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COMPUTATION OF THE COEFFICIENTS MULTIPLYING
THE INDEPENDENT TWO-PARTICLE RADIAL MATRIX ELEMENTS
OF A NUCLEAR HAMILTONIAN

NAZAKAT ULLAH

July 1963

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ABSTRACT

The two-particle matrix element of a nuclear Hamiltonian in the basis of jj coupled functions is expressed as a product of certain coefficients and the independent two-particle radial matrix elements. A FORTRAN program is described which calculates these coefficients for scalar and tensor potentials. The scalar potentials are taken to be spin independent, spin singlet, and spin triplet. A sample numerical output and a FORTRAN listing are also given.

COMPUTATION OF THE COEFFICIENTS MULTIPLYING THE INDEPENDENT TWO-PARTICLE RADIAL MATRIX ELEMENTS OF A NUCLEAR HAMILTONIAN

I. INTRODUCTION

The matrix version of the Hartree-Fock self-consistent-field calculation requires as input data certain coefficients¹ which multiply the independent two-particle radial matrix elements. These coefficients are obtained by summing over spin and isotopic spin and performing angular integrations. If an LS coupling scheme is used, then these coefficients can be expressed in terms of Gaunt coefficients, which are tabulated by Condon and Shortley.² For the jj coupling scheme these coefficients can be expressed as a linear combination of the coefficients obtained in LS coupling, but it becomes quite laborious to calculate them by hand calculation.

For $1p$ shell nuclei most of the calculations are done in the intermediate coupling scheme, and a complete set of either LS or jj basis functions is used. Since the nuclear Hamiltonian also includes noncentral forces, e.g., the tensor force, the only good quantum numbers are J , the total angular momentum quantum number, π , the parity, and T , the total isobaric spin quantum number. Therefore, if the states having a definite value of J , π , and T are constructed by projecting them out from a determinant made up of jj coupled orbitals, then, because of the commutability of the projection operator with the Hamiltonian, the configuration interaction matrix becomes easier to calculate.

An IBM 7090 FORTRAN program is made which calculates the coefficients needed for the input data in the self-consistent-field calculation and the estimation of correlation energy. The coefficients are calculated for various two-particle operators appearing in the nuclear Hamiltonian obtained by fitting the data on light nuclei.³ Appropriate changes have to be made for operators other than those used here.

Section II gives the formulas for the matrix elements of scalar and tensor potentials. The computer program is described in Section III, and the sample output is shown in Section IV. A FORTRAN listing is given at the end.

II. TWO-PARTICLE MATRIX ELEMENTS

The jj coupled function χ_j^m is obtained by vector coupling the spherical harmonic with the elementary spin function $v_{1/2}^{m_s}$; it is given by

$$\chi_j^m = \sum_{m_s=-1/2}^{+1/2} (lm - m_s \frac{1}{2} m_s | l \frac{1}{2} jm) Y_l^{m-m_s} v_{1/2}^{m_s}, \quad (1)$$

where $(lm - m_s \frac{1}{2} m_s | l \frac{1}{2} jm)$ is the Clebsch-Gordan coefficient.

Let $Q(1,2)$ be the central force operator; then the two-particle matrix element is given by

$$\langle R_a \chi_{j_a}^{m_a} R_b \chi_{j_b}^{m_b} | Q(1,2) | R_c \chi_{j_c}^{m_c} R_d \chi_{j_d}^{m_d} \rangle \\ \equiv \langle ab | Q | cd \rangle \equiv (ac | bd)$$

$$= \sum_k \sum_{m_{sa}, m_{sb}, m_{sc}, m_{sd}} A^k(m_{sa}, m_{sc}) C(m_{sa}, m_{sc}; m_{sb}, m_{sd})$$

$$\times B^k(m_{sb}, m_{sd}) F^k(ac | db) \delta[(m_a - m_c), (m_d - m_b)], \quad (2)$$

where, lesser of $|l_a - l_c|, |l_b - l_d| \leq k \leq$ lesser of $(l_a + l_c), (l_b + l_d)$, $k + l_a + l_c = \text{even}$, $k + l_b + l_d = \text{even}$, and the F^k 's are the independent radial integrals. A 7090 program SNUC is available⁴ which calculates these integrals for a general two-nucleon potential.

$C(m_{sa}, m_{sc}; m_{sb}, m_{sd})$ is the spin matrix; it is given by

$$C(m_{sa}, m_{sc}; m_{sb}, m_{sd}) \\ = \langle \frac{1}{2} m_{sa} \frac{1}{2} m_{sb} | Q^{\text{spin}} | \frac{1}{2} m_{sc} \frac{1}{2} m_{sd} \rangle, \quad (3)$$

where Q^{spin} is the spin-dependent part of the operator $Q(1,2)$. $A^k(m_{sa}, m_{sc})$, $B^k(m_{sb}, m_{sd})$ are given by

$$A^k(m_{sa}, m_{sc}) = (l_a m_a - m_{sa} \frac{1}{2} m_{sa} | l_a \frac{1}{2} j_a m_a) \\ \times (l_c m_c - m_{sc} \frac{1}{2} m_{sc} | l_c \frac{1}{2} j_c m_c) \\ \times C^k(l_a m_a - m_{sa}, l_c m_c - m_{sc}), \\ B^k(m_{sb}, m_{sd}) = (l_b m_b - m_{sb} \frac{1}{2} m_{sb} | l_b \frac{1}{2} j_b m_b) \\ \times (l_d m_d - m_{sd} \frac{1}{2} m_{sd} | l_d \frac{1}{2} j_d m_d) \\ \times C^k(l_d m_d - m_{sd}, l_b m_b - m_{sb}), \quad (4)$$

where C^k are the Gaunt coefficients.² They are expressed in terms of the Clebsch-Gordan coefficients as

$$C^k(l_1 m_1, l_2 m_2) = \left[\frac{2l_2 + 1}{2l_1 + 1} \right]^{1/2}.$$

$$\times (l_2 m_2 k m_1 - m_2 | l_2 k l_1 m_1) (l_2 0 k 0 | l_2 k l_1 0). \quad (5)$$

The spin matrix $C(m_{sa}, m_{sc}; m_{sb}, m_{sd})$ is calculated for spin-independent, spin singlet $\frac{1}{4}(1 - \sigma_1 \cdot \sigma_2)$, and spin-triplet $\frac{1}{4}(3 + \sigma_1 \cdot \sigma_2)$ operators. These operators were used in the calculation of the ground state properties and the low-lying states of the light nuclei.⁵ The spin matrices for these operators are shown below:

$$C^{\text{spin-indep.}} = \begin{matrix} (m_{sb}, m_{sd}) \\ (m_{sa}, m_{sc}) \end{matrix} \begin{matrix} \alpha\alpha & \alpha\beta & \beta\alpha & \beta\beta \\ \alpha\alpha & \begin{pmatrix} 1 & 0 & 0 & 1 \end{pmatrix} \\ \alpha\beta & \begin{pmatrix} 0 & 0 & 0 & 0 \end{pmatrix} \\ \beta\alpha & \begin{pmatrix} 0 & 0 & 0 & 0 \end{pmatrix} \\ \beta\beta & \begin{pmatrix} 1 & 0 & 0 & 1 \end{pmatrix} \end{matrix}$$

$$C^{\text{spin-singlet}} = \begin{matrix} (m_{sb}, m_{sd}) \\ (m_{sa}, m_{sc}) \end{matrix} \begin{matrix} \alpha\alpha & \alpha\beta & \beta\alpha & \beta\beta \\ \alpha\alpha & \begin{pmatrix} 0 & 0 & 0 & \frac{1}{2} \end{pmatrix} \\ \alpha\beta & \begin{pmatrix} 0 & 0 & -\frac{1}{2} & 0 \end{pmatrix} \\ \beta\alpha & \begin{pmatrix} 0 & -\frac{1}{2} & 0 & 0 \end{pmatrix} \\ \beta\beta & \begin{pmatrix} \frac{1}{2} & 0 & 0 & 0 \end{pmatrix} \end{matrix}$$

$$C^{\text{spin-triplet}} = \begin{matrix} (m_{sb}, m_{sd}) \\ (m_{sa}, m_{sc}) \end{matrix} \begin{matrix} \alpha\alpha & \alpha\beta & \beta\alpha & \beta\beta \\ \alpha\alpha & \begin{pmatrix} 1 & 0 & 0 & \frac{1}{2} \end{pmatrix} \\ \alpha\beta & \begin{pmatrix} 0 & 0 & \frac{1}{2} & 0 \end{pmatrix} \\ \beta\alpha & \begin{pmatrix} 0 & \frac{1}{2} & 0 & 0 \end{pmatrix} \\ \beta\beta & \begin{pmatrix} \frac{1}{2} & 0 & 0 & 1 \end{pmatrix} \end{matrix}$$

These matrices are given as explicit input at the outset of the computer program.

In the two-particle matrix element given by (2), the isotopic spin factor has been left out. The matrix of the isotopic spin operator can be easily calculated, and the isotopic-spin dependence can be included by multiplying the computer output by the appropriate factors.

For the tensor operator $V(r_{12})S_{12}$, the two-particle matrix is given by

$$\begin{aligned} & \langle ab | VS | cd \rangle \\ &= \sum_{k, k'} \sum_{m_{sa}, m_{sb}, m_{sc}, m_{sd}} A^k(m_{sa}, m_{sc}) C(m_{sa}, m_{sc}; m_{sb}, m_{sd}) \\ & \quad \times D^{k, k'}(m_{sa}, m_{sc}; m_{sb}, m_{sd}) B^{k'}(m_{sb}, m_{sd}) \\ & \quad \times I^{kk'}(ac | db) \delta[(m_a - m_c), (m_d - m_b)], \quad (6) \end{aligned}$$

where $|l_a - l_c| \leq k \leq (l_a + l_c)$, $|l_b - l_d| \leq k' \leq (l_b + l_d)$, $l_a + l_c + k = \text{even}$, $l_b + l_d + k' = \text{even}$,

$$D^{kk'}(m_{sa}, m_{sc}; m_{sb}, m_{sd}) = C^2(k m_a - m_c - m_{sa} + m_{sc}, k' m_d - m_b - m_{sd} + m_{sb}), \quad (7)$$

and $I^{kk'}$ are the independent radial integrals. The spin matrix $C(m_{sa}, m_{sc}; m_{sb}, m_{sd})$ for the tensor operator is given by

$$C^{\text{tensor}} = \begin{matrix} (m_{sb}, m_{sd}) \\ (m_{sa}, m_{sc}) \end{matrix} \begin{matrix} \alpha\alpha & \alpha\beta & \beta\alpha & \beta\beta \\ \alpha\alpha & \begin{pmatrix} \frac{2}{3} & \sqrt{\frac{2}{3}} & -\sqrt{\frac{2}{3}} & -\frac{2}{3} \end{pmatrix} \\ \alpha\beta & \begin{pmatrix} \sqrt{\frac{2}{3}} & 2\sqrt{\frac{2}{3}} & -\frac{2}{3} & -\sqrt{\frac{2}{3}} \end{pmatrix} \\ \beta\alpha & \begin{pmatrix} -\sqrt{\frac{2}{3}} & -\frac{2}{3} & 2\sqrt{\frac{2}{3}} & \sqrt{\frac{2}{3}} \end{pmatrix} \\ \beta\beta & \begin{pmatrix} -\frac{2}{3} & -\sqrt{\frac{2}{3}} & \sqrt{\frac{2}{3}} & \frac{2}{3} \end{pmatrix} \end{matrix}$$

III. DESCRIPTION OF THE COMPUTER PROGRAM

The computer program calculates the coefficients which multiply the independent radial integrals in (2) and (6). For scalar potentials the coefficients which multiply the independent radial integrals $F^k(ac | db)$ are

$$\sum_{m_{sa}, m_{sb}, m_{sc}, m_{sd}} A^k(m_{sa}, m_{sc})$$

$$\times C(m_{sa}, m_{sc}; m_{sb}, m_{sd}) B^k(m_{sb}, m_{sd}).$$

These coefficients are calculated for spin-independent, spin-singlet, and spin-triplet operators. For any other central force operator which has a spin dependence of the form $(a + b \sigma_1 \cdot \sigma_2)$, a few minor changes have to be made to get these coefficients. For the tensor operator the coefficients which multiply the independent radial integrals $I^{k, k'}(ac | db)$ are

$$\sum_{m_{sa}, m_{sb}, m_{sc}, m_{sd}} A^k(m_{sa}, m_{sc}) C(m_{sa}, m_{sc}; m_{sb}, m_{sd})$$

$$\times D^{k, k'}(m_{sa}, m_{sc}; m_{sb}, m_{sd}) B^{k'}(m_{sb}, m_{sd}).$$

The FORTRAN program uses a subroutine called CLEB(X), which calculates the Clebsch-Gordan coefficients. It requires the arguments of Clebsch-Gordan coefficients in the following fashion:

$$\begin{aligned} X(1) &= j_1 \\ X(2) &= j_2 \\ X(3) &= j \\ X(4) &= m_1 \\ X(5) &= m_2 \\ X(6) &= M \end{aligned}$$

As input data the program uses the values of l_a , l_b , l_c , l_d , j_a , j_b , j_c , j_d , m_a , m_b , m_c , m_d , the number of values of k , the number of pairs (k, k') , the initial value of k , and the values of the pairs (k, k') . The input data in the first 7 columns of the first card are shown below:

Card	Quantity
Column	
1-2	$N1$ = number of values of k in decimal integer i2
3-4	$N2$ = number of pairs (k, k') in decimal integer i2
5-7	$VKIN$ = initial value of k in fixed point decimal F3.1.

The rest of the columns contain the values of $l = \text{ØRBV}(i)$, $j = \text{TAM}(i)$, $m = \text{TAMM}(i)$, where $i = 1, 2, 3, 4$ corresponds to a, b, c, d , in fixed point decimal F5.1.

The values of the pair $[k = \text{VKTE1}(i), k' = \text{VKTE2}(i)]$ where $i = 1, \dots, N2$, are supplied in fixed point decimal F5.1 on the second card.

The output from the computer are the values of

$\text{CKCØI}(K)$ = coefficient for spin-independent operator
 $\text{CKCØS}(K)$ = coefficient for spin-singlet operator
 $\text{CKCØTR}(K)$ = coefficient for the spin-triplet operator

where $K = 1, \dots, N1$; and the values of

$\text{CKCØT}(K)$ = coefficient for tensor force radial integral $I^{k, k'}$

where $K = 1, \dots, N2$, in floating point decimal E14.6.

IV. SAMPLE NUMERICAL OUTPUT

As an example we consider the two-particle matrix element

$$\langle R_a d_{5/2}^{5/2} R_b d_{5/2}^{-5/2} | \text{op.} | R_c p_{3/2}^{1/2} R_d p_{3/2}^{-1/2} \rangle,$$

where l_j^m denotes the jj couples function χ_j^m obtained by vector coupling a spherical harmonic of order l with the elementary spin function. For scalar potentials there are 2 independent radial integrals F^1, F^3 . For the tensor potential there are 4 independent radial integrals $I^{1,1}, I^{1,3}, I^{3,1}, I^{3,3}$. The input data are shown below:

$N1=2 \quad N2=4 \quad VKIN=1.$

ØRBV(i)	TAM(i)	TAMM(i)	i=1, ..., 4
2.	2.5	2.5	
2.	2.5	-2.5	
1.	1.5	.5	
1.	1.5	-.5	

VKTE1(i)	VKTE2(i)	i=1, ..., 4
1.	1.	
1.	3.	
3.	1.	
3.	3.	

The computer output consists of the coefficients which multiply the independent radial integrals. They are shown below:

Independent radial integrals

F^1 spin-indep. F^1 spin-singlet F^1 spin-triplet

Coefficients

-0. 0.666667E-01 -0.666667E-01

Independent radial integrals

F^3 spin-indep. F^3 spin-singlet F^3 spin-triplet

Coefficients

0.408163E-01 0.224490E-01 0.183673E-01

Independent radial integrals

$I^{1,1}$ $I^{1,3}$ $I^{3,1}$ $I^{3,3}$

Coefficients

-0.177778E-01 0.199513E-01
0.199513E-01 -0.489796E-02

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FORTRAN LISTING

```

C      COEFFICIENTS FOR MATRIX ELEMENTS IN J-J COUPLING
      DIMENSION X(6), ØRBV(4), TAM(4), TAMM(4), VKTE1(10), VKTE2(10), SMI(4,4)
      1, SMS(4,4), SMTR(4,4), SMTE(4,4), CØNS1(4), CØNS2(4), VCC1(4), VCC2(4), VC
      2CA(4), VCCB(4), VCKAC(10), VCKBD(10), VKAC(4,10), VKBD(4,10), CKCØI(5), C
      3KCØS(5), CKCØTR(5), CKCØT(10), VCT(10), VKT(4,4,10)
      SMI(1,1)=1.
      SMI(1,2)=.0
      SMI(1,3)=.0
      SMI(1,4)=1.
      SMI(2,1)=.0
      SMI(2,2)=.0
      SMI(2,3)=.0
      SMI(2,4)=.0
      SMI(3,1)=.0
      SMI(3,2)=.0
      SMI(3,3)=.0
      SMI(3,4)=.0
      SMI(4,1)=1.
      SMI(4,2)=.0
      SMI(4,3)=.0
      SMI(4,4)=1.
      SMS(1,1)=.0
      SMS(1,2)=.0
      SMS(1,3)=.0
      SMS(1,4)=.5
      SMS(2,1)=.0
      SMS(2,2)=.0
      SMS(2,3)=-.5
      SMS(2,4)=.0
      SMS(3,1)=.0
      SMS(3,2)=-.5
      SMS(3,3)=.0
      SMS(3,4)=.0
      SMS(4,1)=.5
      SMS(4,2)=.0
      SMS(4,3)=.0
      SMS(4,4)=.0
      SMTR(1,1)=1.
      SMTR(1,2)=.0
      SMTR(1,3)=.0
      SMTR(1,4)=.5
      SMTR(2,1)=.0
      SMTR(2,2)=.0
      SMTR(2,3)=.5
      SMTR(2,4)=.0
      SMTR(3,1)=.0
      SMTR(3,2)=.5
      SMTR(3,3)=.0
      SMTR(3,4)=.0
      SMTR(4,1)=.5
      SMTR(4,2)=.0
      SMTR(4,3)=.0
      SMTR(4,4)=1.
      SMTE(1,1)=.66666666
      SMTE(1,2)=.81649658
      SMTE(1,3)=-.81649658
      SMTE(1,4)=-.66666666
      SMTE(2,1)=.81649658
      SMTE(2,2)=1.63299316
      SMTE(2,3)=-.66666666

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```

SMTE(2,4)=-.81649658
SMTE(3,1)=-.81649658
SMTE(3,2)=-.66666666
SMTE(3,3)=1.63299316
SMTE(3,4)=.81649658
SMTE(4,1)=-.66666666
SMTE(4,2)=-.81649658
SMTE(4,3)=.81649658
SMTE(4,4)=.66666666
CØNS1(1)=.5
CØNS1(2)=.5
CØNS1(3)=-.5
CØNS1(4)=-.5
CØNS2(1)=.5
CØNS2(2)=-.5
CØNS2(3)=.5
CØNS2(4)=-.5
10 READ INPUT TAPE 5,15,N1,N2,VKIN,(ØRBV(I),TAM(I),TAMM(I),I=1,4)
15 FØRMAT (2I2,F3.1,12F5.1)
  READ INPUT TAPE 5,30,(VKTE1(I),VKTE2(I),I=1,N2)
30 FØRMAT(12F5.1)
  IF (TAMM(1)+TAMM(2)-TAMM(3)-TAMM(4))180,20,180
20 DØ 25 I=1,4
  X(1)=ØRBV(I)
  X(2)=.5
  X(3)=TAM(I)
  X(4)=TAMM(I)-.5
  X(5)=.5
  X(6)=TAMM(I)
  VCC1(I)=CLEB(X)
  X(1)=ØRBV(I)
  X(2)=.5
  X(3)=TAM(I)
  X(4)=TAMM(I)+.5
  X(5)=-.5
  X(6)=TAMM(I)
25 VCC2(I)=CLEB(X)
  VCCA(1)=VCC1(1)*VCC1(3)
  VCCA(2)=VCC1(1)*VCC2(3)
  VCCA(3)=VCC2(1)*VCC1(3)
  VCCA(4)=VCC2(1)*VCC2(3)
  VCCB(1)=VCC1(2)*VCC1(4)
  VCCB(2)=VCC1(2)*VCC2(4)
  VCCB(3)=VCC2(2)*VCC1(4)
  VCCB(4)=VCC2(2)*VCC2(4)
  DØ 45 K=1,N1
  X(1)=ØRBV(3)
  X(2)=VKIN
  X(3)=ØRBV(1)
  X(4)=.0
  X(5)=.0
  X(6)=.0
  VCKAC(K)=CLEB(X)
  X(1)=ØRBV(2)
  X(2)=VKIN
  X(3)=ØRBV(4)
  X(4)=.0
  X(5)=.0
  X(6)=.0
  VCKBD(K)=CLEB(X)

```

```

DØ 50 I=1,4
X(1)=ØRBV(3)
X(2)=VKIN
X(3)=ØRBV(1)
X(4)=TAMM(3)-CØNS2(I)
X(5)=TAMM(1)-TAMM(3)-CØNS1(I)+CØNS2(I)
X(6)=TAMM(1)-CØNS1(I)
VKAC(I,K)=CLEB(X)
X(1)=ØRBV(2)
X(2)=VKIN
X(3)=ØRBV(4)
X(4)=TAMM(2)-CØNS1(I)
X(5)=TAMM(4)-TAMM(2)-CØNS2(I)+CØNS1(I)
X(6)=TAMM(4)-CØNS2(I)
50 VKBD(I,K)=CLEB(X)
45 VKIN=VKIN+2.
PARA1=((2.*ØRBV(3)+1.)/(2.*ØRBV(1)+1.))**.5
PARA2=((2.*ØRBV(2)+1.)/(2.*ØRBV(4)+1.))**.5
PARA3=PARA1*PARA2
DØ 65 K=1,N1
CKCØI(K)=.0
CKCØS(K)=.0
CKCØTR(K)=.0
DØ 70 I=1,4
DØ 70 J=1,4
CKCØI(K)=CKCØI(K)+VCCA(I)*VKAC(I,K)*VCCB(J)*VKBD(J,K)*SMI(I,J)
CKCØS(K)=CKCØS(K)+VCCA(I)*VKAC(I,K)*VCCB(J)*VKBD(J,K)*SMS(I,J)
70 CKCØTR(K)=CKCØTR(K)+VCCA(I)*VKAC(I,K)*VCCB(J)*VKBD(J,K)*SMTR(I,J)
CKCØI(K)=CKCØI(K)*PARA3*VCKAC(K)*VCKBD(K)
CKCØS(K)=CKCØS(K)*PARA3*VCKAC(K)*VCKBD(K)
65 CKCØTR(K)=CKCØTR(K)*PARA3*VCKAC(K)*VCKBD(K)
SUM=.0
DØ 135 I=1,4
135 SUM=SUM+ØRBV(I)
IF (SUM) 170,170,140
140 DØ 155 K=1,N2
CKCØT(K)=.0
X(1)=ØRBV(3)
X(2)=VKTE1(K)
X(3)=ØRBV(1)
X(4)=.0
X(5)=.0
X(6)=.0
VCKAC(K)=CLEB(X)
X(1)=ØRBV(2)
X(2)=VKTE2(K)
X(3)=ØRBV(4)
X(4)=.0
X(5)=.0
X(6)=.0
VCKBD(K)=CLEB(X)
X(1)=VKTE2(K)
X(2)=2.
X(3)=VKTE1(K)
X(4)=.0
X(5)=.0
X(6)=.0
VCT(K)=CLEB(X)
PARA4=((2.*VKTE2(K)+1.)/(2.*VKTE1(K)+1.))**.5
DØ 160 I=1,4

```

```

X(1)=ØRBV(3)
X(2)=VKTE1(K)
X(3)=ØRBV(1)
X(4)=TAMM(3)-CØNS2(I)
X(5)=TAMM(1)-TAMM(3)-CØNS1(I)+CØNS2(I)
X(6)=TAMM(1)-CØNS1(I)
VKAC(I,K)=CLEB(X)
DØ 160 J=1,4
X(1)=ØRBV(2)
X(2)=VKTE2(K)
X(3)=ØRBV(4)
X(4)=TAMM(2)-CØNS1(J)
X(5)=TAMM(4)-TAMM(2)-CØNS2(J)+CØNS1(J)
X(6)=TAMM(4)-CØNS2(J)
VKBD(J,K)=CLEB(X)
X(1)=VKTE2(K)
X(2)=2.
X(3)=VKTE1(K)
X(4)=TAMM(4)-TAMM(2)-CØNS2(J)+CØNS1(J)
X(5)=-CØNS1(I)+CØNS2(I)-CØNS1(J)+CØNS2(J)
X(6)=TAMM(1)-TAMM(3)-CØNS1(I)+CØNS2(I)
VKT(I,J,K)=CLEB(X)
160 CKCØT(K)=CKCØT(K)+VCCA(I)*VKAC(I,K)*VCCB(J)*VKBD(J,K)*VKT(I,J,K)*S
  IMTE(I,J)
155 CKCØT(K)=CKCØT(K)*PARA3*VCKAC(K)*VCKBD(K)*VCT(K)*PARA4
  GØ TØ 195
170 DØ 175 K=1,N2
175 CKCØT(K)=.0
  GØ TØ 195
180 DØ 185 K=1,N1
  CKCØI(K)=.0
  CKCØS(K)=.0
185 CKCØTR(K)=.0
  DØ 190 K=1,N2
190 CKCØTR(K)=.0
195 WRITE ØUTPUT TAPE 6,200,(CKCØI(K),CKCØS(K),CKCØTR(K),K=1,N1),(CKCØ
  IT(K),K=1,N2)
200 FØRMAT(5E14.6)
  GØ TØ 10
  END

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