Flavor Asymmetry ($\bar{d} - \bar{u}$) in Termodinamics Model for the Nucleon.

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Abstract

On the basis of thermodynamic model, difference of antiquark distributions ($\bar{d} - \bar{u}$) is constructed. The comparison with other models is carried out.

The precise knowledge of the u, $\overline{u}, d$ and $\overline{d}$ quark distributions in the nucleon is very important for theoretical investigatins. The flavor asymmetry

$$f(x, Q^2) = \overline{d} - \overline{u} \tag{1}$$

as a function of two invariant variables is of special interest. There are several parametrizations for function (1) elaborated by Gluck, Reya, Vogt[1], CTEQ-Collab.[2], Martin, Robert, Stirling[3], however they have been thought not to be reliable for precise description of the nucleon structure.

In this work we suggest a simple analytical expression for flavor asymmetry obtained in the framework of the thermodynamical model, which was reported at the Workshop in Samara [4, 5]. A modification for the neutron structure function F_2^n also reported at this Workshop[6] In this model structure function is described by 3-term expression

$$F_2^N = F^{SEA} + F^R + F^{PL} \tag{2}$$

where each term has the exponential form

$$\frac{Nxexp(-z)}{z^n}, \tag{3}$$

$$z = \sqrt{a^2 + \frac{\Delta(x - x_0)^2}{x(1-x)}} \tag{4}$$

with n=3,1,0 for the 1st, 2d and 3d term respectively. A normalization factor N and parameters a, Δ, x_0 are different for each therm and denoted by the additional index SEA, R, PL.

The function (1) is constructed in the two-term form:

$$\overline{d} - \overline{u} = N^{RH} \frac{exp(-z_{RH})}{z_{RH}} + N_1^{PL} \exp(-z_{PL}) \tag{5}$$

where

$$N^{RH} = \frac{0.1137\Delta_{RH} exp(a_{RH})}{1 + 2 \cdot 10^{-4} \Delta_{RH}^2} \tag{6}$$

$$N_1^{PL} = -\frac{0.01\Delta_{PL} exp(a_{PL})}{1 + 2 \cdot 10^{-4} \Delta_{PL}^3} \tag{7}$$

Function (3) depends on 2 arguments of the form (4) with the parameters which determine Q^2- evolution by the following formulas:

$$\Delta = \Phi \ln(1 + p + \lambda Q^2) \tag{8}$$

$$a_{RH}^2 = \Delta_{RH}(1 + a_{RH})/C_{RH} \tag{9}$$

$$a_{PL} = \Delta_{PL}/C_{PL} \tag{10}$$

$$x_0^{RH} = 0, x_0^{PL} = B_{PL}/(\Delta_{PL} C_{PL}) \tag{11}$$

$$C = C^0 + d_{PL}/\Delta_{PL} \tag{12}$$

	C^0	d	B	Φ	p	λ
RH	24	0	0	16.29	0.00318	0.486
PL_1	6	5.73	1.91	2.85	0.07	5.7

Here C^0 is heat capasity of the excited remnant system R which appears in the virtual transition $\gamma^* + p \to q + R$.

This system has the temperature T related to the mass of the virtual state by the classical formula

$$M = CT \tag{13}$$

Parameters in the formulas (6,7) have been obtained when experimental data [7, 8] are used.

Figs.1,2 show our function (1) together with the experimental points and GRV94 [1] - parametrization. GRV parametrization gives a monotonic function decreasing with x, contrary to our function changing the sign at about 0.4 for $Q^2 = 54$ GeV^2. The same peculiarity has the MRST 98-parametrization.

It is important that we see an essential Q^2-dependence which yields a signficant effect in the neutron structure function F_2^N [6].

References

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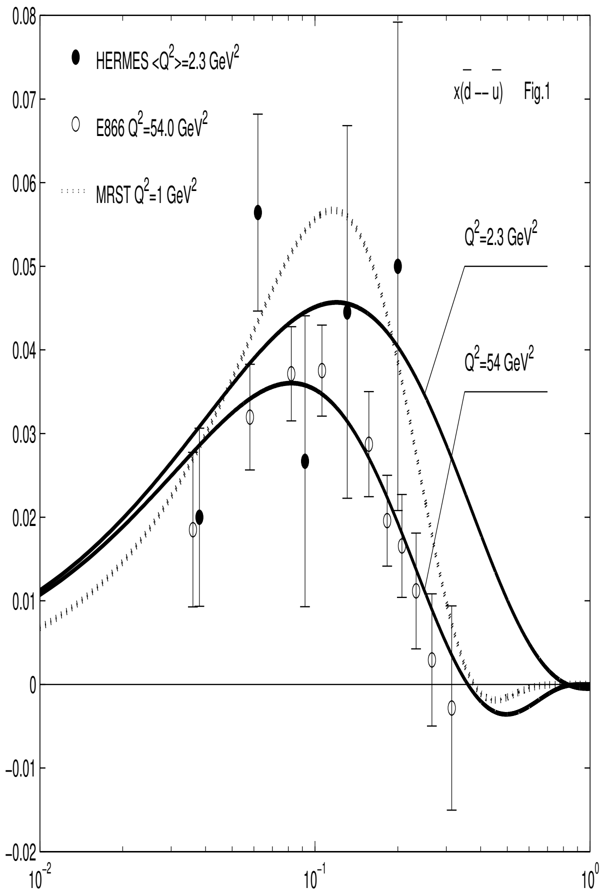

Figure 1: Termodinamical model for function $x(\overline{d} - \overline{u})$ and MRST98-parametrization [3] , solid and dashed lines respectively. Experimental points are from [7, 8] .

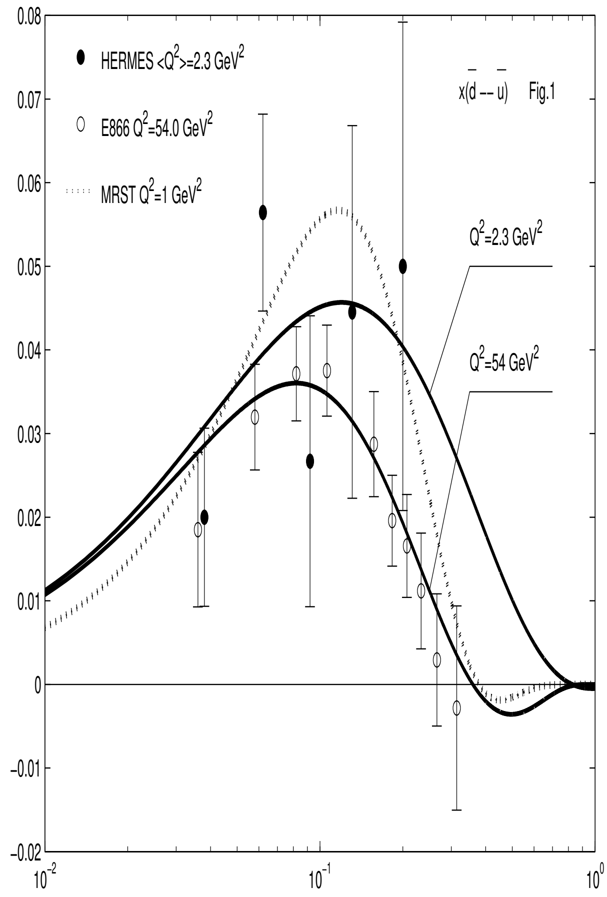

Figure 2: Termodinamical model for function $\overline{d} - \overline{u}$ together with the experimental points [7, 8] and GRV94-parametrization [1].