Turbulent-transport of energetic ions in tokamak plasmas with on-axis neutral beam injection

A. E. White[1], D. C. Pace[2], W. W. Heidbrink[3], M. A. Van Zeeland[2], T. L. Rhodes[4], G. R. McKee[5], G. Wang[4], Z. Yan[5], J. C. Hillesheim[4], G. M. Staebler[2]

[1] Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139, USA
[2] General Atomics, PO Box 85608, San Diego, CA 92186-5608, USA
[3] University of California Irvine, University Dr., Irvine, CA 92697, USA
[4] University of California Los Angeles, Los Angeles, CA 90095-7099, USA
[5] University of Wisconsin-Madison, 1500 Engineering Dr., Madison, WI 53706, USA

E-mail: whitea@mit.edu

Abstract.

Turbulent-transport of fast ions is predicted by theory and simulations to increase in high temperature plasmas, when the ratio of fast-ion energy to temperature, E/T, is reduced. In DIII-D experiments featuring 2.5 MW of on-axis beam injection, the ratio $E/T_e(0)$ is reduced by increasing central electron temperature a factor of two using an additional 3.3 MW centrally deposited electron cyclotron heating. Comparisons between measured fast ion density profiles and classically predicted profiles in both the low and high temperature plasmas show that there is evidence of fast ion transport by turbulence during on-axis beam injection, but there is no measured increase in turbulent-transport of fast ions at lower $E/T_e(0)$. Changes in the nature of the long wavelength turbulence ($k_\theta \rho_s < 0.5$), from predominantly ion temperature gradient mode driven turbulence to trapped electron mode driven turbulence, as T_e is increased may be related to the observed absence of the E/T_e scaling in these experiments.