Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Towards a global model of equilibrium solar behavior: the tachocline as a trans-Alfvenic feature LEE GUNDERSON, AMITAVA BHATTACHARJEE, Center for Heliophysics, Princeton Plasma Physics Laboratory, Princeton University, LUCA GUAZZOTTO, Auburn University — Observations and simulations suggest that thermal wind balance holds to lowest order in the solar convection zone (SCZ), and an analytic model of solar rotation has been developed by further assuming a functional relationship between the entropy and rotation. Below the SCZ, analytic arguments and simulations have implicated the necessity of a large poloidal field in the deep solar interior for the thin structure of the tachocline. We seek to unify these pictures and find a global equilibrium base state of solar behavior by starting from the exact solution to axisymmetric ideal MHD, the generalized Grad-Shafranov equation, thereby including magnetic field and poloidal flow from the onset. We find that a tachocline-like structure naturally arises as an equilibrium feature if the poloidal Alfvénic Mach number approaches unity near the bottom of the SCZ. FLOW, a code developed to analyze tokamak equilibrium with arbitrary flow, has been adapted for use in the solar regime and used to examine effects of magnetic field and poloidal flow on thermal wind balance. The next steps include: including the Alfvénic transition, establishing linear stability, and considering the effects of stresses and dissipation.

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Date submitted: 24 Jul 2015 Electronic form version 1.4