

ENTRY NO. 80
 NAME OF MACHINE PSI 590 MeV Ring Cyclotron Date: September 1989
 INSTITUTION PSI, Paul Scherrer Institut
 ADDRESS CH-5232 Villigen PSI, Switzerland
 TEL (0)56/99'31'11 TELEX 827 442 psi ch
 IN CHARGE U. Schryber REPORTED BY M. Olivo and W. Joho

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 8 Research staff and 10 Operators
 OPERATION 160 hr/wk, On target 140 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
 max 9 cm, Field 15 kG at 1.5E5
 AVERAGE FIELD at R ext 8.7 kG Ampere turns
 B max / < B > 2.4
 NUMBER OF SECTORS {compact 8} Spiral, max 35 deg
 {separated 18} 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 5E-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 q²/A² MeV/amu
 (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 dimension
 RF 50,63 to MHz, stable ± 1E-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) < 3E-4
 ENERGY GAIN, max 2200 kV/turn
 RF PHASE, stable to ± 0.01 deg
 RF POWER input, max 4x200 kW
 FREQUENCY MODULATION, rate /s
 modulator, type
 beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE 2E-6 Torr or mbar
 PUMPS, No, Type, Size 4 one-stage forepumps 200m³/h each,
 4 two-stage forepumps 100m³/h ea.; 4 Turbomolecular-
 500 l/s ea.; 4 Cryogenics- 800 l/s N₂ + 2000 l/s H₂
 ION SOURCES 4 Ti-sublimators 14000 l/s ea.
 see preceding entries: PSI Injector 1 and 2

* additional flattop cavity at 152MHz, 350kV

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 10
 MAG SPECTROGRAPH, type 2 pion spectrometers
 COMPUTER model PDP's and VAX's
 OTHER FACILITIES 2 superconducting muon channels and
 annexes for medical pion therapy, nucleon area,
 crystal spectrom. and material irradiation

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (µA)	
	Goal	Achieved	Internal	External
p	590	590		200-300
SECONDARY				(part/s)
π ⁺		260	9E9/100	µA
µ ⁻		57	3E7/100	µA

BEAM PROPERTIES

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

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 100% SOLID STATES PHYSICS 100%
 BIOMEDICAL APPLICAT. * 20% ISOTOPE PRODUCTIONS
 * approx. 15 µA are splitted from the main beam
 and directed towards the pion target serv. med. annex.

REFERENCES/NOTES

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

PLAN VIEW OF FACILITY, COMMENTS, ETC.

