

**ENTRY NO. 20**

NAME OF MACHINE S.A.R.A. Injector  
 INSTITUTION INSTITUT DES SCIENCES NUCLEAIRES  
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 IN CHARGE P.MARTIN/M.FRUNEAU REPORTED BY P. MARTIN

**HISTORY AND STATUS**

DESIGN, date 1962 Model tests 1963  
 ENG DESIGN, date 1963-1965  
 CONSTRUCTION, date 1963-1967  
 FIRST BEAM, date (or goal) July 1968  
 MAJOR ALTERATIONS

COST, ACCELERATOR \$ 2.10<sup>6</sup>  
 COST, FACILITY, total \$ 6.10<sup>6</sup>  
 FUNDED BY I.N2.P3/C.N.R.S.

**ACCELERATOR STAFF, OPERATION AND DEVELOPMENT**

SCIENTISTS 1 ENGINEERS 9  
 TECHNICIANS 28 CRAFTS 1  
 GRAD STUDENTS involved during year 1

OPERATED BY Research staff or Operators  
 OPERATION 144 hr/wk. On target 130 hr/wk

TIME DISTR, in house 50 %, outside 50 %  
 BUDGET, op & dev 6.10<sup>5</sup> \$ (whole S.A.R.A.)  
 FUNDED BY I.N2.P3/C.N.R.S.

**RESEARCH STAFF, not included above**

USERS, in house 40 outside 40  
 GRAD STUDENTS involved during year 4

RESEARCH BUDGET, in house  
 FUNDED BY I.N2.P3/C.N.R.S.

**MAGNET**

POLE FACE, diameter (compact) 212 cm, R-extraction cm  
 R injection cm  
 GAP, min 16 cm, Field 19 kG  
 max 36 cm, Field 12 kG at 360.10<sup>3</sup>  
 AVERAGE FIELD at R ext 16 kG Ampere turns  
 B max / < B > 1.2

NUMBER OF SECTORS {compact 4 } Spiral, max 40 deg  
 {separated }  
 SECTOR ANGLE (ISSC) deg

TRIMMING COILS 11 circular  
 4 harmonic

CONDUCTOR, material and type Copper 18x13 mm bore φ 10  
 STORED ENERGY (cryogenic) MJ

POWER: main coils 270 max kW: current stability 1.10<sup>-5</sup>  
 trimming coils 10 max kW: current stability 1.10<sup>-5</sup>

WEIGHT: Fe 200 tons: coils 8 tons  
 COOLING system

ION ENERGY (Bending limit) E/A = 90 q<sup>2</sup>/A<sup>2</sup> MeV/amu  
 (Focusing limit) E/A = q/A MeV/amu

**ACCELERATION SYSTEM**

DEES, number 2 angle 80 deg  
 BEAM APERTURE 4 cm; DC Bias kV

TUNED by, coarse fine  
 RF 10.5 to 21 MHz, stable ± 10<sup>-6</sup>

Orb F 3.5 to 15 MHz  
 HARMONICS, RF/Orb F, used 1, 2, 3

DEE-Gnd, max 60 kV, min gap cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 10<sup>-4</sup>

ENERGY GAIN, max 240 kV/turn  
 RF PHASE, stable to ± 10 deg

RF POWER input, max 2 x 20 kW  
 FREQUENCY MODULATION, rate /s

modulator, type  
 beam pulse, width

**VACUUM SYSTEM**

OPERATING PRESSURE 10<sup>-6</sup> Torr or mbar  
 PUMPS, No, Type, Size 2 XNRC oil diffusion

**ION SOURCES**

ECR, external

**INJECTION SYSTEM**

Electrostatic inflector for axial injection

**EXTRACTION SYSTEM**

Electrostatic deflector + magnetic channel

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 300 m<sup>2</sup>; movable 500 m<sup>2</sup>  
 TARGET STATIONS 7 in 6 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type Narrow range 0.9 GeV/C

COMPUTER model PDP11/34 on line +

OTHER FACILITIES PDP11/34 off line + VME system

**CHARACTERISTIC BEAMS**

PARTICLE	ENERGY (MeV)		CURRENT (pμA)	
	Goal	Achieved	Internal	External
12 P <sub>3+</sub>		60	20	10
C <sup>3+</sup>	63	63	5	2
SECONDARY			(part/s)	

**BEAM PROPERTIES**

MEASURED	CONDITIONS	
	MEASURED	CONDITIONS
PULSE WIDTH 5 RF deg	5 pμA of 63 MeV	C <sup>3+</sup> ions
PHASE EXC. max RF deg	pμA of MeV	C <sup>3+</sup> ions
EXTRACT eff. 60 %	5 pμA of 63 MeV	C <sup>3+</sup> ions
RESOL ΔE/E 0.4 %	pμA of MeV	ions
EMITTANCE		
(π mm-mrad) 15 axial	5 pμA of 63 MeV	C <sup>3+</sup>
17 rad		

**OPERATING PROGRAMS, time distribution**

BASIC NUCLEAR PHYSICS 90% SOLID STATES PHYSICS  
 BIOMEDICAL APPLICAT 5% ISOTOPE PRODUCTIONS  
 ATOMIC PHYSICS 5%

**REFERENCES/NOTES**

- 1) Annales de Radioélectricité T.XXI n° April 1966
- 2) p. 122 - 150

**PLAN VIEW OF FACILITY, COMMENTS, ETC.**

Injector of the two cyclotrons system S.A.R.A.  
 see entry n° 18

