

ENTRY No. FM1  
 NAME OF MACHINE SYNCHROCYCLOTRON 200 MeV protons (S.C. 200 ) DATE April 1989  
 INSTITUTION Institut de Physique Nucléaire (I.P.N.)  
 ADDRESS 91406 ORSAY CEDEX - FRANCE  
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 IN CHARGE Mr. J. GUILLOT REPORTED BY Mr. M. LOUIS

#### HISTORY AND STATUS

DESIGN, date 1972 Model tests  
 ENG DESIGN, date 1973  
 CONSTRUCTION, date September 1975  
 FIRST BEAM, date (or goal) 20.06.1977  
 MAJOR ALTERATIONS

COST, ACCELERATOR about 10 MF. 1975  
 COST, FACILITY, total about 20 MF.  
 FUNDED BY Institut de Physique Nucléaire & Phys. Particules

#### ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 1  
 TECHNICIANS 18 CRAFTS  
 GRAD STUDENTS involved during year  
 OPERATED BY Research staff or 8 Operators  
 OPERATION 104 hr/wk, On target 200 hr/wk  
 TIME DISTR. in house 90 %, Outside 10 %  
 BUDGET, op & dev 570 KF. (1989)

FUNDED BY  
 RESEARCH STAFF, not included above  
 USERS, in house 50 outside 20  
 GRAD STUDENTS involved during year

RESEARCH BUDGET, in house  
 FUNDED BY C.N.R.S., I.N.S.P.

#### MAGNET

POLE FACE, diameter (compact) 320 cm, R extraction 140 cm  
 R injection 1 cm 16.07 to 14.8  
 GAP, min 40 cm, Field 15.4 14.1 kG  
 max cm, Field 15.4 14.1 kG } at 6.3 & 5. x 10<sup>5</sup>  
 AVERAGE FIELD at R ext kG } Ampere turns  
 B max / < B >

NUMBER OF SECTORS { compact } Spiral, max .. deg  
 { separated }

SECTOR ANGLE (SSC) no. deg

TRIMMING COILS yes

CONDUCTOR, material and type copper

STORED ENERGY (cryogenic)

POWER: main coils 350 max, kW; current stability  $\pm 3 \cdot 10^{-5}$   
 trimming coils max, kW; current stability  $\pm 3 \cdot 10^{-5}$

WEIGHT: Fe 900 tons; coils 22 tons

COOLING system De-ionized water

ION ENERGY (bending limit) E/A = 223 q<sup>2</sup>/a<sup>2</sup> MeV/amu  
 (focusing limit) E/A = q<sup>2</sup>/a<sup>2</sup> MeV/amu

#### ACCELERATION SYSTEM

DEES, number 1; angle 180 deg

BEAM APERTURE 6 cm; DC Bias 1 kV

TUNED by, coarse line

RF 25 to 10 MHz, stable  $\pm$

Orb F 25 to 10 MHz

HARMONICS, RF/Orb F, used

DEE Gnd, max 20 kV, min gap 0.4 cm

STABILITY, (pk-pk noise)/(pk RF volt) 20

ENERGY GAIN, max 20 kV/turn

RF PHASE, stable to  $\pm$  deg

RF POWER input, max 30 kW

FREQUENCY MODULATION, rate 440 anc 700 new /s

modulator, type rotating condenser

beam pulse, width 50-100 micro-second

#### VACUUM SYSTEM

OPERATING PRESSURE Torr or mbar

PUMPS, No, Type, Size oil diffusion Galileo

16.000 l/s

#### ION SOURCES

Pig Hot Filament

#### INJECTION SYSTEM

Internal ion source

#### EXTRACTION SYSTEM

Electromagnetic and magnetostatic channels

#### FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 500 m<sup>2</sup>; movable m<sup>2</sup>

TARGET STATIONS 3 in rooms

STATIONS served at same time, max

MAG SPECTROGRAPH, type 102°N = 1/2

COMPUTER model micro-processors

OTHER FACILITIES on-line Mass Spectrometer

ISOCELE II

#### CHARACTERISTIC BEAMS

| PARTICLE          | ENERGY (MeV) |          | CURRENT (pA) |          |
|-------------------|--------------|----------|--------------|----------|
|                   | Goal         | Achieved | Internal     | External |
| P                 | 168 to 201   |          | 4            | 3        |
| d                 | 83 to 107    |          | 9            | 7        |
| <sup>3</sup> He++ | 233 to 281   |          | 3.2          | 2.5      |
| <sup>4</sup> He++ | 166 to 216   |          | 3.2          | 2.5      |

#### SECONDARY

(part/s)

#### BEAM PROPERTIES

| MEASURED                 | CONDITIONS    |            |
|--------------------------|---------------|------------|
|                          | MEASURED      | CONDITIONS |
| PULSE WIDTH RF deg       | pA of MeV     | ions       |
| PHASE EXC, max RF deg    | pA of MeV     | ions       |
| EXTRACT eff 30 %         | pA of 201 MeV | P. ions    |
| RESOL $\Delta E/E$ 0.7 % | pA of 201 MeV | P. ions    |
| EMITTANCE                |               |            |

( $\pi$  mm. mrad) { 9 axial } 4 pA of 201 MeV P. ions  
 { 19 rad }

#### OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 90 % SOLID STATES PHYSICS

BIOMEDICAL APPLICAT. 10 % ISOTOPE PRODUCTIONS

Protontherapy

#### REFERENCES/NOTES

In project, 100 % Protontherapy programs

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