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Measuring Properties of Magnetic Reconnection in Nonlinear Resistive and Two-Fluid Toroidal Simulations of Sawteeth MATTHEW BEIDLER, PAUL CASSAK, West Virginia University, STEPHEN JARDIN, Princeton Plasma Physics Laboratory, NATHANIEL FERRARO, General Atomics — The sawtooth crash in tokamaks limits the core temperature, harms confinement, and seeds disruptions. A predictive capability of its ramifications has been elusive. Extended-MHD physics is needed to properly analyze the magnetic reconnection that occurs during the crash phase, but it has only recently been integrated into codes using a toroidal geometry. In this study, we employ the three-dimensional toroidal, extended-MHD code M3D-C1 to study reconnection during the sawtooth crash. We study the nonlinear evolution of a test equilibrium in a non-reduced field representation for resistive-MHD and the two-fluid model. We find that the toroidal mode growth rates for the two-fluid reconnection process exhibit a nonlinear acceleration and greatly exceed that of a similar resistive MHD model, more closely in line with experimental results. Furthermore, by sampling the two-fluid simulation data in the plane perpendicular to the helical (m,n)=(1,1) mode, we present the first observation of the quadrupole out-of-plane magnetic field appearing during sawtooth reconnection with the Hall term. We also explore how reconnection as viewed in the helically perpendicular plane varies toroidally, which affects the symmetry of the reconnection geometry and the local diamagnetic effects.

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