

ENTRY NO. 8

NAME OF MACHINE University of Manitoba Spiral Ridge Cyclotron
 INSTITUTION University of Manitoba Accelerator Laboratory
 ADDRESS University of Manitoba, Winnipeg, Manitoba, R3T 2N2, CANADA
 TEL (204) 474-9378 TELEX 07-587721
 IN CHARGE J.S.C. McKee REPORTED BY S. Oh, V. Derenchuk, J. Anderson

HISTORY AND STATUS

DESIGN, date 1959 Model tests 1959-1961
 ENG DESIGN, date 1960-63
 CONSTRUCTION, date 1960-64
 FIRST BEAM, date (or goal) 1965
 MAJOR ALTERATIONS 100% external injection (1965).
 Magnetic field reshaped (1985) & a new dee system (1985).
 COST, ACCELERATOR \$ 600,000.00 (1960).
 COST, FACILITY, total \$ 1,500,000.00
 FUNDED BY University of Manitoba and NSERC

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 5 ENGINEERS 1
 TECHNICIANS 3 CRAFTS 1
 GRAD STUDENTS involved during year 8
 OPERATED BY X Research staff or Operators
 OPERATION hr/wk. On target hr/wk
 TIME DISTR, in house % outside %
 BUDGET, op & dev \$ 500,000.00
 FUNDED BY NSERC, University of Manitoba

RESEARCH STAFF, not included above

USERS, in house 13 outside 14
 GRAD STUDENTS involved during year 12
 RESEARCH BUDGET, in house
 FUNDED BY NSERC

MAGNET

POLE FACE, diameter (compact) 117 cm, R-extraction 30-52 cm
 R injection 0.8 cm
 GAP, min 3.6 cm, Field 26.5 kG
 max 15 cm, Field 15.5 kG at 280,000 Ampere turns
 AVERAGE FIELD at R ext 19.2-19.7 kG
 B max / 1.4
 NUMBER OF SECTORS {compact 4} Spiral, max 50 deg
 {separated}

SECTOR ANGLE (SSC) deg
 TRIMMING COILS Total of 64 Invar blocks situated on the four hills*
 CONDUCTOR, material and type Water cooled copper
 STORED ENERGY (cryogenic) MJ
 POWER: main coils 113 max kW; current stability 1/10⁴
 trimming coils * max kW; current stability *
 WEIGHT: Fe 38 tons; coils 4 tons
 COOLING system Demineralized water
 ION ENERGY (Bending limit) E/A = 50 q²/A² MeV/amu
 (Focusing limit) E/A = q/A MeV/amu

ACCELERATION SYSTEM

DEES, number 2 angle 55 deg
 BEAM APERTURE 1.8 cm; DC Bias -1 kV
 TUNED by, coarse Sliding Short fine Variable capacitor
 RF 21 to 31 MHz, stable ± ±1/10⁶
 Orb F 15.25 to 28.3 MHz
 HARMONICS, RF/Orb F, used 1 or 2
 DEE-Gnd, max 42 kV, min gap 0.3 cm
 STABILITY, (pk-pk noise)/(pk RF v_{q1}) 1/10³
 ENERGY GAIN, max 80 for H, 140 for D kV/turn
 RF PHASE, stable to ± 1 deg
 RF POWER input, max 2 x 15 kW
 FREQUENCY MODULATION, rate /s
 modulator, type E
 beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE 15-25 x 10⁻⁶ Torr or mbar
 PUMPS, No, Type, Size 2 x 16" Balzers diffusion pumps, 1 x 6" NRC diffusion pump, 2 cryopumps on injection system

ION SOURCES

Duoplasmatron, Ehlers source for H⁻ & D⁻, Lamb-shift nuclear spin filter source for H⁺ & D⁺ ions.

INJECTION SYSTEM

Axial injection

EXTRACTION SYSTEM

Stripping of electrons from H⁻ & D⁻ by a stripping foil.

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 300 m²; movable 20 m²
 TARGET STATIONS 7 in 2 rooms
 STATIONS served at same time, max 1
 MAG SPECTROGRAPH, type
 COMPUTER model VAX 11/750
 OTHER FACILITIES PIXE, Neutral Hydrogen Beam, 10-50 MeV, Proton Microprobe, High resolution spectroscopy, Isotope production

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (µA)	
	Goal	Achieved	Internal	External
P	20-50	20-50	10-1	10-1
d	10-27	11-21	5-1	5-1
H ⁰	10-50	23-47	4	0.25
d	10-27	11-21	12-2 nA	
SECONDARY			(part/s)	
n			~4 x 10 ⁷ sr ⁻¹	

BEAM PROPERTIES

MEASURED	CONDITIONS	
	MEASURED	CONDITIONS
PULSE WIDTH 20 RF deg	1 µA of 20-50 MeV	P ions
PHASE EXC. max 12 RF deg	µA of MeV	P ions
EXTRACT eff. 100%	µA of 20-50 MeV	P ions
RESOL ΔE/E 1.2%	µA of MeV	P ions
EMITTANCE		
(π mm-mrad) axial	µA of MeV	
rad		

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 40% SOLID STATES PHYSICS
 BIOMEDICAL APPLICAT. 20% ISOTOPE PRODUCTIONS 5%
 Applied Physics 35%

REFERENCES/NOTES

- IEEE Trans. Nucl. Sci. NS-32, No. 5 (1985) 2724.
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*Invar is an alloy with temperature dependent permeability. Magnetic field is shaped by controlling the temperature

PLAN VIEW OF FACILITY, COMMENTS, ETC. of each Invar block.

