

SAMB for “CM”

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- Group: No. 31 T_d $-43m$ [cubic]
- Generation condition
 - model type: **tight_binding**
 - time-reversal type: **electric**
 - irrep: [A1]
 - **spinless**

- Kets: dimension = 8

Table 1: Hilbert space for full matrix.

No.	ket	No.	ket	No.	ket	No.	ket	No.	ket
1	$s@C_1$	2	$p_x@C_1$	3	$p_y@C_1$	4	$p_z@C_1$	5	$s@H_1$
6	$s@H_2$	7	$s@H_3$	8	$s@H_4$				

- Sites in (primitive) unit cell:

Table 2: Site-clusters.

	site	position	mapping
S ₁ [1o: -43m]	C 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 [4a: .3m]	H ₁	$\begin{pmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{pmatrix}$	[1,5,9,16,17,18]
	H ₂	$\begin{pmatrix} -\frac{1}{3} & -\frac{1}{3} & \frac{1}{3} \end{pmatrix}$	[2,6,11,13,21,23]
	H ₃	$\begin{pmatrix} \frac{1}{3} & -\frac{1}{3} & -\frac{1}{3} \end{pmatrix}$	[3,7,12,15,19,24]

continued ...

Table 2

site	position	mapping
H ₄	$\begin{pmatrix} -\frac{1}{3} & \frac{1}{3} & -\frac{1}{3} \end{pmatrix}$	[4,8,10,14,20,22]

- Bonds in (primitive) unit cell:

Table 3: Bond-clusters.

	bond	tail	head	n	#	$\mathbf{b@c}$	mapping
B ₁ [4a: .3m]	b ₁	H ₁	C ₁	1	1	$\begin{pmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{pmatrix} @ \begin{pmatrix} \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \end{pmatrix}$	[1,5,9,16,17,18]
	b ₂	H ₂	C ₁	1	1	$\begin{pmatrix} -\frac{1}{3} & -\frac{1}{3} & \frac{1}{3} \end{pmatrix} @ \begin{pmatrix} -\frac{1}{6} & -\frac{1}{6} & \frac{1}{6} \end{pmatrix}$	[2,6,11,13,21,23]
	b ₃	H ₃	C ₁	1	1	$\begin{pmatrix} \frac{1}{3} & -\frac{1}{3} & -\frac{1}{3} \end{pmatrix} @ \begin{pmatrix} \frac{1}{6} & -\frac{1}{6} & -\frac{1}{6} \end{pmatrix}$	[3,7,12,15,19,24]
	b ₄	H ₄	C ₁	1	1	$\begin{pmatrix} -\frac{1}{3} & \frac{1}{3} & -\frac{1}{3} \end{pmatrix} @ \begin{pmatrix} -\frac{1}{6} & \frac{1}{6} & -\frac{1}{6} \end{pmatrix}$	[4,8,10,14,20,22]
B ₂ [6b: 2.mm]	b ₅	H ₂	H ₁	1	1	$\begin{pmatrix} -\frac{2}{3} & -\frac{2}{3} & 0 \end{pmatrix} @ \begin{pmatrix} 0 & 0 & \frac{1}{3} \end{pmatrix}$	[1,-2,-13,16]
	b ₆	H ₄	H ₃	1	1	$\begin{pmatrix} -\frac{2}{3} & \frac{2}{3} & 0 \end{pmatrix} @ \begin{pmatrix} 0 & 0 & -\frac{1}{3} \end{pmatrix}$	[3,-4,19,-22]
	b ₇	H ₃	H ₁	1	1	$\begin{pmatrix} 0 & -\frac{2}{3} & -\frac{2}{3} \end{pmatrix} @ \begin{pmatrix} \frac{1}{3} & 0 & 0 \end{pmatrix}$	[5,-7,17,-24]
	b ₈	H ₄	H ₂	1	1	$\begin{pmatrix} 0 & \frac{2}{3} & -\frac{2}{3} \end{pmatrix} @ \begin{pmatrix} -\frac{1}{3} & 0 & 0 \end{pmatrix}$	[6,-8,-14,21]
	b ₉	H ₄	H ₁	1	1	$\begin{pmatrix} -\frac{2}{3} & 0 & -\frac{2}{3} \end{pmatrix} @ \begin{pmatrix} 0 & \frac{1}{3} & 0 \end{pmatrix}$	[9,-10,18,-20]
	b ₁₀	H ₃	H ₂	1	1	$\begin{pmatrix} \frac{2}{3} & 0 & -\frac{2}{3} \end{pmatrix} @ \begin{pmatrix} 0 & -\frac{1}{3} & 0 \end{pmatrix}$	[11,-12,-15,23]

- SAMB:

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

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

$$\boxed{\text{No. 2}} \quad \hat{Q}_0^{(A_1)} [\mathbf{M}_3, \mathbf{S}_1]$$

$$\hat{Z}_2 = \mathbb{X}_5[\mathbb{Q}_0^{(a,A_1)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_1)}]$$

$$\boxed{\text{No. 3}} \quad \hat{Q}_0^{(A_1)} [M_1, S_2]$$

$$\hat{Z}_3 = \mathbb{X}_1[Q_0^{(a, A_1)}] \otimes \mathbb{U}_2[Q_0^{(s, A_1)}]$$

$$\boxed{\text{No. 4}} \quad \hat{Q}_0^{(A_1)} [M_1, B_1]$$

$$\hat{Z}_4 = \mathbb{X}_1[Q_0^{(a, A_1)}] \otimes \mathbb{U}_3[Q_0^{(u, A_1)}]$$

$$\boxed{\text{No. 5}} \quad \hat{Q}_0^{(A_1)} [M_2, B_1]$$

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

$$\boxed{\text{No. 6}} \quad \hat{Q}_0^{(A_1)} [M_1, B_2]$$

$$\hat{Z}_6 = \mathbb{X}_1[Q_0^{(a, A_1)}] \otimes \mathbb{U}_7[Q_0^{(u, A_1)}]$$

Table 4: Atomic SAMB group.

group	bra	ket
M ₁	s	s
M ₂	s	p_x, p_y, p_z
M ₃	p_x, p_y, p_z	p_x, p_y, p_z

Table 5: Atomic SAMB.

symbol	type	group	form
\mathbb{X}_1	$Q_0^{(a, A_1)}$	M ₁	$\begin{pmatrix} 1 \end{pmatrix}$
\mathbb{X}_2	$Q_{1,0}^{(a, T_2)}$	M ₂	$\begin{pmatrix} 1 & 0 & 0 \end{pmatrix}$
\mathbb{X}_3	$Q_{1,1}^{(a, T_2)}$	M ₂	$\begin{pmatrix} 0 & 1 & 0 \end{pmatrix}$
\mathbb{X}_4	$Q_{1,2}^{(a, T_2)}$	M ₂	$\begin{pmatrix} 0 & 0 & 1 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
\mathbb{X}_5	$\mathbb{Q}_0^{(a, A_1)}$	M_3	$\begin{pmatrix} \frac{\sqrt{3}}{3} & 0 & 0 \\ 0 & \frac{\sqrt{3}}{3} & 0 \\ 0 & 0 & \frac{\sqrt{3}}{3} \end{pmatrix}$

Table 6: Uniform SAMB.

symbol	type	cluster	form
\mathbb{U}_1	$\mathbb{Q}_0^{(s, A_1)}$	S_1	$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
\mathbb{U}_2	$\mathbb{Q}_0^{(s, A_1)}$	S_2	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 0 & \frac{1}{2} \end{pmatrix}$
\mathbb{U}_3	$\mathbb{Q}_0^{(u, A_1)}$	B_1	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \end{pmatrix}$
\mathbb{U}_4	$\mathbb{Q}_{1,0}^{(u, T_2)}$	B_1	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \end{pmatrix}$

continued ...

Table 6

symbol	type	cluster	form
\mathbb{U}_5	$\mathbb{Q}_{1,1}^{(u,T_2)}$	B_1	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \end{pmatrix}$
\mathbb{U}_6	$\mathbb{Q}_{1,2}^{(u,T_2)}$	B_1	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \end{pmatrix}$
\mathbb{U}_7	$\mathbb{Q}_0^{(u,A_1)}$	B_2	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} \\ 0 & \frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} \\ 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}}{6} \\ 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} & 0 \end{pmatrix}$

Table 7: Polar harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$\mathbb{Q}_0^{(A_1)}$	0	A_1	—	—	1
2	$\mathbb{Q}_{1,0}^{(T_2)}$	1	T_2	—	0	x
3	$\mathbb{Q}_{1,1}^{(T_2)}$	1	T_2	—	1	y
4	$\mathbb{Q}_{1,2}^{(T_2)}$	1	T_2	—	2	z

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

Table 8: Conjugacy class.

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

Table 9: Symmetry operations.

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

Table 10: Character table.

	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 11: 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 12: 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			$A_1 + E$	$T_1 + T_2$	$T_1 + T_2$
T_1				$A_1 + E + T_2$	$A_2 + E + T_1 + T_2$
T_2					$A_1 + E + T_2$

Table 13: Anti-symmetric product, $[\Gamma \otimes \Gamma']_-$.

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

Table 14: 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	$\begin{pmatrix} 1 & 2 & 0 \end{pmatrix}$

continued ...

Table 14

No.	position	No.	position	No.	position	No.	position
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 15: Virtual-cluster basis.

symbol	1	2	3	4	5	6	7	8	9	10
$\mathbb{Q}_0^{(A_1)}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$
	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$
	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$						
$\mathbb{Q}_{1,0}^{(T_2)}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	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

continued ...

Table 15

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

continued ...

Table 15

symbol	1	2	3	4	5	6	7	8	9	10
	$-\frac{7\sqrt{39}}{156}$	$-\frac{7\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$-\frac{5\sqrt{39}}{156}$	$\frac{7\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$
	$\frac{7\sqrt{39}}{156}$	$-\frac{5\sqrt{39}}{156}$	$-\frac{\sqrt{39}}{78}$	$\frac{7\sqrt{39}}{156}$						
$\mathbb{Q}_{4,0}^{(T_1)}$	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
	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	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$						
$\mathbb{Q}_6^{(A_2)}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$
	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$
	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$						