

# SAMB for “CM”

Generated on 2023-06-12 22:37 by MultiPie 1.1.7

- 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 <sub>1</sub> C <sub>1</sub>	$\begin{pmatrix} 0 & 0 & 0 \end{pmatrix}$	[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 <sub>2</sub> H <sub>1</sub>	$\begin{pmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{pmatrix}$	[1,5,9,16,17,18]
H <sub>2</sub>	$\begin{pmatrix} -\frac{1}{3} & -\frac{1}{3} & \frac{1}{3} \end{pmatrix}$	[2,6,11,13,21,23]
H <sub>3</sub>	$\begin{pmatrix} \frac{1}{3} & -\frac{1}{3} & -\frac{1}{3} \end{pmatrix}$	[3,7,12,15,19,24]

*continued ...*

Table 2

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

- Bonds in (primitive) unit cell:

Table 3: Bond-clusters.

	bond	tail	head	$n$	#	$\mathbf{b@c}$	mapping
B <sub>1</sub>	b <sub>1</sub>	H <sub>1</sub>	C <sub>1</sub>	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 <sub>2</sub>	H <sub>2</sub>	C <sub>1</sub>	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 <sub>3</sub>	H <sub>3</sub>	C <sub>1</sub>	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 <sub>4</sub>	H <sub>4</sub>	C <sub>1</sub>	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 <sub>2</sub>	b <sub>5</sub>	H <sub>2</sub>	H <sub>1</sub>	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 <sub>6</sub>	H <sub>4</sub>	H <sub>3</sub>	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 <sub>7</sub>	H <sub>3</sub>	H <sub>1</sub>	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 <sub>8</sub>	H <sub>4</sub>	H <sub>2</sub>	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 <sub>9</sub>	H <sub>4</sub>	H <sub>1</sub>	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 <sub>10</sub>	H <sub>3</sub>	H <sub>2</sub>	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]

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- 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 <sub>1</sub>	$s$	$s$
M <sub>2</sub>	$s$	$p_x, p_y, p_z$
M <sub>3</sub>	$p_x, p_y, p_z$	$p_x, p_y, p_z$

Table 5: Atomic SAMB.

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

*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	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$						
$\mathbb{Q}_6^{(A_2)}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$
	$\frac{\sqrt{6}}{12}$	$\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$
	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$	$-\frac{\sqrt{6}}{12}$						