Giant sawteeth in DIII-D and the quasi-interchange mode*

A.D. Turnbull[1], E.A. Lazarus[2], M. Choi[1], and L.L. Lao[1]

[1]*General Atomics, P.O. Box 85608, San Diego, CA 92186-5608, USA.*
[2]*Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831, USA.*

Analysis of a single-null ion cyclotron resonance frequency (ICRF)-heated DIII-D discharge that exhibited giant sawteeth similar to those observed in the JET tokamak finds that the underlying ideal mode has characteristics more like the quasi-interchange mode [1] than the conventional internal kink. The discharge equilibria were reconstructed through consecutive cycles of the sawtooth ramp and crash phases. The reconstructions determine that the axis safety factor $q_0 \sim 0.9$ at the time of the crash. Experimentally, the discharge exhibits a crash in the poloidal field, B_θ, that is much slower than the crash in the central electron temperature, T_e, in contrast to the conventional Kadomtsev model [2]. However, it is in qualitative agreement with the original model proposed by Wesson, where the T_e crash is due to the ideal plasma motion and the B_θ change occurs from resistive diffusion through the subsequent ramp [1]. The result has probable implications for giant sawteeth and suggests a re-interpretation of the giant sawtooth experiments in JET [3]. A hybrid model is proposed in which the $q = 1$ surface plays a role in the B_θ crash in addition to the change in B_θ driven by resistive diffusion during the ramp phase.

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