Equation of State for Nano-Systems Near the Critical Point

Alexander Alekhin [C, S]
Physics Department, Kyiv National Taras Shevchenko University, Kyiv, Ukraine

The features of macro-inhomogeneous systems under gravity near the critical point [1] have been compared with the properties of small nano-systems near the critical point [2]. By using the fluctuation theory of phase transitions [3] it was concluded that a macro-inhomogeneous system near the critical point consists of the continuous height distribution of small nano-fluctuation systems. Their size, $L = 2R_c$, varies along the height within the limits of values $L=(1\text{-}10^2)$ nm [4] (R_c is correlation length). The individual characteristics of these small confined systems determine and certainly influence the properties of whole macroscopic system. It was also obtained that the different thermodynamic and correlation properties of the macro-inhomogeneous system depend on its linear size ($\Delta\mu \sim L^{-x}$) [1]. These properties of the macro-system have a non-monotonic temperature dependence under the stationary fields $\Delta\mu$ and for the linear size L of the system [1]. Similar features were found by contemporary studies of the properties of small confined systems near the critical point [5]. On the basis of the similarity of the properties of these systems near the critical point the equation of state of small nano-systems near the critical point [6] has been proposed by using the fluctuation theory of phase transitions [3] and equations of M. Fisher [2]. The values of the shifts of the critical parameters for small nano-systems have been calculated by these equations. The results are confirmed [6] by the experimental data [5].

1. A.D. Alekhin, Journal of Molecular Liquids, 127, (2006) 62.
2. M.E. Fisher, M.N. Barber, Phys. Rev. Lett., 28, (1972) 1516.
3. A.Z. Patashinskii, V.L. Pokrovskii, Fluctuation theory of phase transition, Pergamon, Oxford, 1979.
4. A.D. Alekhin, , JETPh, 72, (5) (1977) 1880.
5. V.P. Voronov, V.M. Buleyko, JETPh, 113, (3) (1998) 1071.
6. A.D. Alekhin, Bulletin of KNU. Physics and Mathematics 3, (2006) 399.