RF POWER MEASUREMENTS ON THE DIII-D GYROTRON INSTALLATION*

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Electron cyclotron heating (ECH) and electron cyclotron current drive (ECCD) play an important part in the active control of advanced tokamak discharges. The gyrotron complex at 110 GHz on the DIII-D facility was built to provide the required EC power. The maximum injected rf power has exceeded 3.5 MW for generated power in excess of 4.0 MW.

Analysis of many plasma physics experiments requires accurate measurements of the rf power injected into the tokamak from each gyrotron. Power measurements have been made on DIII-D using calorimetric techniques to obtain the power loading of gyrotron components such as the output window, the cavity, the collector and the coupling optics. In principle, any of these measurements can be combined with *a priori* knowledge of gyrotron performance to determine the generated power. But these measurements yield the generated, rather than the injected power, and require that the gyrotrons be properly tuned for maximum performance. In the DIII-D facility cooling system the mixing is poor, therefore baseline temperature fluctuations having the temporal signature of the calorimetry response being measured can lead to errors. These difficulties have been addressed by improved algorithms for analyzing the calorimetry diagnostics on the DIII-D system and by development of a device for measurement of the rf power near the launcher. The device is based on the direct calorimetric measurement of the rf power radiated through a gap in well-aligned waveguides carrying the $HE_{1,1}$ fundamental waveguide mode. Approximately 0.03% of the total rf power passing through the waveguide is radiated and heats the uncooled structure of the monitor. The response is rapid compared to the heat diffusion time scale, therefore the peak change in temperature of an internal absorptive element can be used to determine the power. The device is sensitive to high order modes, which must be minimized. The method provides a direct measurement of the injected rf power from each waveguide, fast data time and independence from temperature stability of the cooling water. Improved calorimetry measurements will be compared with direct measurements using the power monitor.

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