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 γ-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 Ψ_{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 γ-quantum polarization vector. The amplitude (1) describes the observable photoproduction reactions of the following types:

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

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 total angular momentum $I = 1/2$ for $\gamma + N \to B + P$ and $I = 3/2$ for $\gamma + N \to B^* + V$.

From (1) we obtain the following structure for the amplitudes of the processes $\gamma + N \to B + P$:

$$\begin{aligned}
&f_s(\gamma p \to n\,\pi^+) = a_2 + 3\,a_3 + 5\,a_4, && f_s(\gamma n \to p\,\pi^-) = a_2 - 3a_3 + 5\,a_4,\\
&f_s(\gamma p \to p\,\pi^0) = -\sqrt{2}\,a_2 + 4\sqrt{2}\,a_4, && f_s(\gamma n \to n\,\pi^0) = -2\sqrt{2}\,a_2 - \sqrt{2}\,a_4,\\
&f_s(\gamma p \to p\,\eta) = 3\sqrt{6}\,a_2 , && f_s(\gamma n \to n\,\eta) = 2\sqrt{6}\,a_2 + \sqrt{6}\,a_4,\\
&f_s(\gamma p \to \Sigma^+ K^0) = -10\,a_2 + 4\,a_4, && f_s(\gamma n \to \Sigma^- K^+) = 5\,a_2 + 15a_3 - 2\,a_4,\\
&f_s(\gamma p \to \Sigma^0 K^+) = \frac{5}{\sqrt{2}}\,a_2 + \frac{15}{\sqrt{2}}\,a_3 + \frac{1}{\sqrt{2}}\,a_4, && f_s(\gamma n \to \Sigma^0 K^0) = 5\sqrt{2}\,a_2 - \frac{1}{\sqrt{2}}\,a_4,\\
&f_s(\gamma p \to \Lambda\,K^+) = \sqrt{3/2}(a_2 + 3\,a_3 - 3\,a_4), && f_s(\gamma n \to \Lambda\,K^0) = -\sqrt{3/2}(2a_2 + 3\,a_4).
\end{aligned} \tag{3}$$

According to (3), the following relations hold between the amplitudes:

$$\begin{aligned}
&f_s(\gamma p \to n\pi^+) + f_s(\gamma n \to p\pi^-) = \sqrt{2}\,[f_s(\gamma p \to P\pi^0) - f_s(\gamma n \to n\pi^0)],\\
&f_s(\gamma p \to \Sigma^+ K^0) + f_s(\gamma n \to \Sigma^- K^+) = \sqrt{2}\,[f_s(\gamma p \to \Sigma^0 K^+) - f_s(\gamma n \to \Sigma^0 K^0)],
\end{aligned} \tag{4a}$$

which are valid at the level of the isotopic SU(2) symmetry,

$$\begin{aligned}
&f_s(\gamma p \to n\pi^+) = \sqrt{2}\,f_s(\gamma p \to \frac{\Sigma^0 - \sqrt{3}\,\Lambda}{2}\,K^+),\ f_s(\gamma p \to \Sigma^+ K^0) = \sqrt{2}\,f_s(\gamma p \to p\,\frac{\pi^0 - \sqrt{3}\,\eta}{2}),\\
&f_s(\gamma n \to n\,\frac{\pi^0 - \sqrt{3}\,\eta}{2}) = -f_s(\gamma n \to \frac{\Sigma^0 - \sqrt{3}\,\Lambda}{2}\,K^0),
\end{aligned} \tag{4b}$$

which are valid in SU(3) symmetry, and

$$\begin{aligned}
f_s(\gamma n \to n\eta) &= -\sqrt{3}\,f_s(\gamma n \to n\pi^0),\\
\sqrt{3}\,f_s(\gamma p \to p\eta) = f_s(\gamma p \to p\pi^0) - \sqrt{2}\,f_s(\gamma p \to \Sigma^+ K^0) &= 2f_s(\gamma n \to \Sigma^0 K^0) - f_s(\gamma n \to n\pi^0)\\
&= -f_s(\gamma p \to p\pi^0) - 4f_s(\gamma n \to n\pi^0),
\end{aligned} \tag{4c}$$

which are valid in only in SU(6) symmetry.

The most detailed data on photoproduction near threshold are available for pion production reactions. It is known that the production of neutral π^0 mesons is greatly suppressed, compared with the production of charged $\pi^\pm$ mesons. Thus, according to the electric dipole model

$$f_s(\gamma n \to n\pi^0) = 0, \quad |f_s(\gamma n \to p\pi^-)|/|f_s(\gamma p \to n\pi^+)|^2 = 1.3, \tag{5}$$

from which, assuming that a_2, a_3, and a_4 are real, we can readily obtain that

$$|f_s(\gamma p \to p\pi^0)|^2/|f_s(\gamma p \to n\pi^+)|^2 \simeq \frac{1}{100},$$

which is in good agreement with the predictions of the dipole model.

According to (5), the amplitudes a_2 and a_4 are considerably smaller than the amplitude a_3:

$$a_2/a_3 = -a_4/2a_3 \simeq \frac{1}{50}.$$

This leads to the following results: 1) The photoproduction of η mesons in the s-states should be suppressed; 2) the cross section for the production of Λ hyperons on a proton should greatly exceed the cross section for the photoproduction of Λ hyperons on a neutron; 3) many more charged K^+ mesons than neutral K^0 mesons should be produced in the reactions $\gamma + N \rightarrow \Sigma + K$.

We can also obtain expressions for the amplitudes of the processes $\gamma + N \rightarrow B^* + P$ in terms of the parameters a_2, a_3, and a_4. Leaving out the explicit forms of these expressions, we note only that the relations that follow from them for the amplitudes coincide fully with the relations which are valid in SU(3) symmetry, while the relations which are specific for the SU(6) symmetry intermix the amplitudes for baryon photoproduction and baryon resonances. If we retain only the amplitude a_3, we find that the cross sections for the production of charged mesons together with the isobar greatly exceed the cross sections for the production of neutral mesons - a perfectly natural fact from the point of view of the model of electric dipole absorption.

[1] F. Gursey and L. Radicati, Phys. Rev. Lett. 13, 173 (1964); A. Pais, Phys. Rev. Lett. 13, 175 (1964); B. Sakita, Phys. Rev. 136, B1756 (1964); Gursey, Pais, and Radicati, Phys. Rev. Lett. 13, 299 (1964).

[2] K. Johnson and S. B. Treiman, Phys. Rev. Lett. 14, 189 (1965); Blankenbecler, Goldberger, Johnson, and Treiman, ibid 14, 518 (1965); Carter, Coyne, and Meshkov, ibid 14, 523 (1965); V. Barger and M. H. Rubin, ibid 14, 713 (1965).

[3] W. Lock, Nuclear Physics of High-Energy Particles, Methuen, 1960.

FABRY-PEROT INTERFEROMETER FOR THE SHORT MILLIMETER AND SUBMILLIMETER BANDS WITH METALLIC GRIDS HAVING PERIODS SMALLER THAN THE WAVELENGTH

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We have made extensive use of elements which have a periodic structure with a period smaller than the wavelength [1)] in quasioptical installations with monochromatic generators of short millimeter and submillimeter waves. These elements are made of parallel metal wires stretched over metal rings. The condition $a > \lambda > l > 2r$ was satisfied, with a the inside diameter of the metal ring (aperture), λ the wavelength, l the period of the wires, and r the wire radius.

In particular, we have constructed a Fabry-Perot interferometer using such grids as mirrors. One grid of the interferometer was rigidly secured, and the other could be moved slowly, with the aid of a special precision mechanism, so that both grids [2)] remained parallel to each other. The interferometer could operate both in reflection and transmission. Such an interferometer has an unusually large bandwidth. Thus, a single model could be used for measure-