

ENTRY No. FM-8

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 4.5 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
AVERAGE FIELD at R ext 18.1 kG } Ampere turns
B max/

NUMBER OF SECTORS { compact - } 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 = q²/a² 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 8 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 m² ; movable m²
TARGET STATIONS in rooms
STATIONS served at same time, max
MAG SPECTROGRAPH, type
COMPUTER model
OTHER FACILITIES

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (μA)	
	Goal	Achieved	Internal	External
proton		160	1 μ A	0.02 μ A

SECONDARY

(part/s)

BEAM PROPERTIES

MEASURED		CONDITIONS	
PULSE WIDTH 60	RF deg	μ A of	MeV .. ions
PHASE EXC, max	RF deg	μ A of	MeV .. ions
EXTRACT eff	%	μ A of	MeV .. ions
RESOL ΔE/E 1.5	%	μ A of	MeV .. ions
EMITTANCE			
(π mm. mrad) { .. axial }	{ .. rad }	μ A of	MeV .. ions

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 2% SOLID STATES PHYSICS 0%
BIOMEDICAL APPLICAT. 95% ISOTOPE PRODUCTIONS 2%
radiation damage, 1%

REFERENCES/NOTES

Self-supporting operation at \$2400 per 24 hour day 1981-82.
Primarily used for proton beam therapy; 1700 patients so far,
170 per year. Third treatment area now under construction.

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS