

ENTRY NO. C55 Date August 1995
 Name of Machine PSI Philips Cyclotron "Injector I"
 Institution PSI, Paul Scherrer Institute
 Address CH-5232 Villigen PSI, Switzerland
 Tel ++41 (0)56-310 21 11 Telex - Fax ++41 (0)56-310 33 83 E-MAIL SCHMELZBACH@psi.ch
 In Charge: Dr. U. Schryber Reported by: Dr. P.-A. Schmelzbach

HISTORY

MILESTONE DATES:

Design 1967-1969 Model Tests 1968-1971
 Construction 1970-1973 First Beam Jan. 1st, 1974

DESIGN/CONSTRUCTION BY:

in house other Philips

COST: Accelerator 14 MSFr Facility *

FUNDED BY: Swiss Federal Government

STATUS

STAFF: Machine

Scientists 1 Engineers 1

Technicians 4 Students

Research (in house/external) VE + pol. Inj. mode

Scientists 10 / 80 Engineers /

Technicians / Students / 30

BUDGET: Machine * Funded by *

Research * Funded by *

TIME DISTRIBUTION:

Basic Research (in house/external) 10 % / 55 %

Applied Program (in house/external) 22 % / %

Maintenance 10 % Development 3 %

MAGNET

POLE PARAMETERS:

Diameter 250 cm R_{extract} 105 cm R_{inject} 1.5 cm

HILL PARAMETERS: Gap (min) 24 cm B_{max} T

(@ AT) Gap (max) cm B_{min} T

VALLEY PARAMETERS: Gap (min) 45 cm B_{max} T

(@ AT) Gap (max) cm B_{min} T

AVERAGE FIELD: $\langle B \rangle_{\text{min}}$ T $\langle B \rangle_{\text{max}}$ 1.65 T

NUMBER OF SECTORS: compact/separated 4 /

sector angle deg. spiral (max) 55 deg.

FIELD TRIMMING: Trim Coils 12 concentric

Harmonic Coils 4 sets harmonic

Other

CURRENT: Main Coils 700 Amps Stability 10^{-6}

Trim Coils 250 Amps Stability 10^{-6}

Stored Energy (cryogenic) MJ

WEIGHT: Iron 470 tons Conductor 20 t Al

ION ENERGY: Bending Limit $E/A = 135 \text{ q}^2/\text{A}^2 \text{ MeV/u}$

Focusing Limit $E/A = 135 \text{ q/A MeV/u}$

ACCELERATION SYSTEM

FUNDAMENTAL ACCELERATION:

Description: 1. Dee, 2 HF systems (VE/Inj. modes)

No. of Gaps/turn 2 $dE/dn(\text{max})$ 0.16 MeV/q

Voltage (max) 0.08 MV Harmonic f_H/f_{ion} 1 / 3

Freq 4.6 to 17/50 MHz Power in (max) 0.1 MW

Stability: Phase 1 deg. / 0.1 deg Voltage 10^{-2} / 10^{-4}

OTHER CAVITIES (Flattopping or otherwise):

Description:

Region of Influence: R_{min} cm R_{max} cm

No. of Gaps/turn $dE/dn(\text{max})$ MeV/q

Voltage (max) MV Harmonic f_H/f_{ion}

Freq MHz Power in (max) MW

Stability: Phase Voltage

VACUUM SYSTEM

OPERATING PRESSURE: without gas $5 \cdot 10^{-7}$ mbar

PUMPS: (No. and type) 20000 + 12000 l/s oil diff. pumps

(Balzers), cryogenic panels (Philips)

ION SOURCE(S)

Type	Intensity (mA)	@ $\epsilon_n = \beta\gamma\epsilon$ ($\pi \text{ mm mrad}$)	Ion Species
(a) Internal Livingston			p, d, He
(b) axial: atomic beam pol. source			p, d
(c) ECR "Caprice" 1.1 T, 10 GHz, heavy ion source			
(d)			He-Pb

INJECTION SYSTEM

axial: e.m. quads, spherical de- Efficiency %
 flector, buncher, mirror

EXTRACTION SYSTEM

electrostatic, electromagnetic, magn. Efficiency 93 %

CHARACTERISTIC BEAMS

Accelerated Ions	E/A (MeV/u)	Current (part μA)	
		Internal	External
(a) p. (Inj. mode)	72	215	200
(b) p. (VE mode)	10 - 72	≤ 110	≤ 100
(c) ECRIS	2 - 30		see ref. 7)
(d) pol. p. (d)	10 - 72	≤ 15	≤ 12

Secondary Particles	E (MeV)	part/sec
(a) n, pol. n	30 - 70	$\leq 5 \cdot 10^{-5} \text{ /s / cm}^2$
(b) n, pol. n	200 - 580	$5 \cdot 10^{-6} \text{ /s / cm}^2$
(c)		

EXTRACTED BEAM PROPERTIES:

For 100 μA of 72 MeV/u p ions
 $\Delta E/E$ 0.5 % $\Delta\phi$ 15 °rf
 $\epsilon_n = \beta\gamma\epsilon$ x 3 $\pi \text{ mm mrad}$ z 2 $\pi \text{ mm mrad}$

FACILITIES FOR RESEARCH

SHIELDED AREA: Fixed 400 m^2 Moveable m^2

Target Stations: 10 No. Served At Same Time: 1

MAGNETIC SPECTROMETERS:

OTHER FACILITIES: n-production targets, spin rotators,

users owned/operated devices: crystal spectrometer

4 π -scattering chambers, double scattering apparatus,

spectrometers, biol. vertical beam, OPTIS-Eye cancer

treatment, Isotope production.

REFERENCES/NOTES

(a) See references 1-7 mentioned below.
 (b)

PLAN VIEW OF FACILITY, COMMENTS

* see PSI-590 MeV Ring Cyclotron (this compilation)

1) The SIN injector cyclotron (A. Baan et al.)

IEEE Trans. Nucl. Sci. NS-20.3 (1973) 257

2) The axial injection system of the SIN injector cyclotron (N. Hazewindus), I. Design considerations/II. Description and experiments, buncher, Nucl. Instr. & Meth. 129 (1975) 325/331

3) The central region of the SIN injector cyclotron (J. M. van Nieuwland et al.) Nucl. Instr. Meth. 142 (1977) 339

4) Improvements in the SIN injector RF system (P. Sigg) Nucl. Instr. & Meth. 155 (1978) 1

5) Aspects of the 100 μA operation (G. Heidenreich et al.) 9th Int. Conf. on Cyclotrons, Caen (1981) 365

6) Polarized Beams at PSI (P.-A. Schmelzbach et al.) European Particle Accelerator Conference, Rome (1988)

7) Commissioning and First Operating Experience with the ECR Heavy Ion Source at the PSI Philips Cyclotr. (P.-A. Schmelzbach and S. Drack) Contr. to this Conf.