When $v_{ph}$ approaches $c/\gamma_0$, the amplitude $E_{max\ max}$ increases rapidly, but remains bounded, since by virtue of condition (1) $v_{ph}$ cannot be arbitrarily close to $c/\gamma_0$. Using this condition and the dispersion equation (5) we can obtain an estimated upper bound for $E_{max\ max}$:

$$\frac{E^2_{max\ max}}{8\pi} \sim n_0 \mathcal{E}_0 \frac{\omega_0^2 a^2}{c^2}. \tag{9}$$

Since $\omega_0 a/c >> 1$, the maximum energy of the electric field of the wave greatly exceeds the beam energy.

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# POSSIBLE VERIFICATION OF THE POMERANCHUK THEOREM IN Kd INTERACTIONS

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According to recent experiments performed at Serpukhov [1], there is an unexpectedly large difference between the total cross sections of $K^+$ and $K^-$ mesons on protons and deuterons. This situation casts doubts on the validity of the Pomeranchuk theorem [2]. Since the dispersion relations (d. r.) impose strong limitations on the energy dependence of the real and imaginary parts of the scattering amplitudes, it is possible to use the experimental information on the phase shifts of the forward amplitudes at the energies attainable in contemporary accelerators, in order to clarify the character of the behavior of the total cross sections at higher energies.

In [3] we used d.r. to predict the phase shifts of the amplitudes of $K^\pm p$ and $K^\pm n$ scattering and the amplitude of $K^0$-meson regeneration on protons, assuming that the approximately-constant values of the total cross sections, measured in Serpukhov [1], constitute the asymptotic values. Similar reasoning for $K^\pm d$ scattering makes it possible to carry out an additional independent verification of the Pomeranchuk theorem. Owing to the absence of models for the description of the amplitudes in the low-energy and asymptotic energy regions, the d.r. for $K^\pm d$ scattering was not used before.

The amplitudes $f_\pm = D_\pm + iA_\pm$ for $K^\pm d$ scattering forward satisfy the d.r. [4]

$$D_\pm(\omega) = I_\pm(\omega) + \frac{k^2}{4\pi^2}\int_{\omega_0}^{\infty}\frac{d\omega'}{k'}\left[\frac{\sigma_+(\omega')}{\omega' \mp \omega} + \frac{\sigma_-(\omega')}{\omega' \pm \omega}\right], \tag{1}$$

where all the quantities are expressed in the laboratory system. The terms $I_\pm$ contain unknown subtraction constants and dispersion integrals up to an energy $\omega_0$ = 0.79 GeV, above which the total cross sections $\sigma_\pm$ are known from experiment [4, 5]. Using the available data up to 20 GeV for $K^\pm d$ and up to 55 GeV

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for $K^-d$ scattering, and assuming constant values $\sigma_+ = (33.8 \pm 0.5)$mb and $\sigma_- = (39.8 \pm 0.5)$mb at higher energies, it is possible to calculate the integral terms in (1) exactly. From the explicit form of $I_\pm(\omega)$ [4], it follows that at high energies $I_\pm(\omega) \sim \pm C\omega$, where C is a certain constant. Such a dependence of $I_\pm$ on $\omega$ is sufficiently accurate already at several GeV [3]. A comparison of the prediction of (1) with recent experimental measurements of $D_-$ at k = 3 Gev/c [6] leads to a value $C = (-3.1 \pm 1.0)\ \mathrm{GeV}^{-2}$.

The table lists the values of $\alpha_\pm \equiv D_\pm/A_\pm$, $\alpha_{reg} \equiv \mathrm{Re}\, f_{reg}/\mathrm{Im}\, f_{reg}$, and $\phi_f \equiv \arg(if_{reg})$ obtained from (1). Here $f_{reg}$ is the amplitude of the regeneration of the $K^0$ mesons on deuterons, and is given by the formula $f_{reg} = f_+ - f_-$ as a result of the charge independence. Just as in the case of $K^\pm N$ scattering [3], the total errors of the quantities $\alpha_\pm$ and $\alpha_{reg}$, which are listed at the end of the table, are practically independent of the energy, since the main contribution to them is made by $I_\pm$. Moreover, these errors are in the main systematic, i.e., the values of $\alpha_\pm$ and $\alpha_{reg}$ have been determined with high accuracy apart from additive constants. There the value of $\alpha_{reg}$ is a more correct reflection of the magnitude of errors than the angle $\phi_f$ customarily employed as a parameter in regeneration analysis: It should be noted that the predictions of the phase of regeneration on deuterons are more reliable than the corresponding results [3] for regeneration on protons, since the calculation of $\alpha_{reg}$ depends in the case of protons on the data in $K^\pm n$ scattering and on the Glauber approximation [7].

| $\omega$, GeV | $\alpha_-$ | $\alpha_+$ | $\alpha_{reg}$ | $\phi_f$, deg |
|---|---|---|---|---|
| 6 | − 0.07 | − 0.03 | − 0.21 | $11^{+38}_{-47}$ |
| 25 | − 0.09 | 0.08 | − 1.10 | $47^{+24}_{-83}$ |
| 40 | − 0.11 | 0,10 | − 1.39 | $54^{+18}_{-76}$ |
| 70 | − 0.14 | 0,14 | − 1.71 | $59^{+14}_{-59}$ |
| 100 | − 0.15 | 0,17 | − 1.92 | $62^{+12}_{-50}$ |
| 200 | − 0.18 | 0,21 | − 2.36 | $67^{+9}_{-43}$ |
| 400 | − 0,21 | 0.25 | − 2.80 | $70^{+7}_{-23}$ |
| Errors | ± 0.13 | ± 0,15 | ± 1.70 | — |

If the Pomeranchuk theorem is valid, then an estimate of the phases of the Kd-scattering amplitudes can be obtained with the aid of the standard Regge-pole model for $K^\pm N$ scattering [8] and the Glauber formula [7] for $K^\pm d$ scattering, namely, $\alpha_-$ is nearly zero at all energies above several GeV, $\alpha_+$ approaches zero slowly from the side of negative values, and $\alpha_{reg}$ tends to a positive limit (i.e., the limit of $\phi_f$ is negative).

In our case, on the other hand, we should have, within the limits of errors, the inequalities $\alpha_- < 0$, $\alpha_+ > 0$, and $\alpha_{reg} < 0$ at all $\omega \gtrsim 70$ GeV[2] (see table). It is most probable that such a behavior takes place already at considerably

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[2] Similar calculations for KN scattering lead to the conclusion that these inequalities should hold, within the limits of errors, at $\omega \gtrsim 300$ GeV. However, owing to the overlap of the error corridors the results of the calculations of phases for the KN and Kd scattering are compatible.

lower energies. Consequently, measurement of the phases of the amplitudes on deuterons in the region of energies attainable by the Serpukhov accelerator would be a sensitive method of verifying the Pomeranchuk theorem. It is important to note that it would be particularly useful to determine the energy dependence of these phases, and not merely their values at one energy, since the predictions for each value of $\alpha_{\pm}$ and $\alpha_{\text{reg}}$ have been determined from the d.r. only accurate to an additive constant.

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## TEMPERATURE DEPENDENCE OF MOBILITY AND LONGITUDINAL MAGNETORESISTANCE OF p-Ge IN A STRONG MAGNETIC FIELD

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In order to study the electron-phonon interaction in germanium, we undertook a measurement of the temperature dependence of the mobility of p-Ge in a strong magnetic field up to 100 kOe in the temperature interval 62 - 200°K.

The experimental and theoretical study of the electron-phonon interaction in germanium has been the subject of a number of papers, a review of which is given in [1]. The reason for the interest in this question is the fact that the mobility $\mu(T)$ in p-Ge varies like $\mu(T) \sim T^{-2.3}$ in the temperature interval 125 - 300°K, whereas in N-Ge the variation is $\mu(T) \sim \mu T^{-1.6}$. A theory that takes into account the scattering of the carriers by the deformation potential of the lattice yields, in the case of a single-valey semiconductor, the relation $\mu(T) \sim T^{-1.5}$, which is close to that observed in the case of n-Ge, although the latter is a many-valley semiconductor. A rigorous theoretical analysis of the temperature dependence of the mobility in a real semiconductor is quite difficult, since the theory includes unknown constants of the interaction between the electrons and the acoustic or optical phonons, as well as the constants of the intervalley scattering. These are usually determined by fitting the theoretical dependence of the mobility of that observed in the experiment. The mobility dependence $\mu(T) \sim T^{-2.3}$ in p-Ge is attributed to the strong interaction between the holes and the optical phonons. It must be borne in mind here, however, that a distinguishing feature of p-Ge is the presence of two types of holes, light with an effective mass $m_1 \simeq 0.04m_0$ ($m_0$ is the free-electron mass), and heavy with mass $m_2 \simeq 0.3m_0$.

In the analysis of the temperature dependence $\mu(T)$ in p-Ge, no account was taken of the influence exerted on the mobility by each type of hole separately. The mobility of p-Ge in the presence of one type of hole can be experimentally measured in a strong magnetic field. If a strong field of