ENTRY No. C63

NAME OF MACHINE Cleveland Clinic Fast Neutron Therapy Facility
INSTITUTION ... National Aeronautics & Administrations Lewis Research Center
ADDRESS ..... M.S. 49-2 ....21000 Brookpark Rd. ..Cleveland, OH 44135
TEL ..(216) 433-6379..... TELEX
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 ..... 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) 175 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/ <B> .....
NUMBER OF SECTORS { compact ...3.. / separated ..... } Spiral, max .. deg
SECTOR ANGLE (SSC) ..... deg
TRIMMING COILS ....8 pair.....
.....
CONDUCTOR, material and type ..copper-hollow H_2O 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... q^2/a^2 MeV/amu
(focusing limit) E/A = ...45... q^2/a^2 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 ..13.6..... to .....23... mHz, stable ± ...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 mbar
PUMPS, No, Type, Size ..two 40 cm diam. diffusion pumps.
.....with freon baffles.....
.....

ION SOURCES

.....Internal, hooded, hot filament.....

INJECTION SYSTEM

.....

EXTRACTION SYSTEM

..Electrostatic deflector and magnetic channel.....

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed ..... m^3 ; movable ..... m^3
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 teletheapy unit .....
.....
.....

CHARACTERISTIC BEAMS

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

SECONDARY (part/s)
neutrons from 43 MeV p on Be yields 20 rad/min .....
125 cm $50 .....

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 ...60.. %	..30... pμ A of 43.. MeV p.. ions
RESOL ΔE/E ..... %	..... pμ A of .... MeV ... ions

EMITTANCE
(π mm. mrad) { ... axial / .... rad } ..... pμA of ..... MeV ... Ions

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