

A High Resolution Thermal Mapping of SF₆ Fluid Near Its Criticality in Weightlessness

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Early stage of thermal equilibration near the liquid-gas critical point of fluid sample in a constant volume cell is rapid due to the adiabatic process, called "piston effect." Nevertheless, the later stage of the equilibration is governed by the slow diffusive process. Therefore the complete equilibration process depends on the thermal performance of the regulation system, and then of the sample cell material, its geometry, thermophysical properties of the sample fluid, and the thermal history of the sample. Experiments to study the critical phenomena extremely close to the critical point have been hampered by the resulting residual temperature gradient and its associated local density inhomogeneity. Even for a high quality level thermal regulation, this residual temperature inhomogeneity inside the fluid can be extremely small near the critical point and not measurable directly using a conventional thermometry. Here we show indirect measurements of two dimensional temperature and density profile of near critical SF₆ fluid in an entire cylindrical cell by a wide field-of-view turbidity measurements and a theoretical equation-of-state model. This turbidity measurement was performed in weightless conditions using the DECLIC (Dispositif pour l'Etude de la Croissance et des Liquides Critiques) facility and the ALI insert on board International Space Station (ISS). We will present the new thermal mapping technique for a near critical fluid and its applications to study critical phenomena.