

ENTRY NO. 053 Date July 1992
 Name of Machine PSI Philips Cyclotron "Injector I"
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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 5 / 75 Engineers /
 Technicians / Students / 30
BUDGET: Machine * Funded by *
 Research * Funded by *
TIME DISTRIBUTION:
 Basic Research (in house/external) 3 % / 70 %
 Applied Program (in house/external) 14 % / %
 Development 3 % Maintenance 10 %

MAGNET

POLE PARAMETERS:
 Diameter 250 cm $R_{extract}$ 105 cm R_{inject} 1.5 cm
HILL PARAMETERS: Gap (min) 24 cm B_{max} T
 (θ AT) Gap (max) cm B_{min} T
VALLEY PARAMETERS: Gap (min) 45 cm B_{max} T
 (θ AT) Gap (max) cm B_{min} T
 AVERAGE FIELD: $< B >_{min}$ T $< B >_{max}$ 16.5 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 t Conductor 20 t Al
ION ENERGY: Bending Limit $E/A = 135$ q²/A² MeV/u
 Focussing Limit $E/A = 135$ q/A MeV/u

ACCELERATION SYSTEM

FUNDAMENTAL ACCELERATION:
 Description: 1 Dee, 2 HF systems (VE/Inj. modes)
 No. of Gaps/turn 2 $dE/dn(max)$ 0.16 MeV/q
 Voltage(max) 0.08 MV Harmonic f_{rf}/f_{ion} 1.3/3
 Freq 4.6 to 17/50 MHz Power in(max) 0.1 MW
 Stability: Phase 1 deg / 0.1 deg Voltage $10E-2$ / $10E-4$
OTHER CAVITIES (Flattopping or otherwise):
 Description:
 Region of Influence: R_{min} cm R_{max} cm
 No. of Gaps/turn $dE/dn(max)$ MeV/q
 Voltage(max) MV Harmonic f_{rf}/f_{ion}
 Freq MHz Power in(max) MW
 Stability: Phase Voltage

VACUUM SYSTEM

OPERATING PRESSURE: without gas $10E-6$ mbar
PUMPS: No. and type 20000 + 12000 17's oil-diff. pumps
 (Bärfers), cryogenic panél (Philips)

ION SOURCE(S)

Type	Intensity (mA)	θ (mm mrad)	$\epsilon_n = \beta\gamma\epsilon$ (mm mrad)	Ion Species
(a) Internal Livingston				$P_{s,d}$ (A,Z) (14,4)
(b) axial: atomic beam pol. source				$P_{s,d}$
(c) axial: atomic beam pol. source				$P_{s,d}$
(d) ECR "Caprice" heavy ion source (1993)				

INJECTION SYSTEM

axial: e.m. quads, buncher, mirror. Efficiency %

EXTRACTION SYSTEM

electrostatic, electromagn., 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) N_{4+}	5-30	4	3/0-01
(d) pol. p. (d)	10-72	≤ 15	≤ 12
Secondary Particles		E (MeV)	
(a) p. pol. n	30-70	≤ 5	part/sec 2
(b) p. pol. n	200-580	5	$E-6/s/cm^2$
(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 mm mrad z 2 mm mrad

FACILITIES FOR RESEARCH

SHIELDED AREA: Fixed m² Moveable m²
 Target Stations: No. Served At Same Time: 1
MAGNETIC SPECTROMETERS:
OTHER FACILITIES: no-production targets, spin rotators,
 users owned/operated devices: crystal spectrometer,
 4 π scattering chambers, double scattering apparatus,
 spectrometers, bio vertical beam (1993)

PLAN VIEW OF FACILITY, COMMENTS

* see PSI 590 MeV Ring Cyclotron (this compilation)

REFERENCES/NOTES

- The SIN injector cyclotron (A. Baan et al.) IEEE Trans. Nucl. Sci. NS-20.3 (1973) 257
- 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
- The central region of the SIN injector cyclotron (J.M. van Nieuwland et al.) Nucl. Instr. Meth. 142 (1977) 339
- Improvements in the SIN injector RF system (P. Sigg) Nucl. Instr. & Meth. 155 (1978) 1
- Aspects of the 100 μA operation (G. Heidenreich et al.) 9th Int. Conf. on Cyclotrons, Caen (1981) 365
- Polarized Beams at PSI (P.-A. Schmelzbach et al.) European Particle Accelerator Conference, Rome (1988)