ENTRY NO. 65

NAME OF MACHINE SIN 590 MeV Ring Cyclotron Date: April 1984

INSTITUTION Swiss Institute for Nuclear Research

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IN CHARGE U. Schryber REPORTED BY W. Joho and M. Olivo

HISTORY AND STATUS

DESIGN, date 1962 Model tests 1962/68

ENG DESIGN, date 1967/71

CONSTRUCTION, date 1969/74

FIRST BEAM, date (or goal) Jan. 18, 1974

MAJOR ALTERATIONS Flattop RF-System since 1979

COST, ACCELERATOR 35 MSFr. (1974)

COST, FACILITY, total 134 MSFr. (1975)

FUNDED BY Swiss Federal Government

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 15 ENGINEERS 15

TECHNICIANS 25 CRAFTS 5

GRAD STUDENTS involved during year 2

OPERATED BY 6 Research staff or 15 Operators

OPERATION 160 hr/wk. On target 120 hr./wk

TIME DISTR. in house 20 % Outside 80 %

BUDGET, op & dev 5 MSFr. (no salaries)

FUNDED BY Swiss Federal Government

RESEARCH STAFF, not included above

USERS, in house outside 60

GRAD STUDENTS involved during year 50

RESEARCH BUDGET, in house 10 MSFr. (no salaries)

FUNDED BY Swiss Federal Government

MAGNET

POLE FACE, diameter (compact) cm, R extraction 445 cm

R injection 210 cm

GAP, min 5 cm, Field 20.9 kG
min 9 cm, Field 15 kG } at $1.5 \cdot 10^5$ Ampere turns

AVERAGE FIELD at R ext 8.7 kG

B max/ < B > 2.4

NUMBER OF SECTORS compact ; separated 8 Spiral, max 35 deg

SECTOR ANGLE (SSC) 18 deg

TRIMMING COILS 18

CONDUCTOR, material and type OFHC copper

STORED ENERGY (cryogenic) MJ

POWER main coils 650 max, kW; current stability $5 \cdot 10^{-6}$

trimming coils 20 max, kW; current stability

WEIGHT: Fe 1960 tons; coils 28 tons

COOLING system demin. water

ION ENERGY (bending limit) E/A = 590 q^2/a^2 MEV/amu

(focusing limit) E/A = q/a MeV/amu

ACCELERATION SYSTEM

DEES, number * 4 cavities deg

BEAM APERTURE 4 cm; DC Bias kV

TUNED by, coarse fine change of dimension

RF 50.63 to mHz, stable ± 10^{-6}

Orb F 8.41 to mHz

HARMONICS, RF/Orb F, used 6

DEE—Gnd, max 550 kV, min gap 15 cm

STABILITY, (pk-pk noise)/(pk RF volt) $< 3 \cdot 10^{-4}$

ENERGY GAIN, max 2200 kV/turn

RF PHASE, stable to ± 0.01 deg

RF POWEP input, max 4 x 200 kW

FREQUENCY MODULATION, rate /s

modulator, type

beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE $2 \cdot 10^{-6}$ Torr or mbar

PUMPS, No, Type, Size 4 titanium-sublimators at 14 000 l/s

ION SOURCES

see preceding entry: SIN Injector Cyclotron

* additional flattop cavity at 152 MHz, 350 kV

INJECTION SYSTEM

Magnetic and electrostatic channel

EXTRACTION SYSTEM

Electrostatic septum

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed m²; movable 600 m²

TARGET STATIONS 2 in series

STATIONS served at same time, max 11

MAG SPECTROGRAPH, type Pion spectrometer

COMPUTER model

OTHER FACILITIES 2 superconducting muon channels and medical annex for pion therapy

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
p	590	590		100-190
SECONDARY (part/s)				
π^+		350	$9 \cdot 10^9$	
μ^-		120	$3 \cdot 10^7$	

BEAM PROPERTIES

MEASURED		CONDITIONS
PULSE WIDTH	6 RF deg	150 pμ A of 590 MeV p ions
PHASE EXC. max ±3 RF deg		150 pμ A of 590 MeV p ions
EXTRACT eff	99.98%	150 pμ A of 590 MeV p ions
RESOL $\Delta E/E < 0.05$ %		150 pμ A of 590 MeV p ions
EMITTANCE (π mm. mrad)	1 axial, 2 rad	150 pμ A of 590 MeV p

OPERATING PROGRAMS, time distribution

Ring Cyclotron in operation: 72 % of total beam time, 11 target areas simultaneously served.
EXPERIMENTAL PROGRAM:
High-Energy and Nuclear Physics: 39 groups.
Applications in Solid State Physics and Chemistry: 16 groups.
Biological and Medical Applications, Pion Therapy: 11 groups.

REFERENCES/NOTES

- W. Joho, M. Olivo, T. Stammbach, H. Willax, IEEE NS-24 (1977) 1618
- W. Joho, IEEE NS-26 (1979) 1950