Turbulent convection in rotating slender cells

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Abstract

Turbulent convection in the interiors of the Sun and the Earth occurs at high Rayleigh numbers Ra, low Prandtl numbers Pr, and different levels of rotation rates. To understand the combined qualitative effects better, we study rotating turbulent convection for Pr = 0.021, and varying Rossby numbers Ro, using direct numerical simulations in a slender cylinder of diameter one-tenth its height. This confinement allows us to attain high enough Rayleigh numbers. We are motivated by the earlier finding in the absence of rotation that heat transport at high enough Ra is similar between confined and extended domains. We make comparisons with higher aspect ratio data where possible. We study the effects of rotation on the global transport of heat and momentum as well as flow structures for increasing rotation at a few fixed values of Ra as well as for increasing Ra (up to 10^{10}) at the fixed, low Ekman number of $1.45 \times 10\{-6\}$. $We find that the flow structure, which is initially helical, develops progressively finer compo$

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