§ 37. Numerical Analyses of Small-Scale TWDEC Experimental Device[1)]

Ishikawa, M., Horita, K. (University of Tsukuba)
Yasaka, Y. (Maizuru National College of Technology)
Tomita, Y.

The authors have carried out numerical analyses of TWDEC, which is a direct energy converter to convert the kinetic energy of energetic charged particles into electricity, and tried to find how to improve the performance of a small-scale experimental device, which consists of the ion source, the modulator, and the decelerator.

Figure 1 shows the relation of the conversion efficiency and the phase difference between voltages of modulator and decelerator. Numerical results agree well with experimental results, showing that the efficiency strongly depends on the phase difference.

Numerical results also have demonstrated that the variation of the energy distribution of ion beams between injector and decelerator becomes quite similar to the experimental results.

In order to improve the performance of TWDEC and to obtain higher efficiency, we have optimized the interval of each electrode of the decelerator. Figure 2 shows the relation of the efficiency and the length of decelerator. The line of 'constant' represents the efficiency obtained under the condition that the intervals between electrodes are constant, and that of 'change' is obtained under the condition that the intervals are optimized. Optimization the configuration of the electrodes of decelerator results in the increase of the efficiency with the number of electrodes and the length of decelerator, whereas the constant interval of electrodes cannot increase the efficiency even though many electrodes are used. The optimum configuration can yield up to 58% of efficiency with this small device.

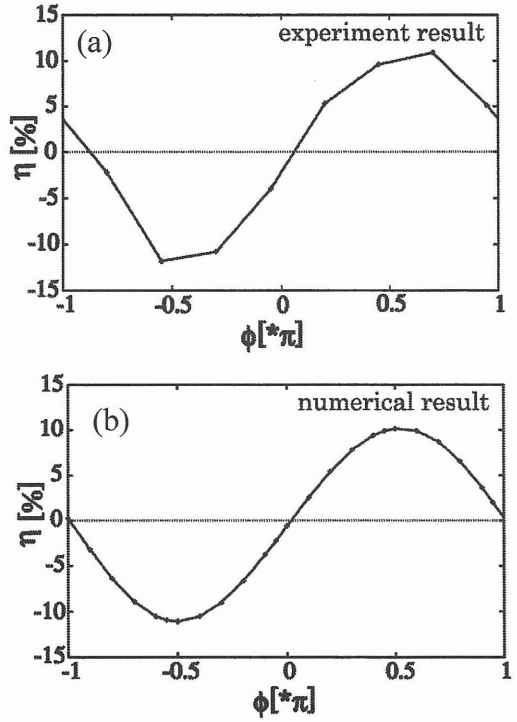

Fig. 1. Relation of efficiency against phase difference, (a) experimental result and (b) numerical result.

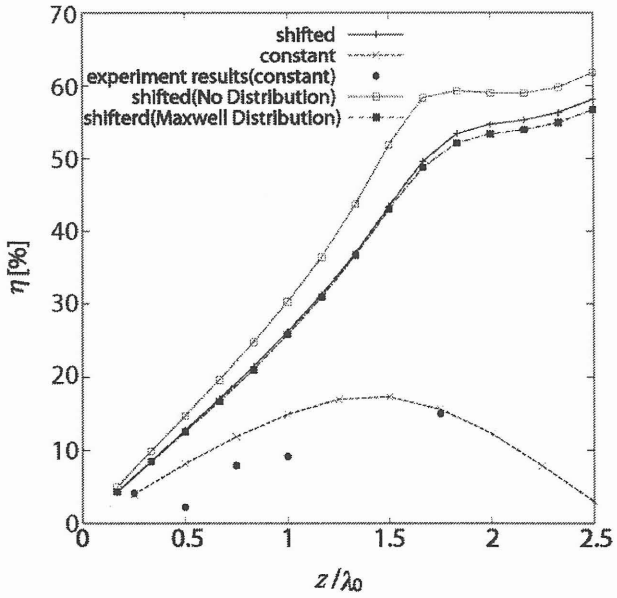

Fig. 2. Relation of efficiency and decelerator length for cases of constant and optimized intervals.

Reference
1) Horita, K., Ishikawa, M., Yasaka, Y., AIAA-2003-3868, 34th AIAA Plasmadynamics and Lasers Conference, June 2003.