

Reduction and Resource Recycling of High-level Radioactive Wastes through Nuclear Transmutation

(6-3) A Conceptual Design of ImPACT2017 Low β Model

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Abstract: A conceptual design of the low energy(100keV/u ~ 5MeV/u) part of 1A deuteron single-cell linear accelerator(SCL: (ImPACT2017 model), which has been proposed for the reduction and resource recycling of high level radioactive wastes, is presented.

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Keywords: SCL, LLFP, nuclear transmutation

1. Introduction

High current beam of a magnitude of 1A is required to transmute and mitigate the long lived fission products(LLFP). We have proposed a linear accelerator (ImPACT2017 model) which consists of single cell cavities with magnetic focusing elements to accept 1A beam with large bore[1]. A conceptual accelerator design of the low β section is presented in this talk.

2. Outline of low β section

The low β section is composed of about 90 single cells and each cell includes a single rf cavity having a 25 MHz resonant frequency and a focusing solenoid. The rf cavity has a capacitive plate to keep an outer diameter of not more than 2m and the maximum rf voltage is about 300kV which is about 1.2 Kilpatrick. The transit time factor at 5MeV/u is more than 0.95.

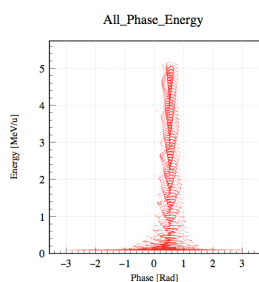


Fig.1 Beam capture and acceleration

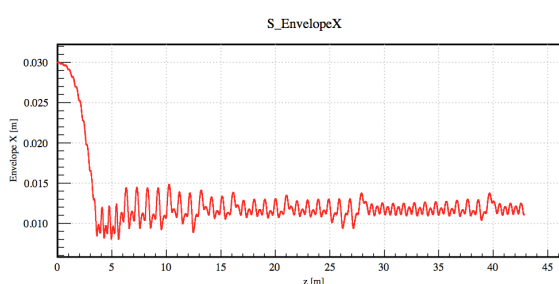


Fig.2 Variations of the rms beam size in transverse direction

The rf voltage and phase of each single cavity are properly chosen to optimize the beam capture and acceleration. The optimization is carried out in evaluating the adiabatic parameter [2]. The longitudinal beam behaviors are simulated under these circumstances and plotted in Fig.1. The space charge effects are significant in the low energy region. Bunch defocusing and deterioration caused by a space charge impedance and beam loading could be overcome with an rf feedback and/or a detuning of the rf cavity of each cell. To manage the transverse defocusing, solenoid focusing is applied. The transverse beam size including space charge effect is shown in Fig.2.

3. Conclusion

A high intensity hadron linear accelerator with single cell cavity system (SCL: ImPACT2017 model) has been proposed for mitigation of LLFP with nuclear transmutation. A design study of the low β section of the SCL shows the beam behaviors meet the requirements well for 1A beam acceleration.

References

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