ENTRY NO. 84

NAME OF MACHINE University of Colorado Isochronous Cyclotron DATE July 1978
INSTITUTION University of Colorado, Nuclear Physics Laboratory
ADDRESS Boulder, Colorado 80309 USA

IN CHARGE J.J. Kraushaar, D.A. Lind REPORTED by A.B. Phillips

HISTORY AND STATUS

DESIGN, date 1956-57 MODEL tests 1957-59
ENG. DESIGN, date 1958-61
CONSTRUCTION, date 1960-62
FIRST BEAM date (or goal) 1962; full use 1963
MAJOR ALTERATIONS Added beam transport system
OPERATION, 105 hr/wk; On Target 82 hr/wk
TIME DIST., in house 99.5 %, outside 0.5 %
USERS' SCHEDULING CYCLE 2 - 4 weeks
COST, ACCELERATOR $\$1.55 \times 10^6$
COST, FACILITY, total $\$2.95 \times 10^6$
FUNDED BY DOE and State of Colorado

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 2
TECHNICIANS 3 CRAFTS 2
GRAD STUDENTS involved during year 0
OPERATED BY X Res staff or Operators
BUDGET, op & dev Included in research budgt.
FUNDED BY DOE and State of Colorado

RESEARCH STAFF, not included above

USERS, in house 12 outside 5
GRAD STUDENTS involved during year 15
RES. BUDGET, in house $1,151,000
FUNDED BY DOE, NIH, and State of Colo.

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 44 m^2
movable 12 m^2
TARGET STATIONS 7 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type Energy-loss
COMPUTER, model PDP-9, PDP-11
OTHER FACILITIES Isotope production; Irradiation, solid state; Biological; Neutron time-of-flight; Fast rabbit; Beam-swinger

REFERENCES/NOTES

1. J.J. Kraushaar, D.A. Lind, M.E. Rickey, and W.R. Smythe, European Organization for Nuclear Research (CERN) Report 63-19, p.31-38 (1963).

2. D.A. Lind, J.J. Kraushaar, W.R. Smythe, and M.E. Rickey, Nuclear Inst. & Meth. 18, 62-65 (1962).

MAGNET

POLE FACE diameter 132 cm; R extraction 60 cm
GAP, min 12 cm; Field kG
max 21 cm; Field kG
AVERAGE FIELD at R ext 12.6 kG
at 0.3×10^6 ampere turns
CURRENT STABILITY ± 10 parts/10^6; $B_{max}/\langle B\rangle$ 1.25
NUMBER OF SECTORS 4 ; SPIRAL, max 45 deg
POLE FACE COIL PAIRS: AVF 4 /sec;
Harmonic correction 1 pair
Rad grad 4 /sec or Circ coils
WEIGHT: Fe 85 U.S. tons; Coils 14 U.S. tons
CONDUCTOR, Material and type Cu
STORED ENERGY MJ
COOLING SYSTEM Internal distilled water
POWER: Main coils 100 max, kW
Trimming coils 48 max, kW
YOKE/POLE AREA 130 %
SECTOR ANGLE (Sep Sec) --- deg
ION ENERGY (Bending limit) E/A = 36 q^2/A^2 MeV
(Focusing limit) E/A = 28 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3.2 cm; DC BIAS 0 kV
TUNED by, coarse move short fine auto VC
RF 6 to 21 mHz, stable ± 0.5 parts /10^6
Orb F 1.2 to 21 mHz; GAIN, max 150 kV/turn
HARMONICS, RF/Orb F, used 1 & 3
DEE-Gnd, max 85 kV, min gap 2.5 cm
STABILITY, (pk-pk noise)/(pk RF volt) 4×10^{-4}
RF PHASE stable to ± 0.72 deg
RF POWER input, max 75 kW
RF PROTECT circuit, speed 5 μsec
Type dee spark sensor
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size one 20-inch oil diffusion, one 10-inch oil diffusion
OPERATING PRESSURE 2 μTorr,
PUMPDOWN TIME 3 hrs

ION SOURCES/INJECTION SYSTEM

Hooded arc, H_2O cooled Cu chimney, pulsing option

EXTRACTION SYSTEM

Electrostatic deflector, mag. channel

CONTROL SYSTEM

Manual

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	10-30	0.3-28
	d	18	0.3-18
	^{3}He	45	16-44
	α	36	2-36
CURRENT		(μA)	(μA)
Internal	p		200
	^{3}He		100
	α		100
External	p		40
	^{3}He		20
	α		15
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	2 RF deg	5 μA of 23 MeV p
Phase Exc, max	2 RF deg	5 μA of 23 MeV p
Extract Eff	10-40 %	μA of MeV
Res, ΔE/E	0.05 %	5 μA of 23 MeV p
Emittance (mm-mrad)	5.08 axial; 1.83 radial	65%·5 μA of 23 MeV p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	95 %
Solid State Physics	--- %
Bio-Medical Applications	1 %
Isotope Production	1 %
Development	1 %
Applied Nuc. Science (Environment)	2 %

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

Other features and Operation summary:

Hydrogen ion source can be pulsed by control electrode to eliminate beam bursts for time-of-flight measurements. This source has also been used to identify true single-turn extractions.

A beam-swinger capable of delivering beam from -90° to $+135^{\circ}$ on a fixed target supplies input for a fixed 90° energy-loss spectrometer. The spectrometer has a resolution $\Delta E/E = 5 \times 10^{-4}$ and uses a multi-wire proportional chamber. The beam-swinger also varies the scattering angle in experiments using long fixed flight paths of 9 and 30 meters for neutron time-of-flight.

Selected references (continued)

3. D.A. Lind, M.E. Rickey, and B.M. Bardin, Nucl. Instr. & Meth. 18, 19, 129-134 (1962).

4. Rodman Smythe, Nucl. Instr. & Meth. 18, 19, 582 (1962).

5. Jon W. Osterlund and Rodman Smythe, IEEE Transaction on Nuclear Science NS-12, No. 3, 174 (1965).

6. R.F. Bentley, L.A. Erb, D.A. Lind, C.D. Zafiratos, and C.S. Zaidins, Nucl. Instr. & Meth. 83, 245 (1970).