ENTRY NO. 72

NAME OF MACHINE: NAC Pretoria Cyclotron

INSTITUTION: National Accelerator Centre, Council for Scientific and Industrial Research
ADDRESS: NAC, CSIR, P O Box 395, Pretoria, 0001, Republic of South Africa
TEL: 012-86-9211 TELEX: 3-630 SA
IN CHARGE: F J Haasbroek REPORTED BY: A H Botha

HISTORY AND STATUS

DESIGN, date: 1950 Model tests: –
ENG DESIGN, date: 1951 – 1953
CONSTRUCTION, date: 1953 – 1958
FIRST BEAM, date (or goal): 1958
MAJOR ALTERATIONS: (See below)

COST, ACCELERATOR:
COST, FACILITY, total: R200 000 (1958)
FUNDED BY: CSIR

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS: – ENGINEERS: 1 (part-time)
TECHNICIANS: 6 CRAFTS: 2
GRAD STUDENTS involved during year: –
OPERATED BY: – Research staff or: 5 Operators
OPERATION: 136 hr/wk. On target: 110 hr/wk
TIME DISTR. in house: 100 %, outside: – %
BUDGET, op & dev: –
FUNDED BY: CSIR

RESEARCH STAFF, not included above

USERS, in house: 4 outside: 3
GRAD STUDENTS involved during year: –
RESEARCH BUDGET, in house: –
FUNDED BY: CSIR

MAGNET

POLE FACE, diameter (compact): 112 cm, R-extraction: 49,5 cm
R injection: – cm
GAP, min 14,7 cm, Field 17,7 kG
max 15,9 cm, Field 16,4 kG } at 0,32 × 10^6 Ampere turns
AVERAGE FIELD at R ext: 17,0 kG
B max/<B>: 1,04
NUMBER OF SECTORS: compact 3, separated – Spiral, max 0 deg
SECTOR ANGLE (SSC): – deg
TRIMMING COILS: Two sets of circular coils and one set of harmonic coils.
CONDUCTOR, material and type: Aluminium
STORED ENERGY (cryogenic): 0,2 MJ
POWER: main coils 70 max kW: current stability 10^{-4}
trimming coils 2 max kW: current stability 10^{-3}
WEIGHT: Fe 73,8 tons: coils 5,4 tons
COOLING system: Demineralised water
ION ENERGY (Bending limit) E/A = 32 q^2/A^2 MeV/amu
(Focusing limit) E/A = 15,3 q/A MeV/amu

ACCELERATION SYSTEM

DEES, number: 2 angle: 140 deg
BEAM APERTURE: 5 cm; DC Bias: – kV
TUNED by, coarse: MS fine: VC, AUTO
RF: 10,8 to 17,4 MHz, stable ± 10 ppm
Orb F: 10,8 to 17,4 MHz
HARMONICS, RF/Orb F, used: 1
DEE–Gnd, max: 72 kV, min gap: 1 cm
STABILITY, (pk-pk noise)/(pk RF volt): –
ENERGY GAIN, max: 270 kV/turn
RF PHASE, stable to ±: – deg
RF POWER input, max.: 2 × 20 kW
FREQUENCY MODULATION, rate: – /s
modulator, type: –
beam pulse, width: –

VACUUM SYSTEM

OPERATING PRESSURE: 50 × 10^{-6} Torr or mbar
PUMPS, No, Type, Size:
2 Diffusion, HV 2,2 $m^3.s^{-1}$ and a $m^3.s^{-1}$
2 Roughing, 176 $m^3.h^{-1}$ and 15 $m^3.h^{-1}$

ION SOURCES

Internal Hot Cathode Source

INJECTION SYSTEM

–

EXTRACTION SYSTEM

DC Electrostatic Channel, Two Magnetic Channels

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed: 150 m^2; movable: 0 m^2
TARGET STATIONS: 3 in 1 rooms
STATIONS served at same time, max: 1
MAG SPECTROGRAPH, type: –
COMPUTER model: –
OTHER FACILITIES: 1. Isotope Production Facility
2. Fast Neutron Facility

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
p	8	5,8–15,3	700	60
d	16	11,5–17,3	700	60
^{3}He		18–38	150	50
^{4}He	32	23–34,6	150	50
SECONDARY			(part/s)	

BEAM PROPERTIES

	MEASURED	CONDITIONS
PULSE WIDTH	RF deg	pμA of MeV ions
PHASE EXC. max	45 RF deg	100 pμA of 16 MeV d ions
EXTRACT eff	30 %	60 pμA of 16 MeV d ions
RESOL ΔE/E	%	pμA of MeV ions
EMITTANCE (π mm-mrad)	7,2 axial, 7,2 rad	50 pμA of 16 MeV d

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 0% SOLID STATES PHYSICS 0%
BIOMEDICAL APPLICAT. 15% ISOTOPE PRODUCTIONS 78%

REFERENCES/NOTES

1) Nucl. Inst. & Meth., 3, 323 (1958)
2) Nucl. Inst. & Meth., 8, 261 (1960)
3) Tydskr. Natuurwet., 333 (1967)

PLAN VIEW OF FACILITY, COMMENTS, ETC.

During 1960 Thomas shims were installed in order to improve the vertical focusing.

The cyclotron has been modified for variable energy operation and for acceleration of He-ions during 1969. A ^{3}He-recovering system has been installed.

Two magnetic channels have been installed in order to improve the focusing along the extraction orbit.

A fixed horizontal collimator, with a remote controlled variable field, for high-energy neutrons has been acquired and will be used for therapy and radiobiological studies.