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Pressure distribution of gluons inside the proton using Tsallis entropy within the MIT Bag Model

The non-extensive Tsallis statistics has been widely used to describe high energy data. This statistics was made as a generalization to Boltzmann statistics in order to benefit long-range-interacting many body Hamiltonian systems [1]. This formalism is based on the entropy S_q, the entropic index q measures the deviation respect to Bolztmann statistics. The success of Tsallis statistics to describe very well many transverse momentum distributions of heavy ion collisions has leaded to guess that there is a connection between the nonextensivity and the physics of the nuclear matter. Therefore, many researches are recently focusing on finding this connection, especially in the deconfinement of nuclear matter. On the other hand, few months ago it was published an article where V. D. Burkert, L. Elouadrhiri and F. X. Girod presented the pressure distribution inside the proton [2]. However, this pressure is only due to quarks, gluons are not considered. For that reason in this work we present a way to obtain the pressure distribution of gluons inside the proton considering the non-extensive Tsallis entropy within the MIT Bag Model as a consequence of the interaction between quarks and gluons. We also present and discuss the consequences of the non-extensivity in the phase diagram and the pressure curve as a function of temperature and the q parameter. While there is a binding pressure of gluons at distances near the centre of the proton, there is a repulsive pressure at greater distances. The quark pressure is slightly more dominant than the gluon pressure at distances near the centre of the proton. However, at greater distances the gluon pressure is more dominant.

[1] C. Tsallis, Introduction to nonextensive statistical mechanics: Approaching a complex world, Springer, New York, (2009).
[2] V. D. Burkert, L. Elouadrhiri and F. X. Girod, The pressure distribution inside the proton, Nature, 557 (2018) 396-399.

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