

General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

NASA-CR-
99610

SPIN-OTHER-ORBIT MATRIX ELEMENTS

FOR f^4 CONFIGURATIONS*

J. A. Barnes, B. L. Carroll and L. M. Flores
Lockheed Electronics Company, Houston, Texas

February 1969



ABSTRACT

The Spin-Other-Orbit matrix elements for f^4 electron configurations are computed and tabulated for general usage.

* This research was supported by NASA contract NAS 9-5384 for the Manned Spacecraft Center, National Aeronautics and Space Administration.

FACILITY FORM 6	N 69-22342	
	(ACCESSION NUMBER)	(THRU)
	14	1
	(PAGES)	(CODE)
	CS-99610	24
	(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

I. INTRODUCTION

In recent years, angular momentum techniques developed by Racah¹ have enabled researchers to derive closed form matrix expressions for various atomic interaction operators within and between complex configurations. However, the construction of an interaction matrix for a given representation generally involves a long and tedious computational process. Therefore, once it has been accomplished, it is desirable that other active researchers should not have to duplicate the effort. It is with this purpose that we present in this paper the Spin-Other-Orbit matrix elements for the f^4 configuration².

II. MATRIX ELEMENTS OF THE SPIN-OTHER-ORBIT INTERACTION

The matrix elements of the Spin-Other-Orbit interaction for f^n configurations³ can be written in tensor operator form as $(f^n_{\gamma SLJ} | H_{soo} | f^n_{\gamma' S' L' J'})$

$$= \delta(J, J') (-1)^{S'+L+J} \begin{Bmatrix} S & S' & 1 \\ L' & L & J \end{Bmatrix}$$

$$\times \{ (f^n_{\gamma SL} || H_{soo}^1 || f^n_{\gamma' S' L'}) + (f^n_{\gamma SL} || H_{soo}^2 || f^n_{\gamma' S' L'}) \} \quad (1)$$

The reduced matrix elements of H_{soo}^1 and H_{soo}^2 , occurring in the above expression, are given by $(f^n_{\gamma SL} || H_{soo}^1 || f^n_{\gamma' S' L'})$

$$= \left[-2nM^0(84)^{1/2} + 6(3)^{1/2} \sum_k \sum_k (-1)^{K+k} \right]$$

$$X \begin{pmatrix} 3 & | & c^K & | & 3 \end{pmatrix} \begin{pmatrix} 3 & | & u^{(Kk)} & | & 3 \end{pmatrix} \begin{Bmatrix} K & 3 & 3 \\ 3 & k & 1 \end{Bmatrix} \\ \times M^{(k-1)} \left[(f_{\gamma SL}^n | v^{11} | f_{\gamma' S' L'}^n) \right], \quad (2)$$

where $k = 1, 3, 5$, $K = k \pm 1$, and ,

$$(f_{\gamma SL}^n | H_{S_{00}}^2 | f_{\gamma' S' L'}^n) = -2(3)^{1/2} \sum_k \sum_k (-1)^{k+K+L+L'} \\ \times \begin{pmatrix} 3 & | & c^K & | & 3 \end{pmatrix} \begin{pmatrix} 3 & | & u^{(Kk)} & | & 3 \end{pmatrix} M^{k-1} \\ \times \left[\sum_{\gamma'' L''} (f_{\gamma SL}^n | u^K | f_{\gamma'' S'' L''}^n) (f_{\gamma'' S'' L''}^n | v^{1k} | f_{\gamma' S' L'}^n) \right. \\ \left. \begin{Bmatrix} L & K & L'' \\ k & L' & 1 \end{Bmatrix} + 2 \sum_{\gamma'' L''} (f_{\gamma SL}^n | u^k | f_{\gamma'' S'' L''}^n) \right. \\ \left. \times (f_{\gamma'' S'' L''}^n | v^{1K} | f_{\gamma' S' L'}^n) \begin{Bmatrix} L & k & L'' \\ K & L' & 1 \end{Bmatrix} \right]. \quad (3)$$

The term with $k = 1$, $K = 0$ should be omitted from the summation for the first term in braces of Eq. (3) since it is already included in Eq. (2). The reduced matrix elements occurring in Eqs. (2) and (3) have the following expressions:

$$(f_{\gamma SL}^n | u^{(k)} | f_{\gamma' S' L'}^n) = n\{(2L+1)(2L'+1)\}^{1/2} \\ \sum_{\bar{\gamma} \bar{S} \bar{L}} (f_{\gamma SL}^{n-1} | f_{\bar{\gamma} \bar{S} \bar{L}}^{n-1}) (f_{\bar{\gamma} \bar{S} \bar{L}}^{n-1} | f_{\gamma' S' L'}^n) (-1)^{L+L'+3+k} \\ \times \begin{Bmatrix} L & 3 & L \\ 3 & L & k \end{Bmatrix}, \quad (4)$$

$$(f^n_{\gamma SL} || V^{(1k)} || f^n_{\gamma' S' L'}) = n(3/2)^{1/2} \{(2S+1)(2S'+1)(2L+1)(2L'+1)\}^{1/2}$$

$$\times \sum_{\bar{\gamma} \bar{S} \bar{L}} (f^n_{\gamma SL} \{ | f^{n-1}_{\bar{\gamma} \bar{S} \bar{L}} \} f^n_{\gamma' S' L'})$$

$$\times \left\{ \begin{matrix} S & S' & 1 \\ 1/2 & 1/2 & \bar{S} \end{matrix} \right\} \left\{ \begin{matrix} L & L' & k \\ 3 & 3 & \bar{L} \end{matrix} \right\} (-1)^{S+\bar{L}+S'+L+3+3/2+k}, \quad (5)$$

$$(3 || C^k || 3) = -7 \begin{pmatrix} 3 & k & 3 \\ 0 & 0 & 0 \end{pmatrix}. \quad (6)$$

Horie⁴ defined the matrix elements of the quantity $U^{(K,k)}$ as

$$(3 || U^{(k-1,k)} || 3) = 7(-1)^{(k-1)/2} \left\{ \frac{(K+1)(2k-1)(2k+1)}{3} \right\}^{1/2} \\ \times \left\{ \frac{(k-1)!(k+1)!(6-k)!}{(7+k)!} \right\}^{1/2} \\ \times \left(\frac{7+k}{2} \right)! / \left[\left(\frac{k-1}{2} \right)! \left(\frac{k+1}{2} \right)! \left(\frac{5-k}{2} \right)! \right], \quad (7)$$

and

$$(3 || U^{(k+1,k)} || 3) = - \left\{ \frac{k(2k+3)}{(k+1)(2k-1)} \right\}^{1/2} (3 || U^{(k-1,k)} || 3). \quad (8)$$

In Eqs. (4) thru (6),

$$\begin{pmatrix} a & b & c \\ 0 & 0 & 0 \end{pmatrix} \quad \text{and} \quad \left\{ \begin{matrix} a & b & c \\ d & e & f \end{matrix} \right\}$$

are the Wigner 3-j and 6-j symbols. The coefficients $(f^n_{\gamma SL} \{ | f^{n-1}_{\bar{\gamma} \bar{S} \bar{L}} \})$ are the coefficients of fractional parentage introduced by Racah¹. The matrix elements of the tensor operators $U^{(k)}$ and $V^{(11)}$ and appropriate fractional parentage coefficients have been tabulated by Neilson and Koster⁵.

The radial integral, $M^{(k-1)}$, is defined by Marvin⁶ as,

$$M^{(k-1)} = \left(\frac{1}{4c^2} \right) \int_{r_j > r_1} \int P_{nl}^2(r_1) \left(\frac{r_1^{k-1}}{r_j^{k+2}} \right) P_{nl}^2(r_j) dr_1 dr_j ,$$

where P_{nl} is the radial wave function for the shell (nl) and c is the speed of light.

III. DISCUSSION OF TABLE

Table I presents a tabulation of the matrix elements of the Spin-Other-Orbit operator H_{soo} for f^4 configurations. The calculations were performed in single precision on the Univac 1108 computer. A comparison with the diagonal matrix elements of f^4 presented by Judd, et al⁷, indicates an accuracy of at least seven significant figures.

The matrix elements are tabulated in J-blocks. The states $|(Urv)SL)$ labeling a given J-block are listed in parenthesis beside the J-value⁸. The matrices of H_{soo} are presented in upper-half diagonal form. Only the non-zero elements are listed for a given J-block. Each matrix element is given as the sum of three terms, one for each radial integral M^k . In a given J-block, the coefficients of the M^k 's are listed in rows to the right of the desired matrix element. Each entry in the table is to be multiplied by the power of ten indicated by its following single digit.

Acknowledgement

We wish to express our gratitude to Mrs. D. A. Barton and Miss A. E. Dillinger for their assistance in the preparation of this work.

BIBLIOGRAPHY

¹G. Racah, Phys. Rev. 62, 438 (1942); 63, 367 (1943); 76, 1352 (1949).

²J. A. Barnes, B. L. Carroll and L. M. Flores, J. Chem. Phys. (To be published). This paper presented the Spin-Other-Orbit matrix elements for the f^3 configuration.

³B. G. Wybourne, Spectroscopic Properties of Rare Earths, (Interscience Publishers, Inc., New York, 1956).

⁴H. Horie, Progr. Theoret. Phys. 10, 296 (1953).

⁵C. W. Nielson and G. F. Koster; Spectroscopic Coefficients for p^n , d^n and f^n Configurations, (M.I.T. Press, Cambridge, Mass., 1964).

⁶H. H. Marvin, Phys. Rev. 71, 102 (1947).

⁷B. R. Judd, H. M. Crosswhite, and Hannah Crosswhite, Phys. Rev. 169, 130 (1968).

⁸The state notation may be related to that used by Nielson and Koster⁵ through the use of their tables presented on pages 2 and 3.

TABLE I. SPIN-OTHER-ORBIT INTERACTION OF f^4 ELECTRONS FOR VARIOUS J LEVELS.^a

J = 10.0 ^b		(3004)3M, (2204)1M ^c		(U _{TV})SL (U' _T 'V')S'L'		M ⁰	M ²	M ⁴	M ⁶	M ⁸
(3004)3M		(3004)3M ^d		(2204)1M		1.006549+0	-1.763200+0	-1.730239+0		
J = 9.0		(2104)3L, (3004)3M,		(U _{TV})SL (U' _T 'V')S'L'		M ⁰	M ²	M ⁴	M ⁶	M ⁸
(2104)3L		(2104)3L		(3004)3M		5.478112+0	2.355841+0	1.060883+0		
(3004)3M		(3004)3M		(3004)3M		5.177775+0	-4.417506-1	-4.041580-1		
J = 8.0		(2004)5L, (2104)3K, (3004)3K, (2104)3L, (3004)3M, (2104)1L, (2204)1L,		(U _{TV})SL (U' _T 'V')S'L'		M ⁰	M ²	M ⁴	M ⁶	M ⁸
(2004)5L		(2004)5L		(2104)3L		2.4654843-1	-3.998680-1	-4.619118-1		
(2104)3K		(2104)3K		(2104)3L		4.0333869+0	-2.887764+0	-3.016684+0		
(3004)3K		(3004)3K		(2104)3L		5.097219+0	-6.847640-1	-2.5944802-1		
(2104)3K		(2104)3K		(3004)3M		-2.3493308+0	3.274791-1	1.003148+0		
(3004)3K		(3004)3K		(2104)1L		-4.2831892+0	-4.981886+0	-6.2237191-1		
(2104)1L		(2104)1L		(2204)1L		-9.1893360-1	-3.090967+0	-1.536429+0		
(3004)3K		(3004)3K		(3004)3M		5.177776+1	-4.417507+0	-4.041580+0		
(2204)1L		(2204)1L		(2104)1L		-1.993452+0	-1.449784+0	1.089071-1		
(3004)3K		(3004)3K		(2204)1L		3.425778+0	-2.565045+0	1.030250+0		
J = 7.0		(2004)5L, (2004)3L, (3004)3L, (2104)3K, (2104)3K, (2104)3L, (2104)1K,		(U _{TV})SL (U' _T 'V')S'L'		M ⁰	M ²	M ⁴	M ⁶	M ⁸
(2004)5L		(2004)5L		(3004)3K		9.424237-1	-7.044378-1	-2.364214+0		
(2004)3L		(2004)3L		(2104)1K		2.138088+0	-6.422773-1	-4.419805-1		
(3004)3L		(3004)3L		(2104)3K		5.121822+0	2.534991-1	2.512877-1		
(2104)3K		(2104)3K		(3004)3K		4.581212-2	6.519891-1	9.686486-1		
(3004)3K		(3004)3K		(2104)3L		3.908955+0	-1.033022+0	-5.701123-1		
(2004)3L		(2004)3L		(2104)1K		-1.844100+0	-1.806848+0	-3.499768-1		
(3004)3L		(3004)3L		(3004)3K		5.231743+0	-1.997113-1	2.916879-1		
(2104)3K		(2104)3K		(2104)3L		-2.204794+0	1.988321+0	-4.821626-2		
(3004)3K		(3004)3K		(2104)1K		1.322335+0	1.536046+0	-2.797481-2		
(2104)1K		(2104)1K		(2104)3L		4.587498+1	-6.162874+0	-2.650322+0		
(3004)3L		(3004)3L		(2104)1K		5.926134+0	3.646760+0	-7.769039-1		

TABLE I. (continued)

$J = 4.0$									
(1102)3M, (2002)11, (2004)56, (2004)51, (1104)3M, (2104)3M, (3004)31, (2104)33, (2104)3K, (3004)3K, (3004)31, (2204)11, (2204)11, (2204)11,									
(U ₁ V ₁ SL (U ₁ T ¹ V ¹ SL ¹ M ⁰ M ² M ⁴ M ⁶ M ⁸ M ¹⁰ M ¹² M ¹⁴ M ¹⁶ M ¹⁸ M ²⁰ M ²² M ²⁴ M ²⁶ M ²⁸ M ³⁰ M ³² M ³⁴ M ³⁶ M ³⁸ M ⁴⁰ M ⁴² M ⁴⁴ M ⁴⁶ M ⁴⁸ M ⁵⁰ M ⁵² M ⁵⁴ M ⁵⁶ M ⁵⁸ M ⁶⁰ M ⁶² M ⁶⁴ M ⁶⁶ M ⁶⁸ M ⁷⁰ M ⁷² M ⁷⁴ M ⁷⁶ M ⁷⁸ M ⁸⁰ M ⁸² M ⁸⁴ M ⁸⁶ M ⁸⁸ M ⁹⁰ M ⁹² M ⁹⁴ M ⁹⁶ M ⁹⁸ M ¹⁰⁰ M ¹⁰² M ¹⁰⁴ M ¹⁰⁶ M ¹⁰⁸ M ¹¹⁰ M ¹¹² M ¹¹⁴ M ¹¹⁶ M ¹¹⁸ M ¹²⁰ M ¹²² M ¹²⁴ M ¹²⁶ M ¹²⁸ M ¹³⁰ M ¹³² M ¹³⁴ M ¹³⁶ M ¹³⁸ M ¹⁴⁰ M ¹⁴² M ¹⁴⁴ M ¹⁴⁶ M ¹⁴⁸ M ¹⁵⁰ M ¹⁵² M ¹⁵⁴ M ¹⁵⁶ M ¹⁵⁸ M ¹⁶⁰ M ¹⁶² M ¹⁶⁴ M ¹⁶⁶ M ¹⁶⁸ M ¹⁷⁰ M ¹⁷² M ¹⁷⁴ M ¹⁷⁶ M ¹⁷⁸ M ¹⁸⁰ M ¹⁸² M ¹⁸⁴ M ¹⁸⁶ M ¹⁸⁸ M ¹⁹⁰ M ¹⁹² M ¹⁹⁴ M ¹⁹⁶ M ¹⁹⁸ M ²⁰⁰ M ²⁰² M ²⁰⁴ M ²⁰⁶ M ²⁰⁸ M ²¹⁰ M ²¹² M ²¹⁴ M ²¹⁶ M ²¹⁸ M ²²⁰ M ²²² M ²²⁴ M ²²⁶ M ²²⁸ M ²³⁰ M ²³² M ²³⁴ M ²³⁶ M ²³⁸ M ²⁴⁰ M ²⁴² M ²⁴⁴ M ²⁴⁶ M ²⁴⁸ M ²⁵⁰ M ²⁵² M ²⁵⁴ M ²⁵⁶ M ²⁵⁸ M ²⁶⁰ M ²⁶² M ²⁶⁴ M ²⁶⁶ M ²⁶⁸ M ²⁷⁰ M ²⁷² M ²⁷⁴ M ²⁷⁶ M ²⁷⁸ M ²⁸⁰ M ²⁸² M ²⁸⁴ M ²⁸⁶ M ²⁸⁸ M ²⁹⁰ M ²⁹² M ²⁹⁴ M ²⁹⁶ M ²⁹⁸ M ³⁰⁰ M ³⁰² M ³⁰⁴ M ³⁰⁶ M ³⁰⁸ M ³¹⁰ M ³¹² M ³¹⁴ M ³¹⁶ M ³¹⁸ M ³²⁰ M ³²² M ³²⁴ M ³²⁶ M ³²⁸ M ³³⁰ M ³³² M ³³⁴ M ³³⁶ M ³³⁸ M ³⁴⁰ M ³⁴² M ³⁴⁴ M ³⁴⁶ M ³⁴⁸ M ³⁵⁰ M ³⁵² M ³⁵⁴ M ³⁵⁶ M ³⁵⁸ M ³⁶⁰ M ³⁶² M ³⁶⁴ M ³⁶⁶ M ³⁶⁸ M ³⁷⁰ M ³⁷² M ³⁷⁴ M ³⁷⁶ M ³⁷⁸ M ³⁸⁰ M ³⁸² M ³⁸⁴ M ³⁸⁶ M ³⁸⁸ M ³⁹⁰ M ³⁹² M ³⁹⁴ M ³⁹⁶ M ³⁹⁸ M ⁴⁰⁰ M ⁴⁰² M ⁴⁰⁴ M ⁴⁰⁶ M ⁴⁰⁸ M ⁴¹⁰ M ⁴¹² M ⁴¹⁴ M ⁴¹⁶ M ⁴¹⁸ M ⁴²⁰ M ⁴²² M ⁴²⁴ M ⁴²⁶ M ⁴²⁸ M ⁴³⁰ M ⁴³² M ⁴³⁴ M ⁴³⁶ M ⁴³⁸ M ⁴⁴⁰ M ⁴⁴² M ⁴⁴⁴ M ⁴⁴⁶ M ⁴⁴⁸ M ⁴⁵⁰ M ⁴⁵² M ⁴⁵⁴ M ⁴⁵⁶ M ⁴⁵⁸ M ⁴⁶⁰ M ⁴⁶² M ⁴⁶⁴ M ⁴⁶⁶ M ⁴⁶⁸ M ⁴⁷⁰ M ⁴⁷² M ⁴⁷⁴ M ⁴⁷⁶ M ⁴⁷⁸ M ⁴⁸⁰ M ⁴⁸² M ⁴⁸⁴ M ⁴⁸⁶ M ⁴⁸⁸ M ⁴⁹⁰ M ⁴⁹² M ⁴⁹⁴ M ⁴⁹⁶ M ⁴⁹⁸ M ⁵⁰⁰ M ⁵⁰² M ⁵⁰⁴ M ⁵⁰⁶ M ⁵⁰⁸ M ⁵¹⁰ M ⁵¹² M ⁵¹⁴ M ⁵¹⁶ M ⁵¹⁸ M ⁵²⁰ M ⁵²² M ⁵²⁴ M ⁵²⁶ M ⁵²⁸ M ⁵³⁰ M ⁵³² M ⁵³⁴ M ⁵³⁶ M ⁵³⁸ M ⁵⁴⁰ M ⁵⁴² M ⁵⁴⁴ M ⁵⁴⁶ M ⁵⁴⁸ M ⁵⁵⁰ M ⁵⁵² M ⁵⁵⁴ M ⁵⁵⁶ M ⁵⁵⁸ M ⁵⁶⁰ M ⁵⁶² M ⁵⁶⁴ M ⁵⁶⁶ M ⁵⁶⁸ M ⁵⁷⁰ M ⁵⁷² M ⁵⁷⁴ M ⁵⁷⁶ M ⁵⁷⁸ M ⁵⁸⁰ M ⁵⁸² M ⁵⁸⁴ M ⁵⁸⁶ M ⁵⁸⁸ M ⁵⁹⁰ M ⁵⁹² M ⁵⁹⁴ M ⁵⁹⁶ M ⁵⁹⁸ M ⁶⁰⁰ M ⁶⁰² M ⁶⁰⁴ M ⁶⁰⁶ M ⁶⁰⁸ M ⁶¹⁰ M ⁶¹² M ⁶¹⁴ M ⁶¹⁶ M ⁶¹⁸ M ⁶²⁰ M ⁶²² M ⁶²⁴ M ⁶²⁶ M ⁶²⁸ M ⁶³⁰ M ⁶³² M ⁶³⁴ M ⁶³⁶ M ⁶³⁸ M ⁶⁴⁰ M ⁶⁴² M ⁶⁴⁴ M ⁶⁴⁶ M ⁶⁴⁸ M ⁶⁵⁰ M ⁶⁵² M ⁶⁵⁴ M ⁶⁵⁶ M ⁶⁵⁸ M ⁶⁶⁰ M ⁶⁶² M ⁶⁶⁴ M ⁶⁶⁶ M ⁶⁶⁸ M ⁶⁷⁰ M ⁶⁷² M ⁶⁷⁴ M ⁶⁷⁶ M ⁶⁷⁸ M ⁶⁸⁰ M ⁶⁸² M ⁶⁸⁴ M ⁶⁸⁶ M ⁶⁸⁸ M ⁶⁹⁰ M ⁶⁹² M ⁶⁹⁴ M ⁶⁹⁶ M ⁶⁹⁸ M ⁷⁰⁰ M ⁷⁰² M ⁷⁰⁴ M ⁷⁰⁶ M ⁷⁰⁸ M ⁷¹⁰ M ⁷¹² M ⁷¹⁴ M ⁷¹⁶ M ⁷¹⁸ M ⁷²⁰ M ⁷²² M ⁷²⁴ M ⁷²⁶ M ⁷²⁸ M ⁷³⁰ M ⁷³² M ⁷³⁴ M ⁷³⁶ M ⁷³⁸ M ⁷⁴⁰ M ⁷⁴² M ⁷⁴⁴ M ⁷⁴⁶ M ⁷⁴⁸ M ⁷⁵⁰ M ⁷⁵² M ⁷⁵⁴ M ⁷⁵⁶ M ⁷⁵⁸ M ⁷⁶⁰ M ⁷⁶² M ⁷⁶⁴ M ⁷⁶⁶ M ⁷⁶⁸ M ⁷⁷⁰ M ⁷⁷² M ⁷⁷⁴ M ⁷⁷⁶ M ⁷⁷⁸ M ⁷⁸⁰ M ⁷⁸² M ⁷⁸⁴ M ⁷⁸⁶ M ⁷⁸⁸ M ⁷⁹⁰ M ⁷⁹² M ⁷⁹⁴ M ⁷⁹⁶ M ⁷⁹⁸ M ⁸⁰⁰ M ⁸⁰² M ⁸⁰⁴ M ⁸⁰⁶ M ⁸⁰⁸ M ⁸¹⁰ M ⁸¹² M ⁸¹⁴ M ⁸¹⁶ M ⁸¹⁸ M ⁸²⁰ M ⁸²² M ⁸²⁴ M ⁸²⁶ M ⁸²⁸ M ⁸³⁰ M ⁸³² M ⁸³⁴ M ⁸³⁶ M ⁸³⁸ M ⁸⁴⁰ M ⁸⁴² M ⁸⁴⁴ M ⁸⁴⁶ M ⁸⁴⁸ M ⁸⁵⁰ M ⁸⁵² M ⁸⁵⁴ M ⁸⁵⁶ M ⁸⁵⁸ M ⁸⁶⁰ M ⁸⁶² M ⁸⁶⁴ M ⁸⁶⁶ M ⁸⁶⁸ M ⁸⁷⁰ M ⁸⁷² M ⁸⁷⁴ M ⁸⁷⁶ M ⁸⁷⁸ M ⁸⁸⁰ M ⁸⁸² M ⁸⁸⁴ M ⁸⁸⁶ M ⁸⁸⁸ M ⁸⁹⁰ M ⁸⁹² M ⁸⁹⁴ M ⁸⁹⁶ M ⁸⁹⁸ M ⁹⁰⁰ M ⁹⁰² M ⁹⁰⁴ M ⁹⁰⁶ M ⁹⁰⁸ M ⁹¹⁰ M ⁹¹² M ⁹¹⁴ M ⁹¹⁶ M ⁹¹⁸ M ⁹²⁰ M ⁹²² M ⁹²⁴ M ⁹²⁶ M ⁹²⁸ M ⁹³⁰ M ⁹³² M ⁹³⁴ M ⁹³⁶ M ⁹³⁸ M ⁹⁴⁰ M ⁹⁴² M ⁹⁴⁴ M ⁹⁴⁶ M ⁹⁴⁸ M ⁹⁵⁰ M ⁹⁵² M ⁹⁵⁴ M ⁹⁵⁶ M ⁹⁵⁸ M ⁹⁶⁰ M ⁹⁶² M ⁹⁶⁴ M ⁹⁶⁶ M ⁹⁶⁸ M ⁹⁷⁰ M ⁹⁷² M ⁹⁷⁴ M ⁹⁷⁶ M ⁹⁷⁸ M ⁹⁸⁰ M ⁹⁸² M ⁹⁸⁴ M ⁹⁸⁶ M ⁹⁸⁸ M ⁹⁹⁰ M ⁹⁹² M ⁹⁹⁴ M ⁹⁹⁶ M ⁹⁹⁸ M ¹⁰⁰⁰ M ¹⁰⁰² M ¹⁰⁰⁴ M ¹⁰⁰⁶ M ¹⁰⁰⁸ M ¹⁰¹⁰ M ¹⁰¹² M ¹⁰¹⁴ M ¹⁰¹⁶ M ¹⁰¹⁸ M ¹⁰²⁰ M ¹⁰²² M ¹⁰²⁴ M ¹⁰²⁶ M ¹⁰²⁸ M ¹⁰³⁰ M ¹⁰³² M ¹⁰³⁴ M ¹⁰³⁶ M ¹⁰³⁸ M ¹⁰⁴⁰ M ¹⁰⁴² M ¹⁰⁴⁴ M ¹⁰⁴⁶ M ¹⁰⁴⁸ M ¹⁰⁵⁰ M ¹⁰⁵² M ¹⁰⁵⁴ M ¹⁰⁵⁶ M ¹⁰⁵⁸ M ¹⁰⁶⁰ M ¹⁰⁶² M ¹⁰⁶⁴ M ¹⁰⁶⁶ M ¹⁰⁶⁸ M ¹⁰⁷⁰ M ¹⁰⁷² M ¹⁰⁷⁴ M ¹⁰⁷⁶ M ¹⁰⁷⁸ M ¹⁰⁸⁰ M ¹⁰⁸² M ¹⁰⁸⁴ M ¹⁰⁸⁶ M ¹⁰⁸⁸ M ¹⁰⁹⁰ M ¹⁰⁹² M ¹⁰⁹⁴ M ¹⁰⁹⁶ M ¹⁰⁹⁸ M ¹¹⁰⁰ M ¹¹⁰² M ¹¹⁰⁴ M ¹¹⁰⁶ M ¹¹⁰⁸ M ¹¹¹⁰ M ¹¹¹² M ¹¹¹⁴ M ¹¹¹⁶ M ¹¹¹⁸ M ¹¹²⁰ M ¹¹²² M ¹¹²⁴ M ¹¹²⁶ M ¹¹²⁸ M ¹¹³⁰ M ¹¹³² M ¹¹³⁴ M ¹¹³⁶ M ¹¹³⁸ M ¹¹⁴⁰ M ¹¹⁴² M ¹¹⁴⁴ M ¹¹⁴⁶ M ¹¹⁴⁸ M ¹¹⁵⁰ M ¹¹⁵² M ¹¹⁵⁴ M ¹¹⁵⁶ M ¹¹⁵⁸ M ¹¹⁶⁰ M ¹¹⁶² M ¹¹⁶⁴ M ¹¹⁶⁶ M ¹¹⁶⁸ M ¹¹⁷⁰ M ¹¹⁷² M ¹¹⁷⁴ M ¹¹⁷⁶ M ¹¹⁷⁸ M ¹¹⁸⁰ M ¹¹⁸² M ¹¹⁸⁴ M ¹¹⁸⁶ M ¹¹⁸⁸ M ¹¹⁹⁰ M ¹¹⁹² M ¹¹⁹⁴ M ¹¹⁹⁶ M ¹¹⁹⁸ M ¹²⁰⁰ M ¹²⁰² M ¹²⁰⁴ M ¹²⁰⁶ M ¹²⁰⁸ M ¹²¹⁰ M ¹²¹² M ¹²¹⁴ M ¹²¹⁶ M ¹²¹⁸ M ¹²²⁰ M ¹²²² M ¹²²⁴ M ¹²²⁶ M ¹²²⁸ M ¹²³⁰ M ¹²³² M ¹²³⁴ M ¹²³⁶ M ¹²³⁸ M ¹²⁴⁰ M ¹²⁴² M ¹²⁴⁴ M ¹²⁴⁶ M ¹²⁴⁸ M ¹²⁵⁰ M ¹²⁵² M ¹²⁵⁴ M ¹²⁵⁶ M ¹²⁵⁸ M ¹²⁶⁰ M ¹²⁶² M ¹²⁶⁴ M ¹²⁶⁶ M ¹²⁶⁸ M ¹²⁷⁰ M ¹²⁷² M ¹²⁷⁴ M ¹²⁷⁶ M ¹²⁷⁸ M ¹²⁸⁰ M ¹²⁸² M ¹²⁸⁴ M ¹²⁸⁶ M ¹²⁸⁸ M ¹²⁹⁰ M ¹²⁹² M ¹²⁹⁴ M ¹²⁹⁶ M ¹²⁹⁸ M ¹³⁰⁰ M ¹³⁰² M ¹³⁰⁴ M ¹³⁰⁶ M ¹³⁰⁸ M ¹³¹⁰ M ¹³¹² M ¹³¹⁴ M ¹³¹⁶ M ¹³¹⁸ M ¹³²⁰ M ¹³²² M ¹³²⁴ M ¹³²⁶ M ¹³²⁸ M ¹³³⁰ M ¹³³² M ¹³³⁴ M ¹³³⁶ M ¹³³⁸ M ¹³⁴⁰ M ¹³⁴² M ¹³⁴⁴ M ¹³⁴⁶ M ¹³⁴⁸ M ¹³⁵⁰ M ¹³⁵² M ¹³⁵⁴ M ¹³⁵⁶ M ¹³⁵⁸ M ¹³⁶⁰ M ¹³⁶² M ¹³⁶⁴ M ¹³⁶⁶ M ¹³⁶⁸ M ¹³⁷⁰ M ¹³⁷² M ¹³⁷⁴ M ¹³⁷⁶ M ¹³⁷⁸ M ¹³⁸⁰ M ¹³⁸² M ¹³⁸⁴ M ¹³⁸⁶ M ¹³⁸⁸ M ¹³⁹⁰ M ¹³⁹² M ¹³⁹⁴ M ¹³⁹⁶ M ¹³⁹⁸ M ¹⁴⁰⁰ M ¹⁴⁰² M ¹⁴⁰⁴ M ¹⁴⁰⁶ M ¹⁴⁰⁸ M ¹⁴¹⁰ M ¹⁴¹² M ¹⁴¹⁴ M ¹⁴¹⁶ M ¹⁴¹⁸ M ¹⁴²⁰ M ¹⁴²² M ¹⁴²⁴ M ¹⁴²⁶ M ¹⁴²⁸ M ¹⁴³⁰ M ¹⁴³² M ¹⁴³⁴ M ¹⁴³⁶ M ¹⁴³⁸ M ¹⁴⁴⁰ M ¹⁴⁴² M ¹⁴⁴⁴ M ¹⁴⁴⁶ M ¹⁴⁴⁸ M ¹⁴⁵⁰ M ¹⁴⁵² M ¹⁴⁵⁴ M ¹⁴⁵⁶ M ¹⁴⁵⁸ M ¹⁴⁶⁰ M ¹⁴⁶² M ¹⁴⁶⁴ M ¹⁴⁶⁶ M ¹⁴⁶⁸ M ¹⁴⁷⁰ M ¹⁴⁷² M ¹⁴⁷⁴ M ¹⁴⁷⁶ M ¹⁴⁷⁸ M ¹⁴⁸⁰ M ¹⁴⁸² M ¹⁴⁸⁴ M ¹⁴⁸⁶ M ¹⁴⁸⁸ M ¹⁴⁹⁰ M ¹⁴⁹² M ¹⁴⁹⁴ M ¹⁴⁹⁶ M ¹⁴⁹⁸ M ¹⁵⁰⁰ M ¹⁵⁰² M ¹⁵⁰⁴ M ¹⁵⁰⁶ M ¹⁵⁰⁸ M ¹⁵¹⁰ M ¹⁵¹² M ¹⁵¹⁴ M ¹⁵¹⁶ M ¹⁵¹⁸ M ¹⁵²⁰ M ¹⁵²² M ¹⁵²⁴ M ¹⁵²⁶ M ¹⁵²⁸ M ¹⁵³⁰ M ¹⁵³² M ¹⁵³⁴ M ¹⁵³⁶ M ¹⁵³⁸ M ¹⁵⁴⁰ M ¹⁵⁴² M ¹⁵⁴⁴ M ¹⁵⁴⁶ M ¹⁵⁴⁸ M ¹⁵⁵⁰ M ¹⁵⁵² M ¹⁵⁵⁴ M ¹⁵⁵⁶ M ¹⁵⁵⁸ M ¹⁵⁶⁰ M ¹⁵⁶² M ¹⁵⁶⁴ M ¹⁵⁶⁶ M ¹⁵⁶⁸ M ¹⁵⁷⁰ M ¹⁵⁷² M ¹⁵⁷⁴ M ¹⁵⁷⁶ M ¹⁵⁷⁸ M ¹⁵⁸⁰ M ¹⁵⁸² M ¹⁵⁸⁴ M ¹⁵⁸⁶ M ¹⁵⁸⁸ M ¹⁵⁹⁰ M ¹⁵⁹² M ¹⁵⁹⁴ M ¹⁵⁹⁶ M ¹⁵⁹⁸ M ¹⁶⁰⁰ M ¹⁶⁰² M ¹⁶⁰⁴ M ¹⁶⁰⁶ M ¹⁶⁰⁸ M ¹⁶¹⁰ M ¹⁶¹² M ¹⁶¹⁴ M ¹⁶¹⁶ M ¹⁶¹⁸ M ¹⁶²⁰ M ¹⁶²² M ¹⁶²⁴ M ¹⁶²⁶ M ¹⁶²⁸ M ¹⁶³⁰ M ¹⁶³² M ¹⁶³⁴ M ¹⁶³⁶ M ¹⁶³⁸ M ¹⁶⁴⁰ M ¹⁶⁴² M ¹⁶⁴⁴ M ¹⁶⁴⁶ M ¹⁶⁴⁸ M ¹⁶⁵⁰ M ¹⁶⁵² M ¹⁶⁵⁴ M ¹⁶⁵⁶ M ¹⁶⁵⁸ M ¹⁶⁶⁰ M ¹⁶⁶² M ¹⁶⁶⁴ M ¹⁶⁶⁶ M ¹⁶⁶⁸ M ¹⁶⁷⁰ M ¹⁶⁷² M ¹⁶⁷⁴ M ¹⁶⁷⁶ M ¹⁶⁷⁸ M ¹⁶⁸⁰ M ¹⁶⁸² M ¹⁶⁸⁴ M ¹⁶⁸⁶ M ¹⁶⁸⁸ M ¹⁶⁹⁰ M ¹⁶⁹² M ¹⁶⁹⁴ M ¹⁶⁹⁶ M ¹⁶⁹⁸ M ¹⁷⁰⁰ M ¹⁷⁰² M ¹⁷⁰⁴ M ¹⁷⁰⁶ M ¹⁷⁰⁸ M ¹⁷¹⁰ M ¹⁷¹² M ¹⁷¹⁴ M ¹⁷¹⁶ M ¹⁷¹⁸ M ¹⁷²⁰ M ¹⁷²² M ¹⁷²⁴ M ¹⁷²⁶ M ¹⁷²⁸ M ¹⁷³⁰ M ¹⁷³² M ¹⁷³⁴ M ¹⁷³⁶ M ¹⁷³⁸ M ¹⁷⁴⁰ M ¹⁷⁴² M ¹⁷⁴⁴ M ¹⁷⁴⁶ M ¹⁷⁴⁸ M ¹⁷⁵⁰ M ¹⁷⁵² M ¹⁷⁵⁴ M ¹⁷⁵⁶ M ¹⁷⁵⁸ M ¹⁷⁶⁰ M ¹⁷⁶² M ¹⁷⁶⁴ M ¹⁷⁶⁶ M ¹⁷⁶⁸ M ¹⁷⁷⁰ M ¹⁷⁷² M ¹⁷⁷⁴ M ¹⁷⁷⁶ M ¹⁷⁷⁸ M ¹⁷⁸⁰ M ¹⁷⁸² M ¹⁷⁸⁴ M ¹⁷⁸⁶ M ¹⁷⁸⁸ M ¹⁷⁹⁰ M ¹⁷⁹² M ¹⁷⁹⁴ M ¹⁷⁹⁶ M ¹⁷⁹⁸ M ¹⁸⁰⁰ M ¹⁸⁰² M ¹⁸⁰⁴ M ¹⁸⁰⁶ M ¹⁸⁰⁸ M ¹⁸¹⁰ M ¹⁸¹² M ¹⁸¹⁴ M ¹⁸¹⁶ M ¹⁸¹⁸ M ¹⁸²⁰ M ¹⁸²² M ¹⁸²⁴ M ¹⁸²⁶ M ¹⁸²⁸ M ¹⁸³⁰ M ¹⁸³² M ¹⁸³⁴ M ¹⁸³⁶ M ¹⁸³⁸ M ¹⁸⁴⁰ M ¹⁸⁴² M ¹⁸⁴⁴ M ¹⁸⁴⁶ M ¹⁸⁴⁸ M ¹⁸⁵⁰ M ¹⁸⁵² M ¹⁸⁵⁴ M ¹⁸⁵⁶ M ¹⁸⁵⁸ M ¹⁸⁶⁰ M ¹⁸⁶² M ¹⁸⁶⁴ M ¹⁸⁶⁶ M ¹⁸⁶⁸ M ¹⁸⁷⁰ M ¹⁸⁷² M ¹⁸⁷⁴ M ¹⁸⁷⁶ M ¹⁸⁷⁸ M ¹⁸⁸⁰ M ¹⁸⁸² M ¹⁸⁸⁴ M ¹⁸⁸⁶ M ¹⁸⁸⁸ M ¹⁸⁹⁰ M ¹⁸⁹² M ¹⁸⁹⁴ M ¹⁸⁹⁶ M ¹⁸⁹⁸ M ¹⁹⁰⁰ M ¹⁹⁰² M ¹⁹⁰⁴ M ¹⁹⁰⁶ M ¹⁹⁰⁸ M ¹⁹¹⁰ M ¹⁹¹² M ¹⁹¹⁴ M ¹⁹¹⁶ M ¹⁹¹⁸ M ¹⁹²⁰ M ¹⁹²² M ¹⁹²⁴ M ¹⁹²⁶ M ¹⁹²⁸ M ¹⁹³⁰ M ¹⁹³² M ¹⁹³⁴ M ¹⁹³⁶ M ¹⁹³⁸ M ¹⁹⁴⁰ M ¹⁹⁴² M ¹⁹⁴⁴ M ¹⁹⁴⁶ M ¹⁹⁴⁸ M ¹⁹⁵⁰ M ¹⁹⁵² M ¹⁹⁵⁴ M ¹⁹⁵⁶ M ¹⁹⁵⁸ M ¹⁹⁶⁰ M ¹⁹⁶² M ¹⁹⁶⁴ M ¹⁹⁶⁶ M ¹⁹⁶⁸ M ¹⁹⁷⁰ M ¹⁹⁷² M ¹⁹⁷⁴ M ¹⁹⁷⁶ M ¹⁹⁷⁸ M ¹⁹⁸⁰ M ¹⁹⁸² M ¹⁹⁸⁴ M ¹⁹⁸⁶ M ¹⁹⁸⁸ M ¹⁹⁹⁰ M ¹⁹⁹² M ¹⁹⁹⁴ M ¹⁹⁹⁶ M ¹⁹⁹⁸ M ²⁰⁰⁰ M ²⁰⁰² M ²⁰⁰⁴ M ²⁰⁰⁶ M ²⁰⁰⁸ M ²⁰¹⁰ M ²⁰¹² M ²⁰¹⁴ M ²⁰¹⁶ M ²⁰¹⁸ M ²⁰²⁰ M ²⁰²² M ²⁰²⁴ M ²⁰²⁶ M ²⁰²⁸ M ²⁰³⁰ M ²⁰³² M ²⁰³⁴ M ²⁰³⁶ M ²⁰³⁸ M ²⁰⁴⁰ M ²⁰⁴² M ²⁰⁴⁴ M ²⁰⁴⁶ M ²⁰⁴⁸ M ²⁰⁵⁰ M ²⁰⁵² M ²⁰⁵⁴ M ²⁰⁵⁶ M ²⁰⁵⁸ M ²⁰⁶⁰ M ²⁰⁶² M ²⁰⁶⁴ M ²⁰⁶⁶ M ²⁰⁶⁸ M ²⁰⁷⁰ M ²⁰⁷² M ²⁰⁷⁴ M ²⁰⁷⁶ M ²⁰⁷⁸ M ²⁰⁸⁰ M ²⁰⁸² M ²⁰⁸⁴ M ²⁰⁸⁶ M ²⁰⁸⁸ M ²⁰⁹⁰ M ²⁰⁹² M ²⁰⁹⁴ M ²⁰⁹⁶ M ²⁰⁹⁸ M ²¹⁰⁰ M ²¹⁰² M ²¹⁰⁴ M ²¹⁰⁶ M ²¹⁰⁸ M ²¹¹⁰ M ²¹¹² M ²¹¹⁴ M ²¹¹⁶ M ²¹¹⁸ M ²¹²⁰ M ²¹²² M ²¹²⁴ M ²¹²⁶ M ²¹²⁸ M ²¹³⁰ M ²¹³² M ²¹³⁴ M ²¹³⁶ M ²¹³⁸ M ²¹⁴⁰ M ²¹⁴² M ²¹⁴⁴ M ²¹⁴⁶ M ²¹⁴⁸ M ²¹⁵⁰ M ²¹⁵² M ²¹⁵⁴ M ²¹⁵⁶ M ²¹⁵⁸ M ²¹⁶⁰ M ²¹⁶² M ²¹⁶⁴ M ²¹⁶⁶ M ²¹⁶⁸ M ²¹⁷⁰ M ²¹⁷² M ²¹⁷⁴ M ²¹⁷⁶ M ²¹⁷⁸ M ²¹⁸⁰ M ²¹⁸² M ²¹⁸⁴ M ²¹⁸⁶ M ²¹⁸⁸ M ²¹⁹⁰ M ²¹⁹² M ²¹⁹⁴ M ²¹⁹⁶ M ²¹⁹⁸ M ²²⁰⁰ M ²²⁰² M ²²⁰⁴ M ²²⁰⁶ M ²²⁰⁸ M ²²¹⁰ M ²²¹² M ²²¹⁴ M ²²¹⁶ M ²²¹⁸ M ²²²⁰ M ²²²² M ²²²⁴ M ²²²⁶ M ²²²⁸ M ²²³⁰ M ²²³² M ²²³⁴ M ²²³⁶ M ²²³⁸ M ²²⁴⁰ M ²²⁴² M ²²⁴⁴ M ²²⁴⁶ M ²²⁴⁸ M ²²⁵⁰ M ²²⁵² M ²²⁵⁴ M ²²⁵⁶ M ²²⁵⁸ M ²²⁶⁰ M ²²⁶² M ²²⁶⁴ M ²²⁶⁶ M ²²⁶⁸ M ²²⁷⁰ M ²²⁷²									

TABLE I. (continued)

J = 4.0	UTV'SL	U'T'V'S'L'	M ⁰	M ²	M ⁴	UTV'SL	U'T'V'S'L'	M ⁰	M ²	M ⁴
(1004)3F	(1002)3F	(1002)3F	-1.879999+1	-5.323333-1	7.575755-1	(2104)3F	(2104)3F	1.924784+0	-7.968794-1	-1.028230+0
	(2002)16	(2002)16	-3.063767+0	-2.321031-2	4.040710+0	(3004)3F	(3004)3F	-6.443473-2	1.936674+0	9.852586-1
	(2004)15F	(2004)15F	6.721110+0	1.192924+0	1.018349+0	(2104)36	(2104)36	3.490139+0	1.432872+0	-8.120547-1
	(1004)15F	(1004)15F	-5.000000+0	1.166664+0	3.030303-1	(2104)36	(2104)36	1.067849+0	3.509035+0	2.561930+0
	(2004)156	(2004)156	-3.233695+0	8.169227-1	1.068990+0	(3004)36	(3004)36	6.903829+1	1.059248+0	3.148114+1
	(1004)13F	(1004)13F	-1.222222-1	-1.222222-1	2.020201+1	(2004)16	(2004)16	-1.088281+1	-5.312530-1	2.205030-1
	(2104)13F	(2104)13F	-3.853570+0	8.493235-1	-1.710337-1	(2104)16	(2104)16	3.543202+0	3.265599+0	2.340462+0
	(3004)13F	(3004)13F	7.97170-1	3.575398+0	3.944123+0	(2104)3F	(2104)3F	-1.841666+1	4.212119+0	2.737602+0
	(2004)136	(2004)136	4.583730+0	1.173347+0	1.694723+0	(3004)3F	(3004)3F	-3.723797+0	-2.339126+0	-3.537829+0
	(2104)136	(2104)136	-4.300004+0	2.245933+0	1.144000+0	(2004)36	(2004)36	-1.197302+0	-3.358204+0	-7.175853+0
(1102)3M	(3004)136	(3004)136	4.360313-1	1.955537+0	2.168144+0	(2104)36	(2104)36	-7.248634-2	1.300359+0	-4.561303-1
	(2004)16	(2004)16	-2.562846+0	-9.015544-1	-4.742599+0	(3004)36	(3004)36	5.770651+0	-5.486487+0	-7.422544+0
	(2104)16	(2104)16	-6.632148+0	-1.766742+0	-1.768445+0	(2004)16	(2004)16	1.181923+0	1.979072+0	1.970020+0
	(1102)3M	(1102)3M	2.967999+1	-2.853332+0	-1.442424+0	(2104)16	(2104)16	2.524541+0	6.974461+0	9.748338+0
	(2002)16	(2002)16	4.99370-1	4.589802+0	3.664558+0	(2204)16	(2204)16	-3.103143-1	-6.313137+0	-1.747872+0
	(2004)156	(2004)156	-2.735646+0	-6.156221-1	-9.766190-1	(3004)3F	(3004)3F	-1.547777+1	6.774410+1	-6.499371-1
	(2004)151	(2004)151	5.613835+0	-3.997730+0	-3.494160+0	(2004)36	(2004)36	-4.130677+0	4.271742+0	3.139998+0
	(2004)136	(2004)136	-1.692960+0	-1.425298+0	-7.178198-1	(2104)36	(2104)36	3.633596+0	3.511687+0	5.775712+0
	(2104)136	(2104)136	-2.272495-1	-1.019249+0	-1.130087+0	(3004)36	(3004)36	1.975067+0	1.771575+0	4.605977+0
	(3004)136	(3004)136	-5.75837+0	2.510563+0	2.432285+0	(2004)16	(2004)16	1.352674+0	-3.140947+0	4.070992-1
(2004)136	(1104)13M	(1104)13M	-2.493333+0	1.692931-1	5.932053-2	(2104)16	(2104)16	4.178551-1	1.017203+0	-1.649490+0
	(1004)13F	(1004)13F	-7.195910+0	-8.554577-1	-1.303772+0	(3004)3M	(3004)3M	1.744090+0	3.955838+0	2.898866+0
	(2204)1M	(2204)1M	-5.232069+0	2.802387+0	2.002144+0	(2104)16	(2104)16	-1.144813+0	9.802018-1	-1.585477+0
	(1004)15F	(1004)15F	2.999999+1	2.999999+0	4.000000+0	(2104)1M	(2104)1M	3.324910+0	1.133792+1	1.552452+1
	(2004)156	(2004)156	4.308420+0	5.570482+0	9.253031+0	(1104)3M	(1104)3M	5.366293+0	3.402914-2	-8.948978-2
	(2004)136	(2004)136	6.037102+0	-6.425653+0	-4.922437+0	(2104)1M	(2104)1M	1.898695-1	1.355735+0	8.451704-1
	(2104)136	(2104)136	9.205845+0	4.575277+0	3.338247+0	(3004)3M	(3004)3M	-3.074221-1	-1.110221-1	2.182609-1
	(3004)136	(3004)136	-1.602081+0	-1.197515+0	1.198986+0	(2004)31	(2004)31	-5.273096+0	-2.542126+0	-4.576333-1
	(2004)156	(2004)156	-1.045000+1	2.448484+0	2.610880+0	(3004)31	(3004)31	-1.752848+0	-2.706153+0	-4.272498+0
	(2004)136	(2004)136	-9.412507-1	2.113489-1	-2.823580+0	(2104)1M	(2104)1M	8.210197-1	9.205377-1	2.456622+0
	(2104)136	(2104)136	2.953856+0	1.023599+0	5.512898+0	(2204)1M	(2204)1M	-2.621535+0	2.812529+0	1.001072+0
(2004)151	(3004)136	(3004)136	4.406410+0	4.803609+0	6.002591+0	(2104)3M	(2104)3M	4.543701+0	-9.242644-1	-4.380712-1
	(1104)13M	(1104)13M	1.313814+0	-1.164968+0	-1.6449238+0	(3004)13M	(3004)13M	-7.9440849-1	-1.479004+0	-1.912741+0
	(2104)13M	(2104)13M	1.031847+0	-1.063701+0	-4.451015-1	(2004)31	(2004)31	-2.132005+0	1.539782+0	4.925736+0
	(3004)13M	(3004)13M	1.659561+0	-4.964259+0	-5.213724+0	(3004)31	(3004)31	2.2325042+0	2.416239+0	2.894536+0
	(2004)151	(2004)151	4.949998+1	-8.181814-1	5.578505-1	(2104)1M	(2104)1M	3.335023+0	-3.873521+0	-1.926513+0
	(1104)13M	(1104)13M	-2.143817+0	-2.739323+0	-1.117717+0	(2204)1M	(2204)1M	-1.934941+0	2.410531-1	7.385130-1
	(2104)13M	(2104)13M	3.559594+0	2.065193+0	1.587193-1	(3004)3M	(3004)3M	4.734442+0	-5.513802-1	-7.618053-1
	(3004)13M	(3004)13M	-5.011973+0	-2.229276+0	-4.853501+0	(2004)31	(2004)31	-3.607767+0	4.998769+0	4.144589+0
	(2004)131	(2004)131	1.118032+0	1.174500+0	2.244807-1	(3004)31	(3004)31	-9.304774-1	-3.180150+0	-2.228906+0
	(3004)131	(3004)131	-4.303303-1	-5.046412+0	-4.214401+0	(2104)1M	(2104)1M	2.445312+0	-1.799922+0	2.772118+0
(2004)136	(2004)136	(2004)136	-1.965217+1	-6.262625-1	-7.6338770-1	(2204)1M	(2204)1M	-5.457160+0	3.504402+0	3.475541+0
	(2104)136	(2104)136	2.028999+0	3.627160+0	4.868249+0	(2004)31	(2004)31	3.449989+1	-9.595959-1	-1.698629+0
	(3004)136	(3004)136	3.872982+0	9.587262-1	-1.391523+0	(3004)31	(3004)31	-2.694300+0	1.125541+0	-3.711150-2
	(1104)13M	(1104)13M	-7.512198+0	2.753329+0	1.731536+0	(2104)1M	(2104)1M	-9.497685+0	1.660797+0	5.252680-1
	(2104)13M	(2104)13M	2.818960+0	3.598185+0	-2.989078+0	(2204)1M	(2204)1M	2.042654+0	-1.027854+0	8.768622-1
	(3004)13M	(3004)13M	-2.227921+0	-1.423555+0	-1.423494+0	(3004)31	(3004)31	3.555553+1	4.282826+0	6.155255+0
	(2104)1M	(2104)1M	-7.657279+0	-2.092147-1	1.334941+0	(2104)1M	(2104)1M	8.090396+1	-3.541232-2	1.158002+0
	(2204)1M	(2204)1M	-6.822419-1	-1.529876+0	2.462085+0	(2204)1M	(2204)1M	6.483647+0	1.135540+1	1.453535+1
	(1004)13F	(1004)13F	-7.195910+0	-8.554577-1	-1.303772+0	(3004)3M	(3004)3M	1.744090+0	3.955838+0	2.898866+0
	(2204)1M	(2204)1M	-5.232069+0	2.802387+0	2.002144+0	(2104)16	(2104)16	-1.144813+0	9.802018-1	-1.585477+0
	(1004)15F	(1004)15F	2.999999+1	2.999999+0	4.000000+0	(2104)1M	(2104)1M	3.324910+0	1.133792+1	1.552452+1

J = 4.0 (1002)3F, (1102)3M, (2002)16, (2004)15F, (2004)156, (2004)151, (1004)13F, (2104)13F, (3004)13F.

(2004)136, (2104)136, (3004)136, (1104)13M, (2104)16, (2204)16.

UTV'SL	U'T'V'S'L'	M ⁰	M ²	M ⁴	UTV'SL	U'T'V'S'L'	M ⁰	M ²	M ⁴
(1002)3F	(1002)3F	-1.879999+1	-5.323333-1	7.575755-1	(2104)3F	(2104)3F	1.924784+0	-7.968794-1	-1.028230+0
(2002)16	(2002)16	-3.063767+0	-2.321031-2	4.040710+0	(3004)3F	(3004)3F	-6.443473-2	1.936674+0	9.852586-1
(2004)15F	(2004)15F	6.721110+0	1.192924+0	1.018349+0	(2104)36	(2104)36	3.490139+0	1.432872+0	-8.120547-1
(1004)15F	(1004)15F	-5.000000+0	1.166664+0	3.030303-1	(2104)36	(2104)36	1.067849+0	3.509035+0	2.561930+0
(2004)156	(2004)156	-3.233695+0	8.169227-1	1.068990+0	(3004)36	(3004)36	6.903829+1	1.059248+0	3.148114+1
(1004)13F	(1004)13F	-1.222222-1	-1.222222-1	2.020201+1	(2004)16	(2004)16	-1.088281+1	-5.312530-1	2.205030-1
(2104)13F	(2104)13F	-3.853570+0	8.493235-1	-1.710337-1	(2104)16	(2104)16	3.543202+0	3.265599+0	2.340462+0
(3004)13F	(3004)13F	7.97170-1	3.575398+0	3.944123+0	(2104)3F	(2104)3F	-1.841666+1	4.212119+0	2.737602+0
(2004)136	(2004)136	4.583730+0	1.173347+0	1.694723+0	(3004)3F	(3004)3F	-3.723797+0	-2.339126+0	-3.537829+0
(2104)136	(2104)136	-4.300004+0	2.245933+0	1.144000+0	(2004)36	(2004)36	-1.197302+0	-3.358204+0	-7.175853+0
(3004)136	(3004)136	4.360313-1	1.955537+0	2.168144+0	(2104)36	(2104)36	-7.248634-2	1.300359+0	-4.561303-1
(2004)16	(2004)16	-2.562846+0	-9.015544-1	-4.742599+0	(3004)36	(3004)36	5.770651+0	-5.486487+0	-7.422544+0
(2104)16	(2104)16	-6.632148+0	-1.766742+0	-1.768445+0	(2004)16	(2004)16	1.181923+0	1.979072+0	1.970020+0
(1102)3M	(1102)3M	2.967999+1	-2.853332+0	-1.442424+0	(2104)16	(2104)16	2.524541+0	6.974461+0	9.748338+0
(2002)16	(2002)16	4.99370-1	4.589802+0	3.664558+0	(2204)16	(2204)16	-3.103143-1	-6.313137+0	-1.747872+0
(2004)156	(2004)156	-2.735646+0	-6.156221-1	-9.766190-1	(3004)3F	(3004)3F	-1.547777+1	6.774410+1	-6.499371-1
(2004)151	(2004)151	5.613835+0	-3.997730+0	-3.494160+0	(2004)36	(2004)36	-4.130677+0	4.271742+0	3.139998+0
(2004)136	(2004)136	-1.692960+0	-1.425298+0	-7.178198-1	(2104)36	(2104)36	3.633596+0	3.511687+0	5.775712+0
(2104)136	(2104)136	-2.272495-1	-1.019249+0	-1.130087+0	(3004)36	(3004)36	1.975067+0	1.771575+0	4.605977+0
(3004)136	(3004)136	-5.75837+0	2.510563+0	2.432285+0	(2004)16	(2004)16	1.352674+0	-3.140947+0	4.070992-1
(1104)13M	(1104)13M	-2.493333+0	1.692931-1	5.932053-2	(2104)16	(2104)16	4.178551-1	1.017203+0	-1.649490+0

TABLE I. (continued)

[illegible]

TABLE I. (continued)

	J = 1.0									
	U _T V _S L (U _T V _S L ²)	M ⁰	M ²	M ⁴	M ⁶	U _T V _S L (U _T V _S L ²)	M ⁰	M ²	M ⁴	M ⁶
(2002)10	(2004)10	2.879294+0	-6.366753-1	-1.377879+0	(2104)3F	3.859980-1	3.678679+0	6.887886+0		
	(2104)10	4.410146+0	-3.223234+0	-3.588002+0	(3004)3F	4.716400+0	3.013594+0	9.864556-1		
	(1104)3P	-3.856089+0	9.836635-1	8.156723-1	(2004)1D	1.350744+0	2.467579+0	5.986193+0		
	(3004)3P	2.470285+0	3.702110+0	4.414329+0	(2104)1D	1.307698+1	6.761508+0	3.230042+0		
	(2004)3D	2.760306-2	-3.744754+0	-3.508877+0	(2204)1D	5.535598-1	-2.482631+0	3.483355+0		
	(2104)3D	1.061425+1	1.599189+0	1.752362+0	(2104)3D	3.984125+0	8.161113-1	9.565783-1		
	(1004)3F	-1.328167+0	-8.201249-1	-1.124950+0	(1004)3F	-2.186965-1	-2.575197+0	-2.386974+0		
	(2104)3F	-1.118729+0	-5.017329+0	-5.562824+0	(2104)3F	3.836844+0	-5.632820+0	-2.499508-2		
	(3004)3F	6.379067+0	-2.102685+0	-1.041839+0	(3004)3F	2.709227+0	-2.106024+0	8.489698+0		
	(1104)3P	-1.311826+1	-9.938075-1	1.174500+0	(2004)1D	-4.815962+0	-2.106024+0	-7.788357-1		
(2004)15D	(3004)3P	-1.108864+1	-1.108864+1	-4.916889+0	(2104)1D	2.293767+0	-4.034410+0	-6.498551+0		
	(2004)15D	1.829999+1	7.799994+0	9.136359+0	(2204)1D	1.362749-1	4.583861-1	2.278506-1		
	(1004)3F	2.122167+0	-3.332951+0	-5.554418+0	(1004)3F	1.328517+1	-5.876530-1	-5.331049-2		
	(1104)3P	-2.117702+0	-2.117702+0	-6.831295-1	(2104)3F	-2.569045+0	1.062506+0	1.904307+0		
	(3004)3P	-3.776142+0	-7.765121+0	-7.883084+0	(3004)3F	8.857964-2	-2.582232+0	-1.313678+0		
	(2004)3D	-1.000001-1	1.422221+0	-1.510099+0	(2004)1D	1.345571+1	3.066178+0	-2.597362+0		
	(2104)3D	-5.596555+0	-8.944643-1	-2.901973+0	(2104)1D	-1.083850+0	3.570926+0	3.151059+0		
	(1004)3F	6.535858+1	-8.739517-1	-1.001664-1	(2104)3F	2.455555+1	-5.616159+0	-3.650136+0		
	(2104)3F	-3.859981-1	-4.327857-1	-1.919357+0	(3004)3F	4.965063+0	3.118835+0	4.717105+0		
	(3004)3F	-2.021315+0	8.357487-1	8.317794-1	(2004)1D	-5.798008+0	5.354604+0	3.008920+0		
(1004)15F	(1004)15F	2.924999+1	-2.999979+0	-3.409089-1	(2104)1D	7.492146+0	1.086989+1	1.083334+1		
	(2004)15F	2.820523+0	3.646737+0	2.784262+0	(2204)1D	-1.019803+0	1.715124+0	1.324188+0		
	(2004)3D	-8.270658+0	-6.612296+0	-4.526228+0	(3004)3F	2.090369+1	-9.032546-1	8.665828-1		
	(2104)3D	-4.429267+0	3.922774+0	4.614826+0	(2004)1D	2.151960+0	3.960007-2	-1.144648+0		
	(1004)3F	7.607262-1	-5.627436-1	5.071507-2	(2104)1D	4.875592-1	-1.898526+0	3.399518+0		
	(2104)3F	-5.472151+0	8.646467-1	1.733681+0	(2204)1D	7.613343+0	-2.748570+0	-1.413875+0		
	(3004)3F	-7.277562-1	1.631938+0	-7.363925-1						
	J = 1.0									
	U _T V _S L (U _T V _S L ²)	M ⁰	M ²	M ⁴	M ⁶	U _T V _S L (U _T V _S L ²)	M ⁰	M ²	M ⁴	M ⁶
(1102)3P	(1102)3P	6.999997+0	8.733330+0	9.969692+0	(2004)3D	-1.012945+1	-9.323120+0	-5.543476+0		
	(2004)3D	1.080000+1	-3.533332+0	-2.606059+0	(2104)3D	-5.424723+0	4.804398+0	5.651984+0		
	(1104)3P	-1.646667-1	1.144444+0	1.247474+0	(1104)3P	4.194444+0	-1.733332+0	-5.916664+0		
	(3004)3P	-6.743803+0	1.128992+0	8.969197-1	(3004)3P	1.289801-1	-8.844328-1	9.433645-1		
	(2004)3D	-1.702099+0	-3.200528-1	6.678786-1	(2004)3D	-8.779631+0	-1.505703+0	3.670028-1		
	(2104)3D	7.091238-1	3.180313+0	3.526084+0	(2104)3D	-5.318429-1	-8.017039+0	-5.180055+0		
	(2004)15D	3.049999+1	1.229999+1	1.522726+1	(3004)3P	5.605555+0	5.587876+0	6.321622+0		
	(1004)15F	1.385640+0	-2.078460+0	-3.4464100+0	(2004)3D	-8.443711-1	-8.092804-1	1.277024+0		
	(1104)3P	-1.933332+0	-3.099999+0	-9.999992-1	(2104)3D	-5.412486+0	4.547758+0	5.023232+0		
	(3004)3P	-5.527707+0	-1.136697+1	-2.153966+1	(2004)3D	1.281428+1	-2.333332+0	-2.119047+0		
(1004)15F	(2004)3D	-6.546544-2	9.310625-1	2.952553+0	(2104)3D	-1.547435+0	7.795785-1	5.711229+0		
	(2104)3D	-3.663808+0	-5.855643-1	-1.899787+0	(2104)3D	1.195237+1	2.448484+0	2.869735+0		
	(1004)15F	3.899998+1	-3.999999+0	-4.545452-1						
	J = 0.0									
	U _T V _S L (U _T V _S L ²)	M ⁰	M ²	M ⁴	M ⁶	U _T V _S L (U _T V _S L ²)	M ⁰	M ²	M ⁴	M ⁶
(1102)3P	(1102)3P	1.699411+1	-2.683281+0	-1.219673+0	(2004)15D	3.655998+1	1.555999+1	1.827272+1		
	(1104)3P	-4.173992+0	-1.590092+0	6.324230-1	(1104)3P	-2.232420+0	-3.579570+0	-1.154700+0		

TABLE I. (continued)

(1102)3P	(3004)3P	1.977452+0	8.069470+0	9.833779+0	(1104)3P	(3004)3P	-6.382846+0	-1.312545+1	-1.332485+1
(1102)3P	(1102)3P	1.399999+1	1.746666+1	1.993938+1	(1104)3P	(1104)3P	8.388884+0	-3.466665+0	-1.183333+1
(2004)5D	(2004)5D	1.247076+1	-4.079940+0	-3.009218+0	(3004)3P	(3004)3P	2.579617-1	-1.768866+0	1.884729+0
(1104)3P	(1104)3P	-3.333333-1	2.288888+0	2.494948+0	(2204)1S	(2204)1S	3.146427+0	-5.720773+0	-1.950263+0
(3004)3P	(3004)3P	-1.348761+1	2.257984+0	1.793839+0	(3004)3P	(3004)3P	1.121111+1	1.117575+1	1.264324+1
(2204)1S	(2204)1S	-2.292853+0	-4.767311+0	-3.900527+0	(2204)1S	(2204)1S	-9.803050+0	-2.943792+1	-3.709794+1

^aThe non-zero elements of the upper-half diagonal are listed in the table.

^bThe states, (Urv)SL, listed beside each J-value form the matrix grid for the J-block.

^cThe state notation, (Urv)SL, is similar in form to that used by Nielson and Koster (Ref.5) in that the multiplicity is not placed as a superscript.

^dA given matrix element is formed from the sum of the three radial coefficients, listed to the right of the element, each multiplied by their appropriate radial integral.

^eEach table entry is to be multiplied by the power of ten indicated by its following single digit.