A quantum generalization of equilibrium statistical thermodynamics

A.D. Sukhanov and O.N. Golubjeva

Joint Institute for Nuclear Research, Dubna, Russia

Two versions of a quantum generalization of equilibrium statistical thermodynamics are offered. A generalized model of an external environment of object – quantum-thermo-stat is used. A thermal equilibrium is characterized by the effective temperature having nonzero restriction from below. This value takes into account joint stochastic influence of quantum and thermal types. Within the macro-version of the theory quantum effects are taken into account directly without using of an operator formalism. Effective macroparameters are entered but traditional ratios between them are kept. Essentially a new macro-parameter of the theory is effective entropy. At low temperatures it comes nearer to the nonzero value equal to Boltzmann constant. Within the micro-version of the theory similar results for macro-parameters of quantum oscillator in thermostat can be received by dint of averaging of micro-parameters on a complex wave function, dependent on temperature. As an essentially new micro-parameter of the theory is determined operator of stochastic influence. The module of the operator average value has a sense of a new macro- parameter – the effective influence. At low temperatures it comes nearer to half of the Planck constant. At any temperatures through the same macro-parameter it is possible to express effective temperature and effective entropy that provides a mutual coordination between the macro- and the micro-versions of the suggested theory. The consent of results between the given theory and experimental data is shown: at the limit of low temperatures the ratio "effective influence to effective entropy" is determined by the ratio of the constants of Planck and Boltzmann. It differs from zero result predicted by the standard statistical mechanics.