

Entry: **C59**  
**Machine Name:** PSI Injector 2 Cyclotron  
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## HISTORY

**Design by:** PSI (former SIN) -team  
**Construction time:** 1978 - 1983  
**First beam:** April 1984

## CHARACTERISTIC BEAMS

ions / energy (MeV/n) / current (pps) / power (W) :  
 - Protons, 72 MeV, 1.5 (-2.0) mA, 100 (.140) kW  
 - .....  
 - .....  
 - .....

### transmission efficiency (total)

- typical: - best:

### transverse emittance (rms)

- vertical: 1.0 $\pi$  mmmrad  
 - horizontal: 1.0 $\pi$  mmmrad

longitudinal emittance (rms) 0.1% \* <2deg  $\Delta E/E$ .deg RF

## USES

basic research: 74 % therapy: .....  
 development: 12 % isotope production: 20 % (parasit.)  
 other applications: ..... % maintenance: 9 %  
 beam tuning: 5 %  
 total time: 7300 h/year

## TECHNICAL DATA

### a) magnet

type: separate sector magnets  
**Kb:** 72 MeV/n **Kf:** 72 MeV/n  
 average field (min-max): 0.33 - 0.36 T  
 number of magnet sectors: 4  
 - angle: 27 deg  
 - spiral (max): 0 deg

### pole parameters

- diameter: 7 m  
 - injection radius: 0.406 m  
 - extraction radius: 3.505 m

hill gap: 0.035 m valley gap: (open)

### field trimming

- trim coils  
 - number: 11  
 - current (max): 40 A  
 - harmonic coils  
 - number: 1  
 - current (max): 200 A  
 - others  
 - number: .....  
 - current (max): .....

### main coils:

- number: 4 pairs  
 - Ampere-turns: 38 e3 A.T.  
 - current: 400 A

### stored energy:

weight : - iron: 4\*180 t - coils: 4\*0.96t

### power

- main coils (total): kW  
 - trim coils (total max): kW  
 - refrigerator (cryogenic): .....

### b) RF

#### - acceleration

- frequency range: 50.633 MHz  
 - harmonic modes: 10th  
 - number of dees: 2 cavities  
 - angular aperture: 2 gaps at 20 deg per cavity  
 - voltage:- average (min-max): 200 kV per gap  
 - variation with radius: 125-250kV  
 - .....

- power in (max): 2\*180 kW  
 - stability: - phase: 0.01 deg - voltage: 0.03 %

#### - other cavities

- purpose: acceleration (flattop in original design)  
 - frequency range: 151.9 MHz  
 - region of influence: 0.8 - 3.5 m  
 - voltage (max): 50 kV  
 - power in (max): 10 kW  
 - stability:- phase: <0.1 deg - voltage: 0.1%

### c) injection

#### - internal source:

- external (radial/axial): Injection at 870 keV

- elements: conical injection shim in one magnet tip

- source voltage: 60kV  
 - injection energy: 0.87 MeV/n  
 - buncher: 1, with 7-10 kV

- injection efficiency:  $\approx 20$  % (phase selection from DC beam)

### d) ion sources/injector

Multicusp ion source with 60 kV extraction, inside of the 810 kV Cockcroft-Walton preaccelerator

### e) extraction

- elements, characteristics:  
 - electrostatic extraction channel  
 - septum magnet inside vacuum chamber  
 - .....

### - efficiency

- typical: 99.97 % - best:  $\approx 100$ %

### f) vacuum

- pumps: 4 turbopumps  
 - .....

- achieved vacuum: 1.3 e-4 Pa

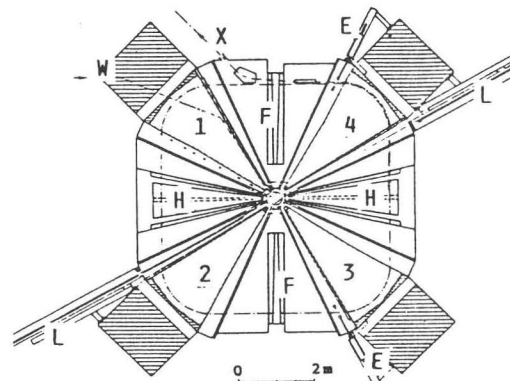
## REFERENCES

U.Schryber et al, Proc 9<sup>th</sup> Int Cycl Conf., Caen (1981) 43  
 U.Schryber et al, Proc EPAC 1992, p173 ff  
 U. Schryber et al, Proc. 14<sup>th</sup> Int Cycl Conf, Cape Town

## EXPERIMENTAL FACILITIES

Injector for the PSI 590 MeV Ring Cyclotron  
 Isotope production with splitted 72 MeV beam

## PLAN VIEW OF FACILITY



1 - 4 : sectormagnets,  
 H: main RF cavities, F: flattop cavities  
 L: long radial probes, E: probes at extraction  
 W: 870 keV injection beam (above magnet yoke)  
 X: 72 MeV extracted beam

## COMMENTS

10<sup>th</sup> harmonic, low field, large machine to get space for 870 keV injection. Optimized for high current 72MeV p.