THERMODYNAMIC FRAMEWORK FOR THE GROUND STATE OF A SIMPLE QUANTUM SYSTEM

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The ground state of a two-level system (associated with probabilities p and $1-p$, respectively) defined by a general Hamiltonian $H=H_c+V$ is studied. The simple case characterized by $V=0$, whose Hamiltonian H_0 is represented by a diagonal matrix, is well established and solvable within Boltzmann-Gibbs(BG) statistical mechanics; in particular, it follows the third law of thermodynamics, presenting zero entropy ($S_{BG}=0$) at zero temperature ($T=0$). Herein it is shown that the introduction of V in the Hamiltonian may lead to a nontrivial ground state, characterized by an entropy S (with S different from S_{BG}). It allows for the introduction of an effective temperature which is shown to be a parameter conjugated to the entropy S. Based on this, one introduces an infinitesimal heatlike quantity, leading to a consistent thermodynamic framework, and by proposing an infinitesimal form for the first law, a Carnot cycle and thermodynamic potentials are obtained. All results found are very similar to those of usual thermodynamics.