

# SAMB for “Cs1”

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- Group: No. 6  $C_s^1 Pm$  (b-axis setting) [ monoclinic ]
  - Associated point group: No. 4  $C_s m$  (b-axis setting) [ monoclinic ]
  - Generation condition
    - model type: **tight\_binding**
    - time-reversal type: **electric**
    - irrep: [A’]
    - **spinful**
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- Unit cell:
  - $a = 1.0$ ,  $b = 1.0$ ,  $c = 1.0$ ,  $\alpha = 90.0$ ,  $\beta = 90.0$ ,  $\gamma = 90.0$
- Lattice vectors:
  - $\mathbf{a}_1 = (1.0 \ 0 \ 0)$
  - $\mathbf{a}_2 = (0 \ 1.0 \ 0)$
  - $\mathbf{a}_3 = (0 \ 0 \ 1.0)$

Table 1: High-symmetry line:  $\Gamma$ -X.

symbol	position	symbol	position
$\Gamma$	$\begin{pmatrix} 0 & 0 & 0 \end{pmatrix}$	X	$\begin{pmatrix} \frac{1}{2} & 0 & 0 \end{pmatrix}$

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- Kets: dimension = 4

Table 2: Hilbert space for full matrix.

No.	ket	No.	ket	No.	ket	No.	ket
1	$(p_x, \uparrow)@A_1$	2	$(p_x, \downarrow)@A_1$	3	$(p_y, \uparrow)@A_1$	4	$(p_y, \downarrow)@A_1$

- Sites in (primitive) unit cell:

Table 3: Site-clusters.

site	position	mapping
S <sub>1</sub> A <sub>1</sub>	$\begin{pmatrix} 0 & 0 & 0 \end{pmatrix}$	[1,2]

- Bonds in (primitive) unit cell:

Table 4: Bond-clusters.

bond	tail	head	$n$	#	$\mathbf{b}@c$	mapping
B <sub>1</sub> b <sub>1</sub>	A <sub>1</sub>	A <sub>1</sub>	1	1	$\begin{pmatrix} 0 & 0 & -1 \end{pmatrix} @ \begin{pmatrix} 0 & 0 & \frac{1}{2} \end{pmatrix}$	[1,2]
B <sub>2</sub> b <sub>2</sub>	A <sub>1</sub>	A <sub>1</sub>	1	2	$\begin{pmatrix} 1 & 0 & 0 \end{pmatrix} @ \begin{pmatrix} \frac{1}{2} & 0 & 0 \end{pmatrix}$	[1,2]
B <sub>3</sub> b <sub>3</sub>	A <sub>1</sub>	A <sub>1</sub>	1	3	$\begin{pmatrix} 0 & 1 & 0 \end{pmatrix} @ \begin{pmatrix} 0 & \frac{1}{2} & 0 \end{pmatrix}$	[1,-2]
B <sub>4</sub> b <sub>4</sub>	A <sub>1</sub>	A <sub>1</sub>	2	1	$\begin{pmatrix} 1 & 0 & -1 \end{pmatrix} @ \begin{pmatrix} \frac{1}{2} & 0 & \frac{1}{2} \end{pmatrix}$	[1,2]
B <sub>5</sub>	b <sub>5</sub>	A <sub>1</sub> A <sub>1</sub>	2	2	$\begin{pmatrix} 0 & 1 & 1 \end{pmatrix} @ \begin{pmatrix} 0 & \frac{1}{2} & \frac{1}{2} \end{pmatrix}$	[1]
	b <sub>6</sub>	A <sub>1</sub> A <sub>1</sub>	2	2	$\begin{pmatrix} 0 & -1 & 1 \end{pmatrix} @ \begin{pmatrix} 0 & \frac{1}{2} & \frac{1}{2} \end{pmatrix}$	[2]
B <sub>6</sub> b <sub>7</sub>	A <sub>1</sub>	A <sub>1</sub>	2	3	$\begin{pmatrix} 1 & 0 & 1 \end{pmatrix} @ \begin{pmatrix} \frac{1}{2} & 0 & \frac{1}{2} \end{pmatrix}$	[1,2]
B <sub>7</sub>	b <sub>8</sub>	A <sub>1</sub> A <sub>1</sub>	2	4	$\begin{pmatrix} -1 & 1 & 0 \end{pmatrix} @ \begin{pmatrix} \frac{1}{2} & \frac{1}{2} & 0 \end{pmatrix}$	[1]
	b <sub>9</sub>	A <sub>1</sub> A <sub>1</sub>	2	4	$\begin{pmatrix} -1 & -1 & 0 \end{pmatrix} @ \begin{pmatrix} \frac{1}{2} & \frac{1}{2} & 0 \end{pmatrix}$	[2]

- SAMB:

$$\boxed{\text{No. 1}} \quad \hat{Q}_0^{(A')} [M_1, S_1]$$

$$\hat{Z}_1 = \mathbb{X}_1[Q_0^{(a,A')}] \otimes \mathbb{Y}_1[Q_0^{(s,A')}]$$

$$\hat{Z}_1(\mathbf{k}) = \mathbb{X}_1[Q_0^{(a,A')}] \otimes \mathbb{U}_1[Q_0^{(s,A')}]$$

$$\boxed{\text{No. 2}} \quad \hat{Q}_2^{(A',2)} [M_1, S_1]$$

$$\hat{Z}_2 = \mathbb{X}_2[Q_2^{(a,A',2)}] \otimes \mathbb{Y}_1[Q_0^{(s,A')}]$$

$$\hat{Z}_2(\mathbf{k}) = \mathbb{X}_2[Q_2^{(a,A',2)}] \otimes \mathbb{U}_1[Q_0^{(s,A')}]$$

$$\boxed{\text{No. 3}} \quad \hat{Q}_0^{(A')}(1, 1) [M_1, S_1]$$

$$\hat{Z}_3 = \mathbb{X}_3[Q_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_1[Q_0^{(s,A')}]$$

$$\hat{Z}_3(\mathbf{k}) = \mathbb{X}_3[Q_0^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[Q_0^{(s,A')}]$$

$$\boxed{\text{No. 4}} \quad \hat{Q}_2^{(A',3)}(1, -1) [M_1, S_1]$$

$$\hat{Z}_4 = \mathbb{X}_4[Q_2^{(a,A',3)}(1, -1)] \otimes \mathbb{Y}_1[Q_0^{(s,A')}]$$

$$\hat{Z}_4(\mathbf{k}) = \mathbb{X}_4[Q_2^{(a,A',3)}(1, -1)] \otimes \mathbb{U}_1[Q_0^{(s,A')}]$$

$$\boxed{\text{No. 5}} \quad \hat{Q}_0^{(A')} [M_1, B_1]$$

$$\hat{Z}_5 = \mathbb{X}_1[Q_0^{(a,A')}] \otimes \mathbb{Y}_2[Q_0^{(b,A')}]$$

$$\hat{Z}_5(\mathbf{k}) = \mathbb{X}_1[Q_0^{(a,A')}] \otimes \mathbb{U}_1[Q_0^{(s,A')}] \otimes \mathbb{F}_1[Q_0^{(k,A')}]$$

$$\boxed{\text{No. 6}} \quad \hat{Q}_2^{(A',2)} [M_1, B_1]$$

$$\hat{Z}_6 = \mathbb{X}_2[Q_2^{(a,A',2)}] \otimes \mathbb{Y}_2[Q_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_6(\mathbf{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_1[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 7}} \quad \hat{\mathbb{Q}}_0^{(A')}(1, 1) \text{ } [\mathbb{M}_1, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_7 = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_2[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_7(\mathbf{k}) = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_1[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 8}} \quad \hat{\mathbb{Q}}_2^{(A',3)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_8 = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{Y}_2[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_8(\mathbf{k}) = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_1[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 9}} \quad \hat{\mathbb{G}}_1^{(A')}(1, 1) \text{ } [\mathbb{M}_1, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_9 = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{Y}_3[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_9(\mathbf{k}) = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_2[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 10}} \quad \hat{\mathbb{G}}_1^{(A')}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{10} = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{Y}_3[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{10}(\mathbf{k}) = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_2[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 11}} \quad \hat{\mathbb{G}}_3^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{11} = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{Y}_3[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{11}(\mathbf{k}) = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_2[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 12}} \quad \hat{\mathbb{G}}_3^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{12} = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{Y}_3[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{12}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_2[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 13}} \quad \hat{\mathbb{Q}}_0^{(A')} [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{13} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{Y}_4[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{13}(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_3[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 14}} \quad \hat{\mathbb{Q}}_2^{(A',2)} [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{14} = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{Y}_4[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{14}(\mathbf{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_3[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 15}} \quad \hat{\mathbb{Q}}_0^{(A')}(1, 1) [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{15} = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_4[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{15}(\mathbf{k}) = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_3[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 16}} \quad \hat{\mathbb{Q}}_2^{(A',3)}(1, -1) [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{16} = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{Y}_4[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{16}(\mathbf{k}) = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_3[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 17}} \quad \hat{\mathbb{G}}_1^{(A')}(1, 1) [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{17} = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{Y}_5[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{17}(\mathbf{k}) = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_4[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 18}} \quad \hat{\mathbb{G}}_1^{(A')}(1, -1) [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{18} = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{Y}_5[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{18}(\mathbf{k}) = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_4[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 19}} \quad \hat{\mathbb{G}}_3^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{19} = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{Y}_5[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{19}(\mathbf{k}) = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_4[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 20}} \quad \hat{\mathbb{G}}_3^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_2]$$

$$\hat{Z}_{20} = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{Y}_5[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{20}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_4[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 21}} \quad \hat{\mathbb{Q}}_0^{(A')} \text{ } [\mathbb{M}_1, \mathbb{B}_3]$$

$$\hat{Z}_{21} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{Y}_6[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{21}(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_5[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 22}} \quad \hat{\mathbb{Q}}_2^{(A',2)} \text{ } [\mathbb{M}_1, \mathbb{B}_3]$$

$$\hat{Z}_{22} = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{Y}_6[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{22}(\mathbf{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_5[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 23}} \quad \hat{\mathbb{Q}}_0^{(A')}(1, 1) \text{ } [\mathbb{M}_1, \mathbb{B}_3]$$

$$\hat{Z}_{23} = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_6[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{23}(\mathbf{k}) = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_5[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 24}} \quad \hat{\mathbb{Q}}_2^{(A',3)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_3]$$

$$\hat{Z}_{24} = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{Y}_6[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{24}(\mathbf{k}) = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_5[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 25}} \quad \hat{\mathbb{Q}}_1^{(A',1)}(1, 1) \text{ [M}_1, \text{B}_3]$$

$$\hat{Z}_{25} = -\mathbb{X}_{12}[\mathbb{M}_1^{(a,A'',2)}(1, 1)] \otimes \mathbb{Y}_7[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{25}(\mathbf{k}) = -\mathbb{X}_{12}[\mathbb{M}_1^{(a,A'',2)}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_6[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 26}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1, 1) \text{ [M}_1, \text{B}_3]$$

$$\hat{Z}_{26} = \mathbb{X}_{11}[\mathbb{M}_1^{(a,A'',1)}(1, 1)] \otimes \mathbb{Y}_7[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{26}(\mathbf{k}) = \mathbb{X}_{11}[\mathbb{M}_1^{(a,A'',1)}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_6[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 27}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1, -1) \text{ [M}_1, \text{B}_3]$$

$$\hat{Z}_{27} = \mathbb{X}_{13}[\mathbb{M}_1^{(a,A'',1)}(1, -1)] \otimes \mathbb{Y}_7[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{27}(\mathbf{k}) = \mathbb{X}_{13}[\mathbb{M}_1^{(a,A'',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_6[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 28}} \quad \hat{\mathbb{G}}_2^{(A',1)}(1, -1) \text{ [M}_1, \text{B}_3]$$

$$\hat{Z}_{28} = -\mathbb{X}_{15}[\mathbb{M}_3^{(a,A'',4)}(1, -1)] \otimes \mathbb{Y}_7[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{28}(\mathbf{k}) = -\mathbb{X}_{15}[\mathbb{M}_3^{(a,A'',4)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_6[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 29}} \quad \hat{\mathbb{G}}_2^{(A',2)}(1, -1) \text{ [M}_1, \text{B}_3]$$

$$\hat{Z}_{29} = -\mathbb{X}_{14}[\mathbb{M}_3^{(a,A'',1)}(1, -1)] \otimes \mathbb{Y}_7[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{29}(\mathbf{k}) = -\mathbb{X}_{14}[\mathbb{M}_3^{(a,A'',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_6[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 30}} \quad \hat{\mathbb{Q}}_1^{(A',1)} \text{ [M}_1, \text{B}_3]$$

$$\hat{Z}_{30} = -\mathbb{X}_{16}[\mathbb{M}_1^{(a,A'',2)}] \otimes \mathbb{Y}_7[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{\mathbb{Z}}_{30}(\mathbf{k}) = -\mathbb{X}_{16}[\mathbb{M}_1^{(a,A'',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_6[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 31}} \quad \hat{\mathbb{Q}}_0^{(A')} [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{31} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{Y}_8[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{31}(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_7[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 32}} \quad \hat{\mathbb{Q}}_2^{(A',2)} [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{32} = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{Y}_8[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{32}(\mathbf{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_7[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 33}} \quad \hat{\mathbb{Q}}_0^{(A')}(1, 1) [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{33} = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_8[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{33}(\mathbf{k}) = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_7[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 34}} \quad \hat{\mathbb{Q}}_2^{(A',3)}(1, -1) [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{34} = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{Y}_8[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{34}(\mathbf{k}) = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_7[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 35}} \quad \hat{\mathbb{G}}_1^{(A')}(1, 1) [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{35} = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{Y}_9[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{35}(\mathbf{k}) = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_8[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 36}} \quad \hat{\mathbb{G}}_1^{(A')}(1, -1) [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{36} = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{Y}_9[\mathbb{T}_0^{(b,A')}]$$



$$\hat{\mathbb{Z}}_{36}(\mathbf{k}) = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_8[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 37}} \quad \hat{\mathbb{G}}_3^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{37} = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{Y}_9[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{37}(\mathbf{k}) = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_8[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 38}} \quad \hat{\mathbb{G}}_3^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_4]$$

$$\hat{\mathbb{Z}}_{38} = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{Y}_9[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{38}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_8[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 39}} \quad \hat{\mathbb{Q}}_0^{(A')} \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{39} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{Y}_{10}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{39}(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_9[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 40}} \quad \hat{\mathbb{Q}}_2^{(A',2)} \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{40} = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{Y}_{10}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{40}(\mathbf{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_9[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 41}} \quad \hat{\mathbb{Q}}_1^{(A',1)} \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{41} = \mathbb{X}_5[\mathbb{Q}_2^{(a,A'',2)}] \otimes \mathbb{Y}_{11}[\mathbb{Q}_1^{(b,A'')}]$$

$$\hat{\mathbb{Z}}_{41}(\mathbf{k}) = \mathbb{X}_5[\mathbb{Q}_2^{(a,A'',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{10}[\mathbb{Q}_1^{(k,A'')}]$$

$$\boxed{\text{No. 42}} \quad \hat{\mathbb{Q}}_0^{(A')}(1, 1) \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{42} = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_{10}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{42}(\mathbf{k}) = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_9[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 43}} \quad \hat{\mathbb{Q}}_2^{(A',3)}(1,-1) \text{ [M}_1, \text{B}_5]$$

$$\hat{Z}_{43} = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1,-1)] \otimes \mathbb{Y}_{10}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{43}(\mathbf{k}) = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1,-1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_9[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 44}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1,-1) \text{ [M}_1, \text{B}_5]$$

$$\hat{Z}_{44} = \mathbb{X}_6[\mathbb{Q}_2^{(a,A'',1)}(1,-1)] \otimes \mathbb{Y}_{11}[\mathbb{Q}_1^{(b,A'')}]$$

$$\hat{Z}_{44}(\mathbf{k}) = \mathbb{X}_6[\mathbb{Q}_2^{(a,A'',1)}(1,-1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{10}[\mathbb{Q}_1^{(k,A'')}]$$

$$\boxed{\text{No. 45}} \quad \hat{\mathbb{G}}_1^{(A')}(1,1) \text{ [M}_1, \text{B}_5]$$

$$\hat{Z}_{45} = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1,1)] \otimes \mathbb{Y}_{12}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{45}(\mathbf{k}) = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{11}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 46}} \quad \hat{\mathbb{Q}}_1^{(A',1)}(1,1) \text{ [M}_1, \text{B}_5]$$

$$\hat{Z}_{46} = -\mathbb{X}_{12}[\mathbb{M}_1^{(a,A'',2)}(1,1)] \otimes \mathbb{Y}_{13}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{46}(\mathbf{k}) = -\mathbb{X}_{12}[\mathbb{M}_1^{(a,A'',2)}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{12}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 47}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1,1) \text{ [M}_1, \text{B}_5]$$

$$\hat{Z}_{47} = \mathbb{X}_{11}[\mathbb{M}_1^{(a,A'',1)}(1,1)] \otimes \mathbb{Y}_{13}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{47}(\mathbf{k}) = \mathbb{X}_{11}[\mathbb{M}_1^{(a,A'',1)}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{12}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 48}} \quad \hat{\mathbb{G}}_1^{(A')}(1,-1) \text{ [M}_1, \text{B}_5]$$

$$\hat{Z}_{48} = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1,-1)] \otimes \mathbb{Y}_{12}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{48}(\mathbf{k}) = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{11}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 49}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{49} = \mathbb{X}_{13}[\mathbb{M}_1^{(a,A'',1)}(1, -1)] \otimes \mathbb{Y}_{13}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{\mathbb{Z}}_{49}(\mathbf{k}) = \mathbb{X}_{13}[\mathbb{M}_1^{(a,A'',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{12}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 50}} \quad \hat{\mathbb{G}}_3^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{50} = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{Y}_{12}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{50}(\mathbf{k}) = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{11}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 51}} \quad \hat{\mathbb{G}}_3^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{51} = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{Y}_{12}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{51}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{11}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 52}} \quad \hat{\mathbb{G}}_2^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{52} = -\mathbb{X}_{15}[\mathbb{M}_3^{(a,A'',4)}(1, -1)] \otimes \mathbb{Y}_{13}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{\mathbb{Z}}_{52}(\mathbf{k}) = -\mathbb{X}_{15}[\mathbb{M}_3^{(a,A'',4)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{12}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 53}} \quad \hat{\mathbb{G}}_2^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{53} = -\mathbb{X}_{14}[\mathbb{M}_3^{(a,A'',1)}(1, -1)] \otimes \mathbb{Y}_{13}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{\mathbb{Z}}_{53}(\mathbf{k}) = -\mathbb{X}_{14}[\mathbb{M}_3^{(a,A'',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{12}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 54}} \quad \hat{\mathbb{Q}}_1^{(A',1)} \text{ } [\mathbb{M}_1, \mathbb{B}_5]$$

$$\hat{\mathbb{Z}}_{54} = -\mathbb{X}_{16}[\mathbb{M}_1^{(a,A'',2)}] \otimes \mathbb{Y}_{13}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{\mathbb{Z}}_{54}(\mathbf{k}) = -\mathbb{X}_{16}[\mathbb{M}_1^{(a,A'',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{12}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 55}} \quad \hat{\mathbb{Q}}_0^{(A')} [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{55} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{Y}_{14}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{55}(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{13}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 56}} \quad \hat{\mathbb{Q}}_2^{(A',2)} [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{56} = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{Y}_{14}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{56}(\mathbf{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{13}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 57}} \quad \hat{\mathbb{Q}}_0^{(A')}(1, 1) [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{57} = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_{14}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{57}(\mathbf{k}) = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{13}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 58}} \quad \hat{\mathbb{Q}}_2^{(A',3)}(1, -1) [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{58} = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{Y}_{14}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{58}(\mathbf{k}) = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{13}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 59}} \quad \hat{\mathbb{G}}_1^{(A')}(1, 1) [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{59} = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{Y}_{15}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{59}(\mathbf{k}) = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{14}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 60}} \quad \hat{\mathbb{G}}_1^{(A')}(1, -1) [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{60} = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{Y}_{15}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{60}(\mathbf{k}) = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{14}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 61}} \quad \hat{\mathbb{G}}_3^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{61} = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{Y}_{15}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{61}(\mathbf{k}) = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{14}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 62}} \quad \hat{\mathbb{G}}_3^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_6]$$

$$\hat{\mathbb{Z}}_{62} = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{Y}_{15}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{62}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{14}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 63}} \quad \hat{\mathbb{Q}}_0^{(A')} \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{\mathbb{Z}}_{63} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{Y}_{16}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{63}(\mathbf{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a,A')}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{15}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 64}} \quad \hat{\mathbb{Q}}_2^{(A',2)} \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{\mathbb{Z}}_{64} = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{Y}_{16}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{\mathbb{Z}}_{64}(\mathbf{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{15}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 65}} \quad \hat{\mathbb{Q}}_1^{(A',1)} \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{\mathbb{Z}}_{65} = \mathbb{X}_5[\mathbb{Q}_2^{(a,A'',2)}] \otimes \mathbb{Y}_{17}[\mathbb{Q}_1^{(b,A'')}]$$

$$\hat{\mathbb{Z}}_{65}(\mathbf{k}) = \mathbb{X}_5[\mathbb{Q}_2^{(a,A'',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{16}[\mathbb{Q}_1^{(k,A'')}]$$

$$\boxed{\text{No. 66}} \quad \hat{\mathbb{Q}}_0^{(A')}(1, 1) \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{\mathbb{Z}}_{66} = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1, 1)] \otimes \mathbb{Y}_{16}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{66}(\mathbf{k}) = \mathbb{X}_3[\mathbb{Q}_0^{(a,A')}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{15}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 67}} \quad \hat{\mathbb{Q}}_2^{(A',3)}(1,-1) \text{ [M}_1, \text{B}_7]$$

$$\hat{Z}_{67} = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1,-1)] \otimes \mathbb{Y}_{16}[\mathbb{Q}_0^{(b,A')}]$$

$$\hat{Z}_{67}(\mathbf{k}) = \mathbb{X}_4[\mathbb{Q}_2^{(a,A',3)}(1,-1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{15}[\mathbb{Q}_0^{(k,A')}]$$

$$\boxed{\text{No. 68}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1,-1) \text{ [M}_1, \text{B}_7]$$

$$\hat{Z}_{68} = \mathbb{X}_6[\mathbb{Q}_2^{(a,A'',1)}(1,-1)] \otimes \mathbb{Y}_{17}[\mathbb{Q}_1^{(b,A'')}]$$

$$\hat{Z}_{68}(\mathbf{k}) = \mathbb{X}_6[\mathbb{Q}_2^{(a,A'',1)}(1,-1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{16}[\mathbb{Q}_1^{(k,A'')}]$$

$$\boxed{\text{No. 69}} \quad \hat{\mathbb{G}}_1^{(A')}(1,1) \text{ [M}_1, \text{B}_7]$$

$$\hat{Z}_{69} = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1,1)] \otimes \mathbb{Y}_{18}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{69}(\mathbf{k}) = \mathbb{X}_7[\mathbb{M}_1^{(a,A')}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{17}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 70}} \quad \hat{\mathbb{Q}}_1^{(A',1)}(1,1) \text{ [M}_1, \text{B}_7]$$

$$\hat{Z}_{70} = -\mathbb{X}_{12}[\mathbb{M}_1^{(a,A'',2)}(1,1)] \otimes \mathbb{Y}_{19}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{70}(\mathbf{k}) = -\mathbb{X}_{12}[\mathbb{M}_1^{(a,A'',2)}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{18}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 71}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1,1) \text{ [M}_1, \text{B}_7]$$

$$\hat{Z}_{71} = \mathbb{X}_{11}[\mathbb{M}_1^{(a,A'',1)}(1,1)] \otimes \mathbb{Y}_{19}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{71}(\mathbf{k}) = \mathbb{X}_{11}[\mathbb{M}_1^{(a,A'',1)}(1,1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{18}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 72}} \quad \hat{\mathbb{G}}_1^{(A')}(1,-1) \text{ [M}_1, \text{B}_7]$$

$$\hat{Z}_{72} = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1,-1)] \otimes \mathbb{Y}_{18}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{72}(\mathbf{k}) = \mathbb{X}_8[\mathbb{M}_1^{(a,A')}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{17}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 73}} \quad \hat{\mathbb{Q}}_1^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{Z}_{73} = \mathbb{X}_{13}[\mathbb{M}_1^{(a,A'',1)}(1, -1)] \otimes \mathbb{Y}_{19}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{73}(\mathbf{k}) = \mathbb{X}_{13}[\mathbb{M}_1^{(a,A'',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{18}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 74}} \quad \hat{\mathbb{G}}_3^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{Z}_{74} = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{Y}_{18}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{74}(\mathbf{k}) = \mathbb{X}_9[\mathbb{M}_3^{(a,A',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{17}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 75}} \quad \hat{\mathbb{G}}_3^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{Z}_{75} = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{Y}_{18}[\mathbb{T}_0^{(b,A')}]$$

$$\hat{Z}_{75}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{M}_3^{(a,A',2)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{17}[\mathbb{T}_0^{(k,A')}]$$

$$\boxed{\text{No. 76}} \quad \hat{\mathbb{G}}_2^{(A',1)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{Z}_{76} = -\mathbb{X}_{15}[\mathbb{M}_3^{(a,A'',4)}(1, -1)] \otimes \mathbb{Y}_{19}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{76}(\mathbf{k}) = -\mathbb{X}_{15}[\mathbb{M}_3^{(a,A'',4)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{18}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 77}} \quad \hat{\mathbb{G}}_2^{(A',2)}(1, -1) \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{Z}_{77} = -\mathbb{X}_{14}[\mathbb{M}_3^{(a,A'',1)}(1, -1)] \otimes \mathbb{Y}_{19}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{77}(\mathbf{k}) = -\mathbb{X}_{14}[\mathbb{M}_3^{(a,A'',1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{18}[\mathbb{T}_1^{(k,A'')}]$$

$$\boxed{\text{No. 78}} \quad \hat{\mathbb{Q}}_1^{(A',1)} \text{ } [\mathbb{M}_1, \mathbb{B}_7]$$

$$\hat{Z}_{78} = -\mathbb{X}_{16}[\mathbb{M}_1^{(a,A'',2)}] \otimes \mathbb{Y}_{19}[\mathbb{T}_1^{(b,A'')}]$$

$$\hat{Z}_{78}(\mathbf{k}) = -\mathbb{X}_{16}[\mathbb{M}_1^{(a,A'',2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A')}] \otimes \mathbb{F}_{18}[\mathbb{T}_1^{(k,A'')}]$$

Table 5: Atomic SAMB group.

group	bra	ket
M <sub>1</sub>	$(p_x, \uparrow), (p_x, \downarrow), (p_y, \uparrow), (p_y, \downarrow)$	$(p_x, \uparrow), (p_x, \downarrow), (p_y, \uparrow), (p_y, \downarrow)$

Table 6: Atomic SAMB.

symbol	type	group	form
$\mathbb{X}_1$	$\mathbb{Q}_0^{(a,A')}$	M <sub>1</sub>	$\begin{pmatrix} \frac{1}{2} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} \end{pmatrix}$
$\mathbb{X}_2$	$\mathbb{Q}_2^{(a,A',2)}$	M <sub>1</sub>	$\begin{pmatrix} \frac{1}{2} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & -\frac{1}{2} & 0 \\ 0 & 0 & 0 & -\frac{1}{2} \end{pmatrix}$
$\mathbb{X}_3$	$\mathbb{Q}_0^{(a,A')}(1,1)$	M <sub>1</sub>	$\begin{pmatrix} 0 & 0 & -\frac{i}{2} & 0 \\ 0 & 0 & 0 & \frac{i}{2} \\ \frac{i}{2} & 0 & 0 & 0 \\ 0 & -\frac{i}{2} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_4$	$\mathbb{Q}_2^{(a,A',3)}(1,-1)$	M <sub>1</sub>	$\begin{pmatrix} 0 & 0 & 0 & -\frac{i}{2} \\ 0 & 0 & -\frac{i}{2} & 0 \\ 0 & \frac{i}{2} & 0 & 0 \\ \frac{i}{2} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_5$	$\mathbb{Q}_2^{(a,A'',2)}$	M <sub>1</sub>	$\begin{pmatrix} 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} \\ \frac{1}{2} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_6$	$\mathbb{Q}_2^{(a,A'',1)}(1,-1)$	M <sub>1</sub>	$\begin{pmatrix} 0 & 0 & 0 & -\frac{1}{2} \\ 0 & 0 & \frac{1}{2} & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ -\frac{1}{2} & 0 & 0 & 0 \end{pmatrix}$

*continued ...*



Table 6

symbol	type	group	form
$\mathbb{X}_7$	$\mathbb{M}_1^{(a,A')}(1,1)$	$M_1$	$\begin{pmatrix} 0 & \frac{\sqrt{19}i}{19} & 0 & \frac{3\sqrt{19}}{38} \\ -\frac{\sqrt{19}i}{19} & 0 & \frac{3\sqrt{19}}{38} & 0 \\ 0 & \frac{3\sqrt{19}}{38} & 0 & -\frac{2\sqrt{19}i}{19} \\ \frac{3\sqrt{19}}{38} & 0 & \frac{2\sqrt{19}i}{19} & 0 \end{pmatrix}$
$\mathbb{X}_8$	$\mathbb{M}_1^{(a,A')}(1,-1)$	$M_1$	$\begin{pmatrix} 0 & -\frac{7\sqrt{38}i}{76} & 0 & -\frac{\sqrt{38}}{76} \\ \frac{7\sqrt{38}i}{76} & 0 & -\frac{\sqrt{38}}{76} & 0 \\ 0 & -\frac{\sqrt{38}}{76} & 0 & -\frac{5\sqrt{38}i}{76} \\ -\frac{\sqrt{38}}{76} & 0 & \frac{5\sqrt{38}i}{76} & 0 \end{pmatrix}$
$\mathbb{X}_9$	$\mathbb{M}_3^{(a,A',1)}(1,-1)$	$M_1$	$\begin{pmatrix} 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & -\frac{1}{2} \\ \frac{1}{2} & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{10}$	$\mathbb{M}_3^{(a,A',2)}(1,-1)$	$M_1$	$\begin{pmatrix} 0 & \frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} \\ -\frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} & 0 \\ 0 & -\frac{\sqrt{2}}{4} & 0 & -\frac{\sqrt{2}i}{4} \\ -\frac{\sqrt{2}}{4} & 0 & \frac{\sqrt{2}i}{4} & 0 \end{pmatrix}$
$\mathbb{X}_{11}$	$\mathbb{M}_1^{(a,A'',1)}(1,1)$	$M_1$	$\begin{pmatrix} 0 & \frac{2\sqrt{19}}{19} & 0 & -\frac{3\sqrt{19}i}{38} \\ \frac{2\sqrt{19}}{19} & 0 & \frac{3\sqrt{19}i}{38} & 0 \\ 0 & -\frac{3\sqrt{19}i}{38} & 0 & -\frac{\sqrt{19}}{19} \\ \frac{3\sqrt{19}i}{38} & 0 & -\frac{\sqrt{19}}{19} & 0 \end{pmatrix}$
$\mathbb{X}_{12}$	$\mathbb{M}_1^{(a,A'',2)}(1,1)$	$M_1$	$\begin{pmatrix} -\frac{1}{2} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & -\frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} \end{pmatrix}$
$\mathbb{X}_{13}$	$\mathbb{M}_1^{(a,A'',1)}(1,-1)$	$M_1$	$\begin{pmatrix} 0 & \frac{5\sqrt{38}}{76} & 0 & \frac{\sqrt{38}i}{76} \\ \frac{5\sqrt{38}}{76} & 0 & -\frac{\sqrt{38}i}{76} & 0 \\ 0 & \frac{\sqrt{38}i}{76} & 0 & \frac{7\sqrt{38}}{76} \\ -\frac{\sqrt{38}i}{76} & 0 & \frac{7\sqrt{38}}{76} & 0 \end{pmatrix}$
$\mathbb{X}_{14}$	$\mathbb{M}_3^{(a,A'',1)}(1,-1)$	$M_1$	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{4} & 0 & \frac{\sqrt{2}i}{4} \\ \frac{\sqrt{2}}{4} & 0 & -\frac{\sqrt{2}i}{4} & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} \\ -\frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} & 0 \end{pmatrix}$

continued ...

Table 6

symbol	type	group	form
$\mathbb{X}_{15}$	$\mathbb{M}_3^{(a,A'',4)}(1,-1)$	$M_1$	$\begin{pmatrix} \frac{1}{2} & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & 0 & 0 \\ 0 & 0 & -\frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} \end{pmatrix}$
$\mathbb{X}_{16}$	$\mathbb{M}_1^{(a,A'',2)}$	$M_1$	$\begin{pmatrix} 0 & 0 & -\frac{i}{2} & 0 \\ 0 & 0 & 0 & -\frac{i}{2} \\ \frac{i}{2} & 0 & 0 & 0 \\ 0 & \frac{i}{2} & 0 & 0 \end{pmatrix}$

Table 7: Cluster SAMB.

symbol	type	cluster	form
$\mathbb{Y}_1$	$\mathbb{Q}_0^{(s,A')}$	$S_1$	$\begin{pmatrix} 1 \end{pmatrix}$
$\mathbb{Y}_2$	$\mathbb{Q}_0^{(b,A')}$	$B_1$	$\begin{pmatrix} 1 \end{pmatrix}$
$\mathbb{Y}_3$	$\mathbb{T}_0^{(b,A')}$	$B_1$	$\begin{pmatrix} i \end{pmatrix}$
$\mathbb{Y}_4$	$\mathbb{Q}_0^{(b,A')}$	$B_2$	$\begin{pmatrix} 1 \end{pmatrix}$
$\mathbb{Y}_5$	$\mathbb{T}_0^{(b,A')}$	$B_2$	$\begin{pmatrix} i \end{pmatrix}$
$\mathbb{Y}_6$	$\mathbb{Q}_0^{(b,A')}$	$B_3$	$\begin{pmatrix} 1 \end{pmatrix}$
$\mathbb{Y}_7$	$\mathbb{T}_1^{(b,A'')}$	$B_3$	$\begin{pmatrix} i \end{pmatrix}$
$\mathbb{Y}_8$	$\mathbb{Q}_0^{(b,A')}$	$B_4$	$\begin{pmatrix} 1 \end{pmatrix}$
$\mathbb{Y}_9$	$\mathbb{T}_0^{(b,A')}$	$B_4$	$\begin{pmatrix} i \end{pmatrix}$
$\mathbb{Y}_{10}$	$\mathbb{Q}_0^{(b,A')}$	$B_5$	$\begin{pmatrix} \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{Y}_{11}$	$\mathbb{Q}_1^{(b,A'')}$	$B_5$	$\begin{pmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{Y}_{12}$	$\mathbb{T}_0^{(b,A')}$	$B_5$	$\begin{pmatrix} \frac{\sqrt{2}i}{2} & \frac{\sqrt{2}i}{2} \end{pmatrix}$
$\mathbb{Y}_{13}$	$\mathbb{T}_1^{(b,A'')}$	$B_5$	$\begin{pmatrix} \frac{\sqrt{2}i}{2} & -\frac{\sqrt{2}i}{2} \end{pmatrix}$
$\mathbb{Y}_{14}$	$\mathbb{Q}_0^{(b,A')}$	$B_6$	$\begin{pmatrix} 1 \end{pmatrix}$

continued ...

Table 7

symbol	type	cluster	form
$\mathbb{Y}_{15}$	$\mathbb{T}_0^{(b,A')}$	$B_6$	$\begin{pmatrix} i \end{pmatrix}$
$\mathbb{Y}_{16}$	$\mathbb{Q}_0^{(b,A')}$	$B_7$	$\begin{pmatrix} \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{Y}_{17}$	$\mathbb{Q}_1^{(b,A'')}$	$B_7$	$\begin{pmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{Y}_{18}$	$\mathbb{T}_0^{(b,A')}$	$B_7$	$\begin{pmatrix} \frac{\sqrt{2}i}{2} & \frac{\sqrt{2}i}{2} \end{pmatrix}$
$\mathbb{Y}_{19}$	$\mathbb{T}_1^{(b,A'')}$	$B_7$	$\begin{pmatrix} \frac{\sqrt{2}i}{2} & -\frac{\sqrt{2}i}{2} \end{pmatrix}$

Table 8: Uniform SAMB.

symbol	type	cluster	form
$\mathbb{U}_1$	$\mathbb{Q}_0^{(s,A')}$	$S_1$	$\begin{pmatrix} 1 \end{pmatrix}$

Table 9: Structure SAMB.

symbol	type	cluster	form
$\mathbb{F}_1$	$\mathbb{Q}_0^{(k,A')}$	$B_1$	$\sqrt{2}c_{001}$
$\mathbb{F}_2$	$\mathbb{T}_0^{(k,A')}$	$B_1$	$\sqrt{2}s_{001}$
$\mathbb{F}_3$	$\mathbb{Q}_0^{(k,A')}$	$B_2$	$\sqrt{2}c_{002}$
$\mathbb{F}_4$	$\mathbb{T}_0^{(k,A')}$	$B_2$	$\sqrt{2}s_{002}$
$\mathbb{F}_5$	$\mathbb{Q}_0^{(k,A')}$	$B_3$	$\sqrt{2}c_{003}$
$\mathbb{F}_6$	$\mathbb{T}_1^{(k,A'')}$	$B_3$	$\sqrt{2}s_{003}$
$\mathbb{F}_7$	$\mathbb{Q}_0^{(k,A')}$	$B_4$	$\sqrt{2}c_{004}$
$\mathbb{F}_8$	$\mathbb{T}_0^{(k,A')}$	$B_4$	$\sqrt{2}s_{004}$
$\mathbb{F}_9$	$\mathbb{Q}_0^{(k,A')}$	$B_5$	$c_{005} + c_{006}$
$\mathbb{F}_{10}$	$\mathbb{Q}_1^{(k,A'')}$	$B_5$	$c_{005} - c_{006}$

*continued ...*

Table 9

symbol	type	cluster	form
$\mathbb{F}_{11}$	$\mathbb{T}_0^{(k,A')}$	B <sub>5</sub>	$s_{005} + s_{006}$
$\mathbb{F}_{12}$	$\mathbb{T}_1^{(k,A'')}$	B <sub>5</sub>	$s_{005} - s_{006}$
$\mathbb{F}_{13}$	$\mathbb{Q}_0^{(k,A')}$	B <sub>6</sub>	$\sqrt{2}c_{007}$
$\mathbb{F}_{14}$	$\mathbb{T}_0^{(k,A')}$	B <sub>6</sub>	$\sqrt{2}s_{007}$
$\mathbb{F}_{15}$	$\mathbb{Q}_0^{(k,A')}$	B <sub>7</sub>	$c_{008} + c_{009}$
$\mathbb{F}_{16}$	$\mathbb{Q}_1^{(k,A'')}$	B <sub>7</sub>	$c_{008} - c_{009}$
$\mathbb{F}_{17}$	$\mathbb{T}_0^{(k,A')}$	B <sub>7</sub>	$s_{008} + s_{009}$
$\mathbb{F}_{18}$	$\mathbb{T}_1^{(k,A'')}$	B <sub>7</sub>	$s_{008} - s_{009}$

Table 10: Polar harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$\mathbb{Q}_0^{(A')}$	0	$A'$	—	—	1
2	$\mathbb{Q}_1^{(A'')}$	1	$A''$	—	—	$y$
3	$\mathbb{Q}_2^{(A'',1)}$	2	$A''$	1	—	$\sqrt{3}yz$
4	$\mathbb{Q}_2^{(A'',2)}$	2	$A''$	2	—	$\sqrt{3}xy$
5	$\mathbb{Q}_2^{(A',2)}$	2	$A'$	2	—	$\frac{\sqrt{3}(x-y)(x+y)}{2}$
6	$\mathbb{Q}_2^{(A',3)}$	2	$A'$	3	—	$\sqrt{3}xz$

Table 11: Axial harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$\mathbb{G}_1^{(A'',1)}$	1	$A''$	1	—	$X$

*continued ...*

Table 11

No.	symbol	rank	irrep.	mul.	comp.	form
2	$\mathbb{G}_1^{(A'',2)}$	1	$A''$	2	—	$Z$
3	$\mathbb{G}_1^{(A')}$	1	$A'$	—	—	$Y$
4	$\mathbb{G}_3^{(A'',1)}$	3	$A''$	1	—	$\frac{X(2X^2-3Y^2-3Z^2)}{2}$
5	$\mathbb{G}_3^{(A'',4)}$	3	$A''$	4	—	$\frac{\sqrt{15}Z(X-Y)(X+Y)}{2}$
6	$\mathbb{G}_3^{(A',1)}$	3	$A'$	1	—	$\sqrt{15}XYZ$
7	$\mathbb{G}_3^{(A',2)}$	3	$A'$	2	—	$-\frac{Y(3X^2-2Y^2+3Z^2)}{2}$

- 
- Group info.: Generator =  $\{\mathbf{m}_{010}|0\}$

Table 12: Conjugacy class (point-group part).

rep. SO	symmetry operations
$\{1 0\}$	$\{1 0\}$
$\{\mathbf{m}_{010} 0\}$	$\{\mathbf{m}_{010} 0\}$

Table 13: Symmetry operations.

No.	SO	No.	SO	No.	SO	No.	SO	No.	SO
1	$\{1 0\}$	2	$\{\mathbf{m}_{010} 0\}$						

Table 14: Character table (point-group part).

	1	$m_{010}$
$A'$	1	1
$A''$	1	-1

Table 15: Parity conversion.

$\leftrightarrow$	$\leftrightarrow$
$A' (A'')$	$A'' (A')$

Table 16: Symmetric product,  $[\Gamma \otimes \Gamma']_+$ .

	$A'$	$A''$
$A'$	$A'$	$A''$
$A''$	$A''$	$A'$

Table 17: Anti-symmetric product,  $[\Gamma \otimes \Gamma']_-$ .

$A'$	$A''$
-	-

Table 18: Virtual-cluster sites.

No.	position	No.	position
1	$\begin{pmatrix} 0 & 1 & 0 \end{pmatrix}$	2	$\begin{pmatrix} 0 & -1 & 0 \end{pmatrix}$

Table 19: Virtual-cluster basis.

symbol	1	2
$Q_0^{(A')}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
$Q_1^{(A'')}$	$\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$