Simulations of Beam Ion Transport During Tearing Modes in the DIII-D Tokamak

E.M. Carolipio, W.W. Heidbrink

Department of Physics and Astronomy

University of California

Irvine, California 92697

C.B. Forest

Department of Physics

University of Wisconsin, Madison

Madison, Wisconsin 53706

R.B. White

Princeton Plasma Physics Laboratory

Princeton, New Jersey 08543

ABSTRACT

Large coherent MHD modes are observed to reduce the neutral beam current drive efficiency and 2.5 MeV neutron emission in DIII-D by as much as ~65% [Forest, C.B., *et al.*, Phys. Rev. Lett. **79** (1997) 427]. These modes result in large (width w $\lesssim$ 20 cm for minor radius $a \sim 60$ cm) stationary, single helicity, magnetic islands, which might cause anomalous deuterium beam ion losses through orbit stochasticity. An analytic estimate predicts that co-going, passing deuterons with $E \gtrsim 40$ keV become stochastic at island widths comparable to those in the experiment. A Hamiltonian guiding center code is used to follow energetic particle trajectories with the tearing mode modeled as a radially extended, single helicity perturbation. In the simulations, the lost neutral beam current drive and neutron emission are 35% and 40%, respectively, which is consistent with the measured reductions of 40%±14% and 40%±10%. Several features of the lost particle distribution indicate that orbit stochasticity is the loss mechanism in the simulations and strongly suggest that the same mechanism is responsible for the losses observed in the experiment.