In this case, however, there should be a considerable excess of γ quanta in the region $E_\gamma \sim 100$ MeV, something apparently not observed. b) The quanta in the energy region >50 keV experience, as a result of the direct Compton effect, absorption within the sources or in the intergalactic space.

However, since the cross section of the Compton effect decreases with energy like $\sim \ln E_\gamma/E_\gamma$ (at $E_\gamma >> mc^2$), this effect will be negligibly small when $E_\gamma >> mc^2$, and consequently should not affect the energies $E_\gamma \sim 100$ MeV, where the observations do not contradict the representation of the spectrum by a single power-law curve in the entire interval 0.1 - 1000 MeV. Nor is it helpful that at $E_\gamma > 2mc^2$ pair production sets in, in which photons are also absorbed, since the cross section of this process on hydrogen is smaller than the Thompson cross section by more than one order of magnitude. The question of the break in the region $E_\gamma \sim 10 - 100$ keV calls for an additional analysis.

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VERIFICATION OF THE MODELS OF THE ASYMPTOTIC BEHAVIOR OF THE AMPLITUDES OF $K^{\pm}p$ SCATTERING

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Experimental data on the total cross section of K^-p scattering above 20 GeV [1] do not agree with extrapolation of the parametrizations at lower energies, obtained on the basis of a sum of several Regge poles [2, 3]. Recently proposed models make it possible to parametrize properly the new data, but call for the presence of either Regge cuts [4] or for terms that violate the Pomeranchuk theorem [5 - 8]. Consequently, there is at present great ambiguity in the theoretical description of the $K^{\pm}p$ scattering at high energies. It is shown in the present paper that by using a simple sum rule it is possible to limit considerably the number of different parametrizations.

Let $F_\pm(\omega)$ be the amplitudes of forward $K^{\pm}p$ scattering in the laboratory system, satisfying the optical theorem

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$$\sigma_{\pm}(\omega) = 4\pi \mathrm{Im} F_{\pm}(\omega)/k,$$

where $\omega^2 = k^2 + m_k^2$. Using the well-known properties of analyticity and crossing symmetry of the amplitudes [9] and applying the Cauchy theorem to $F_-(\omega)$ along a closed contour consisting of the straight-line segment $-W + i\varepsilon \lesssim \omega \lesssim W + i\varepsilon$ $(\varepsilon \to 0+)$ and the semi-circle $S(W)$, where $\omega = W \exp(i\phi)$, $0 \leq \phi \leq \pi$, we can obtain the sum rule

$$\frac{1}{4\pi}\int_{m_K}^{W} k\,[\sigma_-(\omega) - \sigma_+(\omega)]\,d\omega + \int_{\omega_{\pi\lambda}}^{m_K} \mathrm{Im} F_-(\omega)\,d\omega - 0{,}19\,G^2 \simeq R(W), \tag{1}$$

where $G^2 = g_\lambda^2 + 0.84\, g_\Sigma^2$, g_Y is the KNY coupling constant, and

$$R(W) = -\,\mathrm{Im}\int_{S(W)} F_-(\omega)\,d\omega. \tag{2}$$

Equation (1) is analogous to the standard sum rule at finite energies [10]. Its derivation, however, does not require any assumptions concerning the asymptotic behavior of the amplitudes.

For $W \leq 20$ GeV, the first integral in (1) can be calculated on the basis of the experimental data on $\sigma_\pm$. References to them can be found in [9]. For $W \geq 10$ GeV, the contribution of the second and third terms in (1) does not exceed several per cent of the contribution of the first term, so that the left side of Eq. (1) is not sensitive to the models on the basis of which these terms are calculated. For concreteness, the integral in the non-physical region $\omega_{\pi\lambda} \leq \omega \leq m_K$ was calculated using the K^-p scattering length given in [11]. The values of the coupling constants were taken from a recent paper [12], namely $G^2 = 8.8 \pm 3.0$, which agrees with the earlier estimates [9].

From Eq. (2) for each considered model of $F_\pm(\omega)$ it is necessary for $|\omega| \geq W$ to make a definite prediction of the values of $R(W)$. For different models, at three values of W, the table lists a comparison of the values of $R(W)$ (in natural units) with the values of the left side of Eq. (1). The degree of violation of the Pomeranchuk theorem in each model is characterized by the predicted difference of the asymptotic cross sections $\Delta\sigma \equiv \sigma_-(\infty) - \sigma_+(\infty)$. It is clear from the results listed in the table that $R(W)$ is quite sensitive to the choice of the model. In particular, the sum rule cannot be reconciled in any way with the hypothesis [7, 8] that the cross section $\sigma_\pm$ reach their asymptotic limits $\sigma_\pm(\infty)$ already at 20 GeV. This extreme hypothesis also gives the poorest agreement with a certain parameter obtained by a model-independent method [13] and describing the asymptotic behavior of $F_\pm(\omega)$.

Reference	$\Delta\sigma$, mb	R, 10 GeV	R, 16 GeV	R, 20 GeV
[2] 1)	0	82	168	236
[3] 1)	0	75	145	198
[4] 1)	0	78	150	205
[5] 1)	2,5	91	193	277
[6]	2,1 ±0,3	64 ±6	137 ±13	198 ±18
[7, 8] 2)	3,7 ±0,5	–	–	152 ±21
Left side of Eq. (1)		73 ±2	176 ±3	234 ±7

1) The parameter errors are not given.
2) The sum rule is not applicable in this case for W < 20 GeV.

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CHIRAL DYNAMICS OF A_1-ρ-π SYSTEM

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1. A constructive method of extracting the consequences of current algebra is the method of effective Lagrangians [1 - 5]. Our remark consists of the fact that in the usual chiral scheme for the A_1-ρ-π system [3 - 5] there is an arbitrariness connected with the presence in the Lagrangian of different terms with three and four field derivatives. In the present paper we construct an effective interaction Lagrangian of the A_1-, ρ-, and π-mesons containing not more than two derivatives in each term and giving the minimum (≤ 2) degree of the 4-momenta in all the vertices. The limitation of the dependence of the contact vertices on the 4-momenta leads to reasonable physical consequences, for example, the frequently discussed anomalous magnetic moment δ of the A_1 meson is equal to -1.

2. Assume that we have in the $SU_2 \times SU_2$ group a linearly-transforming vector in axial-vector field $\vec{\rho}_\mu$ and $\vec{a}_\mu$, and also a pion field $\vec{\pi}$ with a non-linear transformation law [1, 2]

$$\delta \vec{\pi} = - \vec{\alpha} \times \vec{\pi} + f_\pi \vec{\beta} \sigma, \quad \sigma = (1 - \vec{\pi}^2/f_\pi^2)^{1/2} , \tag{1}$$

where $\vec{\alpha}$ and $\vec{\beta}$ are infinitesimal parameters and $f_\pi \approx 95$ MeV is the pion decay constant. Then the pions enter in the Lagrangian via the covariant derivative [1 - 5]:

$$\nabla_\mu \pi^a = \{\delta_{ab} + [f_\pi^2 \sigma (1+\sigma)]^{-1} \pi^a \pi^b\} (D_\mu \pi^b + g f_\pi \sigma a_\mu^b), \tag{2}$$

where a, b = 1, 2, 3 and $D_\mu \vec{\pi} = \partial_\mu \vec{\pi} - g\vec{\rho}_\mu \times \vec{\pi}$.

The invariant $(\nabla_\mu \vec{\pi})^2$ contains a non-physical bilinear coupling $\vec{a}_\mu \partial_\mu \vec{\pi}$, which is usually eliminated from L by introducing a new field