Ion optical design of spiral bunchers for high current injector at IUAC

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Abstract

The high current injector (HCI) acts as alternate injector to superconducting LINAC in addition to existing pelletron accelerator. The longitudinal beam dynamics of the full facility requires two 48.5Mhz spiral bunchers in medium and high energy beam transport section respectively. The bunchers are required to control phase growth of ion beam as well as appropriate phase matching to the next section. Both bunchers have been studied by code TRACE 3D [1] for longitudinal beam dynamics and by CST MWS for field computation. Finally a multiparticle code TRACK [2] is used for verifying the beam optics simulation with field data from CST MWS.

Longitudinal beam dynamics

The spiral resonators are preferred due to their high shunt impedance, good mechanical strength and compact structure over quarter wave resonators. The arc length of spiral is chosen to be $\lambda/4$ i.e. 1547mm. It consists of two gaps of equal length with accelerating voltage longitudinal in direction and a drift section in between them. An energy spread of 0.5 to 1% is predicted by beam optics calculations after RFQ and DTL using TRACE 3D and TRACK codes. The design parameters of both bunchers used in medium and high energy beam transport sections (MEBT and HEBT) are given in Table-1. The beam optics and field computation analysis is presented in the paper.

Table 1: Design parameters of spiral buncher

Parameters	MEBT Section	HEBT Section
Length of the cavity $\beta\lambda$ (mm)	122	384
No. of accelerating gaps	2	2
Max. Bunching Voltage (kV)	50	150
Transverse Emiitance (π mm-mrad)	35	12
Longitudinal Emittance (π deg.keV)	300	700

References

[1] K.R.Crandall, TRACE 3-D Documentation, Report LA-11054-MS, Los Alamos, 1987.
[2] TRACK: THE NEW BEAM DYNAMICS CODE, Proceedings of 2005 Particle Accelerator Conference