HADRON AND QUARK FORM FACTORS IN THE RELATIVISTIC HARMONIC OSCILLATOR MODEL

V.V. Burov[1], N.Sagimbayeva[1]

[1]Joint Institute for Nuclear Research, Dubna, Russian Federation

e-mail: naz_21088@mail.ru

Nucleon, pion and quark form factors are studied within the relativistic harmonic oscillator model including the quark spin. The nucleon charge, magnetic and axial form factors and the pion charge form factor can be explained with one oscillator parameter if one accounts for the scaling rule and the size of the constituent quarks. We analyze the proton electromagnetic and weak form factors (FFs) and the pion charge FF in the framework of the Relativistic Harmonic Oscillator Model (RHOM). A method for building a covariant and gauge-invariant current within the $\widetilde{U}(12) \otimes O$ (3, 1) model was proposed. Covariant and gauge-invariant current for the SU (6) $\otimes$ O (3, 1) model was found and it was shown that all the nucleon FFs can be described in this case. However, the agreement with the experimental data is here much worse than within the nonrelativistic model that takes into account the Lorentz contraction of the nucleon wave function, although the latter model fails to describe the electric FF of the neutron.

The aim of the present note is to describe the nucleon FFs within RHOM using the SU (6) $\otimes$ O (3, 1) scheme of derivation of the covariant and gauge-invariant currents under the assumption that the behavior of the FFs when $q^2 \to \infty$ is governed by the quark counting and that there holds the experimentally observable scaling, i.e.$\mathrm{G_E^p}(\mathrm{q}^2) = \mathrm{G}_M^{\mathrm{p}}(\mathrm{q}^2)/\mu_p = \mathrm{G_M^n}(\mathrm{q}^2)/\mu_n$, where $\mu_{n,p}$ are the magnetic moments of neutron and proton.

The model gives a simple description of the experimental data on nucleon and pion FFs provided by only one arbitrary parameter is used. Note that the quality of the description can be improved upon by using $g_M(q^2)$ and $g_A(q^2)$ to fit the nucleon FFs. The model could then be used, with all the parameters fixed, in investigations of the strong πNN vertex, Δ- isobar FFs, and nucleon structure functions etc. Besides, the model can be easily extended to systems with a number of quarks larger than three, e. g. to the study of the deuteron FFs.

References:

[1] M. Blagojevic and D. Lalovic, Prog. Theor. Phys., 51 (1974) 1152.
[2] S. Ishida, A. Matsuda and M. Namiki, Prog. Theor. Phys., 57 (1977) 210.
[3] S. Saito, Prog. Theor. Phys., 58 (1977) 1802.