ENTRY No. 101 Indiana University
NAME OF MACHINE Cyclotron Facility DATE
INSTITUTION Indiana University
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IN CHARGE J. Cameron REPORTED BY D.L. Friesel

HISTORY AND STATUS

DESIGN, date 1966 Model tests 1967-1972
ENG DESIGN, date 1968-1973
CONSTRUCTION, date 1968-1974
FIRST BEAM, date (or goal) September 24, 1975
MAJOR ALTERATIONS Electron Cooling Ring
$K = 560q^2/A$ Completed 1988
COST, ACCELERATOR $5 x 10^6 (initial operation, 1970 dollars)
COST, FACILITY, total $11 x 10^6 (initial operation, 1970 dollars)
FUNDED BY National Science Foundation

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 27 ENGINEERS 8
TECHNICIANS 29 CRAFTS 8
GRAD STUDENTS involved during year 2
OPERATED BY 4 Research staff or 9 Operators
OPERATION 138 Av. hr/wk, On target 115 Av. hr/wk
TIME DISTR. in house 50% %, Outside 50% %
BUDGET, op & dev $9 x 10^6$
FUNDED BY National Science Foundation, Indiana University

RESEARCH STAFF, not included above

USERS, in house 30 outside 180
GRAD STUDENTS involved during year 20 in house; 18 outside
RESEARCH BUDGET, in house $1.2 x 10^6$
FUNDED BY National Science Foundation

MAGNET (Main Cyclotron)

POLE FACE, diameter (compact) --- cm, R extraction 330 cm
R injection 101 cm
GAP, min 7.6 cm, Field 16.5 kG
max ∞ cm, Field <.2 kG
at 150,000 Ampere turns
AVERAGE FIELD at R ext 6.4 kG
B max/ <B> 2.50
NUMBER OF SECTORS compact --- / separated 4 Spiral, max N/A deg
SECTOR ANGLE (SSC) 36 deg
TRIMMING COILS 21 gradient, 4 axial harmonic, 4 radial harmonic
CONDUCTOR, material and type Hollow Copper
STORED ENERGY (cryogenic) --- MJ
POWER: main coils 400 max, kW ; current stability 5 parts in 10^6
trimming coils 100 max, kW ; current stability 4 parts in 10^6
WEIGHT: Fe 2000 tons ; coils 10 tons
COOLING system Deionized Water
ION ENERGY (bending limit) E/A = 215 q^2/a^2 MeV/amu
(focusing limit) E/A = 215 q^2/a^2 MeV/amu

ACCELERATION SYSTEM

DEES, number 2 ; angle (45° Geo.) (180° RF) deg
BEAM APERTURE 4 cm ; DC Bias 0 kV
TUNED by, coarse panels fine none
RF 25 to 35.5 mHz, stable ± 0.5 Hz
Orb F 1.6 to 9.0 mHz
HARMONICS, RF/Orb F, used 3-8, 11-16
DEE - Gnd, max 140 kV, min gap 3.0 cm
STABILITY, (pk-pk noise)/(pk RF volt) 1 part in 10^3
ENERGY GAIN, max 560 kV/turn
RF PHASE, stable to ± 0.5 deg
RF POWER input, max 150 kW
FREQUENCY MODULATION, rate --- /s
modulator, type ---
beam pulse, width $1 x 10^{-9}$ sec

VACUUM SYSTEM

OPERATING PRESSURE $2 x 10^{-9}$ Torr or mbar
PUMPS, No, Type, Size 2 35" Diffusion
4 CTI 20" Cryopanels

ION SOURCES

Duoplasmotron (H^+, H_2^+, H^-, d, He^+)
Beta-Euchriptite (Li^+)
Hot Filament PIG (H^+, He^{++})
Atomic Beam ($\vec{p}$,$\vec{d}$)

INJECTION SYSTEM

600 keV DC Terminal plus 1/3 Scale Injector Cyclotron

EXTRACTION SYSTEM

Non-Resonant Electrostatic/Magnetic

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 300 m² ; movable 800 m²
TARGET STATIONS 8 in 6 rooms
STATIONS served at same time, max 2
MAG SPECTROGRAPH, type QQDD (30 mSr), High Res. K600 QDD
COMPUTER model 1 VAX 8600, 3 VAX 750, PDP 11/44
OTHER FACILITIES Many Micro Vaxes
1) Beam Splitting Serves 2 Users Simultaneously
2) Stripper loop provides high brightness beams with variable pulse periods (1.8 to 10 μSec)

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
$p(\vec{p})$	200	215	7(0.5)	6(0.5)
$d(\vec{d})$	104	100	2(0.4)	1.5(0.3)
$^3He, ^4He$	300/200	270/200	0.7	0.6
$^6Li, ^7Li$	300/260	154/100	0.7	0.6

SECONDARY (part/s)
N/A

BEAM PROPERTIES

MEASURED		CONDITIONS
PULSE WIDTH	4 RF deg	all pμ A of all MeV all ions
PHASE EXC, max	7 RF deg	" pμ A of " MeV " ions
EXTRACT eff	98 %	" pμ A of " MeV " ions
RESOL ΔE/E	.04 %	" pμ A of " MeV " ions

EMITTANCE
(π mm. mrad) 1.5 axial / 1.5 rad all pμA of all MeV all ions

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 95% SOLID STATES PHYSICS ---
BIOMEDICAL APPLICAT. --- ISOTOPE PRODUCTIONS ---
Radiation Damage, Effects of Radiation on Satellite Born Equip. and other applications 5%

REFERENCES/NOTES

1) IUCF Status Report, R.E. Pollock, IEEE Trans, Nucl. Science, NS-26, No. 2, p. 1965 (1978).
2) The IUCF Cooler, R.E. Pollock, IEEE Trans. Nucl. Sci., NS-30, No. 4, p. 2056 (1983).

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS