§2. Development of ECH Power Monitor Using the Diffraction Grating

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Electron cyclotron heating is one of the important tool for investigating the transport process in plasma. In the transport analysis, the power deposition profile and deposited total power are the key parameters. The ratio of the total absorbed power to that of injected power depends on the plasma parameters. Furthermore, the output power from gyrotron is assumed to be constant in the steady operation, but sometimes varies in time or intentionally modulated. It is important to have a reliable and real time input power monitor. The microwave power is transmitted quasi-optically by a mirror array in CHS. The input power had been calibrated by the water dummy load placed at the vacuum window. But this method can give only the time integrated power and assumes the reproducibility of the gyrotron. A real time power monitor utilizing the principle of diffraction grating is produced and one of the transmission mirrors, which is the last flat mirror just in front of the vacuum window, is replaced with this grating power monitor.

The transmitted power is focused as the waist to be 25 mm at the vacuum window. This means the input beam for the grating is not a plane wave. The order of the difraction is chosen so as to eliminate other order diffractions from the grating. The principle is shown in Fig. 1. The grating is formed just as the curved mirror surface finishing. The mill with which the mirror surface is cut is scanned along with the designed curves with distances which satisfy the condition that -1 -st order diffracted beam is a desired one. As a result, residual hill on the mirror forms the grating. The height of the hill is 50 mm as the total diffraction efficiency should be less than 30dB so that the negligible power loss for the main heating beam but sufficient intensity from stray microwave in the transmission system. The profile of the grating is shown in Fig. 2. With low power testing, it is confirmed that diffracted beam has the profile and intensity almost as designed. In Fig. 3 is shown the cross calibration using the water dummy load and signal. This power monitor is used routinely to get the input power.

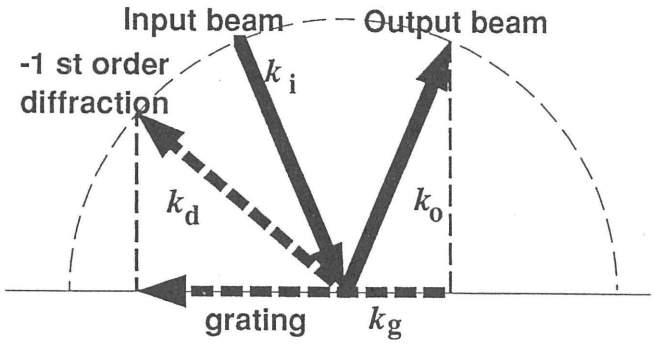

Fig. 1 The principle of -1 -st order diffraction grating.

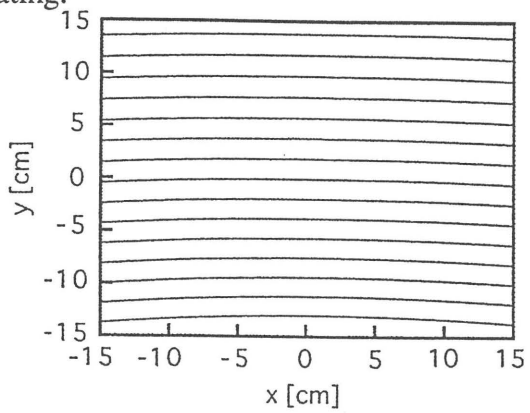

Fig. 2 The profile of the grating. Only one line by every 5 lines are drawn for the simplicity.

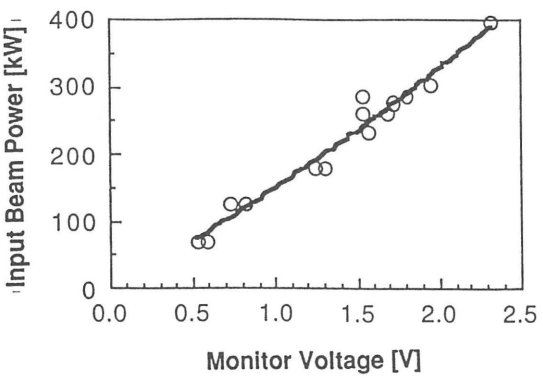

Fig. 3 Cross calibration of the power monitor and the power measured from water dummy load.