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Effects of Velocity and Temperature Boundary Conditions in Turbulent Thermal Convection HANS JOHNSTON, UMass Amherst, DAVID GOLUSKIN, Columbia University, CHARLES DOERING, University of Michigan, GLENN FLIERL, MIT — We report on results of high resolution direct numerical simulations of two-dimensional Rayleigh-Bénard convection for Rayleigh numbers up to $Ra = 10^{10}$ in order to study the influence of both temperature and velocity boundary conditions on the turbulent heat transport. In the first scenario, while imposing the no-slip velocity boundary condition, we consider the extreme cases of fixed heat flux (where the top and bottom boundaries are poor thermal conductors) and fixed temperature (perfectly conducting boundaries). Both cases display identical heat transport at high Rayleigh numbers fitting a power law $\nu \approx 0.138 \times Ra^{.285}$ with a scaling exponent indistinguishable from $2/7 = 0.2857\ldots$ above $Ra = 10^7$. The findings are compared and contrasted with results of recent three-dimensional simulations and experiments. In the second scenario we consider the setup originally considered by Rayleigh for calculating conditions for the onset of thermal convection, fixed temperature boundary condition with free-slip velocity boundary conditions. Somewhat surprisingly, at high Rayleigh numbers a strong shear flow develops with periodic "bursting" of the thermal boundary layers. We'll discuss this phenomena and its impact on the heat transport.

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