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Emergence of Macroscopic Transport Barriers from Staircase Structures[1] ARASH ASHOURVAN, Princeton Plasma Physics Laboratory, PATRICK H. DIAMOND, University of California San Diego — A theory is presented for the formation and evolution of coupled density staircases (SC) and zonal shear profiles in a simple model of drift-wave turbulence. Density, vorticity and fluctuation potential enstrophy are the fields evolved for this system. Formation of SC structures is due to inhomogeneous mixing of generalized potential vorticity (PV), resulting in the sharpening of density and vorticity gradients in some regions and weakening them in others. The positive feedback which drives SC formation is implemented via a Rhines scale dependent mixing length. When PV gradients steepen, the density SC structure develops into a lattice of mesoscale 'jumps', and 'steps', which are respectively, regions of local gradient steepening and flattening. The jumps merge and migrate in radius, leading to the development of macroscale profile structures from mesoscale elements. Furthermore, depending on the sources and boundary conditions, either a region of enhanced confinement, or a region with strong turbulence can form at the edge. We present extensive studies of bifurcation physics of the *global* state, including results on the flux-gradient landscapes. This model is the first to demonstrate how mesoscale condensation of SCs leads to global states of enhanced confinement.

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