ENTRY NO. 79

NAME OF MACHINE Lawrence Berkeley Laboratory 88-Inch Cyclotron DATE 7/28/78
INSTITUTION Lawrence Berkeley Laboratory
ADDRESS 1 Cyclotron Road, Berkeley, California 94720, U.S.A.

IN CHARGE David K. Scott REPORTED by Richard A. Gough

HISTORY AND STATUS

DESIGN, date 1958 MODEL tests 1958-59
ENG. DESIGN, date 1959-1961
CONSTRUCTION, date 1959-1962
FIRST BEAM date (or goal) int. 1961; ext. 1962
MAJOR ALTERATIONS None

OPERATION, 160 hr/wk; On Target 122 hr/wk
TIME DIST., in house 50 %, outside 50* %
USERS' SCHEDULING CYCLE one weeks
COST, ACCELERATOR 2.9×10^6
COST, FACILITY, total 8.0×10^6
FUNDED BY U.S. Department of Energy

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 2 ENGINEERS 3
TECHNICIANS 13 CRAFTS 5
GRAD STUDENTS involved during year 0
OPERATED BY ____ Res staff or X Operators
BUDGET, op & dev 1.47×10^6
FUNDED BY U. S. Department of Energy

RESEARCH STAFF, not included above

USERS, in house 12 outside 61/year
GRAD STUDENTS involved during year 15
RES. BUDGET, in house $805,000
FUNDED BY U.S. Department of Energy

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed - m^2
movable 700 m^2
TARGET STATIONS 14 in 8 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type LBL QSD
COMPUTER, model SCC-660, ModComp 4, PDP-15
OTHER FACILITIES Isotope Production, Bio-Medical Irradiation Facility, On-Line (He Jet) Mass Separator, Polarimeter, Transfermium Chemistry Facility, In-Beam Gamma Ray Facility

REFERENCES/NOTES

Nucl. Instr. & Meth. 18-19, 33&59 (1962).
CERN Report 63-19, 8 (1963).
IEEE Trans.Nucl.Sci. NS-13, 4, 364 (1966).
Nucl. Instr. & Meth. 72, 61 (1969).
Proc. 5th Int'l Cycl. Conf. 610 (1971).
IEEE Trans.Nucl.Sci. NS-19, 2, 114 (1972).
Proc. 6th Int'l Cycl. Conf. 265 (1972).
Nucl. Instr.&Meth. (in press) LBL-6502.

(*21% by Users Outside LBL, 29% by LBL and UC Berkeley Staff Non Resident at Cyclotron)

MAGNET

POLE FACE diameter 224 cm; R extraction 99 cm
GAP, min 19 cm; Field 20 kG
max 30 cm; Field 14 kG
} at 0.55×10^6 ampere turns
AVERAGE FIELD at R ext 17 kG
CURRENT STABILITY 10 parts/10^6; $B_{max}/\langle B \rangle$ 1.18
NUMBER OF SECTORS 3 ; SPIRAL, max 55 deg
POLE FACE COIL PAIRS: AVF - /sec;
Harmonic correction 5
Rad grad - /sec or Circ coils 17
WEIGHT: Fe 290 tons; Coils 10 tons
CONDUCTOR, Material and type Copper
STORED ENERGY ~ 1.4 MJ
COOLING SYSTEM Demineralized water
POWER: Main coils 450 max, kW
Trimming coils 580 max, kW
YOKE/POLE AREA 102 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 145 q^2/A^2 MeV
(Focusing limit) E/A = 70 q/A MeV

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 5.53 to 16.5 mHz, stable ± 0.01 /10^6
Orb F 1.1 to 16.5 mHz; GAIN, max ≤ 150 kV/turn
HARMONICS, RF/Orb F, used 1,3,5
DEE-Gnd, max 75 kV, min gap 1 cm
STABILITY, (pk-pk noise)/(pk RF volt) 10^{-3}
RF PHASE stable to ± - deg
RF POWER input, max 250 kW
RF PROTECT circuit, speed ~ 15 μsec
Type Thyratron
FREQUENCY MODULATION, rate 0 /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 4 Diffusion pumps (two 76cm, two25cm) & 20°K He cryopanel
OPERATING PRESSURE 1-2 μTorr,
PUMPDOWN TIME 1-4 hrs to operate; 24 hrs to base

ION SOURCES/INJECTION SYSTEM

Int.fil A ≤ 4, Int. Penning A > 4, Ext.polarized p,d,Ext. Penning(1979)

EXTRACTION SYSTEM

D. C. Electrostatic Deflector

CONTROL SYSTEM

Manual

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	P	50	60
	α	130	140
	$^{12}C^{4+}$	-	193.4
	$^{16}O^{6+}$	-	315
CURRENT		(μA)	(μA)
Internal	P		3000@15cm
	α		500@15cm
External	P		30-200
	α		10-100
	$^{7}Li^{2+}$		5
	$^{10}B^{3+}$		95
	$^{40}Ar^{8+}$		0.9
	pol. p,d	(part/s)	0.3 (part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions			
Pulse Width	6-20	RF deg	10	μA of	65	MeV α
Phase Exc, max	20	RF deg	10	μA of	65	MeV α
Extract Eff	50	%	10	μA of	65	MeV α
Res, ΔE/E	0.3	%	10	μA of	65	MeV α

Emittance

(mm-mrad) { 70 axial / 50 radial } 10 μA of 65 MeV α

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	90 %
Solid State Physics	0 %
Bio-Medical Applications	2 %
Isotope Production	1 %
Development	7 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Noteworthy features are the high intensity polarized proton and deuteron beams, and high energy heavy-ion beams, such as ^{16}O -20 MeV/nucleon. Fully stripped beams of ^{14}N - 32 MeV/nucleon have also been accelerated ($\leqslant 10^3$ particle/second). These energies approach the anticipated lowest energies of the Bevalac after the planned upgrading, permitting complementary studies of heavy ion reactions.

88-INCH CYCLOTRON FACILITY