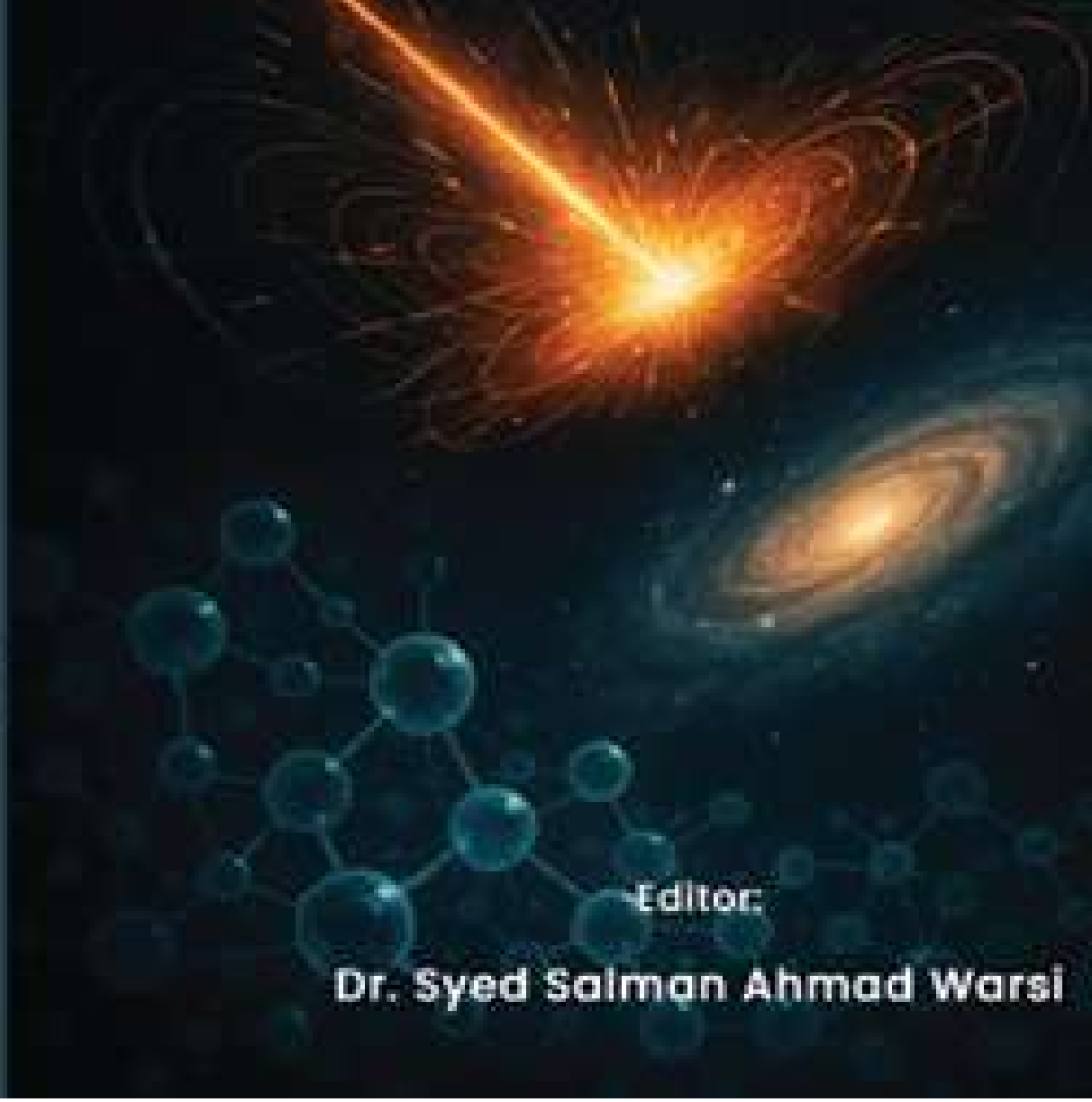
ADVANCES IN CONTEMPORARY PHYSICS

HIGH-ENERGY, COSMOLOGY, AND SOFT MATTER



Editor:
Dr. Syed Salman Ahmad Warsi

ADVANCES IN CONTEMPORARY PHYSICS: HIGH-ENERGY, COSMOLOGY, AND SOFT MATTER

Advances In Contemporary Physics

High-Energy, Cosmology, and Soft Matter

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NON-EXTENSIVE STATISTICAL MECHANICS: INTRODUCTION AND ITS APPLICATION IN HEAVY-ION PHYSICS

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This chapter presents an introduction to the non-extensive statistical mechanics and its application in the high energy physics specially in the context of the matter created in the heavy ion collision experiments at RHIC (BNL) and LHC (CERN). The non-extensive Tsallis distribution function and the computation of various thermodynamical quantities in the non-extensive framework have been defined. The fitting of the hadron transverse momentum using the power law distribution has been explained. Apart from that some transport and screening properties of non-extensive quark gluon plasma have also been discussed.

INTRODUCTION:

A large number of particles are generated at the ultra-relativistic heavy ion collisions at RHIC and LHC which requires the use of statistical mechanics [1, 2]. It was found that use of statistical models to calculate the hadron multiplicities in pp collisions agreed very well with other approaches [3-5]. The study of this multi particle system created at ultra-relativistic collision is very active area of research in both nuclear as well as high energy physics. For that purpose perturbative quantum chromo-dynamics (QCD) is widely used. Due to the confinement the perturbative approach is not reliable at low temperatures and density. So non perturbative approaches like Lattice QCD, renormalization group approach etc are used. At finite temperature naive perturbation theory is broken so one needs to resume an infinite subset of diagrams which contribute to the lower order in coupling. Apart from that one gets gauge dependent damping rates for quarks and gluons. This problem was circumvented by a resummation program named HTL where effective propagators and vertices are used in place of the naive ones.

In most of the studies related to the quark gluon plasma or the hadronic systems the Boltzmann Gibbs version of the distribution functions have been extensively used. But it has been found that transverse momentum spectra of the hadrons follow Boltzmann distribution in hadronic collisions and this observation was pointed out by Hagedorn a long ago [7].

Now a days power law distribution have been widely applied in the physics of the heavy ion collisions [8-16] to describe the transverse momentum spectra of secondary particles produced in