Determination of Wall Reflectivity for ECE Frequencies in DIII–D*

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It is generally accepted that for complete metal walls in a tokamak reactor, synchrotron losses are insignificant. However, for first walls of graphite or ceramic, losses will be higher due to the lower reflectivity of these materials. An experimental study of the wall reflectivity for electron cyclotron frequencies in the DIII–D tokamak is reported, a device that has 90% of its interior surface covered with graphite tiles. Measurements of optically-thin harmonics ($\omega=n\omega_{ce}, n\geq 4$) are made for two polarizations from thermal plasma discharges using an absolutely calibrated Michelson interferometer. The measured polarizations are horizontal and vertical which correspond primarily to ordinary-mode and extraordinary-mode emission, respectively. The emission spectra are compared to simulations from an ECE radiation transport code. The simulation model assumes quasi-perpendicular propagation between plane parallel walls characterized by a reflection coefficient r and polarization transfer fraction p. Multiple bounces are followed until a steady state is reached. Experimental values for r and p are obtained by finding the values that minimize the total error between the measured and simulated ECE spectra for the two polarizations combined. For three well-diagnosed discharges, ranges of values r=0.72–0.78 and p=0.15–0.25 are found for the frequency range 150–400 GHz. Limitations of the wall reflection model and other sources of error are discussed.

*Work supported by U.S. Department of Energy under Contract Nos. DE-AC03-89ER51114 and DE-FG-03-96ER54373.

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