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Low rossby number heat transport in rotating Rayleigh-Benard convection[1] KEITH JULIEN, ANTONIO RUBIO, University of Colorado at Boulder, GEOFFREY VASIL, CITA, University of Toronto, EDGAR KNOBLOCH, University of California at Berkeley — Recent laboratory experiments of turbulent rotating Rayleigh-Bénard convection, performed entirely within the regime of strong rotational constraint, have revealed a sharp transition in the scaling of the heat transport as a function of the thermal forcing. This is embodied by the nondimensional Nusselt-Rayleigh scaling law, $Nu \propto Ra^{\alpha}$, where a steep scaling regime ($\alpha > 1$) gives way to a comparatively shallower regime ($\alpha < 1/2$) typical of non-rotating turbulent convection. A crossover between the thermal and viscous boundary layers has been proposed as the root-cause of this remarkable result, yet a similar transition is found in the presence of stress-free boundary conditions where viscous layer boundary layers are absent. Unfortunately, the dynamics within the thermal boundary layer remain poorly understood due to resolution challenges at low Rossby number. Utilizing numerical simulations of the asymptotically exact nonhydrostatic balanced geostrophic equations we present an alternative explanation, not reliant on the form of the mechanical boundary conditions, but based on loss of geostrophic balance within the thermal boundary layers as a result of vigorous vortical motions. We show that the bottleneck for heat transport is the turbulent interior.

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