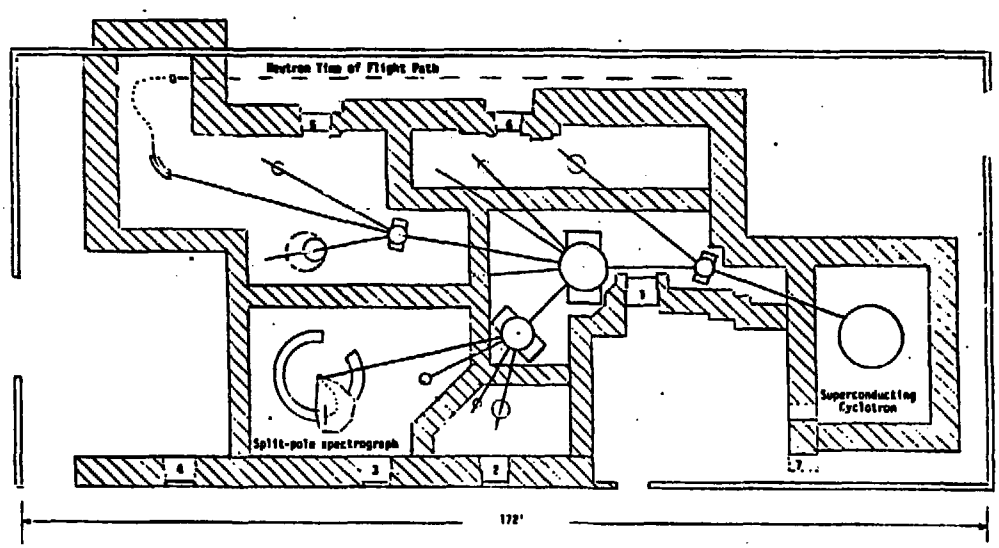
	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The K500 will be used as a standalone research cyclotron for several years, and beam line configuration for this phase is sketched below. The K500 is also intended to be the injector cyclotron in a planned two cyclotron system (K500+ K800). Additional experimental rooms approximately doubling the overall facility will also be provided for the double cyclotron system.



typing limit

ENTRY NO. 68

NAME OF MACHINE Anna and Louis Hand Cyclotron Complex DATE July 1978
INSTITUTION Mount Sinai Medical Center
ADDRESS 4300 Alton Road, Miami Beach, Florida

IN CHARGE J. E. Beaver REPORTED by J. E. Beaver

HISTORY AND STATUS

DESIGN, date _____ MODEL tests 1971
ENG. DESIGN, date Cyclotron Corp. CS-30
CONSTRUCTION, date _____
FIRST BEAM date (or goal) 1972
MAJOR ALTERATIONS None

OPERATION, 80 hr/wk; On Target 75 hr/wk
TIME DIST., in house 60 %, outside 40 %
USERS' SCHEDULING CYCLE one weeks
COST, ACCELERATOR _____
COST, FACILITY, total _____
FUNDED BY Mount Sinai Medical Center

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 3
TECHNICIANS 2 CRAFTS 0
GRAD STUDENTS involved during year 0
OPERATED BY _____ Res staff or x Operators
BUDGET, op & dev _____
FUNDED BY Mount Sinai Medical Center

RESEARCH STAFF, not included above

USERS, in house 3 outside 1
GRAD STUDENTS involved during year 0
RES. BUDGET, in house _____
FUNDED BY Mount Sinai Medical Center

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 90 m^2
movable _____ m^2
TARGET STATIONS 8 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES
Target facility
Hot cells
Chemistry facility

REFERENCES/NOTES

MAGNET

POLE FACE diameter 91 cm; R extraction 42 cm
GAP, min 7 cm; Field _____ kG
max 12 cm; Field _____ kG
AVERAGE FIELD at R ext _____ kG
} at _____ X 10^6 ampere turns
CURRENT STABILITY _____ parts/10^6; $B_{max}/\langle B \rangle$ _____
NUMBER OF SECTORS 3 ; SPIRAL, max _____ deg
POLE FACE COIL PAIRS: AVF _____ /sec;
Harmonic correction _____
Rad grad _____ /sec or Circ coils _____
WEIGHT: Fe 24 tons; Coils 1 tons
CONDUCTOR, Material and type Copper
STORED ENERGY _____ MJ
COOLING SYSTEM Distilled water
POWER: Main coils 60 max, kW
Trimming coils _____ max, kW
YOKE/POLE AREA _____ %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg
BEAM APERTURE _____ cm; DC BIAS _____ kV
TUNED by, coarse Mag fine Mag
RF _____ to _____ mHz, stable ± _____ /10^6
Orb F _____ to _____ mHz; GAIN, max _____ kV/turn
HARMONICS, RF/Orb F, used _____
DEE-Gnd, max _____ kV, min gap _____ cm
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max _____ kW
RF PROTECT circuit, speed _____ μsec
Type _____
FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size one 25 cm diffusion pump
OPERATING PRESSURE 4 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM

Internal Penning

EXTRACTION SYSTEM

Electrostatic deflector + mag channel

CONTROL SYSTEM

Conventional

typing limit

ENTRY NO. 68 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P		26.5
	d		15
	He-3		39
CURRENT		(μA)	(μA)
Internal	P		300
	d		250
External	P		50
	d		50
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	70	%		μA of		MeV
Res, ΔE/E		%		μA of		MeV
Emittance (mm-mrad)	axial / radial			μA of		MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	10 %
Isotope Production	80 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 69

NAME OF MACHINE NASA-Lewis Research Center DATE 1/79
INSTITUTION National Aeronautics & Space Admin., Lewis Research Center
ADDRESS 21000 Brookpark Road, Cleveland, Ohio 44135

IN CHARGE James W. Blue REPORTED by James W. Blue

HISTORY AND STATUS

DESIGN, date (1) MODEL tests Magnet (1968)
ENG. DESIGN, date 1967
CONSTRUCTION, date 1970
FIRST BEAM date (or goal) July 1972
MAJOR ALTERATIONS Fast neutron cancer therapy facility 1976
OPERATION, 80 hr/wk; On Target 40 hr/wk
TIME DIST., in house 40 %, outside 60 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR 1.5M
COST, FACILITY, total .4M
FUNDED BY NACA-NASA

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS none ENGINEERS 1
TECHNICIANS 1 CRAFTS none
GRAD STUDENTS involved during year none
OPERATED BY ____ Res staff or 3 Operators
BUDGET, op & dev
FUNDED BY NASA & NIH

RESEARCH STAFF, not included above

USERS, in house 3 outside 3
GRAD STUDENTS involved during year 2
RES. BUDGET, in house 40K + salaries
FUNDED BY NASA-NIH

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 180 vault/150 beam/ area m^2
movable none m^2
TARGET STATIONS 2 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type no
COMPUTER, model two PDP-15
OTHER FACILITIES fast neutron vertical beam and fast neutron horizontal beam.

REFERENCES/NOTES

MAGNET

POLE FACE diameter 175 cm; R extraction 73.5 cm
GAP, min 17 cm; Field 8.8 kG
max ____ cm; Field 19.2 kG
at .5 X 10^6 ampere turns
AVERAGE FIELD at R ext 15.2 kG
CURRENT STABILITY 10 parts/10^6; $B_{max}/(B)$ 1.26
NUMBER OF SECTORS 3 ; SPIRAL, max 10° deg
POLE FACE COIL PAIRS: AVF none /sec;
Harmonic correction 3
Rad grad none /sec or Circ coils 7
WEIGHT: Fe 206 tons; Coils 28 tons
CONDUCTOR, Material and type copper
STORED ENERGY ____ MJ
COOLING SYSTEM water
POWER: Main coils 250 max, kW
Trimming coils ____ max, kW
YOKE/POLE AREA 81 %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 134 deg
BEAM APERTURE 3.8 cm; DC BIAS none kV
TUNED by, coarse 4 panels fine 2 panels
RF 13.5 to 23 mHz, stable ± .01 /10^6
Orb F 6.7 to 23 mHz; GAIN, max 220 kV/turn
HARMONICS, RF/Orb F, used 1 and 2
DEE-Gnd, max 70 kV, min gap ____ cm
STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}
RF PHASE stable to ± 20 deg
RF POWER input, max 200 kW
RF PROTECT circuit, speed 10 μsec
Type Ignitron
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size 2, oil diffusion, 16"
OPERATING PRESSURE 8×10^{-6} with gas μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

internal, hooded, hot filament

EXTRACTION SYSTEM

D.C. electrostatic and 50 kW magnetic channel

CONTROL SYSTEM

semi-automatic turn on

typing limit

ENTRY NO. 69 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	50	46
	d	28	26
	^{3}He		88
	^{4}He	56	52
CURRENT		(μA)	(μA)
Internal	p	200	200
	d	200	200
	α	50	30
External	p		30
	d		30
	α		10
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured			Conditions			
Pulse Width	<1°	RF deg	5	μA of	43	MeV	p
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff		%		μA of		MeV	
Res, ΔE/E		%		μA of		MeV	
Emittance (mm-mrad)	axial / radial			μA of		MeV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	10 %
Solid State Physics	20 %
Bio-Medical Applications	50 %
Isotope Production	20 %
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

(1) This cyclotron has the dee design and magnetic field configuration of the MSU cyclotron and a modification of the Princeton RF system. The adaptation of these designs to the NASA 60", fixed frequency cyclotron was done in 1967 and 1968. The RF modification is described in NASA TN-5546.

typing limit

ENTRY NO. 70

NAME OF MACHINE Naval Research Laboratory Cyclotron DATE 7/24/78
INSTITUTION Naval Research Laboratory, Radiation Technology Division
ADDRESS Washington, D. C. USA 20375

IN CHARGE Rollon O. Bondelid REPORTED by Rollon O. Bondelid

HISTORY AND STATUS

DESIGN, date Note[1] MODEL tests Note[1]
ENG. DESIGN, date 1963 - 1964
CONSTRUCTION, date 1965 - 1967
FIRST BEAM date (or goal) int. 1967; ext. 1968
MAJOR ALTERATIONS Note[2]

OPERATION, 52 hr/wk; On Target 50 hr/wk
TIME DIST., in house 60 %, outside 40 %
USERS' SCHEDULING CYCLE 6 weeks
COST, ACCELERATOR $1.8 x 10^6
COST, FACILITY, total $6 x 10^6
FUNDED BY U.S. Navy Department

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 0 ENGINEERS 4
TECHNICIANS 6 CRAFTS 2
GRAD STUDENTS involved during year 3
OPERATED BY Res staff or x Operators
BUDGET, op & dev
FUNDED BY Office of Naval Research & Users

RESEARCH STAFF, not included above

USERS, in house 11 outside 3
GRAD STUDENTS involved during year 3
RES. BUDGET, in house 725k
FUNDED BY Office of Naval Research

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 868 m^2
movable m^2
TARGET STATIONS 4 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type -
COMPUTER, model SEL 32/55
OTHER FACILITIES Double-focusing 2.75 meter beam analyzing magnet; Provision for 11 beam paths, 8 with analyzed beam; Beam Pickoff Unit for time-of-flight measurements.

REFERENCES/NOTES

[1] Horizontal median plane version of ORIC.

[2] Conversion to RCA 4648 power tetrode from RCA 6949 in late 1976. New computer installed July 1976.

MAGNET

POLE FACE diameter 193 cm; R extraction 80 cm
GAP, min 19 cm; Field 22.7 kG } at ___ X 10^6 ampere turns
max 71 cm; Field 12.7 kG
AVERAGE FIELD at R ext 17 kG
CURRENT STABILITY 50 parts/10^6; $B_{max}/\langle B \rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max 30 deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction 3/sector
Rad grad --- /sec or Circ coils 10
WEIGHT: Fe 250 tons; Coils 45 tons
CONDUCTOR, Material and type CU, square hollow
STORED ENERGY ~ 6.5 MJ
COOLING SYSTEM demineralized water
POWER: Main coils 800 max, kW
Trimming coils 350 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = - q^2/A^2 MeV
(Focusing limit) E/A = ~ 75 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 4.5 cm; DC BIAS 0 kV
TUNED by, coarse MS fine VC, auto
RF 7.5 to 22.5 mHz, stable ± 1 /10^6
Orb F 1.5 to 22.5 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 1.3
DEE-Gnd, max 70 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) .005
RF PHASE stable to ± ~ 3 deg
RF POWER input, max 300 kW
RF PROTECT circuit, speed 1 μsec
Type Ignitron crowbar
FREQUENCY MODULATION, rate NA /sec
MODULATOR, type NA
BEAM PULSE, width NA

VACUUM SYSTEM

PUMPS, No., Type, Size 2 diffusion 30", 32" (32k & 50 k ℓ/sec
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 3.0 - 3.5 hrs

ION SOURCES/INJECTION SYSTEM

Hot filament

EXTRACTION SYSTEM

Electrostatic with magnetic channel

CONTROL SYSTEM

Conventional

typing limit

ENTRY NO. 70 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	70	52
	d	40	40
	α	78	78
	^{3}He	120	90
CURRENT		(μA)	(μA)
Internal	p	30	30
	d	30	30
	α	30	30
External	p	10	10
	d	12	12
	α	10	10
		(part/s)	(part/s)
Secondary			

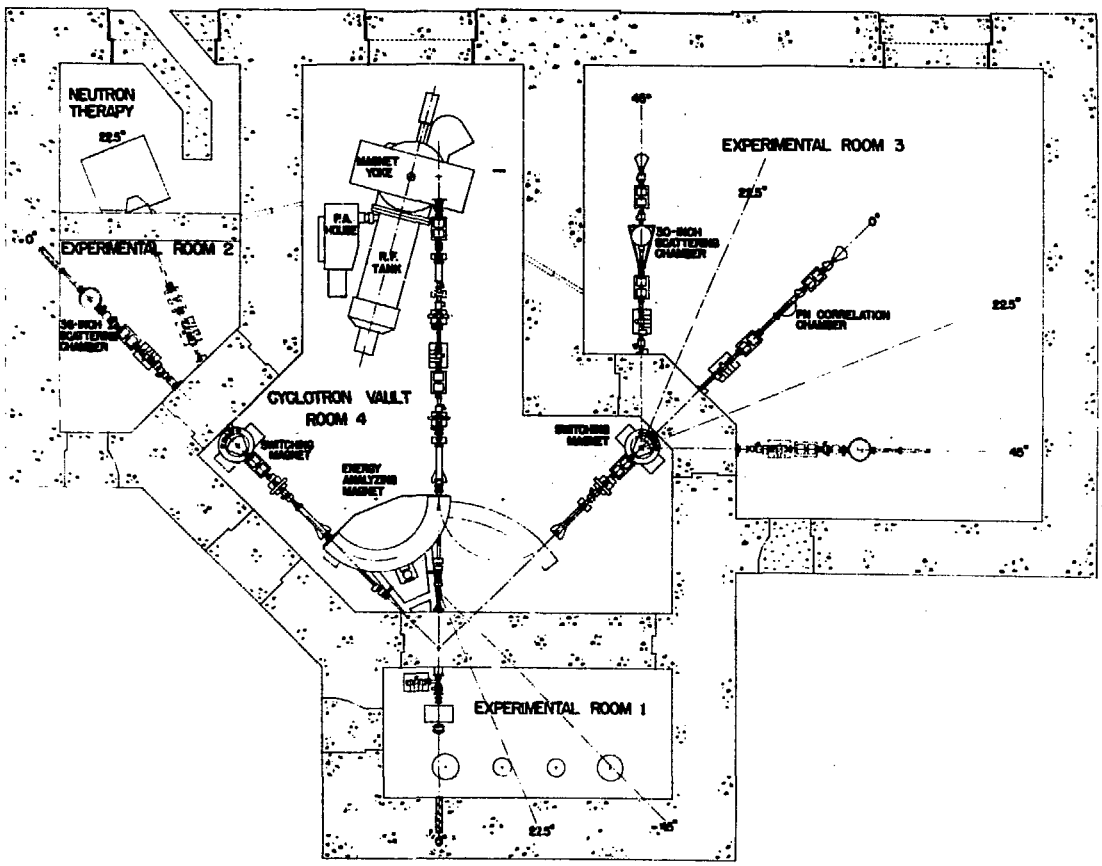
BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	5	RF deg		μA of		MeV
Phase Exc, max	30	RF deg		μA of		MeV
Extract Eff	40	%		μA of		MeV
Res, ΔE/E		%		μA of		MeV
Emittance (mm-mrad)	10 axial / 30 radial			μA of		MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	0 %
Solid State Physics	40 %
Bio-Medical Applications	60 %
Isotope Production	0 %
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



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ENTRY NO. 71

NAME OF MACHINE NEN Cyclotron 1 DATE 30 Jan 1979
INSTITUTION New England Nuclear Corporation
ADDRESS 601 Treble Cove Rd., N. Billerica, MA

IN CHARGE J. L. Need REPORTED by J. L. Need

HISTORY AND STATUS Built by the Cyclotron Corp.
DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date March 70
FIRST BEAM date (or goal) July 70
MAJOR ALTERATIONS None

OPERATION, 90 hr/wk; On Target 87 hr/wk
TIME DIST., in house 100 %, outside _____ %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR _____
COST, FACILITY, total _____
FUNDED BY New England Nuclear Corp.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS 2
GRAD STUDENTS involved during year None
OPERATED BY _____ Res staff or None Operators
BUDGET, op & dev _____
FUNDED BY _____

RESEARCH STAFF, not included above None

USERS, in house _____ outside _____
GRAD STUDENTS involved during year _____
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH None

SHIELDED AREA, fixed _____ m^2
movable _____ m^2
TARGET STATIONS _____ in _____ rooms
STATIONS served at same time, max _____
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 96.6 cm; R extraction 43 cm
GAP, min 5.1 cm; Field 21.0 kG
max 10.2 cm; Field 13.5 kG
AVERAGE FIELD at R ext 16.5 kG
} at .14 X 10^6 ampere turns
CURRENT STABILITY 30 parts/10^6; $B_{max}/\langle B \rangle$ 1.22
NUMBER OF SECTORS 3 ; SPIRAL, max 5 deg
POLE FACE COIL PAIRS: AVF None /sec;
Harmonic correction 11 sector
Rad grad None /sec or Circ coils None
WEIGHT: Fe 19.5 tons; Coils 2.5 tons
CONDUCTOR, Material and type Strap copper
STORED ENERGY -- MJ
COOLING SYSTEM Deionized water
POWER: Main coils 45 max, kW
Trimming coils 0.5 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) -- deg
ION ENERGY (Bending limit) E/A = -- q^2/A^2 MeV
(Focusing limit) E/A = -- q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90 deg
BEAM APERTURE 2.5 cm; DC BIAS 2.5 kV
TUNED by, coarse Tap bars fine panels
RF 25.0 to 12.7 mHz, stable ± _____ /10^6
Orb F 25.0 to 12.7 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 1st
DEE-Gnd, max 30 kV, min gap .40 cm
STABILITY, (pk-pk noise)/(pk RF volt) --
RF PHASE stable to ± -- deg
RF POWER input, max 55 kW
RF PROTECT circuit, speed 5 μsec
Type Clamps pass tube grid
FREQUENCY MODULATION, rate None /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 1, 10" oil diffusion
OPERATING PRESSURE _____ μTorr,
PUMPDOWN TIME 1.5 hrs

ION SOURCES/INJECTION SYSTEM
Gold cathode, radial

EXTRACTION SYSTEM
Electrostatic deflector - Magnetic channel

CONTROL SYSTEM
Manual

typing limit

ENTRY NO. 71 cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	22	22
	d	12.5	12.5
	3HE	30	33
	α	25	25
CURRENT		(μA)	(μA)
Internal	p	500	200
	d	500	200
	3HE	200	200
External	p	200	60
	d	200	100
	3HE	100	90
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width		RF deg		μA of		MeV	
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	75	%	50	μA of	22	MeV	p
Res, ΔE/E	16	%	5	μA of	22	MeV	p
Emittance (mm-mrad) axial / radial				μA of		MeV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	95 %
Development	5 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 72

NAME OF MACHINE NEN Cyclotron 2 DATE 30 Jan 1979
INSTITUTION New England Nuclear Corporation
ADDRESS 601 Treble Cove Rd., N. Billerica, MA

IN CHARGE J. L. Need REPORTED by J. L. Need

HISTORY AND STATUS Designed & built by The Cyclotron Corp.
DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date Aug. 76
FIRST BEAM date (or goal) Nov. 76
MAJOR ALTERATIONS None

OPERATION, 90 hr/wk; On Target 85 hr/wk
TIME DIST., in house 100 %, outside _____ %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR _____
COST, FACILITY, total _____
FUNDED BY New England Nuclear Corp.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS 2
GRAD STUDENTS involved during year None
OPERATED BY _____ Res staff or X Operators
BUDGET, op & dev _____
FUNDED BY _____

RESEARCH STAFF, not included above None

USERS, in house _____ outside _____
GRAD STUDENTS involved during year _____
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH None

SHIELDED AREA, fixed _____ m^2
movable _____ m^2
TARGET STATIONS _____ in _____ rooms
STATIONS served at same time, max _____
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 96.52 cm; R extraction 41.9 cm
GAP, min 5.08 cm; Field 22.5 kG
max 10.16 cm; Field 14.4 kG
AVERAGE FIELD at R ext 17.5 kG
} at .26 X 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B\rangle$ 1.28
NUMBER OF SECTORS 3 ; SPIRAL, max _____ deg
POLE FACE COIL PAIRS: AVF None /sec;
Harmonic correction 2/sector - inner & outer
Rad grad None /sec or Circ coils None
WEIGHT: Fe 22.5 tons; Coils 2 tons
CONDUCTOR, Material and type Hollow copper
STORED ENERGY _____ MJ
COOLING SYSTEM Deionized water
POWER: Main coils 51 max, kW
Trimming coils 1.2 max, kW
YOKE/POLE AREA 111 %
SECTOR ANGLE (Sep Sec) -- deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = 26 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 81 deg
BEAM APERTURE 1.9 cm; DC BIAS 2.5 kV
TUNED by, coarse shorting bar fine capacitor
RF 26.943 to -- mHz, stable ± -- /10^6
Orb F " to -- mHz; GAIN, max 25 kV/turn
HARMONICS, RF/Orb F, used 1st
DEE-Gnd, max 34 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) --
RF PHASE stable to ± -- deg
RF POWER input, max 55 kW
RF PROTECT circuit, speed 5 μsec
Type Clamps pass tube grid
FREQUENCY MODULATION, rate None /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 1-10" oil diffusion
OPERATING PRESSURE 10-20 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM
Pig, cold cathode, radial

EXTRACTION SYSTEM
None

CONTROL SYSTEM
Manual

typing limit

ENTRY NO. 72 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	26.1	26.1
CURRENT		(μA)	(μA)
Internal	p	100	450
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	____ RF deg		____ μA of	____ MeV	____
Phase Exc, max	____ RF deg		____ μA of	____ MeV	____
Extract Eff	____ %		____ μA of	____ MeV	____
Res, ΔE/E	____ %		____ μA of	____ MeV	____
Emittance					
(mm-mrad)	____ axial	____ radial	____ μA of	____ MeV	____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	90 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 73

NAME OF MACHINE NEN Cyclotron 3 DATE 30 Jan 1979
INSTITUTION New England Nuclear Corporation
ADDRESS 601 Treble Cove Rd., N. Billerica, MA

IN CHARGE J. L. Need REPORTED by J. L. Need

HISTORY AND STATUS Designed & built by The Cyclotron Corp.
DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date May 78
FIRST BEAM date (or goal) Aug 78
MAJOR ALTERATIONS None

OPERATION, 90 hr/wk; On Target 85 hr/wk
TIME DIST., in house 100 %, outside _____ %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR _____
COST, FACILITY, total _____
FUNDED BY New England Nuclear Corp.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS 2
GRAD STUDENTS involved during year None
OPERATED BY _____ Res staff or X Operators
BUDGET, op & dev _____
FUNDED BY _____

RESEARCH STAFF, not included above None

USERS, in house _____ outside _____
GRAD STUDENTS involved during year _____
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH None

SHIELDED AREA, fixed _____ m^2
movable _____ m^2
TARGET STATIONS _____ in _____ rooms
STATIONS served at same time, max _____
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 96.52 cm; R extraction 41.9 cm
GAP, min 5.08 cm; Field 22.5 kG } at .26 x 10^6 ampere turns
max 10.16 cm; Field 14.4 kG
AVERAGE FIELD at R ext 17.5 kG
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ 1.28
NUMBER OF SECTORS 3 ; SPIRAL, max _____ deg
POLE FACE COIL PAIRS: AVF None /sec;
Harmonic correction 2/sector - inner & outer
Rad grad None /sec or Circ coils None
WEIGHT: Fe 22.5 tons; Coils 2 tons
CONDUCTOR, Material and type Hollow copper
STORED ENERGY _____ MJ
COOLING SYSTEM Deionized water
POWER: Main coils 51 max, kW
Trimming coils 1.2 max, kW
YOKE/POLE AREA 111 %
SECTOR ANGLE (Sep Sec) -- deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = 26 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 81 deg
BEAM APERTURE 1.9 cm; DC BIAS 2.5 kV
TUNED by, coarse Shorting bar fine capacitor
RF 26.943 to -- mHz, stable ± -- /10^6
Orb F " to -- mHz; GAIN, max 25 kV/turn
HARMONICS, RF/Orb F, used 1st
DEE-Gnd, max 34 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) --
RF PHASE stable to ± -- deg
RF POWER input, max 55 kW
RF PROTECT circuit, speed 5 μsec
Type Clamps pass tube grid
FREQUENCY MODULATION, rate None /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 1-10" oil diffusion

OPERATING PRESSURE 10-20 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM
Pig, cold cathode, radial

EXTRACTION SYSTEM
None

CONTROL SYSTEM
Manual

typing limit

ENTRY NO. 73 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	26.1	26.1
CURRENT		(μA)	(μA)
Internal	p	100	450
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	____ %	____ μA of ____ MeV ____
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance		
(mm-mrad)	____ axial / ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	90 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 74

NAME OF MACHINE NEN Cyclotron 4 DATE 30 Jan 1979
INSTITUTION New England Nuclear Corporation
ADDRESS 601 Treble Cove Rd., N. Billerica, MA

IN CHARGE J. L. Need REPORTED by J. L. Need

HISTORY AND STATUS Designed & built by The Cyclotron Corp.
DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date Dec. 79
FIRST BEAM date (or goal) Feb. 80
MAJOR ALTERATIONS None

OPERATION, 90 hr/wk; On Target 85 hr/wk
TIME DIST., in house 100 %, outside _____ %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR _____
COST, FACILITY, total _____
FUNDED BY New England Nuclear Corp.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS 2
GRAD STUDENTS involved during year None
OPERATED BY _____ Res staff or X Operators
BUDGET, op & dev _____
FUNDED BY _____

RESEARCH STAFF, not included above None

USERS, in house _____ outside _____
GRAD STUDENTS involved during year _____
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH None

SHIELDED AREA, fixed _____ m^2
movable _____ m^2
TARGET STATIONS _____ in _____ rooms
STATIONS served at same time, max _____
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 96.52 cm; R extraction 41.9 cm
GAP, min 5.08 cm; Field 22.5 kG
max 10.16 cm; Field 14.4 kG
AVERAGE FIELD at R ext 17.5 kG
} at .26 x 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/(B)$ 1.28
NUMBER OF SECTORS 3 ; SPIRAL, max _____ deg
POLE FACE COIL PAIRS: AVF None /sec;
Harmonic correction 2/sector - inner & outer
Rad grad None /sec or Circ coils None
WEIGHT: Fe 22.5 tons; Coils 2 tons
CONDUCTOR, Material and type Hollow copper
STORED ENERGY _____ MJ
COOLING SYSTEM Deionized water
POWER: Main coils 51 max, kW
Trimming coils 1.2 max, kW
YOKE/POLE AREA 111 %
SECTOR ANGLE (Sep Sec) -- deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = 26 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 81 deg
BEAM APERTURE 1.9 cm; DC BIAS 2.5 kV
TUNED by, coarse shorting bar fine capacitor
RF 26.943 to -- mHz, stable ± -- /10^6
Orb F " to -- mHz; GAIN, max 25 kV/turn
HARMONICS, RF/Orb F, used 1st
DEE-Gnd, max 34 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) --
RF PHASE stable to ± -- deg
RF POWER input, max 55 kW
RF PROTECT circuit, speed 5 μsec
Type Clamps pass tube grid
FREQUENCY MODULATION, rate None /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 1-10" oil diffusion
OPERATING PRESSURE 10-20 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM
Pig, cold cathode, radial

EXTRACTION SYSTEM
None

CONTROL SYSTEM
Manual

typing limit

ENTRY NO. 74 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	26.1	26.1
CURRENT		(μA)	(μA)
Internal	p	100	450
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	____	RF deg	____	μA of	____	MeV ____
Phase Exc, max	____	RF deg	____	μA of	____	MeV ____
Extract Eff	____	%	____	μA of	____	MeV ____
Res, ΔE/E	____	%	____	μA of	____	MeV ____
Emittance (mm-mrad)	____ axial / ____ radial		____	μA of	____	MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	90 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 75

NAME OF MACHINE Oak Ridge Isochronous Cyclotron (ORIC) DATE 6/19/78
INSTITUTION Holifield Heavy Ion Research Facility, Oak Ridge National Lab.
ADDRESS P.O. Box X, Bldg. 6000, Oak Ridge, Tennessee 37830, USA

IN CHARGE James B. Ball REPORTED by S. W. Mosko

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests 1958-59
ENG. DESIGN, date 1959-1961
CONSTRUCTION, date 1959-1962
FIRST BEAM date (or goal) 1963
MAJOR ALTERATIONS New dee, 1977
25 MV tandem injector, 1979
OPERATION, ~108 hr/wk; On Target ~65 hr/wk
TIME DIST., in house * %, outside * %
USERS' SCHEDULING CYCLE ~12 weeks
COST, ACCELERATOR $2.27 x 10^6
COST, FACILITY, total $6 x 10^6
FUNDED BY U.S. Department of Energy

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS 3
TECHNICIANS 7 CRAFTS 9
GRAD STUDENTS involved during year 0
OPERATED BY Res staff or x Operators
BUDGET, op & dev $1.1 x 10^6
FUNDED BY U.S. Department of Energy

RESEARCH STAFF, not included above

USERS, in house 25 outside 200
GRAD STUDENTS involved during year
RES. BUDGET, in house $2.4 x 10^6
FUNDED BY U.S. Department of Energy

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 235 m^2
movable 330 m^2
TARGET STATIONS 14 in 5 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type QID
COMPUTER, model 2 - SEL 840A
OTHER FACILITIES
On-Line Mass Spectrometer
Time-of-Flight Spectrometer
In-Beam Gamma Ray Facility
Transfermium Chemistry Facility

REFERENCES/NOTES

R.J. Jones, et al., Nucl. Instr. & Meth., Vol. 18,19 (1962) pp. 46-61.
R.S. Lord, et al., Seventh Internat. Conf. on Cyclotrons and their Applications, Zurich (1975), pp. 622-625.
*Time is assigned by Program Committee. No distinction is made between "In-house" and "Outside" proposals.

typing limit

MAGNET

POLE FACE diameter 193 cm; R extraction 75 cm
GAP, min 19 cm; Field 23.7 kG
max 71 cm; Field 14.0 kG
AVERAGE FIELD at R ext 19.2 kG
} at 1.60 x 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B \rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max 30 deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction 3 per sector
Rad grad /sec or Circ coils 10
WEIGHT: Fe 200 tons; Coils 9 tons
CONDUCTOR, Material and type Aluminum
STORED ENERGY ~ 10 MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 1800 max, kW
Trimming coils 500 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 100 q^2/A^2 MeV
(Focusing limit) E/A = ~75 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 2.5 cm; DC BIAS 0 kV
TUNED by, coarse Short. Pl. fine Trim. Cap.
RF 6.8 to 20.4 mHz, stable ± 1 part /10^6
Orb F 2.3 to 20.4 mHz; GAIN, max 160 kV/turn
HARMONICS, RF/Orb F, used 1, 3
DEE-Gnd, max 80 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.0005
RF PHASE stable to ± deg
RF POWER input, max 200 kW
RF PROTECT circuit, speed 1 μsec
Type Ignitron crowbar
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion pumps (one 50 cm, two 80 cm); He cryopanels
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 8 hrs

ION SOURCES/INJECTION SYSTEM

Internal Penning; 25MV tandem electrostatic injector-stripper (1979)

EXTRACTION SYSTEM

Electrostatic deflector + mag. channel

CONTROL SYSTEM

Mod. Comp. III computer plus some conventional

ENTRY NO. 75 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	$^{14}N^{5+}$		180
	$^{16}O^{6+}$		225
	$^{20}Ne^{6+}$		180
	$^{40}Ar^{8+}$		160
CURRENT		(μA)	e (μA)
Internal			
External	$^{14}N^{5+}$		2
	$^{16}O^{6+}$		3
	$^{20}Ne^{6+}$		3
	$^{40}Ar^{8+}$		1.2
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff		%		μA of		MeV
Res, ΔE/E		%		μA of		MeV

Emittance (mm-mrad) { 10 axial, 30 radial } 5 μA of 40 MeV P

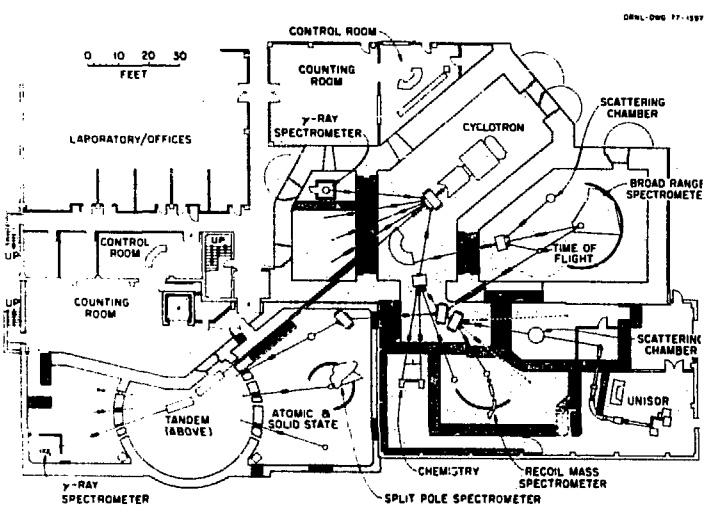
OPERATING PROGRAMS, time dist

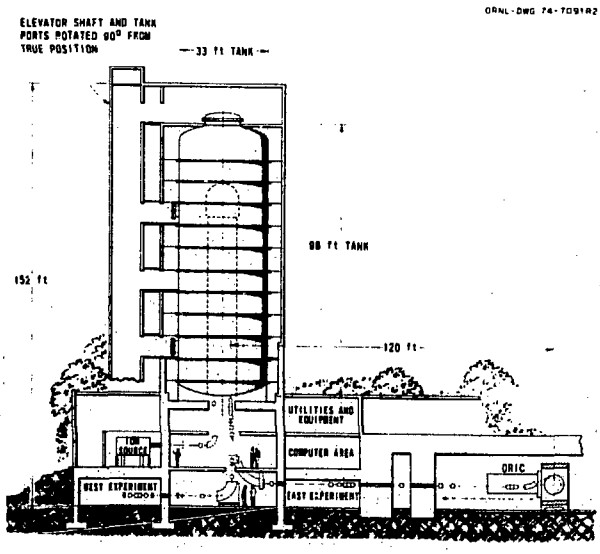
Basic Nuclear Physics	80	%
Solid State Physics		%
Bio-Medical Applications		%
Isotope Production	5	%
Development	10	%
Materials Science	5	%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

ORIC was originally designed for both light and heavy ion acceleration. Most early experiments used beams of protons, deuterons, and alphas. More recently, experimental program emphasis has shifted to heavy ions with 90% of all operation using beams of C, N, O, Ne, and Ar.

During 1977-78, ORIC underwent several modifications to permit operation as a medium-energy booster for the new Holifield 25 MV tandem electrostatic accelerator. First beams from the booster configuration are expected in late-1979. Examples of beams to be available: ^{16}O - 25 MeV/A; ^{79}Br - 12 MeV/A; ^{127}I - 8 MeV/A; ^{165}Ho - ∿6 MeV/A.





typing limit

ENTRY NO. 76

NAME OF MACHINE Princeton AVF Cyclotron DATE Aug. 21, 1978
INSTITUTION Princeton University, The Joseph Henry Laboratory of Physics
ADDRESS Princeton, New Jersey 08540

IN CHARGE Rubby Sherr REPORTED by Richard Kouzes

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests
ENG. DESIGN, date 1966-1967
CONSTRUCTION, date 1967-1968
FIRST BEAM date (or goal) December 1968
MAJOR ALTERATIONS None

OPERATION, 80 hr/wk; On Target 70 hr/wk
TIME DIST., in house 75 %, outside 25 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR $1.45 x 10^6
COST, FACILITY, total $3.0 x 10^6
FUNDED BY Accel. and 70% of Lab by Univ. Beam Transport System by US-AEC

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 0 ENGINEERS 1
TECHNICIANS 3 CRAFTS 0
GRAD STUDENTS involved during year 0
OPERATED BY X Res staff or Operators
BUDGET, op & dev $1.7 x 10^5
FUNDED BY NSF

RESEARCH STAFF, not included above

USERS, in house 9 outside 13
GRAD STUDENTS involved during year 9
RES. BUDGET, in house $2.5 x 10^5
FUNDED BY NSF

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 0 m^2
movable 325 m^2
TARGET STATIONS 8 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type 14 msr Q3D
COMPUTER, model Data General Eclipse
OTHER FACILITIES Scattering Chambers 150, 50, 30 cm.; On-Line Recirculating Gas Target; Orange Spectrometer; Pair Spectrometer; On-Line Atomic Beams Machine; See "Other Features"

REFERENCES/NOTES

Pollock, R. E., Proceedings of the Fifth International Cyclotron Conference (1969), p. 120.

MAGNET

POLE FACE diameter 175 cm; R extraction 75 cm
GAP, min 17 cm; Field 19.5 kG
max 50 cm; Field 8 kG
AVERAGE FIELD at R ext 15 kG
} at .51 x 10^6 ampere turns
CURRENT STABILITY ±5 parts/10^6; $B_{max}/\langle B \rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max ∿ 0 deg
POLE FACE COIL PAIRS: AVF 0 /sec;
Harmonic correction 2
Rad grad 0 /sec or Circ coils 8
WEIGHT: Fe 100 tons; Coils 16 tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM Water
POWER: Main coils 175 kW max, kW
Trimming coils 20 max, kW
YOKE/POLE AREA 90 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 138 deg
BEAM APERTURE 4.5 cm; DC BIAS 0 kV
TUNED by, coarse Movable Panel fine None
RF 11.2 to 24.5 mHz, stable ± .1 /10^6
Orb F 5.6 to 20.6 mHz; GAIN, max 250 kV/turn
HARMONICS, RF/Orb F, used 1,2,4
DEE-Gnd, max 70 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) .0005
RF PHASE stable to ± - deg
RF POWER input, max 300 kW
RF PROTECT circuit, speed 1 μsec
Type ignitron crowbar
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 1-Diffusion
OPERATING PRESSURE 5 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM

Hooded Arc; Cold Cathode

EXTRACTION SYSTEM DC Electrostatic followed by laminated, compensated magnetic deflector

CONTROL SYSTEM

typing limit

ENTRY NO. 76 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P	50	50
	d/α	30/60	30/58
	He-3	80	85
CURRENT		(μA)	(μA)
Internal	P		>1000
	d/α		200/30
	He-3		>100
External	P		25
	d/		18/10
	He-3		10
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

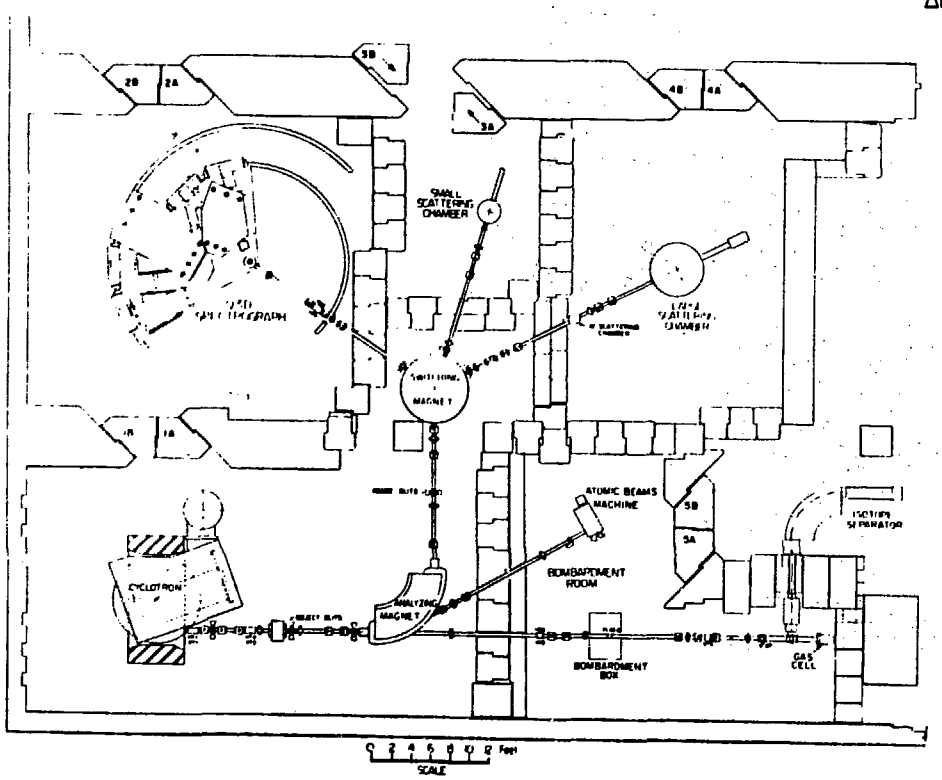
	Measured		Conditions			
Pulse Width	1.6	RF deg	1	μA of	28	MeV P
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	>95	%	1	μA of	42	MeV P
Res, ΔE/E	.05	%	1	μA of	42	MeV P
Emittance						
(mm-mrad)	axial / radial			μA of		MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics & Chemistry	96	%
Solid State Physics		%
Bio-Medical Applications	1	%
Isotope Production	1	%
Development	2	%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

1. Accelerator design based on Michigan State University cyclotron.
2. Obtains single turn extraction by means of internal phase selection.
3. Q3D spectrograph: $p/_{\Delta p} = 1 \times 10^4$
4. On-line isotope separator: 90^0 sector magnet, 150 cm radius, $M/_{\Delta M} > 3 \times 10^3$



typing limit

ENTRY NO. 77

NAME OF MACHINE Sloan-Kettering Institute Cyclotron
INSTITUTION Sloan-Kettering Institute for Cancer Research
LOCATION New York, New York DATE May, 1975

IN CHARGE T.Y.T. Kuo REPORTED by T.Y.T. Kuo

HISTORY AND STATUS

DESIGN, date CS-15, Cyclotron Corporation MODEL tests
ENG. DESIGN, date
CONSTRUCTION, date Nov. 1967
FIRST BEAM date (or goal)
MAJOR ALTERATIONS see features
OPERATION, 60 hr/wk; On Target 30 hr/wk
TIME DIST., in house 98 % outside 2 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY ERDA

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1/2 ENGINEERS 1.2
TECHNICIANS 0 CRAFTS 0.2
ADMIN & CLER 0 TOTAL 1.9
GRAD. STUDENTS involved during year 0
OPERATED BY x Res staff or x Sp operators
BUDGET, op & dev
FUNDED BY NCI, ERDA

RESEARCH STAFF, not included above

USER GROUPS, in house 8 outside 1
STAFF SCIENTISTS, in house outside
TOTAL RES STAFF, in house 15 outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY NCI, ERDA

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 60 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 IBM 1800
FACILITIES for:
Isotope production Internal & External
Irradiation, Solid State Yes
Biological Yes
Time-of-Flight Study Being developed
On-Line Mass Separation

NOTATIONS

MAGNET

POLE FACE dia 80 cm; R ext 36 cm
GAP, min 5 cm; Field 20 kG
max 10 cm; Field 12 kG } at 0.2 x 10^6 A-turns
AVE FIELD at R max 16 kG
CURRENT, STABILITY ± 100 parts/10^6
B max/<B> =
AVF SECTORS 3 SPIRAL, max 0 deg
POLE FACE coil pairs, AVF /sec
Harmonic /sec; Rad Grad /sec, or
circular; HEAVY ION, E max = q^2/A
WEIGHT, Fe 14, Cu, or Al tons
POWER, main coils 40, pole tips
total kW; cooled by water
YOKE/POLE area %; θ sec (Sect Mag) deg
TOTAL POWER, installed 0.06 MW
normal load 0.04 MW

ION SOURCE, int PIG *
ext

ACCELERATION SYSTEM

DEES, number 2, width 120 deg
BEAM APERTURE 2 cm; DC BIAS 1.5 kV
TUNED by, coarse MP, fine VC, Trimmer
RF 12, 16, 24 MHz, stable ± 10 /10^6
Orb F 12, 16, 24 Mc/s; GAIN 120 kV/t
HARMONICS, RF/OF, used 1
DEE-Gnd, max 30 kV, x/field, min cm,
STABILITY, (pk-pk noise)/(pk RF volt) 0.0005
RF PHASE stable to ± deg
RF POWER input, max 30 kW
RF PROTECT circuit, speed μs
type Ignitron crowbar
EXTRACT System
see features

FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width nsec
(FM only)

SELECTED REFERENCES

1. Radiology 93,331-337,1969.
2. IEEE Tran. Nucl. Sci. NS-14(3) 1967.
3. Proc. of the 5th Int. Cyc. Conf. 1969.
4. Proc. of the 6th Int. Cyc. Conf. 1972.
5. Proc. of the 1975 Nat. Acc. Conf.

Typing limit

ENTRY NO. 77 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	15	14.7
	d	7.5	7.9
	$^3He^{++}$	20	23.3
CURRENT		(μA)	(μA)
Internal	p	100	500
	d	100	800 *
	$^3He^{++}$	100	400 *
External	p	50	100 **
	d	50	400 **
	$^3He^{++}$	50	200 **
		(part/s)	(part/s)
Secondary	n ***		$2x10^{13}$
HEAVIEST ion	alpha		

** 300μA ext.
* 400μA int.

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	70 %	200 μA of 23 MeV $^3He^{++}$
Res, ΔE/E	%	μA of MeV
Emittance (mm-mrad)	50 axial, 50 radial	90% μA of MeV
VACUUM norm	1 μtorr; PUMPDOWN time	2 hr

OPERATING PROGRAMS, time dist

Basic Nuclear Physics/Chemistry	%
Solid State Physics	%
Bio-Medical Applications	100 %
Isotope Production	%
Materials Science	%
	%

OTHER FEATURES and OPERATION SUMMARY

This is the first proto-type cyclotron built by the Cyclotron Corporation, Berkeley, California. Major modifications included: Dees and RF system, ion source and extraction system.

* There are four independent coordinate controls for the ion source. The high beam currents are resulted from high operating power density in the order of 140 kW/cm^3.

** The extraction system:

Harmonic coils: azimuthal angle and current controls
Deflector: fine adjust of extraction radius (change of energy also)
taper angle adjust
channal gap adjust
dc voltage adjust
Magnetic channel: compensated-iron type
entrance position control
exit position control
channel curvature control

*** Neutron programs: Dosimetry
Neutron Physics
Activation
Therapy

Typing limit

ENTRY NO. 78

NAME OF MACHINE Texas A&M Variable Energy Cyclotron DATE 7/78

INSTITUTION Texas A&M University

ADDRESS College Station, Texas 77843

IN CHARGE D. H. Youngblood REPORTED by R. C. Rogers

HISTORY AND STATUS

DESIGN, date 1964 MODEL tests None

ENG. DESIGN, date 1964-1966

CONSTRUCTION, date 1965-1967

FIRST BEAM date (or goal) August 8, 1967

MAJOR ALTERATIONS none

OPERATION, 160 hr/wk; On Target _____ hr/wk

TIME DIST., in house 75 %, outside 25 %

USERS' SCHEDULING CYCLE 4 weeks

COST, ACCELERATOR $3 x 10^6

COST, FACILITY, total $6 x 10^6

FUNDED BY State of Texas, AEC, Welch Foundation

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 4

TECHNICIANS 11 CRAFTS 4

GRAD STUDENTS involved during year _____

OPERATED BY _____ Res staff or X Operators

BUDGET, op & dev $505,000

FUNDED BY State of Texas

RESEARCH STAFF, not included above

USERS, in house 27 outside _____

GRAD STUDENTS involved during year 20

RES. BUDGET, in house $515,000

FUNDED BY NSF, DOE, Welch Foundation

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 447 m^2

movable 0 m^2

TARGET STATIONS 12 in 5 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type Enge split pole

COMPUTER, model IBM 7094, PDP-15/40

OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 224 cm; R extraction 99 cm

GAP, min 19 cm; Field 21.8 kG } at 56 x 10^6 ampere turns

max 30 cm; Field 14.2 kG

AVERAGE FIELD at R ext 17.1 kG

CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ 1.2

NUMBER OF SECTORS 3 ; SPIRAL, max 55 deg

POLE FACE COIL PAIRS: AVF _____ /sec;

Harmonic correction 5

Rad grad _____ /sec or Circ coils 17

WEIGHT: Fe 290 tons; Coils 12 tons

CONDUCTOR, Material and type Cu

STORED ENERGY _____ MJ

COOLING SYSTEM H_2O

POWER: Main coils 490 max, kW

Trimming coils 460 max, kW

YOKE/POLE AREA 100 %

SECTOR ANGLE (Sep Sec) _____ deg

ION ENERGY (Bending limit) E/A = 147 q^2/A^2 MeV

(Focusing limit) E/A = 70 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg

BEAM APERTURE 3.8 cm; DC BIAS 0 kV

TUNED by, coarse MP fine VC

RF 5.5 to 15.5 mHz, stable ± 10 /10^6

Orb F 1.87 to 15.5 mHz; GAIN, max 160 kV/turn

HARMONICS, RF/Orb F, used 1.3

DEE-Gnd, max 80 kV, min gap _____ cm

STABILITY, (pk-pk noise)/(pk RF volt) .002

RF PHASE stable to ± 1.1 deg

RF POWER input, max 200 kW

RF PROTECT circuit, speed 1 μsec

Type thyratron crowbar

FREQUENCY MODULATION, rate _____ /sec

MODULATOR, type _____

BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 4, oil diffusion, 1-35", 1-10", 2-6"

OPERATING PRESSURE 1-2 μTorr,

PUMPDOWN TIME 4 hrs

ION SOURCES/INJECTION SYSTEM

Internal filament, Internal cold cathode, Axial injector for polarized p, d, ^3He

EXTRACTION SYSTEM

electrostatic

CONTROL SYSTEM

manual

typing limit

ENTRY NO. 78 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	50	50
	d		60
	^{3}He		100
	α		130
CURRENT		(μA)	(μA)
Internal	p	1000	300
	d		150
	α		200
External	d		80
	$\vec{p}$		1.05
	HI*		
		(part/s)	(part/s)
Secondary			

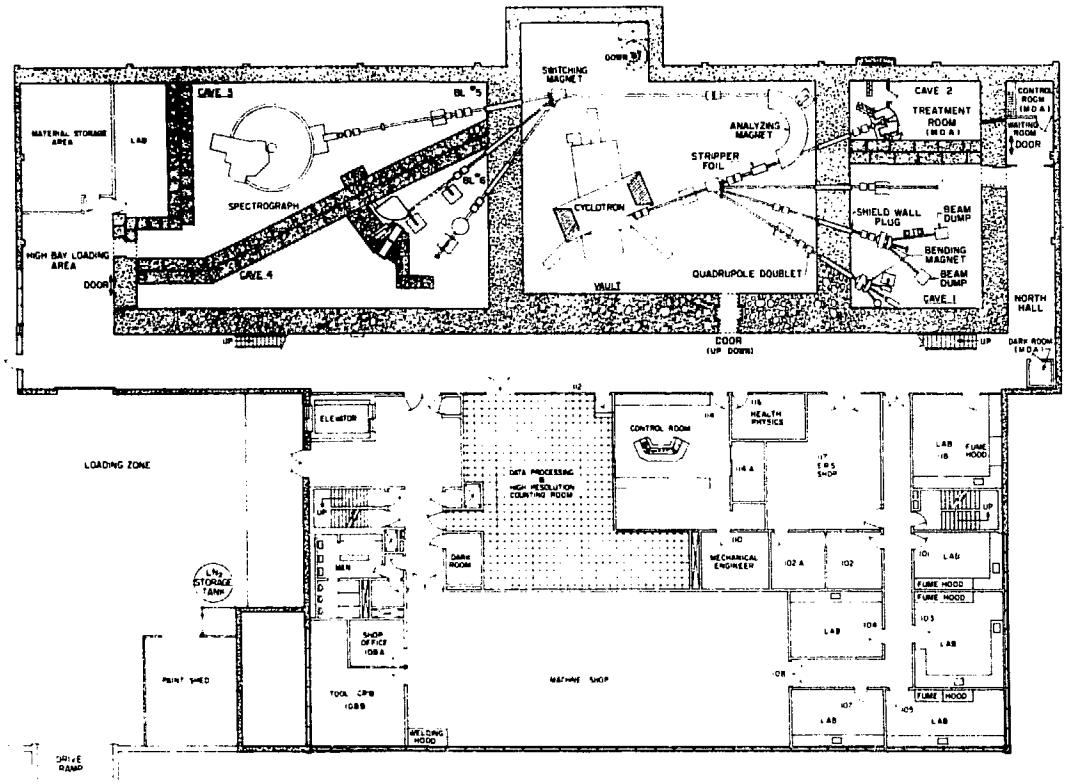
BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	4.5	RF deg	0.2	μA of	120	MeV	$^4He^{+2}$
Phase Exc, max	30	RF deg	var	μA of	20	MeV	d^+
Extract Eff	75	%	1.6	μA of	20	MeV	d^+
Res, ΔE/E	0.5	%	10	μA of	40	MeV	$^4He^{+2}$
Emittance (mm-mrad)	NM axial / NM radial		___	μA of	___	MeV	___

OPERATING PROGRAMS, time dist

Basic Nuclear Physics/Chemistry	81	%
Solid State Physics		%
Bio-Medical Applications	13	%
Isotope Production		%
Development	6	%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



*Heavy-ion beams account for 36% of all operational beams. Heavy-ion energies range from 0.5 MeV/amu for $^{136}Xe^{8+}$ to 25 MeV/amu for $^{12}C^{5+}$. Intensities vary from a low of .15 eμA for $^{14}N^{6+}$ to as much as 10 eμA for $^{11}B^{3+}$.

typing limit

ENTRY NO. 79

NAME OF MACHINE Lawrence Berkeley Laboratory 88-Inch Cyclotron DATE 7/28/78
INSTITUTION Lawrence Berkeley Laboratory
ADDRESS 1 Cyclotron Road, Berkeley, California 94720, U.S.A.

IN CHARGE David K. Scott REPORTED by Richard A. Gough

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests 1958-59
ENG. DESIGN, date 1959-1961
CONSTRUCTION, date 1959-1962
FIRST BEAM date (or goal) int. 1961; ext. 1962
MAJOR ALTERATIONS None

OPERATION, 160 hr/wk; On Target 122 hr/wk
TIME DIST., in house 50 %, outside 50* %
USERS' SCHEDULING CYCLE one weeks
COST, ACCELERATOR $2.9 × 10^6
COST, FACILITY, total $8.0 × 10^6
FUNDED BY U.S. Department of Energy

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 3
TECHNICIANS 13 CRAFTS 5
GRAD STUDENTS involved during year 0
OPERATED BY Res staff or X Operators
BUDGET, op & dev $1.47 × 10^6
FUNDED BY U. S. Department of Energy

RESEARCH STAFF, not included above

USERS, in house 12 outside 61/year
GRAD STUDENTS involved during year 15
RES. BUDGET, in house $805,000
FUNDED BY U.S. Department of Energy

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed - m^2
movable 700 m^2
TARGET STATIONS 14 in 8 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type LBL QSD
COMPUTER, model SCC-660, ModComp 4, PDP-15
OTHER FACILITIES Isotope Production, Bio-Medical Irradiation Facility, On-Line (He Jet) Mass Separator, Polarimeter, Transfermium Chemistry Facility, In-Beam Gamma Ray Facility

REFERENCES/NOTES

Nucl. Instr. & Meth. 18-19, 33&59 (1962).
CERN Report 63-19, 8 (1963).
IEEE Trans.Nucl.Sci. NS-13, 4, 364 (1966).
Nucl. Instr. & Meth. 72, 61 (1969).
Proc. 5th Int'l Cycl. Conf. 610 (1971).
IEEE Trans.Nucl.Sci. NS-19, 2, 114 (1972).
Proc. 6th Int'l Cycl. Conf. 265 (1972).
Nucl. Instr.&Meth. (in press) LBL-6502.

(*21% by Users Outside LBL, 29% by LBL and UC Berkeley Staff Non Resident at Cyclotron)

typing limit

MAGNET

POLE FACE diameter 224 cm; R extraction 99 cm
GAP, min 19 cm; Field 20 kG } at 0.55 × 10^6 ampere turns
max 30 cm; Field 14 kG
AVERAGE FIELD at R ext 17 kG
CURRENT STABILITY 10 parts/10^6; $B_{max}/(B)$ 1.18
NUMBER OF SECTORS 3 ; SPIRAL, max 55 deg
POLE FACE COIL PAIRS: AVF - /sec;
Harmonic correction 5
Rad grad - /sec or Circ coils 17
WEIGHT: Fe 290 tons; Coils 10 tons
CONDUCTOR, Material and type Copper
STORED ENERGY ∿ 1.4 MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 450 max, kW
Trimming coils 580 max, kW
YOKE/POLE AREA 102 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 145 q^2/A^2 MeV
(Focusing limit) E/A = 70 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3.8 cm; DC BIAS 0 kV
TUNED by, coarse mov.panels fine var. cap, auto
RF 5.53 to 16.5 mHz, stable ± 0.01 /10^6
Orb F 1.1 to 16.5 mHz; GAIN, max ≤ 150 kV/turn
HARMONICS, RF/Orb F, used 1,3,5
DEE-Gnd, max 75 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}
RF PHASE stable to ± - deg
RF POWER input, max 250 kW
RF PROTECT circuit, speed ∿ 15 μsec
Type Thyratron
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 4 Diffusion pumps (two 76cm, two 25cm) & 20°K He cryopanel
OPERATING PRESSURE 1-2 μTorr,
PUMPDOWN TIME 1-4 hrs to operate; 24 hrs to base

ION SOURCES/INJECTION SYSTEM

Int.fil A ≤ 4, Int. Penning A > 4, Ext.polarized p.d, Ext. Penning (1979)

EXTRACTION SYSTEM

D. C. Electrostatic Deflector

CONTROL SYSTEM

Manual

ENTRY NO. 79 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	50	60
	α	130	140
	$^{12}C^{4+}$	-	193.4
	$^{16}O^{6+}$	-	315
CURRENT		(μA)	(μA)
Internal	p		3000@15cm
	α		500@15cm
External	p		30-200
	α		10-100
	$^{7}Li^{2+}$		5
	$^{10}B^{3+}$		95
	$^{40}Ar^{8+}$		0.9
	pol. p,d	(part/s)	0.3 (part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	6-20	RF deg	10	μA of	65	MeV	α
Phase Exc, max	20	RF deg	10	μA of	65	MeV	α
Extract Eff	50	%	10	μA of	65	MeV	α
Res, ΔE/E	0.3	%	10	μA of	65	MeV	α
Emittance (mm-mrad)	70 axial / 50 radial		10	μA of	65	MeV	α

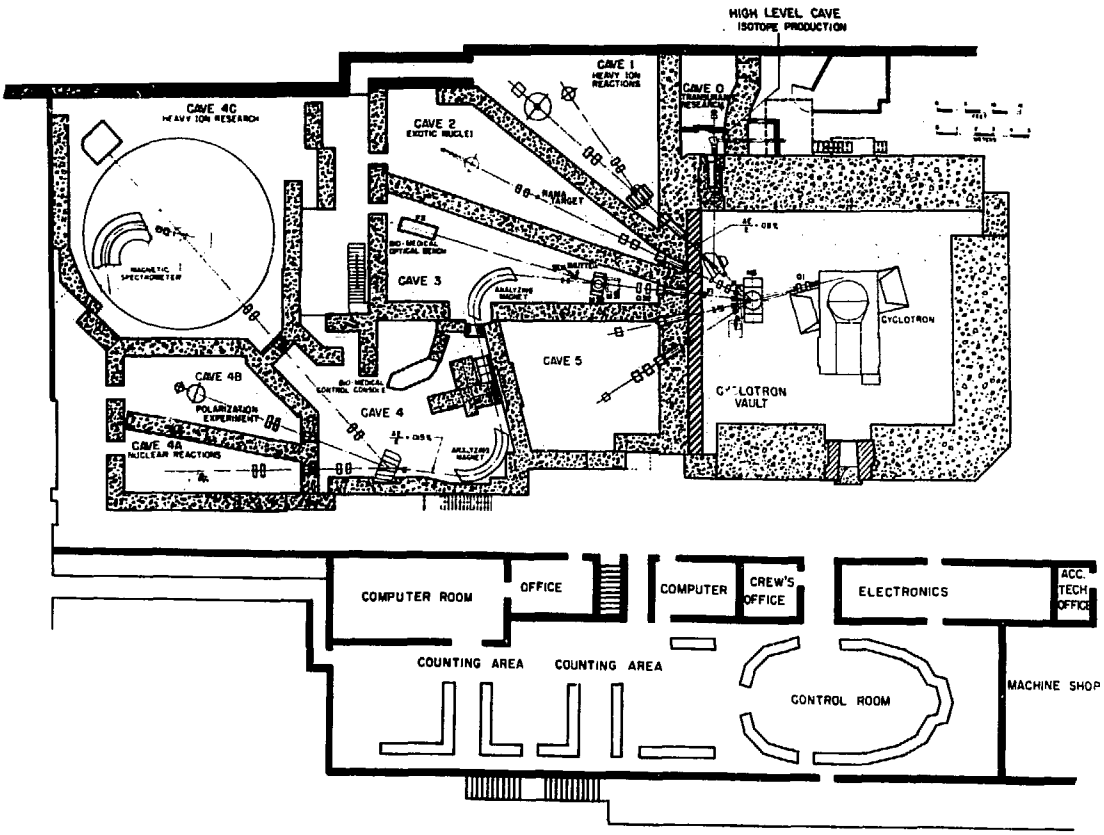
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	90 %
Solid State Physics	0 %
Bio-Medical Applications	2 %
Isotope Production	1 %
Development	7 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Noteworthy features are the high intensity polarized proton and deuteron beams, and high energy heavy-ion beams, such as ^{16}O -20 MeV/nucleon. Fully stripped beams of ^{14}N - 32 MeV/nucleon have also been accelerated ($\leq 10^3$ particle/second). These energies approach the anticipated lowest energies of the Bevalac after the planned upgrading, permitting complementary studies of heavy ion reactions.

88-INCH CYCLOTRON FACILITY



typing limit

ENTRY NO. 80

NAME OF MACHINE Davis 76" Isochronous Cyclotron DATE July 31, 1978
INSTITUTION Crocker Nuclear Laboratory, University of California
ADDRESS Davis, California 95616

IN CHARGE J. A. Jungerman REPORTED by J. A. Jungerman

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date ORIC copy
CONSTRUCTION, date 1964-1966
FIRST BEAM date (or goal) Int., ext. 1966
MAJOR ALTERATIONS none

OPERATION, 128 hr/wk; On Target 65 hr/wk
TIME DIST., in house 75 %, outside 25 %
USERS' SCHEDULING CYCLE 4 weeks
COST, ACCELERATOR 1.4×10^6
COST, FACILITY, total 4.5×10^6
FUNDED BY A.E.C., U.D., N.S.F.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2
TECHNICIANS 4 CRAFTS 6
GRAD STUDENTS involved during year 5
OPERATED BY 1/3 Res staff or 2/3 Operators
BUDGET, op & dev $350,000
FUNDED BY beam recharges

RESEARCH STAFF, not included above

USERS, in house 11 outside 5
GRAD STUDENTS involved during year 12
RES. BUDGET, in house $1,065,000
FUNDED BY NCI, DOE, EPA, CA Air Resources Board

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 360 m^2
movable 0 m^2
TARGET STATIONS 7 in 3 rooms
STATIONS served at same time, max 2
MAG SPECTROGRAPH, type none
COMPUTER, model PDP 15/40, PDP 11
OTHER FACILITIES Isotope production, Irradiation; Solid State Biological, ch. part and n Flight study 10 m

REFERENCES/NOTES

MAGNET

POLE FACE diameter 193 cm; R extraction 80 cm
GAP, min 19 cm; Field 22.7 kG
max 71 cm; Field 12.7 kG
AVERAGE FIELD at R ext 17.5 kG
} at 0.8×10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max 30 deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction 3
Rad grad – /sec or Circ coils 10
WEIGHT: Fe 268 tons; Coils 42 tons
CONDUCTOR, Material and type Copper 1" square hollow cord
STORED ENERGY 10 MJ
COOLING SYSTEM Demineralized H_2O
POWER: Main coils 800 max, kW
Trimming coils 500 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 4.5 cm; DC BIAS 0 kV
TUNED by, coarse MS fine VC, auto
RF 7.3 to 22 mHz, stable ± 1 /10^6
Orb F 1.5 to 22 mHz; GAIN, max 180 kV/turn
HARMONICS, RF/Orb F, used 1, 3
DEE-Gnd, max 90 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.005
RF PHASE stable to ± 10 deg
RF POWER input, max 150 kW
RF PROTECT circuit, speed 2 μsec
Type Ignitron Crowbar
FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 2 diffusion pumps 81 cm and 89 cm
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM

Hot fil, mod. LBL 88"

EXTRACTION SYSTEM

CONTROL SYSTEM

typing limit

ENTRY NO. 80 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	20-75	20-65
	α	25-90	25-90
	^{3}He	30-100	35-86
CURRENT		(μA)	(μA)
Internal	p	1000	300+
	α		100
External	p		30
	α		40
	d		40
		(part/s)	(part/s)
Secondary	n		5×10^6
	pol. n		3×10^5

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	4° RF deg	5	μA of	32	MeV	d
Phase Exc, max	40° RF deg	7	μA of	38	MeV	p
Extract Eff	90 %	20	μA of	65	MeV	p
Res, ΔE/E	0.2 %	0.1	μA of	30	MeV	p

Emittance

(mm-mrad) { ____ axial / ____ radial } ____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	35	%
Solid State Physics	2	%
Bio-Medical Applications	5	%
Isotope Production	23	%
Development		%
Elemental Analysis	20	%
Space Simulation	5	%
Hot Atom Chemistry	3	
Machine Improvement	5	
Neutron Therapy	2	

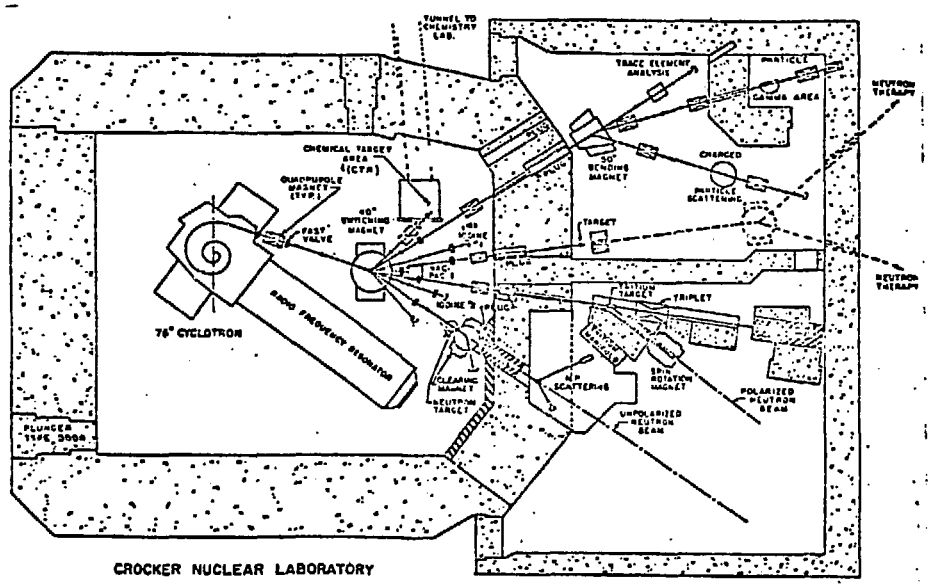
PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The following are special features of the of the Davis 76" Isochronous Cyclotron program:

1. A large and active program in nuetro scattering and reactions in the energy region between 25 MeV and 60 MeV. Both unpolarized and polarized neutron beams of reasonable intensity are available, as is a polarized proton target.

2. The neutron program, when added to programs in charged particle reactions, particle-gamma techniques, and hot atom chemistry, form the research bse of the facility which comprises about half of the scheduled operating time. Considerable work is done in a variety of programs based upon applications of accelerator beams to environmental, medical, and industrial problems, particularly air pollution monitoring, production of ^{123}I and ^{201}Tl for nuclear medicine, and neutron cancer therapy.

3. The accelerator is almost entirely supported by beam recharges from private, state and federal programs.



CROCKER NUCLEAR LABORATORY

typing limit

ENTRY NO. 81

NAME OF MACHINE Injector Cyclotron DATE July '78
INSTITUTION Lawrence Livermore Laboratory
ADDRESS P. O. Box 808, Livermore California 94550

IN CHARGE Carl H. Poppe REPORTED by Ivan D. Proctor

HISTORY AND STATUS

DESIGN, date * MODEL tests
ENG. DESIGN, date
CONSTRUCTION, date 1968
FIRST BEAM date (or goal) 1969
MAJOR ALTERATIONS None

OPERATION, 80 hr/wk; On Target ∿70 hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE ∿8 weeks
COST, ACCELERATOR $430,000
COST, FACILITY, total $580,000
FUNDED BY USDOE

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 0.5 ENGINEERS 1
TECHNICIANS ∿6 CRAFTS
GRAD STUDENTS involved during year 0
OPERATED BY . Res staff or 4 Operators
BUDGET, op & dev
FUNDED BY USDOE

RESEARCH STAFF, not included above

USERS, in house 9.5 outside 3
GRAD STUDENTS involved during year 0
RES. BUDGET, in house
FUNDED BY USDOE

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS 5 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type Split pole
COMPUTER, model PDP 8, PDP 15
OTHER FACILITIES
16 Detector 10.7 m TOF Array

REFERENCES/NOTES

*Cyclotron Corporation
Model CNI-15

MAGNET

POLE FACE diameter 82 cm; R extraction 35 cm
GAP, min 5 cm; Field 20 kG
max 10 cm; Field 12 kG
AVERAGE FIELD at R ext 16.5 kG
} at 0.16 x 10^6 ampere turns
CURRENT STABILITY 40 parts/10^6; $B_{max}/\langle B \rangle$ 1.016
NUMBER OF SECTORS 3 ; SPIRAL, max 30 deg
POLE FACE COIL PAIRS: AVF 0 /sec;
Harmonic correction
Rad grad 1 /sec or Circ coils
WEIGHT: Fe 14 tons; Coils 1.16 tons
CONDUCTOR, Material and type Al
STORED ENERGY MJ
COOLING SYSTEM LCW
POWER: Main coils 58 max, kW
Trimming coils 0 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 15 q^2/A^2 MeV
(Focusing limit) E/A = 15 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 120 deg
BEAM APERTURE 1.9 cm; DC BIAS -1.0 kV
TUNED by, coarse Strap fine Capacitor
RF 12.5 to 25.0 mHz, stable ± 5 /10^6
Orb F 12.5 to 25 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used
DEE-Gnd, max 30 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.1%
RF PHASE stable to ± deg
RF POWER input, max 36 kW
RF PROTECT circuit, speed 20 μsec
Type Crowbar series regulator
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 1500 ℓ/s turbo and 4" DP
OPERATING PRESSURE 1.5 μTorr,
PUMPDOWN TIME ∿8 hrs

ION SOURCES/INJECTION SYSTEM

P.I.G. Internal and External

EXTRACTION SYSTEM

Electrostatic Channel

CONTROL SYSTEM

Manual

typing limit

ENTRY NO. 81 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	H^-	15	15
	D^-	8	8
CURRENT		(μA)	(μA)
Internal	H^-	100	50
	D^-	50	5
External	H^-	50	25
	D^-	25	2
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	15	RF deg	10	μA of	15	MeV	H^-
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	50	%	25	μA of	15	MeV	H^-
Res, ΔE/E	0.2	%	1	μA of	15	MeV	H^-
Emittance (mm-mrad)	25 axial, 30 radial		10	μA of	15	MeV	H^-

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	75 %
Solid State Physics	10 %
Bio-Medical Applications	%
Isotope Production	%
Development	5 %
	%
Applied Physics	10 %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 82

NAME OF MACHINE Biomedical Cyclotron DATE 7-10-78

INSTITUTION University of California - Center for the Health Sciences

ADDRESS Los Angeles, CA 90024

IN CHARGE N.S. MacDonald, Ph.D. REPORTED by N.S. MacDonald, Ph.D.

HISTORY AND STATUS

DESIGN, date -- MODEL tests Comercial (Cyclotron Corp;CS-22) 1970

ENG. DESIGN, date --

CONSTRUCTION, date --

FIRST BEAM date (or goal) 3-15-71

MAJOR ALTERATIONS None

OPERATION, 50 hr/wk; On Target 24 hr/wk

TIME DIST., in house 100 %, outside 0 %

USERS' SCHEDULING CYCLE -- weeks

COST, ACCELERATOR --

COST, FACILITY, total $700,000

FUNDED BY AEC, University

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2

TECHNICIANS 2 CRAFTS --

GRAD STUDENTS involved during year 1

OPERATED BY X Res staff or Operators

BUDGET, op & dev --

FUNDED BY DOE

RESEARCH STAFF, not included above

USERS, in house 3 outside 2

GRAD STUDENTS involved during year 1

RES. BUDGET, in house --

FUNDED BY DOE

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed -- m^2

movable none m^2

TARGET STATIONS 1 in 1 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type --

COMPUTER, model --

OTHER FACILITIES

isotope production yes

irradiaton,solid state yes

Biological no

tim e-of-flight no

REFERENCES/NOTES

MAGNET

POLE FACE diameter 97 cm; R extraction 81 cm

GAP, min 5 cm; Field 20 kG
max 10 cm; Field 12 kG
at 0.2 x 10^6 ampere turns

AVERAGE FIELD at R ext 16 kG

CURRENT STABILITY ±30 parts/10^6; $B_{max}/\langle B\rangle$ 1.25

NUMBER OF SECTORS 3 ; SPIRAL, max 60 deg

POLE FACE COIL PAIRS: AVF 3 -- /sec;

Harmonic correction --

Rad grad -- /sec or Circ coils

WEIGHT: Fe 24 tons; Coils tons

CONDUCTOR, Material and type

STORED ENERGY MJ

COOLING SYSTEM

POWER: Main coils 30KW max, kW

Trimming coils max, kW

YOKE/POLE AREA 100 %

SECTOR ANGLE (Sep Sec) deg

ION ENERGY (Bending limit) E/A = q^2/A^2 MeV

(Focusing limit) E/A = q/A MeV

Penning Cold Cathode

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg

BEAM APERTURE 4 cm; DC BIAS 2.5 kV

TUNED by, coarse straps fine vc auto

RF 12 to 25 mHz, stable ± 10 /10^6

Orb F -- to -- mHz; GAIN, max -- kV/turn

HARMONICS, RF/Orb F, used --

DEE-Gnd, max 25 kV, min gap 1 cm

STABILITY, (pk-pk noise)/(pk RF volt) 17./12kv

RF PHASE stable to ± -- deg

RF POWER input, max 150 kW

RF PROTECT circuit, speed -- μsec

Type ign. crowbar

FREQUENCY MODULATION, rate /sec

MODULATOR, type

BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size

OPERATING PRESSURE μTorr,

PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

Penning Cold Cathode

EXTRACTION SYSTEM

dc electrostatic, mag. channel

CONTROL SYSTEM

typing limit

ENTRY NO. 82 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	22.1	22.1
	d	12.2	12.2
	^{3}He	31.6	31.6
CURRENT		24.6 (μA)	24.6 (μA)
Internal	p	200	100
	d	200	750
	^{3}He	100	90
External	α	100	95
	p		52
	d		75
	^{3}He		50
	α	(part/s)	(part/s) 55
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	____ RF deg	____ μA of ____ MeV ____
Phase Exc, max	____ RF deg	____ μA of ____ MeV ____
Extract Eff	60-70 %	100 μA of 22 MeV H^+
Res, ΔE/E	____ %	____ μA of ____ MeV ____
Emittance (mm-mrad)	____ axial, ____ radial	____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	____ %
Solid State Physics	____ %
Bio-Medical Applications	____ %
Isotope Production	100 %
Development	____ %
	____ %
	____ %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Principal Use: Preparing radionuclides for the nuclear medicine clinic of the hospital, and for research in biology and medicine

Quantitative analyses of Oxygen-18 in small water samples of biological origin by proton activation to Fluorine-18 are routine.

typing limit

ENTRY NO. 83

NAME OF MACHINE FMI Cyclotron
INSTITUTION Franklin McLean Memorial Research Institute
LOCATION 950 E. 59th Street, Chicago, Ill 60637 DATE December 1, 1975

IN CHARGE P.V. Harper REPORTED by L.S. Skaggs

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests 1967
ENG. DESIGN, date 1965-1967
CONSTRUCTION, date 1969
FIRST BEAM date (or goal) July 1969
MAJOR ALTERATIONS Deflector
OPERATION, 45 hr/wk; On Target 20 hr/wk
TIME DIST., in house 100 %, outside ___ %
USERS' SCHEDULING CYCLE ___ weeks
COST, ACCELERATOR ___
COST, FACILITY, total $600,000.00
FUNDED BY US - (AEC) - ERDA

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1/2 ENGINEERS 1
TECHNICIANS 3 CRAFTS 1
ADMIN & CLER ___ TOTAL ___
GRAD. STUDENTS involved during year ___
OPERATED BY x Res staff or and Sp operators
BUDGET, op & dev ___
FUNDED BY USERDA

RESEARCH STAFF, not included above

USER GROUPS, in house 4 outside -
STAFF SCIENTISTS, in house 8 outside -
TOTAL RES STAFF, in house 15 outside -
GRAD STUDENTS involved during year 1
RES. BUDGET, in house ___
FUNDED BY USERDA

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 62 m^2
movable 0 m^2
TARGET STATIONS 2 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max 1
MAG SPECTROGRAPH, type ___
ON-LINE COMPUTER, model ___
FACILITIES for:
Isotope production water cooled targets
Irradiation, Solid State ___
Biological Neutron irradiation & dosimetry
Time-of-Flight Study ___
On-Line Mass Separation ___

NOTATIONS

MAGNET

POLE FACE dia 81 cm; R ext 35 cm
GAP, min 5 cm; Field 20 kG
max 10 cm; Field 12 kG } at 0.2 x 10^6 A-turns
AVE FIELD at R max 16 kG
CURRENT, STABILITY ± 100 parts/10^6
B max/<B> = 1.25
AVF SECTORS 3 SPIRAL, max 0 deg
POLE FACE coil pairs, AVF ___ /sec
Harmonic 1 /sec; Rad Grad ___ /sec, or
___ circular; HEAVY ION, E max = ___ q^2/A
WEIGHT, Fe 14 , Cu, or Al ___ tons
POWER, main coils 58 KW , pole tips ___
total ___ kW; cooled by water
YOKE/POLE area ___ %; θ sec (Sect Mag) ___ deg
TOTAL POWER, installed ___ MW
normal load ___ MW

ION SOURCE, int Ion-heated Cath. Pig
ext ___

ACCELERATION SYSTEM

DEES, number 2 , width 120 deg
BEAM APERTURE 2 cm; DC BIAS 1.5 kV
TUNED by, coarse MS , fine VC-Trimmer
RF 12 to 25 MHz, stable ± 100 /10^6
Orb F 12 to 25 Mc/s, GAIN Max 60 kV/t
HARMONICS, RF/OF, used ___
DEE-Gnd, max 30 kV, x/field, min ___ cm,
STABILITY, (pk-pk noise)/(pk RF volt) ___
RF PHASE stable to ± ___ deg
RF POWER input, max 29 kW
RF PROTECT curcuit, speed ___ μs
type ___
EXTRACT System DC Electrostatic with compensated - iron channel

FREQUENCY MODULATION, rate ___ /sec
MODULATOR, type ___
BEAM PULSE, width ___ nsec

SELECTED REFERENCES

In AIP Conference Proceedings #9, 1972
1. Compact cyclotron engineering for application - G.O. Hendry p. 616-626
2. The ACRH Cyclotron - P.V. Harper et.al. p. 627-637.
3. Design of a Neutron Therapy Facility for a 30-inch cyclotron - F.T. Kuchnir et. al. p. 638-645

Tuning limit

ENTRY NO. 83 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P	15	14.8
	D	8	8.3
	$^3He^{++}$	20	20.3
CURRENT		(μA)	(μA)
Internal	P	100	110
	D	100	490
	^3He	100	120
External	P	50	55
	D	50	270
	^3He	50	53
		(part/s)	(part/s)
Secondary	n		
HEAVIEST ion	ALPHA		

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width		RF deg		μA of		MeV	
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	55	%	270	μA of	8	MeV	D
Res, ΔE/E	1	%		μA of		MeV	
Emittance (mm-mrad)	50 axial, 50 radial		90%				

VACUUM norm 1 μtorr; PUMPDOWN time 2 hr

OPERATING PROGRAMS, time dist

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

OTHER FEATURES and OPERATION SUMMARY

1. ^3He recovery system for economical $^3He^{++}$ operation
2. Particle changes are made in 30 minutes
3. Targets may be irradiated internally or externally.
4. Two external target stations ; one for isotope, the other for neutron production.
5. External beams transport system includes two quadrupole doublets, one steering magnet, one switching magnet, and four collimators.

Typing limit

ENTRY NO. 84

NAME OF MACHINE University of Colorado Isochronous Cyclotron DATE July 1978
INSTITUTION University of Colorado, Nuclear Physics Laboratory
ADDRESS Boulder, Colorado 80309 USA

IN CHARGE J.J. Kraushaar, D.A. Lind REPORTED by A.B. Phillips

HISTORY AND STATUS

DESIGN, date 1956-57 MODEL tests 1957-59
ENG. DESIGN, date 1958-61
CONSTRUCTION, date 1960-62
FIRST BEAM date (or goal) 1962; full use 1963
MAJOR ALTERATIONS Added beam transport system
OPERATION, 105 hr/wk; On Target 82 hr/wk
TIME DIST., in house 99.5 %, outside 0.5 %
USERS' SCHEDULING CYCLE 2 - 4 weeks
COST, ACCELERATOR $1.55 x 10^6
COST, FACILITY, total $2.95 x 10^6
FUNDED BY DOE and State of Colorado

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 2
TECHNICIANS 3 CRAFTS 2
GRAD STUDENTS involved during year 0
OPERATED BY X Res staff or Operators
BUDGET, op & dev Included in research budgt.
FUNDED BY DOE and State of Colorado

RESEARCH STAFF, not included above

USERS, in house 12 outside 5
GRAD STUDENTS involved during year 15
RES. BUDGET, in house $1,151,000
FUNDED BY DOE, NIH, and State of Colo.

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 44 m^2
movable 12 m^2
TARGET STATIONS 7 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type Energy-loss
COMPUTER, model PDP-9, PDP-11
OTHER FACILITIES Isotope production; Irradiation, solid state; Biological; Neutron time-of-flight; Fast rabbit; Beam-swinger

REFERENCES/NOTES

1. J.J. Kraushaar, D.A. Lind, M.E. Rickey, and W.R. Smythe, European Organization for Nuclear Research (CERN) Report 63-19, p.31-38 (1963).

2. D.A. Lind, J.J. Kraushaar, W.R. Smythe, and M.E. Rickey, Nuclear Inst. & Meth. 18, 62-65 (1962).

typing limit

MAGNET

POLE FACE diameter 132 cm; R extraction 60 cm
GAP, min 12 cm; Field kG
max 21 cm; Field kG
AVERAGE FIELD at R ext 12.6 kG
} at 0.3 x 10^6 ampere turns
CURRENT STABILITY ± 10 parts/10^6; $B_{max}/\langle B\rangle$ 1.25
NUMBER OF SECTORS 4 ; SPIRAL, max 45 deg
POLE FACE COIL PAIRS: AVF 4 /sec;
Harmonic correction 1 pair
Rad grad 4 /sec or Circ coils
WEIGHT: Fe 85 U.S. tons; Coils 14 U.S. tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM Internal distilled water
POWER: Main coils 100 max, kW
Trimming coils 48 max, kW
YOKE/POLE AREA 130 %
SECTOR ANGLE (Sep Sec) --- deg
ION ENERGY (Bending limit) E/A = 36 q^2/A^2 MeV
(Focusing limit) E/A = 28 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3.2 cm; DC BIAS 0 kV
TUNED by, coarse move short fine auto VC
RF 6 to 21 mHz, stable ± 0.5 parts /10^6
Orb F 1.2 to 21 mHz; GAIN, max 150 kV/turn
HARMONICS, RF/Orb F, used 1 & 3
DEE-Gnd, max 85 kV, min gap 2.5 cm
STABILITY, (pk-pk noise)/(pk RF volt) 4 x 10^{-4}
RF PHASE stable to ± 0.72 deg
RF POWER input, max 75 kW
RF PROTECT circuit, speed 5 μsec
Type dee spark sensor
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size one 20-inch oil diffusion, one 10-inch oil diffusion
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM

Hooded arc, H_2O cooled Cu chimney, pulsing option

EXTRACTION SYSTEM

Electrostatic deflector, mag. channel

CONTROL SYSTEM

Manual

ENTRY NO. 84 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	10-30	0.3-28
	d	18	0.3-18
	^{3}He	45	16-44
	α	36	2-36
CURRENT		(μA)	(μA)
Internal	p		200
	^{3}He		100
	α		100
External	p		40
	^{3}He		20
	α		15
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	2 RF deg	5 μA of 23 MeV p
Phase Exc, max	2 RF deg	5 μA of 23 MeV p
Extract Eff	10-40 %	μA of MeV
Res, ΔE/E	0.05 %	5 μA of 23 MeV p
Emittance (mm-mrad)	5.08 axial, 1.83 radial	65% · 5 μA of 23 MeV p

OPERATING PROGRAMS, time dist

	%
Basic Nuclear Physics	95
Solid State Physics	---
Bio-Medical Applications	1
Isotope Production	1
Development	1
Applied Nuc. Science (Environment)	2

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Other features and Operation summary:

Hydrogen ion source can be pulsed by control electrode to eliminate beam bursts for time-of-flight measurements. This source has also been used to identify true single-turn extractions.

A beam-swinger capable of delivering beam from -90° to +135° on a fixed target supplies input for a fixed 90° energy-loss spectrometer. The spectrometer has a resolution $\Delta E/E = 5 \times 10^{-4}$ and uses a multi-wire proportional chamber. The beam-swinger also varies the scattering angle in experiments using long fixed flight paths of 9 and 30 meters for neutron time-of-flight.

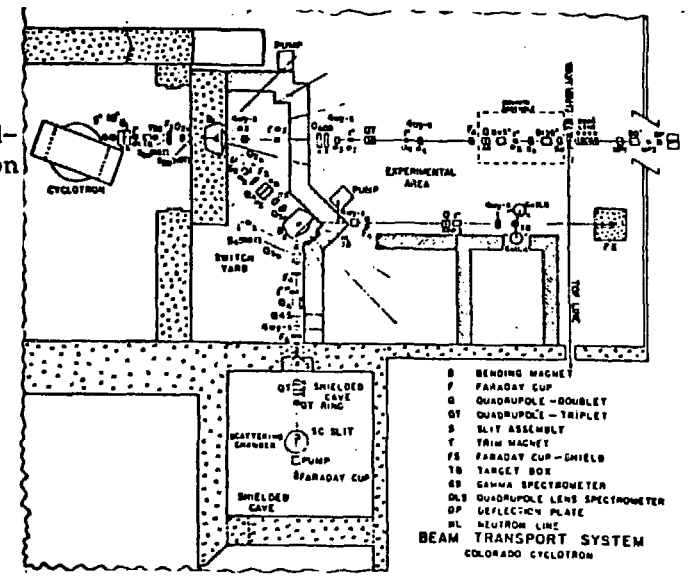
Selected references (continued)

3. D.A. Lind, M.E. Rickey, and B.M. Bardin, Nucl. Instr. & Meth. 18, 19, 129-134 (1962).

4. Rodman Smythe, Nucl. Instr. & Meth. 18, 19, 582 (1962).

5. Jon W. Osterlund and Rodman Smythe, IEEE Transaction on Nuclear Science NS-12, No. 3, 174 (1965).

6. R.F. Bentley, L.A. Erb, D.A. Lind, C.D. Zafiratos, and C.S. Zaidins, Nucl. Instr. & Meth. 83, 245 (1970).



typing limit

ENTRY NO. 85

NAME OF MACHINE University of Maryland Sectored Isochronous Cyclotron DATE 1/3/79
INSTITUTION University of Maryland, Department of Physics
ADDRESS College Park, Maryland 20742

IN CHARGE D. L. Hendrie REPORTED by D. A. Goldberg

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests 1966/67
ENG. DESIGN, date 1967
CONSTRUCTION, date 1967/8
FIRST BEAM date (or goal) Feb. 1970
MAJOR ALTERATIONS Rebuilt Trim Coils 1975
Rebuilt R-F Ground Returns 1978
OPERATION, 130 hr/wk; On Target 104 hr/wk
TIME DIST., in house 88 %, outside 12 %
USERS' SCHEDULING CYCLE ∿ 4wks. weeks
COST, ACCELERATOR $3.3 x 10^6
COST, FACILITY, total $8.5 x 10^5
FUNDED BY U.S.A.E.C. & State of Maryland

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2.5 ENGINEERS 3
TECHNICIANS 7 CRAFTS 3
GRAD STUDENTS involved during year 0
OPERATED BY 35% Res staff or 65% Operators
BUDGET, op & dev See Note (a)
FUNDED BY N.S.F. and Univ. of MD.

RESEARCH STAFF, not included above

USERS, in house 15 outside 16
GRAD STUDENTS involved during year 9
RES. BUDGET, in house See Note (a)
FUNDED BY National Science Foundation

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 1000 m^2
movable ____ m^2
TARGET STATIONS 7 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type n= 1/2, 1 meter
COMPUTER, model IBM 360/44
OTHER FACILITIES Two 5 meter scattering chambers, one 2.5 meter scattering chamber, neutron irradiation, helium jet, neutron time-of-flight.

REFERENCES/NOTES

(a) Total Operating & Research Budget 1979 = $980K
(b) Inner and Outer sets; 2 prs. each.

MAGNET

POLE FACE diameter 267 cm; R extraction 115 cm
GAP, min 18.4 cm; Field 18 kG } at 0.4 X 10^6 ampere turns
max 53.4 cm; Field 12 kG
AVERAGE FIELD at R ext 14 kG
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B\rangle$ 1.4
NUMBER OF SECTORS 4 ; SPIRAL, max 52 deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction See Note b
Rad grad: N/A /sec or Circ coils 16
WEIGHT: Fe 400 tons; Coils 5 tons
CONDUCTOR, Material and type copper
STORED ENERGY ∿ 2 MJ
COOLING SYSTEM Re-circ. deionized water
POWER: Main coils 400 (main)+400 (flutter) max, kW
Trimming coils 200 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) N/A deg
ION ENERGY (Bending limit) E/A = 180 q^2/A^2 MeV
(Focusing limit) E/A = 140 q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 90° deg
BEAM APERTURE 3 cm; DC BIAS 0 kV
TUNED by, coarse mov. panel fine same
RF 9.9 to 21.6 mHz, stable ± .1 /10^6
Orb F 3.8 to 21.6 mHz; GAIN, max 240 kV/turn
HARMONICS, RF/Orb F, used 1,2
DEE-Gnd, max 60 kV, min gap 4 cm
STABILITY, (pk-pk noise)/(pk RF volt) .3%
RF PHASE stable to ± 0.1 deg
RF POWER input, max 750 kW
RF PROTECT circuit, speed 2 μsec
Type Ignitron crowbar
FREQUENCY MODULATION, rate N/A /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size Two NRC HS32-32000
OPERATING PRESSURE 4 μTorr,
PUMPDOWN TIME 4 hrs

ION SOURCES/INJECTION SYSTEM

hot filament hooded arc

EXTRACTION SYSTEM Precessional; electrostatic defl. + mag. channel.

CONTROL SYSTEM

conventional

typing limit

ENTRY NO. 85 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	100	100
	^{4}He	140	165
	^{3}He	185	200
CURRENT		(μA)	(μA)
Internal	p		100
	^{4}He		20
	^{3}He		10
External	p		5
	^{4}He		3
	^{3}He		3
		(part/s)	(part/s)
Secondary			

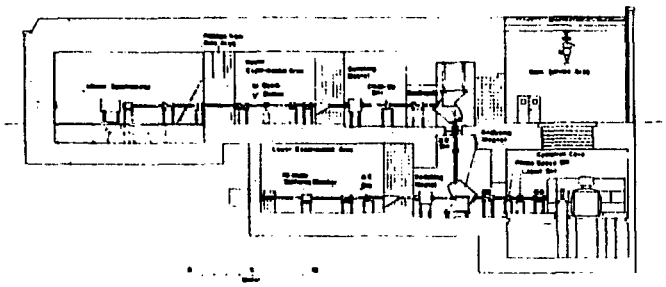
BEAM PROPERTIES

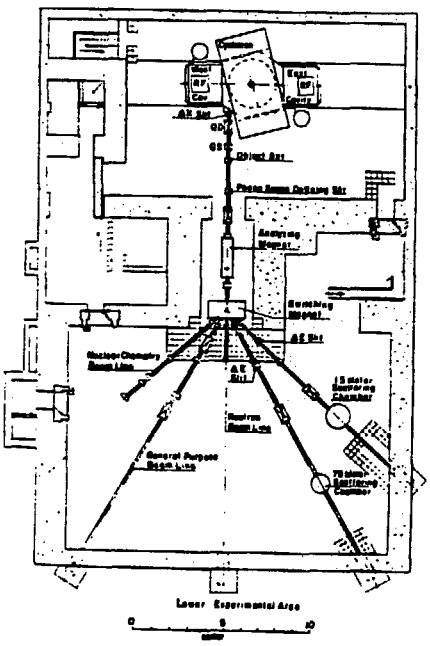
	Measured		Conditions
Pulse Width	12	RF deg	μA of 100 MeV p
Phase Exc, max	±5	RF deg	μA of 100 MeV p
Extract Eff	90	%	μA of 100 MeV p
Res, ΔE/E	.2	%	μA of 100 MeV p
Emittance (mm-mrad)	< 25 axial, < 10 radial		μA of 100 MeV p

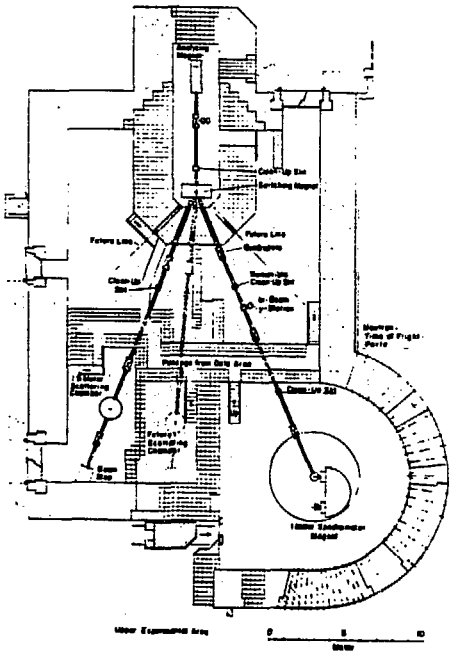
OPERATING PROGRAMS, time dist

Basic Nuclear Physics	87.5 %
Solid State Physics	%
Bio-Medical Applications	2 %
Isotope Production	%
Development	9 %
Atomic Physics 1.5	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES







typing limit

ENTRY NO. 87

NAME OF MACHINE University of Washington 60 inch Cyclotron DATE 8/14/78
INSTITUTION University of Washington
ADDRESS Seattle, Washington 98195

IN CHARGE William G. Weitkamp REPORTED by William G. Weitkamp

HISTORY AND STATUS

DESIGN, date 1947* MODEL tests
ENG. DESIGN, date
CONSTRUCTION, date 1948
FIRST BEAM date (or goal) July 1951
MAJOR ALTERATIONS

OPERATION, 40 hr/wk; On Target 20 hr/wk
TIME DIST., in house 2 %, outside 98 %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR $500,000 (1950)
COST, FACILITY, total $900,000 (1950)
FUNDED BY State of Washington, Office of Naval Research, U.S. Atomic Energy Commission

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS
TECHNICIANS 1 CRAFTS 1/2
GRAD STUDENTS involved during year 0
OPERATED BY Res staff or 1 Operators
BUDGET, op & dev $50,000
FUNDED BY Income from user charges

RESEARCH STAFF, not included above

USERS, in house 2 outside 20
GRAD STUDENTS involved during year 1
RES. BUDGET, in house Variable
FUNDED BY U.S. Department of Energy

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 300 m^2
movable m^2
TARGET STATIONS 1 in 1 rooms
STATIONS served at same time, max
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES

REFERENCES/NOTES

*F.H. Schmidt, G.W. Farwell, J.E. J.E. Henderson, T.J. Morgan and J.F. Streib, Rev. Sci. Instrum. 25, 499 (1954)

MAGNET

POLE FACE diameter 152 cm; R extraction 63 cm
GAP, min 25 cm; Field kG
max cm; Field kG
AVERAGE FIELD at R ext 15 kG
} at 0.36×10^6 ampere turns
CURRENT STABILITY 100 parts/10^6; $B_{max}/(B)$
NUMBER OF SECTORS -- ; SPIRAL, max deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction
Rad grad /sec or Circ coils
WEIGHT: Fe 200 tons; Coils 18 tons
CONDUCTOR, Material and type copper bar
STORED ENERGY MJ
COOLING SYSTEM oil/water
POWER: Main coils 160 max, kW
Trimming coils -- max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) -- deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg
BEAM APERTURE 3-10 cm; DC BIAS kV
TUNED by, coarse shorting stubs fine Variable Vac. capacitor
RF -- to 11.5 mHz, stable ± /10^6
Orb F to 11.5 mHz; GAIN, max 250 kV/turn
HARMONICS, RF/Orb F, used --
DEE-Gnd, max 110 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max 125 kW
RF PROTECT circuit, speed -- μsec
Type
FREQUENCY MODULATION, rate -- /sec
MODULATOR, type --
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 1 DPI MC-7000 20 in. MCF 1400 MCF 700
OPERATING PRESSURE 50 μTorr,
PUMPDOWN TIME 1 1/2 hrs

ION SOURCES/INJECTION SYSTEM

Internal PIG source

EXTRACTION SYSTEM

Electrostatic deflector- RF Combination

CONTROL SYSTEM

Conventional

typing limit

ENTRY NO. 87 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		11.5
	d		21
	α		42
CURRENT		(μA)	(μA)
Internal	p		100
target	d		150
	α		30
External	p		1
scattering	d		1
chamber	α		1
		(part/s)	(part/s)
Secondary	--		

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	____	RF deg	____	μA of	____	MeV ____
Phase Exc, max	____	RF deg	____	μA of	____	MeV ____
Extract Eff	____	%	____	μA of	____	MeV ____
Res, ΔE/E	____	%	____	μA of	____	MeV ____
Emittance (mm-mrad)	____ axial / ____ radial		____	μA of	____	MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	2 %
Solid State Physics	-- %
Bio-Medical Applications	98 %
Isotope Production	%
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 88

NAME OF MACHINE Wash. Univ. Sector Focused Cyclotron DATE 7/19/78
INSTITUTION Washington University
ADDRESS St. Louis, Mo.

IN CHARGE J.T. Hood, Director
E. S. Macias, Director

REPORTED by J. T. Hood

HISTORY AND STATUS

DESIGN, date 1960 MODEL tests 1961-62
ENG. DESIGN, date 1961-63
CONSTRUCTION, date 1962-65
FIRST BEAM date (or goal) 1965
MAJOR ALTERATIONS none

OPERATION, 25 hr/wk; On Target 25 hr/wk
TIME DIST., in house 100 %, outside ____ %
USERS' SCHEDULING CYCLE 1 weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY AFOSR, NSF

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2
TECHNICIANS 1 CRAFTS 1
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or x Operators
BUDGET, op & dev ____
FUNDED BY Washington University

RESEARCH STAFF, not included above

USERS, in house 6 outside ____
GRAD STUDENTS involved during year 6
RES. BUDGET, in house ____
FUNDED BY NIH, EPA, NSF, ERDA

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 100 m^2
movable ____ m^2
TARGET STATIONS 6 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type ____
COMPUTER, model ____
OTHER FACILITIES ____

REFERENCES/NOTES

1. J. T. Hood, R. A. Goldworm, E. S. Macias and D.G. Sarentites, Nuclear Inst. and Meth. 119, 213-215 (1974).
2. E. S. Macias, R. E. Head, H.-C. Hseuh and M. R. Zalutsky, Nuc. Inst. and Meth. 122, 365-368 (1974).

typing limit

MAGNET

POLE FACE diameter 137 cm; R extraction 54.5 cm
GAP, min 14.8 cm; Field 17.8 kG
max 33.8 cm; Field 10.3 kG
AVERAGE FIELD at R ext 14 kG
} at 46 x 10^6 ampere turns
CURRENT STABILITY 20 parts/10^6; $B_{max}/\langle B \rangle$ ____
NUMBER OF SECTORS 3 ; SPIRAL, max low deg
POLE FACE COIL PAIRS: AVF ____ /sec;
Harmonic correction 4/ Sec.
Rad grad ____ /sec or Circ coils 5
WEIGHT: Fe 82 tons; Coils 12 tons
CONDUCTOR, Material and type Cu. Strap
STORED ENERGY ____ MJ
COOLING SYSTEM Oil
POWER: Main coils 120 max, kW
Trimming coils 60 max, kW
YOKE/POLE AREA ____ %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3.2 cm; DC BIAS 0 kV
TUNED by, coarse MS fine VC, Auto
RF 7 to 16 mHz, stable ± 1 /10^6
Orb F 7 to 16 mHz; GAIN, max 120 kV/turn
HARMONICS, RF/Orb F, used ____
DEE-Gnd, max 60 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) ____
RF PHASE stable to ± ____ deg
RF POWER input, max 100 kW
RF PROTECT circuit, speed ____ μsec
Type Plate Overload
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size 2-Oil Diffusion
Twenty and Seven Inch
OPERATING PRESSURE 20 μTorr,
PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM

EXTRACTION SYSTEM
Electrostatic & Magnetic Channel

CONTROL SYSTEM

ENTRY NO. 88 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	α		12-30
	^{3}He		9-37
	p		12
	d		15
CURRENT		(μA)	(μA)
Internal			
External	d		50
	^{3}He		25
	p		20
		(part/s)	(part/s)
Secondary	n		3×10^8/cm^2

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	____	RF deg	____	μA of	____	MeV ____
Phase Exc, max	____	RF deg	____	μA of	____	MeV ____
Extract Eff	____	%	____	μA of	____	MeV ____
Res, ΔE/E	____	%	____	μA of	____	MeV ____
Emittance (mm-mrad)	____ axial / ____ radial		____	μA of	____	MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	25	%
Solid State Physics		%
Bio-Medical Applications	50	%
Isotope Production		%
Development		%
Sample Analysis	25	%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Conversion of 45 inch FF machine.
Provision for reciprocating water cooled target vertically through beam.
Heavy ion source.
Beam pulses ≥ 0.5 μs with adjustable "off interval" available.
Helium-jet recoils transfer system.

typing limit

ENTRY NO. 89

NAME OF MACHINE W. U. Medical School Cyclotron II DATE 7/19/78
INSTITUTION Wash. Univ. Medical School, Barnard Hospital
ADDRESS St. Louis, Mo. USA 63110

IN CHARGE J.T. Hood, Director REPORTED by J.T. Hood
M.M. Ter-Pogossian, Prof. of Radiation Sciences

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date Cyc. Corp. CS-15
CONSTRUCTION, date _____
FIRST BEAM date (or goal) June 1978
MAJOR ALTERATIONS _____

OPERATION, _____ hr/wk; On Target _____ hr/wk
TIME DIST., in house _____ %, outside _____ %
USERS' SCHEDULING CYCLE _____ weeks
COST, ACCELERATOR $650,000.00
COST, FACILITY, total $900,000.00
FUNDED BY NIH (Heart and Lung)

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 2 CRAFTS 2
GRAD STUDENTS involved during year _____
OPERATED BY _____ Res staff or X Operators
BUDGET, op & dev _____
FUNDED BY NIH

RESEARCH STAFF, not included above

USERS, in house 6 outside _____
GRAD STUDENTS involved during year 2
RES. BUDGET, in house _____
FUNDED BY NIH

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed _____ m^2
movable _____ m^2
TARGET STATIONS 3 in 1 rooms
STATIONS served at same time, max _____
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 81 cm; R extraction 35 cm
GAP, min _____ cm; Field _____ kG
max _____ cm; Field _____ kG
AVERAGE FIELD at R ext 16.5 kG
} at _____ X 10^6 ampere turns
CURRENT STABILITY _____ parts/10^6; $B_{max}/\langle B \rangle$ _____
NUMBER OF SECTORS 3 ; SPIRAL, max _____ deg
POLE FACE COIL PAIRS: AVF _____ /sec;
Harmonic correction _____
Rad grad _____ /sec or Circ coils _____
WEIGHT: Fe _____ tons; Coils _____ tons
CONDUCTOR, Material and type Al. Ribbon
STORED ENERGY _____ MJ
COOLING SYSTEM Water
POWER: Main coils 60 max, kW
Trimming coils _____ max, kW
YOKE/POLE AREA _____ %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 120 deg
BEAM APERTURE _____ cm; DC BIAS _____ kV
TUNED by, coarse short fine _____
RF 12 to 25 mHz, stable ± _____ /10^6
Orb F _____ to _____ mHz; GAIN, max _____ kV/turn
HARMONICS, RF/Orb F, used _____
DEE-Gnd, max _____ kV, min gap _____ cm
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max _____ kW
RF PROTECT circuit, speed 40 μsec
Type Crowbar
FREQUENCY MODULATION, rate _____ /sec
MODULATOR, type _____
BEAM PULSE, width _____

VACUUM SYSTEM

PUMPS, No., Type, Size 1-Oil Diffusion -10 Inch
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 1/2 hrs

ION SOURCES/INJECTION SYSTEM

Penning

EXTRACTION SYSTEM

Electrostatic & Magnetic Channel

CONTROL SYSTEM

typing limit

ENTRY NO. 89 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		15
	d		8
	α		16
	^{3}He		20
CURRENT		(μA)	(μA)
Internal	p		150
	d		250
	^{3}He		135
External	p		50
	d		75
	^{3}He		50
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff		%		μA of		MeV
Res, ΔE/E	1	%		μA of		MeV
Emittance (mm-mrad)	50 axial / 50 radial			μA of		MeV

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 90

Kazachstan

NAME OF MACHINE Variable Energy Isochronous Cyclotron DATE Nov. 1973

INSTITUTION Institute of Nuclear Physics

ADDRESS Alma-Ata, Kazach SR, USSR

A. A. Arzumanov

IN CHARGE L. M. Nemenov REPORTED by A. A. Arzumanov

HISTORY AND STATUS

DESIGN, date 1966 MODEL tests 1966-1968

ENG. DESIGN, date 1967-69

CONSTRUCTION, date 1970-71

FIRST BEAM date (or goal) September 1971

MAJOR ALTERATIONS See below

OPERATION, 160 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 ____

GRAD STUDENTS involved during year ____

OPERATED BY ____ Res staff or ____ Operators

BUDGET, op & dev ____

FUNDED BY ____

RESEARCH STAFF, not included above

USERS, in house ____ outside ____

GRAD STUDENTS involved during year ____

RES. BUDGET, in house ____

FUNDED BY ____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ____ m^2

movable ____ m^2

TARGET STATIONS ____ in ____ rooms

STATIONS served at same time, max ____

MAG SPECTROGRAPH, type ____

COMPUTER, model ____

OTHER FACILITIES ____

REFERENCES/NOTES

L.M. Nemenov, A.A. Arzumanov, and P.A. Bersenev, IEEE Trans. Nucl. Sci., NS-13, 4 (1966) 411.

A. A. Arzumanov, L.M. Nemenov, Nucl. Inst. and Meth. 106 (1973) 201.

* MS - moving short circuit;
VC - variable capacitor

typing limit

MAGNET

POLE FACE diameter 150 cm; R extraction 66.5 cm

GAP, min 21 cm; Field 20 kG
max 35 cm; Field 12 kG
} at ____ X 10^6 ampere turns

AVERAGE FIELD at R ext 16.2 kG

CURRENT STABILITY ____ parts/10^6; $B_{max}/\langle B \rangle$ ____

NUMBER OF SECTORS 3 ; SPIRAL, max low deg

POLE FACE COIL PAIRS: AVF ____ /sec;

Harmonic correction 2

Rad grad ____ /sec or Circ coils 9

WEIGHT: Fe ____ tons; Coils ____ tons

CONDUCTOR, Material and type ____

STORED ENERGY ____ MJ

COOLING SYSTEM water

POWER: Main coils 300 max, kW

Trimming coils 50 max, kW

YOKE/POLE AREA ____ %

SECTOR ANGLE (Sep Sec) ____ deg

ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV

(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg

BEAM APERTURE 7 cm; DC BIAS ____ kV

TUNED by, coarse MS* fine VC auto *

RF 8.5 to 19.0 mHz, stable ± ____ /10^6

Orb F 8.5 to 19.0 mHz; GAIN, max 320 kV/turn

HARMONICS, RF/Orb F, used ____

DEE-Gnd, max 80 kV, min gap ____ cm

STABILITY, (pk-pk noise)/(pk RF volt) ____

RF PHASE stable to ± ____ deg

RF POWER input, max ____ kW

RF PROTECT circuit, speed ____ μsec

Type ____

FREQUENCY MODULATION, rate ____ /sec

MODULATOR, type ____

BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size ____

OPERATING PRESSURE ____ μTorr,

PUMPDOWN TIME ____ hrs

ION SOURCES/INJECTION SYSTEM

Hot filament, hooded

EXTRACTION SYSTEM

Radially focusing dc deflector,

CONTROL SYSTEM magnetic channel

ENTRY NO. 90 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		6-30
	^{3}He		19-62
	α		
CURRENT		(μA)	(μA)
Internal	p		200
	^{3}He		20
	α		40
External	p		30
	^{3}He		10
	α		20
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	60	%		μA of		MeV
Res, ΔE/E	0.6	%		μA of		MeV

Emittance (mm-mrad) { 16 axial, 16 radial } 15 μA of 30 MeV p

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Features:

Conversion of 150 cm FF machine.
Two puller slits with moveable slit in central region for phase defining.
Circular coils in separate vacuum box.
^{3}He recovery system.

typing limit

ENTRY NO. 91

NAME OF MACHINE Electron Model, Relativistic RingCyclot. DATE August, 1973
INSTITUTION Joint Institute for Nuclear Research, Lab. Nucl. Probl.
ADDRESS JINR, Head Post Office, POB 79, Moscow, USSR

IN CHARGE Prof. V. P. DZHELEPOV REPORTED by Prof. V. P. DZHELEPOV

HISTORY AND STATUS

DESIGN, date 1964 MODEL tests 1964-66
ENG. DESIGN, date 1966-67
CONSTRUCTION, date 1967
FIRST BEAM date (or goal) 1967
MAJOR ALTERATIONS 1974, 1977

OPERATION, 25 hr/wk; On Target ____ hr/wk
TIME DIST., in house 100 %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY ____

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2
TECHNICIANS 2 CRAFTS 2
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or ____ Operators
BUDGET, op & dev ____
FUNDED BY ____

RESEARCH STAFF, not included above

USERS, in house 14 outside ____
GRAD STUDENTS involved during year ____
RES. BUDGET, in house ____
FUNDED BY JINR

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS ____ in ____ rooms
STATIONS served at same time, max ____
MAG SPECTROGRAPH, type ____
COMPUTER, model ____
OTHER FACILITIES ____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 240 cm; R extraction 101 cm
GAP, min 8 cm; Field ____ kG } at ____ X 10^6 ampere turns
max 8 cm; Field ____ kG
AVERAGE FIELD at R ext 24 kG
CURRENT STABILITY 100 parts/10^6; $B_{max}/\langle B \rangle$ 2.06
NUMBER OF SECTORS 8 ; SPIRAL, max 60 deg
POLE FACE COIL PAIRS: AVF ____ /sec;
Harmonic correction ____
Rad grad ____ /sec or Circ coils ____
WEIGHT: Fe ____ tons; Coils ____ tons
CONDUCTOR, Material and type Cu
STORED ENERGY ____ MJ
COOLING SYSTEM H_2O
POWER: Main coils 80 max, kW
Trimming coils 20 max, kW
YOKE/POLE AREA ____ %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 45 deg
BEAM APERTURE 2 cm; DC BIAS ____ kV
TUNED by, coarse MS fine VC, auto
RF 39.5 to ____ mHz, stable ± 5 /10^6
Orb F 39.5 to ____ mHz; GAIN, max 2 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max ____ kV, min gap 2 cm
STABILITY, (pk-pk noise)/(pk RF volt) 5×10^{-2}
RF PHASE stable to ± 5 deg
RF POWER input, max 40 kW
RF PROTECT circuit, speed ____ μsec
Type ____
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size 9 diffusion pumps

OPERATING PRESSURE 1 μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

Electron injector (6 keV)

EXTRACTION SYSTEM

closed orbit expansion

CONTROL SYSTEM

typing limit

ENTRY NO. 91 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	e	0.4	
CURRENT		(μA)	(μA)
Internal		1000	
External			
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	20	RF deg	10^2 μA of	0.4	MeV	
Phase Exc, max		RF deg	μA of		MeV	
Extract Eff	100	%	μA of		MeV	
Res, ΔE/E		%	μA of		MeV	
Emittance (mm-mrad)	axial / radial		μA of		MeV	

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. 92

NAME OF MACHINE U-200
INSTITUTION Joint Institute for Nuclear Research
LOCATION Dubna, USSR DATE 1972, same for 1975

IN CHARGE G. N. Flerov* REPORTED by same

HISTORY AND STATUS

DESIGN, date 1966 MODEL tests ---
ENG. DESIGN, date 1966-1967
CONSTRUCTION, date 1966-1967
FIRST BEAM date (or goal) int. 1968; ext. 1968
MAJOR ALTERATIONS none
OPERATION, 120 hr/wk; On Target 84 hr/wk
TIME DIST., in house 100 %, 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 operators
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 225 m^2
movable ___ m^2
TARGET STATIONS 4 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max 1
MAG SPECTROGRAPH, type ___
ON-LINE COMPUTER, model ___
FACILITIES for:
Isotope production ___
Irradiation, Solid State ___
Biological ___
Time-of-Flight Study ___
On-Line Mass Separation ___

NOTATIONS

MAGNET

POLE FACE dia 200 cm; R ext 90 cm
GAP, min 3 cm; Field 26 kG
max 15 cm; Field 14 kG } at 059 × 10^6 A-turns
AVE FIELD at R max 20 kG
CURRENT STABILITY ± 100 parts/10^6
B max/<B> 1.3
AVF SECTORS 4 SPIRAL, max --- deg
POLE FACE coil pairs, AVF ___ /sec
Harmonic 4 /sec; Rad Grad --- /sec, or
7 circular; HEAVY ION, E max = 156 q^2/A
WEIGHT, Fe 220, Cu, or Al 11.5 tons
POWER, main coils 350, pole tips 20
total 370 kW; cooled by H_2O
YOKE/POLE area 130 %; θ sec (Sect Mag) ___ deg
TOTAL POWER, installed 1.9 MW
normal load 0.8 MW
ION SOURCE, int arc type with heated cathode
ext ---

ACCELERATION SYSTEM

DEES, number 2, width 45 deg
BEAM APERTURE 2.8 cm; DC BIAS 0 kV
TUNED by, coarse MS, fine ___
RF 12 to 21.5 MHz, stable ± 10 /10^6
Orb F 3 to 10.7 Mc/s; GAIN 275 kV/t
HARMONICS, RF/OF, used 2,3
DEE-Gnd, max 75 kV, x/field, min ___ cm,
STABILITY, (pk-pk noise)/(pk RF volt) ___
RF PHASE stable to ± ___ deg
RF POWER input, max 100 kW
RF PROTECT curcuit, speed ___ μs
type ___
EXTRACT System stripping and dc electrostatic

SELECTED REFERENCES

IEEE Trans.Nucl.Sci. NS-16, No.3, 802, (1969).

*as per cablegram 5/14/75

Typing limit

ENTRY NO. 92 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	$^{4}He^{1+}$	39	36.5
	$^{12}C^{4+}$	208	198
	$^{136}Xe^{30+}$	950	900
		(μA)	(μA)
CURRENT Internal	$^{4}He^{1+}$		≤ 600
	$^{12}C^{3+}$		60
External	α		60
	$^{12}C^{3+}$		60
		(part/s)	(part/s)
Secondary			
HEAVIEST ion	$^{136}Xe^{30+}$		$2 \cdot 10^{10}$

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	90–100	%	60	μA of	109	MeV $^{12}C^{3+}$
Res, ΔE/E	1	%	60	μA of	365	MeV α
Emittance (mm·mrad)	28 axial, 70 radial		5	μA of	36.5	MeV α

VACUUM norm 0.4; 1.0 μtorr; PUMPDOWN time 1 to 6 hr

OPERATING PROGRAMS, time dist

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

OTHER FEATURES and OPERATION SUMMARY

Typing limit

ENTRY NO. 93

NAME OF MACHINE U-300
INSTITUTION Joint Institute for Nuclear Research
LOCATION Dubna, USSR DATE 1972, same for 1975 **

IN CHARGE G. N. Flerov* REPORTED by same

HISTORY AND STATUS

DESIGN, date 1955 MODEL tests ---
ENG. DESIGN, date 1956-1958
CONSTRUCTION, date 1956- 1959
FIRST BEAM date (or goal) int.1960; ext.1965
MAJOR ALTERATIONS none
OPERATION, 150 hr/wk; On Target 120 hr/wk
TIME DIST., in house 95 %, outside 5 %
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 operators
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 10 in 7 ROOMS
STATIONS SERVED AT THE SAME TIME, max 1
MAG SPECTROGRAPH, type ____
ON-LINE COMPUTER, model ____
FACILITIES for:
Isotope production ____
Irradiation, Solid State ____
Biological ____
Time-of-Flight Study ____
On-Line Mass Separation ____

NOTATIONS

MAGNET

POLE FACE dia 310 cm; R ext 138 cm
GAP, min --- cm; Field --- kG
max 54 cm; Field --- kG } at 0.9 x 10^6 A-turns
AVE FIELD at R max 16.7 kG
CURRENT, STABILITY ± 100 parts/10^6
B max/<B> = 1.0
AVF SECTORS --- SPIRAL, max --- deg
POLE FACE coil pairs, AVF --- /sec
Harmonic 4 /sec; Rad Grad --- /sec, or
--- circular; HEAVY ION, E max = 250 q^2/A
WEIGHT, Fe 2090, Cu, or Al 101 tons
POWER, main coils 500, pole tips 10
total 510 kW; cooled by H_2O
YOKE/POLE area 210 %; θ sec (Sect Mag) ____ deg
TOTAL POWER, installed 2.2 MW
normal load 1.0 MW
ION SOURCE, int arc type with heated cathode
ext ---

ACCELERATION SYSTEM

DEES, number 2, width 180 deg
BEAM APERTURE 4-14 cm; DC BIAS 0 kV
TUNED by, coarse MS, fine ____
RF 3 to 6 MHz, stable ± 100 /10^6
Orb F 1.5 to 5.6 Mc/s; GAIN 600 kV/t
HARMONICS, RF/OF, used 1,3
DEE-Gnd, max 150 kV, x/field, min ____ cm,
STABILITY, (pk-pk noise)/(pk RF volt) ____
RF PHASE stable to ± ____ deg
RF POWER input, max 250 kW
RF PROTECT curcuit, speed ____ μs
type ____
EXTRACT System dc electrostatic with magnetic channel

SELECTED REFERENCES

Nucl.Instr.Meth. 93, 3, 557 (1971)

*as per cablegram 5/14/75
**Being converted to U-400, K = 625
First operation expected 1979.

Typing limit

ENTRY NO. 93 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	$^{12}C^{2+}$		83
	$^{22}Ne^{4+}$		182
	$^{40}Ar^{7+}$		305
CURRENT		(μA)	(μA)
Internal	$^{11}B^{2+}$		200
	$^{12}C^{2+}$		200
External	$^{22}Ne^{4+}$		50
	$^{31}P^{6+}$		15
	$^{40}Ar^{7+}$		3
		(part/s)	(part/s)
Secondary	$^{136}Xe^{9+}$		$3 \cdot 10^{12}$
HEAVIEST ion	$^{184}W^{12+}$		10^{10}

OTHER FEATURES and OPERATION SUMMARY

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	____ RF deg	____ μA of	____ MeV	____	
Phase Exc, max	____ RF deg	____ μA of	____ MeV	____	
Extract Eff	25–35 %	50 μA of	182 MeV	$^{22}Ne^{4+}$	
Res, ΔE/E	0.4–0.5 %	____ μA of	____ MeV	____	
Emittance (mm·mrad)	30 axial, 80 radial	10 μA of	83 MeV	$^{12}C^{2+}$	

VACUUM norm 2 μtorr; PUMPDOWN time 10 hr

OPERATING PROGRAMS, time dist

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

Typing limit

ENTRY NO. 95

NAME OF MACHINE Kiev Isochronous Cyclotron DATE April, 1978
INSTITUTION Institute Nuclear Research, Academy of Science UkSSR
ADDRESS USSR Kiev 252028, Prospect Nauky, 119.

IN CHARGE O.F.Nemets REPORTED by A.F.Liney

HISTORY AND STATUS

DESIGN, date 1965-70 MODEL tests 1963-66
ENG. DESIGN, date 1966-1972
CONSTRUCTION, date 1966-1973
FIRST BEAM date (or goal) March 1976
MAJOR ALTERATIONS

OPERATION, 120 hr/wk; On Target 100 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
GRAD STUDENTS involved during year
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USERS, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 1000 m^2
movable 1200 m^2
TARGET STATIONS 16 in 6 rooms
STATIONS served at same time, max
MAG SPECTROGRAPH, type
COMPUTER, model
OTHER FACILITIES

REFERENCES/NOTES

Proceedings of Internation Cyclotron Conference, Vacouver, Canada, 87(1972).

Proceedings 5th All-Union Conf. Charged-Particle Accelerators, "Nauka", Moscow, v.11, 338(1977).

MAGNET

POLE FACE diameter 240 cm; R extraction 103 cm
GAP, min 232 cm; Field 23.0 kG
max 532 cm; Field 11.2 kG
AVERAGE FIELD at R ext 17.0 kG
} at 0.83 x 10^6 ampere turns
CURRENT STABILITY 30 parts/10^6; $B_{max}/(B)$ 1.35
NUMBER OF SECTORS 3 ; SPIRAL, max 45 deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction 3 per sector
Rad grad /sec or Circ coils 15
WEIGHT: Fe 650 tons; Coils 83.5 Cu tons
CONDUCTOR, Material and type Cupruous
STORED ENERGY MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 200 max, kW
Trimming coils 800 max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 140 q^2/A^2 MeV
(Focusing limit) E/A = 100 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 5 cm; DC BIAS 0 kV
TUNED by, coarse MS fine VC, auto
RF 7.5 to 22.5 mHz, stable ± 0.01 /10^6
Orb F 2.5 to 22.5 mHz; GAIN, max 250 kV/turn
HARMONICS, RF/Orb F, used 1, 3
DEE-Gnd, max 125 kV, min gap 5 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.0001
RF PHASE stable to ± deg
RF POWER input, max 450 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion pumps (50 cm)
OPERATING PRESSURE 5 μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

Heated Cathode

EXTRACTION SYSTEM dc electrostatic with compensated magnetic channel and iron channel
CONTROL SYSTEM

typing limit

ENTRY NO. 95 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P	100	72
	d	70	64
		140	128
CURRENT		(μA)	(μA)
Internal	P	100	100
External	P	50	10
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

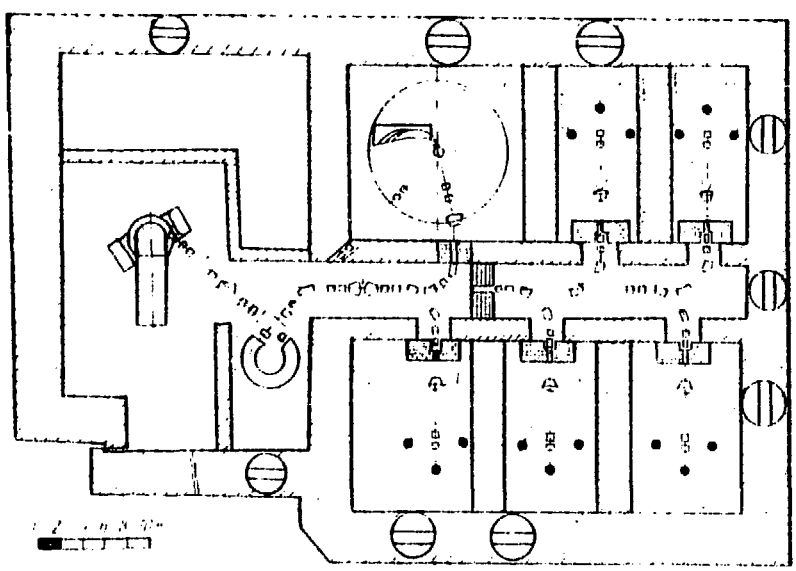
	Measured		Conditions			
Pulse Width	15	RF deg	5	μA of	50	MeV
Phase Exc. max		RF deg		μA of		MeV
Extract Eff	60	%	5	μA of	50	MeV
Res. ΔE/E	0.3	%	5	μA of	50	MeV
Emittance (mm-mrad)	10 axial, 12 radial		2	μA of	50	MeV

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

1. The valley coil will operate at $E_p > 80$ MeV.
2. The cyclotron is intended to be as a pulsed neutron generator.
3. It is supposed to accelerate heavy ions (up to Xe) after the pre-acceleration in the tandem-generator.
4. The source of polarized and deutrons will be desingned and installed.



typing limit

ENTRY NO. FM-1

NAME OF MACHINE The Buenos Aires 180 cm Synchrocyclotron DATE 12-18-78
INSTITUTION Comision Nacional Energia Atomica
ADDRESS Av. Libertador, 8250 Buenos Aires, Argentina

IN CHARGE A. Cevallos REPORTED by N. A. Fazzini

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date 1952
FIRST BEAM date (or goal) November 1954
MAJOR ALTERATIONS 1968

OPERATION, 90 hr/wk; On Target 80 hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE - weeks
COST, ACCELERATOR 10^6 dollars
COST, FACILITY, total 2×10^6 dollars
FUNDED BY Comision Nacional Energia Atomica (C.N.E.A.)

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 4
TECHNICIANS 6 CRAFTS 1
GRAD STUDENTS involved during year 2
OPERATED BY CNEA Res staff or _____ Operators
BUDGET, op & dev $50,000
FUNDED BY CNEA

RESEARCH STAFF, not included above

USERS, in house 10 outside 3
GRAD STUDENTS involved during year 4
RES. BUDGET, in house $60,000
FUNDED BY CNEA

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed One 17 m^2
movable - m^2
TARGET STATIONS 2 in one rooms
STATIONS served at same time, max one
MAG SPECTROGRAPH, type -
COMPUTER, model -
OTHER FACILITIES
Internal beam

REFERENCES/NOTES

MAGNET

POLE FACE diameter 180 cm; R extraction 76 cm
GAP, min - cm; Field - kG
max 35.5 cm; Field 14.4 kG
AVERAGE FIELD at R ext kG
} at - $\times 10^6$ ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ -
NUMBER OF SECTORS - ; SPIRAL, max - deg
POLE FACE COIL PAIRS: AVF - /sec;
Harmonic correction -
Rad grad - /sec or Circ coils -
WEIGHT: Fe 180 tons; Coils 9 tons
CONDUCTOR, Material and type Al
STORED ENERGY - MJ
COOLING SYSTEM Water
POWER: Main coils 220 max, kW
Trimming coils - max, kW
YOKE/POLE AREA - %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = - q^2/A^2 MeV
(Focusing limit) E/A = - q/A MeV

ACCELERATION SYSTEM

DEES, number One angle 180 deg
BEAM APERTURE 10 cm; DC BIAS - 0.5 kV
TUNED by, coarse - fine -
RF 10.1 to 10.5 mHz, stable ± 10 /10^6
Orb F - to - mHz; GAIN, max 19 kV/turn
HARMONICS, RF/Orb F, used -
DEE-Gnd, max 12 kV, min gap 10 cm
STABILITY, (pk-pk noise)/(pk RF volt) -
RF PHASE stable to ± - deg
RF POWER input, max 29 kW
RF PROTECT circuit, speed - μsec
Type -
FREQUENCY MODULATION, rate 2000 c/sec
MODULATOR, type rotating capacitor
BEAM PULSE, width 30 μsec

VACUUM SYSTEM

PUMPS, No., Type, Size 2, oil diffusion 5000 ℓ/sec and 12,000 ℓ/sec
OPERATING PRESSURE 19 μTorr,
PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM
arc and filament

EXTRACTION SYSTEM
Regenerative with magnetic channels

CONTROL SYSTEM
Conventional

typing limit

ENTRY NO. FM-1 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	d	28	27.2
	α	56	55
CURRENT			
Internal		(μA)	(μA)
	d	20	14
	α	4	3
External	d	0.030	0.020
	α	0.002	0.0013
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc. max		RF deg		μA of		MeV
Extract Eff		%		μA of		MeV
Res. ΔE/E	1	%		μA of		MeV

Emittance (mm-mrad) { 50 axial, 70 radial } 3 μA of 27 MeV d

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	80 %
Solid State Physics	- %
Bio-Medical Applications	10 %
Isotope Production	5 %
Development	5 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. FM-2

NAME OF MACHINE McGill Synchrocyclotron DATE July 5, 1978
INSTITUTION Foster Radiation Laboratory, McGill University
ADDRESS 3610 University St., Montreal, Quebec, Canada H3A 2B2

IN CHARGE Dr. S.K. Mark REPORTED by Dr. R.B. Moore

HISTORY AND STATUS

DESIGN, date 1945 MODEL tests None
ENG. DESIGN, date 1945
CONSTRUCTION, date 1947-49
FIRST BEAM date (or goal) 1949
MAJOR ALTERATIONS 1972, 1977 (Coils, Vacuum Chamber, RF System)
OPERATION, 120 hr/wk; On Target 100 hr/wk
TIME DIST., in house 80 %, outside 20 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR 200,000
COST, FACILITY, total 1,000,000
FUNDED BY Various

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 3 CRAFTS
GRAD STUDENTS involved during year None
OPERATED BY X Res staff or Operators
BUDGET, op & dev 250,000
FUNDED BY NRC (Canada)

RESEARCH STAFF, not included above

USERS, in house 12 outside 7
GRAD STUDENTS involved during year 15
RES. BUDGET, in house 400,000
FUNDED BY NRC (Canada), FCAC (Quebec)

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 200 m^2
movable - m^2
TARGET STATIONS Flexible in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type None
COMPUTER, model PDP-8, PDP-15, ADP-11/34
OTHER FACILITIES Two Pneumatic Rapid Extractors, Superconducting Beta Spectrometer, Chemistry Laboratory ISOL

REFERENCES/NOTES

MAGNET

POLE FACE diameter 229 cm; R extraction 91 cm
GAP, min 19 cm; Field 17 kG
max 20 cm; Field 16 kG
AVERAGE FIELD at R ext 16 kG
at 0.6 x 10^6 ampere turns
CURRENT STABILITY 500 parts/10^6; $B_{max}/\langle B \rangle$ N.A.
NUMBER OF SECTORS N.A.; SPIRAL, max N.A. deg
POLE FACE COIL PAIRS: AVF N.A. /sec;
Harmonic correction N.A.
Rad grad N.A. /sec or Circ coils 0.1 T/m
WEIGHT: Fe 200 tons; Coils 16 tons
CONDUCTOR, Material and type Aluminum
STORED ENERGY 0.6 MJ
COOLING SYSTEM Deionized Water
POWER: Main coils 180 max, kW
Trimming coils N.A. max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) N.A. deg
ION ENERGY (Bending limit) E/A = 100 q^2/A^2 MeV
(Focusing limit) E/A = 100 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3 cm; DC BIAS 1.0 kV
TUNED by, coarse - fine -
RF - to - mHz, stable ± - /10^6
Orb F - to mHz; GAIN, max 5 kV/turn
HARMONICS, RF/Orb F, used -
DEE-Gnd, max 20 kV, min gap 3 cm
STABILITY, (pk-pk noise)/(pk RF volt) -
RF PHASE stable to ± - deg
RF POWER input, max 200; 40 Avg. kW
RF PROTECT circuit, speed 10,000 μsec
Type Circuit Breaker
FREQUENCY MODULATION, rate 400 /sec
MODULATOR, type Rotating Capacitor
BEAM PULSE, width 25 μsec

VACUUM SYSTEM

PUMPS, No., Type, Size 2 Diff. Pumps 10,000 ℓ/sec
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM

PIG

EXTRACTION SYSTEM

REG.

CONTROL SYSTEM

MANUAL

typing limit

ENTRY NO. FM-2 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	100	100
	α	100	100
	d	50	50
	^{3}He	133	133
CURRENT		(μA)	(μA)
Internal	p	2	2
	d	3	3
	α, ^{3}He	0.5	0.5
External	p	0.1	0.1
	d	0.1	0.1
	α, ^{3}He	0.05	0.05
		(part/s)	(part/s)
Secondary	-	-	-
	-	-	-

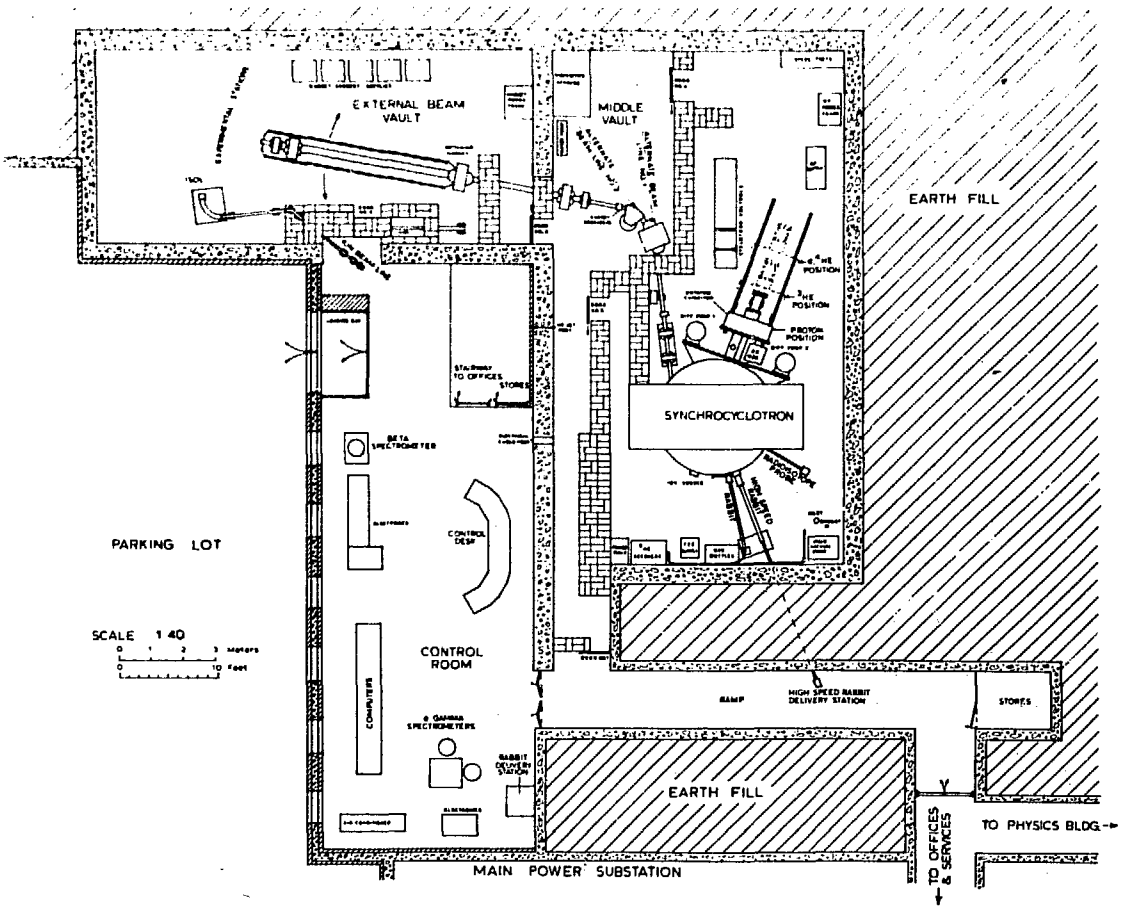
BEAM PROPERTIES

	Measured		Conditions				
Pulse Width	60	RF deg	1	μA of	100	MeV	p
Phase Exc, max	-	RF deg	-	μA of	-	MeV	-
Extract Eff	10	%	0.1	μA of	100	MeV	p
Res, ΔE/E	0.5	%	0.1	μA of	100	MeV	p
Emittance (mm-mrad)	20 axial / 40 radial		0.1	μA of	100	MeV	p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	84 %
Solid State Physics	1 %
Bio-Medical Applications	10 %
Isotope Production	%
Development	5 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



MCGILL SYNCHROCYCLOTRON FACILITY

typing limit

ENTRY NO. FM-3

NAME OF MACHINE CERN 600 MeV Synchro-Cyclotron DATE August 1978
INSTITUTION European Organisation for Nuclear Research (CERN)
ADDRESS CH 1211 Genève 23, Switzerland

IN CHARGE P.H. Standley REPORTED by P.H. Standley

HISTORY AND STATUS

DESIGN, date 1952/3 MODEL tests 1953/4
ENG. DESIGN, date 1953
CONSTRUCTION, date Oct. 54 to July 57
FIRST BEAM date (or goal) August 57
MAJOR ALTERATIONS 1973/74

OPERATION, 150 hr/wk, On Target 144 hr/wk
TIME DIST., in house 5 %, outside 95 %
USERS' SCHEDULING CYCLE --- weeks
COST, ACCELERATOR 30 M Swiss Francs
COST, FACILITY, total 60 M Swiss Francs
FUNDED BY CERN Member States

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 13
TECHNICIANS 47 CRAFTS 10
GRAD STUDENTS involved during year ---
OPERATED BY --- Res staff or 13 Operators
BUDGET, op & dev 11 M Swiss Francs
FUNDED BY CERN Member States

RESEARCH STAFF, not included above

USERS, in house 10 outside ~ 200
GRAD STUDENTS involved during year ---
RES. BUDGET, in house 3 M Swiss Francs
FUNDED BY CERN Member States

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 110 m^2
~~movable~~ unshielded 760 m^2
TARGET STATIONS 12 in 3 rooms
STATIONS served at same time, max 3
MAG SPECTROGRAPH, type Omicron
COMPUTER, model provided by users
OTHER FACILITIES ISOLDE facility serving up to 7 stations with separated beams of unstable nuclei.

REFERENCES/NOTES

1. W. Gentner et al. Philips Tech Rev. 22 p.141, 1961
2. MSC Staff, Proc. 5 Int. Cyclotron Conf. p.719, 1969
3. EG. Michaelis, Proc. 6 Int. Cycl. Conf. p.141. 1972
4. H. Beger et al. Proc. 7 Int. Cycl. Conf. p.49, 1975
5. B.W. Allardyce et al. these Proceedings.

typing limit

MAGNET

POLE FACE diameter 500 cm, R extraction 225 cm
GAP, min 36 cm, Field 18.1 kG
max 45 cm, Field 19.4 kG
at 1.23×10^6 ampere turns
AVERAGE FIELD at R ext 18.1 kG
CURRENT STABILITY 50 parts/10^6, B_{max}/B_0 1
NUMBER OF SECTORS -- SPIRAL, max -- deg
POLE FACE COIL PAIRS AVF -- /sec.
Harmonic correction --
Rad grad -- /sec or Circ coils --
WEIGHT Fe 2500 tons; Coils 60 tons
CONDUCTOR, Material and type Aluminium
STORED ENERGY MJ
COOLING SYSTEM Demineralized Water
POWER Main coils 800 max, kW
Trimming coils -- max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 800 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180-95 deg
BEAM APERTURE 6-12 cm; DC BIAS 1.1 kV
TUNED by, ~~XXXXX~~ Rotating ~~XXX~~ capacitor
RF 30.4 to 16.6 mHz, stable ± -- /10^6
Orb F 30.1 to 16.8 mHz; GAIN, max kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 20 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max 120 kW
RF PROTECT circuit, speed 10 μsec
Type Series modulator cut off
FREQUENCY MODULATION, rate 360 /sec
MODULATOR, type Rotary capacitor
BEAM PULSE, width 30 μs

VACUUM SYSTEM

PUMPS, No., Type, Size Two 38 kℓ s^{-1} (baffled) oil diffusion pumps
OPERATING PRESSURE 0.2 - 0.3 μTorr,
PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM

Mid plane calutron

EXTRACTION SYSTEM electrical septum magnet followed by passive magnetic channel

CONTROL SYSTEM

Conventional. Siemens 301 computer for status bit acquisition.

ENTRY NO. FM-3 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		600
	$^3He^{2+}$		910
	$^{12}C^{4+}$	1030	
CURRENT Internal	p	(μA)	(μA) 4
External	p		3
	$^3He^{2+}$		1
	$^{12}C^{4+}$	~0.1 (fall '79)	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

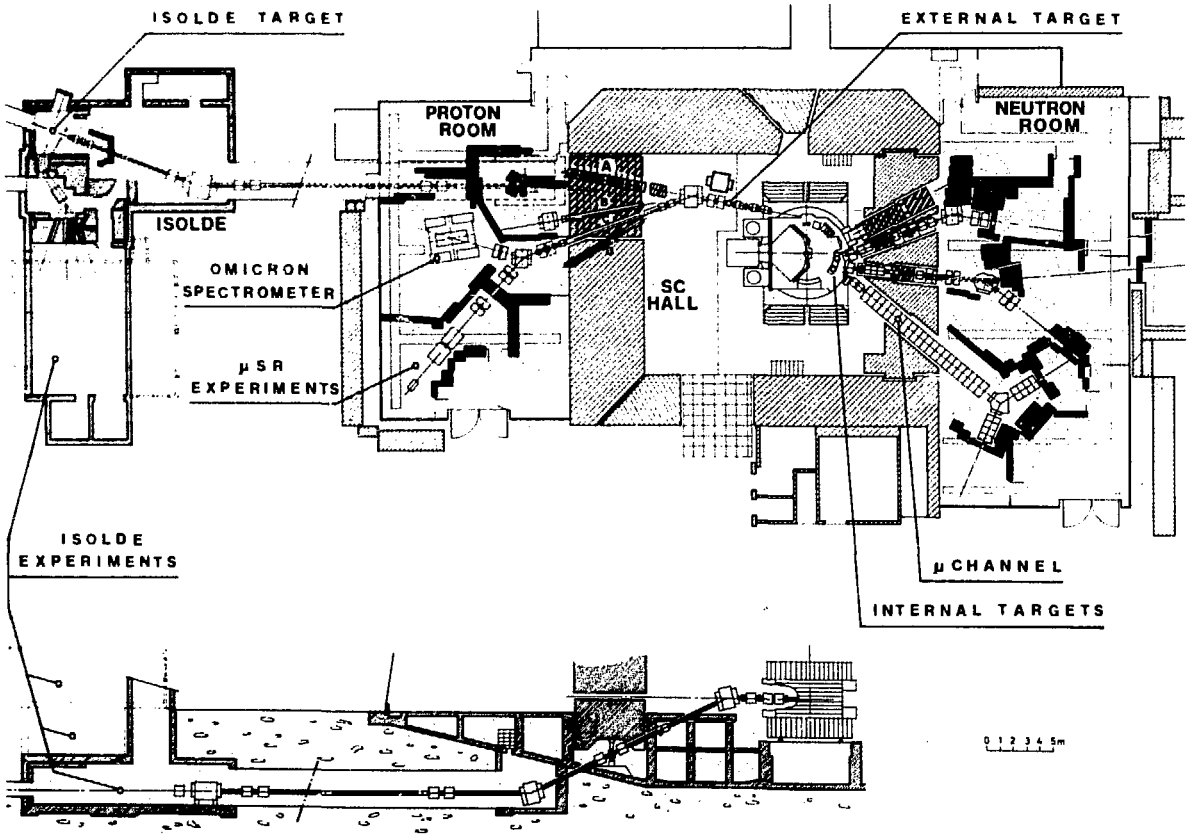
	Measured		Conditions
Pulse Width	RF deg		μA of MeV
Phase Exc. max	RF deg		μA of MeV
Extract Eff	70 %	4	μA of 600 MeV p
Res. ΔE/E	%		μA of MeV
Emittance (mm-mrad)	0.2π axial / 11π radial	3	μA of 600 MeV p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	~50	%
Solid State Physics	contained in μSR	%
Bio-Medical Applications	2	%
Isotope Production		%
Development	10	%
ISOLDE facility	~25	%
μSR	~10	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

1. $^3He^{2+}$ ions were accelerated to full energy and extracted in May 1978.
2. Beams in the "Neutron" Room are derived from internal targets. Beams in the "Proton" Room are derived from an external target in the SC Hall. Alternatively the external primary beam is taken underground to the ISOLDE target.



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ENTRY NO. FM-4

NAME OF MACHINE SYNCHRO-CYCLOTRON - LYON DATE January 79
INSTITUTION UNIVERSITE CLAUDE BERNARD - LYON I - FRANCE
ADDRESS 43 bd du 11 Nov. 1918 - 69621 Villeurbanne - France

IN CHARGE Prof. B. E. LAHNECHE REPORTED by G. HADINGER

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date 1956
CONSTRUCTION, date 1962
FIRST BEAM date (or goal) 1963
MAJOR ALTERATIONS 1965

OPERATION, 110 hr/wk; On Target 20 hr/wk
TIME DIST., in house 90 %, outside 10 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR 2.7 MF
COST, FACILITY, total 7.5 MF
FUNDED BY Ministre de l'Education Nationale

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS _____ ENGINEERS 1
TECHNICIANS 2 CRAFTS _____
GRAD STUDENTS involved during year _____
OPERATED BY _____ Res staff or _____ Operators
BUDGET, op & dev 30 KF
FUNDED BY _____

RESEARCH STAFF, not included above

USERS, in house 8 outside 7
GRAD STUDENTS involved during year _____
RES. BUDGET, in house _____
FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 160 m^2
movable _____ m^2
TARGET STATIONS 6 in 2 rooms
STATIONS served at same time, max _____
MAG SPECTROGRAPH, type _____
COMPUTER, model _____
OTHER FACILITIES _____
pneumatic system for irradiations

REFERENCES/NOTES

G. T. de Kruift and N. F. Verster
CERN report 63-19 (1963) p 80-84

MAGNET

POLE FACE diameter 180 cm, R extraction 75 cm
GAP, min 35 cm, Field 14.7 kG
max 35 cm, Field 14.7 kG
} at 0.61×10^6 ampere turns
AVERAGE FIELD at R ext _____ kG
CURRENT STABILITY 5.0 parts/10^6, B_{max}/B
NUMBER OF SECTORS _____, SPIRAL, max _____ deg
POLE FACE COIL PAIRS AVF _____ /sec,
Harmonic correction _____
Rad grad _____ /sec or Circ coils _____
WEIGHT Fe 180 tons, Coils 10 tons
CONDUCTOR, Material and type Aluminium
STORED ENERGY ~ 1 MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 176 max, kW
Trimming coils _____ max, kW
YOKE/POLE AREA _____ %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 180 deg
BEAM APERTURE 18.5 cm; DC BIAS 0.2 kV
TUNED by, coarse _____ fine _____
RF 10.4 to 11.0 mHz, stable ± _____ /10^6
Orb F _____ to _____ mHz; GAIN, max _____ kV/turn
HARMONICS, RF/Orb F, used _____
DEE-Gnd, max 22 kV, min gap _____ cm
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max 23 kW
RF PROTECT circuit, speed _____ μsec
Type _____
FREQUENCY MODULATION, rate 2000 /sec
MODULATOR, type rotating capacitor
BEAM PULSE, width 40 μ sec macrocycle

VACUUM SYSTEM

PUMPS, No., Type, Size 1 diffusion pump 50 cm
OPERATING PRESSURE 8 μTorr,
PUMPDOWN TIME 4 hrs

ION SOURCES/INJECTION SYSTEM

Open ion source

EXTRACTION SYSTEM

magnetic regenerative

CONTROL SYSTEM

typing limit

ENTRY NO. FM-4 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	d		28
	α		56
CURRENT		(μA)	(μA)
Internal			
	d		30
	α		10
External			
	d		1.5
		(part/s)	(part/s)
Secondary	π		10^{10}

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg	μA at		MeV	
Phase Exc. max		RF deg	μA at		MeV	
Extract Eff	10	%	μA at	28	MeV	d
Res. ΔF/F	2-2.5	%	μA at	28	MeV	d
Emittance (mm-mrad)	120 axial / 120 radial		μA at	28	MeV	d

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	20	%
Solid State Physics	5	%
Bio-Medical Applications	60	%
Isotope Production	15	%
Development		%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Since january 1978 the Synchro-cyclotron is mainly used for medical and biological research. Radionuclides have been prepared for clinical use.

The following isotopes were produced :

Tc^{96} , Tc^{95}

I^{123}

O^{15}

References :

La capacité de diffusion de l'oxygène

R.C. Munsch, B. Philipon, T. Wiesendanger, A. Brune, G. Hadinger

17ème colloque de Médecine Nucléaire de Langue Française

Ed. Kellershohn - Raynaud, C.E.A., p. 202-204

typing limit

ENTRY NO. FM-5

NAME OF MACHINE ORSAY 200 MeV Synchrocyclotron DATE 1978
INSTITUTION Institut de Physique Nucléaire
ADDRESS 91400 Orsay B.P. n° 1

IN CHARGE H. Langevin - A. Laisné REPORTED by P. Debray

HISTORY AND STATUS

DESIGN, date 1972 MODEL tests 72-73
ENG. DESIGN, date 1973
CONSTRUCTION, date Sept. 1975
FIRST BEAM date (or goal) 20-6-1977
MAJOR ALTERATIONS

OPERATION, 48 hr/wk; On Target hr/wk
TIME DIST., in house %, outside 100 %
USERS' SCHEDULING CYCLE weeks
COST, ACCELERATOR env. 10 MF
COST, FACILITY, total env. 20 MF
FUNDED BY Institut National de Physique Nucléaire et de Physique des Particules (IN2P3)

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS 2
TECHNICIANS 6 CRAFTS 5
GRAD STUDENTS involved during year
OPERATED BY Res staff or 6 Operators
BUDGET, op & dev
FUNDED BY IN2P3

RESEARCH STAFF, not included above

USERS, in house outside
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 500 m^2
movable m^2
TARGET STATIONS 3 in 3 rooms
STATIONS served at same time, max
MAG SPECTROGRAPH, type 120 deg n = 1/2
COMPUTER, model IBM 360-50
OTHER FACILITIES On-line Mass Spectrometer Isocèle II

REFERENCES/NOTES

MAGNET

POLE FACE diameter 320 cm; R extraction 140 cm
GAP, min 30 cm; Field kG
max 40 cm; Field 16,15 kG
AVERAGE FIELD at R ext 14,8 kG
} at 0,63 x 10^6 ampere turns
CURRENT STABILITY ± 20 parts/10^6; $B_{max}/\langle B \rangle$
NUMBER OF SECTORS ; SPIRAL, max deg
POLE FACE COIL PAIRS: AVF 1 /sec;
Harmonic correction
Rad grad /sec or Circ coils 1
WEIGHT: Fe tons; Coils tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM De-ionized water
POWER: Main coils 350. max, kW
Trimming coils max, kW
YOKE/POLE AREA 100. %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 223. q^2/A^2 MeV
(Focusing limit) E/A = 223. q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180. deg
BEAM APERTURE 6 cm; DC BIAS 1 kV
TUNED by, coarse fine
RF 25 to 10 mHz, stable ± /10^6
Orb F 25 to 10. mHz; GAIN, max kV/turn
HARMONICS, RF/Orb F, used 3.
DEE-Gnd, max 20 kV, min gap 0.4 cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max 100 kW
RF PROTECT circuit, speed 5 μsec
Type Blocking of the Amplitude Modulator
FREQUENCY MODULATION, rate 430 ; 700-1100 Hz/sec
MODULATOR, type Rotating condenser
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 1 diff. pump (16,000 l.s)

OPERATING PRESSURE 1-5 μTorr,
PUMPDOWN TIME 40 hrs

ION SOURCES/INJECTION SYSTEM

Pulsed Livingtone cathode

EXTRACTION SYSTEM Regenerative Extraction E.M. and M.S. channels.

CONTROL SYSTEM

typing limit

ENTRY NO. FM-5 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P		200 and 170
	d		108 and 90
	$3He^{+}$		283 and 238
	$4He^{++}$		220 and 182
CURRENT		(μA)	(μA)
Internal	P	10	3
	d	10	3
	$3He^{+}$	10	3
External	P	7	
	d	7	
	He	7	
		(part/s)	(part/s)
Secondary			

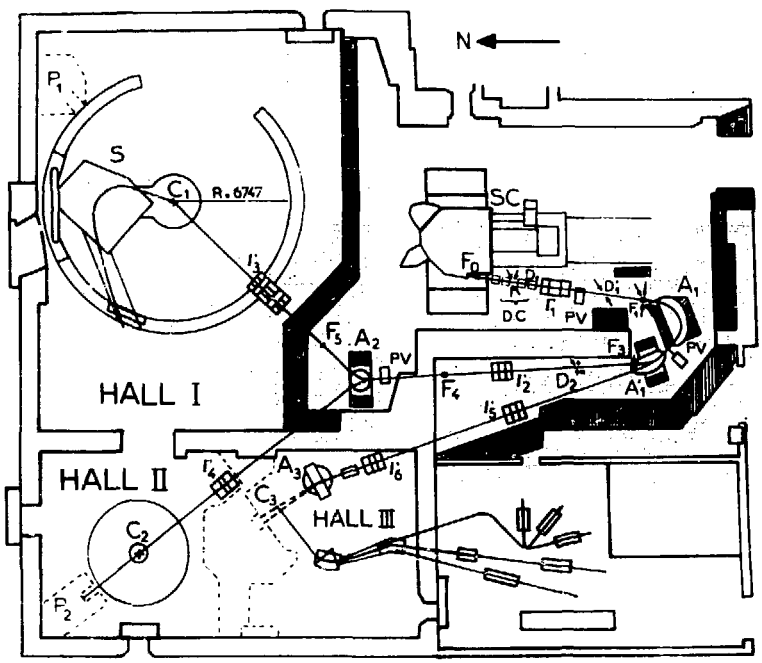
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	70 %	μA of MeV
Res, ΔE/E	%	μA of MeV
Emittance (mm-mrad)	8 π axial, 20 π radial	0.5 μA of 200 MeV P

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	50 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	30 %
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



typing limit

ENTRY NO. FM-6

NAME OF MACHINE Goettingen Synchrocyclotron DATE 8/1/78

INSTITUTION Universitaet of Goettingen, II. Physikalisches Institut

ADDRESS Bunsenstr. 7-9, 3400 Goettingen/BRD

IN CHARGE W.-D. Schmidt-Ott REPORTED by

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests

ENG. DESIGN, date

CONSTRUCTION, date 1960-1962

FIRST BEAM date (or goal) int. beam 1962

MAJOR ALTERATIONS ext. beam 1962

OPERATION, 50 hr/wk; On Target 40 hr/wk

TIME DIST., in house 90 %, outside 10 %

USERS' SCHEDULING CYCLE 3 weeks

COST, ACCELERATOR DM 4.2×10^6

COST, FACILITY, total DM 5.9×10^6

FUNDED BY Fed. Rep. of Germany

Building: Land of Niedersachsen

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1

TECHNICIANS 2 CRAFTS

GRAD STUDENTS involved during year

OPERATED BY Res staff or 2 Operators

BUDGET, op & dev

FUNDED BY Land of Niedersachsen

RESEARCH STAFF, not included above

USERS, in house 20 outside 5

GRAD STUDENTS involved during year 10

RES. BUDGET, in house

FUNDED BY Land of Niedersachsen

Fed. Rep. of Germany

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 160 m^2

movable m^2

TARGET STATIONS 5 in 2 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type

COMPUTER, model LSI 11/03

OTHER FACILITIES Gas-Transport-System Facilities for Short-Lived Spectroscopy and Chemical Separations

REFERENCES/NOTES

Cyclotron:

W. de Groot: Philips Techn. Rev. Vol 12, No 3 (1950)

G.T. de Kruiff, N.F. Vester: CERN-Report 63-19,80 (1963)

Other Facilities; N. Instr. Meth. 130, 177 (75); 141, 553 (77)

MAGNET

POLE FACE diameter 180 cm; R extraction 75 cm

GAP, min 35 cm; Field 14.5 kG } at .5 X 10^6 ampere turns

max cm; Field kG

AVERAGE FIELD at R ext 14.2 kG

CURRENT STABILITY 300 parts/10^6; $B_{max}/\langle B \rangle$ .99

NUMBER OF SECTORS ; SPIRAL, max deg

POLE FACE COIL PAIRS: AVF – /sec;

Harmonic correction –

Rad grad – /sec or Circ coils –

WEIGHT: Fe 250 tons; Coils 2 tons

CONDUCTOR, Material and type Aluminium

STORED ENERGY .5 MJ

COOLING SYSTEM Demineralized water

POWER: Main coils 250 max, kW

Trimming coils max, kW

YOKE/POLE AREA 113 %

SECTOR ANGLE (Sep Sec) deg

ION ENERGY (Bending limit) E/A = 13.9 q^2/A^2 MeV

(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg

BEAM APERTURE 10 cm; DC BIAS -.5 kV

TUNED by, coarse fixed fine variable cap.

RF 10.6 to 11.1 mHz, stable ± /10^6

Orb F same to mHz; GAIN, max 13 kV/turn

HARMONICS, RF/Orb F, used 1

DEE-Gnd, max 20 kV, min gap fixed 7 cm

STABILITY, (pk-pk noise)/(pk RF volt) –

RF PHASE stable to ± – deg

RF POWER input, max 12 kW

RF PROTECT circuit, speed 5 μsec

Type DC and grid current monitors

FREQUENCY MODULATION, rate 2000 /sec

MODULATOR, type rotating capacitor

BEAM PULSE, width 25 μsec

VACUUM SYSTEM

PUMPS, No., Type, Size Diff. pumps 6000 l/sec, modulator: 1000 l/sec

OPERATING PRESSURE 2 μTorr,

PUMPDOWN TIME 5 hrs

ION SOURCES/INJECTION SYSTEM

internal gas discharge (arc)

EXTRACTION SYSTEM

modified regenerative extr. with magn. channel

CONTROL SYSTEM

conventional

typing limit

ENTRY NO. FM-6 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	d	27	27.7
	α	54	55.4
CURRENT		(μA)	(μA)
Internal	d	10	15
		0.2	1.3
External	2 cm² : d		0.1
	α		0.01
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μA of MeV
Phase Exc, max	RF deg	μA of MeV
Extract Eff	5 %	μA of MeV
Res, ΔE/E	1 %	μA of MeV
Emittance (mm-mrad)	100 axial, 100 radial	μA of MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	70 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	25 %
Development	5 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. FM-7

NAME OF MACHINE Uppsala Synchrocyclotron DATE August 1978
INSTITUTION The Gustaf Werner Institute, University of Uppsala
ADDRESS Box 531, S-751 21 Uppsala, Sweden

IN CHARGE Prof. Helge Tyrén REPORTED by Stig Holm

HISTORY AND STATUS

DESIGN, date 1946 MODEL tests 1947
ENG. DESIGN, date 1946-1951
CONSTRUCTION, date 1947 - 1951
FIRST BEAM date (or goal) int. Dec.-51 ext.-56
MAJOR ALTERATIONS Complete reconstruction 1977-
OPERATION, ____ hr/wk; On Target ____ hr/wk
TIME DIST., in house ____ %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY Gustaf Werner

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 15 ENGINEERS 7
TECHNICIANS 4 CRAFTS 7
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or ____ Operators
BUDGET, op & dev $ 500.000
FUNDED BY Govt. and Govt.Research Counsil

RESEARCH STAFF, not included above

USERS, in house ____ outside ____
GRAD STUDENTS involved during year 15
RES. BUDGET, in house $ 400.000
FUNDED BY Govt. and Govt.Res.Couns

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ____ m^2
movable ____ m^2
TARGET STATIONS ____ in ____ rooms
STATIONS served at same time, max ____
MAG SPECTROGRAPH, type ____
COMPUTER, model ____
OTHER FACILITIES ____

REFERENCES/NOTES

MAGNET

POLE FACE diameter ____ cm; R extraction ____ cm
GAP, min ____ cm; Field ____ kG
max ____ cm; Field ____ kG
AVERAGE FIELD at R ext ____ kG
} at ____ X 10^6 ampere turns
CURRENT STABILITY ____ parts/10^6; $B_{max}/\langle B\rangle$ ____
NUMBER OF SECTORS ____ ; SPIRAL, max ____ deg
POLE FACE COIL PAIRS: AVF ____ /sec;
Harmonic correction ____
Rad grad ____ /sec or Circ coils ____
WEIGHT: Fe ____ tons; Coils ____ tons
CONDUCTOR, Material and type ____
STORED ENERGY ____ MJ
COOLING SYSTEM ____
POWER: Main coils ____ max, kW
Trimming coils ____ max, kW
YOKE/POLE AREA ____ %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number ____ angle ____ deg
BEAM APERTURE ____ cm; DC BIAS ____ kV
TUNED by, coarse ____ fine ____
RF ____ to ____ mHz, stable ± ____ /10^6
Orb F ____ to ____ mHz; GAIN, max ____ kV/turn
HARMONICS, RF/Orb F, used ____
DEE-Gnd, max ____ kV, min gap ____ cm
STABILITY, (pk-pk noise)/(pk RF volt) ____
RF PHASE stable to ± ____ deg
RF POWER input, max ____ kW
RF PROTECT circuit, speed ____ μsec
Type ____
FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____

VACUUM SYSTEM

PUMPS, No., Type, Size ____
OPERATING PRESSURE ____ μTorr,
PUMPDOWN TIME ____ hrs

ION SOURCES/INJECTION SYSTEM

EXTRACTION SYSTEM

CONTROL SYSTEM

typing limit

ENTRY NO. FM-7 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	15-200	
	d	25-100	
	^{3}He	75-280	
	^{4}He	25-200	
CURRENT		(μA)	(μA)
Internal	p	≤10	
	d	≤50	
	^{3}He, ^{4}He	≤25	
External	p	≤ 8	
	d	40	
	^{3}He, ^{4}He	20	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	____	RF deg	____ μA of	____ MeV	____
Phase Exc, max	____	RF deg	____ μA of	____ MeV	____
Extract Eff	____	%	____ μA of	____ MeV	____
Res, ΔE/E	____	%	____ μA of	____ MeV	____
Emittance (mm-mrad)	____ axial / ____ radial		____ μA of	____ MeV	____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	50 %
Solid State Physics	%
Bio-Medical Applications	30 %
Isotope Production	20 %
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The cyclotron is under reconstruction to a sectorfocussed machine. High energy protons and ^{3}He particles will be accelerated with frequency modulation while isochronous operation will be possible for lower energies and for other particles. A new building for an enlarged experimental area is being projected.

typing limit

ENTRY NO. FM-8

NAME OF MACHINE Harwell Synchrocyclotron DATE July 1978
INSTITUTION AERE, Harwell (UKAEA)
ADDRESS Didcot, Oxon, England

IN CHARGE C. Whitehead REPORTED by C. Whitehead

HISTORY AND STATUS

DESIGN, date 1946 MODEL tests 1947-48
ENG. DESIGN, date 1947-49
CONSTRUCTION, date 1948-49
FIRST BEAM date (or goal) December 6, 1949
MAJOR ALTERATIONS New RF System & Dee 1969
OPERATION, 60 hr/wk; On Target 50 hr/wk
TIME DIST., in house 80 %, outside 20 %
USERS' SCHEDULING CYCLE 11 weeks
COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY UKAEA

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 4 CRAFTS 4
GRAD STUDENTS involved during year None
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY UKAEA

RESEARCH STAFF, not included above

USERS, in house 3 outside 2
GRAD STUDENTS involved during year 1
RES. BUDGET, in house
FUNDED BY UKAEA

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS 9 in 5 rooms
STATIONS served at same time, max 2
MAG SPECTROGRAPH, type
COMPUTER, model DDP516, plus CAMAC
OTHER FACILITIES

REFERENCES/NOTES

MAGNET

POLE FACE diameter 280 cm; R extraction 122 cm
GAP, min 20 cm; Field kG
max 30 cm; Field kG
AVERAGE FIELD at R ext 16 kG
} at X 10^6 ampere turns
CURRENT STABILITY ±150 parts/10^6; $B_{max}/\langle B \rangle$ 1.03
NUMBER OF SECTORS / ; SPIRAL, max / deg
POLE FACE COIL PAIRS: AVF / /sec;
Harmonic correction /
Rad grad /sec or Circ coils
WEIGHT: Fe 600 tons; Coils 60 tons
CONDUCTOR, Material and type Copper
STORED ENERGY MJ
COOLING SYSTEM Oil
POWER: Main coils 350 max, kW
Trimming coils - max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 160 q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle shaped deg
BEAM APERTURE cm; DC BIAS 1.5 kV
TUNED by, coarse fine
RF 25 to 20 mHz, stable ± /10^6
Orb F to mHz; GAIN, max kV/turn
HARMONICS, RF/Orb F, used First
DEE-Gnd, max 35 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± deg
RF POWER input, max 20 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Oil Diffusion 60cm
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 4 hrs

ION SOURCES/INJECTION SYSTEM

Calutron

EXTRACTION SYSTEM

Magnetic regenerator

CONTROL SYSTEM

typing limit

ENTRY NO. FM-8 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	160	160
	d	85	85
	α	170	170
	^{3}He	222	222
CURRENT		(μA)	(μA)
Internal	p	10	12
	d	10	35
	α	10	1
External	p		0.3
	d		0.3
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of	MeV	
Phase Exc, max		RF deg		μA of	MeV	
Extract Eff	3-5	%	5	μA of	160 MeV	p
Res, ΔE/E		%		μA of	MeV	
Emittance (mm-mrad) axial / radial				μA of	MeV	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	20 %
Solid State Physics	5 %
Bio-Medical Applications	5 %
Isotope Production	%
Development	%
Reactor	70 %
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. FM-9

NAME OF MACHINE Nevis Synchrocyclotron DATE 8/14/78
INSTITUTION Columbia University Physics Department
ADDRESS Nevis Laboratories, Irvington, N.Y. 10533

IN CHARGE Prof. Derek W. Storm REPORTED by same

HISTORY AND STATUS

DESIGN, date 1965-71 MODEL tests same
ENG. DESIGN, date start 1966
CONSTRUCTION, date 9/70-6/75
FIRST BEAM date (or goal) 1975
MAJOR ALTERATIONS Many

OPERATION, 100 hr/wk; On Target 80 hr/wk
TIME DIST., in house 70 %, outside 30 %
USERS' SCHEDULING CYCLE several weeks
COST, ACCELERATOR $6,500,000
COST, FACILITY, total
FUNDED BY NSF

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS 2
TECHNICIANS 8 CRAFTS 3
GRAD STUDENTS involved during year 0
OPERATED BY Res staff or x Operators
BUDGET, op & dev 1.2 x 106
FUNDED BY NSF

RESEARCH STAFF, not included above

USERS, in house 10 outside 7
GRAD STUDENTS involved during year 8
RES. BUDGET, in house $500,000
FUNDED BY NSF

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2
movable m^2
TARGET STATIONS 2 in 1 rooms
STATIONS served at same time, max 2
MAG SPECTROGRAPH, type none
COMPUTER, model PDP-11, EMR 6130
OTHER FACILITIES isotope production

REFERENCES/NOTES

MAGNET

POLE FACE diameter 432 cm; R extraction 195 cm
GAP, min 1.9 cm; Field 19-26 kG
max 95 cm; Field 13.6 kG
AVERAGE FIELD at R ext 20 kG
} at 1.9 x 10^6 ampere turns
CURRENT STABILITY 100 parts/10^6; $B_{max}/\langle B \rangle$ 1.0-1.4
NUMBER OF SECTORS 3 ; SPIRAL, max 35 deg
POLE FACE COIL PAIRS: AVF none /sec;
Harmonic correction none
Rad grad none /sec or Circ coils
WEIGHT: Fe 2300 tons; Coils 187 tons
CONDUCTOR, Material and type copper
STORED ENERGY ~ 25 MJ
COOLING SYSTEM oil, demineralized water
POWER: Main coils 910 kW max, kW
Trimming coils 0 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = 550 q^2/A^2 MeV
(Focusing limit) E/A = 550 q/A MeV
(protons only)

ACCELERATION SYSTEM

DEES, number 1 angle 180-130 deg
BEAM APERTURE 2.5 cm; DC BIAS 2-5 kV
TUNED by, coarse rotating fine capacitor
RF 28. to 19.1 mHz, stable ± /10^6
Orb F to mHz; GAIN, max 20-25 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Grid, max 35 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± (FM cyclotron) deg
RF POWER input, max 150 kW
RF PROTECT circuit, speed 100 μsec
Type bias current detector
FREQUENCY MODULATION, rate 300 /sec
MODULATOR, type series tube
BEAM PULSE, width 20 μs

VACUUM SYSTEM

PUMPS, No., Type, Size 2 oil diffusion pumps 90 cm
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

internal, pulsed, hollow cathode

EXTRACTION SYSTEM magnetic septum peeler regenerator; time varying. mag bump

CONTROL SYSTEM conventional

typing limit

ENTRY NO. FM-9 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	570	570
CURRENT		(μA)	(μA)
Internal			
External	p	15	4
		(part/s)	(part/s)
Secondary	π	10×10^7 π^+	
	μ	18×10^5 μ^+	

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of	MeV	
Phase Exc, max		RF deg		μA of	MeV	
Extract Eff	70	%	3	μA of	570 MeV	p
Res, ΔE/E	1	%		μA of	MeV	
Emittance (mm-mrad)	100 axial / 100 radial		3	μA of	570 MeV	p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	90 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	%
Development	10 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The modification has resulted in an increase from 380 MeV to 570 MeV for protons, with the repetition rate increased from 60/sec to 300/sec. Operation to date has been at 150/sec. This energy increase was achieved by adding sector focusing and changing the field shape. This beam has no micro structure and about 75% macro duty factor. It is used with three secondary charged particle beam lines for simultaneous experiments with $\pi^{\pm}$, $\mu^{\pm}$ and scattered protons. Typical beam intensities have been 1.5 to 2.0 μA on target. The accelerator was closed July 1978.

typing limit

ENTRY NO. FM-10

NAME OF MACHINE 160 MeV Synchrocyclotron DATE 2 Jan. 1979
INSTITUTION Harvard Cyclotron Laboratory, Harvard University
ADDRESS 44 Oxford St., Cambridge, MA 02138

IN CHARGE A.M. Koehler REPORTED by A.M. Koehler

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date 1946
FIRST BEAM date (or goal) 1949
MAJOR ALTERATIONS increased energy external beam, 1957
OPERATION, 45 hr/wk; On Target _____ hr/wk
TIME DIST., in house 5 %, outside 95 %
USERS' SCHEDULING CYCLE ad lib. weeks
COST, ACCELERATOR $1 million
COST, FACILITY, total $1.7 million
FUNDED BY ONR 1946-1967

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 1
TECHNICIANS 3 CRAFTS 3
GRAD STUDENTS involved during year 0
OPERATED BY x Res staff or x Operators
BUDGET, op & dev $250 K direct costs
FUNDED BY users fees & subcontracts

RESEARCH STAFF, not included above

USERS, in house ~1 outside ~ 15
GRAD STUDENTS involved during year 0
RES. BUDGET, in house ~ $5 K
FUNDED BY _____

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed _____ m^2
movable _____ m^2
TARGET STATIONS 3 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type _____
COMPUTER, model PDP11/34
OTHER FACILITIES _____

REFERENCES/NOTES

MAGNET

POLE FACE diameter 241 cm; R extraction 105 cm
GAP, min 29.6 cm; Field 19.0 kG
max 30.5 cm; Field 18.3 kG
AVERAGE FIELD at R ext 18.1 kG
} at 0.6 x 10^6 ampere turns
CURRENT STABILITY ~ 100 parts/10^6; $B_{max}/\langle B \rangle$ _____
NUMBER OF SECTORS _____ ; SPIRAL, max _____ deg
POLE FACE COIL PAIRS: AVF _____ /sec;
Harmonic correction _____
Rad grad _____ /sec or Circ coils _____
WEIGHT: Fe 641 tons; Coils 74 tons
CONDUCTOR, Material and type copper strip
STORED ENERGY _____ MJ
COOLING SYSTEM Deionized water
POWER: Main coils 160 max, kW
Trimming coils none max, kW
YOKE/POLE AREA _____ %
SECTOR ANGLE (Sep Sec) _____ deg
ION ENERGY (Bending limit) E/A = _____ q^2/A^2 MeV
(Focusing limit) E/A = _____ q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 6 cm; DC BIAS -2 kV
TUNED by, coarse _____ fine _____
RF _____ to _____ mHz, stable ± _____ /10^6
Orb F _____ to _____ mHz; GAIN, max _____ kV/turn
HARMONICS, RF/Orb F. used _____
DEE-Gnd, max 10 kV, min gap _____ cm
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max 8 kW
RF PROTECT circuit, speed _____ μsec
Type _____
FREQUENCY MODULATION, rate 0 to 250 /sec
MODULATOR, type Rotating capacitor
BEAM PULSE, width 250 microsec. typ.

VACUUM SYSTEM

PUMPS, No., Type, Size 4 NRC 6" oil
OPERATING PRESSURE 6 x 10^{-6} (3 x 10^{-7} base) μTorr
PUMPDOWN TIME 4 to 10 hrs

ION SOURCES/INJECTION SYSTEM
hot filament, pulsed arc "volcano"

EXTRACTION SYSTEM
Passive regenerator & channel

CONTROL SYSTEM
Relays

typing limit

ENTRY NO. FM-10 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	Proton		160
CURRENT		(μA)	(μA)
Internal			2
External			0.05
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	5	%		μA of		MeV
Res, ΔE/E	1	%		μA of		MeV
Emittance (mm-mrad)	100 axial / 85 radial			μA of		MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics		%
Solid State Physics	& Rad. damage	2 %
Bio-Medical Applications		90 %
Isotope Production		2 %
Development		6 %
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Since 1967 this machine has been operated as required by the needs of several users. The entire operating expense is derived from a fee, currently $1820 per 24-hour day, collected from each user. Principal use is for the treatment of patients, more than 1200 so far. Treatment of pituitary gland disorders has been most important, but clinical applications have been expanding rapidly, now making full use of two separate treatment rooms with beam switching between treatments. Patient load is now 150 to 200 per year.

The equipment and techniques developed for medical work are also convenient for radiation damage studies and for development of particle detection systems. Other applications being developed are proton activation analysis and proton radiography.

References:

A.M. Koehler and K. Johnson, in these Proceedings
A.M. Koehler, in Cyclotrons 1972, AIP Conf. Proc. No. 9

typing limit

ENTRY NO. FM-11

NAME OF MACHINE Space Radiation Effects Laboratory (SREL) DATE July 11, 1978
INSTITUTION College of William and Mary
ADDRESS Newport News, Virginia

IN CHARGE Robert T. Siegel REPORTED by Robert T. Siegel

HISTORY AND STATUS

DESIGN, date 1960-62 MODEL tests
ENG. DESIGN, date 1962-63
CONSTRUCTION, date July, 1963
FIRST BEAM date (or goal) January, 1965
MAJOR ALTERATIONS 1972

OPERATION, 136 hr/wk; On Target 128 hr/wk
TIME DIST., in house %, outside 100 %
USERS' SCHEDULING CYCLE 16 weeks
COST, ACCELERATOR $5,963,000 (incl. orig. beam transport)
COST, FACILITY, total $16,900,000
FUNDED BY NASA

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 4
TECHNICIANS 12 CRAFTS 1
GRAD STUDENTS involved during year 60
OPERATED BY Res staff or X Operators
BUDGET, op & dev $750,000
FUNDED BY NSF and State of Virginia

RESEARCH STAFF, not included above

USERS, in house outside 45
GRAD STUDENTS involved during year 60
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 350 m^2
movable 600 m^2
TARGET STATIONS 7 in 4 rooms
STATIONS served at same time, max 3
MAG SPECTROGRAPH, type
COMPUTER, model IBM 360/44
OTHER FACILITIES

REFERENCES/NOTES

Proceedings of Conference on Cyclotron Improvement, College of William and Mary, 1964. Papers by W. M. Brobeck, R. M. Nissen, J. R. Mulady.

MAGNET

POLE FACE diameter 500 cm; R extraction cm
GAP, min 36 cm; Field 19.5 kG
max 45 cm; Field 18.2 kG
AVERAGE FIELD at R ext 18.2 kG
at 1.3 x 10^6 ampere turns
CURRENT STABILITY 50 parts/10^6; $B_{max}/(B)$
NUMBER OF SECTORS ; SPIRAL, max deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction
Rad grad /sec or Circ coils
WEIGHT: Fe 2700 tons; Coils 60 tons
CONDUCTOR, Material and type
STORED ENERGY MJ
COOLING SYSTEM
POWER: Main coils 950 max, kW
Trimming coils max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 12 cm; DC BIAS -1.4 kV
TUNED by, coarse fine
RF 29.6 to 17.0 mHz, stable ± /10^6
Orb F to mHz; GAIN, max kV/turn
HARMONICS, RF/Orb F, used
DEE-Gnd, max 35 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 2-3%
RF PHASE stable to ± deg
RF POWER input, max 60 kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate 55 /sec
MODULATOR, type Tuning Fork
BEAM PULSE, width 50,000 10 msec, external, internal meso

VACUUM SYSTEM

PUMPS, No., Type, Size
OPERATING PRESSURE μTorr,
PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

Cold cathode

EXTRACTION SYSTEM

Regenerator-Magnetic Channel

CONTROL SYSTEM

typing limit

ENTRY NO. FM-11 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	600	590
	α	710	710
CURRENT		(μA)	(μA)
Internal	p	1	2.5
	α	1	0.5
External	p	10^{11}	4×10^{11}
	α	10^{10}	$> 10^{10}$
		(part/s)	(part/s)
Secondary	π^-	10^7	10^7
	μ	2×10^5	6×10^5

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width		RF deg		μA of		MeV
Phase Exc, max		RF deg		μA of		MeV
Extract Eff	5	%	0.1	μA of	p	MeV 590
Res, ΔE/E		%		μA of		MeV
Emittance (mm-mrad)	axial / radial			μA of		MeV

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	85 %
Solid State Physics	10 %
Bio-Medical Applications	5 %
Isotope Production	%
Development	%
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

1. Two extraction systems for use at 600 MeV and 300 MeV
   Entire extraction systems with internal targets are removable on "platters," with turnover time of ∿ 8 hours.

2. The full external proton beam can be delivered to either of two alternate target areas.

3. Muon Channel (Quadrupole type) used to deliver stopping $\pi^{\pm}$ and $\mu^{\pm}$ beams. Other movable bending and quadrupole magnets available for specialized transport.

4. Electronic equipment pool available for users.

5. IBM 360-44 Data Acquisition System available for users.

SREL operations will be terminated July 31, 1978. Complete phaseout is scheduled for December 31, 1978.

typing limit

ENTRY NO. FM-12

NAME OF MACHINE 184" Synchrocyclotron DATE Jan. 10, 1979
INSTITUTION LBL
ADDRESS

IN CHARGE H. A. Grunder REPORTED by L. Kanstein

HISTORY AND STATUS

DESIGN, date ____ MODEL tests ____
ENG. DESIGN, date ____
CONSTRUCTION, date ____
FIRST BEAM date (or goal) Nov. 1946
MAJOR ALTERATIONS 1949, 1955 to 1957

OPERATION, 25 hr/wk; On Target 24 hr/wk
TIME DIST., in house 99 %, outside 1 %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total ____
FUNDED BY NIH

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ____ ENGINEERS ____
TECHNICIANS 1 CRAFTS 1/2
GRAD STUDENTS involved during year ____
OPERATED BY ____ Res staff or 3 Operators
BUDGET, op & dev 315K
FUNDED BY NIH

RESEARCH STAFF, not included above

USERS, in house 3 outside 2
GRAD STUDENTS involved during year ____
RES. BUDGET, in house $182,070
FUNDED BY NIH

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 200 m^2
movable - m^2
TARGET STATIONS 1 in 1 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type ____
COMPUTER, model ____
OTHER FACILITIES ____

REFERENCES/NOTES

*Used for clinical radiotherapy trials, and some radiobiology

MAGNET

POLE FACE diameter 470 cm; R extraction 208 cm
GAP, min 28 cm; Field 17 kG
max ____ cm; Field 23.4 kG
AVERAGE FIELD at R ext 22.3 kG
} at ____ X 10^6 ampere turns
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ ____
NUMBER OF SECTORS ____ ; SPIRAL, max ____ deg
POLE FACE COIL PAIRS: AVF ____ /sec;
Harmonic correction ____
Rad grad ____ /sec or Circ coils ____
WEIGHT: Fe 4,000 tons; Coils 340 tons
CONDUCTOR, Material and type copper
STORED ENERGY 30 MJ
COOLING SYSTEM oil/water
POWER: Main coils 850kW/1600kW max, kW
Trimming coils ____ max, kW
YOKE/POLE AREA 85 %
SECTOR ANGLE (Sep Sec) ____ deg
ION ENERGY (Bending limit) E/A = ____ q^2/A^2 MeV
(Focusing limit) E/A = ____ q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 12.3 cm; DC BIAS 1.5 kV
TUNED by, coarse ____ fine ____
RF 36 to 18 mHz, stable ± ____ /10^6
Orb F ____ to ____ mHz; GAIN, max 10 kV/turn
HARMONICS, RF/Orb F, used ____
DEE-Gnd, max 11 kV, min gap 12 cm
STABILITY, (pk-pk noise)/(pk RF volt) ____
RF PHASE stable to ± ____ deg
RF POWER input, max 72 kW
RF PROTECT circuit, speed ____ μsec
Type ____
FREQUENCY MODULATION, rate 64 /sec
MODULATOR, type Vibrating Blades
BEAM PULSE, width 13

VACUUM SYSTEM

PUMPS, No., Type, Size 6 20 inch oil Diffusion Pumps
OPERATING PRESSURE 10 μTorr,
PUMPDOWN TIME ____ hrs

ION SOURCES/INJECTION SYSTEM

Open ARC, Hot Filament

EXTRACTION SYSTEM

Le Couteur Regenerator & Mag. Channel

CONTROL SYSTEM

typing limit

ENTRY NO. FM-12 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	proton	740	
	deut.	460	
	alpha	910	
CURRENT		(μA)	(μA)
Internal	P	1	
	D	1	
	α	.5	
External		.12	
		.12	
		.06	
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions				
Pulse Width		RF deg		μA of		MeV	
Phase Exc, max		RF deg		μA of		MeV	
Extract Eff	15	%	.12	μA of	740	MeV	P
Res, ΔE/E		%		μA of		MeV	
Emittance (mm-mrad)	axial / radial			μA of		MeV	

OPERATING PROGRAMS, time dist

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. FM-13

NAME OF MACHINE Dubna 700 MeV High Intensity Phasotron DATE August, 1973
INSTITUTION Joint Institute for Nuclear Research, Lab. of Nucl. Pr.
ADDRESS JINR, Head Post Office, POB 79, Moscow, USSR

IN CHARGE Prof. V.P. DZHELEPOV REPORTED by Prof. V.P. DZHELEPOV

HISTORY AND STATUS

DESIGN, date 1967 MODEL tests 1968-1974
ENG. DESIGN, date 1968-1974
CONSTRUCTION, date 1971-1973
FIRST BEAM date (or goal) 1980
MAJOR ALTERATIONS

OPERATION, 156 hr/wk; On Target hr/wk
TIME DIST., in house 80 %, outside 20 %
USERS' SCHEDULING CYCLE weeks
COST, ACCELERATOR
COST, FACILITY, total 13×10^6 rubles
FUNDED BY JINR

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS ENGINEERS
TECHNICIANS CRAFTS
GRAD STUDENTS involved during year
OPERATED BY Res staff or Operators
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above

USERS, in house 200 outside 30
GRAD STUDENTS involved during year
RES. BUDGET, in house
FUNDED BY

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 1500 m^2 m^2
movable m^2
TARGET STATIONS 4-7 in 2 rooms
STATIONS served at same time, max 2-3
MAG SPECTROGRAPH, type
COMPUTER, model EC-1040, EC-1010, H.P.
OTHER FACILITIES
Isotope production M-5, M-6, MU
Medico-Biological Complex,
YASNAPP.

REFERENCES/NOTES

MAGNET

POLE FACE diameter 600 cm; R extraction 270 cm
GAP, min 15-30 cm; Field 18 kG } at 1.7×10^6 ampere turns
max 120 cm; Field 12 kG }
AVERAGE FIELD at R ext 16.3 kG }
CURRENT STABILITY 50 parts/10^6; $B_{max}/(B)$ 1.1
NUMBER OF SECTORS 4 ; SPIRAL, max 77 deg
POLE FACE COIL PAIRS: AVF 0 /sec;
Harmonic correction 3 per sector
Rad grad /sec or Circ coils
WEIGHT: Fe 7000 tons; Coils 165 tons
CONDUCTOR, Material and type Al
STORED ENERGY about 10 MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 1100 max, kW
Trimming coils max, kW
YOKE/POLE AREA 58.5 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 7-10 cm; DC BIAS 2 kV
TUNED by, coarse VC fine
RF 13.4 to 14.4 mHz, stable ± /10^6
Orb F 13 to 14 mHz; GAIN, max 80 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 50 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
RF PHASE stable to ± 200 deg
RF POWER input, max kW
RF PROTECT circuit, speed μsec
Type
FREQUENCY MODULATION, rate 600 /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion Pumps
OPERATING PRESSURE 3-10 μTorr,
PUMPDOWN TIME about 8 hrs

ION SOURCES/INJECTION SYSTEM

P.I.G. type
Axial injector & Polarized ion source

EXTRACTION SYSTEM

Iron-Current Channel, 70%

CONTROL SYSTEM

typing limit

ENTRY NO. FM-13 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	700	
CURRENT		(μA)	(μA)
Internal	p	50	
External	p	35	
		(part/s)	(part/s)
Secondary	π^-	66×10^6	
	π^+	3×10^8	
	n	7×10^7	

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	____ RF deg	____ μA of	____ MeV	____	
Phase Exc, max	____ RF deg	____ μA of	____ MeV	____	
Extract Eff	____ %	____ μA of	____ MeV	____	
Res, ΔE/E	____ %	____ μA of	____ MeV	____	

Emittance

(mm-mrad) { ____ axial / ____ radial } ____ μA of ____ MeV ____

OPERATING PROGRAMS, time dist

Basic Nuclear Physics ____ %

Solid State Physics ____ %

Bio-Medical Applications ____ %

Isotope Production ____ %

Development ____ %

____ %

____ %

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

typing limit

ENTRY NO. FM-14

NAME OF MACHINE Leningrad Synchrocyclotron
INSTITUTION Leningrad Nuclear Physics Institute, Acad. of Sc. USSR
LOCATION Gatchina, Leningrad District DATE May 1972 ***
188350 USSR
IN CHARGE N.K. Abrosimov REPORTED by N.K. Abrosimov

HISTORY AND STATUS

DESIGN, date _____ MODEL tests _____
ENG. DESIGN, date _____
CONSTRUCTION, date 1967
FIRST BEAM date (or goal) Nov. 1967
MAJOR ALTERATIONS _____
OPERATION, 130 hr/wk; On Target _____ hr/wk
TIME DIST., in house 100 %, outside _____ %
USERS' SCHEDULING CYCLE 3 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 operators
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 2500 m^2
movable _____ m^2
TARGET STATIONS 9 in _____ ROOMS
STATIONS SERVED AT THE SAME TIME, max 2
MAG SPECTROGRAPH, type _____
ON-LINE COMPUTER, model _____
FACILITIES for
Isotope production _____
Irradiation, Solid State _____
Biological _____
Time-of-Flight Study _____
On-Line Mass Separation _____

NOTATIONS

MAGNET

POLE FACE dia 685 cm; R ext 316.5 cm
GAP, min 39 cm; Field _____ kG
max 50 cm; Field 19 kG } at 1.2 × 10^6 A-turns
AVE FIELD at R max 17.86 kG
CURRENT, STABILITY ± 100 parts/10^6
B max/<B> = 1
AVF SECTORS _____ SPIRAL, max _____ deg
POLE FACE coil pairs, AVF _____ /sec
Harmonic _____ /sec; Rad Grad _____ /sec, or
_____ circular; HEAVY ION, E max = _____ q^2/A
WEIGHT, Fe 7800 ~~XXXX~~ Al 174 tons
POWER, main coils 1000, pole tips _____
total 1000 kW; cooled by _____
YOKE/POLE area 128 %; θ sec (Sect Mag) _____ deg
TOTAL POWER, installed 2 MW
normal load 1 MW

ION SOURCE, int open with cold cathode
ext _____

ACCELERATION SYSTEM

DEES, number 1, width 180 deg
BEAM APERTURE 10 cm; DC BIAS 3 kV
TUNED by coarse _____, fine _____
RF 30.5 to 13.2 MHz, stable ± _____ /10^6
Orb F 28.9 to 13.2 Mc/s; GAIN 10 kV/t
HARMONICS, RF/OF, used 1
DEE-Gnd, max 10 kV, x/field, min _____ cm,
STABILITY, (pk-pk noise)/(pk RF volt) _____
RF PHASE stable to ± _____ deg
RF POWER input, max 240 (per pulse) kW
RF PROTECT curcuit, speed _____ μs
type _____
EXTRACT System Non-linear regenerat. systeme

FREQUENCY MODULATION, rate 50 /sec
MODULATOR, type Rotating capasitor
BEAM PULSE, width micro 20 nsec
macro 0.3 msec

SELECTED REFERENCES

1. Proc. of the Intern. Conf. on High Ener. Acc. Yerevan 1969 V.1, P.317,349.
2. Sov. Jour. of Tech. Phys. V.40 p.2593, V.41 p.1222, V.41 p.1769 (1971)

ENTRY NO. FM-14 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P	1000	1000
CURRENT		(μA)	(μA)
Internal	P		0.64
External	P		0.16
		(part/s)	(part/s)
Secondary	π^-		10^5
	π^+		10^6
HEAVIEST ion			

BEAM PROPERTIES

	Measured		Conditions	
Pulse Width	90	RF deg	0.64 μA of 1000	MeV
Phase Exc, max	90	RF deg	0.64 μA of 1000	MeV
Extract Eff	25	%	0.64 μA of 1000	MeV
Res, ΔE/E	1	%	μA of	MeV
Emittance (mm-mrad)	axial / radial		μA of	MeV

VACUUM norm 2 μtorr; PUMPDOWN time 2 hr

OPERATING PROGRAMS, time dist

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

OTHER FEATURES and OPERATION SUMMARY

1. The proton beam is extracted by means of a wide aperture non-linear regenerative systeme. When the extraction systeme was disigned, the spectrum of betatron oscillation present in machine was taken into account.
2. The proton beam may be stretched by means of cee-electrod systeme with the macro duty cycle 50-80% and efficiency 80-50 %. Cee -60° azimuth, freq. range 13.4 to 13.2 MHz, 2.5 kV peak, one long wave type resonance systeme with a ferrite modulation, D.C. power - 2 kW.

Typing limit