THE RIKEN SSC BEAM HANDLING SYSTEM

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ABSTRACT

A separated-sector cyclotron (SSC) is under construction at RIKEN. The present report describes the beam sharing system from the heavy-ion linac to the SSC and the beam transport system from the SSC to the experimental areas.

BEAM SHARING SYSTEM FROM THE LINAC

The ion-optical calculation of the beam transport system was performed on the basis of the following specifications: (1) maximum magnetic rigidity, $B\rho$, is 0.785 T·m for $^{238}U^{40+}$ at 0.84 MeV/u after passing through a charge stripper; (2) emittance in the transverse phase space 6π mm·mrad at maximum; (3) energy resolution, $\Delta E/E$, is less than 0.15 % at FWHM; and (4) the RF phase width of the beam phase is less than 6°.

Figure 1 shows the plan view of the beam transport system from the linac. Beam envelopes throughout the system in the on- and off-midplanes are shown in Fig. 2. The layout and the ion-optical calculation downstream the slit SL0 in Fig. 1 were reported previously.[1]

A pulsed deflection magnet (DS0) is introduced to deflect the beam by an angle of 5.73°. The bending radius is 3 m and the maximum field is 0.26 T. The pole gap is 4 cm, which is large enough compared with the vertical beam size. The coil is wound of copper hollow conductor having a cross section of 9×9 mm^2 with a hole of 6 mm in diameter. The total number of windings is 16. The magnet will be excited in a pulse mode with a rise- and fall-time of 1 msec and a flat-top of 10 msec. The designed values of electric characteristics are listed in Table 1.

The system consisting of two dipole magnets (DS1 and DS2) and five quadrupole magnets (QDS1, QSS1 and QDS2) is a beam shifting section. It is an achromatic transport system. Four quadrupole magnets (QSS2-QSS5) are introduced to perform the shaping of the achromatic beam.

A beam pulsing system with a sinusoidal wave, a pulsed beam chopper and a mechanical beam chopper are planned to be installed on the beam line from the point A to SL0 in Fig. 1 in order to obtain a pulsed beam for TOF or life-time measurements.

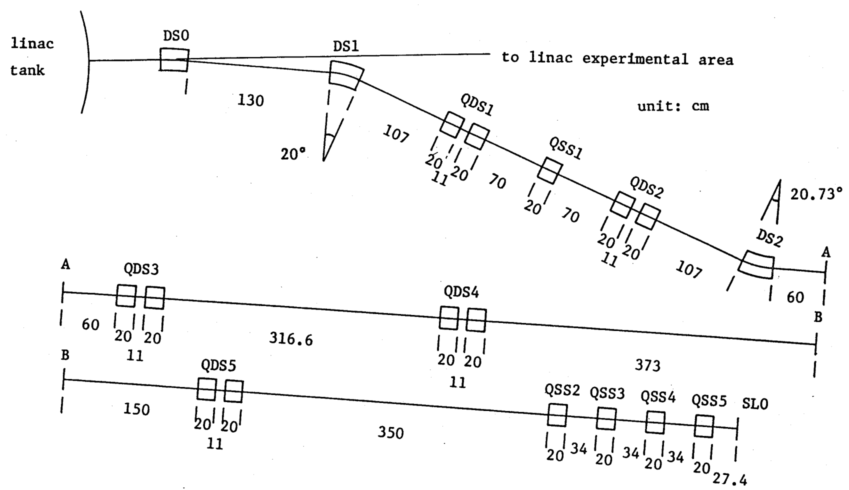

Fig. 1. Plan view of the beam transport system from the linac to the slit SL0.

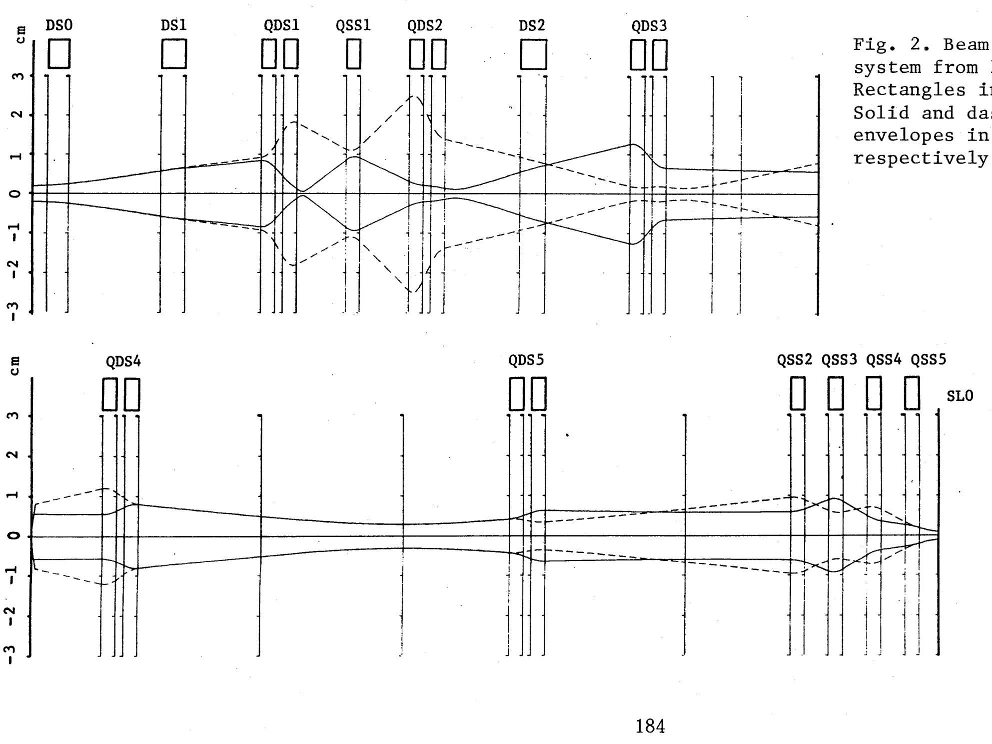

Fig. 2. Beam envelopes through the system from linac to the slit SL0. Rectangles indicate position of magnets. Solid and dashed curve show beam envelopes in the on- and off-midplane, respectively.

BEAM TRANSPORT SYSTEM FROM THE SSC

The plan view of the SSC beam handling system is shown in Fig. 3. Numerical calculation of ion optics was reported previously.[2] The system provides the following beam preparation modes: (1) achromatic, double-telescopic transport to every target area except for Lab. 1; (2) double-dispersive, double-telescopic transport with a momentum resolution up to 25000 in Labs. 2, 3 and 6; and (3) isochronous (≲ 500 psec) non-dispersive, double-telescopic transport to Labs. 4 and 6. A crossed-beam experiment can be performed at the target station T_7.

Sometimes it will be beneficial for two exprerimental groupes to share the beam. For that purpose, every 90° bending magnet in Fig. 3 will be divided into two pieces, one of which deflects the beam by an angle of 25° and the other 65°. It has been confirmed by an ion-optical calculation that the beam condition obtained from the previous analysis with 90° bending magnets is satisfactorily well reproduced by this modified configuration. The dipole magnet which deflects the beam by an angle of 25° will be operated in a pulse mode and two users can share the beam. The pole gap is 6 cm. The coil is wound of copper hollow conductor having a cross section of 12×12 mm^2 with a hole of 8×8 mm^2. The total number of windings is 128. It takes 1 sec to reach the flat-top and also 1 sec to fall down to zero. The beam is shuttered during these transient periods. The flat-top duration will be adjusted according to requirements from experiments. The designed electrical characteristics are listed in table 2.

Table 1

Designed values of electrical characteristics of the pulsed magnet for the linac.

maximum intensity	520 A
resistance	4.4 mΩ
inductance	0.24 mH
direct voltage	2.3 V
$L\frac{dI}{dt}$	125 V
power	1.2 kW

Table 2

Designed values of electrical characteristics of 25° bending magnet.

maximum intensity	485 A
resistance	100 mΩ
inductance	160 mH
direct voltage	48.5 V
$L\frac{dI}{dt}$	155 V
power	24 kW

REFERENCES

* College of Hum. and Science, Nihon University.

1. N. Kishida and Y. Yano, Sci. Papers of IPCR 75 (1981) 214.
2. T. Inamura, N. Kishida, Y. Hata and H. Kamitsubo, Sci. Papers of IPCR 77 (1983) 96.

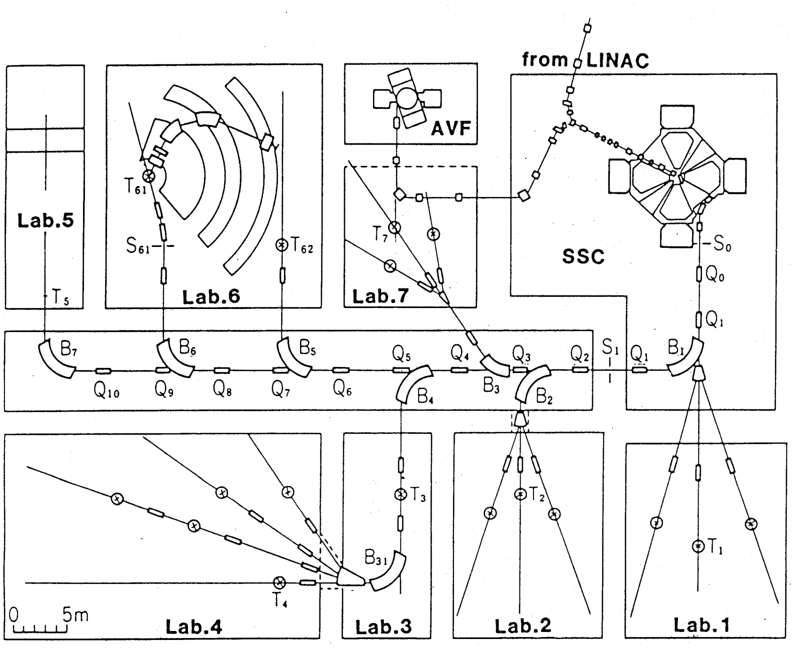

Fig. 3. Plan view of the beam handling system for the RIKEN SSC. S_0 is the object point of the system