

ENTRY NO. 44

NAME OF MACHINE Groningen Isochronous Cyclotron DATE Aug. '78  
 INSTITUTION Kernfysisch Versneller Instituut  
 ADDRESS Zernikelaan 25, Groningen, The Netherlands.  
 IN CHARGE R.H. Siemssen REPORTED by H.W. Schreuder

**HISTORY AND STATUS**

DESIGN, date 1963 MODEL tests 1964-1966  
 ENG. DESIGN, date 1966-1968  
 CONSTRUCTION, date 1968-1970  
 FIRST BEAM date (or goal) 1970  
 MAJOR ALTERATIONS central region (1972)  
 OPERATION, 126 hr/wk; On Target 84% hr/wk  
 TIME DIST., in house 80 %, outside 20 %  
 USERS' SCHEDULING CYCLE - weeks  
 COST, ACCELERATOR \$ 4 \* 10<sup>6</sup>  
 COST, FACILITY, total \_\_\_\_\_  
 FUNDED BY Groningen University

**ACCELERATOR STAFF, OPERATION and DEVELOPMENT**

SCIENTISTS 2 ENGINEERS 1  
 TECHNICIANS 10 CRAFTS 2  
 GRAD STUDENTS involved during year 1  
 OPERATED BY  Res staff or 8 Operators <sup>4)</sup>  
 BUDGET, op & dev \_\_\_\_\_  
 FUNDED BY Groningen University and Foundation F.O.M.

**RESEARCH STAFF, not included above**

USERS, in house 20 outside 8  
 GRAD STUDENTS involved during year 11  
 RES. BUDGET, in house \_\_\_\_\_  
 FUNDED BY Groningen University and Foundation F.O.M.

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed \_\_\_\_\_ m<sup>2</sup>  
 movable 450 m<sup>2</sup> <sup>1)</sup>  
 TARGET STATIONS 8 in 6 rooms  
 STATIONS served at same time, max 1  
 MAG SPECTROGRAPH, type Q3D  
 COMPUTER, model 3 PDP 15  
 OTHER FACILITIES \_\_\_\_\_  
In-beam gamma ray facility  
Gamma multiplicity set-up  
Scattering chambers  
Beam pulser

**REFERENCES/NOTES**

- 1) 3 more target stations and one more room in 1979.
- 2) axial injection in design stage.
- 3) computer control: start in 1979.
- 4) 8 half-time operators.

**MAGNET**

POLE FACE diameter 280 cm; R extraction 121 cm  
 GAP, min 22.4 cm; Field 20 kG } at \_\_\_\_\_ X 10<sup>6</sup>  
 max 45 cm; Field 10 kG } ampere turns  
 AVERAGE FIELD at R ext 16 kG  
 CURRENT STABILITY + 5 parts/10<sup>6</sup>; B<sub>max</sub>/(B) 1.25  
 NUMBER OF SECTORS 3; SPIRAL, max 56 deg  
 POLE FACE COIL PAIRS: AVF \_\_\_\_\_ /sec;  
 Harmonic correction 5 / sector  
 Rad grad \_\_\_\_\_ /sec or Circ coils 12  
 WEIGHT: Fe 650 tons; Coils 29 tons  
 CONDUCTOR, Material and type aluminum  
 STORED ENERGY \_\_\_\_\_ MJ  
 COOLING SYSTEM demin. water  
 POWER: Main coils 360 max, kW  
 Trimming coils 100 max, kW  
 YOKE/POLE AREA 113 %  
 SECTOR ANGLE (Sep Sec) \_\_\_\_\_ deg  
 ION ENERGY (Bending limit) E/A = 160 q<sup>2</sup>/A<sup>2</sup> MeV  
 (Focusing limit) E/A = 80 q/A MeV

**ACCELERATION SYSTEM**

DEES, number 1 angle 180 deg  
 BEAM APERTURE 2.5 cm; DC BIAS 0.5 kV  
 TUNED by, coarse mov. short fine trim. cap.  
 RF 4.7 to 13.9 MHz, stable ± 5 /10<sup>6</sup>  
 Orb F \_\_\_\_\_ to \_\_\_\_\_ MHz; GAIN, max 140 kV/turn  
 HARMONICS, RF/Orb F, used 1,3  
 DEE-Gnd, max 70 kV, min gap 1 cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 3.10<sup>-4</sup>  
 RF PHASE stable to ± \_\_\_\_\_ deg  
 RF POWER input, max 150 kW  
 RF PROTECT circuit, speed \_\_\_\_\_ μsec  
 Type series tube  
 FREQUENCY MODULATION, rate 0 /sec  
 MODULATOR, type \_\_\_\_\_  
 BEAM PULSE, width \_\_\_\_\_

**VACUUM SYSTEM**

PUMPS, No., Type, Size 2 diffusion pumps  
Ø 50 cm, one 3000ℓ/s cryopump  
 OPERATING PRESSURE 2 μTorr,  
 PUMPDOWN TIME 2 hrs

**ION SOURCES/INJECTION SYSTEM**

Livingston (2 types) } 2)  
PIG (in development)

**EXTRACTION SYSTEM**

electrostatic 55°

**CONTROL SYSTEM**

manual <sup>3)</sup>

ENTRY NO. 44 (cont.)

CHARACTERISTIC BEAMS

	Particle	<del>XX</del> 9001 (MeV)	Achieved (MeV)
ENERGY	$\alpha$	25	140
	$^{12}\text{C}^{3+,4+}$	50	200
	$^{16}\text{O}^{4+}$		160
CURRENT		( $\mu\text{A}$ )	( $\mu\text{A}$ )
Internal			
External			
Secondary		(part/s)	(part/s)

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	5-40 RF deg	$\mu\text{A}$ of MeV
Phase Exc, max	RF deg	$\mu\text{A}$ of MeV
Extract Eff	50 %	$\mu\text{A}$ of MeV
Res, $\Delta E/E$	0.3 %	$\mu\text{A}$ of MeV
Emittance	(mm-mrad) { 30 axial } $\mu\text{A}$ of MeV	
		{ 20 radial }

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	80	%
Solid State Physics		%
Bio-Medical Applications	7	%
Isotope Production		%
Development	10	%
radiation damage studies	3	%

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

plan view and status report: Dermois et al., these Proceedings.

- \* ) beam currents for light ions limited by septum dissipation.  
 300 nA analysed beam on target typical  
 beam currents for C and O beams limited by Livingston source:  
 5-400 en A external.