

# Energetic Ion Experiments in DIII-D

W.W. Heidbrink

Contact author: W.W. Heidbrink, University of California, Irvine, CA  
92697 Phone: (949) 824-5398, Fax: (949) 824-7124, email:  
wwheidbr@uci.edu

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ABSTRACT. A summary of fast ion experiments in the DIII-D tokamak is given. Most of the experiments involve  $\sim 80$  keV deuterium beam ions. Deceleration of dilute fast-ion populations is accurately described by Coulomb scattering theory. Fast waves with frequencies several times the deuterium cyclotron frequency interact with beam ions when the product of wavenumber and gyroradius  $k_{\perp}\rho_i$  is  $\gtrsim 1.4$ . Global confinement of fast ions is often excellent, although sawteeth, tearing modes, and beam-driven instabilities can cause additional transport. Intense beam-ion populations often drive instabilities. Toroidicity-induced Alfvén eigenmodes (TAE) and somewhat lower frequency modes (originally called beta-induced Alfvén eigenmodes) are often observed in a wide variety of plasma conditions. Over 50% of the beam power has been lost during strong activity. Damping mechanisms such as mode coupling or radiative damping are needed to explain the observed TAE stability threshold. The most unstable toroidal mode number agrees well with theoretical expectations but the radial and poloidal structure of the mode and the observed beam-ion transport have not been adequately explained. The modes with frequencies below the TAE are probably two types of Energetic Particle Mode: the resonant-TAE and the resonant kinetic bal-

looning mode (r-KBM).

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