A COMPACT LAYOUT FOR IUAC HIGH CURRENT INJECTOR

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Abstract

The High Current Injector for the super-conducting heavy ion LINAC at IUAC consists of an ECR source, RFQ and room temperature DTL to accelerate ion beams, having A/q <= 6, to an energy of 1.8 MeV/u. The HCI beam line runs parallel to the existing LINAC beam line at a distance of around 20 meters. The initially proposed scheme transports the beam from the HCI exit to the LINAC entrance using four numbers of 90^0 bends. This paper proposes a simpler scheme with two achromatic bends of 114^0 and 66^0 and a shorter overall length. The layout and beam dynamics have been modified starting from the ion source to the exit of the DTL to fit the scheme within the geometrical constraints.

INTRODUCTION

Major subsections of the high current injector project at IUAC are the ECR source, 48.5 MHz RFQ and 97 MHz DTL. Ions having a maximum energy of 60 keV/u from the ECR source, located on a high voltage deck, are bunched using a 12.5 MHz multi harmonic buncher and accelerated to 180 keV/u by the 48.5 MHz RFQ, and then fed to the DTL. The 1.8 MeV/u beam from the DTL is transported to the LINAC entrance.

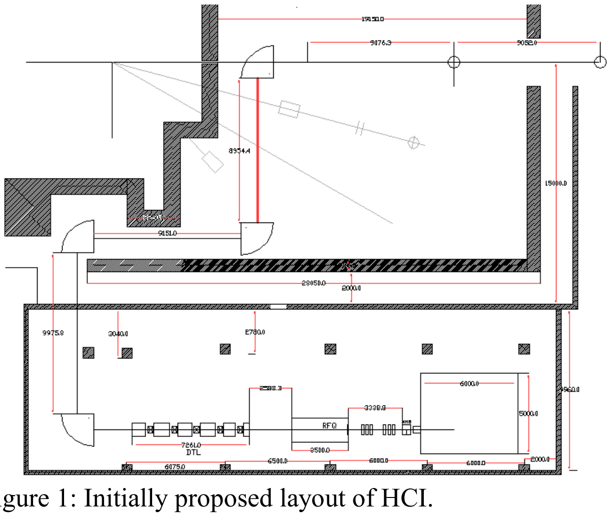

Figure 1: Initially proposed layout of HCI.

The schematic of the old and new beam halls along with the initially proposed scheme/1/ to transport the beam to the entrance of the LINAC is shown in figure1. This scheme requires a long transport line with four 90^0 bends to utilize the existing opening of the old beam hall. The top portion of the figure shows part of the old beam hall with the beam line transporting the Tandem output to the LINAC and the bottom part shows the new beam hall that will house the HCI.

This paper presents a simpler scheme to transport the beam from the HCI to the LINAC, as shown in figure 2. It connects the DTL output to the existing LINAC line using a straight section. Due to geometrical constraints, as you can see from figure 2, this could be achieved only by shortening the total length of the HCI. The size of the ECR platform is reduced and the entire layout is modified to meet this requirement. However, closer packing the transport elements on the ECR deck resulted in a better acceptance of the beam from the ECR source and a reduced maximum transverse dimension of the beam. The output of the DTL is fed to a 114^0 achromatic bend and then taken towards the old beam line with three quadrupole triplets, providing space in between for beam diagnostic elements. Then it is merged with the existing beam line using another 66^0 achromatic bend.

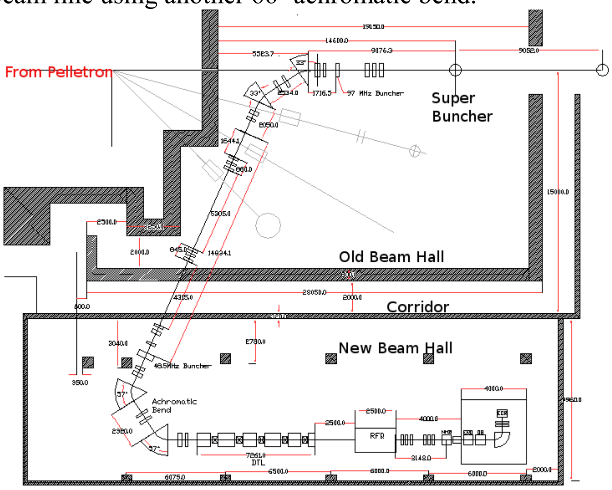

Figure 2 : New layout proposed for HCI.

BEAM DYNAMICS

The beam dynamics is done in three sections. The ECR source to the entrance of RFQ is done using the program TRANSPORT. A transverse emittance of 100 mm-mr is assumed at the exit of the ECR source. The output of this section delivers the beam according to the RFQ input specifications. The RFQ beam dynamics was done earlier, using the program LIDOS. The RFQ output goes through a matching section, consisting of a double gap buncher and several quadrupole magnets, to the input of the DTL

Main objective of this work was to design the high energy beam transport, from DTL output to the LINAC entrance, using minimum number of transport elements and causing a minimum growth in transverse and longitudinal emittance values. The beam parameters at the entrance and exit of the DTL and after high energy beam transport (HEBT) line are shown in table 1.

Table 1: beam parameters

Location	Exrms mm-mr	Eyrms mm-mr	Ezrms Kev-nS	Energy MeV/q
DTL	.5	.5	1	0.18

Entry				
DTL Exit	.63	.59	1.06	1.8
HEBT Exit	.63	.59	1.06	1.8

It can be seen that the HEBT section does not cause any increase in both the longitudinal and transverse emittance values. Longitudinal focussing in HEBT is done by one 48 MHz double gap buncher. It gives a time focus at the 97 MHz buncher located in the old beam line. The beam dynamics calculations for the HEBT were done using the programs LANA and trace3D. Third order optics for the achromatic bends were done using GICOSY. The beam envelopes for the HEBT are shown in figure 3.

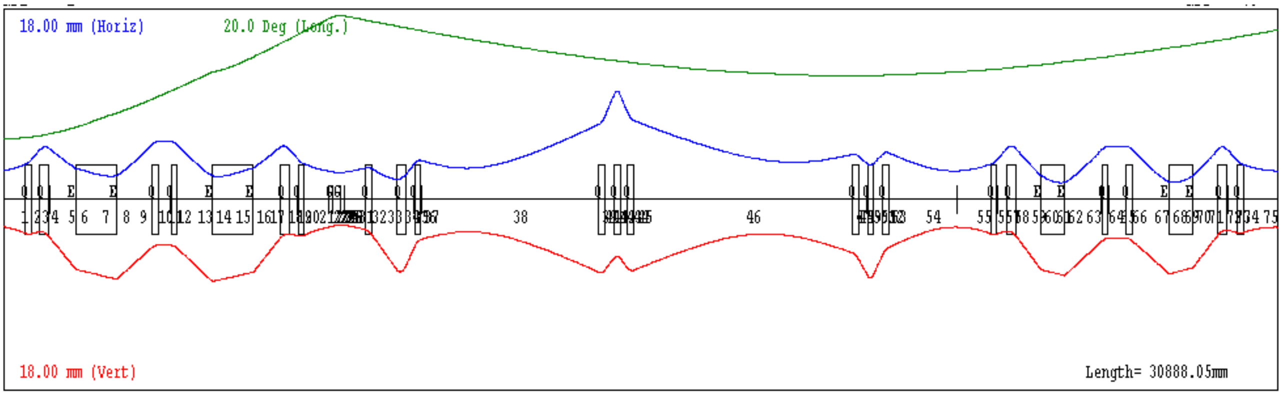

Figure 3: Beam dynamics of HEBT section (output of program trace3D)

CONCLUSION

The beam dynamics studies shows that the new scheme can transport the beam from HCI to the LINAC with two achromatic bends and three quadrupole triplets in a simple manner without degrading the quality of the beam. However, it require a hole to be drilled on the old beam hall wall. It also provides some extra space beyond the 114 degree achromatic bend that can be used for installing devices for characterizing the beam.

REFERENCES

[1] A. Mandal et al. / Physics Procedia 1 (2008)