

**ENTRY No.** 9 University of Manitoba  
 NAME OF MACHINE Cyclotron DATE July 10, 1981  
 INSTITUTION Cyclotron Laboratory, University of Manitoba  
 ADDRESS Winnipeg, Manitoba, Canada R3T 2N2  
 TEL (204) 474-9378 TELEX Q7587721  
 IN CHARGE J.S.C. McKee REPORTED BY S. Oh/ I. Gusdal

**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)

COST, ACCELERATOR \$600,000  
 COST, FACILITY, total \$1,500,000  
 FUNDED BY University & AECP (Canada)

**ACCELERATOR STAFF, OPERATION AND DEVELOPMENT**

SCIENTISTS 2 ENGINEERS 2  
 TECHNICIANS 4 CRAFTS 8  
 GRAD STUDENTS involved during year 1  
 OPERATED BY X Research staff or Operators  
 OPERATION 168 hr/wk, On target ~150 hr/wk  
 TIME DISTR. in house 95% Outside 5%  
 BUDGET, op & dev \$440,000  
 FUNDED BY NSERC (Canada)

**RESEARCH STAFF, not included above**

USERS, in house 12 outside 6  
 GRAD STUDENTS involved during year 10  
 RESEARCH BUDGET, in house \$260,000  
 FUNDED BY NSERC (Canada)

**MAGNET**

POLE FACE, diameter (compact) 117 cm, R extraction 26-53cm  
 R injection 0.5 cm  
 GAP, min 3.6 cm, Field 26.5 kG }  
 max 15 cm, Field 15.5 kG } at 3 x 10<sup>6</sup>  
 AVERAGE FIELD at R ext 19.1-19.7 kG } Ampere turns  
 B max/ <B> 1.4

NUMBER OF SECTORS { compact 4 } Spiral, max 47.5 deg  
 { separated }  
 SECTOR ANGLE (SSC) deg  
 TRIMMING COILS Total of 64 blocks of Invars forms the  
 four hills\*

CONDUCTOR, material and type Water cooled copper  
 STORED ENERGY (cryogenic) MJ  
 POWER: main coils 113 max, kW; current stability 1/10<sup>4</sup>  
 trimming coils \* max, kW; current stability \*  
 WEIGHT: Fe 38 tons; coils 4 tons  
 COOLING system Demineralized Water  
 ION ENERGY (bending limit) E/A = q<sup>2</sup>/a<sup>2</sup> MeV/amu  
 (focusing limit) E/A = .52 q/a MeV/amu

**ACCELERATION SYSTEM**

DEES, number 2; angle 45 deg  
 BEAM APERTURE 1.8 cm; DC Bias -1 kV  
 TUNED by, coarse M.S. fine  
 RF 14.24 to 28.48 MHz, stable ± 1/10<sup>5</sup>  
 Orb F 14.24 to 28.48 MHz  
 HARMONICS, RF/Orb F, used none  
 DEE - Gnd, max 40 kV, min gap 0.3 cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 1/10<sup>3</sup>  
 ENERGY GAIN, max 45 kV/turn  
 RF PHASE, stable to ± 10/10<sup>6</sup> deg  
 RF POWER input, max 15 kW  
 FREQUENCY MODULATION, rate /s  
 modulator, type  
 beam pulse, width

**VACUUM SYSTEM**

OPERATING PRESSURE 1.5 x 10<sup>-6</sup> Torr or mbar  
 PUMPS, No, Type, Size 3 diffusion pumps (Balzers)  
 2 Cryopumps on injection system (air products)

**ION SOURCES**

Duoplasmatron & lamb-shift spin-filter source for  
 H<sup>-</sup> and D<sup>-</sup> ions.

**INJECTION SYSTEM**

Axial injection

**EXTRACTION SYSTEM**

Stripping of electrons from H<sup>-</sup> & D<sup>-</sup> by a stripping foil

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed m<sup>2</sup>; movable ~300 m<sup>2</sup>  
 TARGET STATIONS 7 in 2 rooms  
 STATIONS served at same time, max 1  
 MAG SPECTROGRAPH, type  
 COMPUTER model PDD15/40 + 15/20  
 OTHER FACILITIES P.I.X.E. Analysis; High Resolution  
 Spectroscopy; Polarized He target; Neutron facility;  
 Isotope Production (<sup>123</sup>I, <sup>84</sup>Rb, <sup>81</sup>Kr)

**CHARACTERISTIC BEAMS**

PARTICLE	ENERGY (MeV)		CURRENT (µA)	
	Goal	Achieved	Internal	External
H <sup>-</sup>	22-50			10-0.2µA
D <sup>-</sup>	11-21			3-0.1µA
D <sup>+</sup>	11-21			12-2µA

**SECONDARY**

(part/s)  
 n ~ 4 x 10<sup>9</sup> s<sup>-1</sup>

**BEAM PROPERTIES**

MEASURED CONDITIONS  
 PULSE WIDTH 20 RF deg 1µ A of MeV P ions  
 PHASE EXC, max RF deg µ A of MeV ions  
 EXTRACT eff ~100% µ A of MeV ions  
 RESOL ΔE/E ~1.0% 0.1µ A of 45 MeV P ions  
 EMITTANCE

(π mm. mrad) { axial } µA of MeV ions  
 { rad }

**OPERATING PROGRAMS, time distribution**

BASIC NUCLEAR PHYSICS 85% SOLID STATES PHYSICS .5%  
 BIOMEDICAL APPLICAT. .3% ISOTOPE PRODUCTIONS .5%

**REFERENCES/NOTES**

\*Invar is an alloy with temperature sensitive permeability.  
 Magnetic field is shaped by 64 invar shims (8 under each hill)  
 and controlling the temperature of each invar blocks.

**PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES,**

**COMMENTS** Operates with axially injected beam since  
 1975. Sources include duoplasmatron and lamb-shift  
 polarized source. Polarized <sup>3</sup>He target in operation.

