

ENTRY NO. 79  
 NAME OF MACHINE PSI Injector Cyclotron 2 1) Date: September 1989  
 INSTITUTION PSI, Paul Scherrer Institute  
 ADDRESS CH-5232 Villigen PSI, Switzerland  
 TEL (0)56/99'31'11 TELEX 827 442 psi ch  
 IN CHARGE U. Schryber REPORTED BY W. Joho / U. Schryber

**HISTORY AND STATUS**

DESIGN, date 1972 Model tests 1973/80  
 ENG DESIGN, date 1973/80  
 CONSTRUCTION, date 1978/83  
 FIRST BEAM, date (or goal) April 1984

**MAJOR ALTERATIONS**

COST, ACCELERATOR 22 MSFr.  
 COST, FACILITY, total 134 MSFr.  
 FUNDED BY Swiss Federal Government

**ACCELERATOR STAFF, OPERATION AND DEVELOPMENT**

SCIENTISTS ENGINEERS  
 TECHNICIANS CRAFTS

GRAD STUDENTS involved during year  
 OPERATED BY Research staff or Operators  
 OPERATION hr/wk. On target hr/wk  
 TIME DISTR. in house % outside %

BUDGET, op & dev  
 FUNDED BY

RESEARCH STAFF, not included above 2)  
 USERS, in house outside

GRAD STUDENTS involved during year  
 RESEARCH BUDGET, in house  
 FUNDED BY

**MAGNET**

POLE FACE, diameter (compact) cm, R-extraction cm  
 R injection 46 cm  
 GAP, min 3.5 cm, Field 11.0 kG  
 max 3.5 cm, Field 11.0 kG at 3E4  
 AVERAGE FIELD at R ext kG Amperes turns  
 B max / < B >

NUMBER OF SECTORS {compact } Spiral, max. 0 deg  
 {separated 4. }  
 SECTOR ANGLE (SSC) 27 deg

TRIMMING COILS 11 pairs per magnet 3)

CONDUCTOR, material and type OFHC-copper

STORED ENERGY (cryogenic) MJ

POWER: main coils 4.35 max kW current stability 5E-6  
 trimming coils tot. 15 max kW current stability 5E-5

WEIGHT: Fe 4x180 tons coils 4x0.96 tons  
 COOLING system demin. water

ION ENERGY (Bending limit) E/A = 72 q<sup>2</sup>/A<sup>2</sup> MeV/amu  
 (Focusing limit) E/A = q/A MeV/amu

**ACCELERATION SYSTEM**

DEES, number 2 4) angle 18°(RF) 20°(geom)  
 BEAM APERTURE cm; DC Bias kV  
 TUNED by, coarse fine Trim, cap.  
 RF 50.63 to MHz, stable ± E-6  
 Orb F 5.063 to MHz  
 HARMONICS, RF/Orb F, used 10  
 DEE-Gnd, max 250 kV, min gap 3.0-16.0 cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 3E-4  
 ENERGY GAIN, max 1000 kV/turn  
 RF PHASE, stable to ± <0,0> deg  
 RF POWER input, max inc, beam power 2x200 kW  
 FREQUENCY MODULATION, rate /s  
 modulator, type  
 beam pulse, width

**VACUUM SYSTEM**

OPERATING PRESSURE 1E-6 Torr or mbar  
 PUMPS, No, Type, Size 4 turbo-molecular pumps  
 2200 l/s each

**ION SOURCES**

Cusp type, in Cockcroft-Walton preaccelerator

**INJECTION SYSTEM**

Axial, at 870 keV, magn. cone with n=0,6

**EXTRACTION SYSTEM**

2 septum magnets with 5.5° and 39.5°

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed m<sup>2</sup>; movable m<sup>2</sup>  
 TARGET STATIONS in ppm  
 STATIONS served at same time, max  
 MAG SPECTROGRAPH, type  
 COMPUTER model  
 OTHER FACILITIES

**CHARACTERISTIC BEAMS**

PARTICLE	ENERGY (MeV)		CURRENT (µA)	
	Goal	Achieved	Internal	External
p	72	72	>1000	>1000
SECONDARY (part/s)				

**BEAM PROPERTIES**

MEASURED	CONDITIONS	
	MEASURED	CONDITIONS
PULSE WIDTH 20 RF deg	1000 µA of MeV ions	
PHASE EXC, max RF deg	µA of MeV ions	
EXTRACT eff. 99.8%	1000 µA of MeV ions	
RESOL ΔE/E 0.6%	1000 µA of MeV ions	
EMITTANCE		
(π mm-mrad) ~ 3 axial	200 µA of MeV	
~ 3 rad		

**OPERATING PROGRAMS, time distribution**

BASIC NUCLEAR PHYSICS SOLID STATES PHYSICS  
 BIOMEDICAL APPLICATIONS ISOTOPE PRODUCTIONS ~20%  
 Injection into 590 MeV Ring Cyclotron 100%  
 Biomed. Applic. and isotope prod. parasitic

**REFERENCES/NOTES**

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

PLAN VIEW OF FACILITY: see "PSI 590 MeV Ring Cycl."

**COMMENTS:**

- Two stage accelerator for 72 MeV protons (see Proc. 9th Inst. Conf. on Cyclotrons and their Application, (1981), 43)  
 Stage 1: 870 keV DC preacc. (Cockcroft-Walton)  
 Stage 2: Isochronous ring cyclotron
- See PSI 590 MeV Ring Cyclotron (this compilation)
- Special coils outside vacuum chamber for correction of isochronism
- RF-systems: two λ/2-resonators (50.6 MHz) for acceleration and two flat-top cavities (151.8 MHz)