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Does confined turbulent convection ever attain the 'asymptotic scaling' with 1/2–power? JOSEPH NIEMELA, International Centre for Theoretical Physics, KATEPALLI SREENIVASAN, New York University — We examine turbulent thermal convection for very high Rayleigh numbers using cryogenic helium in a cylindrical container with diameter-to-height aspect ratio $\gamma = 1$, and confirm that the Nusselt number, Nu, follows approximately the 1/3 power of the Rayleigh number, Ra, for Ra $\leq \times$ 2 10^{14}: Nu = 0.064 $\mathrm{Ra}^{1/3}$. However, when Ra is pushed to higher values by approaching the critical point of helium in the temperature-pressure phase diagram, we observe a new state of enhanced heat transport, corresponding approximately to Nu = 0.078 $\mathrm{Ra}^{1/3}$. The transition between the two states of the 1/3-power occurs with a log-log slope of roughly $1/2$. Comparing experiments in the same apparatus but with $\gamma = 4$ - as well as slightly different paths through the pressure-temperature phase space with the same aspect ratio - we find that the transition value of Ra is not unique and can vary by an order of magnitude or more depending on experimental conditions. In particular, the transition does not correlate with dynamical parameters such as the Rayleigh number. However, it correlates reasonably well with a non-dimensional parameter related to variability of fluid conductivity and viscosity, occurring when the mean pressures and temperatures approach their critical values closer. No asymptotic transition to a half-power heat transport law was discerned.

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