Method of calculating the free energy of three-dimensional uniaxial magnet in an external field on the basis of the higher non-Gaussian distribution

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The microscopic approach to calculating the free energy of a three-dimensional Ising-like system in a homogeneous external field is developed in the higher non-Gaussian approximation (the ρ^6 model) at temperatures above the critical value of T_c (T_c is the phase-transition temperature in the absence of an external field). The free energy of the system is found by separating the contributions from the short- and long-wave spin-density oscillation modes taking into account the generalized point of exit of the system from the critical regime as a function of both the temperature and field variables. A calculation technique is based on the first principles of statistical physics and is naturally realized without any general assumptions and without any adjustable parameters. Our analytical calculations do not involve series expansions in the scaling variable and are valid near the critical point not only in the regions of the so-called weak and strong external fields but also in the crossover region between these fields, where power series in the scaling variable are not effective. The obtained expression for the free energy contains the leading terms and terms determining the temperature and field confluent corrections.