ENTRY NO. 99
NAME OF MACHINE FMI CYCLOTRON
INSTITUTION Franklin McLean Memorial Research Institute, University of Chicago
ADDRESS 950 East 59th Street, Chicago, IL 60637
TEL ..... TELEX .....
IN CHARGE P.V. Harper ..... REPORTED BY A. J. Creer

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 .....
COST, FACILITY, total 600K
FUNDED BY .....

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT
SCIENTISTS .5 ..... ENGINEERS 1
TECHNICIANS 2 ..... 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 ..... outside -
GRAD STUDENTS involved during year .....
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 ~~min~~ 10 cm, Field 12 kG at 2×10^5
AVERAGE FIELD at R ext 16 kG Ampere turns
B max/ < B > 1.25
NUMBER OF SECTORS { compact ..... } Spiral, max ... deg
{ separated ..... }
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 ..... 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 POWEP 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

EXTRACTION SYSTEM
Electrostatic Channel with Compensated Iron Channel

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
SECONDARY		(part/s)		

BEAM PROPERTIES

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

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

REFERENCES/NOTES In AIP Conference Proceedings, #9, 1972
1) Compact Cyclotron Engg. G.O. Hendry.
2) ACRH Cyclotron, P.V. Harper.
3) Design of Neutron Therapy Facility, F.T. Kuchnir.

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.