

Applications of an Optical Method for Relative Pressure and Density Characterization on SF₆ near Its Critical Point

Y. Garrabos^C, C. Lecoutre-Chabot^S, F. Palencia and D. Beysens

ESEME - Institut de Chimie de la Matière Condensée de Bordeaux, CNRS, Pessac Cedex, France
garrabos@icmcb-bordeaux.cnrs.fr

We have used an academic optical method to measure the relative mean density of a slightly off-critical pure fluid filling a sample cell of constant volume submitted to Earth's gravitational acceleration. This is accomplished by measuring the position of the liquid-gas meniscus and the density gradient as a function of the temperature difference from the critical temperature, thanks to the high-level measurements performed on the qualification model of the advanced CNES-ALICE 2 facility. Careful symmetrical design of the experimental cells, high performance temperature control (0.01 mK), and high optical resolution (0.01 mm) on the meniscus position allow a precision of $5 \cdot 10^{-4}$ on the value of the average density of a fluid, relatively to its critical density. Combining different well-defined orientations of the cell's dead volume relative to Earth's gravity, we use the compressibility effects to analyze the amplitude D of the power law for the critical isotherm. Comparison with the results of a simple model that takes into account the varying cross sections of the cell and integrates the density profile over the total height of the cell, yields the determination of D when the average density of the cell is changed. Another objective of our studies concerns the experimental determination of the "rectilinear" diameter law of SF₆ close to its critical point, using a constant volume fluid cell at various calibrated average densities. Our results do not evidence any curvature of this law close to the Critical Point. Finally an experimental determination of the absolute critical density of SF₆ is made, using a double weighing method. The precision of these results is discussed in the light of each particular experimental procedure, and comparison with published equivalent results is given.