Transition to the usual non-Hermitian field notation may be accomplished by diagonalization of the matrices ν, ζ_3, and τ_3 appearing above; after such diagonalization the nucleon field components would be those for which the matrix $\nu\zeta_3$ took on the eigenvalue $+1$, while the cascade particle components would be those for which $\nu\zeta_3$ assumed the value -1. The choice of A in L_A determines the orbital parity of the K particle. The Lagrangians L_A entail the most symmetric orbital parity assignments for the heavy fermions, as well as conservation of parity in K interactions. Similar results may be obtained for less symmetric parity assignments and with relaxation of such conservation.

A more detailed discussion of the entire subject will appear shortly.

[1] J. Schwinger, Lectures on Fundamental Interactions, Harvard-Massachusetts Institute of Technology, 1956 (unpublished).

[2] A similar interaction scheme has been proposed by M. Gell-Mann, [*Proceedings of the Seventh Annual Rochester Conference on High-Energy Physics, 1957* (Interscience Publishers, Inc., New York, 1957)], based upon a somewhat more phenomenological approach.

[3] This statement is correct only if there is no parity duplication of K, Λ, and Σ fields.

Associated Production in Pion-Nucleon Collisions and Charge Independence*

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USING the method of Low,[1] we have derived the equation for the Heisenberg scattering amplitude describing the processes $\pi+N\rightarrow\Lambda+K$ and $\pi+N\rightarrow\Sigma+K$. In the "one-meson" approximation,[1] with pair intermediate states omitted, we obtain a linear integral equation for this amplitude. The inhomogeneous term is the Born approximation, and the kernel of the uncrossed one-meson term is the pion-nucleon scattering amplitude. The crossed one-meson term involves the pion-hyperon scattering amplitude and may be treated with the inhomogeneous term. A partial-wave study of the Born approximation has been made, using the Hamiltonian suggested recently by Gell-Mann[2] with the assumption of spin-parity 0^- for the K mesons and $\frac{1}{2}^+$ for the Λ and Σ hyperons. S, P, and D waves have been included to first order in an expansion in powers of the ratio of the intermediate-state baryon kinetic energy to its mass. At 1-Bev pion bombarding energy, we find that a coupling essentially of the form

$$g(\bar{\Lambda}\gamma_5 NK-\bar{\Sigma}_\alpha\gamma_5 N\tau_\alpha K+\text{Hermitian conjugate})$$

yields the strong backward preference of the Λ hyperons in the center-of-mass system that has been observed experimentally.[3,4] We use the notation of reference 2, in which a symbol for a particle denotes the operator that destroys it. (N stands for nucleon and the decomposition into charge states is to be understood.) Also, in accord with early experiments,[4–6] the Σ^0 hyperons tend to be produced somewhat preferentially backwards. However, in direct opposition to experiment,[4,5] the Σ^+ are produced preferentially backwards (with about the same total cross sections as the Σ^0 and Λ^0). Corrections from the one-meson terms that might alter the latter result would at the same time turn the Σ^0 angular distribution around. If the spin-parity assignments above turn out to be correct and if pair effects may be neglected, the failure to explain simultaneously the Σ^0 and Σ^+ angular distributions with a charge-independent Hamiltonian might be attributable to a failure of charge independence in associated production. A study designed to estimate pair effects in this high-energy collision process is being pursued and will be discussed in a more complete report of this work at a later date.

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[2] M. Gell-Mann, Phys. Rev. **106**, 1296 (1957).

[3] Budde, Chretien, Leitner, Samios, Schwartz, and Steinberger, Phys. Rev. **103**, 1827 (1956).

[4] D. Glaser (private communications).

[5] Brown, Glaser, Meyer, Perl, Vander Velde, and Cronin, Phys. Rev. **107**, 906 (1957).

[6] J. J. Sakurai, Phys. Rev. **107**, 908 (1957).

Polarized Protons from the Elastic Scattering of α-Particles by Hydrogen*

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DOUBLE scattering experiments at 2.9, 3.0, and 5.3 Mev[1–3] have demonstrated that the spin-orbit forces in Li^5 make possible the use of He^4 as a polarizer and polarizer-analyzer for fast protons.

Recent calculations by Gammel and Thaler,[4] based on phase-shift analyses of p-He^4 elastic scattering data, predict that, at certain angles, the elastically scattered protons will be highly polarized for incident energies up to at least 10 Mev.

The purposes of the present experiment were to check the above-mentioned predictions in detail, by examining the dependence of polarization on scattering angle for 10-Mev protons on He^4, and to devise a method for obtaining a highly-polarized and well-collimated beam of 10-Mev protons of sufficient intensity for use in elastic and inelastic scattering experiments. As it turned out, the same method suffices for accomplishing both objectives.

The experimental arrangement is illustrated in Fig. 1. A target containing 4 atmos of H_2 is irradiated with a beam of 25-Mev alpha particles. (This is equivalent to 6.25-Mev protons on He^4, an energy at which the polarization *vs* scattering angle can be predicted with confidence.) The protons knocked on at 25° (130° c.m. for protons on He^4) to the incident alpha beam are