ENTRY NO. 62

NAME OF MACHINE Cyclo-Graaff Injector, Triangle Universities Nuclear Laboratory (TUNL) DATE 1/8/79
INSTITUTION Duke University, UNC-CH, NCSU
ADDRESS Durham, N. C.

IN CHARGE E. G. Bilpuch REPORTED by F. O. Purser

HISTORY AND STATUS

DESIGN, date 1964* MODEL tests ---
ENG. DESIGN, date 1965
CONSTRUCTION, date
FIRST BEAM date (or goal) Factory 1966, Site 1968
MAJOR ALTERATIONS Harmonic Coil Sets

OPERATION, 50 hr/wk; On Target 50 hr/wk
TIME DIST., in house 100 %, outside %
USERS' SCHEDULING CYCLE 4 weeks
COST, ACCELERATOR Cyclotron $360,000.00
COST, FACILITY, total Tandem $1,250,000.00 $3,945,000.00
FUNDED BY ~~AEC, NSF, HEW, N.C., Duke Univ.~~

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS Part time ENGINEERS 0
TECHNICIANS 4 CRAFTS 1-4
GRAD STUDENTS involved during year Part Time
OPERATED BY X Res staff or Operators
BUDGET, op & dev
FUNDED BY US DOE and Universities

RESEARCH STAFF, not included above

USERS, in house -- outside --
GRAD STUDENTS involved during year 26
RES. BUDGET, in house $800,000.00
FUNDED BY US DOE

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 1000 m^2
movable m^2
TARGET STATIONS 11 in 3 rooms
STATIONS served at same time, max 2
MAG SPECTROGRAPH, type ---
COMPUTER, model DDP-224
OTHER FACILITIES

REFERENCES/NOTES

* Invention of Cyclo-Graaff by H. W. Newson
The Cyclo-Graaff, Concept and Practice, F.O. Purser, H.W. Newson, N.R. Roberson, E.G. Bilpuch and R.L. Walter, Proceedings of the Fifth International Cyclotron Conference, Oxford, Eng., 1969

MAGNET

POLE FACE diameter 80 cm; R extraction 33.5 cm
GAP, min 5 cm; Field 20 kG } at X 10^6 ampere turns
max 10 cm; Field 12 kG
AVERAGE FIELD at R ext 16.4 kG
CURRENT STABILITY parts/10^6; $B_{max}/\langle B \rangle$ 1.25
NUMBER OF SECTORS 3 ; SPIRAL, max 0 deg
POLE FACE COIL PAIRS: AVF /sec;
Harmonic correction 2
Rad grad 0 /sec or Circ coils
WEIGHT: Fe tons; Coils tons
CONDUCTOR, Material and type
STORED ENERGY MJ
COOLING SYSTEM Hollow core copper H_2O
POWER: Main coils 30 KW max, kW
Trimming coils max, kW
YOKE/POLE AREA %
SECTOR ANGLE (Sep Sec) deg
ION ENERGY (Bending limit) E/A = q^2/A^2 MeV
(Focusing limit) E/A = q/A MeV

ACCELERATION SYSTEM

DEES, number 2 angle 120 deg
BEAM APERTURE 2 cm; DC BIAS 1.0 kV
TUNED by, coarse R.F. Strap fine movable strap
RF 12 to 25.5 mHz, stable ± 50 /10^6
Orb F 12 to 25.5 mHz; GAIN, max 100 kV/turn
HARMONICS, RF/Orb F, used 1
DEE-Gnd, max 35 kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.002
RF PHASE stable to ± 5 deg
RF POWER input, max 40 kW
RF PROTECT circuit, speed 1.0 μsec
Type Ignition Crowbar
FREQUENCY MODULATION, rate /sec
MODULATOR, type
BEAM PULSE, width

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion Pumps, 2 12", 1 4".
OPERATING PRESSURE μTorr,
PUMPDOWN TIME hrs

ION SOURCES/INJECTION SYSTEM

PIG, Axial Injection

EXTRACTION SYSTEM D.C. Electrostatic with 1st harmonic bump and magnetic channel.

CONTROL SYSTEM

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	H^-	15	15
	D^-	8	8
CURRENT		(μA)	(μA)
Internal	H^-	50	100
	D^-	20	50
External	H^-	10	25
	D^-	2	10
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured		Conditions		
Pulse Width	18 RF deg	20 μA of	15 MeV	H^-	
Phase Exc, max	____ RF deg	____ μA of	____ MeV		
Extract Eff	30.50%	15 μA of	15 MeV	H^-	
Res, ΔE/E	0.3%	15 μA of	15 MeV	H^-	
Emittance					
(mm-mrad) { 20 axial, 20 radial }		10 μA of	15 MeV	H^-	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	100 %
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	%
Development	%
	%
	%

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

Beam Properties with Internal Phase Limiting Slits

Pulse Width 3.2 RF Deg. 1.5 μA of 15 MeV H^-

Extract Eff. 60 % 2.0 " 15 " H^-

Res. ΔE/E 0.1 % 2.0 " 15 " H^-

Burst Length ≤ 0.5 ns

SELECTED REFERENCES (Cont)

An Operational Review of the TUNL Cyclo-Graaff, H.W. Newson, E.G. Bilpuch, F.O. Purser, J.R. Boyce, Duke University and TUNL and T.B. Clegg, University of North Carolina at Chapel Hill and TUNL, Nucl. Instr. and Meth. 122 (1974) 99.

Cyclo-Graaff Laboratory