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MIS22-P10 Room:Convention Hall Time:May 23 13:45-15:15

Rotating convection of a liquid metal by laboratory experiments and numerical simulations

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We performed laboratory experiments of Rayleigh-Benard convection on a rotating table by using liquid gallium, to see the effect of Coriolis force on the flow pattern in low Prandtl number (Pr) fluids. The vessel we used has a square geometry with aspect ratio five; convection is driven by bottom heating and top cooling. The range of Rayleigh number (Ra) is from 10^3 to 10^5, and the Pr of liquid gallium is 0.025. The range of Taylor number (Ta), which is proportional to the square of the rotating speed, is from 0 to 10^7. Flow patterns were visualized by ultrasonic velocity profiling method, and convective flow structures with time variation were clearly observed. We compared the results with the experiments using water (Pr=6) in the same geometry.

We also made up codes for numerical simulation of thermal convection with Coriolis force, to compare with the results obtained by these laboratory experiments. Theoretical studies for the onset of instability indicates that the critical Ra is proportional to $\mathrm{Ta}^{2/3}$ in an asymptotic form, and the state of overstability occurs for $\mathrm{Pr} < 0.6$. Our numerical result reproduced the relation of critical Ra on Ta, depending on Pr. Convection patterns above the critical Ra are consistent with that observed in the laboratory experiments. We analyzed the global structure and its time variations.

Keywords: rotating convection, liquid metal, Coriolis force, laboratory experiment, numerical simulation