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3.18 SENSITIVITY OF PROTON POLARIZATION IN $d(\vec{e},e'\vec{p})n$ REACTION TO NEUTRON ELECTRIC FORM FACTOR

M.P. Rekalo, G.I. Gakh, A.P. Rekalo

Institute of Physics and Technology, the Ukrainian Academy of Sciences, Kharkov 310108, USSR

We carried out the theoretical analysis of the proton polarization from the $d(\vec{e},e'\vec{p})n$ reaction in order to investigate its sensitivity to the neutron electric form factor G_{En}. In the general case, all components of the proton polarization vector $\vec{P}$ are nonzero. They are defined by five structure functions [1)]

$$\begin{aligned}
\sigma P_x &= \lambda_e N\left[\sqrt{1-\varkappa^2}\,P_x^{(0)} + \cos\varphi\sqrt{2\varkappa(1-\varkappa)}\,P_x^{(1)}\right],\\
\sigma P_y &= \lambda_e N\sin\varphi\sqrt{2\varkappa(1-\varkappa)}\,P_y^{(1)},\\
\sigma P_z &= \lambda_e N\left[\sqrt{1-\varkappa^2}\,P_z^{(0)} + \cos\varphi\sqrt{2\varkappa(1-\varkappa)}\,P_z^{(1)}\right],
\end{aligned} \qquad (1)$$

where σ is the differential cross section for the $d(e,e'p)n$ process with unpolarized particles, $\lambda_e = \pm 1$ depending on the mutual orientation of the initial electron spin and momentum, N is the kinematical factor, $\varkappa$ is the parameter describing the virtual photon linear polarization, φ is the angle between the electron scattering plane and the $\gamma^* d \to np$ reaction plane (xz), $P_i^{(0)}$ and $P_i^{(1)}$ are the structure functions, the z axis is directed along the virtual photon 3-momentum.

The structure functions $P_i^{(0,1)}(\theta_p, E_{np}, K^2)$ are calculated here in the framework of the relativistic impulse approximation (Fig.1)(θ_p is the proton scattering angle in the $\gamma^* d \to np$ reaction c.m.s., E_{np} is the n-p c.m.s. relative energy). The dnp-vertex form factors are taken from [2)] using the Paris deuteron wave function[3)]. The dipole fit and the scaling law relations are used for the proton electromagnetic form factors and for the neutron magnetic form factor.

The sensitivity of some components of the $\vec{P}$ to the G_{En} is demonstrated by using the following three parametrizations [4)] for G_{En}: (1)- $G_{En} = \mu_n \tau G_{Ep}/(1-5.6\tau)$, (2)- $G_{En}=0$ and (3)- $G_{En} = \tau G_{Mn}$, where $\mu_n = -1.913$, $\tau = K^2/4m^2$, m is the nucleon mass.

It is seen from Fig.2 that at $\theta_p < 90°$ the $R^{(1)}_{x,z} = P^{(1)}_{x,z}/(H_{11}+H_{22})$ weakly depend on θ_p (H_{11}, H_{22} are the transverse structure functions for the $d(e,e'p)n$ cross section in the unpolarized case). However, in the region of $\theta_p \approx 90°$ (where the interference between the neutron and proton diagrams is essential) the sign of the $R_x^{(1)}$ changes. It is natural that at $\theta_p > 90°$ the main contribution must be from the neutron diagram. Low $R_x^{(1)}$ polarization values near $\theta_p \approx 180°$ are determined by the smallness of the $G_{Mn}G_{En}$ product. The high energy neutron polarization (or the low energy proton polarization in the lab.system) appears to be sensitive to the G_{En} value just at $\theta_p \approx 180°$. The angle $\theta_p^{(0)}$ at which the sign of the $R_x^{(1)}$ changes depends on the G_{En} form factor parametrization. This may, in principle, be used for determining G_{En}.

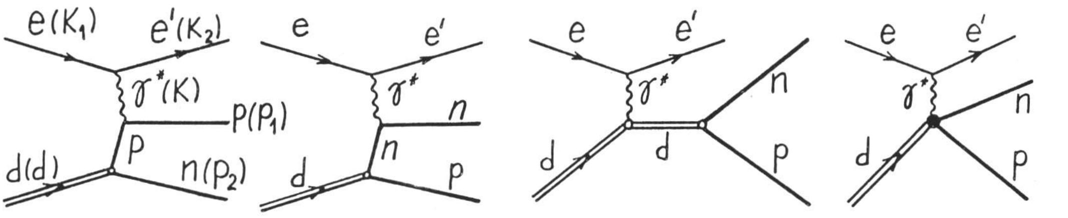

Fig.1. Feynman diagrams

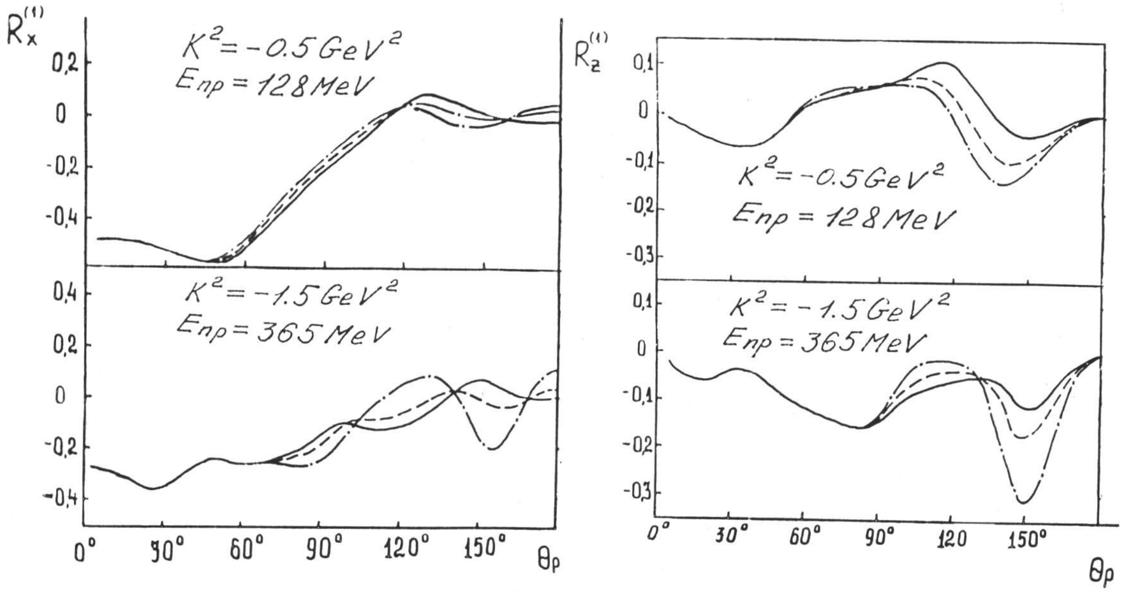

Fig.2. The dependence of the $R_x^{(1)}$, $R_z^{(1)}$ on the choice of G_{En} parametrization. The dashed, solid and dash-dotted curves correspond to parametrizations 1, 2, 3 (see the text) of G_{En}, respectively.

References

1) M.P.Rekalo, G.I.Gakh, A.P.Rekalo: Preprint KhFTI 83-4,Kharkov,1983
2) W.W.Buck, F.Gross: Phys.Rev.D20 (1979) 2361
3) M.Lacombe et al.:Phys.Lett.101B (1981) 139
4) R.G.Arnold, C.E.Carlson, F.Gross: Phys.Rev.C21 (1980) 1426