DESIGN OF THE BEAM TRANSPORT SYSTEM FOR THE IPCR SSC

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Abstract

The beam transport system from RILAC(Riken Heavy Ion Linac Facility) to IPCR SSC is designed. The system is composed of a charge stripping and charge selection part, subsequent achromatic beam transport line, and a beam optical matching system.

The purpose of the beam transport system is to bring the preaccelerated beam from RILAC to the SSC and to change its properties according to the requirements of the SSC at injection point. The demanded performance of the beam transport system is as follows: (1) the system is required to transport the particles of maximum magnetic rigidity of p=0.2354 GeV/c corresponding to a $^{238}U^{40+}$ beam of 0.84 MeV/A; (2) the system can transport the beam from RILAC which has vertical and horizontal emittance of 5 mm x 5 mrad· π= 25π mm·mrad and 0.3 % energy spread without any beam losses; (3) achromatic transport is realizable; (4) the system prepares the beam shape, dispersion and pulse length which the beam injection system (see another part of this contributed paper) requires at the beam matching point.

The computer program TRANSPORT is used to calculate beam optics to first order[1]. In designing the system cares are taken that quadrupole field gradients do not exceed about 1.5 kGauss/cm and that each object waist is transformed into an image waist independently of starting phase ellipse. Therefore the strength of the magnetic elements are determined by only the magnetic rigidity of the beam. The layout of the beam transport system is shown in Fig. 1. Each bending part and each straight line are composed of an achromatic transport system with mirror symmetry and a doubly telescopic system, respectively[2]. So the shape of the initial phase ellipse are unchangeably transported from an object to an image.

The transport system from S_0 to S_2 constitutes a charge stripping and charge selection part, and it has enough momentum resolution to separate U^{39+} ions from U^{40+} ions at slit S_1. This is demonstrated in Fig. 2. The dipole magnet D_8 operates as switching magnet because of the beam from the injector AVF cyclotron being injected through it. Therefore D_8 and D_7 have no face angle and the quadrupole triplet QT_7 is used to get vertical focusing. Two quadrupole doublet QD_{13} and QD_{14} constitute the beam matching system which matches horizontal and vertical phase ellipses to the SSC acceptance. Momentum dispersion matching is performed by the subsequent beam injection system.

It is pointed out that a central position phase space matching is very important in high harmonics accelerations[3]. Now buncher calculations considering the above condition are under way. A possibility of beam sharing between RILAC and the SSC is also investigated.

References

1) K.L. Brown et al., SLAC-91(1974)
2) F. Hinterberger, Nucl. Instr. and Meth. 111(1973)189
3) W.M. Schulte and H.L. Hagedoorn, IEEE Trans. Nucl. Sci. NS-26, 2(1979)2388

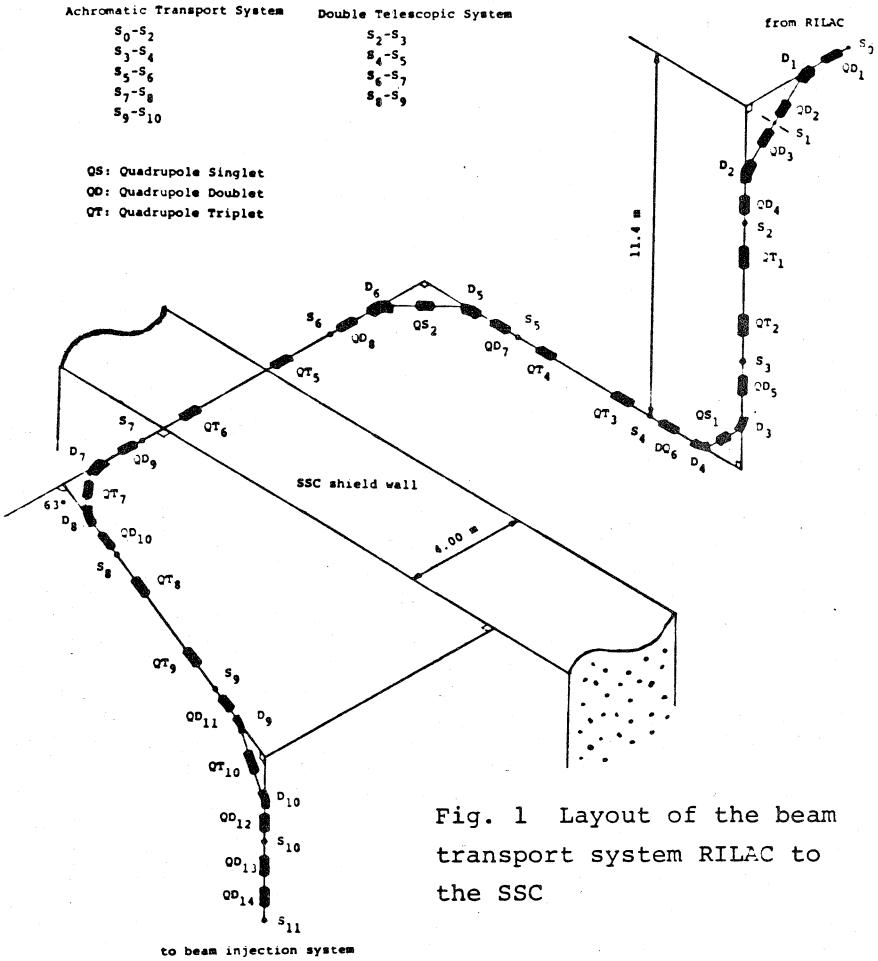

Fig. 1 Layout of the beam transport system RILAC to the SSC

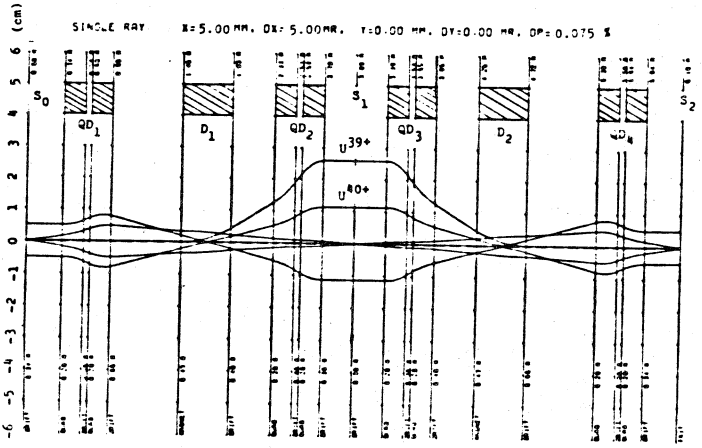

Fig. 2 Single ray plot of U^{40+} and U^{39+} ions of 0.2354 GeV/c. A charge stripper is placed in S_0 and a charge selection slit is placed in S_1.