An application of geometrization in generalized statistical mechanics

M. Portesi[1], Y. Alvarez[2]

[1]Instituto de Fisica La Plata (CONICET) and Dpto de Fisica (UNLP), La Plata, Argentina

[2]Dpto de Fisica, Fac de Ciencias Exactas, Universidad Nacional de La Plata, Argentina

Geometrical aspects of the space of parameters for a physical system are discussed within the framework of a nonextensive statistical setting. For this purpose, generalized quantities are employed, based on general measures of information gain. The overall scenario is provided by a combination of differential geometry and information theory. Indeed, as geometry studies mutual relations between elements such as distance and curvature, it provides the information sciences with powerful tools. Information geometric methods allow for the study of physical systems that undergo a phase transition, where the formalism gives a characterization of critical phenomena from a geometrical point of view. The mechanism is to generate a distance in the space of thermodynamic parameters of the problem, and to study its variation in order to detect critical behavior which reveals in the metric tensor and the scalar curvature of the thermodynamic manifold. Generalized entropic measures of information can be used for this purpose. Previous studies comprise applications to noninteracting as well as interacting systems, like fluid and spin systems. It is seen that the scalar curvature measures interatomic interactions, acquainting for the size of organized fluctuating microscopic structures, and even indicating whether the interactions are effectively attractive or repulsive. Here we consider the geometrization of thermostatistics for systems of interest as is the case of type-II superconductors, for which the best description involves a mixing of nonextensive entropies with different entropic indices. The thermodynamic parameters that control the behavior of the system are taken as the temperature and external magnetic fields. The solution of the physical problem under study can be given in terms of a probability distribution which can be obtained from maximization of generalized nonextensive entropic forms. In terms of those thermodynamic parameters, the geometric magnitudes of the statistical manifold are analyzed.

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