Beam Transport System from the INS-SF Cyclotron to TARN

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Abstract

Beam transport system from the INS-SF Cyclotron to TARN was designed and constructed. The system is composed of optical matching elements, beam monitoring devices and vacuum system.

Beam transport system

This transport system must provide between two different kinds of accelerators, cyclotron and storage ring. It has capabilities to make matching of transverse phase space and momentum dispersion. The optical system are composed of four sections. They are 1) momentum analyzing section, 2) double achromatic beam section where both the dispersion function (η) and its derivative (η') are made to be zero, 3) matching section of the transverse phase spaces and 4) momentum matching section where the dispersion parameters are adjusted to the values required from the optics of the strage ring.

Analysis of the beam optics was performed with the aid of the computer program MAGIC. Calculated results for the size of beam envelope and the dispersion function along the optical axis of the system are shown in Fig.1. The layout of the transport system is illustrated in other session of this paper.

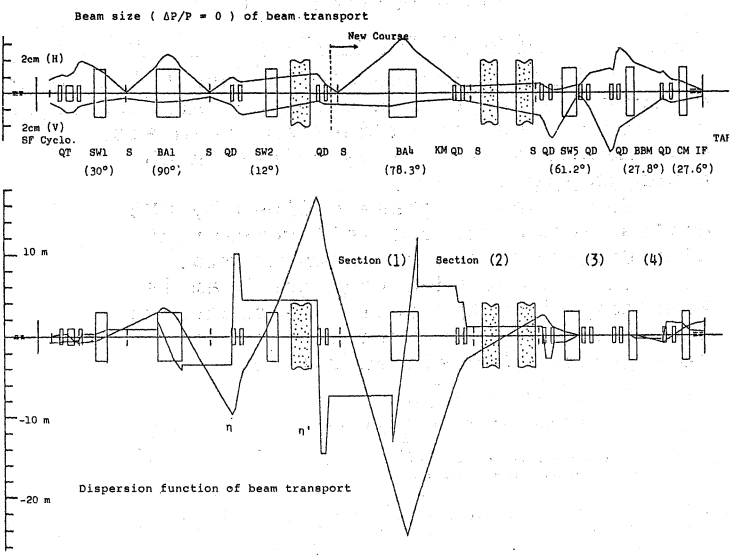

Fig.1 Beam envelopes and dispersion functions

The beam is transferred from the cyclotron to TARN by the distance of about 45 meters. The constructed optical matching elements were analyzer magnets (BA1 and BA4), bending magnets (SW5, BBM and CM), ten quadrupole magnets, two electrostatic inflectors, a kicker magnet and steering magnets of six sets. Beam-monitoring devices consist of seven slits of various kind , an emittance monitor and five profile monitors. The vacuum system composed of two regular pumping systems and three stages of differential pumping system.

Construction of elements

The analyzing magnets, named BA1 and BA4, were constructed each of which has a uniform field and is edge focusing type.

The modified window-frame structures were chosen and designed using the computer program TRIM. Magnetic field were measured with a system of temperature-controlled Hall probe.

Two bending magnets, SW5 and BBM, which were modified and converted from the elements of the beam courses of the INS-FM cyclotron.

Main features of the small-aperture quadrupole magnets are their strong magnetic field gradients and compactness of the mechanical structure. The field strength were measured with the Hall probe and twin coils translated horizontally.

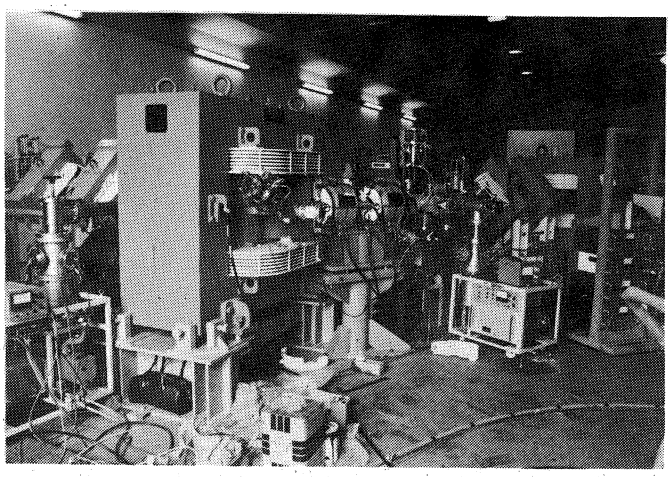

Fig.2 Transport line in TARN experi. hall

Time structure of the incident beam to TARN is controlled by a kicker magnet of deflection angle, duration time and maximum repetition rate of 1.25 mrad, 80μs and 100 Hz, respectively. The kicker magnet of H-type was made by a ferrite. Figure 2 shows the beam transport line in the TARN experimental hall.

Results of beam transporting experiment

In 1979, first beam of H_2^+ and He^{2+} were transported from the cyclotron to injection point of TARN and injected in the ring. With the use of monitoring devices, beam size were measured at various points which is given in Fig.3.

The measured phase ellipes by EM2 emittance monitor are well consistent with designed ones as shown in Fig.4.

It is concluded that the beam is transported by the optical elements so that the orbit characteristics well agree with the designed values.

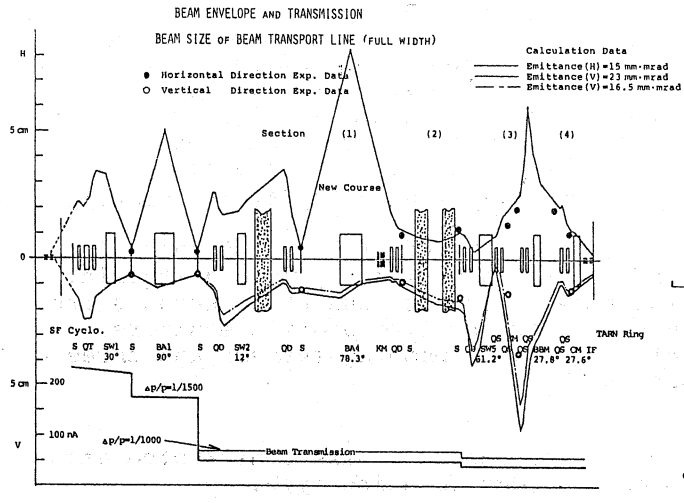

Fig.3 Beam envelope and Transmission

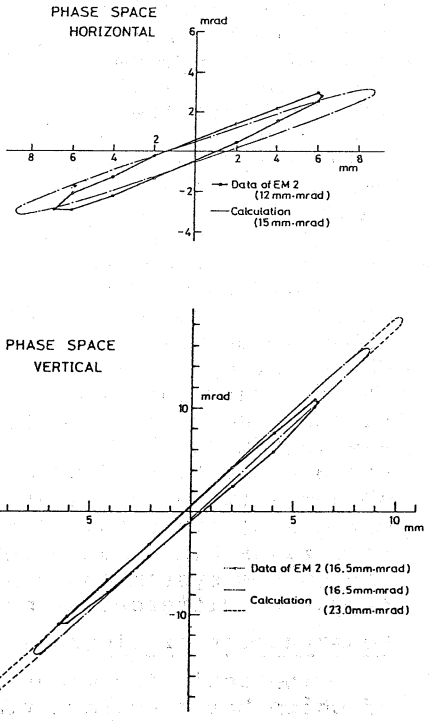

Fig.4 Beam phase ellipes