

ENTRY NO. 86

NAME OF MACHINE **88-Inch Cyclotron**
 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 ions, MOPA RF System, ECR source 1984**
 COST, ACCELERATOR **$\$3.5 \times 10^6$ (1962)**
 COST, FACILITY, total **$\$5.1 \times 10^6$ (1962)**
 FUNDED BY **U.S. Department of Energy**

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS **2** ENGINEERS **3**
 TECHNICIANS **11** CRAFTS **2**
 GRAD STUDENTS involved during year **0**
 OPERATED BY **0** Research staff or **4** Operators
 OPERATION **116** hr/wk, On target **80** hr/wk
 TIME DISTR, in house **63** %, outside **37** %
 BUDGET, op & dev **116** %

FUNDED BY **U.S. Department of Energy**

RESEARCH STAFF, not included above

USERS, in house **32** outside **115**
 GRAD STUDENTS involved during year **15**
 RESEARCH BUDGET, in house **15** %
 FUNDED BY **U.S. Department of Energy**

MAGNET

POLE FACE, diameter (compact) **224** cm, R-extraction **99** cm
 R injection **99** cm
 GAP, min **19** cm, Field **21** kG
 max **30** cm, Field **15** kG at 0.64×10^6
 AVERAGE FIELD at R ext **18** kG Ampere turns
 B max / < B > **1.17**

NUMBER OF SECTORS {compact **3**} Spiral, max **55** deg
 {separated **3**}

SECTOR ANGLE (ISSC) **3** deg
 TRIMMING COILS **17** circular, **5** valley harmonic

CONDUCTOR, material and type **Copper, hollow water-cooled**

STORED ENERGY (cryogenic) **1** 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 **DeminerIALIZED 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 $\pm 10^{-8}$
 Orb F **1.1** to **16.2** MHz
 HARMONICS, RF/Orb F, used **1, 3, 5, 7**
 DEE-Gnd, max **50** kV, min gap (puller) **1** cm
 STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}
 ENERGY GAIN, max **100** kV/turn
 RF PHASE, stable to \pm deg
 RF POWER input, max **300** kW
 FREQUENCY MODULATION, rate **0** /s
 modulator, type **beam pulse, width**

VACUUM SYSTEM

OPERATING PRESSURE **$1-2 \times 10^{-6}$** Torr or mbar
 PUMPS, No, Type, Size **Four oil diffusion pumps, (Two 81 cm, Two 25 cm), two 20°K cryopanel.**

ION SOURCES

Internal fil., Ext. pol., Ext. ECR (1984)

INJECTION SYSTEM

Internal source. External sources with axial injection

EXTRACTION SYSTEM

D.C. electrostatic deflector

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed **7** m²; movable **800** m²
 TARGET STATIONS **12** in **8** rooms rooms
 STATIONS served at same time, max **1**
 MAG SPECTROGRAPH, type **QSD, LBL Design**
 COMPUTER model **2 MOD Comp Classics, VAX 780**
 OTHER FACILITIES **Isotope production, On-line Mass Separator (He Jet), Trans-Uranium chemistry, In-beam Gamma-ray hall, Polarimeter, TOF System**

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (μ A)	
	Goal	Achieved	Internal	External
p	≤ 50	2-55	≤ 3000	1-200
⁴ He	≤ 130	3-140	≤ 250	2-50
¹⁶ O ²⁺	8+	9-560		.006-13
⁴⁰ Ar ²⁺	8+	4-787		.0002-3

† Highest intensities for low or mid-range energies

BEAM PROPERTIES

MEASURED	CONDITIONS	
	MEASURED	CONDITIONS
PULSE WIDTH 6-20 RF deg	.5 μ A of .65 MeV	.5 ions
PHASE EXC, max 20 RF deg	.5 μ A of .65 MeV	.5 ions
EXTRACT eff. .50 %	.5 μ A of .65 MeV	.5 ions
RESOL $\Delta E/E$.0.3 %	.5 μ A of .65 MeV	.5 ions
EMITTANCE	.22 axial	.5 μ A of .65 MeV
(π mm-mrad)	.16 rad	.5 μ A of .65 MeV

OPERATING PROGRAMS, time distribution (%)

BASIC NUCLEAR PHYSICS **.84** SOLID STATES PHYSICS **.11**
 BIOMEDICAL APPLICAT. **.5** ISOTOPE PRODUCTIONS **.5**
 DEVELOPMENT **.5**

REFERENCES/NOTES *Installed, 300 kw max. power used.

- 1) International Cyclotron Conferences.
- 2) Nucl. Instr. & Meth. 154, 1 (1978)
- 3) IEEE Trans. Nucl. Sci. NS-28, 3, 2934 (1981).
- 4) IEEE Trans. Nucl. Sci., NS-32, 5, 1745 (1985).

PLAN VIEW OF FACILITY, COMMENTS, ETC.

