

Experimental study of thermal convection in liquid Gallium

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Thermal convection in the earth's core is investigated numerically by many geo-scientists. Applying actual information obtained in experiment to the numerical calculation is important to improve the calculation. But there is little experimental study using liquid metal because of its difficulties, for example optical technique cannot be applied to measure the convective motion in liquid metal. In this study, we attempt to measure thermal convection in liquid metal by means of ultrasonic velocity profiler, UVP.

Rayleigh-Benard convection is one of the most fundamental flows in the thermal convection. It has been recognized that large scale motion like cell exists in this convection for liquid metal layers. These cells oscillate with a certain period and the temperature fluctuation has the corresponding period. However the course of these behaviors has not been understood.

When the Rayleigh number is enough large to the critical Rayleigh number, thermal plume generated by separation of the thermal boundary layer is dominant in Rayleigh-Benard convection. This study aims to clarify a behavior of the thermal plume appearing in a liquid metal relating for investigating the periodic motion in liquid metal. UVP measurement of the thermal plume is performed in glycerol solution as transparent fluid to compare the obtained spatio-temporal velocity distribution with the actual behavior of the thermal plume. Ascending velocity obtained from the UVP measurement corresponds with that in the visualization. Furthermore, UVP measurement detects an intermittent separation of the thermal boundary layer. The measurement system is also utilized for the measurement of the thermal plume in a liquid Gallium layer and for the measurement of a large-scale convective motion in a liquid Gallium layer.