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Nonlinear Evolution of Nonthermal Ion Distributions in the Presence of High Power Ion Cyclotron Resonance Heating[1]

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The nonlinear evolution of nonthermal ion distribution functions in the presence of high power ICRF waves is of great interest in both present day tokamaks and in future burning plasmas. Wave-particle interactions of special interest include evolution of the ion distribution due to wave-driven velocity space diffusion, as well as ICRF wave interaction with nonthermal distributions of fast neutral beam ions and fusion generated alpha-particles. In order to accurately simulate these interactions a full-wave field solver has been developed to compute the wave propagation using a plasma response that is valid to all orders in the ion Larmor radius and is valid for arbitrary ion particle distributions. A novel re-formulation of the quasilinear diffusion coefficient has made it possible to couple electric field predictions from this field solver to a bounce averaged Fokker Planck code. The combined model is then iterated until a self-consistent ion particle distribution is achieved. We have also coupled a Monte Carlo orbit code to a full-wave field solver in order to explore situations where finite orbit effects may be important. Results and implications from these combined models will be discussed for experiments in the DIII-D, NSTX, and Alcator C-Mod devices.

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