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

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.