ENTRY NO. 83

NAME OF MACHINE FMI Cyclotron
INSTITUTION Franklin McLean Memorial Research Institute
LOCATION 950 E. 59th Street, Chicago, Ill 60637 DATE December 1, 1975

IN CHARGE P.V. Harper REPORTED by L.S. Skaggs

HISTORY AND STATUS

DESIGN, date 1965 MODEL tests 1967
ENG. DESIGN, date 1965-1967
CONSTRUCTION, date 1969
FIRST BEAM date (or goal) July 1969
MAJOR ALTERATIONS Deflector
OPERATION, 45 hr/wk; On Target 20 hr/wk
TIME DIST., in house 100 %, outside ____ %
USERS' SCHEDULING CYCLE ____ weeks
COST, ACCELERATOR ____
COST, FACILITY, total $600,000.00
FUNDED BY US - (AEC) - ERDA

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 1/2 ENGINEERS 1
TECHNICIANS 3 CRAFTS 1
ADMIN & CLER ____ TOTAL ____
GRAD. STUDENTS involved during year ____
OPERATED BY x Res staff or and Sp operators
BUDGET, op & dev ____
FUNDED BY USERDA

RESEARCH STAFF, not included above

USER GROUPS, in house 4 outside -
STAFF SCIENTISTS, in house 8 outside -
TOTAL RES STAFF, in house 15 outside -
GRAD STUDENTS involved during year 1
RES. BUDGET, in house ____
FUNDED BY USERDA

FACILITIES FOR RESEARCH PROGRAMS

SHIELDED AREA, fixed 62 m^2
movable 0 m^2
TARGET STATIONS 2 in 2 ROOMS
STATIONS SERVED AT THE SAME TIME, max 1
MAG SPECTROGRAPH, type ____
ON-LINE COMPUTER, model ____
FACILITIES for:
Isotope production water cooled targets
Irradiation, Solid State ____
Biological Neutron irradiation & dosimetry
Time-of-Flight Study ____
On-Line Mass Separation ____

NOTATIONS

MAGNET

POLE FACE dia 81 cm; R ext 35 cm
GAP, min 5 cm; Field 20 kG
max 10 cm; Field 12 kG at 0.2 x 10^6 A-turns
AVE FIELD at R max 16 kG
CURRENT, STABILITY ± 100 parts/10^6
B max/<B> = 1.25
AVF SECTORS 3 SPIRAL, max 0 deg
POLE FACE coil pairs, AVF ____ /sec
Harmonic 1 /sec; Rad Grad ____ /sec, or
____ circular; HEAVY ION, E max = ____ q^2/A
WEIGHT, Fe 14 , Cu, or Al ____ tons
POWER, main coils 58 KW , pole tips ____
total ____ kW; cooled by water
YOKE/POLE area ____ %; θ sec (Sect Mag) ____ deg
TOTAL POWER, installed ____ MW
normal load ____ MW

ION SOURCE, int Ion-heated Cath. Pig
ext ____

ACCELERATION SYSTEM

DEES, number 2 , width 120 deg
BEAM APERTURE 2 cm; DC BIAS 1.5 kV
TUNED by, coarse MS , fine VC-Trimmer
RF 12 to 25 MHz, stable ± 100 /10^6
Orb F 12 to 25 Mc/s; GAIN Max 60 kV/t
HARMONICS, RF/OF, used ____
DEE-Gnd, max 30 kV, x/field, min ____ cm,
STABILITY, (pk-pk noise)/(pk RF volt) ____
RF PHASE stable to ± ____ deg
RF POWER input, max 29 kW
RF PROTECT curcuit, speed ____ μs
type ____
EXTRACT System DC Electrostatic with compensated - iron channel

FREQUENCY MODULATION, rate ____ /sec
MODULATOR, type ____
BEAM PULSE, width ____ nsec

SELECTED REFERENCES

In AIP Conference Proceedings #9, 1972
1. Compact cyclotron engineering for application - G.O. Hendry p. 616-626
2. The ACRH Cyclotron - P.V. Harper et.al. p. 627-637.
3. Design of a Neutron Therapy Facility for a 30-inch cyclotron - F.T. Kuchnir et. al. p. 638-645

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P	15	14.8
	D	8	8.3
	$^3He^{++}$	20	20.3
CURRENT		(μA)	(μA)
Internal	P	100	110
	D	100	490
	^3He	100	120
External	P	50	55
	D	50	270
	^3He	50	53
		(part/s)	(part/s)
Secondary	n		
HEAVIEST ion	ALPHA		

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	____	RF deg	____	μA of ____	MeV	____
Phase Exc, max	____	RF deg	____	μA of ____	MeV	____
Extract Eff	~~55~~	%	~~270~~	μA of ~~8~~	MeV	~~D~~
Res, ΔE/E	1	%	____	μA of ____	MeV	____
Emittance (mm-mrad)	50 axial, 50 radial		90%			

VACUUM norm 1 μtorr; PUMPDOWN time 2 hr

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	100 %
Isotope Production	%
	%

OTHER FEATURES and OPERATION SUMMARY

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.