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Generalized Stationary States for Plasmas with Conserved Global Helicities A. KULLBERG, E.D. HELD, W.F. EDWARDS, Utah State University — After decades of work on the subject of minimum energy states for plasmas, a novel theory[1] has been developed which includes all of the terms in the energy integral and adjoins local constraint equations that avoid the common assumption of quasineutrality. In order to verify the predictions of this theory as well as extend it to toroidal geometry, we present complimentary work that constrains the variation of total plasma energy under the assumption of conserved global helicities. The resultant Euler-Lagrange equations take the form of coupled, nonlinear partial differential equations for the magnetic and electric fields, plasma flows and densities and the Lagrangian multipliers associated with conserved global helicities. Assumptions regarding symmetry are then employed to convert the Euler-Lagrange equations to coupled ordinary differential equations which are solved using finite-difference, relaxation techniques. Quantitative comparisons of the solutions from these theories are made for the problems of diamagnetism in slab geometry, which is relevant to space plasma in the Venus ionosphere, and cylindrical screw pinches, which is relevant to the confinement of fusion plasmas in the laboratory. Preliminary work regarding minimum energy states in toroidal geometry is also presented.

[1]W. F. Edwards and E. D. Held, *Phys. Rev. Lett.,* **11**, 255001 (2004)

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