GLUON CORRELATION MOMENTS RATIO IN THE INSTANTON FIELD

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The instanton-induced multiple events in high energy collisions are considered in nonperturbative quantum chromodynamics (QCD). Here we obtained unusual behaviour of ratio of correlation moments H_q for such processes which can be used for experimental search of instantons.

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As it is known, Yang–Mills gauge theories have highly degenerated vacuum structure on the classical level [1]. Quantum tunnelling transitions between different vacuum states are associated with instantons [2].

Experimental search of the QCD-instantons goes already at HERA (DESY, Hamburg) in electron–proton deep inelastic scattering [3]. There are following theoretically predicted features of instanton canal of multiple production: high parton multiplicity (about $10 \div 20$ at HERA [3,4]); isotropic parton distribution in the instanton rest system and homogeneous quarks flavours distribution [5]; specific behaviour of total cross section [4] and two-particle correlation function [6].

Here we study the behaviour of ratio of correlation moments $H_q = K_q/F_q$ [7] as the new criterions of instanton identification. Here F_q, K_q and H_q are factorial, cumulant and co-called H_q-moments correspondingly. Correlation moments ratio H_q is *more precise* quantity for distinguishing of multiplicity distribution [7].

In quasiclassical approximation Poisson distribution for the probability of n gluon production was obtained for the instanton-induced multigluon final states [3,8]. In this case we have the trivial results: $G(z) = \mathrm{e}^{A[z-1]}$, $F_q = 1$, $K_q = \delta_{q1}$, $H_1 = \delta_{q1}$.

Taking into account first quantum correction we obtain the following formula for the generating function takes place [6]:

$$G(z) \equiv \sum_{n=0}^{\infty} P_n z^n = \mathrm{e}^{A[z-1]} \frac{1+Bz^2}{1+B}, \quad A = \frac{4\pi}{\alpha_0}\left(\frac{1-x'}{x'}\right)^2,$$
$$B = -\frac{2\pi}{\alpha_0}\left(\frac{1-x'}{x'}\right)^3, \quad x' \sim 0.5 \div 1. \qquad (1)$$

where coupling constant of strong interaction $\alpha_0 = \alpha(\rho_{\mathrm{cut}})$, ρ_{cut} is instanton size cut off, x' — Bjorken variable of parton–parton collisions.

By straight calculation we obtain H_q moments behaviour as a function on q (Fig. 1). H_q-moments are negative, have first minimum at $q = 2$. Such dependence of H_q on their rank q may be new criterion of identification of instantons at experiment.

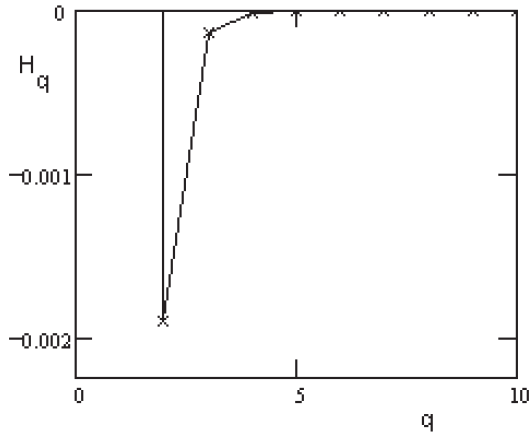

Fig. 1. H_q as the functions of its rank

The reason is unusual and specific position of the first minimum for this nonperturbative process, which does not move by the next quantum corrections in chosen interval of variables as estimations show. Perturbative QCD calculations confirmed by experimental data for ordinary multiple production of different types give the first minimum at $q = 5$. Such clear distinction of perturbative and nonperturbative calculations is of principle both from experimental and theatrical point of view.

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