

ENTRY No. C64

NAME OF MACHINE Cleveland Clinic Fast Neutron Therapy Facility
INSTITUTION National Aeronautics & Administration, Lewis Research Center
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IN CHARGE James Blue REPORTED BY James Blue

HISTORY AND STATUS

DESIGN, date Ref. 1 Model tests
ENG DESIGN, date 1968-69
CONSTRUCTION, date 1970
FIRST BEAM, date (or goal) 1972
MAJOR ALTERATIONS Vertical and horizontal beams of
fast neutrons for cancer therapy
COST, ACCELERATOR \$ 1.5 M
COST, FACILITY, total \$ 2.0 M
FUNDED BY NASA, Cleveland Clinic, NCI
ACCELERATOR STAFF, OPERATION AND DEVELOPMENT
SCIENTISTS 0 ENGINEERS 1
TECHNICIANS 1 CRAFTS 1
GRAD STUDENTS involved during year 0
OPERATED BY Research staff or 1 Operators
OPERATION 30 hr/wk, On target 10 hr/wk
TIME DISTR. in house 90 % Outside 10 %
BUDGET, op & dev \$ 75,000
FUNDED BY NCI
RESEARCH STAFF, not included above
USERS, in house 2 outside 10
GRAD STUDENTS involved during year 0
RESEARCH BUDGET, in house \$ 25,000
FUNDED BY NCI, NASA
MAGNET
POLE FACE, diameter (compact) 17.5 cm, R extraction 73.5 cm
R injection 1.5 cm
GAP, min 17 cm, Field 19.2 kG }
max 41 cm, Field 8.8 kG } at
AVERAGE FIELD at R ext kG } Ampere turns
B max/
NUMBER OF SECTORS { compact 3 } Spiral, max deg
SECTOR ANGLE (SSC) { separated } deg
TRIMMING COILS 8 pair
CONDUCTOR, material and type copper-hollow, H₂O cooled
STORED ENERGY (cryogenic) MJ
POWER: main coils 250 max, kW; current stability 10
trimming coils 10 max, kW; current stability 100
WEIGHT: Fe 206 tons; coils 28 tons
COOLING system deionized water
ION ENERGY (bending limit) E/A = 55 q²/a² MeV/amu
(focusing limit) E/A = 45 q²/a² MeV/amu

ACCELERATION SYSTEM

DEES, number 2; angle 134 deg
BEAM APERTURE 2.5 cm; DC Bias 0 kV
TUNED by, coarse panels fine panels
RF 13.5 to 23 MHz, stable $\pm 10^{-8}$
Orb F 6, 7 to 23 MHz
HARMONICS, RF/Orb F, used 1 & 2
DEE - Gnd, max 70 kV, min gap 5 cm
STABILITY, (pk-pk noise)/(pk RF volt)
ENERGY GAIN, max 220 kV/turn
RF PHASE, stable to ± 2 deg
RF POWER input, max 200 kW
FREQUENCY MODULATION, rate /s
modulator, type
beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE 10^{-5} Torr or inbar
PUMPS, No, Type, Size two 40 cm diam. diffusion pumps
with freqn. baffles

ION SOURCES

Internal, hooded, hot filament

INJECTION SYSTEM

EXTRACTION SYSTEM

Electrostatic deflector and magnetic channel

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m²; movable m²
TARGET STATIONS 3 in two rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type none
COMPUTER model two IBM-PC
OTHER FACILITIES Cobalt-60 teletherapy unit

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (pA)	
	Goal	Achieved	Internal	External
p	50	46		50
d	26	26		50
³ He	80	80		5
⁴ He	52	52		5

SECONDARY
neutrons from 43 MeV p on Be yields 20 rad/min (part/s)
125 cm SSQ

BEAM PROPERTIES

MEASURED		CONDITIONS	
PULSE WIDTH	RF deg	pA of	MeV ions
PHASE EXC, max	RF deg	pA of	MeV ions
EXTRACT eff	%	30 pA of	43 MeV p ions
RESOL $\Delta E/E$	%	pA of	MeV ions

EMITTANCE

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

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS SOLID STATES PHYSICS
BIOMEDICAL APPLICAT. 95% ISOTOPE PRODUCTIONS 1%
RADIATION DAMAGE 4%

REFERENCES/NOTES

1) Modified 60" fixed freq. cycl. to MSU magnetic field and dee design with redesigned rf system.

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS