during the explosion of a wire in vacuum. The ionic currents drawn off from such a discharge must be hundreds of times smaller than the electronic currents, because the ratio of these currents with the same anode voltage is determined by the square root of the inverse ratio of the masses bearing the charges, which is also confirmed in the works considered.

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(γ, p) Reactions Associated with the Formation of Ground State Nuclei

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DURING the last few years a great deal of confirmation has been obtained for the existence of the so-called "giant" resonance in photonuclear reactions [such as (γ,n) and (γ,p) reactions] which is caused by the location between 15 and 25 mev of the center of gravity of dipole levels excited through nuclear absorption of $E1$ γ-quanta.[1] Beginning in 1952, a group of Canadian physicists[2-4] have distinguished an entire series of separate resonance levels in the "giant" (γ, n) resonance of a few light nuclei (Li^7, C^{12}, O^{16}, F^{19}). The study of the photonuclear excitation function fine structure is of decided interest both for nuclear spectroscopy and for the determination of the character of γ-ray absorption by nuclei. In connection with the latter question it is especially important not only to determine the contribution of any of the individual levels to the observed yield but also to reveal the nature of the final nuclear state [which is not usually done in the study of (γ, p) and (γ, n) reactions] as well as the angular distribution of the emitted particles.

In the present note we wish to estimate the contribution of individual levels to photonuclear (γ, p) reactions, which can be obtained from experimental data regarding the cross sections of reverse (p, γ) reactions that take place without cascade emission of γ-rays ($\sigma_{p\gamma}$). The cross sections $0_{\gamma,p}$) reactions connected with the formation of ground states in the final nuclei are related to the (p, γ) cross sections by the simple relationships of detailed balancing; for example, in the case of O^{16} (γ, p) N^{15} we have:

$$\sigma_{\gamma 0} = \sigma_{pN} 2 \frac{16}{15} \frac{mc^2 (h\nu - Q)}{(h\nu)^2} \frac{2I_N + 1}{2I_O + 1}.$$

Here I_N(=½) and I_O (=0) are the spins of N^{15} and N^{16}, m is the proton mass, Q(=12.11 mev) is the energy released by the reaction, $h\nu$ is the energy of a γ-quantum associated with the proton energy (E_p) in the (p, γ) reaction by the relationship $h\nu = Q + (15/16)E_p$. From an analysis of the data in the literature, considerable information can be obtained concerning (γ, p) reactions associated with the formation of ground state final nuclei in the case of five light nuclei: B^{10}, C^{12}, N^{14}, O^{16} and S^{32}. The results are summarized in the Table and Figure.

As can be seen from the Table and Figure, the maximum cross sections for (γ, p) reactions connected with the formation of ground state final nuclei associated with individual levels, sometimes exceed by a large factor the maximum cross sections in "giant" resonance. The integral cross sections of such reactions which are associated with individual levels amount to about 10% of the integral cross sections in "giant" resonance, which encompass all possible states of the final nuclei. Consideration of this fact leads to some increase in the experimental values of the gamma absorption cross sections (σ_γ) and to reduction of the difference between the theoretical and experimental values of $\sigma_{\gamma\,\mathrm{int}}$ for light nuclei as has been noted in Ref. 15, for example. It will be necessary to use extensive experimental data concerning (p, γ) and (n, γ) reactions in order to make an independent check of the results from

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Capture of K^--Mesons by Deuterium and Hyperon-Nucleon Interaction

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THE study of K-meson capture in hydrogen and deuterium can provide valuable information not only concerning the properties of K-mesons but also concerning the interactions between hyperons and nucleons. In particular, it may be possible to answer the question about the existence of bound states of a hyperon-nucleon system. Examples of such reactions (occurring with conservation of "strangeness"[1] and, consequently, possessing large cross sections) are

1) $K^- + d \to \Lambda + n + \pi^\circ$,	1') $K^- + p \to \Lambda + \pi^\circ$,
2) $K^- + d \to \Lambda + p + \pi^-$,	2') $K^- + n \to \Lambda + \pi^-$,
3) $K^- + d \to \Sigma^- + n + \pi^+$,	3') $K^- + p \to \Sigma^- + \pi^+$,
4) $K^- + d \to \Sigma^+ + n + \pi^-$,	4') $K^- + p \to \Sigma^+ + \pi^-$,
5) $K^- + d \to \Sigma^\circ + n + \pi^\circ$,	5') $K^- + p \to \Sigma^\circ + \pi^\circ$,
6) $K^- + d \to \Sigma^\circ + p + \pi^-$,	6') $K^- + n \to \Sigma^\circ + \pi^-$,
7) $K^- + d \to \Sigma^- + p + \pi^\circ$,	7') $K^- + n \to \Sigma^- + \pi^\circ$.

As definite examples we shall consider reactions 3 and 3'.

Assuming that the hyperon has spin 1/2, the amplitude of reaction 3' will in general be of the form

$$A = a + \mathbf{b}\vec{\sigma}, \tag{1}$$

where a and $\mathbf{b}$ are functions of the K- and π-meson momenta; of k and p and of the spin of the K-meson, if this amplitude exists. The differential cross section of this reaction, averaged over the spins of the heavy particles, is

$$d\sigma = (|a|^2 + |b|^2)\, d\Omega. \tag{2}$$

If we consider the formation of π^+-mesons near the upper limit of their energy spectrum in reaction (3) we have for the corresponding cross section in the momentum approximation[2]

$$d\sigma = \left| \int \psi_f^*(\vec{\rho}) \exp\{i\vec{\varkappa}\vec{\rho}\}\, \psi_0(\vec{\rho})\, d\vec{\rho} \right|^2 \frac{d\mathbf{f}}{(2\pi)^3}\, d\Omega, \tag{3}$$

$$\vec{\varkappa} = \frac{M_1}{M_1 + M_2}(\mathbf{k} - \mathbf{p}).$$

Here M_1 and M_2 are the nucleon and hyperon masses and $\mathbf{f}$ is their relative momentum. Averaging over the spins of the baryons, we obtain

$$d\sigma = \{|a|^2 + {}^2/_3 |b|^2) |I_t|^2 + {}^1/_3 |b|^2 |I_s|^2\} (2\pi)^{-3} f^2\, df\, d\Omega_f\, d\Omega. \tag{4}$$

Here

$$I_{t,s} = \int \varphi_f^{(t,s)*}(\vec{\rho}) \exp\{i\vec{\varkappa}\vec{\rho}\}\, \varphi_0(\vec{\rho})\, d\vec{\rho}.$$

Taking

$$\varphi_0 = \sqrt{\alpha/2\pi}\, \frac{e^{-\alpha\rho}}{\rho}, \tag{5}$$

$$\varphi_f^{(t,s)} = \exp\{i\mathbf{f}\vec{\rho}\} - (e^{-2i\delta_{t,s}} - 1)\frac{e^{-if\rho}}{2if\rho},$$

where $\delta_{t,s}$ is the S-phase in the triplet and singlet states of the hyperon-nucleon system, we obtain (after integrating over all directions)

$$\int |I_{t,s}|^2 d\Omega_f = 8\pi\alpha \left\{ \frac{4\pi}{[\alpha^2 + (\varkappa - f)^2][\alpha^2 + (\varkappa + f)^2]} + \frac{\pi}{2(\varkappa f)^2} \ln \frac{\alpha^2 + (\varkappa - f)^2}{\alpha^2 + (\varkappa + f)^2} \right. \tag{6}$$
$$\times \left[\sin 2\delta_{t,s} \left(\operatorname{arctg}\frac{\varkappa + f}{\alpha} + \operatorname{arctg}\frac{\varkappa - f}{\alpha} \right) - \sin^2\delta_{t,s} \ln \frac{\alpha^2 + (f + \varkappa)^2}{\alpha^2 + (f - \varkappa)^2} \right]$$
$$\left. + \frac{\pi}{(\varkappa f)^2} \sin^2\delta_{t,s} \left[\left(\operatorname{arctg}\frac{\varkappa + f}{\alpha} + \operatorname{arctg}\frac{\varkappa - f}{\alpha} \right)^2 + \frac{1}{4}\left(\ln \frac{\alpha^2 + (\varkappa + f)^2}{\alpha^2 + (\varkappa - f)^2} \right)^2 \right] \right\}.$$

When we make use of the relationship