An Improved Linear Model of Electron Cyclotron Current Drive Efficiency

Y.R. Lin-Liu[1] and R. Prater[2]
Department of Physics, National Dong Hwa University, Taiwan[1]
General Atomics, San Diego, CA, USA[2]

Electron cyclotron current drive (ECCD) will be an important tool for current profile control in ITER. In modeling the ECCD efficiency, there are two widely used linear models of Cohen [1] and the authors [2]. Both models use the Green's function techniques to calculate the current drive efficiency. In dealing with the wave-particle interactions, they invoke the small gyro-radius expansion and keep only the leading order contributions to simplify the wave-induced diffusion operator in velocity space. The approximation leads to a current drive efficiency which is independent of wave polarization. The validity of the approximation may be justified for the X-modes and it is not so clear for the O-modes. In this work, we make improvement on the linear ECCD models by using the relativistic generalization of the local Kennel-Engelmann rf diffusion operators to describe the wave-particle interactions. The effects of wave polarization on the ECCD efficiency are fully accounted for. The predictions of the improved ECCD model will be presented in the parameter regimes relevant to the ECCD experiments of the DIII-D tokamak and ITER.

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