By making use of the following transformations[3]

$$\Omega_{jl'M}(\mathrm{n}) = \sigma \mathrm{n}\, \Omega_{jlM}(\mathrm{n}),$$

$$\sum_M (\Omega^*_{jlM}(\mathrm{n}_0)\, u)\, \Omega_{jlM}(\mathrm{n}) = \frac{1}{4\pi}\left(\alpha_{jl} + \frac{\beta_{jl}}{i \sin\vartheta}[\mathrm{n}_0\mathrm{n}]\sigma\right),$$

$$\alpha_{jl} = (j + 1/2)\, P_l(\cos\vartheta), \quad \beta_{jl}$$

$$= \mp P_l^1 \text{ for } \quad l = j \mp 1/2, \ \cos\vartheta = \mathrm{n}_0\mathrm{n}$$

(P_l and P_l^1 are Legendre functions), we have

$$\sum_M (\Omega^*_{jlM}(\mathrm{n}_0)\, v)\, \Omega_{jlM}(\mathrm{n}) = \sigma(\mathrm{n}\, r_{jl} + \mathrm{n}_0 q_{jl}),$$

$$r_{jl} = \beta_{jl} / \sin\vartheta; \quad q_{jl} = \alpha_{jl} - \beta_{jl}\, \mathrm{tg}\, \vartheta.$$

Use of well-known relations between Legendre polynomials leads to the equation

$$r_{j,\, j+1/2} + r_{j,\, j-1/2} = q_{j,\, j+1/2}$$

$$+ q_{j,\, j-1/2} = (d / d\cos\vartheta)(P_{j+1/2} - P_{j-1/2}).$$

Inserting all of this into the expression for b , we have finally

$$b = B(\vartheta)\, \sigma\, (\mathrm{n}_0 + \mathrm{n}),$$

$$B(\vartheta) = \frac{1}{2ik} \sum_j S_{j+1/2,\, j-1/2} \frac{d}{d\cos\vartheta}(P_{j+1/2} - P_{j-1/2}).$$

For small momenta we can retain in this expression only the term with $j = 1/2$, corresponding to transitions $s_{1/2} \leftrightarrows p_{1/2}$. Then B does not depend on the angles, and the differential cross-section for scattering with change of intrinsic parity takes the form

$$|b|^2 = \sigma_0 (1 + \cos\vartheta),$$

where σ_0 is a constant and, according to general properties of the elements of the scattering matrix, $\sigma_0 \sim k^2$. Unfortunately , this dependence of the cross-section on angle and momentum is not sufficient by itself for an experimental singling-out of the process under consideration here, since the differential cross-section for ordinary scattering at small momenta contains an analogous dependence

$$|a|^2 = c_1 + c_2 \cos\vartheta,$$

where c_1 and c_2 are constants (the first term corresponds to the s-wave and the second to interference between the s- and p-waves).

From the expression for b it follows that in this type of scattering no polarization of the nucleons occurs. But if the nucleon was polarized before the scattering, then the spin components perpendicular to the vector $n_0 + n$ change sign.

All the preceeding discussion applies also to the scattering of Σ and Λ particles by nuclei of spin 0, if the spin of these particles is equal to ½. The same expressions also describe the processes

$$K + N \rightarrow \Sigma + \pi; \quad K + N \rightarrow \Lambda + \pi,$$

with the amplitude b in this case referring to the appearance of a hyperon of the same intrinsic parity as the incident K particle (since an odd π meson is produced).

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Translated by W. H. Furry
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Absorption of γ-Quanta of 500 mev Mean Energy in Lead, Copper and Aluminum

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WE measured the absorption coefficients of γ-quanta of 500 mev energy in Pb, Cu and Al. γ-quanta from the decay of π^0-mesons produced in the internal phasotron target by protons of 660 mev were registered by a 12 channel-pair γ-spectrometer. The spectrometer was placed at the distance of 23 m from the target. A device, periodically covering the γ-beam by a lead absorber, was placed before the collimator situated in a 4 meter thick shielding wall 13 meters from the spectrometer. A lead plate in the form of a half-disc, mounted on the reductor axis of an electric motor, periodically covered the γ-beam making 12 r.p.m. The counting of the γ-quanta registered by the spectrometer was done separately for the cases of the completely covered and completely uncovered beam.

For the purpose of the determination of the absorption coefficients of γ-quanta in Cu and Al by means of the same revolving device, the lead absorber was periodically changed by a copper and an aluminum absorber. A frequent change of the absorbers made it possible to carry out the measurements without a monitor and, besides, removed errors due to the time variation of the sensitivity of the spectrometer. The γ-beam, after traversing the collimator, was purified from electrons and positrons by a special magnet.

The values of the absorption coefficients (in cm^2/g) of γ-quanta of the energy $E_\gamma = 500 \pm 50$ mev, obtained in our work, are:

$$\text{Pb}: 0.1115 \pm 0.0025; \quad \text{Cu}: 0.0510 \pm 0.0025; \quad \text{Al}: 0.0295 \pm 0.0017.$$

The absorption of γ-quanta of $E_\gamma = 500$ mev is due basically to electron-positron pair production. The calculation shows that the absorption due to the photoeffect and the Compton effect amounts for Pb to ~ 0.5%, for Cu to ~ 1.2% and for Al to ~ 2% of the total absorption cross-section.

The γ-absorption cross-sections obtained by us are in a good agreement with the results of calculations by Davies et al[1].

It should be noted that the results for γ-quanta of 500 mev, which are in agreement with the calculations, were obtained with a lead filter of the thickness 5.55 g/cm^2 permanently placed in the beam. The values of cross-sections obtained without this filter were 10% higher. No influence of such a filter was observed in measurements of the cross-section for 280 mev γ-quanta. The obtained value of the cross-section for 280 mev γ-quanta is in good agreement with Ref. 2. It has not been possible to explain the cause for the higher result for the absorption cross-section of 500 mev γ-quanta in the absence of the additional lead filter.

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Translated by H. Kasha
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A Physical Model of the Hyperon

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IN recent times a number of attempts have been made to reduce the number of particles that are regarded as "elementary" by regarding some of them as compound structures.[1–5] Some proposals of this sort are not in agreement with experiment and with the very successful phenomenological scheme of Gell–Mann, since they lead to charge states that most probably do not exist in nature.[3,5] The one that seems most natural is an early proposal of Goldhaber,[2] which, being applied in the light of our present knowledge, provides the correct charge multiplet of the hyperon and a very attractive picture of the interaction of baryons and heavy mesons.

We assume that hyperons are bound systems* of nucleons and $\bar{K}$–mesons, which, according to Gell–Mann, form a charge doublet $\bar{K}(\bar{K}^0, \bar{K}^-)$. The nucleon and the $\bar{K}$–meson can form singlet and triplet charge states. The singlet state can be identified with Λ^0, the triplet with $\Sigma^+, \Sigma^0, \Sigma^-$. The qualitative features of the proposed interaction between K–mesons and nucleons are such that, in agreement with experiment, the binding forces are independent of the charge and depend only on the isotopic spin, the forces being larger for the antiparallel orientation of the isotopic spins. As a model for the Ξ–particle (which we assume to be a doublet) one can take the bound system of a Λ^0 or a Σ–particle and a $\bar{K}$-meson (doublet of the $N\bar{K}\bar{K}$ system). According to the idea being developed here there must exist a hyperon with isotopic spin $T = 3/2$ and with a mass greater than the mass of the Ξ, if the interaction between the Σ and $\bar{K}$–particles is sufficiently strong to form a bound system with parallel isotopic spins. If there is no degeneracy, then there can exist other states with $T = 1/2$ besides the Ξ. For the state with $T = 1/2$ higher than the Ξ and for the components $T_3 = \pm 1/2$ of the state $T=3/2$