

Two-Fluid and Resistive Nonlinear Simulations of Tokamak Equilibrium, Stability, and Reconnection

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The NIMROD[1] and M3D[2,3] codes now each have both a resistive MHD and a two-fluid (2F) capability including gyro-viscosity and Hall terms. We describe: (1) a new 3D verification and validation test in the resistive MHD regime using an applied loop voltage in which the two codes are in detailed agreement and they each match the experimental sawtooth period to within 10%, (2) new studies that illuminate the effect of 2F physics on spontaneous rotation in tokamaks and the effect on linear stability, and (3) nonlinear reconnection in regimes of relevance to fusion plasmas with reconnection rates that are independent of the resistivity, and (4) linear two-fluid tearing mode calculations including electron mass that agree with analytic studies over a wide range of parameter regimes.