Thus, the C-parity violating amplitudes are of the form

$$f_i(q^2)\ \bar{\Psi}\ O^i_{\mu'}\ \Psi\ (g_{\mu\mu'} - q_\mu q_{\mu'}/q^2)\ ,$$

with $q_{\mu'}\bar{\Psi}O^i_{\mu'}\Psi \neq 0$. Now to make the amplitude analytic at $q = 0$ we must have $f_i(q^2) = q^2\varphi_i(q^2)$. Our statement follows from the fact that the term proportional to q_μ makes no contribution to the elastic scattering of the electron.

We note incidentally, for reference purposes, that in the Rarita-Schwinger formalism [3] for particles with spin 3/2 the electromagnetic current contains at first glance six independent terms:

$$A_1 = \bar{\Psi}_\mu\ (p_2)\ \gamma_\sigma\ \Psi_\mu\ (p_1)\ ,$$

$$A_2 = \bar{\Psi}_\mu\ (p_2)\ \gamma_\sigma\ \Psi_\nu\ (p_1)\ p_{1\mu}\ p_{2\nu}\ ,$$

$$A_3 = \bar{\Psi}_\mu\ (p_2)\ \Psi_\nu\ (p_1)\ p_{1\mu}\ p_{2\nu}\ (p_1 + p_2)_\sigma\ ,$$

$$A_4 = \bar{\Psi}_\mu\ (p_2)\ \Psi_\mu\ (p_1)\ (p_1 + p_2)_\sigma\ ,$$

$$A_5 = \bar{\Psi}_\mu\ (p_2)\ \Psi_\sigma\ (p_1)\ p_{1\mu} + \bar{\Psi}_\sigma\ (p_2)\ \Psi_\mu\ (p_1)\ p_{2\mu}\ ,$$

$$A_6 = \bar{\Psi}_\mu\ (p_2)\ \Psi_\sigma\ (p_1)\ p_{1\mu} - \bar{\Psi}_\sigma\ (p_2)\ \Psi_\mu\ (p_1)\ p_{2\mu}\ ,$$

whereas it follows from general considerations [4] that there should be only five.

Indeed, we can verify that the quantities A_i are related by

$$\frac{1}{2}\ (p_1 + p_2)^2\ A_1 - A_2 - \frac{m}{(p_1 + p_2)^2}\ A_3 - mA_4 + mA_5 = 0.$$

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CONSTANTS OF INTERACTION OF VECTOR MESONS WITH NUCLEONS. PHOTOPRODUCTION OF π^0 AND η MESONS ON NUCLEONS AND ELECTROMAGNETIC FORM FACTORS OF NUCLEONS

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An appreciable contribution to the $\pi^0 p$ photoproduction amplitude at small angles and large γ-quantum energies is made by peripheral mechanisms corresponding to vector-meson exchange [1]. Interest in such mechanisms is due to the possibility of determining the widths of radiative decays of vector mesons. In this note we estimate the ratio of the contributions of various vector mesons to the amplitudes of the processes $\gamma + P \to P + \pi^0$, and $\gamma + P \to P + \eta$. The matrix element describing vector-meson exchange is written in the form

$$M = \bar{u}(P_2)[P_\mu F_E + i\epsilon_{\mu\nu\rho\sigma}P_\nu q_\rho \gamma_\sigma \gamma_5 F_M]u(P_1)\epsilon_{\mu\nu'\rho'\sigma'}e_{\nu'}k_{\rho'}r_{\sigma'} , \tag{1}$$

$$F_E = \frac{G_E g(V \to P\gamma)}{q^2 - m_V^2} , \qquad F_M = \frac{G_M g(V \to P\gamma)}{q^2 - m_V^2} ,$$

where G_E and G_M are the constants for the interaction between the vector mesons and the nucleons, $g(V \to P\gamma)$ is the constant responsible for the decay $V \to P + \gamma$, $P = P_1 + P_2$, $q = P_1 - P_2$, P_1, P_2, k, and r are the f-momenta of the initial and final protons, the photon, and the produced meson, e is the γ-quantum polarization vector, and m_V the mass of the intermediate vector meson.

According to SU(6) symmetry [2] we have F coupling for constants of the type G_E, while for the constants G_M the couplings of the type F and D enter in proportion to (3D + 2F). The constants $g(V \to P\gamma)$ can be expressed in the framework of SU(6) symmetry [3] in terms of one parameter. Using these considerations, we obtain for the π^0- and η-meson photoproduction amplitudes

$$F_E(\pi) = a_E \left(\frac{1}{q^2 - m_\rho^2} + \frac{3}{q^2 - m_\omega^2} \right), \quad F_M(\pi) = a_M \left(\frac{1}{q^2 - m_\rho^2} + \frac{3}{q^2 - m_\omega^2} \right),$$

$$F_E(\eta) = \frac{a_E}{\sqrt{3}} \left(\frac{3}{q^2 - m_\rho^2} + \frac{1}{q^2 - m_\omega^2} - \frac{4}{q^2 - m_\varphi^2} \right), \tag{2}$$

$$F_M(\eta) = \frac{a_M}{\sqrt{3}} \left(\frac{3}{q^2 - m_\rho^2} + \frac{1}{q^2 - m_\omega^2} - \frac{4/5}{q^2 - m_\varphi^2} \right),$$

where a_E and a_M are proportional to the product of the constants G_E or G_M by $g(V \to P\gamma)$.

We note that the differential cross section does not contain interference of the terms proportional to F_E and F_M; furthermore, F_E leads to an angular dependence of the cross section $\sim\sin^2\theta$, i.e., it leads to a contribution that vanishes at zero angle. This behavior can be readily understood by recalling that F_E is connected with the amplitude of photoproduction without nucleon spin flip, while F_M is connected with the amplitude with spin flip. The contributions of F_E and F_M can in principle be differentiated on the basis of their different angular dependences.

It follows from (2) that:

(i) φ-meson exchange makes no contribution to the π^0-production amplitude, while all three vector mesons contribute to η-production.

(ii) The contribution of the ω meson is 9 times larger than the contribution of the ρ meson to π^0 photoproduction, and the interference of the ω and ρ contributions is also significant. To the contrary, in η photoproduction the ρ-meson contribution is 9 times larger than that of the ω meson.

(iii) $F_E(\eta) \simeq 0$ because of the near-equality of the masses of ω, ρ, and φ.

(iv) In our approximation the cross section of π^0 photoproduction at zero angle is 3 times larger than the cross section of η photoproduction.

Let us attempt to compare the predictions of SU(6) symmetry for the constants of interaction between vector mesons and nucleons, using the experimental data on the nucleon electromagnetic form factors. According to present-day notions, the form factors are approximated by the sum of the contributions of pole diagrams corresponding to exchange of neutral vector mesons, with the constants G_E determining the charge form factors and G_M the magnetic form factors. In the investigated region of q^2 the isoscalar form factors are determined by the contributions of the ω and φ mesons, while those of the isovector form factors are determined by the contributions of the ρ meson and the hypothetical ρ' meson [4]:

$$G_{ES} = \frac{1.24}{1 - q^2/15.8} - \frac{0.74}{1 - q^2/26.7}, \quad G_{EV} = \frac{2.01}{1 - q^2/14.5} - \frac{1.51}{1 - q^2/23.0},$$

$$G_{MS} = \frac{1.12}{1 - q^2/15.8} - \frac{0.68}{1 - q^2/26.7}, \quad G_{MV} = \frac{6.23}{1 - q^2/14.5} - \frac{3.87}{1 - q^2/23.0},$$

where the numerators contain products of the corresponding interaction constants. We therefore have for the ratios of the constants

$$G_M\,(PP\omega)\gamma_\omega \,/\, G_M\,(PP\varphi)\gamma_\varphi = -1.65\ (-2.5),$$

$$G_M\,(PP\rho)\gamma_\rho \,/\, G_M\,(PP\varphi)\gamma_\varphi = -9.1\ (-7.5)\ ,$$

$$G_E\,(PP\omega)\gamma_\omega \,/\, G_E\,(PP\varphi)\gamma_\varphi = 1.7\ (0.5)\ ,$$

$$G_E\,(PP\rho)\gamma_\rho \,/\, G_E\,(PP\varphi)\gamma_\varphi = -2.7\ (1.5),$$

where the parentheses contain the theoretical ratios. While the agreement between the experimental and theoretical ratios is satisfactory for the magnetic form factors, there is disparity both in sign and in magnitude for the charge form factors.

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