2. We assume that the current is an octet. We then obtain in addition to (1) and (2)

$$
\begin{aligned}
&2g(K_c^* K_c) + g(K_n^* K_n) = -3\mu\,(K^{*0}),\\
&g(\omega\pi) + \sqrt{3}\,g(\eta\rho) = 3g(\rho\pi) + 3\sqrt{3}\,g(\eta\omega) + 2\sqrt{2}\,g(\Phi\pi), \qquad (7)\\
&\mu(\rho^+) - \mu(K^{*+}) = 2\mu(K^{*0}).
\end{aligned}
$$

If we now leave out the terms with $T(189^8)$, we obtain the additional relation

$$g(K_c^* K_c) + 2g(K_n^* K_n) = \sqrt{2}\,g(\Phi\pi) + g(\omega\pi) - 6g(\rho\pi). \qquad (7a)$$

3. We take into account only that part of the medium-strong interaction, which is a scalar and a 35-plet. We obtain (1), (2), and

$$
\begin{aligned}
&g(\Phi\pi) = 0; \quad g(\omega\pi) = \mu(\rho^+),\\
&g(\rho\pi) - \mu(\rho^+) = g(K_c^* K_c) - \mu(K^{*+}) = g(K_n^* K_n) - \mu(K^{*0}).
\end{aligned} \qquad (8)
$$

Finally, if we again assume that the current is an octet, then we obtain the additional equalities given in (7), the first of which is equivalent to

$$g(\omega\pi) = 3g(\rho\pi). \qquad (9)$$

Thus, the broken SU(3) and SU(6) symmetries lead in the general case to the same relations. If we assume that the current is an octet, then both schemes give, generally speaking, different results. It is perfectly feasible to check these relations experimentally.

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[1] S. Badier and C. Bouchiat, Phys. Lett. 15, 98 (1965); L. D. Solov'ev, Phys. Lett. 16, 345 (1965); V. V. Anisovich et al., Phys. Lett. 16, 194 (1965); M. P. Rekalo, JETP Letters 1, No. 3, 31 (1965), translation p. 91 (the last reference contains errors).
[2] S. Okubo, The University of Rochester Report NYO-10254, 1963.
[3] J. J. Sakurai, Phys. Rev. 132, 434 (1964); T. K. Kuo and Tsu Yao, Phys. Rev. Lett. 13, 415 (1964).
[4] M. A. Beg and V. Singh, Phys. Rev. Lett 13, 418 (1964).

## INFLUENCE OF INTENSE LASER RADIATION ON THE DISPERSIVE PROPERTIES OF "TRANSPARENT" CRYSTALS

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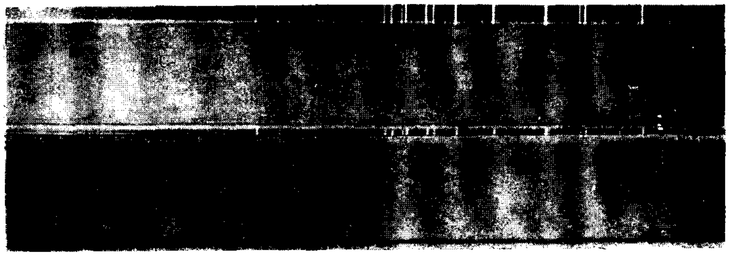
In a study of the conditions for self-trapping of a laser beam [1], for the generation of harmonics by different means [2], and for similar phenomena, an important role is played by the change induced in the dispersive properties of the medium by the action of the powerful laser light beam; the mechanisms of this change may generally speaking be different. We have observed such changes in spectral investigations of some semiconductor crystals, which are transparent in the ruby-laser radiation range, at the instant of a laser pulse.

To obtain the spectra, we used an ISSh-500 flash lamp with flash duration 2 - 3 μsec. A delay circuit made it possible to photograph the spectrum during different instants of the laser pulse. The latter was approximately 400 μsec long and had an energy 1.5 J. CdS crystals in the form of thin strips were fastened on a glass base. Besides the absorption edge, it was possible to distinguish on the spectrograms obtained at room temperature also the interference pattern due to multiple reflection. By photographing the spectrum at the instant of action of the laser pulse, with the laser beam partially focused, we observed a small but distinct shift of the interference fringes towards the longer wavelengths (see the Figure). These shifts corresponded to an approximate average increase of ~0.01 in the refractive index. Sharper focusing (spot diameter smaller than 1 mm) damages the irradiated section of the crystal.



It must be emphasized that a small shift of the interference pattern was observed also in the crystal regions next to the irradiated section. Within the limits of the height of the employed crystals (~4 mm), this shift was independent of the distance to the directly irradiated section.

Preliminary observations carried out on some ZnS samples, have shown that an equally noticeable shift takes place here, too.

With respect to the mechanism of the observed changes in the dispersive properties and absorption properties, all that can be advanced at the moment are some ideas. The changes pertaining directly to the irradiated section of the crystal can be connected with the action of the electric field of the light wave (the Franz-Keldysh effect [3]), and also with some heating of the crystal. It is probable that the observed shift is due to the influence of the elastic waves which may be produced. As to the changes in the non-irradiated section of the crystal, the situation is even less clear. There is no direct action of the electric field here. An explanation connected with the action of elastic factors is difficult, because the shift always has the same sign and there is no gradient of the shift along the height of the crystal. To attribute these changes to a temperature effect it is necessary to suggest some rapid heat-transfer mechanism. Thus, a final clarification of the mechanism of the described phenomena calls for further research.

It is interesting to note that the shift of the fringes on a spectrogram obtained almost directly before the instant of crystal breakdown was 30 - 40 $cm^{-1}$, i.e., there was no appreciable heating of the irradiated section of the crystal at that instant. On the other hand, on some spectrograms, several emission lines were obtained in the region from 25,500 to 19,500 $cm^{-1}$, and must apparently be identified with the Cd and Ca lines. The appearance of these lines must obviously be related to evaporation and heating to a high temperature (on the order of 10,000°C) of some amounts of crystal and base material. However, if the damage to the crystal is itself connected with some thermal effect, then its mechanism is complicated. It is more likely that the crystal damage begins as a result of an explosion connected with the appreciable heat released in sections of small dimensions, too small to appear in the spectra. Such local heating may result not only from single-photon absorption by different defects, but also from nonlinear effects of the type considered in [4].

[1] Chiao, Garmire, and Townes, Phys. Rev. Lett. 13, 479 (1964).
[2] P. A. Franken and J. F. Ward, Revs. Mod. Phys. 35, 23 (1963); A. M. Bonch-Bruevich and V. A. Khodovoi, UFN 85, 3 (1965), Soviet Phys. Uspekhi 8, 1 (1965).
[3] L. V. Keldysh, JETP 34, 1138 (1958), Soviet Phys. JETP 7, 738 (1958); W. Franz, Z. Naturforsch. 13a, 484 (1958).
[4] L. V. Keldysh, JETP 47, 1945 (1964), Soviet Phys. JETP 20, 1307 (1965).

## PHOTOPRODUCTION OF MESONS ON NUCLEONS AND SU(6) SYMMETRY

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In this note we indicate some consequences of SU(6) symmetry [1] for the processes of meson photoproduction on nucleons. It is assumed, as is customary [2], that the use of SU(6) symmetry is justified in the case of meson production in the s-state (accompanied by absorption of a $\gamma$-quantum of the electric dipole type). We can then write for the photoproduction amplitude

$$F = \bar{\Psi}^{A'B'C'}[\delta^A_{A'}\,\delta^B_{B'}\,\delta^C_{C'}\,M^D_E\,Q^E_D\,a_1 + 18a_2\,\delta^B_{B'}\,\delta^C_{C'}\,(M^A_D\,Q^D_{A'} + M^D_{A'}\,Q^A_D) + 18a_3\,\delta^B_{B'}\,\delta^C_{C'}\,(M^A_D\,Q^D_{A'} - M^D_{A'}\,Q^A_D) + a_4\,\delta^C_{C'}\,M^A_{A'}\,Q^B_{B'}]\,\Psi_{ABC}, \tag{1}$$

where $\Psi_{ABC}$ is a symmetrical tensor describing the baryons, and $M^A_{A'}$ is a second-rank tensor describing the mesons:

$$Q^A_{A'} \equiv Q^{i\alpha}_{i'\alpha'} = (\vec{\sigma}\cdot\vec{\epsilon})^i_{i'}\,Q^\alpha_{\alpha'}, \qquad Q^\alpha_{\alpha'} = \begin{pmatrix} 2 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}, \tag{2}$$

where $\vec{\epsilon}$ is the $\gamma$-quantum polarization vector. The amplitude (1) describes the observable photoproduction reactions of the following types:

$$\gamma + N \to B + P, \quad \gamma + N \to B^* + P, \quad \gamma + N \to B + V, \quad \text{and } \gamma + N \to B^* + V,$$

where B and $B^*$ are baryons from the octet or decuplet, while P and V are the pseudoscalar and vector mesons. We are interested in processes of the first two types, since the production of mesons in the s-state is described in this case by a single amplitude, corresponding to a