Monte-Carlo Simulation of Fast Alfvén Wave Interactions with Neutral-Beam and Minority Ions on the DIII-D and C-Mod Tokamaks*
M. Choi,1 V.S. Chan,1 V. Tang,2 J. Wright,2 and P. Bonoli2
1General Atomics, P.O. Box 85608, San Diego, California, USA
2MIT Plasma Science and Fusion Center, Cambridge USA

To quantitatively simulate the resonant interaction of fast Alfvén wave (FW) heating and Coulomb collisions on energetic ions, including finite orbit effects, a Monte-Carlo code ORBIT-RF has been coupled with a 2D full wave code TORIC. ORBIT-RF solves Hamiltonian guiding center drift equations to follow trajectories of test ions in 2D axisymmetric numerical magnetic equilibrium under Coulomb collisions and ICRF quasi-linear heating. Monte-Carlo operators for pitch-angle scattering and drag calculate the changes of test ions in velocity and pitch angle due to Coulomb collisions. A rf-induced random walk model describing fast ion stochastic interaction with FW reproduces quasi-linear diffusion in velocity space. FW fields and its wave numbers from TORIC are passed on to ORBIT-RF to calculate perpendicular rf kicks of resonant ions with a arbitrary harmonic rf diffusion operator. ORBIT-RF coupled with TORIC using a single dominant toroidal and poloidal wave number has demonstrated consistency of simulations with previous DIII-D FW experimental results for interaction between injected neutral-beam ions and FW, including measured neutron enhancement and enhanced high energy tail. Comparison with C-Mod fundamental heating discharges yielded reasonable agreement.

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