

Whether the Hypothesis of Conformal Invariance Is Fulfilled Near the Critical Points of Fluids?

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Conformal transformations were introduced in the physics of phase transitions by A.M. Polyakov [1]. Based on the hypothesis of conformal invariance (CI), scale invariance with anomalous dimensions was proposed [2], both in the theory of critical phenomena for fluctuating quantities and in hadronic interactions. The CI hypothesis also proves to be fundamental in interdisciplinary research, for example, to explain the formation of hexagonal structures in the system of grid cells in the brain (2014 Nobel Prize in Physiology and medicine) [3]. An important consequence of CI hypothesis in the physics of phase transitions, according to [4], is the orthogonality relation for two fluctuating quantities of transitions with different scale dimensions within the algebra of fluctuating quantities, which was proposed by V.L. Pokrovskii [5] (see also [6]). The aim of this work is to verify for the first time the CI hypothesis for the liquid-vapor critical points of single-component fluids based on existing experimental data. For this purpose, we used experimental data for carbon dioxide [7], water [8,9], and polyol ester (POE9) lubricant with a higher critical temperature, for which experimental data are available in the scientific literature [10]. These fluids have critical temperatures $T_C = 304.1\text{K}$, $T_C = 647.1\text{ K}$ and $T_C = 970.0\text{ K}$ and critical densities $\rho_C = 467.6\text{ kg/m}^3$, $\rho_C = 322.0\text{ kg/m}^3$ and $\rho_C = 220.3\text{ kg/m}^3$, respectively. It was proven that for the studied fluids the hypothesis of conformal invariance holds in temperature intervals determined from experimental data near their liquid-vapor critical points. The values of the temperature intervals in which the hypothesis of conformal invariance near the liquid-vapor critical points is fulfilled depend on the absolute values of the critical parameters of the studied fluids. Confirmation of the CI hypothesis also means that the temperature derivative of the coexistence-curve diameter retains the weak singularity with the exponent of the isochoric heat capacity [11-13].

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