framework of the same pole mechanism, improves the agreement between theory and experiment in comparison with the peripheral model. It is interesting to note that in the case of a pheripheral model the best description of the experiment is also obtained at $G^2 = 7$ F. This value of G^2 agrees with the results of an analysis of the reaction $He^3(d, p)He^4$ within the framework of the peripheral model [2] ($G^2 = 7.1$ F); it is somewhat lower than the value $G^2 = 11.3$ F obtained in [7] for the constant of the isotropically-similar process $\alpha \to \tau + n$ by using the dispersion relations for the amplitude of the elastic forward $n\alpha$ scattering. The vertex constant G_{ABC} for the decay (fusion) via the channel $A \to B + C$ is connected with the coefficient in the asymptotic wave function of this channel, and contains important spectroscopic information; unlike the customarily employed reduced width θ, its definition does not contain a model quantity such as the channel radius.

[1] I.S. Shapiro, Teoriya priyamykh yadernykh reaktsii (Theory of Direct Nuclear Reactions), Gosatomizdat, 1963; Usp. Fiz. Nauk 92, 549 (1967) [Sov. Phys.-Usp. 10, 515 (1968)].
[2] E.I. Dolinskii, Izv. AN SSSR, ser. fiz. 34, 167 (1970).
[3] V.S. Popov, Zh. Eksp. Teor. Fiz. 47, 2229 (1964) [Sov. Phys.-JETP 20, 1494 (1965)].
[4] M.M. Al-Beidovi, L.D. Blokhintsev, E.I. Dolinskii, and V.V. Turovtsev, Vestnik MGU, ser. fiz.-astr. No. 6, 3 (1967).
[5] P.W. Allison and R. Smythe, Nucl. Phys. A121, 97 (1968).
[6] I. Borbei, E.I. Dolinskii, and V.V. Turovtsev, Yad. Fiz. 8, 492 (1968) [Sov. J. Nuc. Phys. 8, 287 (1969)].
[7] M.P. Locher, Nucl. Phys. B36, 634 (1972).

PHOTOPRODUCTION OF CHARGE PIONS ON NUCLEI AND VIOLATION OF THE VECTOR DOMINANCE MODEL

S.R. Gevorkyan[1] and A.V. Tarasov
Joint Institute for Nuclear Research

Submitted 24 July 1972
ZhETF Pis. Red. 16, No. 7, 418 - 420 (5 October 1972)

The cross sections for the photoproduction of charged pions on nuclei, calculated in [1] within the framework of the vector dominance model (VDM), using the approximate procedure for taking into account the effective nucleon numbers N^{eff} on the energy [2] are on the whole in satisfactory agreement with the experimental data [3]. However, when a more accurate account is taken of the energy dependence of N^{eff} (see Eq. (1) below) within the framework of the VDM, a noticeable discrepancy is observed between the predictions of the theory and experiment (see curve 1), thus indicating either violation of the VDM, or incorrectness of the scheme used to describe the interaction of the particles with the nuclei. An indication that the VDM is apparently violated should be the discrepancy between the values of the coupling constant $\gamma_\rho^2/4\pi$ obtained from an analysis of the photoproduction of $\pi^\pm$ mesons on nucleons [4] ($\gamma_\rho^2/4\pi \simeq 0.3$), and from the data on the photoproduction of ρ^0 mesons on nucleons [5] ($\gamma_\rho^2/4\pi \simeq 0.7$) observed in recent years. Consequently, the comparison of the theoretical calculations with the experimental data on the photoproduction of charged pions on nuclei can serve only as a verification of the theory of incoherent production of particles on nuclei. Assuming, just as in the VDM, that the amplitudes of the processes of photoproduction of particles on nucleons are proportional to

[1] Erevan Physics Institute.

the amplitudes of their production by ρ^0 mesons, but (unlike in the VDM) that the proportionality coefficients are different for different processes, and using the technique for calculating the cross sections of incoherent processes within the framework of the theory of incoherent production of particles on nuclei [6], we can obtain for the differential cross sections of the process $\gamma A \to \pi^+ A'$ the following expression:

$$d\sigma/dt = \frac{Z}{2A} \int \omega_0(\beta)\beta d\beta T_0(\sqrt{-t}\beta) N^{eff}(\beta),$$

$$N^{eff}(\beta) = \int d^2B \{ \int dz\, \rho(\mathbf{B},z) \exp[-(\sigma_\pi - \omega_\pi)\int_z^\infty \rho(\mathbf{B},z')dz'] -$$

$$- W \mathrm{Re}\, \sigma_\rho' \int dz_1 dz_2\, \rho(\mathbf{B},z_1)\rho(\mathbf{B},z_2) \exp[i\Delta(z_1 - z_2) -$$

$$-\left(\frac{\sigma_\rho'}{2}\right)\int_{z_1}^{z_2} \rho(\mathbf{B},z')dz' - (\sigma_\pi - \omega_\pi)\int_{z_2}^{\infty} \rho(\mathbf{B},z')] + W^2 \times$$

$$\times [\omega_\rho \int dz_1 dz_2\, \rho(\mathbf{B}_1 z_1)\rho(\mathbf{B},z_2) \exp[-(\sigma_\rho - \omega_\rho)\int_{z_1}^{z_2}\rho(\mathbf{B},z')dz' -$$

$$-(\sigma_\pi - \omega_\pi)\int_{z_2}^{\infty}\rho(\mathbf{B},z')dz'] + \mathrm{Re}\,\sigma_\rho'\left(\frac{\sigma_\rho'}{2} - \omega_\rho\right)\int dz_1 dz_2 dz_3 \times$$

$$\times \rho(\mathbf{B},z_1)\rho(\mathbf{B},z_2)\rho(\mathbf{B},z_3) \times \exp[i\Delta(z_1 - z_2) - \frac{\sigma_\rho'}{2} \times \tag{1}$$

$$\times \int_{z_1}^{z_2}\rho(\mathbf{B},z')dz' - (\sigma_\rho - \omega_\rho)\int_{z_2}^{z_3}\rho(\mathbf{B},z')dz' - (\sigma_\pi - \omega_\pi)\int_{z_3}^{\infty}\rho(\mathbf{B},z')dz']]\},$$

where

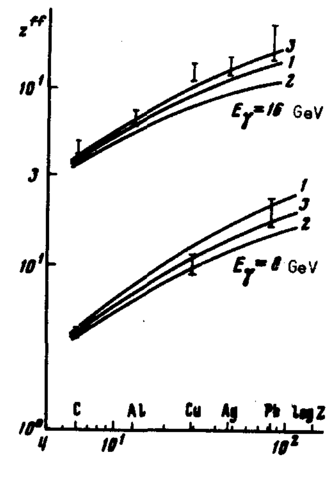
$$W = \frac{f(\gamma N \to \rho^0 N) f(\rho^0 p \to n\pi^+)}{f(\rho^0 N \to \rho^0 N) f(\gamma p \to \pi^+ n)}, \quad \sigma_{\pi(\rho)}' = \frac{4\pi}{ik} f(0)_{\pi(\rho)N \to \pi(\rho)N},$$

$$\omega_x \equiv \omega_x(\beta) = \int \frac{d\sigma_x}{dt}(t)\, I_0(\sqrt{-t}\beta)\, dt, \quad x = 0, \pi, \rho. \tag{2}$$

The figure shows the values of the quantities

$$Z^{eff} = \frac{d\sigma}{dt}(\gamma A \to \pi^+ A') \Big/ \frac{d\sigma}{dt}(\gamma N \to \pi^+ N),$$

calculated in accordance with formula (1) assuming the VDM to be valid ($W = 1$, curve 2) and violated ($W = 0.7$, curve 3) at energies $E_\gamma = 86$ eV and $E_\gamma = 166$ eV, and at a momentum transfer $t = -0.45\ (\mathrm{GeV}/c)^2$. Curve 1, which is shown for comparison, corresponds to calculations within the framework of the VDM using the interpolation formula of [2]. The experimental points were taken from [3]. It was assumed in the calculation that $\sigma_\rho = \sigma_\pi$ and $\alpha_\rho = \alpha_\pi = 0$. The slopes of the differential cross sections, in the case of π^+-meson photoproduction and elastic scattering, were assumed to be $a_{\gamma\pi} = 2.5\ (\mathrm{GeV}/c)^{-2}$ and



$a_{\pi\pi} = 8\ (\text{GeV/c})^{-2}$, respectively. As seen from the figure, a more accurate allowance for the energy dependence of N^{eff}, together with allowance for the violation of the VDM (curve 3), results in the best agreement between theory and experiment. In our opinion, this agreement confirms the correctness of the fundamental principles on which the theory of incoherent processes, developed in [6], is based. This makes it possible to apply this theory to the analysis of incoherent production of unstable particles and to determine the characteristics of their interaction with nucleons.

The authors thank G.A. Vartapetyan, L.I. Lapidus, and S.G. Matinyan for valuable remarks and stimulating discussions.

[1] G. von Bochmann, B. Margolis, and C.L. Tang, Phys. Rev. Lett. 24, 483 (1970).
[2] K. Gottfried and D.R. Yennie, Phys. Rev. 182, 1595 (1969).
[3] A.M. Boyarski et al., Phys. Rev. Lett. 23, 1343 (1969).
[4] R. Diebold and J. Poirier, Phys. Rev. Lett. 22, 906 (1969).
[5] J. Park et al., Nucl. Phys. B36, 404 (1972).
[6] S.R. Gevorkyan and A.V. Tarasov, JINR Preprints R2-2752 and R2-5864.

STABILITY OF A TOKAMAK WITH A NON-ROUND PLASMA-LOOP CROSS SECTION

L.S. Solov'ev
Submitted 26 July 1972
ZhETF Pis. Red. 16, No. 7, 420 - 423 (5 October 1972)

In connection with the interest aroused by Tokamaks with quasi-elliptic cross sections [1], it is timely to discuss some questions involved in the stability of such systems, and in particular the resultant limitation on the plasma pressure.

The destabilizing factors responsible for the hydromagnetic instability of the plasma are, generally speaking, the pressure gradient and the longitudinal current in the plasma torus, and the stability conditions impose limitations on both these quantities. The conditions of local stability for configurations in which the plasma pressure falls off away from the magnetic axis turn out to be most critical in the vicinity of the magnetic axis. For a system of the Tokamak type, Mercier's necessary stability criterion [2, 3] and the sufficient criterion [4, 5] (derived for arbitrary toroidal configurations) reduce in this case, respectively, to the conditions

$$\frac{A-(1+\epsilon/2)(1+\epsilon)x^2}{R^2} - \frac{2\epsilon^2\beta}{(1+\epsilon+\sqrt{1-\epsilon^2})^3 a^2 x^2} > 0, \qquad (1)$$

$$\frac{A-(1+\epsilon/2)(1+\epsilon)x^2}{R^2} - \frac{\beta}{(1+\epsilon)^2 a^2 x^2} > 0. \qquad (2)$$

The first terms, which are the same in both criteria, describe the magnetic well ($\sim -V''(\phi)$, where ϕ is the longitudinal magnetic flux)

$$x = \frac{jR}{2B}, \quad A = 1 + \frac{3\epsilon}{4}(1+\Gamma) \qquad (3)$$