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The scattering of electromagnetic waves from turbulent plasmas[1]
A. K. RAM, MIT-PSFC, K. HIZANIDIS, NTUA, Greece — In fusion devices, radio frequency (RF) electromagnetic waves encounter turbulent plasmas along their path from the excitation structures to the core of the plasma. In order to optimize heating and current drive by the RF waves, it is necessary to understand the effect of the density turbulence on the propagation characteristics of the waves. A common approach towards quantifying the effects of turbulence is the Kirchhoff technique. Here the wave fields and their normal derivatives are evaluated at a surface separating two different densities using physical optics. The fields at any point on this surface are approximated to be the same as the fields on a tangent plane at that point. Using the Kirchhoff technique, we show that turbulence can lead to changes in the propagation vector and polarization of the waves, side-scattering, and coupling between different plasma waves. This affects the spatial uniformity of power flow into the plasma. Full wave analytical calculations and numerical simulations confirm these physical results. The theory applies to all RF waves, irrespective of their frequency, and allows for arbitrary plasma density variations.

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