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Self Consistently Calculated Zonal Flow Shears and Stability and Its Implications Y. KOSUGA, P.H. DIAMOND, University of California, San Diego — In this work, we derive an *exact* expression for the zonal flow velocity profile using conservation of potential enstrophy for drift wave models, in a *stationary state*. This result extends the Charney-Drazin theorem, familiar from geophysical fluid dynamics, and should be contrasted to previous zonal flow models in that it: a.) is derived for the *stationary* turbulence-flow system, rather than for the transient growth phase. b.) links the zonal flow directly to the driving transport *flux*, which is *fixed*. c.) is formulated in *real* space, instead of Fourier space, which is critical to determine the strength of the shear and curvature of zonal flow (n.b. the former controls turbulent transport and the latter controls Kelvin-Helmholtz instability of zonal flows). We have obtained results for the flow shear profile and the flow curvature profile. Results indicate that: a.) zonal flow *shear* is determined primarily by the driving flux and the profile of the flow damping, which allows determination of the critical flux for reduction of turbulent transport. b.) zonal flow *curvature* is determined by the flow damping curvature, along with the profile of potential enstrophy dissipation, which determines a condition for KH stability. This research was supported by U.S Department of Energy Grant Nos. DE-FG02-04ER54738, DE-FC02-08ER54959 and DE-FC02-08ER54983.

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