ENTRY No. FM-6

NAME OF MACHINE CERN 600 MeV synchrocyclotron DATE May 1989

INSTITUTION European Organization for Nuclear Research (CERN)

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IN CHARGE B.W. Allardyce REPORTED BY B.W. Allardyce

HISTORY AND STATUS

DESIGN, date 1952/53 Model tests 1953/54

ENG DESIGN, date 1953

CONSTRUCTION, date October 1953 to July 1957

FIRST BEAM, date (or goal) 1st August 1957

MAJOR ALTERATIONS 1973/1974 SC Improvement Programme (SCIP)

COST, ACCELERATOR 30 M Swiss Francs

COST, FACILITY, total 60 M Swiss Francs

FUNDED BY CERN Member states

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 1 ENGINEERS 2

TECHNICIANS 25 CRAFTS 8

GRAD STUDENTS involved during year -

OPERATED BY Research staff or 11 Operators

OPERATION 150 hr/wk, 4000 hrs/yr authorized

TIME DISTR. in house 5 %, Outside 95 %

BUDGET, op & dev 1.1 MSFr

FUNDED BY CERN Member states

RESEARCH STAFF, not included above

USERS, in house 10 outside 200 to 250

GRAD STUDENTS involved during year

RESEARCH BUDGET, in house 0.8 MSFr

FUNDED BY CERN Member states

MAGNET

POLE FACE, diameter (compact) 500 cm, R extraction 225 cm

R injection cm

GAP, min 36 cm, Field 18.1 kG
max 45 cm, Field 19.4 kG
} at 1.23.10⁶ Ampere turns

AVERAGE FIELD at R ext 18.1 kG

B max/ <B>

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

SECTOR ANGLE (SSC) deg

TRIMMING COILS

CONDUCTOR, material and type Aluminium

STORED ENERGY (cryogenic) MJ

POWER : main coils 800 max, kW ; current stability 5.10⁻⁵
trimming coils max, kW ; current stability

WEIGHT : Fe 2500 tons ; coils 60 tons

COOLING system demineralized water

ION ENERGY (bending limit) E/A = 800 q²/a² MeV/amu
(focusing limit) E/A = q²/a² MeV/amu

ACCELERATION SYSTEM

DEES, number 1; 180° at small radius, 95° large radius

BEAM APERTURE 6-12 cm ; DC Bias up to 1.1 kV

TUNED by, rotating capacitor (ROTCO)

RF 30.4 to 16.6 MHz for protons
20.3 to 13.9 for $^3He^{2+}$ ions

HARMONICS, RF/Orb F, used 1

DEE - Gnd, max 20-25 kV, min gap cm

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

ENERGY GAIN, max kV/turn

RF PHASE, stable to ± deg

RF POWER input, max 120 kW

FREQUENCY MODULATION, rate 360-400 /s
modulator, type rotating capacitor (ROTCO)
beam pulse, width 40 μsec

VACUUM SYSTEM

OPERATING PRESSURE 2 to 3 10^{-7} Torr or mbar

PUMPS, No, Type, Size two 38000 l/sec oil diffusion with refrigerated baffles

ION SOURCES

Mid-plane hooded-arc PIG source pulsed. Radius of first orbit 1 cm

INJECTION SYSTEM

Internal source

EXTRACTION SYSTEM

Regenerator plus electrical septum magnet followed by passive magnetic channel

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 Ba the use of orbit displacement coil (Kim Coil) the total duty cycle of the beam can be around 50 to 60% with no rf microstructure

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
Protons		600	~7	5.0 (or 3.10^{13}/s)
$^3He^{2+}$		910	~5	2.3 (or $1.4.10^{12}$/s)
$^{12}C^{4+}$		1020		0.2 (or 10^{12}/s)
$^{18}O^{6+}$		1530		0.05 (or 3.10^{11}/s)
$^{20}Ne^{5+}$		980		0.06 (or 4.10^{11}/s)
$^{12}C^{3+}$		588		0.2 (or 10^{12}/s)

SECONDARY

		(part/s)
pions (+)	300 MeV/c	3.10^6/s
muons (+)	250 MeV/c	3.10^4/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	50 to 70%	pμ A of	MeV ions
RESOL ΔE/E	%	pμ A of	MeV ions

EMITTANCE

(π mm. mrad) { b axial / rad } pμA of MeV ions

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 2/3 SOLID STATES PHYSICS 1/3

BIOMEDICAL APPLICAT. 0 ISOTOPE PRODUCTIONS 0

Isolde facility is now the primary user with some μSR

Heavy ion programme has been phased out, except $^3He^{2+}$

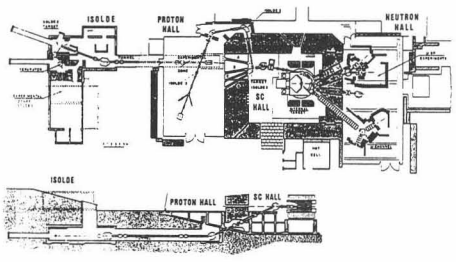
REFERENCES/NOTES

1) W. Gentner et al. Philips Tech.Rev.22, p.141, 1961

2) H. Beger et al. Proc. 7 Int.Cycl.Conf. 1975, p.149

3) B.W. Allardyce et al. Proc.10th Intl.Cycl.Conf.1984, p.4

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS



The figure shows the SC machine and the experimental zones. On the right hand side, the Neutron Hall is fed with beams orginating from internal targets. On the left are the two Isolde zones : the new IS3 separator feeds its radioactive beams into the so-called Proton-Hall ; the IS2 separator is housed in an underground zone shown in elevation underneath.