Time-Dependent Modeling of Fast Wave Absorption With Multiple Nonlinear Damping Mechanisms*

R.I. Pinsker,[1] M. Porkolab,[2] M. Choi,[1] R.W. Harvey,[3] and the RF SciDAC Team
[1]*General Atomics, San Diego, California, USA*
[2]*MIT Plasma Science and Fusion Center, Cambridge USA*
[3]*CompX, Del Mar, California, USA*

Recent DIII-D experiments on the absorption of fast waves (FWs) by moderate to high ion cyclotron harmonic damping [1] have motivated a substantial modeling effort within the RF SCiDAC community. Work using the AORSA full wave solver coupled to the CQL3D Fokker-Planck code has shown that the presence of a dilute hydrogen minority species in the nominally deuterium plasma can lead to significant cyclotron absorption on the hydrogen, when a high energy tail in the hydrogen velocity distribution is assumed to be the initial condition. In this work, a simple 0-D time dependent absorption and transport model is used to predict the plasma response to a step in FW power when multiple FW absorption mechanisms are present. When at least one of the damping mechanisms has an important nonlinearity (all of the core absorption mechanisms are nonlinear in this sense), both the partition between the various absorption channels in the steady-state solution and the time required to reach the final state depend strongly on the initial conditions. We conclude that modeling that considers only a single nonlinear damping mechanism at a time is unlikely to adequately reproduce the observed plasma response.

[1] R.I. Pinsker, *et al.*, Nucl. Fusion **46**, S416 (2006).

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