

SAMB for “GaAs”

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- Group: No. 216 T_d^2 $F-43m$ [cubic]
 - Associated point group: No. 31 T_d $-43m$ [cubic]
 - Generation condition
 - model type: **tight_binding**
 - time-reversal type: **electric**
 - irrep: [A1]
 - spinless
-

- Unit cell:
 $a = 1.0$, $b = 1.0$, $c = 1.0$, $\alpha = 90.0$, $\beta = 90.0$, $\gamma = 90.0$
- Lattice vectors:
 $\mathbf{a}_1 = (1.0 \ 0 \ 0)$
 $\mathbf{a}_2 = (0 \ 1.0 \ 0)$
 $\mathbf{a}_3 = (0 \ 0 \ 1.0)$
- Plus sets:
 $+(0 \ 0 \ 0)$
 $+(0 \ \frac{1}{2} \ \frac{1}{2})$
 $+(\frac{1}{2} \ 0 \ \frac{1}{2})$
 $+(\frac{1}{2} \ \frac{1}{2} \ 0)$

Table 1: High-symmetry line: Γ -X.

symbol	position	symbol	position
Γ	$(0 \ 0 \ 0)$	X	$(\frac{1}{2} \ 0 \ 0)$

- Kets: dimension = 6

Table 2: Hilbert space for full matrix.

No.	ket	No.	ket	No.	ket	No.	ket	No.	ket
1	$p_x @ \text{Ga}_1$	2	$p_y @ \text{Ga}_1$	3	$p_z @ \text{Ga}_1$	4	$p_x @ \text{As}_1$	5	$p_y @ \text{As}_1$
6	$p_z @ \text{As}_1$								

- Sites in (primitive) unit cell:

Table 3: Site-clusters.

site	position	mapping
S ₁ Ga ₁	$\begin{pmatrix} 0 & 0 & 0 \end{pmatrix}$	[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24]
S ₂ As ₁	$\begin{pmatrix} \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \end{pmatrix}$	[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24]

- Bonds in (primitive) unit cell:

Table 4: Bond-clusters.

bond	tail	head	n	#	$\mathbf{b@c}$	mapping	
B ₁	b ₁	As ₁	Ga ₁	1	1	$\begin{pmatrix} \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \end{pmatrix} @ \begin{pmatrix} \frac{1}{8} & \frac{1}{8} & \frac{1}{8} \end{pmatrix}$	[1,5,9,16,17,18]
	b ₂	As ₁	Ga ₁	1	1	$\begin{pmatrix} -\frac{1}{4} & -\frac{1}{4} & \frac{1}{4} \end{pmatrix} @ \begin{pmatrix} \frac{3}{8} & \frac{3}{8} & \frac{1}{8} \end{pmatrix}$	[2,6,11,13,21,23]
	b ₃	As ₁	Ga ₁	1	1	$\begin{pmatrix} \frac{1}{4} & -\frac{1}{4} & -\frac{1}{4} \end{pmatrix} @ \begin{pmatrix} \frac{1}{8} & \frac{3}{8} & \frac{3}{8} \end{pmatrix}$	[3,7,12,15,19,24]
	b ₄	As ₁	Ga ₁	1	1	$\begin{pmatrix} -\frac{1}{4} & \frac{1}{4} & -\frac{1}{4} \end{pmatrix} @ \begin{pmatrix} \frac{3}{8} & \frac{1}{8} & \frac{3}{8} \end{pmatrix}$	[4,8,10,14,20,22]

- SAMB:

$$\boxed{\text{No. 1}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\mathbf{M}_1, \mathbf{S}_1]$$

$$\hat{\mathbb{Z}}_1 = \mathbb{X}_1[\mathbb{Q}_0^{(a, A_1)}] \otimes \mathbb{Y}_1[\mathbb{Q}_0^{(s, A_1)}]$$

$$\hat{\mathbb{Z}}_1(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a, A_1)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s, A_1)}]$$

$$\boxed{\text{No. 2}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\mathbf{M}_1, \mathbf{S}_2]$$

$$\hat{\mathbb{Z}}_2 = \mathbb{X}_1[\mathbb{Q}_0^{(a, A_1)}] \otimes \mathbb{Y}_2[\mathbb{Q}_0^{(s, A_1)}]$$

$$\hat{\mathbb{Z}}_2(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a, A_1)}] \otimes \mathbb{U}_2[\mathbb{Q}_0^{(s, A_1)}]$$

$$\boxed{\text{No. 3}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\mathbf{M}_1, \mathbf{B}_1]$$

$$\hat{\mathbb{Z}}_3 = \mathbb{X}_1[\mathbb{Q}_0^{(a, A_1)}] \otimes \mathbb{Y}_3[\mathbb{Q}_0^{(b, A_1)}]$$

$$\hat{\mathbb{Z}}_3(\mathbf{k}) = \frac{\sqrt{2}\mathbb{X}_1[\mathbb{Q}_0^{(a, A_1)}] \otimes \mathbb{U}_3[\mathbb{Q}_0^{(u, A_1)}] \otimes \mathbb{F}_1[\mathbb{Q}_0^{(k, A_1)}]}{2} - \frac{\sqrt{2}\mathbb{X}_1[\mathbb{Q}_0^{(a, A_1)}] \otimes \mathbb{U}_4[\mathbb{T}_0^{(u, A_1)}] \otimes \mathbb{F}_5[\mathbb{T}_0^{(k, A_1)}]}{2}$$

$$\boxed{\text{No. 4}} \quad \hat{\mathbb{Q}}_3^{(A_1)} [\mathbf{M}_1, \mathbf{B}_1]$$

$$\hat{\mathbb{Z}}_4 = \frac{\sqrt{3}\mathbb{X}_2[\mathbb{Q}_{2,0}^{(a, T_2)}] \otimes \mathbb{Y}_4[\mathbb{Q}_{1,0}^{(b, T_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_3[\mathbb{Q}_{2,1}^{(a, T_2)}] \otimes \mathbb{Y}_5[\mathbb{Q}_{1,1}^{(b, T_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_4[\mathbb{Q}_{2,2}^{(a, T_2)}] \otimes \mathbb{Y}_6[\mathbb{Q}_{1,2}^{(b, T_2)}]}{3}$$

$$\begin{aligned} \hat{\mathbb{Z}}_4(\mathbf{k}) = & \frac{\sqrt{6}\mathbb{X}_2[\mathbb{Q}_{2,0}^{(a, T_2)}] \otimes \mathbb{U}_3[\mathbb{Q}_0^{(u, A_1)}] \otimes \mathbb{F}_2[\mathbb{Q}_{1,0}^{(k, T_2)}]}{6} - \frac{\sqrt{6}\mathbb{X}_2[\mathbb{Q}_{2,0}^{(a, T_2)}] \otimes \mathbb{U}_4[\mathbb{T}_0^{(u, A_1)}] \otimes \mathbb{F}_6[\mathbb{T}_{1,0}^{(k, T_2)}]}{6} + \frac{\sqrt{6}\mathbb{X}_3[\mathbb{Q}_{2,1}^{(a, T_2)}] \otimes \mathbb{U}_3[\mathbb{Q}_0^{(u, A_1)}] \otimes \mathbb{F}_3[\mathbb{Q}_{1,1}^{(k, T_2)}]}{6} \\ & - \frac{\sqrt{6}\mathbb{X}_3[\mathbb{Q}_{2,1}^{(a, T_2)}] \otimes \mathbb{U}_4[\mathbb{T}_0^{(u, A_1)}] \otimes \mathbb{F}_7[\mathbb{T}_{1,1}^{(k, T_2)}]}{6} + \frac{\sqrt{6}\mathbb{X}_4[\mathbb{Q}_{2,2}^{(a, T_2)}] \otimes \mathbb{U}_3[\mathbb{Q}_0^{(u, A_1)}] \otimes \mathbb{F}_4[\mathbb{Q}_{1,2}^{(k, T_2)}]}{6} - \frac{\sqrt{6}\mathbb{X}_4[\mathbb{Q}_{2,2}^{(a, T_2)}] \otimes \mathbb{U}_4[\mathbb{T}_0^{(u, A_1)}] \otimes \mathbb{F}_8[\mathbb{T}_{1,2}^{(k, T_2)}]}{6} \end{aligned}$$

Table 5: Atomic SAMB group.

group	bra	ket
M_1	p_x, p_y, p_z	p_x, p_y, p_z

Table 6: Atomic SAMB.

symbol	type	group	form
X_1	$Q_0^{(a,A_1)}$	M_1	$\begin{pmatrix} \frac{\sqrt{3}}{3} & 0 & 0 \\ 0 & \frac{\sqrt{3}}{3} & 0 \\ 0 & 0 & \frac{\sqrt{3}}{3} \end{pmatrix}$
X_2	$Q_{2,0}^{(a,T_2)}$	M_1	$\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{2}}{2} \\ 0 & \frac{\sqrt{2}}{2} & 0 \end{pmatrix}$
X_3	$Q_{2,1}^{(a,T_2)}$	M_1	$\begin{pmatrix} 0 & 0 & \frac{\sqrt{2}}{2} \\ 0 & 0 & 0 \\ \frac{\sqrt{2}}{2} & 0 & 0 \end{pmatrix}$
X_4	$Q_{2,2}^{(a,T_2)}$	M_1	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{2} & 0 \\ \frac{\sqrt{2}}{2} & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

Table 7: Cluster SAMB.

symbol	type	cluster	form
Y_1	$Q_0^{(s,A_1)}$	S_1	$\begin{pmatrix} 1 \end{pmatrix}$
Y_2	$Q_0^{(s,A_1)}$	S_2	$\begin{pmatrix} 1 \end{pmatrix}$
Y_3	$Q_0^{(b,A_1)}$	B_1	$\begin{pmatrix} \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{pmatrix}$
Y_4	$Q_{1,0}^{(b,T_2)}$	B_1	$\begin{pmatrix} \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} & -\frac{1}{2} \end{pmatrix}$

continued ...

Table 7

symbol	type	cluster	form
\mathbb{Y}_5	$\mathbb{Q}_{1,1}^{(b,T_2)}$	B_1	$\begin{pmatrix} \frac{1}{2} & -\frac{1}{2} & -\frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & -\frac{1}{2} & -\frac{1}{2} \end{pmatrix}$
\mathbb{Y}_6	$\mathbb{Q}_{1,2}^{(b,T_2)}$	B_1	

Table 8: Uniform SAMB.

symbol	type	cluster	form
\mathbb{U}_1	$\mathbb{Q}_0^{(s,A_1)}$	S_1	$\begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}$
\mathbb{U}_2	$\mathbb{Q}_0^{(s,A_1)}$	S_2	$\begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}$
\mathbb{U}_3	$\mathbb{Q}_0^{(u,A_1)}$	B_1	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & 0 \end{pmatrix}$
\mathbb{U}_4	$\mathbb{T}_0^{(u,A_1)}$	B_1	$\begin{pmatrix} 0 & -\frac{\sqrt{2}i}{2} \\ \frac{\sqrt{2}i}{2} & 0 \end{pmatrix}$

Table 9: Structure SAMB.

symbol	type	cluster	form
\mathbb{F}_1	$\mathbb{Q}_0^{(k,A_1)}$	B_1	$\frac{\sqrt{2}c_{001}}{2} + \frac{\sqrt{2}c_{002}}{2} + \frac{\sqrt{2}c_{003}}{2} + \frac{\sqrt{2}c_{004}}{2}$
\mathbb{F}_2	$\mathbb{Q}_{1,0}^{(k,T_2)}$	B_1	$\frac{\sqrt{2}c_{001}}{2} - \frac{\sqrt{2}c_{002}}{2} + \frac{\sqrt{2}c_{003}}{2} - \frac{\sqrt{2}c_{004}}{2}$
\mathbb{F}_3	$\mathbb{Q}_{1,1}^{(k,T_2)}$	B_1	$\frac{\sqrt{2}c_{001}}{2} - \frac{\sqrt{2}c_{002}}{2} - \frac{\sqrt{2}c_{003}}{2} + \frac{\sqrt{2}c_{004}}{2}$
\mathbb{F}_4	$\mathbb{Q}_{1,2}^{(k,T_2)}$	B_1	$\frac{\sqrt{2}c_{001}}{2} + \frac{\sqrt{2}c_{002}}{2} - \frac{\sqrt{2}c_{003}}{2} - \frac{\sqrt{2}c_{004}}{2}$
\mathbb{F}_5	$\mathbb{T}_0^{(k,A_1)}$	B_1	$\frac{\sqrt{2}s_{001}}{2} + \frac{\sqrt{2}s_{002}}{2} + \frac{\sqrt{2}s_{003}}{2} + \frac{\sqrt{2}s_{004}}{2}$
\mathbb{F}_6	$\mathbb{T}_{1,0}^{(k,T_2)}$	B_1	$\frac{\sqrt{2}s_{001}}{2} - \frac{\sqrt{2}s_{002}}{2} + \frac{\sqrt{2}s_{003}}{2} - \frac{\sqrt{2}s_{004}}{2}$
\mathbb{F}_7	$\mathbb{T}_{1,1}^{(k,T_2)}$	B_1	$\frac{\sqrt{2}s_{001}}{2} - \frac{\sqrt{2}s_{002}}{2} - \frac{\sqrt{2}s_{003}}{2} + \frac{\sqrt{2}s_{004}}{2}$

continued ...

Table 9

symbol	type	cluster	form
\mathbb{F}_8	$T_{1,2}^{(k,T_2)}$	B_1	$\frac{\sqrt{2}s_{001}}{2} + \frac{\sqrt{2}s_{002}}{2} - \frac{\sqrt{2}s_{003}}{2} - \frac{\sqrt{2}s_{004}}{2}$

Table 10: Polar harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$Q_0^{(A_1)}$	0	A_1	—	—	1
2	$Q_{1,0}^{(T_2)}$	1	T_2	—	0	x
3	$Q_{1,1}^{(T_2)}$	1	T_2	—	1	y
4	$Q_{1,2}^{(T_2)}$	1	T_2	—	2	z
5	$Q_{2,0}^{(T_2)}$	2	T_2	—	0	$\sqrt{3}yz$
6	$Q_{2,1}^{(T_2)}$	2	T_2	—	1	$\sqrt{3}xz$
7	$Q_{2,2}^{(T_2)}$	2	T_2	—	2	$\sqrt{3}xy$

- Group info.: Generator = $\{2_{001}|0\}$, $\{2_{010}|0\}$, $\{3_{111}^+|0\}$, $\{m_{1-10}|0\}$

Table 11: Conjugacy class (point-group part).

rep. SO	symmetry operations
$\{1 0\}$	$\{1 0\}$
$\{2_{001} 0\}$	$\{2_{001} 0\}$, $\{2_{100} 0\}$, $\{2_{010} 0\}$
$\{3_{111}^+ 0\}$	$\{3_{111}^+ 0\}$, $\{3_{1-1-1}^+ 0\}$, $\{3_{-11-1}^+ 0\}$, $\{3_{-1-11}^+ 0\}$, $\{3_{-111}^- 0\}$, $\{3_{1-1-1}^- 0\}$, $\{3_{-11-1}^- 0\}$, $\{3_{-1-11}^- 0\}$
$\{m_{110} 0\}$	$\{m_{110} 0\}$, $\{m_{101} 0\}$, $\{m_{011} 0\}$, $\{m_{1-10} 0\}$, $\{m_{-101} 0\}$, $\{m_{01-1} 0\}$
$\{-4_{001}^+ 0\}$	$\{-4_{001}^+ 0\}$, $\{-4_{100}^+ 0\}$, $\{-4_{010}^+ 0\}$, $\{-4_{-001}^- 0\}$, $\{-4_{-100}^- 0\}$, $\{-4_{-010}^- 0\}$

Table 12: Symmetry operations.

No.	SO	No.	SO	No.	SO	No.	SO	No.	SO
1	$\{1 0\}$	2	$\{2_{001} 0\}$	3	$\{2_{100} 0\}$	4	$\{2_{010} 0\}$	5	$\{3_{111}^+ 0\}$
6	$\{3_{1-1-1}^+ 0\}$	7	$\{3_{-11-1}^+ 0\}$	8	$\{3_{-1-11}^+ 0\}$	9	$\{3_{111}^- 0\}$	10	$\{3_{1-1-1}^- 0\}$
11	$\{3_{-11-1}^- 0\}$	12	$\{3_{-1-11}^- 0\}$	13	$\{m_{110} 0\}$	14	$\{m_{101} 0\}$	15	$\{m_{011} 0\}$
16	$\{m_{1-10} 0\}$	17	$\{m_{-101} 0\}$	18	$\{m_{01-1} 0\}$	19	$\{-4_{001}^+ 0\}$	20	$\{-4_{100}^+ 0\}$
21	$\{-4_{010}^+ 0\}$	22	$\{-4_{001}^- 0\}$	23	$\{-4_{100}^- 0\}$	24	$\{-4_{010}^- 0\}$		

Table 13: Character table (point-group part).

	1	2_{001}	3_{111}^+	m_{110}	-4_{001}^+
A_1	1	1	1	1	1
A_2	1	1	1	-1	-1
E	2	2	-1	0	0
T_1	3	-1	0	-1	1
T_2	3	-1	0	1	-1

Table 14: Parity conversion.

\leftrightarrow	\leftrightarrow	\leftrightarrow	\leftrightarrow	\leftrightarrow
$A_1 (A_2)$	$A_2 (A_1)$	$E (E)$	$T_1 (T_2)$	$T_2 (T_1)$

Table 15: Symmetric product, $[\Gamma \otimes \Gamma']_+$.

	A_1	A_2	E	T_1	T_2
A_1	A_1	A_2	E	T_1	T_2
A_2		A_1	E	T_2	T_1
E			$A_1 + E$	$T_1 + T_2$	$T_1 + T_2$

continued ...

Table 15

	A_1	A_2	E	T_1	T_2
T_1				$A_1 + E + T_2$	$A_2 + E + T_1 + T_2$
T_2				$A_1 + E + T_2$	

Table 16: Anti-symmetric product, $[\Gamma \otimes \Gamma]_-$.

A_1	A_2	E	T_1	T_2
$-$	$-$	A_2	T_1	T_1

Table 17: Virtual-cluster sites.

No.	position	No.	position	No.	position	No.	position
1	$\begin{pmatrix} 2 & 1 & 0 \end{pmatrix}$	2	$\begin{pmatrix} -2 & -1 & 0 \end{pmatrix}$	3	$\begin{pmatrix} 2 & -1 & 0 \end{pmatrix}$	4	$\begin{pmatrix} -2 & 1 & 0 \end{pmatrix}$
5	$\begin{pmatrix} 0 & 2 & 1 \end{pmatrix}$	6	$\begin{pmatrix} 0 & -2 & 1 \end{pmatrix}$	7	$\begin{pmatrix} 0 & -2 & -1 \end{pmatrix}$	8	$\begin{pmatrix} 0 & 2 & -1 \end{pmatrix}$
9	$\begin{pmatrix} 1 & 0 & 2 \end{pmatrix}$	10	$\begin{pmatrix} -1 & 0 & -2 \end{pmatrix}$	11	$\begin{pmatrix} -1 & 0 & 2 \end{pmatrix}$	12	$\begin{pmatrix} 1 & 0 & -2 \end{pmatrix}$
13	$\begin{pmatrix} -1 & -2 & 0 \end{pmatrix}$	14	$\begin{pmatrix} 0 & 1 & -2 \end{pmatrix}$	15	$\begin{pmatrix} 2 & 0 & -1 \end{pmatrix}$	16	$\begin{pmatrix} 1 & 2 & 0 \end{pmatrix}$
17	$\begin{pmatrix} 0 & 1 & 2 \end{pmatrix}$	18	$\begin{pmatrix} 2 & 0 & 1 \end{pmatrix}$	19	$\begin{pmatrix} 1 & -2 & 0 \end{pmatrix}$	20	$\begin{pmatrix} -2 & 0 & -1 \end{pmatrix}$
21	$\begin{pmatrix} 0 & -1 & 2 \end{pmatrix}$	22	$\begin{pmatrix} -1 & 2 & 0 \end{pmatrix}$	23	$\begin{pmatrix} -2 & 0 & 1 \end{pmatrix}$	24	$\begin{pmatrix} 0 & -1 & -2 \end{pmatrix}$

Table 18: Virtual-cluster basis.

symbol	1	2	3	4	5	6	7	8	9	10
$\mathbb{Q}_0^{(A_1)}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$

continued ...

Table 18

symbol	1	2	3	4	5	6	7	8	9	10
	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$
	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$						
$\mathbb{Q}_{1,0}^{(T_2)}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	0	0	0	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$
	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$
	0	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	0						
$\mathbb{Q}_{1,1}^{(T_2)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	0	0
	0	0	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{10}$	0
	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{20}$						
$\mathbb{Q}_{1,2}^{(T_2)}$	0	0	0	0	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$
	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{20}$
	$\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$						
$\mathbb{Q}_{2,0}^{(E)}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$-\frac{\sqrt{39}}{78}$	$-\frac{\sqrt{39}}{78}$	$-\frac{\sqrt{39}}{78}$	$\frac{7\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$
	$\frac{7\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$-\frac{5\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$
	$\frac{7\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$\frac{7\sqrt{39}}{156}$						
$\mathbb{Q}_{2,1}^{(E)}$	$\frac{3\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{13}$	$-\frac{\sqrt{13}}{13}$	$-\frac{\sqrt{13}}{13}$	$-\frac{\sqrt{13}}{13}$	$\frac{\sqrt{13}}{52}$	$\frac{\sqrt{13}}{52}$
	$\frac{\sqrt{13}}{52}$	$\frac{\sqrt{13}}{52}$	$-\frac{3\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{52}$	$\frac{\sqrt{13}}{13}$	$-\frac{3\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{52}$	$\frac{\sqrt{13}}{13}$	$-\frac{3\sqrt{13}}{52}$	$\frac{\sqrt{13}}{13}$
	$-\frac{\sqrt{13}}{52}$	$-\frac{3\sqrt{13}}{52}$	$\frac{\sqrt{13}}{13}$	$-\frac{\sqrt{13}}{52}$						
$\mathbb{Q}_{2,0}^{(T_2)}$	0	0	0	0	$\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	$\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	0	0
	0	0	0	$-\frac{\sqrt{2}}{4}$	0	0	$\frac{\sqrt{2}}{4}$	0	0	0
	$-\frac{\sqrt{2}}{4}$	0	0	$\frac{\sqrt{2}}{4}$						
$\mathbb{Q}_{2,1}^{(T_2)}$	0	0	0	0	0	0	0	0	$\frac{\sqrt{2}}{4}$	$\frac{\sqrt{2}}{4}$
	$-\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	0	0	$-\frac{\sqrt{2}}{4}$	0	0	$\frac{\sqrt{2}}{4}$	0	$\frac{\sqrt{2}}{4}$
	0	0	$-\frac{\sqrt{2}}{4}$	0						
$\mathbb{Q}_{2,2}^{(T_2)}$	$\frac{\sqrt{2}}{4}$	$\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	0	0	0	0	0	0
	0	0	$\frac{\sqrt{2}}{4}$	0	0	$\frac{\sqrt{2}}{4}$	0	0	$-\frac{\sqrt{2}}{4}$	0
	0	$-\frac{\sqrt{2}}{4}$	0	0						
$\mathbb{Q}_{3,0}^{(T_1)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	0	0	0	0	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$
	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$
	0	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	0						

continued ...

Table 18

symbol	1	2	3	4	5	6	7	8	9	10
$\mathbb{Q}_{3,1}^{(T_1)}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	0	0
	0	0	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{20}$	0
	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{10}$						
$\mathbb{Q}_{3,2}^{(T_1)}$	0	0	0	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$
	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{10}$
	$-\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$						
$\mathbb{Q}_{3,0}^{(T_2)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	0	0	0	0	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$
	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$
	0	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	0						
$\mathbb{Q}_{3,1}^{(T_2)}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	0	0
	0	0	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{20}$	0
	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{10}$						
$\mathbb{Q}_{3,2}^{(T_2)}$	0	0	0	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$
	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{10}$
	$\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$						
$\mathbb{Q}_{4,0}^{(E)}$	$\frac{3\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{13}$	$-\frac{\sqrt{13}}{13}$	$-\frac{\sqrt{13}}{13}$	$-\frac{\sqrt{13}}{13}$	$\frac{\sqrt{13}}{52}$	$\frac{\sqrt{13}}{52}$
	$\frac{\sqrt{13}}{52}$	$\frac{\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$\frac{\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{13}$	$\frac{3\sqrt{13}}{52}$	$\frac{\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{13}$	$\frac{3\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{13}$
	$\frac{\sqrt{13}}{52}$	$\frac{3\sqrt{13}}{52}$	$-\frac{\sqrt{13}}{13}$	$\frac{\sqrt{13}}{52}$						
$\mathbb{Q}_{4,1}^{(E)}$	$\frac{5\sqrt{39}}{156}$	$\frac{5\sqrt{39}}{156}$	$\frac{5\sqrt{39}}{156}$	$\frac{5\sqrt{39}}{156}$	$\frac{\sqrt{39}}{78}$	$\frac{\sqrt{39}}{78}$	$\frac{\sqrt{39}}{78}$	$\frac{\sqrt{39}}{78}$	$-\frac{7\sqrt{39}}{156}$	$-\frac{7\sqrt{39}}{156}$
	$-\frac{7\sqrt{39}}{156}$	$-\frac{7\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$-\frac{5\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$
	$\frac{7\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$\frac{7\sqrt{39}}{156}$						
$\mathbb{Q}_{4,0}^{(T_1)}$	0	0	0	0	$\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	$\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	0	0
	0	0	0	$\frac{\sqrt{2}}{4}$	0	0	$-\frac{\sqrt{2}}{4}$	0	0	0
	$\frac{\sqrt{2}}{4}$	0	0	$-\frac{\sqrt{2}}{4}$						
$\mathbb{Q}_{4,1}^{(T_1)}$	0	0	0	0	0	0	0	0	$\frac{\sqrt{2}}{4}$	$\frac{\sqrt{2}}{4}$
	$-\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	0	0	$\frac{\sqrt{2}}{4}$	0	0	$-\frac{\sqrt{2}}{4}$	0	$-\frac{\sqrt{2}}{4}$
	0	0	$\frac{\sqrt{2}}{4}$	0						
$\mathbb{Q}_{4,2}^{(T_1)}$	$\frac{\sqrt{2}}{4}$	$\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$	0	0	0	0	0	0
	0	0	$-\frac{\sqrt{2}}{4}$	0	0	$-\frac{\sqrt{2}}{4}$	0	0	$\frac{\sqrt{2}}{4}$	0

continued ...

Table 18

symbol	1	2	3	4	5	6	7	8	9	10
	0	$\frac{\sqrt{2}}{4}$	0	0						
$\mathbb{Q}_{5,0}^{(T_1)}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	0	0	0	0	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$
	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$
	0	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	0						
$\mathbb{Q}_{5,1}^{(T_1)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	0	0
	0	0	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{10}$	0
	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{20}$						
$\mathbb{Q}_{5,2}^{(T_1)}$	0	0	0	0	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$
	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	0	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	0	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	0	$\frac{\sqrt{10}}{20}$
	$-\frac{\sqrt{10}}{10}$	0	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$						
$\mathbb{Q}_6^{(A_2)}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$
	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$
	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$						