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DIQUARKS AND NUCLEON STRUCTURE FUNCTIONS

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1. INTRODUCTION

The present paper is a sequel to works [1-4], and it is devoted to the description of the deep-inelastic scattering of leptons on nucleons in the single-term formulation of quantum field theory [5-7]. For this purpose we will use the covariant three-dimensional equations for the wave functions of relativistic two-particle systems, which coincide in form with equations obtained in the covariant Hamilton formulation of quantum field theory [8]. We will restrict ourselves to a model of the nucleon as a bound state of the quark with spin 1/2 and diquark with spin 0 or 1. Let us note that such a "two-particle" model of the nucleon was already considered in a number of works (see, e.g., ref. [9]), and it has become popular in the last time in view of a discussion of the contribution of power $1/Q^2$ -terms to the scaling violation observed experimentally.

Elements of the method of the description of deep-inelastic scattering in the framework of the single-time approach were formulated in ref. [10] and developed in refs. [11,1-4] (for a detailed list of references on this question see refs. [illegible]).

The aim of this work is to obtain formulae for the nucleon structure functions through solutions of the covariant three-dimensional equations for the wave functions of a quark-diquark system. In the next section we shall list basic formulae of the covariant single-time approach, which will be used in the third section for obtaining formulae for the structure functions.

2. THE COVARIANT THREE-DIMENSIONAL EQUATION FOR A QUARK-DIQUARK SYSTEM

The Bethe-Salpeter wave function (WF) for a quark-diquark system can be defined in the form

$$\Psi^{(0)a}_{M\vec{K}s_N\tau_N}(x_1,x_2)=\langle 0|T\{\psi^a(x_1)\phi(x_2)\}|M,\vec{K},s_N,\tau_N\rangle, \tag{2.1}$$

$$\Psi^{(1)a\mu}_{M\vec{K}s_N\tau_N}(x_1,x_2)=\langle 0|T\{\psi^a(x_1)D^\mu(x_2)\}|M,\vec{K},s_N,\tau_N\rangle. \tag{2.2}$$

Here $\Psi^{(0)}$ is the WF of the system composed of the quark with spin 1/2 (the Dirac field operator $\psi^{a}(x_1)$ corresponds to it) and diquark with spin 0 described by the scalar field operator $\phi(x_2)$ (in the Heisenberg representation) and $\Psi^{(1)}$ is the WF of the system that contains the diquark with spin 1 described by the vector field operator $D^{\mu}(x_2)$. The state vector $|M,\vec{K},s_N,\tau_N>$ is characterized by the mass M and momentum $\vec{K}$ of the bound state, nucleon or its resonance and s_N and τ_N are its spin and projection of the spin. The transition from the WF (2.1), (2.2) to the covariantly defined single-time WF is carried out as follows /7/

$$\tilde{\Psi}^{(i)}_{M\vec{K}s_N\tau_N}(p_1,p_2)=\int\int d^4x_1\cdot d^4x_2\cdot\exp(ip_1x_1+ip_2x_2)\cdot \tag{2.3}$$

$$\times\delta[\lambda_P(x_1-x_2)]\cdot\Psi^{(i)}_{M\vec{K}s_N\tau_N}(x_1,x_2),\quad i=0,1.$$

Here $\lambda^{\mu}_{P}\equiv P^{\mu}/\sqrt{P^2}$ is a four-vector of the system velocity ($P=p_1+p_2$). The covariant equating of times in (2.3) is achieved by the δ-function: the quark proper time $\tau_1=\lambda_P x_1$ coincides with the diquark proper time $\tau_2=\lambda_P x_2$ and with the system proper time $\tau=\lambda_P X$, where $X=(x_1+x_2)/2$. Upon performing the time equating, the symbol of T-product in (2.3) can be dropped and the vectors $\vec{p}_1$, $\vec{p}_2$ can be considered as belonging to the mass hyperboloids

$$p_1^{\circ 2}-\vec{p}_1^{\,2}=m_1^2, \tag{2.4}$$

$$p_2^{\circ 2}-\vec{p}_2^{\,2}=m_2^2. \tag{2.5}$$

One can separate the motion of the mass centre in the WF (2.3) due to the transitional invariance:

$$\tilde{\Psi}^{(i)}_{M\vec{K}s_N\tau_N}(p_1,p_2)=(2\pi)^4\,\delta^{(4)}(P-K)\cdot\tilde{\Psi}^{(i)}_{M\vec{K}s_N\tau_N}(p). \tag{2.6}$$

In view of the transformation properties of the field operator the WF of the particle relative motion can be represented in the form

$$\tilde{\Psi}^{(i)}_{M\vec{K}s_N\tau_N}(p)=S_1(L_K)\cdot S_2^{(i)}(L_K)\cdot\int d^3x'\cdot\exp(-i\vec{\Delta}_{p_1,m_1\lambda_P}\cdot\vec{x}')\times \tag{2.7}$$

$$\times\Psi^{(i)}_{M\vec{0}s_N\tau_N}(\vec{x}'),$$

where

$$\Psi^{(0)a}_{M\vec{0}s_N\tau_N}(\vec{x})=<0|\psi^{a}(0,\frac{\vec{x}}{2})\phi(0,-\frac{\vec{x}}{2})|M,\vec{0},s_N,\tau_N>, \tag{2.8}$$

$$\Psi^{(1)a\mu}_{M\vec{0}s_N\tau_N}(\vec{x})=<0|\psi^{a}(0,\frac{\vec{x}}{2})D^{\mu}(0,-\frac{\vec{x}}{2})|M,\vec{0},s_N,\tau_N>, \tag{2.9}$$

and S_1 and $S_2^{(i)}$ are matrices of finite-dimensional representations of the Lorentz group: S_1 corresponds to a spinor field and $S_2^{(i)}$ corresponds to a vector field for $i=1$ and $S_2^{(i)}=1$ for $i=0$. From (2.7) it follows that the relative motion WF depends on the three-dimensional vector $\vec{\Delta}_{p_1,m_1\lambda_P}$ only (see ref. /12/):

$$\tilde{\Psi}^{(i)}_{M\vec{K}s_N\tau_N}(p)=\tilde{\Psi}^{(i)}_{M\vec{K}s_N\tau_N}(\vec{\Delta}_{p_1,m_1\lambda_P}). \tag{2.10}$$

This vector has the meaning of the covariantly defined momentum of the first particle /13/

$$\vec{\Delta}_{p_1,m_1\lambda_P}\equiv(\overrightarrow{L^{-1}_{\lambda_P}\,p_1})=\vec{p}_1-\frac{\vec{P}}{M}(p_1^{\circ}-\frac{\vec{P}\vec{p}_1}{P^{\circ}+M}). \tag{2.11}$$

Analogously, for the second particle we have

$$\vec{\Delta}_{p_2,m_2\lambda_P}\equiv(\overrightarrow{L^{-1}_{\lambda_P}\,p_2})=\vec{p}_2-\frac{\vec{P}}{M}(p_2^{\circ}-\frac{\vec{P}\vec{p}_2}{P^{\circ}+M}).$$

It is easy to check that $\vec{\Delta}_{p_1,m_1\lambda_P}=-\vec{\Delta}_{p_2,m_2\lambda_P}$. Hence one may consider a single vector $\vec{\Delta}_{p,\lambda_P}\equiv\vec{\Delta}_{p_1,m_1\lambda_P}=-\vec{\Delta}_{p_2,m_2\lambda_P}$. The vector $\vec{\Delta}_{p,\lambda_P}$ can be treated as a spatial component of the four-vector $\Delta^{\mu}_{p,\lambda_P}\equiv(L^{-1}_{\lambda_P}p)^{\mu}$. The time component of the vector $\Delta^{\mu}_{p,\lambda_P}$ has the form

$$\Delta^{\circ}_{p,\lambda_P}\equiv(L^{-1}_{\lambda_P}p)^{\circ}=\lambda^{\mu}_{P}p_{\mu}=P^{\mu}p_{\mu}/M. \tag{2.12}$$

The upper sheets of hyperboloids (2.4), (2.5) are known to be the momentum spaces with the Lobachevsky geometry. Under the transformation L

$$p_j\to p_j'=Lp_j,\quad j=1,2;\quad P\to P'=LP$$

from the Lorentz group (that is a group of motions of the Lobachevsky space) components of the four-vectors $\Delta^{\mu}_{p_1,m_1\lambda_P}$, $\Delta^{\mu}_{p_2,m_2\lambda_P}$ transform as follows

$$(\vec{\Delta}_{p_j',m_j\lambda_P'})_k=R_{k\ell}\{V^{-1}(L^{-1},P)\}(\vec{\Delta}_{p_j,m_j\lambda_P})_\ell,\quad k,\ell=1,2,3$$

$$\Delta^{\circ}_{p_j',m_j\lambda_P'}\equiv P'^{\mu}p'_{\mu}=P^{\mu}p_{\mu}\equiv\Delta^{\circ}_{p_j,m_j\lambda_P},$$

where the matrix R describes the Wigner rotations.

Let us define the two-time Green function of the quark-diquark system in analogy with (2.1)-(2.3)

$$(2\pi)^4\cdot\delta^{(4)}(P-K)\cdot\tilde{G}^{(i)}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_K};P^2)=$$

$$=\int d^4x_1 d^4x_2 d^4y_1 d^4y_2 \exp(ip_1x_1+ip_2x_2-ik_1y_1-ik_2y_2)\times \tag{2.13}$$

$$\times\delta[\lambda_P(x_1-x_2)]\cdot\delta[\lambda_K(y_1-y_2)]\cdot G^{(i)}(x_1,x_2;y_1,y_2),$$

where

$$G^{(0)\alpha_1\alpha_2}(x_1,x_2;y_1,y_2)=\langle 0|T\{\psi^{\alpha_1}(x_1)\phi(x_2)\bar{\phi}(y_2)\bar{\psi}^{\alpha_2}(y_1)\}|0\rangle,$$

$$G^{(1)\alpha_1\mu_1\alpha_2\mu_2}(x_1,x_2;y_1,y_2)= \tag{2.14}$$

$$=\langle 0|T\{\psi^{\alpha_1}(x_1)D^{\mu_1}(x_2)\bar{D}^{\mu_2}(y_2)\bar{\psi}^{\alpha_2}(y_1)\}|0\rangle.$$

With the use of the representation of the T-product through the θ-functions a spectral representation for $\tilde{G}^{(i)}$ can be obtained. From it the following expression for the Green function near the bound-state pole with $\sqrt{P^2}=M$ follows (see ref.[7]):

$$\tilde{G}^{(i)}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)= \tag{2.15}$$

$$=\frac{i(2\pi)^3}{2M}\cdot\frac{\tilde{\Psi}^{(i)}_{M\vec{K}s_N\tau_N}(\vec{\Delta}_{p,\lambda_P})\otimes\bar{\tilde{\Psi}}^{(i)}_{M\vec{K}s_N\tau_N}(\vec{\Delta}_{k,\lambda_P})}{\sqrt{P^2}-M+i\epsilon}.$$

In anylogy with ref.[7] let us introduce the following WF and Green functions projected onto the subspaces of states with a positive energy:

$$\phi^{(0)}_{s_N\tau_N;\sigma}(\vec{\Delta}_{p,\lambda_P})=\frac{\Delta^\circ_{p,\lambda_P}}{m_1}\bar{u}_\alpha(\vec{\Delta}_{p_1,\lambda_P};\sigma)\cdot\tilde{\Psi}^{(0)\alpha}_{M\vec{K}s_N\tau_N}(\vec{\Delta}_{p,\lambda_P}),$$

$$\phi^{(1)}_{s_N\tau_N;\sigma\lambda}(\vec{\Delta}_{p,\lambda_P})=\frac{\Delta^\circ_{p,\lambda_P}}{m_1}\bar{u}_\alpha(\vec{\Delta}_{p_1,\lambda_P};\sigma)\cdot\bar{\epsilon}_\mu(\vec{\Delta}_{p_2,\lambda_P};\lambda)\times \tag{2.16}$$

$$\times\tilde{\Psi}^{(1)\alpha\mu}_{M\vec{K}s_N\tau_N}(\vec{\Delta}_{p,\lambda_P});$$

$$\mathcal{G}^{(0)}_{\sigma_1\sigma_2}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)=\frac{1}{4m_1^2}\bar{u}_{\alpha_1}(\vec{\Delta}_{p_1,\lambda_P};\sigma_1)\times$$

$$\times\tilde{G}^{(0)\alpha_1\alpha_2}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)u_{\alpha_2}(\vec{\Delta}_{k_1,\lambda_P};\sigma_2);$$

$$\mathcal{G}^{(1)}_{\sigma_1\lambda_1\sigma_2\lambda_2}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)=\frac{1}{4m_1^2}\bar{u}_{\alpha_1}(\vec{\Delta}_{p_1,\lambda_P};\sigma_1)\times \tag{2.17}$$

$$\times\bar{\epsilon}_{\mu_1}(\vec{\Delta}_{p_2,\lambda_P};\lambda_1)\tilde{G}^{(1)\alpha_1\mu_1\alpha_2\mu_2}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)\times$$

$$\times u_{\alpha_2}(\vec{\Delta}_{k_1,\lambda_P};\sigma_2)\cdot\epsilon_{\mu_2}(\vec{\Delta}_{k_2,\lambda_P};\lambda_2).$$

The bispinors u_α of free quarks with the mass m_1 are normalized by the condition

$$\bar{u}_\alpha(\vec{p},\sigma)u^\alpha(\vec{p},\sigma')=2m_1\cdot\delta_{\sigma\sigma'},$$

and the polarization vectors ϵ_μ of free vector diquarks with the mass m_2 are normalized by the condition

$$\bar{\epsilon}_\mu(\vec{k},\lambda)\cdot\epsilon^\mu(\vec{k},\lambda')=\delta_{\lambda\lambda'}.$$

For the free Green function (2.17) (i.e., in the case of free quarks and diquarks) we have

$$\mathcal{G}^{(0)}_{0\sigma_1\sigma_2}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)=\delta_{\sigma_1\sigma_2}\cdot\mathcal{G}_0(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2),$$

$$\mathcal{G}^{(1)}_{0\sigma_1\lambda_1\sigma_2\lambda_2}(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)=\delta_{\sigma_1\sigma_2}\cdot\delta_{\lambda_1\lambda_2}\times \tag{2.18}$$

$$\times\mathcal{G}_0(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2),$$

where

$$\mathcal{G}_0(\vec{\Delta}_{p,\lambda_P};\vec{\Delta}_{k,\lambda_P};P^2)=i(2\pi)^3(2\Delta^\circ_{p,m_1\lambda_P}\cdot 2\Delta^\circ_{p,m_2\lambda_P})^{-2}\times \tag{2.19}$$

$$\times\delta(\vec{\Delta}_{p,\lambda_P}-\vec{\Delta}_{k,\lambda_P})(M-\Delta^\circ_{k,m_1\lambda_P}-\Delta^\circ_{k,m_2\lambda_P}+i\epsilon)^{-1},$$

and

$$\Delta^{\circ}_{p,m_j\lambda_P} \equiv \sqrt{m_j^2 + \vec{\Delta}^2_{p,\lambda_P}}, \quad \Delta^{\circ}_{k,m_j\lambda_P} \equiv \sqrt{m_j^2 + \vec{\Delta}^2_{k,\lambda_P}} \tag{2.20}$$

Let us introduce the operators of the quasipotential [5] by the relation

$$-i(2\pi)^6 (2\Delta^{\circ}_{p,m_1\lambda_P} \cdot 2\Delta^{\circ}_{k,m_1\lambda_P}) V^{(i)} (\vec{\Delta}_{p,\lambda_P}; \vec{\Delta}_{k,\lambda_P}; P^2) = \tag{2.21}$$

$$= [\mathcal{G}_0^{(i)}]^{-1} (\vec{\Delta}_{p,\lambda_P}; \vec{\Delta}_{k,\lambda_P}; P^2) - [\mathcal{G}^{(i)}]^{-1} (\vec{\Delta}_{p,\lambda_P}; \vec{\Delta}_{k,\lambda_P}; P^2).$$

With the help of (2.15)-(2.17) it is easy to obtain the following equations for the WF $\phi^{(i)}$:

$$2\Delta^{\circ}_{p,m_2\lambda_P}(M - \Delta^{\circ}_{p,m_1\lambda_P} - \Delta^{\circ}_{p,m_2\lambda_P}) \cdot \phi^{(0)}_{s_N\tau_N;\sigma}(\vec{\Delta}_{p,\lambda_P}) =$$

$$= \frac{1}{(2\pi)^3} \int \frac{d^3\vec{\Delta}_{k,\lambda_P}}{2\Delta^{\circ}_{k,m_1\lambda_P}} V^{(0)\sigma'}_{\sigma} (\vec{\Delta}_{p,\lambda_P}; \vec{\Delta}_{k,\lambda_P}; P^2) \phi^{(0)}_{s_N\tau_N;\sigma'}(\vec{\Delta}_{k,\lambda_P}), \tag{2.22}$$

$$2\Delta^{\circ}_{p,m_2\lambda_P}(M - \Delta^{\circ}_{p,m_1\lambda_P} - \Delta^{\circ}_{p,m_2\lambda_P}) \cdot \phi^{(1)}_{s_N\tau_N;\sigma\lambda}(\vec{\Delta}_{p,\lambda_P}) =$$

$$= \frac{1}{(2\pi)^3} \int \frac{d^3\vec{\Delta}_{k,\lambda_P}}{2\Delta^{\circ}_{k,m_1\lambda_P}} V^{(1)\sigma'\lambda'}_{\sigma\lambda} (\vec{\Delta}_{p,\lambda_P}; \vec{\Delta}_{k,\lambda_P}; P^2) \cdot \phi^{(1)}_{s_N\tau_N;\sigma'\lambda'}(\vec{\Delta}_{k,\lambda_P}). \tag{2.23}$$

Following ref. [7] we find the normalization condition for the WF $\phi^{(i)}$ which in the case of the energy-independent quasipotential has the form:

$$\int \frac{d^3\vec{\Delta}_{p,\lambda_P}}{2\Delta^{\circ}_{p,m_1\lambda_P}} |\phi^{(i)}(\vec{\Delta}_{p,\lambda_P})|^2 \cdot 2\Delta^{\circ}_{p,m_1\lambda_P} = 2M. \tag{2.24}$$

Let us perform a "removing" of spins (see, e.g., ref. [13]). Namely, let us introduce the functions [14]

$$\phi^{(0)}_{s_N\tau_N;\sigma'_p}(\vec{\Delta}_{k,\lambda_P}) = \sum_{\sigma'=-1/2}^{1/2} D^{1/2}_{\sigma'_p,\sigma} \{V^{-1}(L_{\vec{\Delta}_{p,\lambda_P}}; \vec{\Delta}_{k,\lambda_P})\} \times$$

$$\times \phi^{(0)}_{s_N\tau_N;\sigma'}(\vec{\Delta}_{k,\lambda_P}), \tag{2.25}$$

$$\phi^{(1)}_{s_N\tau_N;\sigma'_p\lambda'_p}(\vec{\Delta}_{k,\lambda_P}) = \sum_{\sigma'=-1/2}^{1/2} \sum_{\lambda'=-1}^{1} D^{1/2}_{\sigma'_p,\sigma} \{V^{-1}(L_{\vec{\Delta}_{p,\lambda_P}}; \vec{\Delta}_{k,\lambda_P})\} \times \tag{2.26}$$

$$\times D^1_{\lambda'_p,\lambda'} \{V^{-1}(L_{\vec{\Delta}_{p,\lambda_P}}; \vec{\Delta}_{k,\lambda_P})\} \cdot \phi^{(1)}_{s_N\tau_N;\sigma'\lambda'}(\vec{\Delta}_{k,\lambda_P}),$$

in which the spins $\sigma_p \equiv \sigma_{\vec{\Delta}_{p,\lambda_P}}$, $\lambda_p \equiv \lambda_{\vec{\Delta}_{p,\lambda_P}}$ are "sitting" on the momentum $\vec{\Delta}_{p,\lambda_P}$. Here $D^i\{V^{-1}\}$ are functions describing [13,14] the Wigner rotations. The quasipotentials in which all spins are "sitting" on the same momentum $\vec{\Delta}_{p,\lambda_P}$ are defined analogously. From (2.22), (2.23) it is easy to obtain the following equations for the WF (2.25), (2.26):

$$2\Delta^{\circ}_{p,m_2\lambda_P}(M - \Delta^{\circ}_{p,m_1\lambda_P} - \Delta^{\circ}_{p,m_2\lambda_P})\, \phi^{(0)}_{s_N\tau_N;\sigma}(\vec{\Delta}_{p,\lambda_P}) = \tag{2.27}$$

$$= \frac{1}{(2\pi)^3} \int \frac{d^3\vec{\Delta}_{k,\lambda_P}}{2\Delta^{\circ}_{k,m_1\lambda_P}} V^{(0)\sigma'_p}_{\sigma} (\vec{\Delta}_{p,\lambda_P}; \vec{\Delta}_{k,\lambda_P}; P^2) \cdot \phi^{(0)}_{s_N\tau_N;\sigma'_p}(\vec{\Delta}_{k,\lambda_P}),$$

$$2\Delta^{\circ}_{p,m_2\lambda_P}(M - \Delta^{\circ}_{p,m_1\lambda} - \Delta^{\circ}_{p,m_2\lambda_P})\, \phi^{(1)}_{s_N\tau_N;\sigma\lambda}(\vec{\Delta}_{p,\lambda_P}) =$$

$$= \frac{1}{(2\pi)^3} \int \frac{d^3\vec{\Delta}_{k,\lambda_P}}{2\Delta^{\circ}_{k,m_1\lambda_P}} V^{(1)\sigma'_p\lambda'_p}_{\sigma\lambda} (\vec{\Delta}_{p,\lambda_P}; \vec{\Delta}_{k,\lambda_P}; P^2) \times \tag{2.28}$$

$$\times \phi^{(1)}_{s_N\tau_N;\sigma'_p\lambda'_p}(\vec{\Delta}_{k,\lambda_P}).$$

Let us introduce the WF of the quark-diquark system with a definite total spin s and its projection σ:

$$\phi^{(0)}_{s_N\tau_N;s\tau}(\vec{\Delta}_{p,\lambda_P}) = \delta_{ss_N}\, \delta_{\tau\tau_N} \cdot \phi^{(0)}_{s_N\tau_N;\tau}(\vec{\Delta}_{p,\lambda_P}), \tag{2.29}$$

$$\phi^{(1)}_{s_N\tau_N;s\tau}(\vec{\Delta}_{p,\lambda_P}) = \sum_{\sigma,\lambda} \langle \tfrac{1}{2} 1; \sigma\lambda | s,\tau \rangle\, \phi^{(1)}_{s_N\tau_N;\sigma\lambda}(\vec{\Delta}_{p,\lambda_P}),$$

$$\phi^{(0)}_{s_N\tau_N;\,s\tau}(\vec{\Delta}_{k,\lambda_p}) = \delta_{ss_N}\,\delta_{\tau\tau_N}\cdot\delta_{\tau\sigma'_p}\cdot\phi^{(0)}_{s_N\tau_N;\,\sigma'_p}(\vec{\Delta}_{k,\lambda_p}), \tag{2.29'}$$

$$\phi^{(1)}_{s_N\tau_N;\,s\tau}(\vec{\Delta}_{k,\lambda_p}) = \sum_{\sigma_p,\lambda_p} \langle \tfrac{1}{2} 1; \sigma'_p\lambda'_p | s,\tau\rangle\cdot\phi^{(1)}_{s_N\tau_N;\,\sigma'_p\lambda'_p}(\vec{\Delta}_{k,\lambda_p}),$$

where $\langle\frac{1}{2}1;\sigma\lambda|s,\tau\rangle$ and $\langle\frac{1}{2}1;\sigma'_p\lambda'_p|s,\tau\rangle$ are the Clebsh-Gordan coefficients. From (2.27), (2.28) with the help (2.29),(2.29') we obtain the following equations

$$2\Delta^{\circ}_{p,m_2\lambda_p}(M-\Delta^{\circ}_{p,m_1\lambda_p}-\Delta^{\circ}_{p,m_2\lambda_p})\cdot\phi^{(i)}_{s_N\tau_N;\,s\tau}(\vec{\Delta}_{p,\lambda_p}) =$$
$$= \frac{1}{(2\pi)^3}\int\frac{d^3\vec{\Delta}_{k,\lambda_p}}{2\Delta^{\circ}_{k,m_1\lambda_p}}\,V^{(i)s'\tau'}_{s,\tau}(\vec{\Delta}_{p,\lambda_p};\vec{\Delta}_{k,\lambda_p};P^2)\,\phi^{(i)}_{s_N\tau_N\,s'\tau'}(\vec{\Delta}_{k,\lambda_p}), \tag{2.30}$$

where

$$V^{(0)s'\tau'}_{s,\tau} = \delta_{s,1/2}\cdot\delta_{s',1/2}\cdot\delta_{\tau',\tau_p}\cdot V^{(0)\tau_p}_{\tau},$$
$$V^{(1)s'\tau'}_{s,\tau} = \sum_{\sigma;\lambda}\langle\tfrac{1}{2}1;\sigma\lambda|s,\tau\rangle\langle\tfrac{1}{2}1;\sigma'_p\lambda'_p|s,'\tau'\rangle\cdot V^{(1)\sigma'_p\lambda'_p}_{\sigma\lambda}. \tag{2.31}$$

For further calculations it is necessary to specify spin structures of the wave functions. Let us make a natural assumption that the WF (2.16) in the case $s_N=1/2$ can be represented as $(\overset{\circ}{K}\equiv L^{-1}_{\lambda_p}K=(M,\vec{0});\ \lambda_P=\lambda_K)$:

$$\phi^{(0)}_{1/2\tau_N;\sigma}(\vec{\Delta}_{p,\lambda_P}) = \bar{u}_\alpha(\vec{\overset{\circ}{K}},\tau_N)\,u_\beta(\vec{\Delta}_{p,\lambda_P};\sigma)\,\Phi^{(0)}_{\alpha\beta}(\vec{\Delta}_{p,\lambda_P}),$$
$$\phi^{(1)}_{1/2\tau_N;\sigma\lambda}(\vec{\Delta}_{p,\lambda_P}) = \bar{u}_\alpha(\vec{\overset{\circ}{K}},\tau_N)\,u_\beta(\vec{\Delta}_{p,\lambda_P};\sigma)\times \tag{2.32}$$
$$\times\,\epsilon_\rho(\vec{\Delta}_{p_2,\lambda_P};\lambda)\cdot\Phi^{(1)\rho}_{\alpha\beta}(\vec{\Delta}_{p,\lambda_P}).$$

Here $\Phi^{(0)}$ and $\Phi^{(1)}$ are matrix (4x4) functions that may be represented as decompositions over the matrices $I=\{\delta_{ij}\}$, γ^μ, $\sigma^{\mu\nu}=i\gamma^\mu\gamma^\nu$, γ^5, $\gamma^\mu\gamma^5$.

3. THE NUCLEON STRUCTURE FUNCTIONS

The deep-inelastic scattering of a lepton on a hadron with the momentum $\vec{P}$, mass M, spin s, and polarization σ is described by the structure functions $F_i(Q^2,\nu)$, i = 1,2,3, which enter into the decomposition of the hadron current product

$$W_{\alpha\beta}(P,q) = (8\pi)^{-1}\sum_{X,\kappa}(2\pi)^4\delta^{(4)}(P+q-P_X)\langle\vec{P}Ms\sigma|J_\alpha(0)|X,\kappa\rangle\times$$
$$\times\langle X,\kappa|J_\beta(0)|\vec{P}Ms\sigma\rangle = -(g_{\alpha\beta}+\frac{q_\alpha q_\beta}{Q^2})\frac{F_1}{2M}+ \tag{3.1}$$
$$+(P_\alpha+\frac{M\nu}{Q^2}q_\alpha)(P_\beta+\frac{M\nu}{Q^2}q_\beta)\cdot\frac{F_2}{M^2\nu}-\frac{i\epsilon_{\alpha\beta\gamma\delta}P^\gamma q^\delta F_3}{2M^2\nu}$$

To obtain an expression for matrix elements of the current operator $\langle X,\kappa|J_\mu(0)|PMs\sigma\rangle$ through the WF (2.29), let us consider the following functions [10]

$$R^{(0)\alpha}_\mu(X,\kappa|y_1,y_2) = \langle X,\kappa|T\{J_\mu(0)\bar{\phi}(y_2)\bar{\psi}^\alpha(y_1)\}|0\rangle, \tag{3.2}$$
$$R^{(1)\alpha\rho}_\mu(X,\kappa|y_1,y_2) = \langle X,\kappa|T\{J_\mu(0)\bar{D}^\rho(y_2)\bar{\psi}^\alpha(y_1)\}|0\rangle,$$

and their single-time Fourier transforms ($\lambda\equiv\lambda_P$):

$$\tilde{R}^{(i)}_\mu(X,\kappa|\vec{\Delta}_{p,\lambda};P^2) = \int d^4y_1 d^4y_2\exp(-ip_1y_1-ip_2y_2)\times$$
$$\times\,\delta[\lambda(y_1-y_2)]\cdot R^{(i)}_\mu(X,\kappa|y_1,y_2). \tag{3.3}$$

Let us project $\tilde{R}^{(i)}_\mu$ onto the subspaces of states with a positive energy:

$$\mathcal{R}^{(0)}_{\mu\sigma}(X,\kappa|\vec{\Delta}_{p,\lambda};P^2) = \frac{1}{2m_1}\tilde{R}^{(0)\alpha}_\mu(X,\kappa|\vec{\Delta}_{p,\lambda};P^2)\,u_\alpha(\vec{\Delta}_{p,\lambda};\sigma),$$
$$\mathcal{R}^{(1)}_{\mu\sigma\lambda}(X,\kappa|\vec{\Delta}_{p,\lambda};P^2) = \frac{1}{2m_1}\tilde{R}^{(1)\alpha\rho}_\mu(X,\kappa|\vec{\Delta}_{p,\lambda};P^2)\times \tag{3.4}$$
$$\times\,u_\alpha(\vec{\Delta}_{p_1,\lambda};\sigma)\cdot\epsilon_\rho(\vec{\Delta}_{p_2,\lambda};\lambda),$$

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*We use the following standard notation and variables: q is a momentum transfer or momentum of a virtual boson ($\gamma, Z^\circ, W^\pm$), P_X is a total momentum of particles in the final state $|X,\kappa\rangle$ with spin properties denoted by the symbol κ, $Q^2=-q^2$, $\nu=Pq/M$, $x\equiv 1/\omega = Q^2/2M\nu$, $W^2=(P+q)^2$.

and let us pass to functions with definite values of the system spin and its projection:

$$\mathcal{R}^{(0)}_{\mu s\tau} = \delta_{s,1/2} \cdot \delta_{\tau\sigma} \cdot \mathcal{R}^{(0)}_{\mu\sigma} \, ,$$
$$\mathcal{R}^{(1)}_{\mu s\tau} = \sum_{\sigma,\lambda} < \frac{1}{2} 1; \sigma\lambda | s, \tau > \cdot \mathcal{R}^{(1)}_{\mu\sigma\lambda} \, . \tag{3.5}$$

With the use of the representation of T-product through the θ-functions it is not difficult to obtain a spectral representation for the functions $\mathcal{R}^{(i)}_{\mu}$, which gives near the bound state pole with $\sqrt{P^2}=M$ the expression

$$\mathcal{R}^{(i)}_{\mu s\tau}(X,\kappa | \vec{\Delta}_{p,\lambda};\, P^2) \simeq \frac{i(2\pi)^3}{2M} \frac{<X,\kappa | J_\mu(0) | \vec{P} M s_N \tau_N>^{(i)}}{\sqrt{P^2} - M + i\epsilon} \times$$
$$\times \frac{\phi^{(i)}_{s_N\tau_N; s\tau}(\vec{\Delta}_{p,\lambda})}{2\Delta^\circ_{p,m_1\lambda}} \, . \tag{3.6}$$

Let us introduce generalized vertex functions $\Gamma^{(i)}_\mu$ (see ref. [10]):

$$\mathcal{R}^{(i)}_{\mu} = \Gamma^{(i)}_\mu \cdot \mathcal{G}^{(i)} . \tag{3.7}$$

Comparing the expression (3.7) considered near the bound-state pole with $\sqrt{P^2}=M$ with the formula (3.6) we find taking into account (2.15), (2.17):

$$<X,\kappa | J_\mu(0) | \vec{P} M s_N \tau_N>^{(i)} = \int \frac{d^3\vec{\Delta}_{p,\lambda}}{2\Delta^\circ_{p,m_1\lambda}} \cdot$$
$$\times \Gamma^{(i)}_{\mu s\tau}(X,\kappa | \vec{\Delta}_{p,\lambda};P^2) \cdot \phi^{(i)}_{s_N\tau_N; s\tau}(\vec{\Delta}_{p,\lambda}) / 2\Delta^\circ_{p,m_1\lambda} \, . \tag{3.8}$$

The vertex functions $\Gamma^{(i)}_\mu$ can be determined with the help of the expansion in the constant of coupling the lepton with the quark (diquark). In the lowest order

$$\Gamma^{(i)}_{0\mu} = \mathcal{R}^{(i)}_{0\mu} \cdot [\mathcal{G}^{(i)}_0]^{-1} \, . \tag{3.9}$$

Using for $\mathcal{R}^{(i)}_{0\mu}$ the expression that follows from the spectral representation for the function $\mathcal{R}^{(i)}_\mu$ and for $[\mathcal{G}^{(i)}_0]^{-1}$ the formula that is easily found from (2.18), (2.19) we obtain [10,4]

$$\Gamma^{(i)}_{0\mu s\tau}(X,\kappa | \vec{\Delta}_{p,\lambda};P^2) = 2\Delta^\circ_{p,m_1\lambda} \times$$
$$\times <X,\kappa | J_\mu(0) | \vec{\Delta}_{p,\lambda}; -\vec{\Delta}_{p,\lambda}; s,\tau>^{(i)} , \tag{3.10}$$

where

$$|\vec{\Delta}_{p,\lambda}; -\vec{\Delta}_{p,\lambda}; s\tau> = \sum_{\sigma,\lambda'} < \frac{1}{2} 1; \sigma\lambda' | s,\tau> \cdot | \vec{\Delta}_{p,\lambda}; \sigma; -\vec{\Delta}_{p,\lambda}; \lambda'> .$$

for the case of vector diquark, and

$$|\vec{\Delta}_{p,\lambda}; -\vec{\Delta}_{p,\lambda}; s,\tau> = \delta_{s,1/2} \cdot \delta_{\tau\sigma} \cdot |\vec{\Delta}_{p,\lambda}; \sigma; -\vec{\Delta}_{p,\lambda}; 0>$$

for the case of scalar diquark. The matrix element of the current operator in eq. (3.10) describes the transition of the quark-diquark state with the total spin s and its projection τ into the final hadron state $|X,\kappa>$. Substitution (3.10) in (3.8) gives

$$<X,\kappa | J_\mu(0) | P M s_N \tau_N>^{(i)} = \int \frac{d^3\vec{\Delta}_{p,\lambda}}{2\Delta^\circ_{p,m_1\lambda}} \times$$
$$\times <X,\kappa | J_\mu(0) | \vec{\Delta}_{p,\lambda}; -\vec{\Delta}_{p,\lambda}; s,\tau>^{(i)} \cdot \phi^{(i)}_{s_N\tau_N; s\tau}(\vec{\Delta}_{p,\lambda}) \, . \tag{3.11}$$

From (3.1), (3.11) we obtain

$$W^{(i)}_{\mu\nu}(P,q) = (8\pi)^{-1} \sum_{X,\kappa} (2\pi)^4 \delta^{(4)}(P+q-P_X) \times$$
$$\times \int \frac{d^3\vec{\Delta}_{p,\lambda}}{2\Delta^\circ_{p,m_1\lambda}} \cdot \frac{d^3\vec{\Delta}_{p',\lambda}}{2\Delta^\circ_{p',m_1\lambda}} \cdot \bar{\phi}^{(i)}_{s_N\tau_N; s\tau}(\vec{\Delta}_{p,\lambda}) < \vec{\Delta}_{p,\lambda}; -\vec{\Delta}_{p,\lambda}; s,\tau | J_\mu(0) | X,\kappa>^{(i)} \times$$
$$\times <X,\kappa | J_\nu(0) | \vec{\Delta}_{p',\lambda}; -\vec{\Delta}_{p',\lambda}; s,\tau>^{(i)} \cdot \phi^{(i)}_{s_N\tau_N; s\tau}(\vec{\Delta}_{p',\lambda}) \, . \tag{3.12}$$

Let us use the formula (3.12) for finding the structure functions of the electromagnetic lepton-nucleon scattering in the approximation of quark-diquark intermediate states:

$$W^{(i)}_{\mu\nu}(P,q) = (8\pi)^{-1} \sum_{\tau_1,\tau_2} \int \frac{d^3\vec{\Delta}_{p,\lambda}}{2\Delta^\circ_{p,m_1\lambda}} \cdot \frac{d^3\vec{\Delta}_{p',\lambda}}{2\Delta^\circ_{p',m_1\lambda}} \cdot d^4k_1 \times$$
$$\times \theta(k^\circ_1)\delta(k^2_1 - m^2_1) d^4k_2 \theta(k^\circ_2)\delta(k^2_2 - m^2_2)(2\pi)^4 \delta^{(4)}(P+q-k_1-k_2) \times \tag{3.13}$$

$$\times \bar{\phi}^{(i)}_{s_N \tau_N; s\sigma}(\vec{\Delta}_{p,\lambda}) \cdot <\vec{\Delta}_{p,\lambda}; -\vec{\Delta}_{p,\lambda}; s,\sigma | J_\mu(0) | \vec{\Delta}_{k_1,\lambda}; \tau_1; \vec{\Delta}_{k_1,\lambda}; \tau_2 >^{(i)} \times$$

$$\times <\vec{\Delta}_{k_1,\lambda}; \tau_1; \vec{\Delta}_{k_2,\lambda}; \tau_2 | J_\nu(0) | \vec{\Delta}_{p',\lambda}; -\vec{\Delta}_{p',\lambda}; s,\sigma >^{(i)} \cdot \phi^{(i)}_{s_N \tau_N; s\sigma}(\vec{\Delta}_{p',\lambda}).$$

Here $\tau_1 = \pm 1/2$ and $\tau_2 = 0$ for the spinless diquark and $\tau_2 = 0, \pm 1$ for the vector diquark. In the impulse approximation

$$<\vec{k}_1, \tau_1; \vec{k}_2, \tau_2 | J_\mu(0) | \vec{p}_1, \sigma_1; \vec{p}_2, \sigma_2 >^{(i)} =$$

$$= Q_1 <\vec{k}_1, \tau_1 | J_\mu(0) | \vec{p}_1, \sigma_1 >^{(i)} \cdot 2k_{20} \delta(\vec{k}_2 - \vec{p}_2) \delta_{\tau_2 \sigma_2} + \tag{3.14}$$

$$+ Q_2 <\vec{k}_2, \tau_2 | J_\mu(0) | \vec{p}_2, \sigma_2 >^{(i)} \cdot 2k_{10} \delta(\vec{k}_1 - \vec{p}_1) \delta_{\tau_1 \sigma_1},$$

where $Q_1(Q_2)$ is the quark (diquark) charge in units of e. The matrix elements of the current operator between one-particle states have the form: for the quark

$$<\vec{k}_1, \tau_1 | J_\mu(0) | \vec{p}_1, \sigma_1 > = \bar{u}(\vec{k}_1, \tau_1) \gamma_\mu u(\vec{p}_1, \sigma_1), \tag{3.15a}$$

for the spinless diquark

$$<\vec{k}_2, \tau_2 | J_\mu(0) | \vec{p}_2, \sigma_2 > = (k_2 + p_2)_\mu, \tag{3.15b}$$

for the vector diquark

$$<\vec{k}_2, \tau_2 | J_\mu(0) | \vec{p}_2, \sigma_2 > = \bar{\epsilon}^\rho(\vec{k}_2, \tau_2) \cdot [-(k_2 + p_2)_\mu g_{\kappa\rho} + g_{\rho\mu} k_{2\kappa} + g_{\kappa\mu} p_{2\rho}] \cdot \epsilon^\kappa(\vec{p}_2, \sigma_2). \tag{3.15c}$$

After substituting (3.14) into (3.13) we find

$$W^{(i)}_{\mu\nu}(P,q) = (2\pi)^3/4 \sum_{spin} \int \frac{d^3\vec{\Delta}_{k_1,\lambda}}{2\Delta^\circ_{k_1,m_1\lambda}} \cdot \frac{d^3\vec{\Delta}_{k_2,\lambda}}{2\Delta^\circ_{k_2,m_2\lambda}} \times$$

$$\delta^{(4)}(P + q - k_1 - k_2) \cdot (Q_1^2 h^{(i)}_{1\mu\nu} + Q_1 Q_2 h^{(i)}_{2\mu\nu} + Q_2 Q_1 h^{(i)}_{3\mu\nu} + Q_2^2 \cdot h^{(i)}_{4\mu\nu}, \tag{3.16}$$

where $h^{(i)}_{k\mu\nu}$ are products of the one-particle currents of the (3.15) type and the wave functions:

$$h^{(i)}_{1\mu\nu} = \sum_{\tau_1,\tau_2} \sum_{\sigma_1,\sigma_2} (<\tfrac{1}{2} 1; \sigma_1 \sigma_2 | s, \tau>)^2 \cdot <\vec{\Delta}_{k_1,\lambda}; \tau_1 | J_\mu(0) | -\vec{\Delta}_{k_2,\lambda}; \sigma_1 > \times$$

$$\times <-\vec{\Delta}_{k_2,\lambda}; \sigma_1 | J_\nu(0) | \vec{\Delta}_{k_1,\lambda}; \tau_1 > | \phi^{(i)}_{s_N \tau_N; s\tau}(-\vec{\Delta}_{k_2,\lambda})|^2,$$

$$h^{(i)}_{2\mu\nu} = \sum_{\tau_1,\tau_2} \sum_{\sigma_1,\sigma_2} (<\tfrac{1}{2} 1; \sigma_1 \sigma_2 | s, \tau>)^2 \cdot <-\vec{\Delta}_{k_2,\lambda}; \sigma_1 | J_\mu(0) | \vec{\Delta}_{k,\lambda}; \tau_1 > \times$$

$$\times <\vec{\Delta}_{k_2,\lambda}; \tau_2 | J_\nu(0) | -\vec{\Delta}_{k_1,\lambda}; \sigma_2 > \cdot \phi^{(i)}_{s_N \tau_N; s\tau}(\vec{\Delta}_{k_1,\lambda}) \bar{\phi}^{(i)}_{s_N \tau_N; s\tau}(-\vec{\Delta}_{k_2,\lambda}),$$

$$h^{(i)}_{3\mu\nu} = \sum_{\tau_1,\tau_2} \sum_{\sigma_1,\sigma_2} (<\tfrac{1}{2} 1; \sigma_1 \sigma_2 | s, \tau>)^2 \cdot <-\vec{\Delta}_{k_1,\lambda}; \sigma_2 | J_\mu(0) | \vec{\Delta}_{k_2,\lambda}; \tau_2 > \times$$

$$\times <\vec{\Delta}_{k_1,\lambda}; \tau_1 | J_\nu(0) | -\vec{\Delta}_{k_2,\lambda}; \sigma_1 > \cdot \bar{\phi}^{(i)}_{s_N \tau_N; s\tau}(\vec{\Delta}_{k_1,\lambda}) \phi^{(i)}_{s_N \tau_N; s\tau}(-\vec{\Delta}_{k_2,\lambda}),$$

$$h^{(i)}_{4\mu\nu} = \sum_{\tau_1,\tau_2} \sum_{\sigma_1,\sigma_2} (<\tfrac{1}{2} 1; \sigma_1 \sigma_2 | s, \tau>)^2 \cdot <\vec{\Delta}_{k_2,\lambda}; \tau_2 | J_\mu(0) | -\vec{\Delta}_{k_1,\lambda}; \sigma_2 > \times$$

$$\times <-\vec{\Delta}_{k_1,\lambda}; \sigma_2 | J_\nu(0) | \vec{\Delta}_{k_2,\lambda}; \tau_2 > \cdot | \phi^{(i)}_{s_N \tau_N; s\tau}(-\vec{\Delta}_{k_1,\lambda})|^2.$$

4. CONCLUSIONS

In the present work the covariant three-dimensional quasi-potential approach is applied to the description of the quark-diquark bound states with the total spin 1/2 which can be interpreted as nucleons and their resonances. The diquark is considered as a boson with the spin 0 or 1, and the quark has the spin 1/2. The equations for the wave functions and normalization conditions are deduced.

In the approximation of two-particle intermediate states the expressions for the nucleon structure functions are obtained through the wave functions of the bound quark-diquark system and the matrix elements of the current operator corresponding to the elastic scattering of the photon on a quark and on a diquark.

Analysis of scaling properties and comparison of the results with experimental data will be given elsewhere.

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REFERENCES

1. Kapshay V.N. et al. Nuovo Cim., 1981, 66A, p.45.
2. Savrin V.I., Skachkov N.B. Nuovo Cim., 1981, 65A, p.1.
3. Kapshay V.N. et al. JINR, P2-81-481, Dubna, 1981.
4. Linkevich A.D., Savrin V.I., Skachkov N.B. JINR, E2-81-611, Dubna, 1981.
5. Logunov A.A., Tavkhelidze A.N. Nuovo Cim., 1963, 29, p.380.
6. Kadyshevsky V.G., Tavkhelidze A.N. Problems in Theoretical Physics. Essays dedicated to N.N.Bogolubov on the occasion of his sixtieth birthday. "Nauka", M., 1969, p.261; Logunov A.A. et al. Sov.J.Theor.Math.Phys., 1971, 6, p.157; Garsevanishvili V.R. et al. Sov.J.Theor.Math.Phys., 1975, 23, p.310.
7. Faustov R.N. Ann.Phys., 1973, 78, p.176.
8. Kadyshevsky V.G. Sov.JETP, 1964, 46, p.654; 1964, 46, p.872; Nucl.Phys., 1968, B6, p.125.
9. Schmidt I.A., Blankenbecler R. Phys.Rev., 1977, D16, p.1318; Blankenbecler R. Preprint SLAC-PUB-2512, Stanford, SLAC, 1980; Frazer W.R., Gunion J.F. Phys.Rev.Lett., 1980, 45, p.1138; Abbot L.F., Atwood W.B., Barnett R.M. Phys.Rev., 1980, D22, p.582.
10. Faustov R.N. Proc. V Int. Symp. on Many Particle Hadrodynamics. Eisenach and Leipzig, June 4-10, 1974, p.769.
11. Savrin V.I. Sov.J.Theor.Math.Phys., 1976, 29, p.347; 1979, 39, p.48; Kvinikhidze A.N. et al. Sov.J.Part. and Nucl., 1977, 8, p.478; Krasnikov N.V., Chetyrkin K.G. Preprint INR, P-0036, M., 1976; Atakishiev N.M., Mir-Kasimov R.M., Nagiev Sh.M. JINR, P2-80-635, Dubna, 1980.
12. Skachkov N.B., Solovtsov I.L. Sov.J.Theor.Math.Phys., 1979, 41, p.205; Sov.J.Nucl.Phys., 1979, 30, p.1079.
13. Shirokov Yu.M. Sov. JETP, 1958, 35, p.1005; Chgou Guan-Chgao, Shirokov M.I. Sov.JETP, 1958, 34, p.1230.
14. Skachkov N.B. JINR, E2-81-308, Dubna, 1981.

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Линкевич А.Д., Саврин В.И., Скачков Н.Б. E2-82-130

Дикварки и структурные функции нуклонов

Получены формулы, выражающие структурные функции глубоконеупругого лептон-нуклонного рассеяния через релятивистские волновые функции систем, составленных из частиц со спинами 0,1/2 и 1, 1/2. Эти волновые функции являются решениями ковариантных двухчастичных одновременных уравнений, описывающих нуклон как систему, образованную из кварка и дикварка.

Работа выполнена в Лаборатории теоретической физики ОИЯИ.

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Linkevich A.D., Savrin V.I., Skachkov N.B. E2-82-130

Diquarks and Nucleon Structure Functions

Formulae for structure functions of the deep-inelastic lepton-nucleon scattering are obtained through relativistic wave functions of systems composed of particles with spins 0, 1/2 and 1, 1/2. These wave functions are solutions of covariant two-particle single-time equations describing the nucleon as a system formed out of a quark and a diquark.

The investigation has been performed at the Laboratory of Theoretical Physics, JINR.

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