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Large scale structures of a turbulent Rayleigh-Bnard convection in a liquid metal layer confined by a moderate aspect ratio box MEGUMI AKASHI, YUJI TASAKA, Laboratory for Flow Control, Hokkaido University, TAKATOSHI YANAGISAWA, Japan Agency for Marin-Earth Science and Technology , YUICHI MURAI, Laboratory for Flow Control, Hokkaido University, TOBIAS VOGT, SVEN ECKERT, Helmholtz Zendrum Dresden-Rossendorf — We report laboratory experiments of Rayleigh-Bnard convection with a liquid metal, Prandtl number Pr = 0.03, in a rectangular cell at a moderate aspect ratio of 5. The Rayleigh number, Ra, was varied in a range from 7.9 10^3 to 3.5 10^5 in which the regime of thermal turbulence regime is to be expected. Multiple horizontal velocity profiles were measured in the fluid layer by ultrasonic velocity profiling. The reconstruction of the flow pattern elucidated the occurrence of large scale structures with periodic oscillations. An increasing Ra number causes a transition from a quasi-two-dimensional roll-like structure to a three-dimensional cell-like structure. The transition of the flow structure passes several unstable intermediate regimes accompanied by a stepwise increase of the horizontal scale. For explaining the increase in the horizontal scale, we suggest a model relying on observed Ra dependences of the oscillation frequency and the typical flow velocity of the large scales. Moreover, we have found that the morphology of the roll-like structure can be understood by evaluating the effective viscosity and diffusivity on the basis of turbulent fluctuations.

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