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A Comparison of Different Models for Lower Hybrid Current Drive

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Lower hybrid current drive (LHCD) is a promising technique for off-axis current profile control in both intermediate magnetic field (5 - 6T) and high field (8T) next step fusion devices. The attractiveness of this method lies primarily in its relatively high current drive effciency at the lower electron temperatures
characteristic of the outer half of fusion plasmas where local current profile modification is desired.

In view of the promise of this current profile control method, we have undertaken a comparison of two different approaches that are widely used for calculating lower hybrid current drive. In the first method[1] a direct 2-D (velocity) numerical solution of the Fokker Planck equation is obtained and used in a toroidal ray tracing package to compute wave polarizations and the quasilinear rf diffusion coeffciecnt. These physics modules are iterated to obtain a self-consistent electron distribution function $f_e(p_\perp , p_\parallel)$. In the second approach [2,3] an adjoint code is used to obtain the Spitzer – Harm function χ. A combined 1-D parallel velocity Fokker Planck and ray tracing code is then used to compute the wave-induced rf flux which is combined with the Spitzer – Harm function to compute the driven rf current. Generally the predicted current from the exact 2-D approach is found to be larger than the prediction from the adjoint – ray tracing approach. The reasons for this difference will be analyzed and discussed.

Model predictions will be compared for a test case typical of the proposed ITER – FEAT device. We also compare model predictions for the planned lower hybrid current profile control experiment in the Alcator C-Mod tokamak.

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[2] C.F.F. Karney et al., Proceedings of the Eighth Topical Conference on Radio-frequency Heating in Plasmas, AIP Conf. Proc. 190 (AIP, NY, 1989) p. 430.

[3] R.S. Devoto et al., Nucl. Fusion **32**, 773 (1992).