then the argument of the exponential in (6) turns out to be universal for all elastic and inelastic processes. An experimental confirmation of such a possibility would be highly interesting. The value $\phi = \pi/2$ agrees well, as shown in [2], with p-p scattering data.

[1] K. A. Ter-Martirosyan, ITEF Preprint No. 417, 1967.

[2] A. A. Ansel'm and I. T. Dyatlov, YaF 6, 1967, in press.

[3] V. N. Gribov, I. Ya. Pomeranchuk, and K. A. Ter-Martirosyan, YaF 2, 361 (1965), Soviet JNP 2, 258 (1966).

*This condensation was pointed out, in connection with [3], by Gribov, Pomeranchuk, and Ter-Martirosyan back in 1964.

UNIVERSAL INTERACTION OF REGGE PARTICLES WITH VECTOR AND SCALAR CURRENTS

A. A. Migdal

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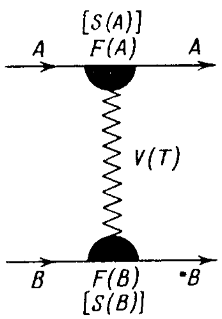
Recently Cabibbo, Horwitz, and Ne'eman [1] advanced the hypothesis that Regge particles corresponding to vector and tensor mesons (V and T reggeons) interact with vector and scalar currents:

$$F_i(A) = \langle A \,|\int d^3x\, \bar{q}(x)\gamma_0 \lambda_i q(x)|\, A\rangle, \tag{1}$$

$$S_i(A) = \langle A \,|\int d^3x\, \bar{q}(x)\lambda_i q(x)|\, A\rangle. \tag{2}$$

Here $F_i(A)$ and $S_i(A)$ are the vertices for the emission of a reggeon V_i or T_i by a particle A; the 4-momentum of the reggeon is assumed equal to zero; $i = 0, 1, \ldots, 8$ is the unitary index; $q(x) = (p, n, \lambda)$ is the quark field operator; γ_0 is a Dirac matrix; λ_i are Gell-Mann matrices ($\lambda_0 = \sqrt{2/3}\,\ell$); the matrix element in (2) is chosen, by definition, in the rest frame of particle A. The normalization of $|A\rangle$ is such that for quarks $F_i(q) = S_i(q) = \lambda_i$.

The contribution of the Regge pole to the scattering amplitude of particles A and B corresponds to the diagram shown in the figure, and the corresponding contribution to the total



The scattered particles exchange a V or T reggeon (wavy line). The reggeon emission vertices F(A), F(B) or S(A), S(B) are blackened.

cross section σ^t_{AB} from the V and T reggeons is, as is well known [2],

$$\sigma^t_{AB}(s) = s^{-1}\sum_{i=0}^{8} S_i(A)S_i(B)(s/\nu_i^s)^{\alpha_i^s} - F_i(A)F_i(B)(s/\nu_i^v)^{\alpha_i^v}. \tag{3}$$

Here s is the invariant square of the cms energy; α_i^v and α_i^s are the values of the trajectory of reggeon i at zero momentum transfer; ν_i^v and ν_i^s are factors with dimensions of the mass squared, which by definition do not depend on the scattered particles A and B.

2. The interaction (1) and (2) was considered in [1,3] within the framework of the non-relativistic quark model. To obtain agreement with experiment, it was necessary to forego the hypothesis that the cross sections are constant: the best agreement with experiment was obtained by choosing in (3) $\alpha_f = 0.92$ in lieu of $\alpha_f = 1$ for the Pomeranchuk f-pole.

The purpose of the present note is to consider the interaction (1) and (2) without the aid of the quark model and to show that this eliminates the contradiction with the hypothesis of constant cross sections.

To this end we assume that the SU(3) symmetry breaking operator belongs to the same octet as the operators (2) (such an addition to the Hamiltonian corresponding to making the λ-quark heavier). Then S_8 coincides, accurate to an inessential common factor, with the addition to the mass of first order in SU(3) breaking:

$$S_8(\text{baryon}) = M - M_0, \quad S_8(\text{meson}) = (m^2 - m_0^2)/2m_0. \tag{4}$$

Here $M_0 = (\Sigma + \Lambda)/2$ and $m_0 = (\eta^2 + \pi^2)/2$ are the unperturbed masses. Hence, knowing the constants f and d for the mass formulas, it is easy to obtain the remaining S_i with $i \neq 0$ using the SU(3) transformation of formula (4).

It is well known that the vector constants F_i are not renormalized (see [4]), so that the result of the quark model remains unchanged here:

$$F_\omega = Y + 2B, \; F_\rho = 2T_{1,2,3}, \; F_\phi = \sqrt{2}(Y - B). \tag{5}$$

Here T_i is the isospin, B the baryon charge, and Y the hypercharge,

$$F_\omega = \sqrt{2/3}F_0 + \sqrt{1/3}F_8, \; F_\phi = -\sqrt{1/3}F_0 + \sqrt{2/3}F_8.$$

The theoretical accuracies of (4) and (5) differ: (4) has the SU(3) symmetry accuracy $\sim$ 20% for mesons and $\sim$ 10% for baryons, while (5) contains exact relations.

3. Let us compare the obtained formulas with experiment.

Table I

	Theory	Reduction of exptl. data
$F_\rho(p)/F_\rho(\pi^+)$	0,5	0.7 ± 0.4
$F_\omega(p)/F_\omega(K^+)$	3	3.0 + 0.2
$F_\rho(p)/F_\rho(K^+)$	1	1.2 ± 0.8

Table II

	Theory	Reduction of exptl. data
$-S_8(p)/S_8(K^-)$	2.3	2.8
$-S_8(\pi^-)/S_8(K^-)$	2.0	1.6
$-S_3(p)/S_8(K^-)$	0.8	0.7
$-(\pi^-\|S_+\|\eta)/S_8(K^-)$	2.6	3.0
$-S_3(K^-)/S_8(K^-)$	2.3	2.8

In Table I we compare with experiment formulas (5) for F_ρ and F_ω; according to (5) $F_\phi = 0$ for nucleons, whereas experiment yields $F_\phi \sim F_\omega/6$ (V. Mel'nikov, private communication). The ratios in Table I do not depend on the factors ν_ρ and ν_ω in (3). The empirical values were taken from [2].

In Table II we compare with experiment the relations between the constants, following from formulas (4). In calculating $(\pi^-|S_+|\eta)$ we took the η-X mixing into account (for details see [5]). The empirical values of S_i in Table II were taken from [2], with due allowance for f-f' mixing with an angle $\theta = 30°$, i.e., the same as for the f and f' mesons [6]. In addition, the constants S_i turned out to be sensitive to the choice of $\nu_8{}^s/\nu_3{}^s$ in formula (3), and therefore this ratio was chosen to agree with experiment; $\nu_8{}^s \sim \nu_3{}^s$ in order of magnitude, as required by SU(3) symmetry.

We emphasize that the constants S_i used by us were obtained in [2] by reduction of experimental data under the assumption that the cross sections are constant, $\alpha_f = 1$. Therefore the fact that theory and experiment agree in Table II within the ∼20% accuracy of SU(3) symmetry means that that there is no contradiction whatever between the hypothesis of universal interaction of the T reggeons (2) and the hypothesis of constant cross sections.

Thus, the hypothesis of the universal interaction of the reggeons with vector and scalar currents has so far been well justified.

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CONTRIBUTION OF UNPAIRED PARTICLE TO THE DEFORMATION OF THE NUCLEUS

E. E. Berlovich and Yu. N. Novikov
A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences
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It was shown in [1] that the experimental values of the internal quadrupole moments θ_0 of certain odd deformed nuclei differ greatly from the values of θ_0 of the preceding even-even nuclei. These changes in the quadrupole moments, which are due to the presence of unpaired particles, reach about 10 - 20% in some cases. The contribution to the quadrupole moment is positive in some cases and negative in others.

It is possible to estimate the contribution of the odd particle to the deformation of the nucleus by calculating the equilibrium deformations of the odd and preceding even-even nculei. We have minimized the sum of the doubly-degenerate single-particle energies corresponding to the Hamiltonian

$$H = T_{\rm kin} + \frac{M}{2}\omega_0^2(\epsilon)\, r^2(1 + \epsilon P_2(\cos\theta)) - c\,\mathbf{l}\,\mathbf{s} - D[\mathbf{l}^2 - \langle \mathbf{l}^2 \rangle_{\rm shell}],$$

where ω_0 is the oscillator frequency, ϵ the deformation parameter, and C and D are parameters that are the same for all shells of like nucleons in the investigated nucleus. This Hamiltonian was proposed in [2] and represents a modification of the universally known expression used in [3].