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Quasi-interchange Modes and the Sawtooth Crash[1] LINDA SUGIYAMA, Massachusetts Institute of Technology, M OKABAYASHI, PPPL — Quasi-interchange (QI) modes over a central region with safety factor $q \sim 1$ and sufficiently low magnetic shear are shown numerically with the M3D code to be able to cause nearly ideal MHD sawtooth crashes with complete flattening of the central temperature and current density. The current density flattens more slowly than temperature. Major differences with early analytical and numerical work, which predicted saturation short of a full crash, include elliptical flux surface shape near $q = 1$, higher central beta, and low shear at $q = 1$ that contribute to instability. Also, unlike the $m/n = 1/1$ internal kink mode, a QI instability can have multiple coherently growing toroidal harmonics, where over $q \leq 1$ the higher $m = n$ components align to reinforce the displacement due to the 1/1 mode. If the sawtooth is stabilized, quasi-steady 1/1 and 2/2 QI modes can sustain a crescent shaped region inside $q = 1$ with higher temperature. The results agree with experimental sawtooth observations in DIII-D[2], JET, and other tokamaks and with central $m = n$ modes driven by local ECH/ECCD in KSTAR.

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[2]E. Lazarus, et al., Phys. Plasmas 14, 055701 (2007)

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