

§ 40. Enhancement of Deceleration Field by Redesign of a Transmission Circuit in a TWDEC Simulator

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One of the key issues to realize D-³He fusion plant is efficient energy recovery of fast protons of 14.7MeV. Use of a traveling wave direct energy converter(TWDEC) is considered to be a desirable scheme for this purpose. In a TWDEC, velocity of fast proton beam is modulated by RF, which becomes density modulated beam in the downstream. The beam induces traveling wave in a transmission circuit, then the beam is decelerated in the field created by the traveling wave. We are studying desirable structure of TWDEC experimentally. We had performed proof of principle experiments of TWDEC, and investigated beam deceleration characteristics. At present, we are trying an enhancement of deceleration field by redesign of a transmission circuit.

Schematic diagram of our experimental equipments is shown in Fig. 1. Helium plasma is created in the ion source, and helium ion beam with velocity modulation is introduced in the decelerator section. The electrodes in the decelerator are connected to a transmission circuit, and this circuit affects the amplitude of induced voltage on the electrodes. We had used line type circuit shown in Fig. 2(a), and we modified the circuit to loop type shown in Fig. 2(b). According to rough estimation, over ten times larger amplitude is expected by this modification.

We constructed the circuit with employing variable capacitors and fixed inductors, which are made of coaxial cables with a shorted end, as Z and Y in Fig. 2, respectively. At first, we tested the circuit using a dual-channel oscillator. Fig. 3 shows an example of the results. From this figure, we find that voltages at 4 terminals(1, 2, 3, 4 in the figure) are almost the same amplitude with 90 degrees intervals, thus the circuit works along expectation.

The circuit was applied to the TWDEC simulator. The induced voltage contained significant amount of third harmonic component. This is because the density modulation of the beam originally contains harmonic components, and the inductance of the inductor used in the circuit is quite large at third harmonic frequency. At present, we are planning a new circuit in which harmonic components are well suppressed.

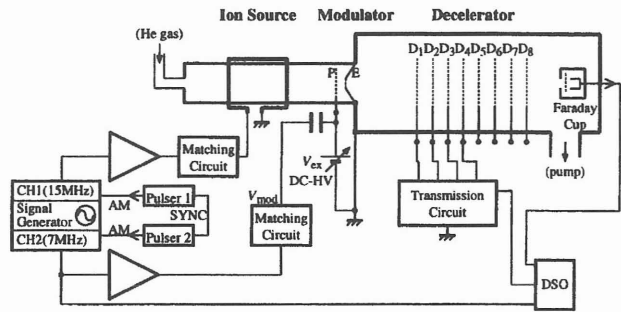
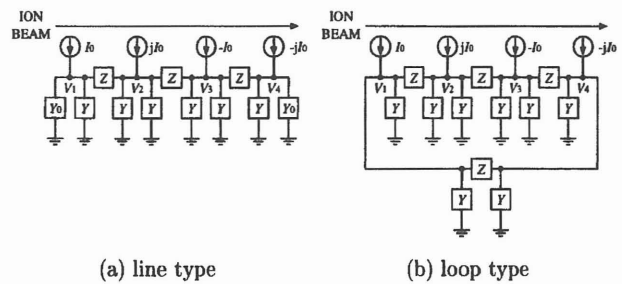


Fig. 1 Schematic diagram of the TWDEC simulator.



(a) line type (b) loop type

Fig. 2 Structure of transmission circuit.
(a) line type (b) loop type

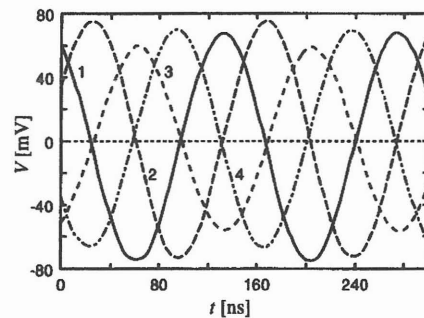


Fig. 3 Voltage waveforms in the transmission circuit on test operation using an oscillator.