物理科学セミナー

A brief introduction to generalized statistical mechanics

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終了後、講師を交えての懇親会を予定しています。

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Abstract

In this talk I will focus on statistical mechanics based on generalized entropies. Recently new entropic measures were proposed by generalizing the functional form of the well known Boltzmann-Gibbs entropy. I will list the various generalized entropies and establish that they satisfy the Shannon-Kinchin axioms. Then I consider a particular generalized entropy, the Tsallis q-entropy and analyze its properties.

The statistical formulation based on Tsallis entropy is derived for both the isothermal and the adiabatic class of ensembles. The probability distribution in the isothermal class can be obtained by optimizing the entropy in three different ways. I will discuss these different methods and explain briefly the method which is being used currently. I will also discuss the perturbative method which was developed to study systems which could not be computed exactly.

As application to specific systems we discuss a system of N-rigid rotators, diatomic molecules and long-range interacting spin systems. The specific heat of a system of N-rigid rotators is studied both in the high and the low temperature limit. In the case of diatomic molecules with both translational and rotational degrees of freedom, we show that there is an inherent mixing between these degrees of freedom due to nonextensivity. Then we examine a system of non-interacting spins and show that the Curie constant depends on the nonextensive parameter q. The model exhibits the phenomenon of dark magnetism in which the effective number of spins is different from the actual number of spins. Finally we analyze a system of interacting spins using a mean field model in which the effective field coefficient is temperature dependent. The generalized form of the Curie-Weiss law is derived. The critical indices do not change with the introduction of Tsallis q-statistics, but the critical temperature and the Curie-Weiss constant depends on the entropic deformation parameter.