**ENTRY No.** 4

NAME OF MACHINE Ciclotron de Energia Variável DATE July 1981
INSTITUTION Instituto de Engenharia Nuclear
ADDRESS CP-2186 - ZC-00 - Rio de Janeiro - Brazil
TEL 230-6289 TELEX 2121112
IN CHARGE Arthur Gerbasi da Silva REPORTED BY J.A.D. Furlanetto

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**HISTORY AND STATUS**

DESIGN, date - Model tests -
ENG DESIGN, date The Cyclotron Corporation CV-28
CONSTRUCTION, date '71 - '74
FIRST BEAM, date (or goal) Dec. '74
MAJOR ALTERATIONS None
COST, ACCELERATOR US$ 0.5 x $10^6$
COST, FACILITY, total US$ 1.3 x $10^6$
FUNDED BY CNEN and FINEP - BRAZIL

**ACCELERATOR STAFF, OPERATION AND DEVELOPMENT**

SCIENTISTS 1 ENGINEERS 1
TECHNICIANS 4 CRAFTS -
GRAD STUDENTS involved during year -
OPERATED BY - Research staff or 3 Operators
OPERATION 14 hr/wk, On target 9 hr/wk
TIME DISTR. in house 80 %, Outside 20 %
BUDGET, op & dev US$ 50 x $10^3$
FUNDED BY CNEN - BRAZIL

**RESEARCH STAFF,** not included above

USERS, in house 12 outside 9
GRAD STUDENTS involved during year 7
RESEARCH BUDGET, in house US$ 0.2 x $10^6$
FUNDED BY CNEN

**MAGNET**

POLE FACE, diameter (compact) 96 cm, R extraction 42 cm
R injection - cm
GAP, min 5.6 cm, Field 21 kG
max cm, Field 14.5 kG } at
AVERAGE FIELD at R ext 18.5 kG } Ampere turns
B max/ <B>
NUMBER OF SECTORS { compact / separated 3 } Spiral, max deg
SECTOR ANGLE (SSC) deg
TRIMMING COILS 4 Pairs
CONDUCTOR, material and type
STORED ENERGY (cryogenic) - MJ
POWER : main coils 60 max, kW ; current stability $10^{-5}$
trimming coils 10 max, kW ; current stability
WEIGHT : Fe 23 tons ; coils tons
COOLING system water
ION ENERGY (bending limit) E/A = 8 $q^2/a^2$ MeV/amu
(focusing limit) E/A = $q/a$ MeV/amu

**ACCELERATION SYSTEM**

DEES, number 2 ; angle 90 deg
BEAM APERTURE 2 cm ; DC Bias 2.5 kV
TUNED by, coarse M.S.P. fine V.Can
RF 6.5 to 25.5 mHz, stable ± 4/$10^5$
Orb F to mHz
HARMONICS, RF/Orb F, used First
DEE - Gnd, max kV, min gap cm
STABILITY, (pk-pk noise)/(pk RF volt)
ENERGY GAIN, max 100 kV/turn
RF PHASE, stable to ± deg
RF POWER input, max 75 kW
FREQUENCY MODULATION, rate /s
modulator, type
beam pulse, width

**VACUUM SYSTEM**

OPERATING PRESSURE $5 \times 10^{-5}$ Torr or mbar
PUMPS, No, Type, Size 1 Oil Diffusion Pump

**ION SOURCES**

P.I.G.

**INJECTION SYSTEM**

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**EXTRACTION SYSTEM**

Electrostatic, mag. channel

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 70 m² ; movable 220 m²
TARGET STATIONS 4 in 2 rooms
STATIONS served at same time, max -
MAG SPECTROGRAPH, type -
COMPUTER model -
OTHER FACILITIES

**CHARACTERISTIC BEAMS**

| PARTICLE | ENERGY (MeV) Goal | Achieved | CURRENT (pμA) Internal | External |
|---|---|---|---|---|
| Protons | 24 | 24 | 80 | 50 |
| Alpha | 28 | 28 | 54 | 45 |
| $^3$He | 36 | 36 | 50 | 35 |
| Deuterons | 14 | 14 | 80 | 50 |
| SECONDARY | | | (part/s) | |

**BEAM PROPERTIES**

| MEASURED | | CONDITIONS | |
|---|---|---|---|
| PULSE WIDTH 54 | RF deg 0.7 | pμ A of 28 | MeV $He^{++}$ ions |
| PHASE EXC, max | RF deg | pμ A of | MeV $H^+$ ions |
| EXTRACT eff 82 % | 6.6 | pμ A of 19 | MeV $H^+$ ions |
| RESOL ΔE/E 0.36 % | 0.7 | pμ A of 28 | MeV $He^{++}$ ions |
| EMITTANCE | | | |
| (π mm. mrad) { .54 axial / .60 rad } | 0.2 | pμA of 28 | MeV $He^{++}$ ions |

**OPERATING PROGRAMS,** time distribution

BASIC NUCLEAR PHYSICS 40% SOLID STATES PHYSICS 20%
BIOMEDICAL APPLICAT. - ISOTOPE PRODUCTIONS 40%

**REFERENCES/NOTES**

**PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS**