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LARGE P_T INCLUSIVE DISTRIBUTIONS IN COMPOSITE MODELS

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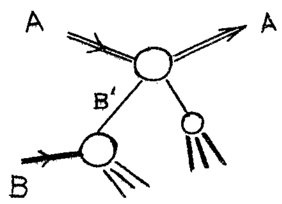
In the paper by A.N.Kvinikhudze,A.N.Sissakian, L.A.Slepchenko,and A.N.Tavkhelidze contributed to the Conference [I], in the framework of three-dimensional formulation of quantum field theory of composite systems the general representation for a production distribution was obtained, which depends crucially on the properties of the constituent quark wave functions and their interaction amplitudes[2,3].

For hadron production at high P_T in the null-plane formalism this approach gives a possibility to estimate the relative importance of the different approximations made in the quark-parton picture [4], and to obtain the distributions for the single-particle, single-jet and two-jet production.

The application of the automodelity principle and quark counting rules[5,6] for the e.m.form factors and exclusive differential cross-sections leads to the quark counting rules for the high P_T hadronic distributions which agree with the results of CIM[7].

Here we list briefly some applications of this approach and we restrict ourselves to the two aspects of the high P_T phenomena: leading particle mechanism and interaction of jets.

i. In case of leading particle production with large transverse momentum, the corresponding single-particle distribution can be represented in the form:



$$\frac{d\sigma^{AB\to A}}{d^3p|E} = \frac{I}{8\pi^2}\sum_b \int dy\, \rho_B^b(y)\, \delta(t+(s+u)y)\cdot$$
$$\cdot\Big|\sum_a \int S_a^{(n)}(x,(I-x)\cdot\Delta)\frac{dx}{x} T_{ab}^{(2)}(s',t')\Big|^2 \qquad (I)$$

where $\sum_a e_a \int S_a(x'(I-x)\Delta)dx = eF_A(t), |t| = \Delta^2$ and $F_A(t)$ is the e.m. form factor.

In general the quantity $S_a(x'(I-x)\Delta_T)$ describes the effects of longitudinal motion[8,9] of the constituent particles(quarks or partons) inside the hadron. In the "static" limit ($x_a \to \mu_a$, μ_a - reduced mass) we have $\sum_a S_a(x,(I-x)\cdot\Delta_T) \to \delta(x-\bar{x})F_A(\Delta_T^2)$ and the leading particle distribution at high P_T reduces to the product of deep-inelastic cross section and the square of e.m. form factor of a beam particle.

$$\frac{d\sigma^{AB\to A}}{d^3p|E} \Rightarrow \sum_{ab}\frac{F_A^2(t)}{x}\left(\cdot\frac{d\sigma^{aB\to ax}}{d^3p|E} = \right.$$
$$\left. = \sum_b \rho_B^b(x)\frac{d\sigma^{ab\to ab}}{dt'}(s',t',u')\right) \qquad (2)$$

where $x = -\dfrac{t}{\mathcal{M}^2 - t}$, $s+t+u \cong \mathcal{M}^2$.

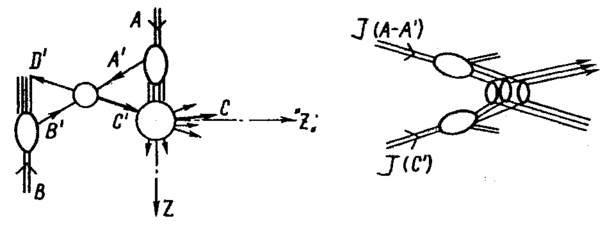
Applying the quark counting rules[6] for the e.m. form factors and differential exclusive cross sections for the different allowed subprocesses we receive the values of the power law exponent in accordance with the experimental data on $Ap \to A+x$ ($A=\pi,p$) and the corresponding exclusive limiting ($x_T=I$) values $\frac{d\sigma}{dt}(\pi p\to\pi p)$ s^{-8}, $\frac{d\sigma}{dt}(pp\to pp)$ s^{-10}, respectively.

The second point we would like to stress here is that for the π-meson production in pp-and πp-collision in addition to the standard central production contribution[7,1] $p_T^{-8}(1-x_T)^9$, this mechanism (2) gives a significant contribution $p_T^{-8}(1-x_T)^7$ to the second (Leading) reaction. Thus, for the same p_T power law the ratio is $R(\frac{pp\to\pi}{\pi\to\pi}) \sim (1-x_T)^2$ which is close to the experimental estimates $F_p - F_\pi = 1.6 \pm 0.5$ [10], and for which the quark fusion mechanism gives too small value of magnitude[11].

ii. Recent experimental data on the high p_T hadron production indicate that the final state events in these processes reveal many interesting features of two-jet structure. Qualitative analysis of these data are extensively discussed in the current theoretical works[13].

Now we draw attention to the problem of interaction between jets produced in the high p_T experiments(one-along the beam axis,the other-perpendicular to it). Note in this connection the experimental evidence[14] in particle production on nuclear targets, that can be of great importance in the interaction with nuclei in the high p_T region multiple scattering effects.

Thus, if we describe the high p_T particle production from the two interacting jets in a manner analogous to the usual treatment of nuclear target effects - the problem is reduced to a small angle(fixed t) collision problem in some rotated frame (see also [15]).



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Viewed in this, a new frame interaction of two jets can be considered as a coherent process where the multiple rescattering may play a significant role. In the framework of this approach the eikonal solution was obtained which takes into account the longitudinal motion of constituents and their rescattering effects[8,9]. In case of the jet distribution the rising rate of the associated jet multiplicity along and opposite the direction of the trigger particle was estimated[9]. In particular,in some restricted kinematical regions the linear growth $\overline{n}(p_T) \sim p_T$ was obtained which is natural for the coherent and SLPA model considerations[16]. In addition to the logarithmic p_T- dependence of $\overline{n}^{\,assoc}(p_T)$ resulting from the parton and bremsstrahlung model calculations[4,17], this contribution can be considered as one part of the two-component description of the average multiplicities[18] in accordance with the 3-component structure of final events[12] in the high p_T experiments. The study of the atomic number dependence of the large p_T hadronic inclusive spectra is of a special interest.

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DYNAMICS OF HIGH MOMENTUM TRANSFER PROCESSES

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Our understanding of this phenomena is based on Field Theory of Quarks interacting through scalar (or pseudoscalar) gluons /1/. It allows one to unify partonology and Quark Counting Power (QCP) rule from one side and reggeology from the other, to understand early scaling in leptohadronic processes and late scaling on p_T in high p_T inclusive hadroproduction.

This approach is based on an algorithm involving the consideration of Feynman diagram asymptotical behaviour and its summation.

TECHNICS: Contribution of any diagram for a given process can be written in α-representation as

$$T \sim \int_c^{i\infty} \frac{\prod d\alpha}{D^2(\alpha)} G(\alpha, m, p_i) e^{\left[\frac{Q(\alpha, p_i)}{D(\alpha)} - \sum_\sigma \alpha_\sigma (m_\sigma^2 - i\varepsilon)\right]}$$

Each integration can be split into a scale part $|\alpha| < \Lambda^{-1} \ll 1/m^2$ and nonscale part $|\alpha| > \Lambda^{-1}$. Scale regime (SR) of a block V is composed by those terms of contribution in which all $\alpha(\in V) < \Lambda^{-1}$. Note that $\alpha \to 0$ means topologically the contraction of corresponding line into a point.

These are "rules of the game" which are proved for each diagram of perturbation expansion in Euclidean region:

Rule I. SR of V determines the asymptotics with respect to those variables which are "killed" by contraction of V into a point.

Figs. 1a,b,d,e,2a,c,3a,c,b,d,e illustrate the connection of different kinematical regions of different processes and small-distance SR blocks V.

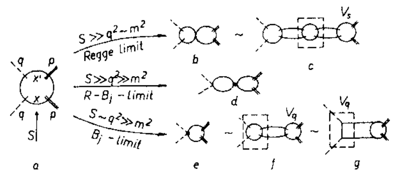

Fig. 1