ENTRY No. 60

NAME OF MACHINE SIN 590 MeV Ring Cyclotron Date July 31, 1981
INSTITUTION Swiss Institute for Nuclear Research
ADDRESS CH - 5234 Villigen, Switzerland
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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 60 outside 50
GRAD STUDENTS involved during year
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
max 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 18 deg
TRIMMING COILS

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

ACCELERATION SYSTEM

DEES, number *4 cavities angle deg
BEAM APERTURE 4 cm ; DC Bias kV
TUNED by, coarse fine change of dimensions
RF 50.63 to mHz, stable $\pm 10^{-6}$
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 POWER 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 ca. 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		100-170
SECONDARY				(part/s)
π^+		350		$9 \cdot 10^9$
μ^-		120		$3 \cdot 10^7$

BEAM PROPERTIES

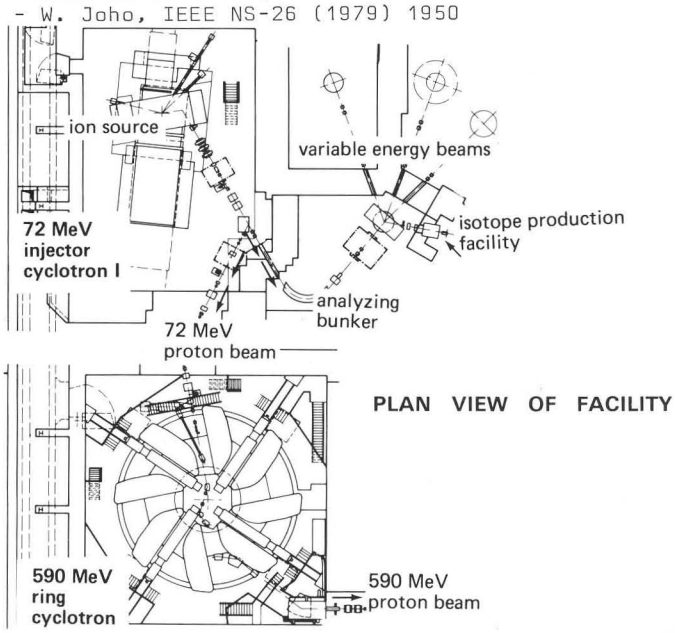
	MEASURED	CONDITIONS
PULSE WIDTH	6 RF deg	100 pμA of 590 MeV p ions
PHASE EXC, max	±3 RF deg	100 pμA of 590 MeV p ions
EXTRACT eff	99.98 %	100 pμA of 590 MeV p ions
RESOL ΔE/E<0.05	%	100 pμA of 590 MeV p ions
EMITTANCE (π mm. mrad)	1 axial / 2 rad	100 pμA of 590 MeV p

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



PLAN VIEW OF FACILITY