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Self-consistent full-wave and Fokker-Planck calculations for ion cyclotron heating in non-Maxwellian plasmas[1]

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High-performance burning plasma devices such as ITER will contain significant concentrations of non-thermal plasma particles arising from fusion reactions, neutral beam injection, and wave-driven diffusion in velocity space. Initial studies in 1-D [1] and experimental results [2] show that non-thermal energetic ions can significantly alter wave propagation and absorption in the ion cyclotron range of frequencies. In addition, these ions can absorb power at high harmonics of the cyclotron frequency where conventional 2-D global-wave models are not valid. In this work, the all-orders, full-wave solver AORSA [3] is generalized to treat non-Maxwellian velocity distributions. Quasi-linear diffusion coefficients are derived directly from the global wave fields and used to calculate the energetic ion velocity distribution with the CQL3D Fokker-Planck code [4]. Alternately, the quasi-linear coefficients can be calculated numerically by integrating the Lorentz force equations along particle orbits. Self-consistency between the wave electric field and resonant ion distribution function is achieved by iterating between the full-wave and Fokker-Planck solutions.

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