NEW TYPE OF 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

Firstly, The HSC model consists of RFQ structure and DT structure. Secondly, the IH structure provides the higher shunt impedance and acceleration gradient. In the structure, E-field is focused in the connection parts of 4-rod and first DT. Thirdly, the radius of RFQ is smaller than radius of DTL. It is means that density of E-field in RFQ section is higher than DTL section. What's more, HSC adopts Direct Plasma Injection Scheme (DPIS). The DPIS could easily create enough C6+ions to the linac by adjusting the distance from target to laser.

3D RESULTS

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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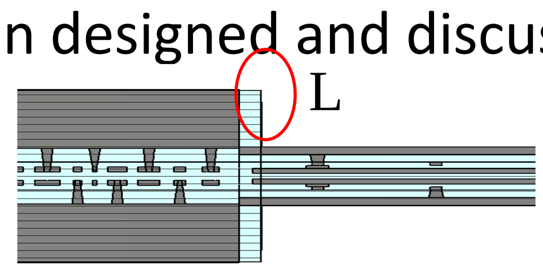

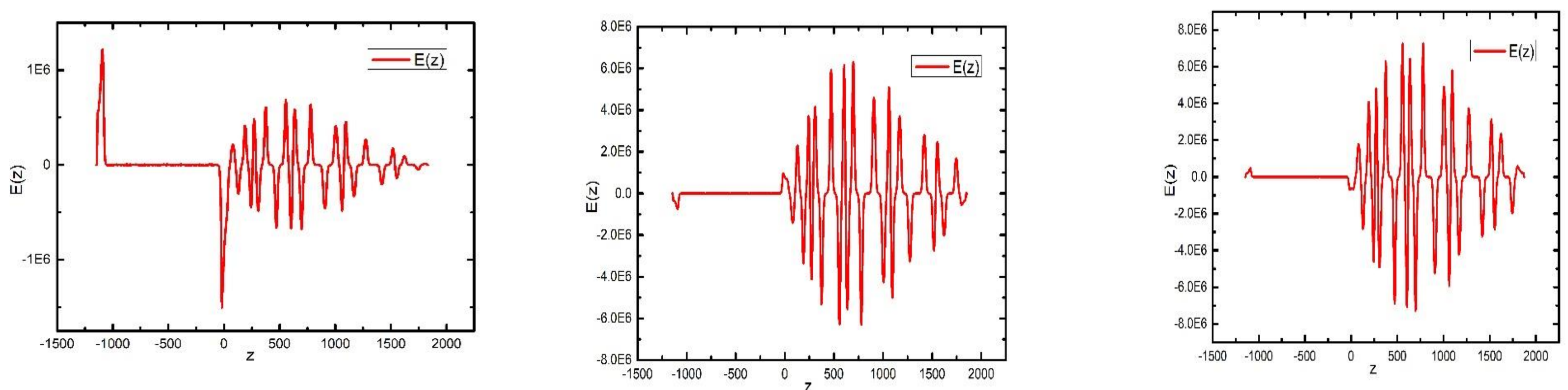

DYNAMICS DESIGN

The parameters of HSC were determined by the output parameters of RFQ section and DTL section, shown in Table 1. But, the distance between exit of RFQ section and first DT (L-RFQ-DT) is the vital important for the transmission efficiency. The transmission efficiency was changed along with the distance, shown in Figure 1. Secondly, L-IS is also an important factor, shown in Fig.2, where L-RFQ-DT equals 2 cm and fringe-field length equals 0.

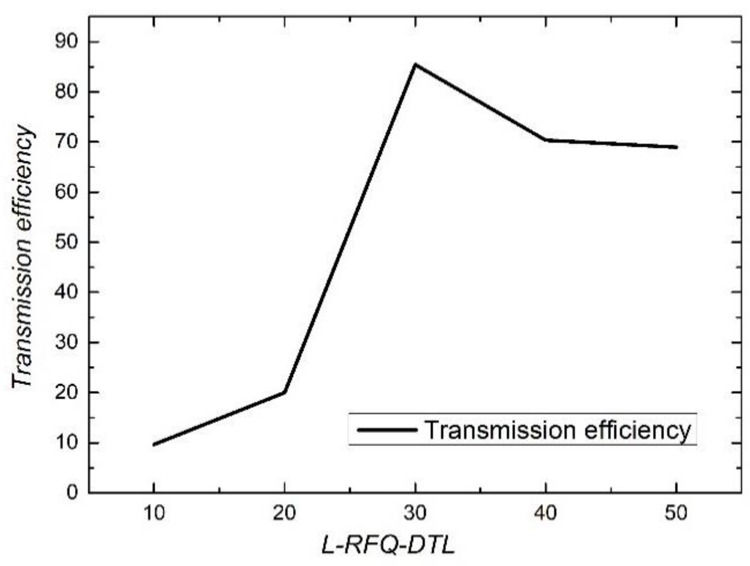

Figure 1: The transmission efficiency and L-RFQ-DT.

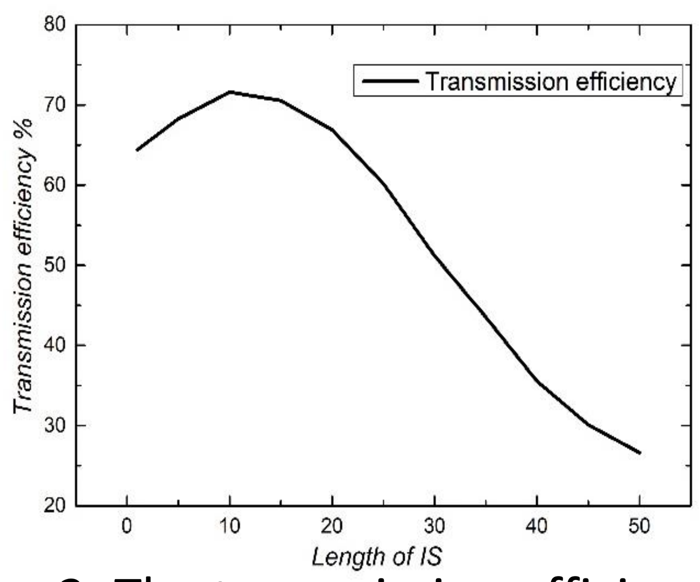

Figure 2: The transmission efficiency and L-IS.

Table1: The parameters of HSC.

HSC	RFQ section	DTL section
Voltage (kV)	85	199
Cell number	90	24
Input energy (MeV/u)	0.02	0.6
Output energy (MeV/u)	0.6	4
Length (mm)	1050	1853
L-IS (mm)	10	
L-RFQ-DT (mm)	59	
L-Pure-Q (mm)	30	

3D RESULTS(2)

The surface current is concentrate in the stem. According to the ANSYS calculations, with water routes for stem cooling and 1% duty, the maximum deformation is occurred in the cavity (between two tuners) and the maximum temperature is about 40℃ and is located in the end of RFQ section. Fig. 15: Images of surface current (left part) and multi-physics analysis

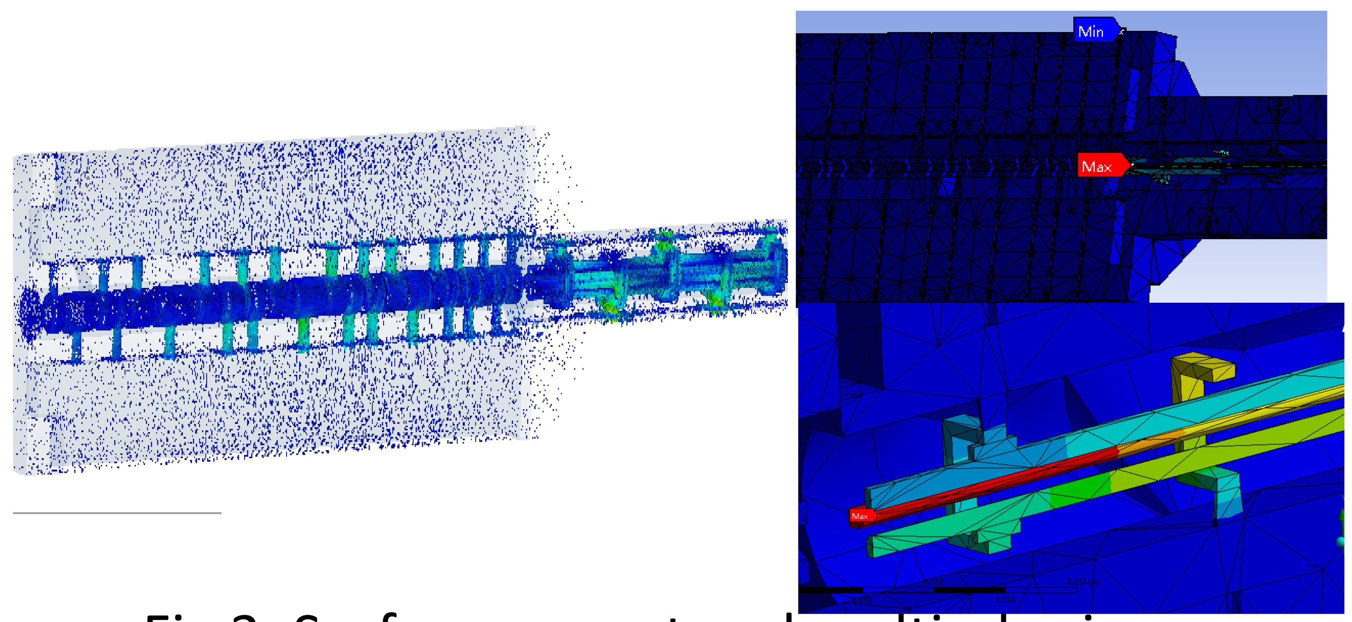

Fig 3: Surface current and multi-physics.

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 optimizing multi-physical fields of HSC by ANSYS. The acceleration test will be operated in this November.