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A theory for optimal heat transfer in a partitioned convection cell[1] JUN CHEN, State Key Lab. for Turb. & Complex Sys., Dept. Mech. & Engg. Sci., College of Engg., Peking Univ., Beijing 100871, China, YUN BAO, Dept. Appl. Mech. & Engg., Sch. Engg., Sun Ya-Sen Univ., Guangzhou 510275, China, ZHEN-SU SHE, State Key Lab. for Turb. & Complex Sys., Dept. Mech. & Engg. Sci., College of Engg., Peking Univ., Beijing 100871, China — We report a theory explaining recent observation of significant enhancement of heat transfer in a partitioned Rayleigh-Bénard convection (RBC), where vertical adiabatic boards are inserted into the enclosure with narrow channel left open between partition boards and the cooling/heating plates. An enhancement of heat transfer of up to 2.7 times is observed compared to normal RBC cell without partitions. It is found that laminar wall jet is formed in the narrow horizontal channel, which makes the thermal boundary layer thinner. Two asymptotic trends, a channel flow and a boundary layer, describe the motions of the jets in the horizontal channel, and the competition between them gives rise to an optimized state for the global heat transfer, with an optimal width of the sub-cell W/H =0.038-0.083 for Γ =1, and an optimal spacing of the horizontal channel b/H=0.011 for Γ =5. The former (channel) yields a heat flux linearly proportional to b for small b, whereas the latter (boundary layer) follows -2/3-law for large b. We suggest that the partitioned RBC provides a vehicle for heat enhancement with a wide range of industrial applications.

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