Generalized statistical mechanics of high energy scattering processes

G.Cigdem Yalcin[1] and Christian Beck[2]

[1]Department of Physics, Faculty of Sciences, Istanbul University, 34134, Vezneciler, Istanbul, Turkey
[2]Queen Mary University of London, School of Mathematical Sciences, Mile End Road, London E14NS, UK
[1]gcyalcin@istanbul.edu.tr, [2]c.beck@qmul.ac.uk

Very recently we have applied q-generalized statistical mechanics methods to high energy scattering processes, which lie at the root of the production process of cosmic rays.

It is known that the Boltzmann-Gibbs formalism has severe restrictions: It is not valid for nonequilibrium systems, it is not valid for systems with long-range interactions (such as gravity), and it is not valid for systems with a very small volume and fluctuating temperature (as probed in scattering processes of cosmic ray particles at very high energies). For these types of complex systems it is useful to generalize the formalism to a more general setting, based on the maximization of more general entropy measures which contain the Shannon entropy as a special case.

In this talk we present how to apply these techniques borrowed from generalized statistical mechanics to analyse the AMS-02 (the Alpha Magnetic Spectrometer) data sets. To conclude, we have shown that the different energy dependences of the spectral indices of positron and electron cosmic rays are well explained by a q-generalized Hagedorn theory.

Also we compare our ongoing analysis for DAMPE (DArk Matter Particle Explore) and CALET (The CALorimetric Electron Telescope), showing that they may be good candidates to keep investigating high energy scattering processes by using generalized statistical mechanics.