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Systematic *ab initio* Hall MHD numerical study of three-dimensional magnetic field relaxation in a closed system.[1] V.S. LUKIN, W. LOWRIE, G.J. MARKLIN, A.H. GLASSER, Plasma Science and Innovation Center, University of Washington, Seattle, WA, C.D. COTHRAN, Advanced Technology Division, SFA Incorporated, Crofton, MD, M.R. BROWN, Swarthmore College, Swarthmore, PA — We study the relaxation of an initial spheromak magnetic field configuration in a closed elongated perfectly conducting cylindrical can to the lowest energy Taylor state characteristic of such a domain. A three-dimensional implicit high order finite (spectral) element code HiFi is used to conduct the simulations in both viscous single-fluid and Hall MHD regimes. It is shown that in the presence of magnetic field dissipation the system consistently relaxes to the fully three-dimensional lowest energy state, calculated independently by an eigenvalue PSI-TET code and confirmed experimentally at the Swarthmore Spheromak Experiment. However, we also show that the rate of relaxation is significantly greater and the dynamics is different in the presence of the two-fluid Hall terms in the Ohm's Law, with all else being equal. Additionally, the dependence of the relaxation rate and dynamics on the ion inertial scale and viscous coefficients is systematically investigated.

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