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Linear 3D Toroidal Two-Fluid Stability Calculations Using M3D-C^1 S. JARDIN, J. BRESLAU, M. CHANCE, J. CHEN, PPPL, N. FERRARO, General Atomics, X. LUO, K. JANSEN, M. SHEPHARD, SCOREC, RPI, CEMM COLLABORATION — The M3D-C^1 code is a two-fluid toroidal magnetohydrodynamic code based on high-order, compact finite elements with C^1 continuity on an unstructured adaptive triangle-based grid. The code is built upon many of the favorable features of the M3D approach to solving the MHD equations in a highly magnetized toroidal plasma. The vector fields use a physics-based decomposition, allowing for two energy-conserving subsets of the full equations (reduced MHD). The efficient split-implicit time advance is closely related to the ideal MHD energy principle, and allows time steps several orders of magnitude in excess of the Courant condition based on the Alfven or whistler waves. The present emphasis is on benchmark calculations for the linearized two fluid MHD equations in 3D toroidal geometry. The computational model has a physically based resistivity profile such that the Lundquist number S varies from 10^8 in the plasma to $\sim 10^0$ in the surrounding 'vacuum' region. Special adaptive meshing algorithms allow high resolution in the resistivity rapid transition region and around mode rational surfaces. Comparisons are made with ideal MHD (PEST-I) and resistive MHD (PEST-III) codes and the dependence of growth rates on dissipative parameters is presented. This work was supported by U.S. DoE contract DE-AC02-76CH03073.

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