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Generalized Stationary States for Fusion Plasmas E.D. HELD, W.F. EDWARDS, A. KULLBERG, Utah State University — The subject of minimum energy states for magnetically confined plasmas dates back to pioneering work by Woltjer[1] and Chandrashekar[2]. After decades of work in this area, a novel theory[3] 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 this talk, we discuss a complimentary version of this recent theory which replaces the local constraints of plasma fluid and Maxwell's equations with the constraints of globally conserved generalized helicities. Comparison is made between the stationary states predicted by these theories for the problems of cylindrical Z-pinch, Θ-pinch and screw pinch plasmas. Importantly, both theories predict that substantial electrostatic fields due to charge separation play a critical role in confinement. We conclude by discussing the application of the theory in toroidal geometry which is relevant to the problem of confining fusion plasmas in laboratory experiments.

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[2]S. Chandrasekhar, *Proc. Natl. Acad. Sci. U.S.A.* **44**, 842 (1958); **42**, 273 (1956)
[3]W. F. Edwards and E. D. Held, *Phys. Rev. Lett.,* **11**, 255001 (2004)

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