Multiple timescale calculations of sawteeth in tokamak plasmas
S.C. JARDIN, PPPL, N. FERRARO, General Atomics, J. BRESLAU, J. CHEN, PPPL — We present results of using M3D-C\textsuperscript{1} \cite{1} to perform 3D nonlinear magnetohydrodynamics calculations of a tokamak plasma that span the timescales associated with ideal and resistive stability as well as parallel and perpendicular transport. We specify the transport coefficients and apply a “current controller” that adjusts the boundary loop-voltage to keep the total plasma current fixed. Depending on the transport model, the plasma either reaches a stationary quasi-helical state in which the central safety factor is approximately unity, or it periodically undergoes sawtooth oscillations \cite{2} with a period that approaches a constant value. These calculations have been performed both in a “fixed boundary” configuration with a wall on the plasma boundary as well as in a “free boundary” configuration with a separatrix surrounded by a scrape-off-layer plasma with open field lines and a resistive wall. We have performed series of runs to determine the dependence of the sequence on the form and magnitude of the resistivity, parallel and cross-field thermal conductivity, and viscosity. We are presently investigating the effect of the plasma shape on the sawtooth behavior, and the effects of two-fluid terms on the dynamics.

\cite{1} J. Breslau, N. Ferraro, S. Jardin, Physics of Plasmas 16 092503 (2009)