ENTRY NO. FM-10

NAME OF MACHINE 160 MeV Synchrocyclotron DATE 27 August, 1981

INSTITUTION Harvard Cyclotron Laboratory, Harvard University

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IN CHARGE A.M. Koehler REPORTED BY A.M. Koehler

HISTORY AND STATUS

DESIGN, date Model tests

ENG DESIGN, date

CONSTRUCTION, date 1946

FIRST BEAM, date (or goal) 1949

MAJOR ALTERATIONS increased energy and external beam, 1957

COST, ACCELERATOR $1,000,000

COST, FACILITY, total $1,700,000

FUNDED BY Office of Naval Research, 1946-67

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 2.5 ENGINEERS 1.5

TECHNICIANS 4 CRAFTS 1.5

GRAD STUDENTS involved during year 1

OPERATED BY X Research staff or X Operators

OPERATION 45 hr/week hr/wk. On target hr/wk

TIME DISTR. in house 5 %, outside 95 %

BUDGET, op & dev $310,000

FUNDED BY User's fees

RESEARCH STAFF, not included above

USERS, in house c. 1 outside c. 12

GRAD STUDENTS involved during year 1

RESEARCH BUDGET, in house $140,000

FUNDED BY National cancer Institute

MAGNET

POLE FACE, diameter (compact) 241 cm, R-extraction 105 cm

R injection cm

GAP, min 29.6 cm, Field 19.0 kG
max 30.5 cm, Field 18.3 kG } at 600,000 Ampere turns

AVERAGE FIELD at R ext 18.1 kG

B max/<B>

NUMBER OF SECTORS { compact -, separated - } Spiral, max deg

SECTOR ANGLE (SSC) - deg

TRIMMING COILS -

CONDUCTOR, material and type copper strip

STORED ENERGY (cryogenic) MJ

POWER: main coils 160 max kW: current stability 0.1%
trimming coils - max kW: current stability -

WEIGHT: Fe 641 tons: coils 74 tons

COOLING system closed loop 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 1; angle 180 deg

BEAM APERTURE 6 cm; DC Bias -2 kV

TUNED by, coarse fine

RF to MHz, stable ±

Orb F to MHz

HARMONICS, RF/Orb F, used

DEE-Gnd, max kV, min gap cm

STABILITY, (pk-pk noise)/(pk RF volt)

ENERGY GAIN, max kV/turn

RF PHASE, stable to ± deg

RF POWER input, max. kW

FREQUENCY MODULATION, rate 0 to 250 /s

modulator, type rotating capacitor

beam pulse, width 200 sec typ

VACUUM SYSTEM

OPERATING PRESSURE -6,000,000 Torr or mbar

PUMPS, No, Type, Size 4 NRC 6" oil

ION SOURCES

INJECTION SYSTEM

hot filament, pulsed arc "volcano"

EXTRACTION SYSTEM

passive regenerator and channel

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m^2; movable m^2

TARGET STATIONS in rooms

STATIONS served at same time, max

MAG SPECTROGRAPH, type

COMPUTER model

OTHER FACILITIES

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
proton		160	1μA	0.02μA
SECONDARY			(part/s)	

BEAM PROPERTIES

	MEASURED	CONDITIONS
PULSE WIDTH	60 RF deg	pμA of MeV ions
PHASE EXC. max	RF deg	pμA of MeV ions
EXTRACT eff	5 %	pμA of MeV ions
RESOL ΔE/E	1.5 %	pμA of MeV ions
EMITTANCE (π mm-mrad)	axial / rad	pμA of MeV

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 2% SOLID STATES PHYSICS 0%

BIOMEDICAL APPLICAT. 95% ISOTOPE PRODUCTIONS 2%

radiation damage, 1%

REFERENCES/NOTES

Self-suporting operation at $2400 per 24 hours day 1981-82. primarily used for proton beam therapy; 1700 patients so far, 170 per year. Third treatment area now underconstruction.

PLAN VIEW OF FACILITY, COMMENTS, ETC.