RF Wave Propagation and Scattering in Turbulent Tokamaks

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Drift wave turbulence driven by the steep ion and electron temperature gradients in H-mode divertor tokamaks produces strong scattering of the RF waves used for heating and current drive [1]. Both the 3-5GHz lower-hybrid (LH) and the 170GHZ electron cyclotron (EC) waves experience scattering and diffraction in propagating through the statistically complex density of the plasma. Ray equations are used in to calculate the spread of the rays and the associated change in the parallel phase velocity of the LH waves and their change of polarization to the Fast Wave branch of the dispersion relation. A Fokker Planck equation for the phase space of the RF plasmons is used to describe the spread of the RF wave power in the complex geometry of a divertor tokamak using the ray tracing code CP3O. The evolution of the electron distribution function from the resonant interactions with the electrons coupled driven by the RF waves is calculated with LUKE [2].

[1] W. Horton, et al., Physics of Plasmas 20, 112508 (2013).

[2] J. Decker, Y. Peysson et al. Physics of Plasmas 21, 092504 (2014); doi: 10.1063/1.4894749 and Nucl. Fusion 51 (2011) 073025 doi: 10.1088/0029-5515/51/7/073025