ENTRY No. 30

NAME OF MACHINE Isochronous variable energy DATE CV 28 TCC Berkeley Sept. 1981
INSTITUTION Institut Medizinische Strahlenphysik und Strahlenbiologie, Universitätsklinikum Essen
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**HISTORY AND STATUS**

DESIGN, date 1973 Model tests 1974
ENG DESIGN, date 1972
CONSTRUCTION, date 1974
FIRST BEAM, date (or goal) Sept. 1975 (Essen)
MAJOR ALTERATIONS

COST, ACCELERATOR s0.9 $10^6$
COST, FACILITY, total s1.6 $10^6$
FUNDED BY Land Nordrhein-Westfalen (University)

**ACCELERATOR STAFF, OPERATION AND DEVELOPMENT**

SCIENTISTS 7 ENGINEERS 4
TECHNICIANS 3 CRAFTS 2
GRAD STUDENTS involved during year
OPERATED BY Research staff or 2 Operators
OPERATION 50 hr/wk, On target 45 hr/wk
TIME DISTR. in house % , Outside %
BUDGET, op & dev
FUNDED BY

**RESEARCH STAFF,** not included above

USERS, in house 3 outside
GRAD STUDENTS involved during year
RESEARCH BUDGET, in house
FUNDED BY

**MAGNET**

POLE FACE, diameter (compact) 96 cm, R extraction 42 cm
R injection cm
GAP, min 5.0 cm, Field 14 kG
max 10.1 cm, Field 20 kG } at 0.25 $10^6$ Ampere turns
AVERAGE FIELD at R ext 17 kG
B max/ <B>
NUMBER OF SECTORS { compact ; separated 3 } Spiral, max 4.7 deg
SECTOR ANGLE (SSC) 120 deg
TRIMMING COILS 3 pairs inner and outer harmonic coils
each 4 pairs profile coils
CONDUCTOR, material and type Cu tubes
STORED ENERGY (cryogenic) MJ
POWER : main coils 70 max, kW ; current stability $2 \cdot 10^{-6}$
trimming coils 20 max, kW ; current stability $2 \cdot 10^{-5}$
WEIGHT : Fe 21 tons ; coils 1.8 tons
COOLING system demineralized water
ION ENERGY (bending limit) E/A = 28 $(H^+24)$ $q^2/a^2$ MeV/amu
(focusing limit) E/A = 28 $q^2/a^2$ MeV/amu

**ACCELERATION SYSTEM**

DEES, number 2 ; angle 90 deg
BEAM APERTURE 2.0 cm ; DC Bias 1 kV
TUNED by, coarse Short Plane fine Trim Capacitor
RF 6.5 to 25.5 mHz, stable ± 100 Hz
Orb F 6.5 to 26.5 mHz
HARMONICS, RF/Orb F, used fundamental
DEE - Gnd, max 30 kV, min gap 1.3 cm
STABILITY, (pk-pk noise)/(pk RF volt)
ENERGY GAIN, max 60 kV/turn
RF PHASE, stable to ± deg
RF POWER input, max 40 kW
FREQUENCY MODULATION, rate 0 /s
modulator, type
beam pulse, width

**VACUUM SYSTEM**

OPERATING PRESSURE < $5 \times 10^{-5}$ Torr Torr or mbar
PUMPS, No, Type, Size NEC 1x25 cm
Oil diffusion pump

**ION SOURCES**

penning ion source

**INJECTION SYSTEM**

**EXTRACTION SYSTEM**

electrostatic deflector magnet channel

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 138 m² ; movable m²
TARGET STATIONS 8 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER model
OTHER FACILITIES isocentric neutron therapy facility
6 external and 1 internal target stations
1 neutron activation station

**CHARACTERISTIC BEAMS**

| PARTICLE | ENERGY (MeV) Goal | Achieved | CURRENT (pμA) Internal | External |
|---|---|---|---|---|
| proton | 2-24 | 2-24 | 300 | 85 |
| deuterons | 3-14 | 3-14 | 400 | 120 |
| Helium 3++ | 5-36 | 5-37 | 150 | 80 |
| Helium 4++ | 6-28 | 6-28 | 100 | 50 |
| SECONDARY | | | (part/s) | |
| | | | | |
| | | | | |

**BEAM PROPERTIES**

| MEASURED | | CONDITIONS | |
|---|---|---|---|
| PULSE WIDTH RF deg | | pμ A of MeV | ions |
| PHASE EXC, max RF deg | | pμ A of MeV | ions |
| EXTRACT eff 70 % | 100 | pμ A of 14 MeV | $d^+$ ions |
| RESOL ΔE/E 0.5 % | 50 | pμ A of 28 MeV | $He^{-4}$ ions |
| EMITTANCE | | | |
| (π mm. mrad) 250 axial ; 250 rad | 100 | pμA of 14 MeV | $d^+$ ions |

**OPERATING PROGRAMS,** time distribution

| | | | |
|---|---|---|---|
| BASIC NUCLEAR PHYSICS | | SOLID STATES PHYSICS | |
| BIOMEDICAL APPLICAT. | 10% | ISOTOPE PRODUCTIONS | 10% |
| Neutron therapy | 42% | Safety tests, maintenance | 17% |
| Radiation physics | 18% | Dead time | 1% |

**REFERENCES/NOTES**

Rassow, J., Hudepohl, G., Maier, E., Meissner, P.:
CIRCE-Cyclotron Isocentric Neutron Therapy Facility. In:
Burger, G., Ebert, H.G.: Proceedings Third Symposium on
Neutron Dosimetry, Munich 1977, EURATOM EUR 5848/DE/EN/FR 1978

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