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Fully Kinetic Simulations of Sawtooth Crashes in Cylindrical Tokamaks RAHUL KUMAR, AMITAVA BHATTACHARJEE, FATIMA EBRAHIMI, Princeton Plasma Physics Laboratory, A-TEAM TEAM — The core plasma in tokamaks is known to exhibit sawtooth oscillations when q-axis drops below unity. In each sawtooth cycle, temperature, density, and current in the core increase gradually, followed by a rapid drop in these quantities. The rapid drop, known as the sawtooth crash, is attributed to magnetic reconnection. We study the sawtooth crash process in three-dimensions using a new fully-kinetic particle-in-cell code called PICTOR. Our self-consistent kinetic simulations reveal that the dynamics at the kinetic scales, which are not resolved by MHD, play a significant role. We find that a) linear growth of large-scale internal kink modes, which precede the crash, is much slower than what is predicted by the MHD, b) turbulence and micro-instabilities are excited within the spatial domain where the safety factor q is less than unity, and their relative strength and nature depend on the radial profile of the safety factor and pressure, and c) the plasma pressure becomes substantially anisotropic during the crash, with distribution functions showing strong non-Maxwellian features.

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