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Rapidly Rotating Wall Mode Convection GEOFFREY VASIL, Canadian Institute for Theoretical Astrophysics, KEITH JULIEN, University of Colorado — In a rapidly rotating finite-aspect ratio system the onset of Rayleigh-Benard convection can occur either via a set of slowly oscillating modes supported in the bulk interior of the domain, or via a set of faster modes that exist in a thin boundary layer attached to side of the container. If the background rotation rate is sufficiently large, then these wall-localized modes are always the preferred pattern of instability. However, extreme wall localization is not the entire picture; wall mode convection is actually a fundamentally multiscale phenomenon. Outside an asymptotically thin boundary layer, the convective modes connect to a dynamical interior that maintains scales set by the geometry of the domain. In the rapidly rotating limit, we derive a new balanced set of reduced PDE's that govern the strongly nonlinear development of the wall-mode instability in the interior of a general container. Furthermore, the small-scale dynamics within the boundary layer are linearly and diagnostically determined in terms of the bulk interior dynamics. The boundary layers then feedback on the interior via a nonlinear lateral heat-flux boundary condition. These new PDE's clearly contain the results from previous linear instability theory. We will also discuss some results in a strongly supercritical regime.

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