ENTRY NO. C51 **Date** June 15/92

Name of Machine NAC Separated-Sector Cyclotron

Institution National Accelerator Centre

Address P O Box 72, Faure 7131, Republic of South Africa

Tel 24-43820 **Telex** tex 555 046 SA **Fax** 24-43525 **EMAIL** POSTMASTER @ NAC.DHL.NAC.AC.ZA

In Charge: D. Reitmann **Reported by:** A.H. Botha

HISTORY

MILESTONE DATES:
Design 1977 Model Tests
Construction 1979 First Beam October 1985
DESIGN/CONSTRUCTION BY:
in house yes other various engineering contractors
COST: Accelerator Facility
FUNDED BY: South African Government

STATUS

STAFF: Machine
Scientists 15 Engineers 15
Technicians 31 Students 2
Research (in house/external)
Scientists 23 / 62 Engineers - / -
Technicians 11 / 0 Students 5 / 15
BUDGET: Machine Funded by SA Government
Research Funded by SA Government
TIME DISTRIBUTION:
Basic Research (in house/external) 16 % / 26 %
Applied Program (in house/external) 3.5 % / 27 %
Development 3 % Maintenance 11.5 %

MAGNET

POLE PARAMETERS:
Diameter - cm $R_{extract}$ 443 cm R_{inject} 101 cm
HILL PARAMETERS: Gap (min) 6.6 cm B_{max} 1.27 T
(@ 1.08×10^3 AT) Gap (max) cm B_{min} T
VALLEY PARAMETERS: Gap (min) cm B_{max} T
(@ AT) Gap (max) cm B_{min} T
AVERAGE FIELD: $< B >_{min}$ T $< B >_{max}$ 0.24 T
NUMBER OF SECTORS: compact/separated / 4
sector angle 34 deg. spiral (max) 0 deg.
FIELD TRIMMING: Trim Coils 29
Harmonic Coils 0
Other 2 yoke coils on each of the 4 sectors
CURRENT: Main Coils 1600 Amps Stability 10^{-3}
Trim Coils 500 Amps Stability 10^{-4}
Stored Energy (cryogenic) 1.5 MJ
WEIGHT: Iron 1400 tons Conductor 5.8 tons
ION ENERGY: Bending Limit E/A = 220 q^2/A^2 MeV/u
Focussing Limit E/A = 220 q/A MeV/u

ACCELERATION SYSTEM

FUNDAMENTAL ACCELERATION:
Description: 2 lambda/2 resonators, push-push mode
No. of Gaps/turn 4 dE/dn(max) 1 MeV/q
Voltage(max) 0.25 MV Harmonic f_{rf}/f_{ion} 4 and 12
Freq 6 to 26 MHz Power in(max) 2 x 0.15 MW
Stability: Phase 0.1 deg Voltage 10^{-3}
OTHER CAVITIES (Flattopping or otherwise):
Description: -
Region of Influence: R_{min} cm R_{max} cm
No. of Gaps/turn dE/dn(max) MeV/q
Voltage(max) MV Harmonic f_{rf}/f_{ion}
Freq MHz Power in(max) MW
Stability: Phase Voltage

VACUUM SYSTEM

OPERATING PRESSURE: 7×10^{-7} mbar
PUMPS: No. and type 4 Rotary vane 120 m^3h^{-1}, 4 Roots 350 m^3h^{-1}, 6 turbo pumps 2 m^3s^{-1} and 2 cryopumps 5 m^3s^{-1}

ION SOURCE(S) k=8 Injector Cyclotron

	Type	Intensity (mA)	@	$\epsilon_n = \beta\gamma\epsilon$ (πmm mrad)	Ion Species
(a)					
(b)					
(c)					
(d)					

INJECTION SYSTEM

2 dipoles and a magnetic channel Efficiency 100 %

EXTRACTION SYSTEM

1 electrostatic channel & 2 septum magnets Efficiency 100 %

CHARACTERISTIC BEAMS

	Accelerated Ions	E/A (MeV/u)	Current(part μA) Internal	External
(a)	p	27 - 220	205	200 (66 MeV)
(b)	d	35 - 40	2	2
(c)	$^4He^{++}$	10 - 12.5	2	2
(d)	$^3He^{++}$	30 - 50	2	2

	Secondary Particles	E (MeV)	part/sec
(a)			
(b)			
(c)			

EXTRACTED BEAM PROPERTIES:
For 35 μA of 66 MeV/u p ions
$\Delta E/E$ 0.4 % $\Delta\phi$ 10 °rf
$\epsilon_n = \beta\gamma\epsilon$ x 2.7 πmm mrad z 0.8 πmm mrad

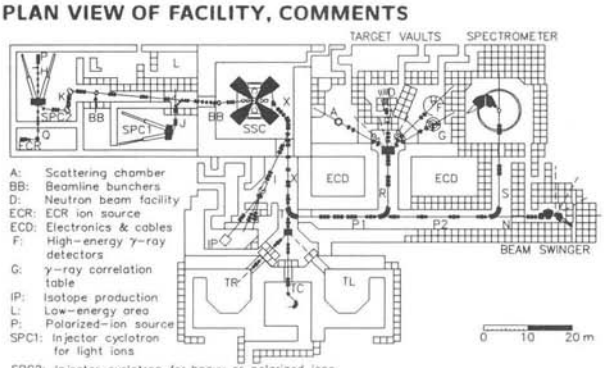
FACILITIES FOR RESEARCH

SHIELDED AREA: Fixed 700 m^2 Moveable 900 m^2
Target Stations: 7 No. Served At Same Time: 1
MAGNETIC SPECTROMETERS: k=600 QDD
OTHER FACILITIES: 66 MeV isocentric system for neutron therapy, a beam swinger for neutron time-of-flight measurements, a 1.5 m scattering chamber, a neutron time-of-flight facility, a 3-armed γ correlation table

REFERENCES/NOTES

(a) Proc. Eleventh Int. Conf., 9 (1986)
(b) Proc. Twelfth Int. Conf., 80 (1989)

PLAN VIEW OF FACILITY, COMMENTS



A: Scattering chamber
BB: Beamline bunchers
D: Neutron beam facility
ECR: ECR ion source
ECD: Electronics & cables
F: High-energy γ-ray detectors
G: γ-ray correlation table
IP: Isotope production
L: Low-energy area
P: Polarized-ion source
SPC1: Injector cyclotron for light ions
SPC2: Injector cyclotron for heavy or polarized ions
SSC: Separated-sector cyclotron
TC: Isocentric system for neutron therapy
TR: Horizontal beam for proton therapy
TL: Future isocentric system for proton therapy
Other letters serve to identify beamlines