ENTRY NO. 119
NAME OF MACHINE FMI CYCLOTRON
INSTITUTION Franklin McLean Memorial Research Institute
ADDRESS 5841 S. Maryland Avenue, Chicago, Illinois 60637
TEL TELEX
IN CHARGE S. J. Gatley REPORTED BY A. J. Creer/N. Odeh

HISTORY AND STATUS
DESIGN, date 1965 Model tests 1967
ENG DESIGN, date 1965-67
CONSTRUCTION, date 1969
FIRST BEAM, date (or goal) July, 1969
MAJOR ALTERATIONS Deflector
COST, ACCELERATOR 240,000
COST, FACILITY, total 600K
FUNDED BY Department of Energy

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT
SCIENTISTS 5 ENGINEERS 1
TECHNICIANS 4 CRAFTS 1
GRAD STUDENTS involved during year -
OPERATED BY X Research staff or Operators
OPERATION 15 hr/wk. On target 10 hr/wk
TIME DISTR. in house 100 %, outside - %
BUDGET, op & dev
FUNDED BY

RESEARCH STAFF, not included above
USERS, in house Yes outside -
GRAD STUDENTS involved during year 4
RESEARCH BUDGET, in house
FUNDED BY

MAGNET
POLE FACE, diameter (compact) 81 cm, R-extraction 35 cm
R injection cm
GAP, min 5 cm, Field 20 kG
max 10 cm, Field 12 kG } at 2×10^5 Ampere turns
AVERAGE FIELD at R ext 16 kG
B max/<B> 1.25
NUMBER OF SECTORS {compact / separated} Spiral, max deg
SECTOR ANGLE (SSC) deg
TRIMMING COILS 3 ea. 8 Turns 100A max.
CONDUCTOR, material and type Al Foil 1 mm
STORED ENERGY (cryogenic) MJ
POWER: main coils 58 max kW: current stability 5×10^{-4}
trimming coils max kW: current stability
WEIGHT Fe 14 tons: coils tons
COOLING system Water
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV/amu
(Focusing limit) E/A = q/A MeV/amu

ACCELERATION SYSTEM
DEES, number 2 angle deg
BEAM APERTURE 2 cm; DC Bias 1.5 KV kV
TUNED by, coarse MS fine VC Trimmer
RF 12 to 25 MHz, stable ± 1×10^{-4}
Orb F 12 to 25 MHz
HARMONICS, RF/Orb F, used
DEE-Gnd, max 30 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
ENERGY GAIN, max 60 max kV/turn
RF PHASE, stable to ± deg
RF POWER input, max. 29 kW
FREQUENCY MODULATION, rate /s
modulator, type
beam pulse, width

VACUUM SYSTEM
OPERATING PRESSURE 1×10^{-5} Torr or mbar
PUMPS, No, Type, Size 1 ea. 10" Oil Diffusion, 1 ea. 21 CFM Mechanical

ION SOURCES
Ion Heated Pig

INJECTION SYSTEM
None

EXTRACTION SYSTEM
Electrostatic Channel with Compensated Iron Chann

FACILITIES FOR RESEARCH
SHIELDED AREA, fixed 62 m², movable -- m²
TARGET STATIONS 2 in 2 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type --
COMPUTER model --
OTHER FACILITIES

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
Proton	15	14.8	110	55
Deut.	8	8.3	400	270
He 3++	20	20.3	120	53
He 4++	15	15	80	40
SECONDARY			(part/s)	

BEAM PROPERTIES

MEASURED		CONDITIONS			
PULSE WIDTH	RF deg	pμA of	MeV	ions	
PHASE EXC. max	RF deg	pμA of	MeV	ions	
EXTRACT eff. 55 %	270	pμA of 8	MeV	D	ions
RESOL ΔE/E 1 %		pμA of	MeV	ions	
EMITTANCE					
(π mm-mrad) 50 axial, 50 rad	90	pμA of	MeV		

OPERATING PROGRAMS, time distribution
BASIC NUCLEAR PHYSICS SOLID STATES PHYSICS
BIOMEDICAL APPLICAT 100% ISOTOPE PRODUCTIONS

REFERENCES/NOTES In AIP Conference Proceedings, #9, 1
1)Compact Cyclotron Engg. G.O. Hendry
2)ACRH Cyclotron, P.V. Harper
3) Design of Neutron Therapy Facility, F.T. Kuchnier

PLAN VIEW OF FACILITY, COMMENTS, ETC.

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