Contribution ID: **7**

Type: **Poster**

Nonextensive thermodynamics for hadrons with finite chemical potentials

QCD at finite temperature has been usually studied within the standard Boltzmann-Gibbs statistics. One of the standard properties of this is that entropy is extensive, which means that for two systems A and B which are independent (in the sense that the probabilities of the states of A+B factorize into those of A and B), the entropy of the joint system S(A+B) is equal to the sum of the individual entropies S(A)+S(B). Very recently it has been shown that the thermodynamics of hadronic systems show some signals of non-extensivity, in particular recent LHC experiment have confirmed that the fireball description based on the BG thermodynamics cannot completely describe the experimental data for pt-distributions for several hadrons produced in p+p collisions, while the descriptions based on Tsallis statistics has been successful in describing the same data [1]. In the Tsallis formalism the entropy of the joint system is S(A+B) = S(A) + S(B) + (1-q) S(A) S(B), where q is a measuring of the degree of nonextensivity. Tsallis statistics is a generalization of the BG statistics [2].

In this work we derive the nonextensive thermodynamics of an ideal gas composed by bosons and/or fermions from its partition function for systems with finite chemical potentials [3]. It is shown that the thermodynamical quantities derived in the present work are in agreement with those obtained in previous works [4]. It is studied in details the chemical freeze-out transition line in the T-mu diagram of QCD, and the effect of non-extensivity on it.

We show that the nonextensive statistics provides a harder equation of state than that predicted by the Boltzmann-Gibbs statistics, i.e. higher values of the pressure for a given energy density. This fact induced us to apply this formalism to study the proto-neutron star stability by solving the Tolman-Oppenheimer-Volkoff (TOV) equations [5]. The most recent experimental measurements demand a larger value for the radius of neutron stars as compared to the prediction from current models, and this implies the need of a harder equation of state [6]. Our results based on a simple thermodynamical description of the neutron star matter within the non extensive statistics go in the right direction to explain star stability.

[1] J. Cleymans, G.I. Lykasov, A.S. Parvan, A.S. Sorin, O.V. Teryaev, Phys. Lett. B 723 (2013) 351-354.
[2] C. Tsallis, J. Stat. Phys. 52 (1988) 479.
[3] E. Megías, D.P. Menezes, A. Deppman, arXiv:1312.7134[hep-ph] (2013).
[4] J.M. Conroy, H.G. Miller and A.R. Plastino, Physics Letters A 374 (2010) 4581-4584.
[5] R.C. Tolman, Phys. Rev. 55, 364 (1939); J.R. Oppenheimer and G.M. Volkoff, Phys. Rev. 55, 374 (1939).
[6] J. Antoniadis et al, Science 26, 340 n. 6131 (2013).

Primary author: Dr MEGIAS, Eugenio (Universitat Autonoma de Barcelona)

Co-authors: Prof. DEPPMAN, Airton (University of São Paulo); Prof. MENEZES, Debora P. (Universidade Federal de Santa Catarina, Brazil)

Presenter: Dr MEGIAS, Eugenio (Universitat Autonoma de Barcelona)