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Design of Practical HSC Type Injector for Cancer Therapy

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ABSTRACT

We provided a compact linac injector, HSC (Hybrid single cavity), for cancer therapy. The HSC, operated in TE_{111} mode, consists of RFQ section and DTL section. This compact linac injector, running in frequency of 100 MHz, accelerates C^{6+} beams with 20 mA from 20keV/u up to 4 MeV/u. The total length of HSC is designed less than 4 meters. We used RGQGen and PIMLOC to achieve the aims. More details will be given in the next parts.

1 INTRODUCTION

According to investigations, there are 6 people per minute suffering from cancer in china. Therefore, accelerators in medical applications have a great prospect. Unfortunately, the system of cancer therapy has a complex control system and huge injector. The factor resists the developments of accelerators in medical applications. The new type injector, HSC, has the ability to directly accelerate the high intensity C^{6+} ion beams. Compared with traditional types, HSC adopts DPIS (direct plasma injection scheme), which could easily supply enough C^{6+}ions to the linac. Secondly, RFQ section and DTL section share the operating system and feed system.

DYNAMICS DESIGN

RFQ Design and DT Design

RFQ section

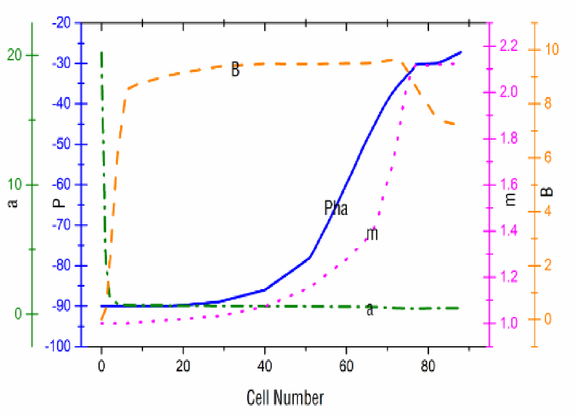

Fig 1: The dynamics parameters of RFQ design.

Table 1: The main Parameters of the RFQ

Parameters	Value
Voltage	85 kV
B	7.1→9.76
m	1→2.11
φ	-90→-26 deg
Input energy	0.02 MeV/u
Output energy	0.6 MeV/u

DTL section

Table 2: Main Parameters of DT Design for HSC Linac

Parameters	Value
Voltage	211 kV
Cell number	24
Length	1753 mm
Bore radius	13 mm
DT radius	30 mm
Phase injection	-112 deg
Input energy	0.6 MeV/u
Output energy	4 MeV/u

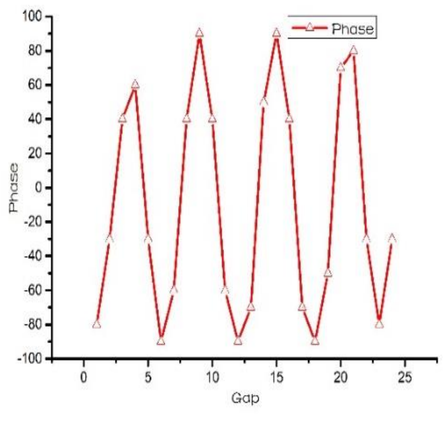

Fig 2: The phase in each gap

DYNAMICS DESIGN

HSC

Table 3 The parameters in HSC.

Parameters	Value
Total length	3019 mm
L RFQ-DTL	59 mm
Rcavity(DTL)	280 mm
Rcavity(RFQ)	95 mm

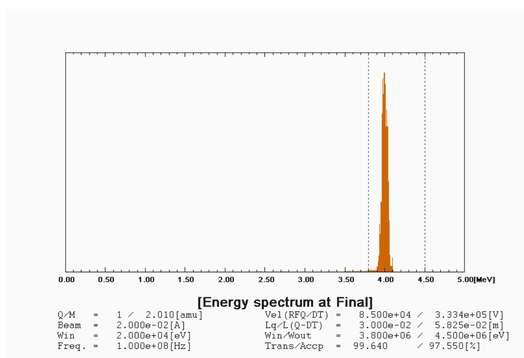

Fig 3 The distribution of Energy at final.

DISSCUSSION

Ordinarily, a MEBT was inserted between RFQ and DTL. On the contrary, the initial HSC model which was only combined RFQ structure and DT structure.

For reducing this concentrated E field distribution, interface structure had been designed and discussed.

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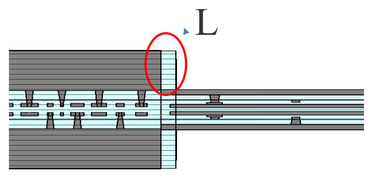

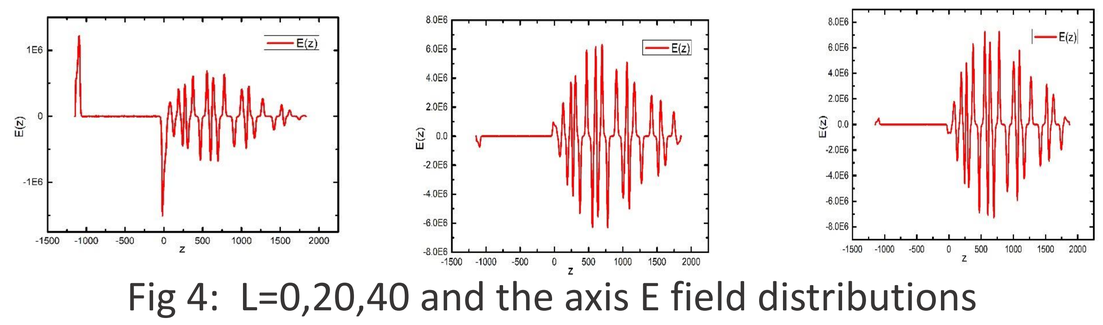

Fig 4: L=0,20,40 and the axis E field distributions simulated by MW-S.

CONCLUSION AND FUTURE PLAN

We have studied a new HSC type linac which is a practical and efficient machine to accelerate high intense ion beam. We discussed the E matching designs for reducing the concentrated electric field distribution and relation of meth and power & frequency.

In the next step, we will study multi-physical fields of HSC by ANSYS. The acceleration test will be operated in this November.