

ENTRY No. 84
 NAME OF MACHINE CLATTERBRIDGE CYCLOTRON DATE 8TH MAY, 1989
 INSTITUTION MEDICAL RESEARCH COUNCIL
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 IN CHARGE T.E. SAXTON REPORTED BY T.E. SAXTON

HISTORY AND STATUS

DESIGN, date 1981/82 Model tests
 ENG DESIGN, date 1981/82
 CONSTRUCTION, date 1982/83
 FIRST BEAM, date (or goal) FACTORY 1983, SITE 1984
 MAJOR ALTERATIONS ADDITION OF PROTON THERAPY FACILITY, 1988

COST, ACCELERATOR £1.5M
 COST, FACILITY, total £4.5M
 FUNDED BY U.K. CANCER CHARITIES

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT
 SCIENTISTS 2 ENGINEERS 3
 TECHNICIANS 2 CRAFTS 1

GRAD STUDENTS involved during year
 OPERATED BY Research staff or Operators
 OPERATION hr/wk, On target hr/wk
 TIME DISTR. in house %, Outside %

BUDGET, op & dev
 FUNDED BY MEDICAL RESEARCH COUNCIL

RESEARCH STAFF, not included above
 USERS, in house 3 outside
 GRAD STUDENTS involved during year

RESEARCH BUDGET, in house
 FUNDED BY IMPERIAL CANCER RESEARCH FUND

MAGNET
 POLE FACE, diameter (compact) 160 cm, R extraction .64 cm
 R injection cm
 GAP, min 12.3 cm, Field 20.7 kG }
 max 22.1 cm, Field 13.0 kG } at 280,000
 AVERAGE FIELD at R ext 17.7 kG } Ampere turns
 B max/ 1.19

NUMBER OF SECTORS { compact 3 } Spiral, max 55 deg
 separated

SECTOR ANGLE (SSC) deg
 TRIMMING COILS 4 SETS HARMONIC COILS
 6 SETS CIRCULAR GRADIENT COILS

CONDUCTOR, material and type HOLLOW COPPER
 STORED ENERGY (cryogenic) MJ
 POWER: main coils 110 max, kW ; current stability 1×10^{-5}
 trimming coils 5 max, kW ; current stability 1×10^{-4}

WEIGHT: Fe 120 tons ; coils 4,4 tons
 COOLING system
 ION ENERGY (bending limit) E/A = .62 q²/a² MeV/amu
 (focusing limit) E/A = q²/a² MeV/amu

ACCELERATION SYSTEM

DEES, number 2 ; angle 80 deg
 BEAM APERTURE 2.5 cm ; DC Bias kV
 TUNED by, coarse fine

RF .25 to mHz, stable $\pm 1 \times 10^{-6}$
 Orb F .25 to mHz

HARMONICS, RF/Orb F, used 1
 DEE - Gnd, max 40 kV, min gap cm
 STABILITY, (pk-pk noise)/(pk RF volt) $< 10^{-3}$

ENERGY GAIN, max 100 kV/turn
 RF PHASE, stable to ± 0.5 deg
 RF POWER input, max 60 kW

FREQUENCY MODULATION, rate /s
 modulator, type
 beam pulse, width

VACUUM SYSTEM
 OPERATING PRESSURE $\leq 10^{-5}$ Torr or mbar

PUMPS, No, Type, Size
 2 x 4000 L/SEC OIL DIFFUSION PUMP
 100cm³/HR+BOOSTER, 20cm³/HR MECHANICAL BACKING

ION SOURCES
 INTERNAL, COLD CATHODE

INJECTION SYSTEM

ELECTROSTATIC+ELECTROMAGNETIC+FOCUSSING CHANNEL

EXTRACTION SYSTEM

FACILITIES FOR RESEARCH

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

CHARACTERISTIC BEAMS

PARTICLE ENERGY (MeV) CURRENT (pA) Internal External
 Goal Achieved

P 60 62.5 >100 50

SECONDARY (part/s)
 P 50 RAD/MIN @ 150CM FROM TARGET AFTER FILTERING

BEAM PROPERTIES

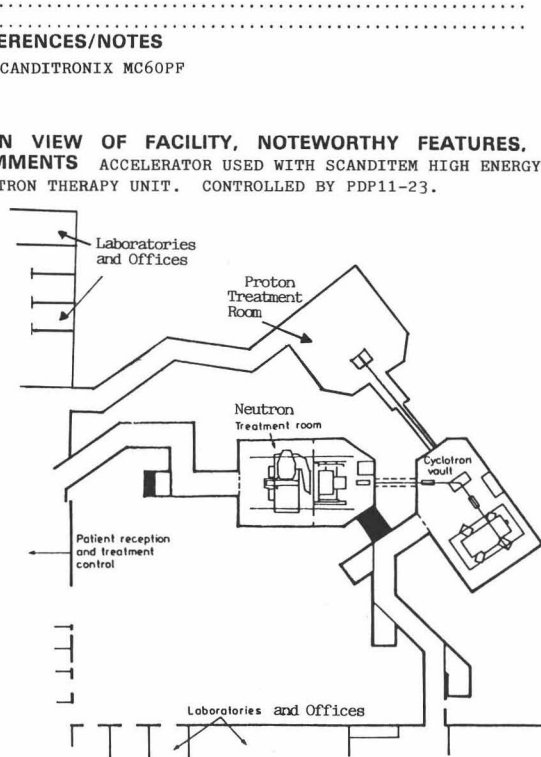
MEASURED CONDITIONS
 PULSE WIDTH RF deg pA of MeV Ions
 PHASE EXC, max RF deg pA of MeV Ions
 EXTRACT eff % pA of MeV Ions
 RESOL $\Delta E/E$ % pA of MeV Ions

EMITTANCE
 (p mm. mrad) { axial rad } pA of MeV Ions

OPERATING PROGRAMS, time distribution
 BASIC NUCLEAR PHYSICS SOLID STATES PHYSICS
 BIOMEDICAL APPLICAT. 100% ISOTOPE PRODUCTIONS

REFERENCES/NOTES
 1) SCANDITRONIX MC60PP

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS
 ACCELERATOR USED WITH SCANDITEM HIGH ENERGY NEUTRON THERAPY UNIT. CONTROLLED BY PDP11-23.



Plan view of Clatterbridge high energy neutron therapy facility.