Contributions to the cross-section differences Δ_{MB} are entirely due to octets whose neutral members are odd under charge conjugation. Consequently the observed 2^+ meson octet is not relevant to the relations in Eqs. (2) and (3). If we make a further assumption that only the one vector-meson octet V is responsible for the Δ_{MB}, then the f/d ratio for the $VB\bar{B}$ charge coupling can be calculated from the experimental total cross sections (the VMM coupling is pure f-type, and the $VB\bar{B}$ magnetic coupling vanishes for forward scattering). The f/d ratio can be calculated from the following expressions:

$$\begin{aligned} f/d &= \Delta_{Kp}/(2\Delta_{\pi p}-\Delta_{Kp}) \\ &= \Delta_{Kp}/(\Delta_{Kp}-2\Delta_{Kn}) \\ &= (\Delta_{\pi p}+\Delta_{Kn})/(\Delta_{\pi p}-\Delta_{Kn}) \end{aligned} \qquad (4)$$

which are equivalent according to Eq. (2). Pure f-type coupling yields the Johnson-Treiman relations as previously noted by Sawyer.[6] The determination of the f/d ratio from the data[4] through Eq. (4) is given in Table II. The results indicate a mean value somewhere between $f/d\approx-3$ and $f/d\approx-5$, showing an appreciable deviation from the universality prediction $d=0$.[7] The errors on the cross sections are sufficiently large to make a precise determination of f/d difficult.

TABLE II. Determinations of the vector meson-nucleon charge coupling f/d ratio from experiment. (Data from Ref. 4.)

P_{LAB} (BeV/c)	f/d ratio for Vector Meson-Baryon charge coupling: $\frac{f}{d}=\frac{\Delta_{Kp}}{(2\Delta_{\pi p}-\Delta_{Kp})}$	$\frac{f}{d}=\frac{\Delta_{Kp}}{(\Delta_{Kp}-2\Delta_{Kn})}$	$\frac{f}{d}=\frac{(\Delta_{\pi p}+\Delta_{Kn})}{(\Delta_{\pi p}-\Delta_{Kn})}$
6	−2.9	−3.9	−3.2
8	−4.2	+3.0	15.0
10	−2.9	−5.2	−3.4
12	−4.8	−4.8	−4.8
14	−3.7	−3.7	−3.7
16	−4.8	−2.9	−3.8
18	−4.3	−2.6	−3.5

In any event we emphasize that the sum rule of Eq. (2) is dependent only on the general octet-dominance property of the $MM\rightarrow\bar{B}B$ channel and not upon these further detailed considerations.

We are grateful to Professor R. F. Sawyer for a discussion of this work. We are indebted to Professor C. Goebel for a helpful discussion and for a careful reading of the manuscript.

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PHYSICAL REVIEW VOLUME 140, NUMBER 5B 6 DECEMBER 1965

$SU(6)$ Predictions for s-Wave Baryon-Baryon Scattering*

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(Received 15 April 1965; revised manuscript received 5 August 1965)

The predictions of the $SU(6)$-symmetry model for s-wave baryon-baryon scattering are derived and compared with some low-energy experimental data.

THE application of $SU(6)$ symmetry to meson-baryon scattering yielded a number of relations that can be compared with experiment.[1] Such comparisons are of interest in determining the validity of $SU(6)$ symmetry and the nonrelativistic limit of its relativistic extensions.[2] In this paper the $SU(6)$ predictions for s-wave baryon-baryon scattering are tabulated and compared with some low-energy experimental data.

For the s-wave baryon-baryon scattering process

$$B(4)+B(2)\rightarrow B(3)+B(1),$$

the $SU(6)$-invariant scattering operator S, which incorporates the generalized Pauli principle, can be written in terms of the 56-dimensional $SU(6)$ baryon wave function[3] as

$$\begin{aligned} S=A\{&\bar{\psi}^{ABC}(1)\psi_{ABC}(2)\bar{\psi}^{DEF}(3)\psi_{DEF}(4) \\ &-\bar{\psi}^{ABC}(1)\psi_{ABC}(4)\bar{\psi}^{DEF}(3)\psi_{DEF}(2)\} \\ &+(C/81)\{\bar{\psi}^{ABC}(1)\psi_{ABD}(2)\bar{\psi}^{EFD}(3)\psi_{EFC}(4) \\ &-\bar{\psi}^{ABC}(1)\psi_{ABD}(4)\bar{\psi}^{EFD}(3)\psi_{EFC}(2)\}. \end{aligned} \qquad (1)$$

The result of Eq. (1) for BB reactions of experimental interest are listed in Table I. Only amplitudes which are isospin-independent are included. The quantities α and β of Table I are scalar products of Pauli spinors,

$$\begin{aligned} \alpha&=\chi^i(1)\chi_i(2)\chi^j(3)\chi_j(4), \\ \beta&=\chi^i(1)\chi_i(4)\chi^j(3)\chi_j(2). \end{aligned} \qquad (2)$$

* Work supported in part by the University of Wisconsin Research Committee with funds granted by the Wisconsin Alumni Research Foundation and in part by the U. S. Atomic Energy Commission under Contract No. AT(11-1)-30. (COO-30-101).

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TABLE I. S-wave amplitudes for baryon-baryon scattering in the $SU(6)$-symmetry model [cf. Eq. (1)].

S-wave reaction amplitude	A	C
$(pp\|pp)$	$\alpha-\beta$	$-3\alpha+3\beta$
$(np\|np)$	α	-3α
$(\Sigma^+p\|\Sigma^+p)$	α	$9\alpha+12\beta$
$(\Sigma^-p\|\Sigma^-p)$	α	$11\alpha-4\beta$
$(\Xi^-p\|\Xi^-p)$	α	$4\alpha+\beta$
$(\Xi^0p\|\Xi^0p)$	α	$11\alpha-4\beta$
$\sqrt{3}(\Lambda p\|\Sigma^0p)$	0	$-3\alpha+6\beta$
$(\Lambda p\|\Lambda p)$	α	0

The decomposition of α and β into singlet (S) and triplet (T^i) amplitudes is

$$\alpha=S+\sum_{i=1}^{3}T^i,$$

$$\beta=-S+\sum_{i=1}^{3}T^i. \tag{3}$$

Using Table I and Eq. (3), the hyperon-nucleon scattering lengths can be expressed in terms of the two $SU(6)$ amplitudes A and C as follows:

$$\begin{aligned} a_{pp}{}^s=a_{np}{}^s=a_{\Sigma^+p}{}^s=a_{np}{}^t&=A-3C,\\ a_{\Lambda p}{}^s=a_{\Lambda p}{}^t&=A,\\ a_{\Sigma^-p}{}^s&=A+15C,\\ a_{\Sigma^-p}{}^t&=A+7C,\\ a_{\Sigma^+p}{}^t&=A+21C. \end{aligned} \tag{4}$$

In addition to the charge-independence relation $a_{pp}{}^s=a_{np}{}^s$ and $SU(3)$ predictions[4] such as $a_{np}{}^s=a_{\Sigma^+p}{}^s$ and $6a_{\Lambda p}{}^s=a_{\Sigma^-p}{}^s+5a_{np}{}^s$, some purely $SU(6)$ predictions obtained from Eq. (4) are

$$a_{np}{}^s=a_{np}{}^t, \tag{5}$$

$$a_{\Lambda p}{}^s=a_{\Lambda p}{}^t, \tag{6}$$

$$8a_{\Lambda p}{}^t=a_{\Sigma^+p}{}^t+7a_{np}{}^t. \tag{7}$$

The $SU(6)$ equality of the singlet and triplet np scattering lengths is in considerable disagreement with the experimental values,[5]

$$\begin{aligned} a_{np}{}^s&=-23.680\pm0.028\text{ F},\\ a_{np}{}^t&=5.399\pm0.011\text{ F}, \end{aligned} \tag{8}$$

as previously pointed out by other authors.[6] Evaluation of the validity of Eqs. (6) and (7) is not possible at the present time due to the rather large errors on the experimental determinations of these scattering lengths.

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TABLE II. S-wave differential cross sections for baryon-baryon scattering in the $SU(6)$-symmetry model.

S-wave unpolarized differential cross section	$\|A\|^2$	$3\|C\|^2$	$3\,\mathrm{Re}(A^*C)$
$d\sigma(pp\to pp)$	1	3	-2
$d\sigma(np\to np)$	1	3	-2
$d\sigma(\Sigma^+p\to\Sigma^+p)$	1	111	10
$d\sigma(\Sigma^0p\to\Sigma^0p)$	1	52	8
$d\sigma(\Sigma^-p\to\Sigma^-p)$	1	31	6
$d\sigma(\Xi^-p\to\Xi^-p)$	1	7	3
$d\sigma(\Xi^0p\to\Xi^0p)$	1	111	10
$d\sigma(\Lambda p\to\Lambda p)$	1	0	0
$d\sigma(\Lambda p\to\Sigma^0p)$	0	3	0
$d\sigma(\Sigma^-p\to\Sigma^0n)$	0	38	0
$d\sigma(\Sigma^-p\to\Lambda n)$	0	6	0

Performing the spin summations over the spinors in Table I, we obtain the s-wave BB scattering-cross-section predictions of Table II. Several $SU(6)$ equalities which follow directly from Table II are

$$R_1=\sigma(pp\to pp)/\sigma(np\to np)=\tfrac{1}{2}, \tag{9}$$

$$R_2=\sigma(\Sigma^-p\to\Sigma^0n)/[\sigma(\Sigma^-p\to\Sigma^0n)+\sigma(\Sigma^-p\to\Lambda n)]=19/22, \tag{10}$$

$$R_3=\sigma(\Lambda p\to\Sigma^0p)/\sigma(\Sigma^-p\to\Sigma^0n)=3/38. \tag{11}$$

The discrepancy in the np scattering-length prediction noted above in Eqs. (5) and (8) will also be reflected in the cross-section equality of Eq. (9).

In writing these $SU(6)$ cross-section equalities we have not taken into consideration possible phase-space modifications. However, such corrections can make appreciable changes in low-energy comparisons of $SU(6)$ predictions. For example, at fixed Σ^- laboratory momentum (p_{Σ^-}) the cross-section ratio R_2 can be written as

$$1/R_2=1+(q_\Lambda/q_{\Sigma^0})\rho, \tag{12}$$

where

$$\rho=|(\Lambda n|\Sigma^-p)|^2/|(\Sigma^0n|\Sigma^-p)|^2,$$

and q is the appropriate center-of-mass momentum of the final state. From Table II we have the $SU(6)$ prediction of $\rho=3/19$. At $p_{\Sigma^-}=145$ MeV, Eq. (12) predicts $R_2=0.68$ contrasted with the value $R_2=0.86$ obtained in the absence of phase-space corrections, i.e., $q_\Lambda/q_{\Sigma^0}=1$. The experimental values of this cross-section ratio are $R_2=0.57\pm0.08$ [7] and $R_2=0.39\pm0.03$ [8] at a mean laboratory momentum of 145 MeV/c.

We were unable to find sufficient data to make a meaningful comparison for the cross-section ratio R_3 of Eq. (11).

We are grateful to Dr. P. B. Kantor and Dr. T. L. Trueman for helpful communications concerning this work.

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