

Entry: **C 56**  
 Machine Name: NAC Separated-Sector Cyclotron  
 Address: P.O. Box 72, Faure 7131 Republic of South Africa  
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Date: June 1998  
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**HISTORY**

Design by: National Accelerator staff  
 Construction time: 1979 – 1985  
 First beam: October 1985

**CHARACTERISTIC BEAMS**

ions / energy (MeV/n) / current (pps) / power (W) :  
 -p.....200.....1.87×10<sup>13</sup>.....600  
 -p.....66.....6.24×10<sup>14</sup>.....6 600  
 -<sup>18</sup>O<sup>4+</sup>.....4.7.....3.1 × 10<sup>11</sup>.....17  
 -<sup>129</sup>Xe<sup>22+</sup>.....6.1.....1.4 × 10<sup>10</sup>.....39.5

transmission efficiency (total)  
 - typical: 99.8 % - best: 100 %  
 transverse emittance (rms)  
 - vertical: 2.7 π mmmrad  
 - horizontal: 0.8 π mmmrad  
 longitudinal emittance (rms) 0.07 ΔE/E.deg RF

**USES**

basic research: 27 % therapy: 22 %  
 development: 1 % isotope production: 28 %  
 other applications: 0 % maintenance: 10 %  
 beam tuning: 12 %  
 total time: 8548 h/year

**TECHNICAL DATA**

**a) magnet**  
 type: sector magnets  
 Kb: 200 MeV/A Kf: 200 MeV/A  
 average field (min-max): 0.517 (0 – 1.256) T  
 number of magnet sectors: 4  
 - angle: 34 deg  
 - spiral (max): 0 deg  
**pole parameters**  
 - diameter: 4.43 m  
 - injection radius: 0.952 m  
 - extraction radius: 4.156 m  
**hill gap:** 0.066 m **valley gap:** ∞ m  
**field trimming**  
 - trim coils  
 - number: 29  
 - current (max): 500 A  
 - harmonic coils  
 - number:  
 - current (max): A  
 - others  
 - number: 4  
 - current (max): 600 A  
**main coils:**  
 - number: 1  
 - Ampere-turns: 80 000 A.T.  
 - current: 1600 A  
**stored energy:** 1.5 MJ  
**weight :** - iron: 1400 t - coils: 5.8 t  
**power**  
 - main coils (total): 650 kW  
 - trim coils (total max): kW  
 - refrigerator (cryogenic): 0 kW

**b) RF**

- acceleration  
 - frequency range: 6 - 26 MHz  
 - harmonic modes: 4 and 12  
 - number of dees: 2  
 - angular aperture: 49 deg  
 - voltage:- average (min-max): 230 kV  
 - variation with radius: 80 % at injection  
 - 100 % at extraction  
 - power in (max): 2× 80 kW  
 - stability:- phase: 0.1 deg - voltage: 0.1 %

- other cavities

- purpose:  
 - frequency range: MHz  
 - region of influence: m  
 - voltage (max): kV  
 - power in (max): kW  
 - stability:- phase: deg - voltage: %

**c) injection**

- internal source:  
 - external (radial/axial): radial  
 - elements: 2 bending magnets and 1 magnetic inflection channel  
 - source voltage: kV  
 - injection energy: (for protons) 8 MeV/n  
 - buncher: Double-gap, sine wave  
 - injection efficiency: 100 %

**d) ion sources/injector**

Solid pole injector cyclotrons SPC1 and SPC2

**e) extraction**

- elements, characteristics:  
 - 2 septum magnets  
 - efficiency  
 - typical: 99.8 % - best: 100 %

**f) vacuum**

- pumps: 4 Rotary vane 120 m<sup>3</sup> h<sup>-1</sup>, 4 Roots 350 m<sup>3</sup> h<sup>-1</sup>,  
 6 turbo pumps 2 m<sup>3</sup> s<sup>-1</sup> and 2 cryopumps 5 m<sup>3</sup> s<sup>-1</sup>.  
 - achieved vacuum: 7 × 10<sup>-5</sup> Pa

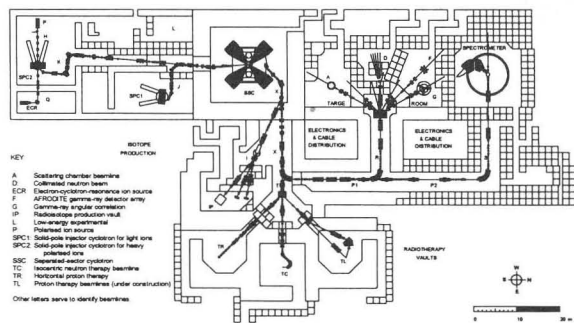
**REFERENCES**

Proc. 11<sup>th</sup> Int. Conf. on Cyclotrons and their Appl. (1986) p.6  
 Proc. 12<sup>th</sup> Int. Conf. on Cyclotrons and their Appl. (1989) p.80

**EXPERIMENTAL FACILITIES**

A 66 MeV isocentric gantry for neutron therapy, a fixed horizontal beamline for proton therapy, a high-energy gamma-ray detectors array AFRODITE, a 1.5m scattering chamber, a neutron beam facility, a triple-arm γ-correlation table and a K600 QDD magnet spectrometer.

**PLAN VIEW OF FACILITY**



**COMMENTS**