§ 10. Application of Millimeter Wave Technology to Plasmas

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The objective is to discuss an ongoing R&D of heating technology by millimeter wave and the related international progress with collaborators who engage in the study using gyrotrons, klystrons, free-electron lasers, and REBs. In the workshop, we focused the program with special subject and reviewed to increase the mutual understanding.

In this year, the subject on a polarizer as topics was mainly discussed and several reseaches were also reported.

Dr. Saegusa presented technology and physics on RF-heating of plasmas in the Ibaraki University. The subject was both development of a polarizer with deep groove and the measurement of electromagnetic fields of fast wave in the tokamak plasma. As for the polarizer, a high-power polarizer with deep groove which is based on the theoretical analysis was proposed. In addition to the low-power test at 170GHz on the polarization, withstanding voltage and ohmic loss of the polarizer were measured by using a gyrotron. It was noted that the developed polarizer can be used for the real system.

On the distribution measurement of fast wave in plasmas, fast waves with two frequencies excited by an antennas produce the beat wave. By using a heavy ion beam probe, the distribution of podermotive potential of beat wave was measured and the electromagetic field distribution was estimated.

Dr. Nagasaki reported development of a polarizer which has grooves with any shape. In general, real shape of the groove in the polarizer is different slightly from the designed shape due to machining. As a result, the performance on polarization may change. To examine the affect, various polarizers with different groove-shape was fabricated and tested with low and high powers. In addition the computer code for taking into consideration on the real shape was developed. In the talk, the prospect of application to the high power transmission line was given.

Dr. Hanada talked about 170GHz ECH-system and plasma production in TRIAM-1M. Since FY2000, 170GHz ECH-system was operated in the TRIAM-1M tokamak to produce and heat toroidal plasmas. Power and pulse width of the 170 GHz-gyrotron are 260kW and 5sec. As a transmission line, the corrugated waveguide system with 31.75 and 62.5 mm in diameter was adopted. In the real machine, the transmission line was evacuated and no window for the tokamak was installed. The result from ECR-plasma production for LHCD was introduced.

Dr. Idei (NIFS) represented development of millimeter wave component based on the phase measurement. In NIFS, the test stand for amplitude and phase measurements is operated and being used for gaussian beam alignment and mirror design.

Dr. Yokoo summarized development of the peniotron which was invented in Tohoku University about 50 years ago and talked the principle and the history. The peniotron is a highly efficient microwave tube. Its efficiency is nearly 100% which is expected at cyclotron harmonics as well as fundamental and shows the experimental results at the third cyclotron harmonic where 92% of efficiency was achieved by using a space harmonic peniotron interaction.

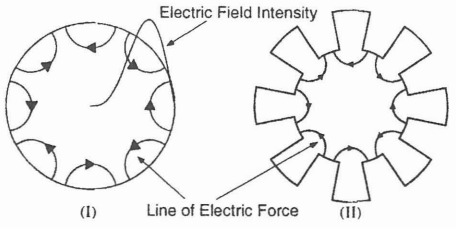

Fig. 1: : The peniotron

The discussion in the workshop was fruitful and constitution of information exchange was confirmed.