$H_0 \approx 5 \times 10^3$ Oe and then $\hbar\omega_c \sim kT$. At nitrogen temperatures we obtain for the foregoing n-InSb densities $\tau \sim 10^{-11} - 10^{-12}$ sec, i.e., the condition $\omega_c\tau > 1$ satisfied.

Let us consider RS from optical phonons in semiconductors. For the cross section for anti-Stokes scattering from longitudinal optical phonons with a large frequency shift we obtain

$$(d\sigma/d\Omega)_2 = A(\theta,\phi)r_0^3\frac{a^4}{m_0}\frac{\hbar}{\omega_{opt}}n^2\frac{\epsilon(\omega_1)}{\epsilon(\omega_2)}\frac{\omega_1^i}{\omega_1^4+\Delta\Omega^2\omega_1^2}\exp-\frac{\hbar\omega_{opt}}{kT}\left(1-\frac{\epsilon_\infty}{\epsilon_0}\right),$$

where ω_{opt} is the frequency of the optical phonon, $\Delta\Omega$ the line width of the optical phonon, ε_0 and ε_∞ the static and high-frequency dielectric constants respectively, $A(\theta, \phi)$ a numerical coefficient that depends on the angle θ between the propagation directions of the incident and scattered radiation and the angle ϕ between $\vec{e}_1$ and $\vec{e}_2$; when $\phi \sim \theta \sim \pi/2$ we have $A(\theta, \phi) \sim 3$.

As an estimate, we get for n-InSb, where the wavelength of the longitudinal optical phonons is $\lambda_0 \sim 51\ \mu$, at room temperatures at $n \sim 10^{17}\ cm^{-3}$, for incident radiation with wavelength $\lambda_1 \sim 100\ \mu$ a value $(d\sigma/dO)_2 \sim 2 \times 10^{-11}\ cm^{-1}$; the corresponding scattered radiation has a wavelength $\lambda_2 \sim 34\ \mu$.

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THE PROCESS $\gamma\pi \to \pi\pi$ IN THE VENEZIANO MODEL AND THE POSSIBILITY OF ITS STUDY IN THE REACTIONS $\pi \to 2\pi$ IN THE COULOMB FIELD OF NUCLEI

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In [1] we investigated the possibilities of experimentally investigating the processes of mesonic photoproduction by observing reactions of the type

$$P + Z \to P + P + Z \qquad (1)$$

(where P is a pseudoscalar meson and Z is the atomic nucleus) in the region of small momentum transfer. The separation of the Coulomb and nuclear reaction mechanisms was based on an estimate of the contribution of the diagram with ω-meson exchange, and was described on the basis of the assumption of a weak dependence of the $3P\gamma$ and $3P\omega$ vertices on the scattering angle in the c.m.s. of the two secondary mesons. This assumption is justified in the meson-pair effective-mass region $s \lesssim m_V^2$ (m_V - mass of vector resonance), where only the lower p-wave is important.

In this paper we determine, within the frameworks of the Venziano model (VM) and the vector-dominance model (VDM), the amplitude of the process

$$\gamma + \pi \to \pi + \pi; \qquad (2)$$

it turns out that the use of these models yields numerical results that differ little from the earlier estimates [1]. The matrix element of the reaction (2) is given by

$$M_{fi} = f_{3\pi\gamma}(s, t, u)\, \xi_{\alpha\beta\gamma}\, \xi_{iklm}\, e_i\, p_k\, p_{1l}\, p_{2m}, \tag{3}$$

where p, p_1, and p_2 are the 4-momenta of the pions, e_i is the polarization of the isoscalar photon; α, β, and γ are isotopic indices; the variables s, t, and u are connected by the relation $s + t + u = 3\mu^2$. The vertex function at the symmetrical point of the Mandelstam plane should be written, from symmetry considerations, in the $f_{3\pi\gamma}(\mu^2, \mu^2, \mu^2) = \sqrt{\alpha}\,\mu^{-3}\Lambda$, where $\Lambda \sim 1$ ($\alpha = 1/137$). Allowance for only the ρ-pole contribution in all three channels yields $\Lambda \simeq 1.3$ (we use the following coupling constants: $f^2_{\rho\pi\pi}/4 \simeq 2.5$, and $f_{\rho\pi\gamma} \simeq 1.1\mu^{-1}\sqrt{\alpha}$ corresponds to $\Gamma_{\rho\pi\gamma} \simeq 700$ keV [2]). The results of various workers [1, 3] do not contradict the estimate $\Lambda \sim 1$, with the exception of [4] ($\Lambda = 0.05 \div 0.15$) and of a recent article [5] in which the technique of "hard" pions (two out of the three pions were chosen, however, with $p^2 = 0$) yielded $\Lambda = 0.03$. The dynamic mechanism capable of leading to such a large deviation of $f_{3\pi\gamma}$ at small s, t, and u from the value that follows from simple dimensional considerations is not clear.

The Regge-pole theory predicts for the amplitude $f_{3\pi\gamma}(s, t, u)$ as $s \to \infty$ and at fixed t an asymptotic form $s^{\alpha_t - 1}$, where α_t is the trajectory of the ρ pole in the t channel. Since the vertices $3\pi\gamma$ and $3\pi\omega$ are characterized by identical quantum numbers and asymptotic forms, it is natural to apply the VM to the description of the process (2). In the VM, the amplitude of the process $\pi\omega \to \pi\pi$ [6]

$$f_{3\pi\omega}(s,t,u) = \frac{\beta}{\pi}\left\{\frac{\Gamma(1-\alpha_s)\Gamma(1-\alpha_t)}{\Gamma(2-\alpha_t-\alpha_s)} + \frac{\Gamma(1-\alpha_u)\Gamma(1-\alpha_t)}{\Gamma(2-\alpha_u-\alpha_t)} + \frac{\Gamma(1-\alpha_s)\Gamma(1-\alpha_u)}{\Gamma(2-\alpha_s-\alpha_u)}\right\} \tag{4}$$

does not contain false poles with an even angular momentum, and has a Regge asymptotic behavior only if the following condition is satisfied

$$\alpha_s + \alpha_t + \alpha_u = 2. \tag{5}$$

To describe the photoproduction reaction (2) it is necessary to go to the limit as $m^2_\omega \to 0$, and then condition (5) becomes

$$\alpha_s + \alpha_t + \alpha_u = 3/2 \tag{6}$$

since $\alpha(\mu^2) = 1/2$ [7], which leads to a loss of the realistic properties of the amplitude (4). We must therefore use a different form of the amplitude, which permits an analytic continuation in the particle masses, to describe the process (2). We choose for this purpose the form proposed by Virasoro [8]

$$A(s,t,u) = \frac{\beta}{\sqrt{\pi}}\, \frac{\Gamma\left(\frac{1-\alpha_s}{2}\right)\Gamma\left(\frac{1-\alpha_t}{2}\right)\Gamma\left(\frac{1-\alpha_u}{2}\right)}{\Gamma\left(1-\frac{\alpha_s+\alpha_t}{2}\right)\Gamma\left(1-\frac{\alpha_s+\alpha_u}{2}\right)\Gamma\left(1-\frac{\alpha_t+\alpha_u}{2}\right)}, \tag{7}$$

which goes over into (4) if the condition (5) is satisfied, and has the correct asymptotic form as $m_\omega^2 \to 0$. The constant $\beta \approx 0.74\mu^{-3}$ is obtained by expanding the amplitude (7) near the point $s = t = u = \mu^2 + m_\omega^2/3$ and comparing with the number of events on the Dalitz plot [9] in the vicinity of this point for the decay $\omega \to 3\pi$. Separating in (7) the contribution of the ρ pole, we obtain $f_{\omega\rho\pi} \approx 18.3$ GeV^{-1}, which agrees with the result of [10]. Recently in [11], by integrating over the entire phase volume of the $\omega \to 3\pi$ decay, it was found that $f_{\omega\rho\pi} \approx 21.5$ GeV^{-1}, which agrees with [12] (this corresponds to $\beta \approx 0.82\mu^{-3}$).

To determine the proportionality constant in the amplitude $f_{3\pi\gamma}$, we use the relation that follows from the VDM,

$$f_{3\pi\gamma} = e/2\gamma_\omega \lim_{m_\omega^2 \to 0} f_{3\pi\omega}$$

(we neglect the contribution of the ϕ meson, since $f_{3\pi\phi} \ll f_{3\pi\omega}$) and then, recognizing that $\gamma_\omega^2/4\pi \approx 3.2$ [13] and $\beta \approx 0.82\mu^{-3}$, we get

$$f_{3\pi\gamma}(s,t,u) = \frac{0{,}13\sqrt{\alpha}}{\mu^3} \frac{\Gamma\left(\frac{1-\alpha_s}{2}\right)\Gamma\left(\frac{1-\alpha_t}{2}\right)\Gamma\left(\frac{1-\alpha_u}{2}\right)}{\Gamma\left(1-\frac{\alpha_s+\alpha_t}{2}\right)\Gamma\left(1-\frac{\alpha_s+\alpha_u}{2}\right)\Gamma\left(1-\frac{\alpha_t+\alpha_u}{2}\right)} \tag{8}$$

where the trajectories α_i are connected by relation (6). From this we get directly $f_{\rho\pi\gamma} \approx 1.1\mu^{-1}\sqrt{\alpha}$, in agreement with [2, 14], and $f_{3\pi\gamma}(\mu^2, \mu^2, \mu^2) \approx 1.1\mu^{-1}\sqrt{\alpha}$. Thus, the use of the VM in lieu of the VDM leads to reasonable quantitative results, making it possible to indicate on its basis the kinetic region where the Coulomb mechanism of reaction (1) predominates, and it is possible to obtain information concerning the cross section of the process (2). Using relation (6) and the linear approximation $\alpha_s = 0.483 + 0.885s$ for the ρ trajectory [7] we find that in the region of the Coulomb maximum with respect to q^2 [1] the electromagnetic mechanism predominates in the pion emission angle region $\lesssim 3°$, and the maximum differential cross section of process (1) occurs at emission angles that decrease from 2.2 to 0.8° when the initial pion energy increases from 10 to 70 GeV in the l.s., with the effective-mass region amounting to $10\mu^2 \lesssim s \lesssim 70\mu^2$. The total cross section of the process (2) at $s = m_\rho^2$ is 260 μb. Plots of the total and differential cross sections vs. s and the scattering angle will be presented in a detailed article.

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ERRATUM

In the article by G. I. Iroshnikov et al., Vol. 10, No. 3, p. 97, second line following Eq. (8), reads "...$f_{3\pi\gamma}(\mu^2, \mu^2, \mu^2) \simeq 1.1\mu^{-1}\sqrt{\alpha}$," should read: "... $f_{3\pi\gamma}(\mu^2, \mu^2, \mu^2) \simeq 1.1\mu^{-3}\sqrt{\alpha}$."