Relative Pseudorapidity Density in Inelastic Proton-Proton Collisions

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Abstract: Here within the lacking part of ultimate theory, i.e. the Scale-Symmetric Theory, we calculated the relative pseudorapidity density in inelastic proton-proton collisions. The derived very simple formula is consistent with all experimental data.

1. Introduction

The General Relativity leads to the non-gravitating Higgs field composed of tachyons [1A]. On the other hand, the Scale-Symmetric Theory (SST), [1], shows that the succeeding phase transitions of such Higgs field lead to the different scales of sizes [1A]. Due to the saturation of interactions via the Higgs field and due to the law of conservation of the half-integral spin that is obligatory for all scales, there consequently appear the superluminal binary systems of closed strings (the entanglons) responsible for the quantum entanglement, stable neutrinos and luminal neutrino-antineutrino pairs which are the components of the luminal Einstein spacetime (it is the Planck scale), cores of baryons, and the cosmic structures that evolution leads to the dark matter, dark energy and expanding universes [1A], [1B]. Due to the symmetrical decays of bosons of the equator of the core of baryons, there appears the atom-like structure of baryons that follows from the Titius-Bode orbits for the nuclear strong interactions [1A].

Within such a theory we derived the very simple formula for the pseudorapidity density in inelastic proton-proton collisions [1A]

$$x = (0.37434 \cdot E)^{1/4}, \quad (1)$$

where $E = sqrt(s_{NN})$ is in TeV.

2. Calculations

We can write formula (1) for $E = sqrt(s_{NN}) = 0.2$ TeV

$$y = (0.37434 \cdot 0.2)^{1/4}. \quad (2)$$

Now we can calculate the relative pseudorapidity density $X = x / y$

$$X = x / y = (E\,[\mathrm{TeV}] / 0.2)^{1/4}. \qquad (3)$$

It is the relative charged-particle pseudorapidity density in relation to the pseudorapidity density at 0.2 TeV for the inelastic proton-proton collisions. Formula (3) is consistent with all experimental data presented here [2], even at low $sqrt(s_{NN})$ (see the lowest curve and the associated experimental data in Fig.2, page 6). Calculate a few results applying formula (3) (there is a 5% uncertainty for the experimental pseudorapidity density ratios [3])

For $E = sqrt(s_{NN}) = 0.02$ TeV we obtain $X = 0.56$. This result is consistent with the data obtained in the NA35 experiment.

For $E = sqrt(s_{NN}) = 2.76$ TeV we obtain $X = 1.93$. This result is consistent with the data obtained in the ALICE experiment.

For $E = sqrt(s_{NN}) = 5.02$ TeV we obtain $X = 2.24$. This result is consistent with the data obtained in the ALICE experiment.

References

[1] Sylwester Kornowski (2015). *Scale-Symmetric Theory*
[1A]: http://vixra.org/abs/1511.0188 (Particle Physics)
[1B]: http://vixra.org/abs/1511.0223 (Cosmology)
[1C]: http://vixra.org/abs/1511.0284 (Chaos Theory)
[1D]: http://vixra.org/abs/1512.0020 (Reformulated QCD)

[2] ALICE Collaboration (12 October 2012). “Pseudorapidity density of charged particles in p-Pb collisions at sqrt(sNN) = 5.02 TeV”
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[3] BRAHMS Collaboration: I. Arsene, et al. (21 January 2004). “Centrality dependence of charged-particle pseudorapidity distributions from d+Au collisions at sqrt(s_{NN})=200 GeV”
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