Abstract Submitted
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Combining confinement and rotation to improve heat transport in Rayleigh-Bnard convection[1] ROBERT HARTMANN, Physics of Fluids Group Twente Max Planck Center, University of Twente, Enschede, The Netherlands, ROBERTO VERZICCO, Dipartimento di Ingegneria Industriale, University of Rome 'Tor Vergata', Rome, Italy, DETLEF LOHSE, RICHARD J. A. M. STEVENS, Physics of Fluids Group Twente Max Planck Center, University of Twente, Enschede, The Netherlands — It has been shown by Chong et al., (2017) that different stabilizing mechanisms similary increase heat transport in Rayleigh-Bnard convection (RBC) compared to the standard non-stabilized system. Here, we study the combination of two stabilizing mechanisms, namely rotation, and confinement, by performing direct numerical simulations of confined rotating RBC in a cylindrical cell for Prandtl number $Pr = 4.38$ and various Rayleigh numbers $Ra \in [2 \cdot 10^8, 7 \cdot 10^9]$. In the absence of rotation, flow confinement can result in a higher heat transport as it makes the large scale circulation more effective in transporting heat, while system rotation can increase heat transport due to a process known as Ekman pumping. We find that Ekman pumping becomes more effective at a certain aspect ratio, i.e. diameter over the height of the sample, when the flow forms a stable structure of two vortices. In addition, we find that for high Ra and very low aspect ratio cells, a third distinct maximum evolves, caused by the formation of a singular strong vortex. We show that for relatively low $Ra < 2 \cdot 10^9$ the combination of confinement and rotation results in the highest heat transport. For $Ra > 2 \cdot 10^9$ the use of confinement is the most effective way to increase heat transport.

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