

ENTRY No. 90

NAME OF MACHINE . . . 88-Inch Cyclotron DATE . . . July 24, 1981
 INSTITUTION . . . Lawrence Berkeley Laboratory
 ADDRESS . . . 1 Cyclotron Road, Berkeley, CA 94720, U.S.A.
 TEL . . . 415-486-5088 TELEX . . . 910-366-2037
 IN CHARGE . . . R. G. Stokstad REPORTED BY . . . David J. Clark

HISTORY AND STATUS

DESIGN, date . . . 1958 Model tests . . . 1958-59
 ENG DESIGN, date . . . 1959-61
 CONSTRUCTION, date . . . 1959-62
 FIRST BEAM, date (or goal) . . . Internal 1961, External 1962
 MAJOR ALTERATIONS External injection with polarized and heavy ions, MOPA RF System
 COST, ACCELERATOR . . . \$3.5 x 10⁶ (1962)
 COST, FACILITY, total . . . \$5.1 x 10⁶ (1962)
 FUNDED BY . . . U. S. Department of Energy
ACCELERATOR STAFF, OPERATION AND DEVELOPMENT
 SCIENTISTS . . . 2 ENGINEERS . . . 4
 TECHNICIANS . . . 15 CRAFTS . . . 4
 GRAD STUDENTS involved during year . . . 0
 OPERATED BY . . . Research staff or . . . X Operators
 OPERATION . . . 160 . . . hr/wk, On target . . . 110 . . . hr/wk
 TIME DISTR. in house . . . 75 . . . %, Outside . . . 25 . . . %
 BUDGET, op & dev . . . \$1.9 x 10⁶
 FUNDED BY . . . U. S. Department of Energy
RESEARCH STAFF, not included above
 USERS, in house (LBL) . . . 20 . . . outside . . . 70/yr.
 GRAD STUDENTS involved during year . . . 20
 RESEARCH BUDGET, in house . . . \$1.8 x 10⁶
 FUNDED BY . . . U. S. Department of Energy

MAGNET

POLE FACE, diameter (compact) 224. cm, R extraction . . . 99. cm
 R injection . . . cm
 GAP, min . . . 19 . . . cm, Field . . . 21 . . . kG }
 max . . . 30 . . . cm, Field . . . 15 . . . kG } at . . . 64 x 10⁶
 AVERAGE FIELD at R ext . . . 18 . . . kG } Ampere turns
 B max/ . . . 1.17 . . .
 NUMBER OF SECTORS { compact . . . 3 . . . } Spiral, max 55 deg
 separated . . . }
 SECTOR ANGLE (SSC) . . . deg
 TRIMMING COILS . . . 17 circular, 5 valley harmonic

CONDUCTOR, material and type Copper, hollow water-cooled
 STORED ENERGY (cryogenic) . . . MJ
 POWER : main coils . . . 700 . . . max, kW ; current stability . . . 10⁻⁵
 *trimming coils . . . 600 . . . max, kW ; current stability . . . 10⁻³
 WEIGHT : Fe . . . 290 . . . tons ; coils . . . 10 . . . tons
 COOLING system Demineralized water
 ION ENERGY (bending limit) E/A = . . . 160 . . . q²/a² MeV/amu
 (focusing limit) E/A = . . . 70 . . . q/a MeV/amu

ACCELERATION SYSTEM

DEES, number . . . 1 . . . ; angle . . . 180 . . . deg
 BEAM APERTURE . . . 3.8 . . . cm ; DC Bias . . . 0 . . . kV
 TUNED by, coarse MoV. panels . . . fine Var. cap. . . auto
 RF . . . 5.5 . . . to . . . 16.2 . . . mHz, stable ± 10⁻⁸
 Orb F . . . 1.1 . . . to . . . 16.2 . . . mHz
 HARMONICS, RF/Orb F, used . . . 1, 3, 5 . . .
 DEE - Gnd, max . . . 75 . . . kV, min gap . . . (at puller) . . . 1 . . . cm
 STABILITY, (pk-pk noise)/(pk RF volt) . . . 10⁻³
 ENERGY GAIN, max . . . 150 . . . kV/turn
 RF PHASE, stable to ± . . . deg
 RF POWER input, max . . . 300 . . . kW
 FREQUENCY MODULATION, rate . . . 0 . . . /s
 modulator, type
 beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE . . . 1-2 x 10⁻⁶ . . . Torr or mbar
 PUMPS, No, Type, Size Four oil diffusion pumps
 (Two 81 cm, two 25 cm, 1N trapped), One 20°K He
 cryopanel

ION SOURCES

Internal fil., FIG, External pol., FIG

INJECTION SYSTEM

Internal sources . . . External sources with axial injection.

EXTRACTION SYSTEM

D.c. electrostatic deflector

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m² ; movable 800 . . . m²
 TARGET STATIONS . . . 14 . . . in . . . 8 . . . rooms
 STATIONS served at same time, max . . . 1 . . .
 MAG SPECTROGRAPH, type . . . QSD, LBL Design
 COMPUTER model MOD Comp IV/25, Classic
 OTHER FACILITIES Isotope production, On-line Mass
 Separator (He Jet), Trans-uranium chemistry, In-beam
 Gamma-Ray, Bio-med Irradiation, Polarimeter, TOF System

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (pμA)	
	Goal	Achieved	Internal	External
p	≤ 50	2-60	≤ 3000	1-200
⁴ He	≤ 130	3-140	≤ 250	2-50
¹⁶ O 2+ . . . 6+		9-150 ^{av}		1-7
⁴⁰ Ar 2+ . . . 8+		4-224		0.5- .5

†Highest intensities for mid-range energies

BEAM PROPERTIES

MEASURED	CONDITIONS	
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PULSE WIDTH 6-20 RF deg	5 . . . μA of .65 MeV α ions	
PHASE EXC, max 20 RF deg	5 . . . μA of .65 MeV α ions	
EXTRACT eff . . . 50 . . . %	5 . . . μA of .65 MeV α ions	
RESOL ΔE/E . . . 3 . . . %	5 . . . μA of .65 MeV α ions	
EMITTANCE		
(π mm. mrad) { 22 axial } 5 . . . μA of .65 MeV α ions		
{ 16. rad }		

OPERATING PROGRAMS, time distribution (%)

BASIC NUCLEAR PHYSICS . . . 89 . . . SOLID STATES PHYSICS . . . 3 . . .
 BIOMEDICAL APPLICAT. ISOTOPE PRODUCTIONS . . . 1 . . .
 DEVELOPMENT . . . 7 . . .

REFERENCES/NOTES

*Installed, 300 kw max. power used.
 International Cyclotron Conferences
 Nucl. Instr. & Meth. 154, 1 (1978)
 IEEE Trans. Nucl. Sci. NS-28, 3,
 2934 (1981)

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS

