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Plasma Relaxation Dynamics Moderated by Current Sheets
ROBERT DEWAR[1], Australian National University, AMITAVA BHATTACHARJEE, Princeton Plasma Physics Laboratory, ZENSHO YOSHIDA, University of Tokyo — Ideal magnetohydrodynamics (IMHD) is strongly constrained by an infinite number of microscopic constraints expressing mass, entropy and magnetic flux conservation in each infinitesimal fluid element, the latter preventing magnetic reconnection. By contrast, in the Taylor-relaxed equilibrium model all these constraints are relaxed save for global magnetic flux and helicity. A Lagrangian is presented that leads to a new variational formulation of magnetized fluid dynamics, *relaxed MHD* (RxMHD), all static solutions of which are Taylor equilibrium states. By postulating that some long-lived macroscopic current sheets can act as barriers to relaxation [1], separating the plasma into multiple relaxation regions, a further generalization, *multi-relaxed MHD* (MRxMHD), is developed. These concepts are illustrated using a simple two-region slab model similar to that proposed by Hahm and Kulsrud—the formation of an initial shielding current sheet after perturbation by boundary rippling is calculated using MRxMHD and the final island state, after the current sheet has relaxed through a reconnection sequence [2], is calculated using RxMHD.

[1] Z Yoshida & RL Dewar, J Phys A **45** 365502 (2012);
[2] RL Dewar, A Bhattacharjee, etal, Phys Plasmas **20**, 082103 (2013)

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