

ENTRY NO. 40

NAME OF MACHINE ... NIRS Isochronous Cyclotron for Medical Use
INSTITUTION National Institute of Radiological Sciences
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IN CHARGE T. Kondo REPORTED BY ... H. Ogawa

HISTORY AND STATUS Thomson-CSF (CGR-MeV Model 930)

DESIGN, date Model tests
ENG DESIGN, date
CONSTRUCTION, date 1972 ~ 1973
FIRST BEAM, date (or goal) Dec. 1973
MAJOR ALTERATIONS

COST, ACCELERATOR
COST, FACILITY, total
FUNDED BY ... the Science and Technology Agency

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 3 ENGINEERS 1
TECHNICIANS 5 CRAFTS
GRAD STUDENTS involved during year
OPERATED BY Research staff or 5 Operators
OPERATION 38 hr/wk. On target hr/wk
TIME DISTR. in house 100 % Outside %
BUDGET, op & dev
FUNDED BY ... the same as the above

RESEARCH STAFF, not included above

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

MAGNET

POLE FACE, diameter (compact) cm, R extraction cm
R injection cm
GAP, min 16.6 cm, Field 20.1 kG }
min 40.5 cm, Field 11.7 kG } at 0.36 x 10⁶
AVERAGE FIELD at R ext 16.4 kG } Ampere turns
B max/ < B >

NUMBER OF SECTORS { compact 4 } Spiral, max 53 deg
{ separated }

SECTOR ANGLE (SSC) deg
TRIMMING COILS 12 Circular Coils
..... 2 per sector

CONDUCTOR, material and type Cu, hollow
STORED ENERGY (cryogenic) MJ
POWER: main coils 360 max, kW; current stability ±2x10⁻⁵
trimming coils 75 max, kW; current stability ±1x10⁻⁴

WEIGHT: Fe 200 tons; coils 6 tons
COOLING system Demineralized water
ION ENERGY (bending limit) E/A = ~110 q²/a² MEV/amu
(focusing limit) E/A = 93 q/a MeV/amu

ACCELERATION SYSTEM

DEES, number 2 86 deg
BEAM APERTURE 3.8 cm; DC Bias 0 kV
TUNED by, coarse MP fine MP Auto
RF 10.6 to 22.0 MHz, stable ± ≤ 1 x 10⁻⁶
Orb F 5.3 to 21.14 MHz
HARMONICS, RF/Orb F, used 1.2
DEE-Gnd, max 50 kV, min gap 4 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
ENERGY GAIN, max 200 kV/turn
RF PHASE, stable to ± 0.5 deg
RF POWER input, max 160 kW
FREQUENCY MODULATION, rate /s
modulator, type
beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE 2 x 10⁻⁶ Torr or mbar
PUMPS, No, Type, Size ... 2 x 22 in. Oil diffusion pumps

ION SOURCES

Hot filament for light ions and penning for heavy ions

INJECTION SYSTEM

EXTRACTION SYSTEM

Electrostatic deflector and magnetic channels

FACILITIES FOR RESEARCH (Active and passive)

SHIELDED AREA, fixed 376 m²; movable m²
TARGET STATIONS 7 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type
COMPUTER model
OTHER FACILITIES ... Cyclotron radiotherapies
Facility, Radiopharmaceuticals production
and Nuclear Medical diagnosis Facilities

CHARACTERISTIC BEAMS

| PARTICLE | ENERGY (MeV) | | CURRENT (pμA) | |
|-----------------|--------------|-----------|---------------|----------|
| | Goal | Achieved | Internal | External |
| p | | 8 ~ 39 | | 20 |
| d | | 12 ~ 52.5 | | 40 |
| ³ He | | 24 ~ 140 | | 15 |
| α | | 24 ~ 105 | | 10 |
| SECONDARY | | | (part/s) | |

BEAM PROPERTIES

MEASURED CONDITIONS
PULSE WIDTH 25 RF deg 20 μA of 30 MeV d ions
PHASE EXC. max RF deg μA of MeV ions
EXTRACT eff 80% 35 μA of 30 MeV d ions
RESOL ΔE/E % μA of MeV ions
EMITTANCE { axial }
(π mm. mrad) { rad } μA of MeV

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS SOLID STATES PHYSICS
BIOMEDICAL APPLICAT. 68% ISOTOPE PRODUCTIONS 32%

REFERENCES/NOTES

- 1) H. Ogawa et al. IEEE NS-26, No.2, 1988-1991(1979)
- 2) Y. Sato et al. Proc. of 9th Intern. Conf. on Cyclotrons, 597-599(1981)

PLAN VIEW OF FACILITY, COMMENTS, ETC.