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:

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

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 $MM\to\bar{B}B$ channel and not upon these further detailed considerations.

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

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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

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

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

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

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,

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

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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).

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