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Marginally stable Rayleigh–Bénard convection BAOLE WEN, University of Michigan, ZIJING DING, University of Cambridge, GREGORY CHINI, University of New Hampshire, RICH KERSWELL, University of Cambridge, UNIVERSITY OF MICHIGAN COLLABORATION, UNIVERSITY OF NEW HAMPSHIRE COLLABORATION, UNIVERSITY OF CAMBRIDGE COLLABORATION — We propose a new strategy to predict the heat transport in 2D Rayleigh–Bénard convection between stress-free isothermal boundaries.The Constantin–Doering–Hopf (CDH) variational framework, in which the temperature is decomposed into a background profile plus a fluctuation field and the background profile is required to satisfy a marginal energy-stability constraint, provides a formalism for determining an upper bound on the heat flux, i.e., the Nusselt number Nu. Although this scheme yields a rigorous upper bound on the flux scaling at large values of Rayleigh number Ra, i.e., $Nu \leq 0.106 Ra^{5/12}$ (Wen *et al.* 2015),the resulting horizontal mean (background plus fluctuation average) temperature profile exhibits much thinner thermal boundary layers than are observed in DNS and laboratory experiments. Here, we incorporate an additional, marginal *linear-stability* constraint on the horizontal mean temperature profile to thicken the boundary layers and thereby bring the predicted and observed profiles into closer agreement. We then develop a time-marching method to numerically solve the modified upper-bound problem. Our analysis reproduces the Malkus/Howard $Nu \sim Ra^{1/3}$ scaling but with a prefactor that closely matches the DNS results.

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