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Temperature-dependent thermal diffusivity in turbulent convection in an extended domain AMBRISH PANDEY, New York University Abu Dhabi, JOERG SCHUMACHER, Ilmenau University of Technology, KATEPALLI R. SREENIVASAN, New York University — In solar convection molecular properties of the fluid depend strongly on the temperature T; for example, the thermal diffusivity varies roughly as $\kappa \sim T^3$. We simulate the effects of such a strongly temperature-dependent thermal diffusivity in the simplified setting of Rayleigh-Bénard (RB) convection in a horizontally-extended domain. The thermal diffusivity is set to decrease from the bottom to the top in a similar way as in the Sun. This variation causes the governing parameters the Rayleigh and Prandtl numbers to decrease with the increasing depth. As a result, we find that the top-down symmetry of statistical moments, which is exactly satisfied in the standard RB case, is broken. While the diffusive and convective heat fluxes remain essentially symmetric about the midplane, the thermal structures develop ever finer granules with increasing height. Furthermore, the turbulent eddy viscosity and diffusivity, and thus the turbulent Prandtl number, vary with height. These behaviors are compared with those of reference RB with parameters corresponding to the top and bottom conditions.

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