

# THE APPLICATION OF THE TIGHT BINDING METHOD TO THE INVESTIGATION OF ENERGY BANDS IN HEXAGONAL CLOSE-PACKED STRUCTURE, II.

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In this work are given these terms in the matrix components of energy for hexagonal close-packed lattice, which contain E-integrals for the neighbour atoms from the second to the fourth.

The first part of this work (1957) contained the calculations of the matrix components of energy for hexagonal close-packed structure in the nearest neighbours approximation. Because the unit cell in hexagonal close-packed structure has two-atomic basis; we have the matrix components of energy of two types:

$$(m/n)_{11} = \sum_i \exp(i\mathbf{k}\mathbf{r}_i) \int \varphi_m^*(\mathbf{r}) H \varphi_n(\mathbf{r} - \mathbf{r}_i) d\mathbf{r},$$

$$(m/n)_{12} = \sum_i \exp(i\mathbf{k}\mathbf{t}_i) \int \varphi_m^*(\mathbf{r}) H \varphi_n(\mathbf{r} - \mathbf{t}_i) d\mathbf{r},$$

where  $\mathbf{r}_i$  are the translation vectors; they give the atom positions in the simple hexagonal lattice denoted by 1,  $\mathbf{t}_i = \mathbf{r}_i + \mathbf{t}_2$ , where  $\mathbf{t}_2 = \left( \frac{1}{2}a, \frac{1}{6}\sqrt{3}a, \frac{1}{2}c \right)$  is the vector joining the basis atoms.  $\mathbf{t}_i$  determine the atom positions in the simple hexagonal lattice denoted by 2.

In previous calculations we have retained in the above written sums only the E-integrals for these vectors  $\mathbf{r}_i$  and  $\mathbf{t}_i$ , which give the positions of the nearest neighbours of the atom at the position (0, 0, 0). Since we used a model of the hexagonal ideal close-packed lattice, we had six atoms at the distance  $a$  in the lattice 1, and six atoms at the same distance in the lattice 2.

When we wish to have a better approximation we should take into account the further neighbours of the zero atom. In the present part of this work we have calculated in the  $(m/n)_{11}$  and  $(m/n)_{12}$  these terms, which contain E-integrals for the neigh-

urs from the second to the fourth. Taking into account the fourth neighbours was necessary because these fourth neighbours appear equally well in the lattice 1, as in the lattice 2. The position vectors of the neighbour atoms and their distances from the zero atom are given in Table I.

TABLE I

The neighbours in the close-packed hexagonal structure

Succesive order of the neighbour	Distance	Number of the neighbours at the same distance	Index of the lattice and the position vectors of the neighbours
0	0	1	1: (0, 0, 0)
1	$a$	12	1: $(\pm 1, 1, 0), (\pm 1, -1, 0), (\pm 2, 0, 0)$ 2: $\left(1, \frac{1}{3}, \pm 1\right), \left(0, -\frac{2}{3}, \pm 1\right), \left(-1, \frac{1}{3}, \pm 1\right)$
2	$\sqrt{2}a$	6	2: $\left(0, \frac{4}{3}, \pm 1\right), \left(2, -\frac{2}{3}, \pm 1\right), \left(-2, -\frac{2}{3}, \pm 1\right)$
3	$\sqrt{\frac{8}{3}}a$	2	1 : $(0, 0, \pm 2)$
4	$\sqrt{3}a$	18	1: $(\pm 3, 1, 0), (0, \pm 2, 0), (\pm 3, -1, 0)$ 2: $\left(3, \frac{1}{3}, \pm 1\right), \left(-3, \frac{1}{3}, \pm 1\right), \left(2, \frac{4}{3}, \pm 1\right), \left(-2, \frac{4}{3}, \pm 1\right), \left(1, -\frac{5}{3}, \pm 1\right), \left(-1, -\frac{5}{3}, \pm 1\right)$

The length units along the axes  $x, y, z$  are defined as previously

$$\alpha = \frac{1}{2}a, \quad \beta = \frac{1}{2}\sqrt{3}a, \quad \gamma = \frac{1}{2}c = a\sqrt{\frac{1}{2}}.$$

The results of the calculations are summarized in two tables. In the Table II are given the expressions for the components  $(m/n)_{11}$  in terms of three-center E-integrals. E-integrals for the atoms at the distance  $\sqrt{\frac{8}{3}}a$  are expressed in terms of independent E-integrals for the vector  $\mathbf{R}_2 = (0, 0, 2)$  (second neighbour of the zero atom in lattice 1). The E-integrals for the atoms at the distance  $\sqrt{3}a$  can be expressed in terms of the independent E-integrals with the centers  $\mathbf{R}_3 = (0, 2, 0)$  and  $-\mathbf{R}_3 = (0, -2, 0)$  (third neighbour of the zero atom in lattice 2). In this case one cannot express all

E-integrals in terms of E-integrals depending on only one position vector. This results from the properties of the symmetry transformations of the lattice. For brevity we introduce in the tables the following definitions

$$E_{m,n}(\mathbf{R}_3) + E_{m,n}(-\mathbf{R}_3) = E_{m,n}(\mathbf{R}_3^+),$$

$$E_{m,n}(\mathbf{R}_3) - E_{m,n}(-\mathbf{R}_3) = E_{m,n}(\mathbf{R}_3^-).$$

In Table III are given the expressions for the elements  $(m/n)_{12}$  in terms of three-center E-integrals. E-integrals for the atoms at the distance  $\sqrt{2}a$  are expressed in terms of E-integrals depending on the vector  $\mathbf{T}_2 = \left(0, \frac{4}{3}, 1\right)$  (second neighbour of the zero atom in the lattice 2), and for the atoms at the distance  $\sqrt{3}a$  are expressed in terms of E-integrals depending on the vector  $\mathbf{T}_3 = \left(2, \frac{4}{3}, 1\right)$  (third neighbour of the zero atom in lattice 2).

Figure 1 displays the positions of the atoms with respect to the zero atom. The heavy lines and full circles refer to the lattice 1, dotted lines and open circles refer

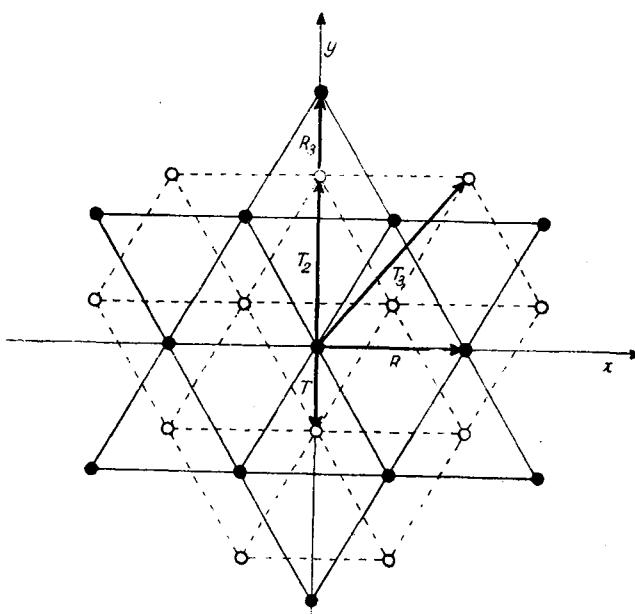


Fig. 1. The positions of the neighbours of order 1, 2, 3, 4 in hexagonal ideal close-packed lattice to the lattice 2. The full circles are in the plane  $z = 0$ , and the open circles are in the plane  $z = \frac{1}{2}c$ . The vectors  $\mathbf{R}$ ,  $\mathbf{R}_3$  and  $\mathbf{T}$ ,  $\mathbf{T}_2$ ,  $\mathbf{T}_3$  are indicated. The vector  $\mathbf{R}_2$  is

perpendicular to the plane of the figure directed upward. The vectors  $\mathbf{R}$  and  $\mathbf{T}$  have been defined in the part I of this work.

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TABLE II

The elements  $(m/n)_{11}$  in terms of E-integrals —the neighbours of the order 2, 3, 4.

$(s/xz) = (x/z) = (x/yz) = (y/xz) = (z/xy) = (xy/yz) = (xz/x^2 - y^2) = (xz/3z^2 - r^2) = 0$
$(s/s) \quad 2E_{s,s}(\mathbf{R}_2) \cos 2\zeta + 2E_{s,s}(\mathbf{R}_3) (2 \cos 3\xi \cos \eta + \cos 2\eta)$
$(s/x) \quad \sqrt{3} \sin 3\xi [E_{s,y}(\mathbf{R}_3^+) \sin \eta + iE_{s,y}(\mathbf{R}_3^-) \cos \eta]$
$(s/y) \quad 2E_{s,y}(\mathbf{R}_2) \cos 2\zeta + E_{s,y}(\mathbf{R}_3^+) (\cos 2\eta - \cos 3\xi \cos \eta) + iE_{s,y}(\mathbf{R}_3^-) (\sin 2\eta + \cos 3\xi \sin \eta)$
$(s/z) \quad 2iE_{s,z}(\mathbf{R}_2) \sin 2\zeta$
$(s/xy) \quad \sqrt{3} \sin 3\xi [E_{s,x^2-y^2}(\mathbf{R}_3^+) \sin \eta + iE_{s,x^2-y^2}(\mathbf{R}_3^-) \cos \eta]$
$(s/yz) \quad 2iE_{s,yz}(\mathbf{R}_2) \sin 2\zeta$
$(s/x^2 - y^2) \quad 2E_{s,x^2-y^2}(\mathbf{R}^2) \cos 2\zeta + E_{s,x^2-y^2}(\mathbf{R}_3^+) (\cos 2\eta - \cos 3\xi \cos \eta) + iE_{s,x^2-y^2}(\mathbf{R}_3^-) (\sin 2\eta + \cos 3\xi \sin \eta)$
$(s/3z^2 - r^2) \quad 2E_{s,3z^2-r^2}(\mathbf{R}_2) \cos 2\zeta + E_{s,3z^2-r^2}(\mathbf{R}_3^+) (2 \cos 3\xi \cos \eta + \cos 2\eta) - iE_{s,3z^2-r^2}(\mathbf{R}_3^-) (2 \cos 3\xi \sin \eta - \sin 2\eta)$
$(x/x) \quad 2E_{x,x}(\mathbf{R}_2) \cos 2\zeta + [E_{x,x}(\mathbf{R}_3) + 3E_{y,y}(\mathbf{R}_3)] \cos 3\xi \cos \eta + 2E_{x,x}(\mathbf{R}_3) \cos 2\eta$
$(x/y) \quad \sqrt{3} [E_{x,x}(\mathbf{R}_3) - E_{y,y}(\mathbf{R}_3)] \sin 3\xi \sin \eta$
$(x/xy) \quad 2E_{x,xy}(\mathbf{R}_2) \cos 2\zeta + \left\{ \frac{1}{2} [E_{x,xy}(\mathbf{R}_3^+) + 3E_{y,x^2-y^2}(\mathbf{R}_3^+)] \times \cos 3\xi \cos \eta + E_{x,xy}(\mathbf{R}_3^+) \cos 2\eta \right\} - i \left\{ \frac{1}{2} [E_{x,xy}(\mathbf{R}_3^-) + 3E_{y,x^2-y^2}(\mathbf{R}_3^-)] \cos 3\xi \sin \eta - E_{x,xy}(\mathbf{R}_3^-) \sin 2\eta \right\}$
$(x/xz) \quad 2iE_{x,xz}(\mathbf{R}_2) \sin 2\zeta$
$(x/x^2 - y^2) = (y/xy) \quad \frac{1}{2} \sqrt{3} \sin 3\xi \{ [E_{x,xy}(\mathbf{R}_3^+) - E_{y,x^2-y^2}(\mathbf{R}_3^+)] \sin \eta + i [E_{x,xy}(\mathbf{R}_3^-) - E_{y,x^2-y^2}(\mathbf{R}_3^-)] \cos \eta \}$
$(x/3z^2 - r^2) \quad \sqrt{3} \sin 3\xi [E_{y,3z^2-r^2}(\mathbf{R}_3^+) \sin \eta + iE_{y,3z^2-r^2}(\mathbf{R}_3^-) \cos \eta]$
$(y/y) \quad 2E_{y,y}(\mathbf{R}_2) \cos 2\zeta + [E_{y,y}(\mathbf{R}_3) + 3E_{x,x}(\mathbf{R}_3)] \cos 3\xi \cos \eta + 2E_{y,y}(\mathbf{R}_3) \cos 2\eta$
$(y/z) \quad 2iE_{y,z}(\mathbf{R}_2) \sin 2\zeta$

(y/yz)	$2iE_{y,yz}(\mathbf{R}_2) \sin 2\zeta$
$(y/x^2 - y^2)$	$2E_{y,x^2-y^2}(\mathbf{R}_2) \cos 2\zeta + \left\{ \frac{1}{2} [E_{y,x^2-y^2}(\mathbf{R}_3^+) + 3E_{x,xy}(\mathbf{R}_3^+)] \times \cos 3\xi \sin \eta + E_{y,x^2-y^2}(\mathbf{R}_3^+) \cos 2\eta \right\} - i \left\{ \frac{1}{2} [E_{y,x^2-y^2}(\mathbf{R}_3^-) + 3E_{x,xy}(\mathbf{R}_3^-)] \cos 3\xi \sin \eta - E_{y,x^2-y^2}(\mathbf{R}_3^-) \sin 2\eta \right\}$
$(y/3z^2 - r^2)$	$2E_{y,3z^2-r^2}(\mathbf{R}_2) \cos 2\zeta + E_{y,3z^2-r^2}(\mathbf{R}_3^+) (\cos 2\eta - \cos 3\xi \cos \eta) + iE_{y,3z^2-r^2}(\mathbf{R}_3^-) (\sin 2\eta + \cos 3\xi \sin \eta)$
$(z/z)$	$2E_{z,z}(\mathbf{R}_2) \cos 2\zeta + 2E_{z,z}(\mathbf{R}_3) (2 \cos 3\xi \cos \eta + \cos 2\eta)$
$(z/yz)$	$2E_{z,yz}(\mathbf{R}_2) \cos 2\zeta + E_{z,yz}(\mathbf{R}_3^+) (\cos 2\eta - \cos 3\xi \cos \eta) + iE_{z,yz}(\mathbf{R}_3^-) (\sin 2\eta + \cos 3\xi \sin \eta)$
$(z/xz)$	$\sqrt{3} \sin 3\xi [E_{z,yz}(\mathbf{R}_3^+) \sin \eta + iE_{z,yz}(\mathbf{R}_3^-) \cos \eta]$
$(z/x^2 - y^2)$	$2iE_{z,x^2-y^2}(\mathbf{R}_2) \sin 2\zeta$
$(z/3z^2 - r^2)$	$2iE_{z,3z^2-r^2}(\mathbf{R}_2) \sin 2\zeta$
$(xy/xy)$	$2E_{xy,xy}(\mathbf{R}_2) \cos 2\zeta + [E_{xy,xy}(\mathbf{R}_3) + 3E_{x^2-y^2,x^2-y^2}(\mathbf{R}_3)] \times \cos 3\xi \cos \eta + 2E_{xy,xy}(\mathbf{R}_3) \cos 2\eta$
$(xy/xz)$	$2iE_{xy,xz}(\mathbf{R}_2) \sin 2\zeta$
$(xy/x^2 - y^2)$	$\sqrt{3} [E_{xy,xy}(\mathbf{R}_3) - E_{x^2-y^2,x^2-y^2}(\mathbf{R}_3)] \sin 3\xi \sin \eta$
$(xy/3z^2 - r^2)$	$\sqrt{3} \sin 3\xi [E_{x^2-y^2,3z^2-r^2}(\mathbf{R}_3^+) \sin \eta + iE_{x^2-y^2,3z^2-r^2}(\mathbf{R}_3^-) \cos \eta]$
$(yz/yz)$	$2E_{yz,yz}(\mathbf{R}_2) \cos 2\zeta + [E_{yz,yz}(\mathbf{R}_3) + 3E_{xz,xz}(\mathbf{R}_3)] \times \cos 3\xi \cos \eta + 2E_{yz,yz}(\mathbf{R}_3) \cos 2\eta$
$(yz/xz)$	$\sqrt{3} [E_{xz,xz}(\mathbf{R}_3) - E_{yz,yz}(\mathbf{R}_3)] \sin 3\xi \sin \eta$
$(yz/x^2 - y^2)$	$2iE_{yz,x^2-y^2}(\mathbf{R}_2) \sin 2\zeta$
$(yz/3z^2 - r^2)$	$2iE_{yz,3z^2-r^2}(\mathbf{R}_2) \sin 2\zeta$
$(xz/xz)$	$2E_{xz,xz}(\mathbf{R}_2) \cos 2\zeta + [E_{xz,xz}(\mathbf{R}_3) + 3E_{yz,yz}(\mathbf{R}_3)] \times \cos 3\xi \cos \eta + 2E_{xz,xz}(\mathbf{R}_3) \cos 2\eta$
$(x^2 - y^2/x^2 - y^2)$	$2E_{x^2-y^2,x^2-y^2}(\mathbf{R}_2) \cos 2\zeta + [E_{x^2-y^2,x^2-y^2}(\mathbf{R}_3) + 3E_{xy,xy}(\mathbf{R}_3)] \cos 3\xi \cos \eta + 2E_{x^2-y^2,x^2-y^2}(\mathbf{R}_3) \cos 2\eta$
$(x^2 - y^2/3z^2 - r^2)$	$2E_{x^2-y^2,3z^2-r^2}(\mathbf{R}_2) \cos 2\zeta + E_{x^2-y^2,3z^2-r^2}(\mathbf{R}_3^+) \times (\cos 2\eta - \cos 3\xi \cos \eta) + iE_{x^2-y^2,3z^2-r^2}(\mathbf{R}_3^-) \times (\sin 2\eta + \cos 3\xi \sin \eta)$
$(3z^2 - r^2/3z^2 - r^2)$	$2E_{3z^2-r^2,3z^2-r^2}(\mathbf{R}_2) \cos 2\zeta + 2E_{3z^2-r^2,3z^2-r^2}(\mathbf{R}_3) \times (2 \cos 3\xi \cos \eta + \cos 2\eta)$

TABLE III

The elements ( $m/n_{12}$ ) in terms of  $E$  integrals — the neighbours of the order 2, 3, 4.

(s/s)	$2E_{s,s}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3}\eta + 2 \cos 2\xi \cos \frac{2}{3}\eta \right) + i \left( \sin \frac{4}{3}\eta - 2 \cos 2\xi \sin \frac{2}{3}\eta \right) \right] + 4E_{s,s}(\mathbf{T}_3) \cos \zeta \left[ \left( \cos 3\xi \cos \frac{1}{3}\eta + \cos 2\xi \cos \frac{4}{3}\eta + \cos \xi \cos \frac{5}{3}\eta \right) + i \left( \cos 3\xi \sin \frac{1}{3}\eta + \cos 2\xi \sin \frac{4}{3}\eta - \cos \xi \sin \frac{5}{3}\eta \right) \right]$
(s/x)	$2\sqrt{3}E_{s,y}(\mathbf{T}_2) \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + i \cos \frac{2}{3}\eta \right) - 2 \cos \zeta \left\{ \left[ E_{s,x}(\mathbf{T}_3) + \sqrt{3}E_{s,y}(\mathbf{T}_3) \right] \sin 3\xi \sin \frac{1}{3}\eta + 2E_{s,x}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + \left[ E_{s,x}(\mathbf{T}_3) - \sqrt{3}E_{s,y}(\mathbf{T}_3) \right] \sin \xi \sin \frac{5}{3}\eta \right) - i \left( \left[ E_{s,x}(\mathbf{T}_3) + \sqrt{3}E_{s,y}(\mathbf{T}_3) \right] \sin 3\xi \cos \frac{1}{3} + 2E_{s,x}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta - \left[ E_{s,x}(\mathbf{T}_3) - \sqrt{3}E_{s,y}(\mathbf{T}_3) \right] \sin \xi \cos \frac{5}{3}\eta \right) \right\}$
(s/y)	$2E_{s,y}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3}\eta - \cos 2\xi \cos \frac{2}{3}\eta \right) + i \left( \sin \frac{4}{3}\eta + \cos 2\xi \times \sin \frac{2}{3}\eta \right) \right] + 2 \cos \zeta \left\{ \left( \left[ \sqrt{3}E_{s,x}(\mathbf{T}_3) - E_{s,y}(\mathbf{T}_3) \right] \cos 3\xi \cos \frac{1}{3}\eta + 2E_{s,y}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta - \left[ \sqrt{3}E_{s,x}(\mathbf{T}_3) + E_{s,y}(\mathbf{T}_3) \right] \times \cos \xi \cos \frac{5}{3}\eta \right) + i \left( \left[ \sqrt{3}E_{s,x}(\mathbf{T}_3) - E_{s,y}(\mathbf{T}_3) \right] \cos 3\xi \sin \frac{1}{3}\eta + \left[ 2E_{s,y}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta + \left[ \sqrt{3}E_{s,x}(\mathbf{T}_3) + E_{s,y}(\mathbf{T}_3) \right] \times \cos \xi \sin \frac{5}{3}\eta \right) \right\}$
(s/z)	$2E_{s,z}(\mathbf{T}_2) \sin \zeta \left[ \left( 2 \cos 2\xi \sin \frac{2}{3}\eta - \sin \frac{4}{3}\eta \right) + i \left( 2 \cos 2\xi \cos \frac{2}{3}\eta + \cos \frac{4}{3}\eta \right) \right] - 4E_{s,z}(\mathbf{T}_3) \sin \zeta \left[ \left( \cos 3\xi \sin \frac{1}{3}\eta + \cos 2\xi \sin \frac{4}{3}\eta - \cos \xi \sin \frac{5}{3}\eta \right) - i \left( \cos 3\xi \cos \frac{1}{3}\eta + \cos 2\xi \cos \frac{4}{3}\eta + \cos 2\xi \cos \frac{5}{3}\eta \right) \right]$

$$\begin{aligned}
(s/xy) \quad & 2\sqrt{3}E_{s,x^2-y^2}(\mathbf{T}_2) \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + i \cos \frac{2}{3}\eta \right) - 2 \cos \zeta \times \\
& \times \left\{ \left[ E_{s,xy}(\mathbf{T}_3) + \sqrt{3}E_{s,x^2-y^2}(\mathbf{T}_3) \right] \sin 3\xi \sin \frac{1}{3}\eta + \right. \\
& + 2E_{s,xy}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + [E_{s,xy}(\mathbf{T}_3) - \sqrt{3}E_{s,x^2-y^2}(\mathbf{T}_3)] \\
& \times \sin \xi \sin \frac{5}{3}\eta \Bigg) - i \left( [E_{s,xy}(\mathbf{T}_3) + \sqrt{3}E_{s,x^2-y^2}(\mathbf{T}_3)] \times \right. \\
& \times \sin 3\xi \cos \frac{1}{3}\eta + 2E_{s,xy}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta - [E_{s,xy}(\mathbf{T}_3) - \\
& - \sqrt{3}E_{s,x^2-y^2}(\mathbf{T}_3) \sin \xi \cos \frac{5}{3}\eta \Bigg) \Bigg\} \\
(s/yz) \quad & - 2E_{s,yz}(\mathbf{T}_2) \sin \zeta \left[ \left( \sin \frac{4}{3}\eta + \cos 2\xi \sin \frac{2}{3}\eta \right) - i \left( \cos \frac{4}{3}\eta - \right. \right. \\
& - \cos 2\xi \cos \frac{2}{3}\eta \Bigg) \Bigg] - 2 \sin \zeta \left\{ \left[ \sqrt{3}E_{s,xz}(\mathbf{T}_3) - E_{s,yz}(\mathbf{T}_3) \right] \times \right. \\
& \times \cos 3\xi \sin \frac{1}{3}\eta + 2E_{s,yz}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta + [\sqrt{3}E_{s,xz}(\mathbf{T}_3) + \\
& + E_{s,yz}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \Bigg) - i \left( [\sqrt{3}E_{s,xz}(\mathbf{T}_3) - E_{s,yz}(\mathbf{T}_3)] \times \right. \\
& \times \cos 3\xi \cos \frac{1}{3}\eta + 2E_{s,yz}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta - \sqrt{3}E_{s,xz}(\mathbf{T}_3) + \\
& + E_{s,yz}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3}\eta \Bigg) \Bigg\} \\
(s/xz) \quad & - 2\sqrt{3}E_{s,yz}(\mathbf{T}_2) \sin 2\xi \sin \zeta \left( \cos \frac{2}{3}\eta - i \sin \frac{2}{3}\eta \right) - 2 \sin \zeta \times \\
& \times \left\{ \left[ E_{s,xz}(\mathbf{T}_3) + \sqrt{3}E_{s,yz}(\mathbf{T}_3) \right] \sin 3\xi \cos \frac{1}{3}\eta + \right. \\
& + 2E_{s,xz}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta - E_{s,xz}(\mathbf{T}_3) - \sqrt{3}E_{s,yz}(\mathbf{T}_3) \Bigg] \times \\
& \times \sin \xi \cos \frac{5}{3}\eta \Bigg) + i \left( [E_{s,xz}(\mathbf{T}_3) + \sqrt{3}E_{s,yz}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3}\eta + \right. \\
& + 2E_{s,xz}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + [E_{s,xz}(\mathbf{T}_3) - \sqrt{3}E_{s,yz}(\mathbf{T}_3)] \times \sin \xi \sin \frac{5}{3}\eta \Bigg) \Bigg\}
\end{aligned}$$

$$\begin{aligned}
(s/x^2 - y^2) & \quad 2E_{s,x^2-y^2}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3}\eta - \cos 2\xi \cos \frac{2}{3}\eta \right) + i \left( \sin \frac{4}{3}\eta + \right. \right. \\
& \quad \left. \left. + \cos 2\xi \sin \frac{2}{3}\eta \right) \right] + 2 \cos \zeta \left\{ \left( [\sqrt{3}E_{s,xy}(\mathbf{T}_3) - E_{s,x^2-y^2}(\mathbf{T}_3)] \times \right. \right. \\
& \quad \times \cos 3\xi \cos \frac{1}{3}\eta + 2E_{s,x^2-y^2}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta - [\sqrt{3}E_{s,xy}(\mathbf{T}_3) + \\
& \quad \left. \left. + E_{s,x^2-y^2}(\mathbf{T}_3) \right] \cos \xi \cos \frac{5}{3}\eta \right) + i \left( [\sqrt{3}E_{s,xy}(\mathbf{T}_3) - \right. \\
& \quad \left. \left. - E_{s,x^2-y^2}(\mathbf{T}_3) \right] \cos 3\xi \sin \frac{1}{3}\eta + 2E_{s,x^2-y^2}(\mathbf{T}_3) \cos 2\xi \times \right. \\
& \quad \times \sin \frac{4}{3}\eta + [\sqrt{3}E_{s,xy}(\mathbf{T}_3) + E_{s,x^2-y^2}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \right\} \\
(s/3z^2 - r^2) & \quad 2E_{s,3z^2-r^2}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3}\eta + 2 \cos 2\xi \cos \frac{2}{3}\eta \right) + i \left( \sin \frac{4}{3}\eta - \right. \right. \\
& \quad \left. \left. - 2 \cos 2\xi \sin \frac{2}{3}\eta \right) \right] + 4E_{s,3z^2-r^2}(\mathbf{T}_3) \cos \zeta \left[ \left( \cos 3\xi \cos \frac{1}{3}\eta + \right. \right. \\
& \quad \left. \left. + \cos 2\xi \cos \frac{4}{3}\eta + \cos \xi \cos \frac{5}{3}\eta \right) + i \left( \cos 3\xi \sin \frac{1}{3}\eta + \cos 2\xi \times \right. \right. \\
& \quad \times \sin \frac{4}{3}\eta - \cos \xi \sin \frac{5}{3}\eta \right] \\
(x/x) & \quad \cos \zeta \left\{ \left( 2E_{x,x}(\mathbf{T}_2) \cos \frac{4}{3}\eta + [E_{x,x}(\mathbf{T}_2) + 3E_{y,y}(\mathbf{T}_2)] \cos 2\xi \times \right. \right. \\
& \quad \times \cos \frac{2}{3}\eta \right) + i \left( 2E_{x,x}(\mathbf{T}_2) \sin \frac{4}{3}\eta - [E_{x,x}(\mathbf{T}_2) + 3E_{y,y}(\mathbf{T}_2)] \times \right. \\
& \quad \times \cos 2\xi \sin \frac{2}{3}\eta \right\} + \cos \zeta \left\{ \left( [E_{x,x}(\mathbf{T}_3) + 2\sqrt{3}E_{x,y}(\mathbf{T}_3) + \right. \right. \\
& \quad \left. \left. + 3E_{y,y}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3}\eta + 4E_{x,x}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta + \right. \right. \\
& \quad \left. \left. + [E_{x,x}(\mathbf{T}_3) - 2\sqrt{3}E_{x,y}(\mathbf{T}_3) + 3E_{y,y}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3}\eta \right) + \right. \\
& \quad \left. + i \left( [E_{x,x}(\mathbf{T}_3) + 2\sqrt{3}E_{x,y}(\mathbf{T}_3) + 3E_{y,y}(\mathbf{T}_3)] \cos 3\xi \times \right. \right. \\
& \quad \times \sin \frac{1}{3}\eta + 4E_{x,x}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta - E_{x,x}(\mathbf{T}_3) - \\
& \quad \left. \left. - 2\sqrt{3}E_{x,y}(\mathbf{T}_3) + 3E_{y,y}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \right) \right\}
\end{aligned}$$

$$\begin{aligned}
(x/y) \quad & \sqrt{3} [E_{x,x}(\mathbf{T}_2) - E_{y,y}(\mathbf{T}_2)] \sin 2\xi \cos \zeta \left( \sin \frac{2}{3} \eta + i \cos \frac{2}{3} \eta \right) - \\
& - \cos \zeta \left\{ \left[ [\sqrt{3} E_{x,x}(\mathbf{T}_3) + 2 E_{x,y}(\mathbf{T}_3) - \sqrt{3} E_{y,y}(\mathbf{T}_3)] \sin 3\xi \times \right. \right. \\
& \times \sin \frac{1}{3} \eta + 4 E_{x,y}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3} \eta - [\sqrt{3} E_{x,x}(\mathbf{T}_3) - 2 E_{x,y}(\mathbf{T}_3) - \\
& - \sqrt{3} E_{y,y}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3} \eta \Bigg) - i \left( [\sqrt{3} E_{x,x}(\mathbf{T}_3) + 2 E_{x,y}(\mathbf{T}_3) - \right. \\
& - \sqrt{3} E_{y,y}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3} \eta + 4 E_{x,y}(\mathbf{T}_3) \times \sin 2\xi \cos \frac{4}{3} \eta + \\
& + [\sqrt{3} E_{x,x}(\mathbf{T}_3) - 2 E_{x,y}(\mathbf{T}_3) - \sqrt{3} E_{y,y}(\mathbf{T}_3) \times \sin \xi \cos \frac{5}{3} \eta \Bigg) \Bigg\} \\
(x/z) \quad & - 2 \sqrt{3} E_{y,z}(\mathbf{T}_2) \sin 2\xi \sin \zeta \left( \cos \frac{2}{3} \eta - i \sin \frac{2}{3} \eta \right) - 2 \sin \zeta \times \\
& \times \left\{ \left( [E_{x,z}(\mathbf{T}_3) + \sqrt{3} E_{y,z}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3} \eta + 2 E_{x,z}(\mathbf{T}_3) \times \right. \right. \\
& \times \sin 2\xi \cos \frac{3}{4} \eta - [E_{x,z}(\mathbf{T}_3) - \sqrt{3} E_{y,z}(\mathbf{T}_3)] \sin \xi \cos \frac{5}{3} \eta \Bigg) + \\
& + i \left( [E_{x,z}(\mathbf{T}_3) + \sqrt{3} E_{y,z}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3} \eta + 2 E_{x,z}(\mathbf{T}_3) \times \right. \\
& \times \sin 2\xi \sin \frac{3}{4} \eta + [E_{x,z}(\mathbf{T}_3) - \sqrt{3} E_{y,z}(\mathbf{T}_3) \sin \xi \sin \frac{5}{3} \eta \Bigg) \Bigg\} \\
(x/xy) \quad & \cos \zeta \left\{ \left( 2 E_{x,xy}(\mathbf{T}_2) \cos \frac{4}{3} \eta + [E_{x,xy}(\mathbf{T}_2) + 3 E_{y,x^2-y^2}(\mathbf{T}_2)] \times \right. \right. \\
& \times \cos 2\xi \cos \frac{2}{3} \eta \Bigg) + i \left( 2 E_{x,xy}(\mathbf{T}_2) \sin \frac{4}{3} \eta - [E_{x,xy}(\mathbf{T}_2) + \right. \\
& + 3 E_{y,x^2-y^2}(\mathbf{T}_2)] \cos 2\xi \sin \frac{2}{3} \eta \Bigg) \Bigg\} + \cos \zeta \left\{ \left( [\sqrt{3} E_{y,x^2-y^2}(\mathbf{T}_3) + \right. \right. \\
& + E_{x,xy}(\mathbf{T}_3) + 3 E_{y,x^2-y^2}(\mathbf{T}_3) + \sqrt{3} E_{y,xy}(\mathbf{T}_3)] \cos 3\xi \times \cos \frac{1}{3} \eta + \\
& + 4 E_{x,xy}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3} \eta - [\sqrt{3} E_{x,x^2-y^2}(\mathbf{T}_3) - E_{x,xy}(\mathbf{T}_3) - \\
& - 3 E_{y,x^2-y^2}(\mathbf{T}_3) + \sqrt{3} E_{y,xy}(\mathbf{T}_3)] \cos \xi \times \cos \frac{5}{3} \eta \Bigg) + i \left( [\sqrt{3} E_{x,x^2-y^2}(\mathbf{T}_3) + \right. \\
& \dots
\end{aligned}$$

$$\begin{aligned}
& + E_{x,xy}(\mathbf{T}_3) + 3E_{y,x^2-y^2}(\mathbf{T}_3) + \sqrt{3}E_{y,xy}(\mathbf{T}_3)] \cos 3\xi \sin \frac{1}{3}\eta + \\
& + 4E_{x,xy}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta + [\sqrt{3}E_{x,x^2-y^2}(\mathbf{T}_3) - E_{x,xy}(\mathbf{T}_3) \\
& - 3E_{y,x^2-y^2}(\mathbf{T}_3) + \sqrt{3}E_{y,xy}(\mathbf{T}_3)] \cos \xi \times \sin \frac{5}{3}\eta \Bigg\} \\
(x/yz) \quad & \sqrt{3}[E_{y,yz}(\mathbf{T}_2) - E_{x,xz}(\mathbf{T}_2)] \sin 2\xi \sin \zeta \left( \cos \frac{2}{3}\eta - i \sin \frac{2}{3}\eta \right) - \\
& - \sin \zeta \left\{ \left( [\sqrt{3}E_{x,xz}(\mathbf{T}_3) - E_{x,yz}(\mathbf{T}_3) + 3E_{x,xz}(\mathbf{T}_3) - \right. \right. \\
& - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3}\eta + 4E_{x,yz}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta + \\
& + [\sqrt{3}E_{x,xz}(\mathbf{T}_3) + E_{x,yz}(\mathbf{T}_3) - 3E_{y,xz}(\mathbf{T}_3) - \\
& - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin \xi \cos \frac{5}{3}\eta \Big) + i \left( [\sqrt{3}E_{x,xz}(\mathbf{T}_3) - \right. \\
& - E_{x,yz}(\mathbf{T}_3) + 3E_{y,xz}(\mathbf{T}_3) - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3}\eta + \\
& + 4E_{x,yz}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta - [\sqrt{3}E_{x,xz}(\mathbf{T}_3) + E_{x,yz}(\mathbf{T}_3) - \\
& \left. \left. - 3E_{y,xz}(\mathbf{T}_3) - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3}\eta \right) \right\} \\
(x/xz) \quad & - \sin \zeta \left\{ \left( 2E_{x,xz}(\mathbf{T}_2) \sin \frac{4}{3}\eta - [E_{x,xz}(\mathbf{T}_2) + 3E_{y,yz}(\mathbf{T}_2)] \times \right. \right. \\
& \times \cos 2\xi \sin \frac{2}{3}\eta \Big) - i \left( 2E_{x,xz}(\mathbf{T}_2) \cos \frac{4}{3}\eta + [E_{x,xz}(\mathbf{T}_2) + \right. \\
& + 3E_{y,yz}(\mathbf{T}_2)] \cos 2\xi \cos \frac{2}{3}\eta \Big) \Big\} - \sin \zeta \left\{ \left( [E_{x,xz}(\mathbf{T}_3) + \right. \right. \\
& + \sqrt{3}E_{x,yz}(\mathbf{T}_3) + \sqrt{3}E_{y,xz}(\mathbf{T}_3) + 3E_{y,yz}(\mathbf{T}_3)] \cos 3\xi \times \\
& \times \sin \frac{1}{3}\eta + 4E_{x,xz}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta - [E_{x,xz}(\mathbf{T}_3) - \\
& - \sqrt{3}E_{x,yz}(\mathbf{T}_3) - \sqrt{3}E_{y,xz}(\mathbf{T}_3) + 3E_{y,yz}(\mathbf{T}_3)] \cos \xi \times \\
& \times \sin \frac{5}{3}\eta \Big) - i \left( [E_{x,xz}(\mathbf{T}_3) + \sqrt{3}E_{x,yz}(\mathbf{T}_3) + \sqrt{3}E_{y,xz}(\mathbf{T}_3) + \right. \\
& \left. \left. + 3E_{y,yz}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3}\eta + 4E_{x,xz}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta + \right. \right. 
\end{aligned}$$

$$\begin{aligned}
& + [E_{x,xz}(\mathbf{T}_3) - \sqrt{3}E_{x,yz}(\mathbf{T}_3) - \sqrt{3}E_{y,xz}(\mathbf{T}_3) + \\
& + 3E_{y,yz}(\mathbf{T}_3)] \cos \xi \operatorname{soc} \frac{5}{3}\eta \Bigg\} \\
(x/x^2 - y^2) & \quad \sqrt{3}[E_{x,xv}(\mathbf{T}_2) - E_{y,x^2-y^2}(\mathbf{T}_2)] \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + i \cos \frac{2}{3}\eta \right) + \\
& + \cos \zeta \left\{ \left[ [E_{x,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{x,xy}(\mathbf{T}_3) + \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - \right. \right. \\
& - 3E_{y,xy}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3}\eta - 4E_{x,x^2-y^2}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + \\
& + [E_{x,x^2-y^2}(\mathbf{T}_3) + \sqrt{3}E_{x,xy}(\mathbf{T}_3) - \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - 3E_{y,xy}(\mathbf{T}_3) \times \\
& \times \sin \xi \sin \frac{5}{3}\eta \Bigg) - i \left( [E_{x,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{x,xy}(\mathbf{T}_3) + \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - \right. \\
& - 3E_{y,xy}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3}\eta - 4E_{x,x^2-y^2}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta - \\
& - [E_{x,x^2-y^2}(\mathbf{T}_3) + \sqrt{3}E_{x,xy}(\mathbf{T}_3) - \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - 3E_{y,xy}(\mathbf{T}_3)] \times \\
& \times \sin \xi \operatorname{soc} \frac{5}{3}\eta \Bigg) \Bigg\} \\
(x/3z^2 - r^2) & 2\sqrt{3}E_{y,3z^2-r^2}(\mathbf{T}_2) \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + i \cos \frac{2}{3}\eta \right) - 2 \cos \zeta \times \\
& \times \left\{ \left( [E_{x,3z^2-r^2}(\mathbf{T}_3) + \sqrt{3}E_{y,3z^2-r^2}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3}\eta + \right. \right. \\
& + 2E_{x,3z^2-r^2}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + [E_{x,3z^2-y^2}(\mathbf{T}_3) - \\
& - \sqrt{3}E_{y,3z^2-r^2}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3}\eta \Bigg) - i \left( [E_{x,3z^2-r^2}(\mathbf{T}_3) + \right. \\
& + \sqrt{3}E_{y,3z^2-r^2}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3}\eta + 2E_{x,3z^2-r^2}(\mathbf{T}_3) \times \sin 2\xi \cos \frac{4}{3}\eta - \\
& - [E_{x,3z^2-r^2}(\mathbf{T}_3) - \sqrt{3}E_{y,3z^2-r^2}(\mathbf{T}_3) \times \sin \xi \cos \frac{5}{3}\eta \Bigg) \Bigg\} \\
(y/y) & \cos \zeta \left\{ \left( 2E_{y,y}(\mathbf{T}_2) \cos \frac{4}{3}\eta + [E_{y,y}(\mathbf{T}_2) + 3E_{x,x}(\mathbf{T}_2)] \cos 2\xi \times \right. \right. \\
& \times \cos \frac{2}{3}\eta \Bigg) + i \left( 2E_{y,y}(\mathbf{T}_2) \sin \frac{4}{3}\eta - [E_{y,y}(\mathbf{T}_2) + 3E_{x,x}(\mathbf{T}_2)] \times \right. \\
& \times \cos 2\xi \sin \frac{2}{3}\eta \Bigg) \Bigg\} + \cos \zeta \left\{ \left( [3E_{x,x}(\mathbf{T}_3) - \sqrt{3}E_{x,y}(\mathbf{T}_3) + \right. \right.
\end{aligned}$$

$$\begin{aligned}
& + E_{y,y}(\mathbf{T}_3) \cos 3\xi \cos \frac{1}{3}\eta + 4E_{y,y}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta + \\
& + [3E_{x,x}(\mathbf{T}_3) + 2\sqrt{3}E_{x,y}(\mathbf{T}_3) + E_{y,y}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3}\eta \Big) + \\
& + i \left( [3E_{x,x}(\mathbf{T}_2) - 2\sqrt{3}E_{x,y}(\mathbf{T}_3) + E_{y,y}(\mathbf{T}_3)] \cos 3\xi \sin \frac{1}{3}\eta + \right. \\
& + 4E_{y,y}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta - [3E_{x,x}(\mathbf{T}_3) + 2\sqrt{3}E_{x,y}(\mathbf{T}_3) + \\
& \left. + E_{y,y}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \right) \Big\} \\
(y/z) & - 2E_{y,z}(\mathbf{T}_2) \sin \zeta \left[ \left( \sin \frac{4}{3}\eta + \cos 2\xi \sin \frac{2}{3}\eta \right) - i \left( \cos \frac{4}{3}\eta - \right. \right. \\
& \left. \left. - \cos 2\xi \cos \frac{2}{3}\eta \right) \right] - 2 \sin \zeta \left\{ \left( [\sqrt{3}E_{x,z}(\mathbf{T}_3) - E_{y,z}(\mathbf{T}_3)] \times \right. \right. \\
& \times \cos \xi \sin \frac{1}{3}\eta + 2E_{y,z}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta + [\sqrt{3}E_{x,z}(\mathbf{T}_3) + \\
& \left. + E_{y,z}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \right) - i \left( [\sqrt{3}E_{x,z}(\mathbf{T}_3) - E_{y,z}(\mathbf{T}_3)] \times \right. \\
& \times \cos 3\xi \cos \frac{1}{3}\eta + 2E_{y,z}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta - [\sqrt{3}E_{x,z}(\mathbf{T}_3) + \\
& \left. \left. + E_{y,z}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3}\eta \right) \right\} \\
(y/xy) & \sqrt{3} [E_{x,xy}(\mathbf{T}_2) - E_{y,x^2-y^2}(\mathbf{T}_2)] \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + i \cos \frac{2}{3}\eta \right) - \\
& - \cos \zeta \left\{ \left( [3E_{x,x^2-y^2}(\mathbf{T}_3) + \sqrt{3}E_{x,xy}(\mathbf{T}_3) - \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - \right. \right. \\
& \left. \left. - E_{y,xy}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3}\eta + 4E_{y,xy}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + \right. \right. \\
& + [3E_{x,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{x,xy}(\mathbf{T}_3) + \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - \\
& \left. \left. - E_{y,xy}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3}\eta \right) - i \left( [3E_{x,x^2-y^2}(\mathbf{T}_3) + \sqrt{3}E_{x,xy}(\mathbf{T}_3) - \right. \right. \\
& - \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - E_{y,xy}(\mathbf{T}_3)] \sin 3\xi \times \cos \frac{1}{3}\eta + \\
& \left. \left. + 4E_{y,xy}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta - [3E_{x,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{x,xy}(\mathbf{T}_3) + \right. \right.
\end{aligned}$$

$$\begin{aligned}
& + \sqrt{3}E_{y,x^2-y^2}(\mathbf{T}_3) - E_{y,xy}(\mathbf{T}_3)] \times \sin \xi \cos \frac{5}{3}\eta \Bigg) \Bigg\} \\
(y/yz) & - \sin \zeta \left\{ \left( 2E_{y,yz}(\mathbf{T}_2) \sin \frac{4}{3}\eta - [3E_{x,xz}(\mathbf{T}_2) + E_{y,yz}(\mathbf{T}_2)] \times \right. \right. \\
& \times \cos 2\xi \sin \frac{2}{3}\eta \Bigg) - i \left( 2E_{y,yz}(\mathbf{T}_2) \cos \frac{4}{3}\eta + [3E_{x,xz}(\mathbf{T}_2) + \right. \\
& \left. \left. + E_{y,yz}(\mathbf{T}_2)] \cos 2\xi \cos \frac{2}{3}\eta \right) \right\} - \sin \zeta \left\{ \left( [3E_{x,xz}(\mathbf{T}_3) - \right. \right. \\
& - \sqrt{3}E_{x,yz}(\mathbf{T}_3) - \sqrt{3}E_{y,xz}(\mathbf{T}_3) + E_{y,yz}(\mathbf{T}_3)] \cos 3\xi \times \\
& \times \sin \frac{1}{3}\eta + 4E_{y,yz}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta - [3E_{x,xz}(\mathbf{T}_3) + \\
& \left. \left. + \sqrt{3}E_{x,yz}(\mathbf{T}_3) + \sqrt{3}E_{y,xz}(\mathbf{T}_3) + E_{y,yz}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \right) - \right. \\
& - i \left( [3E_{x,xz}(\mathbf{T}_3) - \sqrt{3}E_{x,yz}(\mathbf{T}_3) - \sqrt{3}E_{y,xz}(\mathbf{T}_3) + \right. \\
& \left. + E_{y,yz}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3}\eta + 4E_{y,yz}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta + \right. \\
& \left. + [3E_{x,xz}(\mathbf{T}_3) + \sqrt{3}E_{x,yz}(\mathbf{T}_3) + \sqrt{3}E_{y,xz}(\mathbf{T}_3) + \right. \\
& \left. \left. + E_{y,yz}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3}\eta \right) \right\} \\
(y/xz) & \sqrt{3} [E_{y,yz}(\mathbf{T}_2) - E_{x,xz}(\mathbf{T}_2)] \sin 2\xi \sin \zeta \left( \cos \frac{2}{3}\eta - i \sin \frac{2}{3}\eta \right) - \\
& - \sin \zeta \left\{ \left( [\sqrt{3}E_{x,xz}(\mathbf{T}_3) + 3E_{x,yz}(\mathbf{T}_3) - E_{y,xz}(\mathbf{T}_3) - \right. \right. \\
& - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3}\eta + 4E_{y,xz}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta + \\
& + \sqrt{3}E_{x,xz}(\mathbf{T}_3) - 3E_{x,yz}(\mathbf{T}_3) + E_{y,xz}(\mathbf{T}_3) - \\
& \left. \left. - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin \xi \cos \frac{5}{3}\eta \right) + i \left( [\sqrt{3}E_{x,xz}(\mathbf{T}_3) + \right. \right. \\
& + 3E_{x,yz}(\mathbf{T}_3) - E_{y,xz}(\mathbf{T}_3) - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin 3\xi \times \\
& \times \sin \frac{1}{3}\eta + 4E_{y,xz}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta - [\sqrt{3}E_{x,xz}(\mathbf{T}_3) - \\
& - 3E_{x,yz}(\mathbf{T}_3) + E_{y,xz}(\mathbf{T}_3) - \sqrt{3}E_{y,yz}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3}\eta \right) \Bigg\}
\end{aligned}$$

$$\begin{aligned}
(y/x^2 - y^2) & \cos \zeta \left\{ \left( 2E_{y, x^2 - y^2}(\mathbf{T}_3) \cos \frac{4}{3} \eta + [3E_{x, xy}(\mathbf{T}_2) + E_{y, x^2 - y^2}(\mathbf{T}_2)] \times \right. \right. \\
& \times \cos 2\xi \cos \frac{2}{3} \eta \Big) + i \left( 2E_{y, x^2 - y^2}(\mathbf{T}_2) \sin \frac{4}{3} \eta - [3E_{x, xy}(\mathbf{T}_2) + \right. \\
& \left. \left. + E_{y, x^2 - y^2}(\mathbf{T}_2)] \cos 2\xi \sin \frac{2}{3} \eta \right) \right\} - \cos \zeta \left\{ \left( [\sqrt{3}E_{x, x^2 - y^2}(\mathbf{T}_3) - \right. \right. \\
& - 3E_{x, xy}(\mathbf{T}_3) - E_{y, x^2 - y^2}(\mathbf{T}_3) + \sqrt{3}E_{y, xy}(\mathbf{T}_3)] \cos 3\xi \times \cos \frac{1}{3} \eta - \\
& - 4E_{y, x^2 - y^2}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3} \eta - [\sqrt{3}E_{x, x^2 - y^2}(\mathbf{T}_3) + 3E_{x, xy}(\mathbf{T}_3) + \\
& \left. \left. + E_{y, x^2 - y^2}(\mathbf{T}_3) + \sqrt{3}E_{y, xy}(\mathbf{T}_3)] \cos \xi \times \cos \frac{5}{3} \eta \right) + i \left( [\sqrt{3}E_{x, x^2 - y^2}(\mathbf{T}_3) - \right. \right. \\
& - 3E_{x, xy}(\mathbf{T}_3) - E_{y, x^2 - y^2}(\mathbf{T}_3) + \sqrt{3}E_{y, xy}(\mathbf{T}_3)] \cos 3\xi \sin \frac{1}{3} \eta - \\
& - 4E_{y, x^2 - y^2}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3} \eta + [\sqrt{3}E_{x, x^2 - y^2}(\mathbf{T}_3) + 3E_{x, xy}(\mathbf{T}_3) + \\
& \left. \left. + E_{y, x^2 - y^2}(\mathbf{T}_3) + \sqrt{3}E_{y, xy}(\mathbf{T}_3)] \cos \xi \times \sin \frac{5}{3} \eta \right) \right\} \\
(y/3z^2 - r^2) & 2E_{y, 3z^2 - r^2}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3} \eta - \cos 2\xi \cos \frac{2}{3} \eta \right) + i \left( \sin \frac{4}{3} \eta + \right. \right. \\
& \left. \left. + \cos 2\xi \sin \frac{2}{3} \eta \right) \right] + 2 \cos \zeta \left\{ \left( [\sqrt{3}E_{x, 3z^2 - r^2}(\mathbf{T}_3) - \right. \right. \\
& - E_{y, 3z^2 - r^2}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3} \eta + 2E_{y, 3z^2 - r^2}(\mathbf{T}_3) \cos 2\xi \times \\
& \times \cos \frac{4}{3} \eta - \sqrt{3}E_{x, 3z^2 - r^2}(\mathbf{T}_3) + E_{y, 3z^2 - r^2}(\mathbf{T}_3)] \cos \xi \times \cos \frac{5}{3} \eta + \\
& \left. \left. + i \left( [\sqrt{3}E_{x, 3z^2 - r^2}(\mathbf{T}_3) - E_{y, 3z^2 - r^2}(\mathbf{T}_3)] \times \cos 3\xi \sin \frac{1}{3} \eta + \right. \right. \right. \\
& \left. \left. \left. + 2E_{y, 3z^2 - r^2}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3} \eta + \sqrt{3}E_{x, 3z^2 - r^2}(\mathbf{T}_3) + \right. \right. \right. \\
& \left. \left. \left. + E_{y, 3z^2 - r^2}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3} \eta \right) \right\} \\
(z/z) & 2E_{z, z}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3} \eta + 2 \cos 2\xi \cos \frac{2}{3} \eta \right) + i \left( \sin \frac{4}{3} \eta - \right. \right. \\
& - 2 \cos 2\xi \sin \frac{2}{3} \eta \Big) \right] + 4E_{z, z}(\mathbf{T}_3) \cos \zeta \left[ \left( \cos 2\xi \cos \frac{1}{3} \eta + \right. \right. \\
& \left. \left. \right. \right]
\end{aligned}$$

$$\begin{aligned}
& + \cos 2\xi \cos \frac{4}{3} \eta + \cos \zeta \cos \frac{3}{5} \eta \Big) + i \left( \cos 2\xi \sin \frac{1}{3} \eta + \right. \\
& \left. + \cos 2\xi \sin \frac{4}{3} \eta - \cos \xi \sin \frac{5}{3} \eta \right) \Big] \\
(z/xy) \quad & - 2 \sqrt{3} E_{z,x^2-y^2}(\mathbf{T}_2) \sin 2\xi \sin \zeta \left( \cos \frac{2}{3} \eta - i \sin \frac{2}{3} \eta \right) - 2 \sin \zeta \times \\
& \times \left\{ \left( E_{z,xy}(\mathbf{T}_3) + \sqrt{3} E_{z,x^2-y^2}(\mathbf{T}_3) \right) \sin 3\xi \cos \frac{1}{3} \eta + \right. \\
& + 2 E_{z,xy}(\mathbf{T}_3) \sin 2\xi \operatorname{soc} \frac{4}{3} \eta - [E_{z,xy}(\mathbf{T}_3) - \sqrt{3} E_{z,x^2-y^2}(\mathbf{T}_3)] \times \\
& \times \sin \xi \cos \frac{5}{3} \eta \Big) + i \left( [E_{z,xy}(\mathbf{T}_3) + \sqrt{3} E_{z,x^2-y^2}(\mathbf{T}_3)] \times \right. \\
& \times \sin 3\xi \sin \frac{1}{3} \eta + 2 E_{z,xy}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3} \eta + [E_{z,xy}(\mathbf{T}_3) - \\
& \left. - \sqrt{3} E_{z,x^2-y^2}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3} \eta \right) \Big\} \\
(z/yz) \quad & 2 E_{z,yz}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3} \eta - \cos 2\xi \cos \frac{2}{3} \eta \right) + i \left( \sin \frac{4}{3} \eta + \right. \right. \\
& + \cos 2\xi \sin \frac{2}{3} \eta \Big) \Big] + 2 \cos \zeta \left\{ \left( [\sqrt{3} E_{z,xz}(\mathbf{T}_3) - E_{z,yz}(\mathbf{T}_3)] \times \right. \right. \\
& \times \cos 3\xi \cos \frac{1}{3} \eta + 2 E_{z,yz}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3} \eta - [\sqrt{3} E_{z,xz}(\mathbf{T}_3) + \\
& \left. + E_{z,yz}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3} \eta \Big) + i \left( [\sqrt{3} E_{z,xz}(\mathbf{T}_3) - \right. \\
& \left. - E_{z,yz}(\mathbf{T}_3)] \cos 3\xi \sin \frac{1}{3} \eta + 2 E_{z,yz}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3} \eta + \right. \\
& \left. + [\sqrt{3} E_{z,xz}(\mathbf{T}_3) + E_{z,yz}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3} \eta \right) \Big\} \\
(z/xz) \quad & 2 \sqrt{3} E_{z,yz}(\mathbf{T}_3) \sin 2\xi \operatorname{cis} \zeta \left( \sin \frac{2}{3} \eta + i \cos \frac{2}{3} \eta \right) - 2 \cos \times \\
& \times \left\{ \left( [E_{z,xz}(\mathbf{T}_3) + \sqrt{3} E_{z,yz}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3} \eta + \right. \right. \\
& + 2 E_{z,xz}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3} \eta + [E_{z,xz}(\mathbf{T}_3) - \sqrt{3} E_{z,yz}(\mathbf{T}_3)] \times
\end{aligned}$$

$$\begin{aligned}
& \times \sin \xi \sin \frac{5}{3} \eta \Big) - i \left( [E_{z,xx}(\mathbf{T}_3) + \sqrt{3}E_{z,yz}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3} \eta + \right. \\
& \left. + 2E_{z,xz}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3} \eta - [E_{z,xz}(\mathbf{T}_3) - \sqrt{3}E_{z,yz}(\mathbf{T}_3)] \times \right. \\
& \left. \times \sin \xi \cos \frac{5}{3} \eta \right) \Big\} \\
(z/x^2-y^2) & -2E_{z,x^2-y^2}(\mathbf{T}_2) \sin \zeta \left[ \left( \sin \frac{4}{3} \eta + \cos 2\xi \sin \frac{2}{3} \eta \right) - i \left( \cos \frac{4}{3} \eta - \right. \right. \\
& \left. \left. - \cos 2\xi \cos \frac{2}{3} \eta \right) \right] - 2 \sin \zeta \left\{ \left( [\sqrt{3}E_{z,xy}(\mathbf{T}_3) - \right. \right. \\
& \left. \left. - E_{z,x^2-y^2}(\mathbf{T}_3)] \cos 3\xi \sin \frac{1}{3} \eta + 2E_{z,x^2-y^2}(\mathbf{T}_3) \cos 2\xi \times \right. \\
& \left. \times \sin \frac{4}{3} \eta + [\sqrt{3}E_{z,xy}(\mathbf{T}_3) + E_{z,x^2-y^2}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3} \eta \right) - \\
& - i \left( [\sqrt{3}E_{z,xy}(\mathbf{T}_3) - E_{z,x^2-y^2}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3} \eta + \right. \\
& \left. \left. + 2E_{z,x^2-y^2}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3} \eta - [\sqrt{3}E_{z,xy}(\mathbf{T}_3) + \right. \right. \\
& \left. \left. + E_{z,x^2-y^2}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3} \eta \right) \right\} \\
(z/3z^2-r^2) & 2E_{z,3z^2-r^2}(\mathbf{T}_2) \sin \zeta \left[ \left( 2 \cos 2\xi \sin \frac{2}{3} \eta - \sin \frac{4}{3} \eta \right) + i \left( 2 \cos 2\xi \times \right. \right. \\
& \left. \times \cos \frac{2}{3} \eta + \cos \frac{4}{3} \eta \right) \Big] - 4E_{z,3z^2-r^2}(\mathbf{T}_3) \sin \zeta \left[ \left( \cos 3\xi \times \right. \right. \\
& \left. \times \sin \frac{1}{3} \eta + \cos 2\xi \sin \frac{4}{3} \eta - \cos \zeta \sin \frac{5}{3} \eta \right) - i \left( \cos 3\xi \cos \frac{1}{3} \eta + \right. \\
& \left. \left. + \cos 2\xi \cos \frac{4}{3} \eta + \cos \xi \cos \frac{5}{3} \eta \right) \right] \\
(xy/xy) & \cos \zeta \left\{ \left( 2E_{xy,xy}(\mathbf{T}_2) \cos \frac{4}{3} \eta + [E_{xy,xy}(\mathbf{T}_2) + 3E_{x^2-y^2,x^2-y^2}(\mathbf{T}_2)] \times \right. \right. \\
& \left. \times \cos 2\xi \cos \frac{2}{3} \eta \right) + i \left( 2E_{xy,xy}(\mathbf{T}_2) \sin \frac{4}{3} \eta - [E_{xy,xy}(\mathbf{T}_2) + \right. \\
& \left. \left. + 3E_{x^2-y^2,x^2-y^2}(\mathbf{T}_2)] \cos 2\xi \sin \frac{2}{3} \eta \right) \right\} + \cos \zeta \left\{ \left( [E_{xy,xy}(\mathbf{T}_3) + \right. \right. \\
& \left. \left. + 2\sqrt{3}E_{xy,x^2-y^2}(\mathbf{T}_3) + 3E_{x^2-y^2,x^2-y^2}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3} \eta + \right. \right.
\end{aligned}$$

$$\begin{aligned}
& + 4E_{xy,xy}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta + [E_{xy,xy}(\mathbf{T}_3) - \\
& - 2\sqrt{3}E_{xy,x^2-y^2}(\mathbf{T}_3) + 3E_{x^2-y^2,x^2-y^2}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3}\eta \Big) + \\
& + i \left( [E_{xy,xy}(\mathbf{T}_3) + 2\sqrt{3}E_{xy,x^2-y^2}(\mathbf{T}_3) + 3E_{x^2-y^2,x^2-y^2}(\mathbf{T}_3)] \times \right. \\
& \times \cos 3\xi \sin \frac{1}{3}\eta + 4E_{xy,xy}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta - [E_{xy,xy}(\mathbf{T}_3) - \\
& - 2\sqrt{3}E_{xy,x^2-y^2}(\mathbf{T}_3) + 3E_{x^2-y^2,x^2-y^2}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \Big) \Big\} \\
(xy/yx) \quad & \sqrt{3}[E_{yz,x^2-y^2}(\mathbf{T}_2) - E_{xy,xz}(\mathbf{T}_2)] \sin 2\xi \sin \zeta \left( \cos \frac{2}{3}\eta - \right. \\
& \left. - i \sin \frac{2}{3}\eta \right) - \sin \zeta \left\{ \left( [3E_{xz,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{yz,x^2-y^2}(\mathbf{T}_3) + \right. \right. \\
& + \sqrt{3}E_{xy,xz}(\mathbf{T}_3) - E_{xy,yz}(\mathbf{T}_3)] \sin 3\xi \cos \frac{1}{3}\eta + \\
& + 4E_{xy,yz}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3}\eta - [3E_{xz,x^2-y^2}(\mathbf{T}_3) + \\
& + \sqrt{3}E_{yz,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{xy,xz}(\mathbf{T}_3) - E_{xy,yz}(\mathbf{T}_3)] \times \\
& \times \sin \xi \cos \frac{5}{3}\eta \Big) + i \left( [3E_{xz,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{yz,x^2-y^2}(\mathbf{T}_3) + \right. \\
& + \sqrt{3}E_{xy,xz}(\mathbf{T}_3) - E_{xy,yz}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3}\eta + \\
& + 4E_{xy,yz}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + [3E_{xz,x^2-y^2}(\mathbf{T}_3) + \\
& + \sqrt{3}E_{yz,x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{xy,xz}(\mathbf{T}_3) - E_{xy,yz}(\mathbf{T}_3)] \times \\
& \times \sin \xi \sin \frac{5}{3}\eta \Big) \Big\} \\
(xy/xz) \quad & - \sin \zeta \left\{ \left( 2E_{xy,xz}(\mathbf{T}_2) \sin \frac{4}{3}\eta - [E_{xy,xz}(\mathbf{T}_2) + 3E_{yz,x^2-y^2}(\mathbf{T}_2)] \times \right. \right. \\
& \times \cos 2\xi \sin \frac{2}{3}\eta \Big) - i \left( 2E_{xy,xz}(\mathbf{T}_2) \cos \frac{4}{3}\eta + [E_{xz,xz}(\mathbf{T}_2) + \right. \\
& + 3E_{yz,x^2-y^2}(\mathbf{T}_2)] \cos 2\xi \cos \frac{2}{3}\eta \Big) \Big\} - \sin \zeta \times \\
& \times \left\{ \left( [\sqrt{3}E_{xz,x^2-y^2}(\mathbf{T}_3) + 3E_{yz,x^2-y^2}(\mathbf{T}_3) + E_{xy,xz}(\mathbf{T}_3) + \right. \right.
\end{aligned}$$

$$\begin{aligned}
& + \sqrt{3}E_{xy,yz}(T_3) \cos 3\xi \sin \frac{1}{3}\eta + 4E_{xy,xz}(T_3) \cos 2\xi \times \\
& \times \sin \frac{4}{3}\eta + [\sqrt{3}E_{xz,x^2-y^2}(T_3) - 3E_{yz,x^2-y^2}(T_3) - \\
& - E_{xy,xz}(T_3) + \sqrt{3}E_{xy,yz}(T_3)] \cos \xi \sin \frac{5}{3}\eta \Big) - \\
& - i \left( [\sqrt{3}E_{xz,x^2-y^2}(T_3) + 3E_{yz,x^2-y^2}(T_3) + E_{xy,xz}(T_3) + \right. \\
& + \sqrt{3}E_{xy,yz}(T_3) \cos 3\xi \cos \frac{1}{3}\eta + 4E_{xy,xz}(T_3) \cos 2\xi \times \\
& \times \cos \frac{4}{3}\eta - [\sqrt{3}E_{xz,x^2-y^2}(T_3) - 3E_{yz,x^2-y^2}(T_3) - \\
& - E_{xy,xz}(T_3) + \sqrt{3}E_{xy,yz}(T_3)] \cos \xi \cos \frac{5}{3}\eta \Big) \Big\} \\
(xy/x^2-y^2) & \sqrt{3}[E_{xy,xy}(T_2) - E_{x^2-y^2,x^2-y^2}(T_2)] \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + \right. \\
& + i \cos \frac{2}{3}\eta \Big) - \cos \zeta \left\{ \left( [\sqrt{3}E_{xy,xy}(T_3) + 2E_{xy,x^2-y^2}(T_3) - \right. \right. \\
& - \sqrt{3}E_{x^2-y^2,x^2-y^2}(T_3)] \sin 3\xi \sin \frac{1}{3}\eta + 4E_{xy,x^2-y^2}(T_3) \times \\
& \times \sin 2\xi \sin \frac{4}{3}\eta - [\sqrt{3}E_{xy,xy}(T_3) - 2E_{xy,x^2-y^2}(T_3) - \\
& - \sqrt{3}E_{x^2-y^2,x^2-y^2}(T_3)] \sin \xi \sin \frac{5}{3}\eta \Big) - i \left( [\sqrt{3}E_{xy,xy}(T_3) + \right. \\
& + 2E_{xy,x^2-y^2}(T_3) - \sqrt{3}E_{x^2-y^2,x^2-y^2}(T_3)] \sin 3\xi \cos \frac{1}{3}\eta + \\
& + 4E_{xy,x^2-y^2}(T_3) \sin 2\xi \cos \frac{4}{3}\eta + [\sqrt{3}E_{xy,xy}(T_3) - \\
& - 2E_{xy,x^2-y^2}(T_3) - \sqrt{3}E_{x^2-y^2,x^2-y^2}(T_3)] \sin \xi \cos \frac{5}{3}\eta \Big) \Big\} \\
(xy/3z^2-r^2) & 2\sqrt{3}E_{x^2-y^2,3z^2-r^2}(T_2) \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + i \cos \frac{2}{3}\eta \right) - \\
& - 2 \cos \zeta \left\{ \left( [E_{xy,3z^2-r^2}(T_3) + \sqrt{3}E_{x^2-y^2,3z^2-r^2}(T_3)] \times \right. \right.
\end{aligned}$$

$$\begin{aligned}
& \times \sin 3\xi \sin \frac{1}{3}\eta + 2E_{xy,3z^2-r^2}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta + [E_{xy,3z^2-r^2}(\mathbf{T}_3) - \\
& - \sqrt{3}E_{x^2-y^2,3z^2-r^2}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3}\eta \Big) - i \left( [E_{xy,3z^2-r^2}(\mathbf{T}_3) + \right. \\
& + \sqrt{3}E_{x^2-y^2,3z^2-r^2}(\mathbf{T}_2)] \sin 3\xi \cos \frac{1}{3}\eta + 2E_{xy,3z^2-r^2}(\mathbf{T}_3) \times \\
& \times \sin 2\xi \cos \frac{4}{3}\eta - [E_{zy,3z^2-r^2}(\mathbf{T}_3) - \sqrt{3}E_{x^2-y^2,3z^2-r^2}(\mathbf{T}_3)] \times \\
& \times \sin \xi \cos \frac{5}{3}\eta \Big) \Big\} \\
(yz|yz) & \cos \zeta \left\{ \left( 2E_{yz,yz}(\mathbf{T}_2) \cos \frac{4}{3}\eta + [E_{yz,yz}(\mathbf{T}_2) + 3E_{xz,xz}(\mathbf{T}_2)] \times \right. \right. \\
& \times \cos 2\xi \cos \frac{2}{3}\eta \Big) + i \left( 2E_{yz,yz}(\mathbf{T}_2) \cos \frac{4}{3}\eta - [E_{yz,yz}(\mathbf{T}_2) + \right. \\
& + 3E_{xz,xz}(\mathbf{T}_2)] \cos 2\xi \sin \frac{2}{3}\eta \Big) \Big\} + \cos \zeta \left\{ \left( [E_{yz,yz}(\mathbf{T}_3) - \right. \right. \\
& - 2\sqrt{3}E_{yz,xz}(\mathbf{T}_3) + 3E_{xz,xz}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3}\eta + \\
& + 4E_{yz,yz}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3}\eta + [E_{yz,yz}(\mathbf{T}_3) + 2\sqrt{3}E_{yz,xz}(\mathbf{T}_3) + \\
& + 3E_{xz,xz}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3}\eta \Big) + i \left( E_{yz,yz}(\mathbf{T}_3) - \right. \\
& - 2\sqrt{3}E_{yz,xz}(\mathbf{T}_3) + 3E_{xz,xz}(\mathbf{T}_3)] \cos 3\xi \sin \frac{1}{3}\eta + \\
& + 4E_{yz,yz}(\mathbf{T}_3) \cos 2\xi \sin \frac{4}{3}\eta - [E_{yz,yz}(\mathbf{T}_3) + 2\sqrt{3}E_{yz,xz}(\mathbf{T}_3) + \\
& + 3E_{xz,xz}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3}\eta \Big) \Big\} \\
(yz/xz) & \sqrt{3} [E_{xz,xz}(\mathbf{T}_2) - E_{yz,yz}(\mathbf{T}_2)] \sin 2\xi \cos \zeta \left( \sin \frac{2}{3}\eta + i \cos \frac{2}{3}\eta \right) - \\
& - \cos \zeta \left\{ \left( [\sqrt{3}E_{xz,xz}(\mathbf{T}_3) + 2E_{yz,xz}(\mathbf{T}_3) - \sqrt{3}E_{yz,yz}(\mathbf{T}_3)] \times \right. \right. \\
& \times \sin 3\xi \sin \frac{1}{3}\eta + 4E_{yz,xz}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3}\eta - \\
& - [\sqrt{3}E_{xz,xz}(\mathbf{T}_3) - 2E_{yz,xz}(\mathbf{T}_3) - \sqrt{3}E_{yz,yz}(\mathbf{T}_3)] \times
\end{aligned}$$

$$\begin{aligned}
& \times \sin \xi \sin \frac{5}{3} \eta \Big) - i \left( [\sqrt{3}E_{xz,xz}(T_3) + 2E_{yz,xz}(T_3) - \right. \\
& - \sqrt{3}E_{yz,yz}(T_3)] \sin 3\xi \cos \frac{1}{3} \eta + 4E_{yz,xz}(T_3) \sin 2\xi \times \\
& \times \cos \frac{4}{3} \eta + [\sqrt{3}E_{xz,xz}(T_3) - 2E_{yz,xz}(T_3) - \\
& \left. - \sqrt{3}E_{yz,yz}(T_3)] \sin \xi \cos \frac{5}{3} \eta \right\} \\
(yz/x^2 - y^2) & - \sin \zeta \left\{ \left( 2E_{yz, x^2-y^2}(T_2) \sin \frac{4}{3} \eta - [3E_{xy,xz}(T_2) + \right. \right. \\
& + E_{yz, x^2-y^2}(T_2)] \cos 2\xi \sin \frac{2}{3} \eta \Big) - i \left( 2E_{yz, x^2-y^2}(T_2) \times \right. \\
& \times \cos \frac{4}{3} \eta + [3E_{xy,xz}(T_2) + E_{yz, x-y^2}(T_3)] \cos 2\xi \times \\
& \left. \times \cos \frac{2}{3} \eta \right\} + \sin \zeta \left\{ \left( [\sqrt{3}E_{xz, x^2-y^2}(T_3) - 3E_{xy,xz}(T_3) - \right. \right. \\
& - E_{yz, x^2-y^2}(T_3) + \sqrt{3}E_{xy,yz}(T_3)] \cos 3\xi \sin \frac{1}{3} \eta - \\
& - 4E_{yz, x^2-y^2}(T_3) \cos 2\xi \sin \frac{4}{3} \eta + [\sqrt{3}E_{yz, x^2-y^2}(T_3) + \\
& + 3E_{xy,yz}(T_3) + E_{yz, x^2-y^2}(T_3) + \sqrt{3}E_{xy,yz}(T_3)] \times \\
& \times \cos \xi \sin \frac{5}{3} \eta \Big) - i \left( [\sqrt{3}E_{xz, x^2-z^2}(T_3) - 3E_{xy,xz}(T_3) - \right. \\
& - E_{yz, x^2-y^2}(T_3) + \sqrt{3}E_{xy,yz}(T_3)] \cos 3\xi \cos \frac{1}{3} \eta - \\
& - 4E_{yz, x^2-y^2}(T_3) \cos 2\xi \cos \frac{4}{3} \eta - \sqrt{3}E_{xz, x^2-y^2}(T_3) + \\
& + 3E_{xy,xz}(T_3) + E_{yz, x^2-y^2}(T_3) + \sqrt{3}E_{xy,yz}(T_3)] \times \cos \xi \cos \frac{5}{3} \eta \Big) \Big\} \\
(yz/3z^2 - r^2) & - 2E_{yz, 3z^2-r^2}(T_2) \sin \zeta \left[ \left( \sin \frac{4}{3} \eta + \cos 2\xi \sin \frac{2}{3} \eta \right) - \right. \\
& - i \left( \cos \frac{4}{3} \eta - \cos 2\xi \cos \frac{2}{3} \eta \right) \Big] - 2 \sin \zeta \left\{ \left( [\sqrt{3}E_{xz, 3z^2-r^2}(T_3) - \right. \right. \\
& - E_{yz, 3z^2-r^2}(T_3)] \cos 3\xi \sin \frac{1}{3} \eta + 2E_{yz, 3z^2-r^2}(T_3) \times \cos 2\xi \sin \frac{4}{3} \eta + 
\end{aligned}$$

$$\begin{aligned}
& + [\sqrt{3}E_{xz, 3z^2-r^2}(T_3) + E_{yz, 3z^2-r^2}(T_3)] \times \cos \xi \sin \frac{5}{3} \eta \Big) - \\
& - i \left\{ [\sqrt{3}E_{xz, 3z^2-r^2}(T_3) - E_{yz, 3z^2-r^2}(T_3)] \times \cos 3\xi \cos \frac{1}{3} \eta + \right. \\
& + 2E_{yz, 3z^2-r^2}(T_3) \cos 2\xi \cos \frac{4}{3} \eta - [\sqrt{3}E_{xz, 3z^2-r^2}(T_3) + \\
& + E_{yz, 3z^2-r^2}(T_3)] \cos \xi \cos \frac{5}{3} \eta \Big\} \\
(xz/xz) & \cos \zeta \left\{ \left( 2E_{xz, xz}(T_2) \cos \frac{3}{4} \eta + [E_{xz, xz}(T_2) + 3E_{yz, yz}(T_2)] \times \right. \right. \\
& \times \cos 2\xi \cos \frac{2}{3} \eta \Big) + i \left( 2E_{xz, xz}(T_2) \sin \frac{4}{3} \eta - [E_{xz, xz}(T_2) + \right. \\
& \left. \left. + 3E_{yz, yz}(T_2)] \cos 2\xi \sin \frac{2}{3} \eta \right) \right\} + \cos \zeta \left\{ \left( [E_{xz, xz}(T_3) + \right. \right. \\
& + 2\sqrt{3}E(T_3) + 3E_{yz, yz}(T_3)] \cos 3\xi \cos \frac{1}{3} \eta + \\
& \left. \left. + 4E_{xz, xz}(T_3) \cos 2\xi \cos \frac{4}{3} \eta + [E_{xz, xz}(T_3) - \right. \right. \\
& - 2\sqrt{3}E_{yz, xz}(T_3) + 3E_{yz, yz}(T_3)] \cos \xi \cos \frac{5}{3} \eta \Big) + \\
& + i \left( [E_{xz, xz}(T_3) + 2\sqrt{3}E_{yz, xz}(T_3) + 3E_{yz, yz}(T_3)] \times \right. \\
& \times \cos 3\xi \sin \frac{1}{3} \eta + 4E_{xz, xz}(T_3) \cos 2\xi \sin \frac{4}{3} \eta - \\
& \left. \left. - [E_{xz, xz}(T_3) - 2\sqrt{3}E_{yz, xz}(T_3) + 3E_{yz, yz}(T_3)] \times \cos \xi \sin \frac{5}{3} \eta \right) \right\} \\
(xz/x^2-y^2) & \sqrt{3}E_{yz, x^2-y^2}(T_2) - E_{xy, xz}(T_2)] \sin 2\xi \sin \zeta \left( \cos \frac{2}{3} \eta - \right. \\
& \left. - i \sin \frac{2}{3} \eta \right) + \sin \zeta \left\{ \left( [E_{xz, x^2-y^2}(T_3) - \sqrt{3}E_{xy, xz}(T_3) + \right. \right. \\
& + \sqrt{3}E_{yz, x^2-y^2}(T_3) - 3E_{xy, yz}(T_3)] \sin 3\xi \cos \frac{1}{3} \eta - \\
& \left. \left. - 4E_{xz, x^2-y^2}(T_3) \sin 2\xi \cos \frac{4}{3} \eta - [E_{xz, x^2-y^2}(T_3) + \right. \right. \\
& + \sqrt{3}E_{xy, xz}(T_3) - \sqrt{3}E_{yz, x^2-y^2}(T_3) - 3E_{xy, yz}(T_3)] \times
\end{aligned}$$

$$\begin{aligned}
& \times \sin \xi \cos \frac{5}{3} \eta \Big) + i \left( [E_{xz, x^2-y^2}(\mathbf{T}_3) - \sqrt{3}E_{xy, xz}(\mathbf{T}_3) + \right. \\
& + \sqrt{3}E_{yz, x^2-y^2}(\mathbf{T}_3) - 3E_{xy, yz}(\mathbf{T}_3)] \sin 3\xi \sin \frac{1}{3} \eta - \\
& - 4E_{xz, x^2-y^2}(\mathbf{T}_3)] \sin 2\xi \sin \frac{4}{3} \eta + [E_{xz, x^2-y^2}(\mathbf{T}_3) + \\
& + \sqrt{3}E_{xy, xz}(\mathbf{T}_3) - \sqrt{3}E_{yz, x^2-y^2}(\mathbf{T}_3) - 3E_{xy, yz}(\mathbf{T}_3)] \times \sin \xi \sin \frac{5}{3} \eta \Big) \Big\} \\
(xz/3z^2-r^2) & - 2\sqrt{3}E_{yz, 3z^2-r^2}(\mathbf{T}_2) \sin 2\xi \sin \zeta \left( \cos \frac{2}{3} \eta - i \sin \frac{2}{3} \eta \right) - \\
& - 2 \sin \zeta \left\{ \left( [E_{xz, 3z^2-r^2}(\mathbf{T}_3) + \sqrt{3}E_{yz, 3z^2-r^2}(\mathbf{T}_3)] \times \right. \right. \\
& \times \sin 3\xi \cos \frac{1}{3} \eta + 2E_{xz, 3z^2-r^2}(\mathbf{T}_3) \sin 2\xi \cos \frac{4}{3} \eta - \\
& - [E_{xz, 3z^2-r^2}(\mathbf{T}_3) - \sqrt{3}E_{yz, 3z^2-r^2}(\mathbf{T}_3)] \sin \xi \cos \frac{5}{3} \eta \Big) + \\
& + i \left( [E_{xz, 3z^2-r^2}(\mathbf{T}_3) + \sqrt{3}E_{yz, 3z^2-r^2}(\mathbf{T}_3)] \sin 3\xi \times \sin \frac{1}{3} \eta + \right. \\
& + 2E_{xz, 3z^2-r^2}(\mathbf{T}_3) \sin 2\xi \sin \frac{4}{3} \eta + [E_{xz, 3z^2-r^2}(\mathbf{T}_3) - \\
& - \sqrt{3}E_{yz, 3z^2-r^2}(\mathbf{T}_3)] \sin \xi \sin \frac{5}{3} \eta \Big) \Big\} \\
(x^2-y^2/x^2-y^2) & \cos \zeta \left\{ \left( 2E_{x^2-y^2, x^2-y^2}(\mathbf{T}_2) \cos \frac{4}{3} \eta + [E_{x^2-y^2, x^2-y^2}(\mathbf{T}_2) + \right. \right. \\
& + 3E_{xy, xy}(\mathbf{T}_2)] \cos 2\xi \cos \frac{2}{3} \eta \Big) + i \left( 2E_{x^2-y^2, x^2-y^2}(\mathbf{T}_2) \times \right. \\
& \times \sin \frac{4}{3} \eta - [E_{x^2-y^2, x^2-y^2}(\mathbf{T}_2) + 3E_{xy, xz}(\mathbf{T}_2)] \cos 2\xi \times \sin \frac{2}{3} \eta \Big) \Big\} + \\
& + \cos \zeta \left\{ \left( [E_{x^2-y^2, x^2-y^2}(\mathbf{T}_3) - 2\sqrt{3}E_{xy, z^2-r^2}(\mathbf{T}_3) + \right. \right. \\
& + 3E_{xy, xy}(\mathbf{T}_3)] \cos 3\xi \cos \frac{1}{3} \eta + 4E_{x^2-y^2, x^2-y^2}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3} \eta + \\
& + [E_{x^2-y^2, x^2-y^2}(\mathbf{T}_3) + 2\sqrt{3}E_{xy, x^2-y^2}(\mathbf{T}_3) + 3E_{xy, xy}(\mathbf{T}_3)] \cos \xi \cos \frac{5}{3} \eta \Big) + \\
& + i \left( [E_{x^2-y^2, x^2-y^2}(\mathbf{T}_3) - 2\sqrt{3}E_{xy, x^2-y^2}(\mathbf{T}_3) + \right.
\end{aligned}$$

$$\begin{aligned}
 & + 3E_{xy, xy}(\mathbf{T}_3) \cos 3\xi \sin \frac{1}{3} \eta + 4E_{x^2-y^2, x^2-y^2}(\mathbf{T}_3) \times \\
 & \times \cos 2\xi \sin \frac{4}{3} \eta - [E_{x^2-y^2, x^2-y^2}(\mathbf{T}_3) + 2\sqrt{3}E_{xy, x^2-y^2}(\mathbf{T}_3) + \\
 & + 3E_{xy, xy}(\mathbf{T}_3) \cos \xi \sin \frac{5}{3} \eta] \Big\} \\
 (x^2-y^2/3z^2-r^2) & 2E_{x^2-y^2, 3z^2-r^2}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3} \eta - \cos 2\xi \cos \frac{2}{3} \eta \right) + \right. \\
 & + i \left( \sin \frac{4}{3} \eta + \cos 2\xi \sin \frac{2}{3} \eta \right) \Big] + 2 \cos \zeta \times \\
 & \times \left\{ \left( [\sqrt{3}E_{xy, 3z^2-r^2}(\mathbf{T}_3) - F_{x^2-y^2, 3z^2-r^2}(\mathbf{T}_3)] \times \cos 3\xi \cos \frac{1}{3} \eta + \right. \right. \\
 & + 2E_{x^2-y^2, 3z^2-r^2}(\mathbf{T}_3) \cos 2\xi \cos \frac{4}{3} \eta - [\sqrt{3}E_{xy, 3z^2-r^2}(\mathbf{T}_3) + \\
 & + E_{x^2-y^2, 3z^2-r^2}(\mathbf{T}_3)] \cos \xi \times \cos \frac{5}{3} \eta \Big) + i \left( [\sqrt{3}E_{xy, 3z^2-r^2}(\mathbf{T}_3) - \right. \\
 & - E_{x^2-y^2, 3z^2-r^2}(\mathbf{T}_3)] \cos 3\xi \sin \frac{1}{3} \eta + 2E_{x^2-y^2, 3z^2-r^2}(\mathbf{T}_3) \times \\
 & \times \cos 2\xi \sin \frac{4}{3} \eta + [\sqrt{3}E_{xy, 3z^2-r^2}(\mathbf{T}_3) + E_{x^2-y^2, 3z^2-r^2}(\mathbf{T}_3)] \cos \xi \sin \frac{5}{3} \eta \Big) \Big\} \\
 (3z^2-r^2/3z^2-r^2) & 2E_{3z^2-r^2, 3z^2-r^2}(\mathbf{T}_2) \cos \zeta \left[ \left( \cos \frac{4}{3} \eta + 2 \cos 2\xi \cos \frac{2}{3} \eta \right) + \right. \\
 & + i \left( \sin \frac{4}{3} \eta - 2 \cos 2\xi \sin \frac{2}{3} \eta \right) \Big] + 4E_{3z^2-r^2, 3z^2-r^2}(\mathbf{T}_3) \times \\
 & \times \cos \zeta \left[ \left( \cos 3\xi \cos \frac{1}{3} \eta + \cos 2\xi \cos \frac{4}{3} \eta + \cos \xi \cos \frac{5}{3} \eta \right) + \right. \\
 & + i \left( \cos 3\xi \sin \frac{1}{3} \eta + \cos 2\xi \sin \frac{4}{3} \eta - \cos \xi \sin \frac{5}{3} \eta \right) \Big]
 \end{aligned}$$

## КРАТКОЕ СОДЕРЖАНИЕ

М. Мионсек. Применение метода тесной связи для исследования свойств симметрии энергетических полос в компактной гексагональной структуре

В настоящей работе даны те выражения в матричных составных энергии для текзагональных, плотно упакованных, кристаллических сетей, которые содержат интегралы Е для соседних атомов от второго до четвёртого.

## REFERENCES

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