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NEAR-CRITICAL DENSITY FILLING OF THE SF6 FLUID CELL FOR THE ALI-R-DECLIC EXPERIMENT IN WEIGHTLESSNESS

Abstract

Recent turbidity measurements [1] performed in weightless conditions using the CNES-NASA-DECLIC (Dispositif pour l'Etude de la Croissance et des LIquides Critiques) facility and the ALI insert on board International Space Station (ISS) have shown the important role of the reduced density distance from the SF6 critical density in the theoretical analysis of the data. For the future ALI re-flight (ALI-R) experiment, a new upgraded experimental cell is designed with the objective to perform on Earth's the control of density filling with a relative precision of 0.1%. The analyses of the ground-based experiments can be however hampered by several effects, especially the density stratification of the cell, the liquid wetting behavior of the cell walls, and the expected singular curvature of the rectilinear density diameter [2, 3]. In order to optimize the observation of these related effects on the position and shape of the liquid-vapor meniscus, the cell design was then highly symmetrized with respect to any median plane of the total fluid volume. In such a resulting quasi-perfect cylindrical fluid volume, the fine observation of the meniscus position and shape for different orientations of the cell with respect to the Earth's gravity acceleration field is an ideal probe to evidence the non-symmetrical contributions. The latter are expected from departure to the so-called ideal lattice-gas model of the uniaxial 3D-Ising universality class [4]. In addition, the high optical and thermal performances of the ALI-R insert used in the Engineering Model of DECLIC facility allow precise benchmark data to be obtained, which is useful for accurate control of the theoretical estimations based on scaling approaches from renormalization field theory. We will present these new benchmark data for a selected near critical SF6 cell that will to be used in weightless conditions with the ALI-R insert in the DECLIC facility on board the ISS.

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