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An Equilibrium MHD Model of Solar Rotation, Flow, and Magnetism: The Tachocline as a Trans-Alfvnic Feature LEE GUNDERSON, AMITAVA BHATTACHARJEE, Princeton Plasma Physics Laboratory — While helioseismology has revealed the internal density and rotation profile of the sun, knowledge of the magnetic fields and meridional circulation is confined much closer to the surface. We propose analyzing equilibrium profiles of axisymmetric ideal MHD flows as a way to extrapolate inward from this surface data. We present analytic and numerical solutions of the generalized Grad-Shafranov equation in the solar regime. In particular, we analyze behavior near the Alfvénic surface ($\rho v_p^2/B_p^2 = 1$), and propose that its proximity to the tachocline is not coincidental. In addition, profiles with different surface magnetic fields can offer insight about effects of the solar cycle, such as torsional oscillations and active latitudes. Future work includes: analyzing stability of the solutions, including transport to obtain a Grad-Hogan simulation of the solar cycle, and applying to other stars or planetary cores.

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