

# SAMB for “D3”

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- Group: No. 18  $D_3 - 1$  321 (321 setting) [ trigonal ]
- Generation condition
  - model type: **tight\_binding**
  - time-reversal type: **electric**
  - irrep: [A1]
  - **spinful**

- Kets: dimension = 48

Table 1: Hilbert space for full matrix.

No.	ket	No.	ket	No.	ket	No.	ket	No.	ket
1	$(s, \uparrow)@A_1$	2	$(s, \downarrow)@A_1$	3	$(p_x, \uparrow)@A_1$	4	$(p_x, \downarrow)@A_1$	5	$(p_y, \uparrow)@A_1$
6	$(p_y, \downarrow)@A_1$	7	$(p_z, \uparrow)@A_1$	8	$(p_z, \downarrow)@A_1$	9	$(s, \uparrow)@A_2$	10	$(s, \downarrow)@A_2$
11	$(p_x, \uparrow)@A_2$	12	$(p_x, \downarrow)@A_2$	13	$(p_y, \uparrow)@A_2$	14	$(p_y, \downarrow)@A_2$	15	$(p_z, \uparrow)@A_2$
16	$(p_z, \downarrow)@A_2$	17	$(s, \uparrow)@A_3$	18	$(s, \downarrow)@A_3$	19	$(p_x, \uparrow)@A_3$	20	$(p_x, \downarrow)@A_3$
21	$(p_y, \uparrow)@A_3$	22	$(p_y, \downarrow)@A_3$	23	$(p_z, \uparrow)@A_3$	24	$(p_z, \downarrow)@A_3$	25	$(s, \uparrow)@A_4$
26	$(s, \downarrow)@A_4$	27	$(p_x, \uparrow)@A_4$	28	$(p_x, \downarrow)@A_4$	29	$(p_y, \uparrow)@A_4$	30	$(p_y, \downarrow)@A_4$
31	$(p_z, \uparrow)@A_4$	32	$(p_z, \downarrow)@A_4$	33	$(s, \uparrow)@A_5$	34	$(s, \downarrow)@A_5$	35	$(p_x, \uparrow)@A_5$
36	$(p_x, \downarrow)@A_5$	37	$(p_y, \uparrow)@A_5$	38	$(p_y, \downarrow)@A_5$	39	$(p_z, \uparrow)@A_5$	40	$(p_z, \downarrow)@A_5$
41	$(s, \uparrow)@A_6$	42	$(s, \downarrow)@A_6$	43	$(p_x, \uparrow)@A_6$	44	$(p_x, \downarrow)@A_6$	45	$(p_y, \uparrow)@A_6$
46	$(p_y, \downarrow)@A_6$	47	$(p_z, \uparrow)@A_6$	48	$(p_z, \downarrow)@A_6$				

- Sites in (primitive) unit cell:

Table 2: Site-clusters.

	site	position	mapping
S <sub>1</sub>	A <sub>1</sub>	$\begin{pmatrix} 1 & 0 & 1 \end{pmatrix}$	[1]
	A <sub>2</sub>	$\begin{pmatrix} 1 & 0 & -1 \end{pmatrix}$	[2]
	A <sub>3</sub>	$\begin{pmatrix} -1 & -1 & -1 \end{pmatrix}$	[3]
	A <sub>4</sub>	$\begin{pmatrix} 0 & 1 & -1 \end{pmatrix}$	[4]
	A <sub>5</sub>	$\begin{pmatrix} 0 & 1 & 1 \end{pmatrix}$	[5]
	A <sub>6</sub>	$\begin{pmatrix} -1 & -1 & 1 \end{pmatrix}$	[6]

- 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>	A <sub>5</sub>	A <sub>1</sub>	1	1	$\begin{pmatrix} -1 & 1 & 0 \end{pmatrix} @ \begin{pmatrix} \frac{1}{2} & \frac{1}{2} & 1 \end{pmatrix}$	[1]
	b <sub>2</sub>	A <sub>3</sub>	A <sub>2</sub>	1	1	$\begin{pmatrix} -2 & -1 & 0 \end{pmatrix} @ \begin{pmatrix} 0 & -\frac{1}{2} & -1 \end{pmatrix}$	[2]
	b <sub>3</sub>	A <sub>4</sub>	A <sub>3</sub>	1	1	$\begin{pmatrix} 1 & 2 & 0 \end{pmatrix} @ \begin{pmatrix} -\frac{1}{2} & 0 & -1 \end{pmatrix}$	[3]
	b <sub>4</sub>	A <sub>4</sub>	A <sub>2</sub>	1	1	$\begin{pmatrix} -1 & 1 & 0 \end{pmatrix} @ \begin{pmatrix} \frac{1}{2} & \frac{1}{2} & -1 \end{pmatrix}$	[-4]
	b <sub>5</sub>	A <sub>6</sub>	A <sub>5</sub>	1	1	$\begin{pmatrix} -1 & -2 & 0 \end{pmatrix} @ \begin{pmatrix} -\frac{1}{2} & 0 & 1 \end{pmatrix}$	[5]
	b <sub>6</sub>	A <sub>6</sub>	A <sub>1</sub>	1	1	$\begin{pmatrix} -2 & -1 & 0 \end{pmatrix} @ \begin{pmatrix} 0 & -\frac{1}{2} & 1 \end{pmatrix}$	[-6]
B <sub>2</sub>	b <sub>7</sub>	A <sub>2</sub>	A <sub>1</sub>	2	1	$\begin{pmatrix} 0 & 0 & -2 \end{pmatrix} @ \begin{pmatrix} 1 & 0 & 0 \end{pmatrix}$	[1,-2]
	b <sub>8</sub>	A <sub>6</sub>	A <sub>3</sub>	2	1	$\begin{pmatrix} 0 & 0 & 2 \end{pmatrix} @ \begin{pmatrix} -1 & -1 & 0 \end{pmatrix}$	[3,-6]
	b <sub>9</sub>	A <sub>5</sub>	A <sub>4</sub>	2	1	$\begin{pmatrix} 0 & 0 & 2 \end{pmatrix} @ \begin{pmatrix} 0 & 1 & 0 \end{pmatrix}$	[4,-5]

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- SAMB:

$$\boxed{\text{No. 1}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [M_1, S_1]$$

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

$$\boxed{\text{No. 2}} \quad \hat{Q}_0^{(A_1)} [M_2, S_1]$$

$$\hat{Z}_2 = \frac{\sqrt{3}\mathbb{X}_5[Q_1^{(a,A_2)}] \otimes U_2[Q_1^{(s,A_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_6[Q_{1,0}^{(a,E)}] \otimes U_3[Q_{1,0}^{(s,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_7[Q_{1,1}^{(a,E)}] \otimes U_4[Q_{1,1}^{(s,E)}]}{3}$$

$$\boxed{\text{No. 3}} \quad \hat{Q}_2^{(A_1)} [M_2, S_1]$$

$$\hat{Z}_3 = \frac{\sqrt{6}\mathbb{X}_5[Q_1^{(a,A_2)}] \otimes U_2[Q_1^{(s,A_2)}]}{3} - \frac{\sqrt{6}\mathbb{X}_6[Q_{1,0}^{(a,E)}] \otimes U_3[Q_{1,0}^{(s,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_7[Q_{1,1}^{(a,E)}] \otimes U_4[Q_{1,1}^{(s,E)}]}{6}$$

$$\boxed{\text{No. 4}} \quad \hat{G}_2^{(A_1)} [M_2, S_1]$$

$$\hat{Z}_4 = \frac{\sqrt{2}\mathbb{X}_6[Q_{1,0}^{(a,E)}] \otimes U_5[Q_{2,0}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_7[Q_{1,1}^{(a,E)}] \otimes U_6[Q_{2,1}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 5}} \quad \hat{Q}_0^{(A_1)}(1,0) [M_2, S_1]$$

$$\hat{Z}_5 = \frac{\sqrt{3}\mathbb{X}_{10}[Q_{1,1}^{(a,E)}(1,0)] \otimes U_4[Q_{1,1}^{(s,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_8[Q_1^{(a,A_2)}(1,0)] \otimes U_2[Q_1^{(s,A_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_9[Q_{1,0}^{(a,E)}(1,0)] \otimes U_3[Q_{1,0}^{(s,E)}]}{3}$$

$$\boxed{\text{No. 6}} \quad \hat{Q}_2^{(A_1)}(1,0) [M_2, S_1]$$

$$\hat{Z}_6 = -\frac{\sqrt{6}\mathbb{X}_{10}[Q_{1,1}^{(a,E)}(1,0)] \otimes U_4[Q_{1,1}^{(s,E)}]}{6} + \frac{\sqrt{6}\mathbb{X}_8[Q_1^{(a,A_2)}(1,0)] \otimes U_2[Q_1^{(s,A_2)}]}{3} - \frac{\sqrt{6}\mathbb{X}_9[Q_{1,0}^{(a,E)}(1,0)] \otimes U_3[Q_{1,0}^{(s,E)}]}{6}$$

$$\boxed{\text{No. 7}} \quad \hat{G}_2^{(A_1)}(1,0) [M_2, S_1]$$

$$\hat{Z}_7 = \frac{\sqrt{2}\mathbb{X}_{10}[Q_{1,1}^{(a,E)}(1,0)] \otimes U_6[Q_{2,1}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_9[Q_{1,0}^{(a,E)}(1,0)] \otimes U_5[Q_{2,0}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 8}} \quad \hat{G}_2^{(A_1)}(1,-1) [M_2, S_1]$$

$$\hat{Z}_8 = \mathbb{X}_{16}[G_2^{(a,A_1)}(1,-1)] \otimes U_1[Q_0^{(s,A_1)}]$$

$$\boxed{\text{No. 9}} \quad \hat{Q}_2^{(A_1)}(1,-1) [M_2, S_1]$$

$$\hat{Z}_9 = \frac{\sqrt{2}\mathbb{X}_{11}[G_{2,0}^{(a,E,1)}(1,-1)] \otimes U_4[Q_{1,1}^{(s,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{12}[G_{2,1}^{(a,E,1)}(1,-1)] \otimes U_3[Q_{1,0}^{(s,E)}]}{2}$$

$$\boxed{\text{No. 10}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) [\text{M}_2, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{10} = -\frac{\sqrt{2}\mathbb{X}_{13}[\mathbb{G}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_4[\mathbb{Q}_{1,1}^{(s,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{14}[\mathbb{G}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_3[\mathbb{Q}_{1,0}^{(s,E)}]}{2}$$

$$\boxed{\text{No. 11}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, -1) [\text{M}_2, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{11} = -\frac{\sqrt{2}\mathbb{X}_{11}[\mathbb{G}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_6[\mathbb{Q}_{2,1}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{12}[\mathbb{G}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_5[\mathbb{Q}_{2,0}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 12}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, -1) [\text{M}_2, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{12} = -\frac{\sqrt{2}\mathbb{X}_{13}[\mathbb{G}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_6[\mathbb{Q}_{2,1}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{14}[\mathbb{G}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_5[\mathbb{Q}_{2,0}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 13}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 1) [\text{M}_2, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{13} = \mathbb{X}_{15}[\mathbb{G}_0^{(a,A_1)}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_1)}]$$

$$\boxed{\text{No. 14}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{14} = \mathbb{X}_{17}[\mathbb{Q}_0^{(a,A_1)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_1)}]$$

$$\boxed{\text{No. 15}} \quad \hat{\mathbb{Q}}_2^{(A_1)} [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{15} = \mathbb{X}_{18}[\mathbb{Q}_2^{(a,A_1)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_1)}]$$

$$\boxed{\text{No. 16}} \quad \hat{\mathbb{G}}_2^{(A_1)} [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{16} = -\frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{Q}_{2,0}^{(a,E,1)}] \otimes \mathbb{U}_3[\mathbb{Q}_{1,0}^{(s,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{Q}_{2,1}^{(a,E,1)}] \otimes \mathbb{U}_4[\mathbb{Q}_{1,1}^{(s,E)}]}{2}$$

$$\boxed{\text{No. 17}} \quad \hat{\mathbb{Q}}_3^{(A_1)} [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{17} = \frac{\sqrt{2}\mathbb{X}_{23}[\mathbb{Q}_{2,0}^{(a,E,2)}] \otimes \mathbb{U}_3[\mathbb{Q}_{1,0}^{(s,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{24}[\mathbb{Q}_{2,1}^{(a,E,2)}] \otimes \mathbb{U}_4[\mathbb{Q}_{1,1}^{(s,E)}]}{2}$$

$$\boxed{\text{No. 18}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{18} = \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{Q}_{2,0}^{(a,E,1)}] \otimes \mathbb{U}_5[\mathbb{Q}_{2,0}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{Q}_{2,1}^{(a,E,1)}] \otimes \mathbb{U}_6[\mathbb{Q}_{2,1}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 19}} \quad \hat{\mathbb{G}}_3^{(A_1)} [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{19} = \frac{\sqrt{2}\mathbb{X}_{23}[\mathbb{Q}_{2,0}^{(a,E,2)}] \otimes \mathbb{U}_5[\mathbb{Q}_{2,0}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{24}[\mathbb{Q}_{2,1}^{(a,E,2)}] \otimes \mathbb{U}_6[\mathbb{Q}_{2,1}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 20}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 1) [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{20} = \mathbb{X}_{19}[\mathbb{Q}_0^{(a,A_1)}(1, 1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_1)}]$$

$$\boxed{\text{No. 21}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{21} = \mathbb{X}_{20}[\mathbb{Q}_2^{(a,A_1)}(1, -1)] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_1)}]$$

$$\boxed{\text{No. 22}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{22} = -\frac{\sqrt{2}\mathbb{X}_{25}[\mathbb{Q}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_3[\mathbb{Q}_{1,0}^{(s,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{26}[\mathbb{Q}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_4[\mathbb{Q}_{1,1}^{(s,E)}]}{2}$$

$$\boxed{\text{No. 23}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, -1) [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{23} = \frac{\sqrt{2}\mathbb{X}_{27}[\mathbb{Q}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_3[\mathbb{Q}_{1,0}^{(s,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{28}[\mathbb{Q}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_4[\mathbb{Q}_{1,1}^{(s,E)}]}{2}$$

$$\boxed{\text{No. 24}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, -1) [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{24} = \frac{\sqrt{2}\mathbb{X}_{25}[\mathbb{Q}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_5[\mathbb{Q}_{2,0}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{26}[\mathbb{Q}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_6[\mathbb{Q}_{2,1}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 25}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) [\text{M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{25} = \frac{\sqrt{2}\mathbb{X}_{27}[\mathbb{Q}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_5[\mathbb{Q}_{2,0}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{28}[\mathbb{Q}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_6[\mathbb{Q}_{2,1}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 26}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 0) \text{ [M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{26} = -\frac{\sqrt{3}\mathbb{X}_{29}[\mathbb{G}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_4[\mathbb{Q}_{1,1}^{(s,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{30}[\mathbb{G}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_3[\mathbb{Q}_{1,0}^{(s,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{52}[\mathbb{G}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_2[\mathbb{Q}_1^{(s,A_2)}]}{3}$$

$$\boxed{\text{No. 27}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, 0) \text{ [M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{27} = \frac{\sqrt{6}\mathbb{X}_{29}[\mathbb{G}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_4[\mathbb{Q}_{1,1}^{(s,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{30}[\mathbb{G}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_3[\mathbb{Q}_{1,0}^{(s,E)}]}{6} + \frac{\sqrt{6}\mathbb{X}_{52}[\mathbb{G}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_2[\mathbb{Q}_1^{(s,A_2)}]}{3}$$

$$\boxed{\text{No. 28}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, 0) \text{ [M}_3, \text{S}_1]$$

$$\hat{\mathbb{Z}}_{28} = -\frac{\sqrt{2}\mathbb{X}_{29}[\mathbb{G}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_6[\mathbb{Q}_{2,1}^{(s,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{30}[\mathbb{G}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_5[\mathbb{Q}_{2,0}^{(s,E,1)}]}{2}$$

$$\boxed{\text{No. 29}} \quad \hat{\mathbb{Q}}_0^{(A_1)} \text{ [M}_1, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{29} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A_1)}] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 30}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, -1) \text{ [M}_1, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{30} = \frac{\sqrt{3}\mathbb{X}_2[\mathbb{M}_1^{(a,A_2)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_3[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_4[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 31}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) \text{ [M}_1, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{31} = \frac{\sqrt{6}\mathbb{X}_2[\mathbb{M}_1^{(a,A_2)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_3[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_4[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 32}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) \text{ [M}_1, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{32} = -\frac{\sqrt{2}\mathbb{X}_3[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_4[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 33}} \quad \hat{\mathbb{Q}}_0^{(A_1)} \text{ [M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{33} = \frac{\sqrt{3}\mathbb{X}_5[\mathbb{Q}_1^{(a,A_2)}] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_6[\mathbb{Q}_{1,0}^{(a,E)}] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_7[\mathbb{Q}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 34}} \quad \hat{\mathbb{Q}}_2^{(A_1)} [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{34} = \frac{\sqrt{6}\mathbb{X}_5[\mathbb{Q}_1^{(a,A_2)}] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} - \frac{\sqrt{6}\mathbb{X}_6[\mathbb{Q}_{1,0}^{(a,E)}] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_7[\mathbb{Q}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 35}} \quad \hat{\mathbb{G}}_2^{(A_1)} [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{35} = \frac{\sqrt{2}\mathbb{X}_6[\mathbb{Q}_{1,0}^{(a,E)}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_7[\mathbb{Q}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 36}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 0) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{36} = \frac{\sqrt{3}\mathbb{X}_{10}[\mathbb{Q}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_8[\mathbb{Q}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_9[\mathbb{Q}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 37}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, 0) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{37} = -\frac{\sqrt{6}\mathbb{X}_{10}[\mathbb{Q}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{6} + \frac{\sqrt{6}\mathbb{X}_8[\mathbb{Q}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} - \frac{\sqrt{6}\mathbb{X}_9[\mathbb{Q}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 38}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, 0) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{38} = \frac{\sqrt{2}\mathbb{X}_{10}[\mathbb{Q}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_9[\mathbb{Q}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 39}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{39} = \mathbb{X}_{16}[\mathbb{G}_2^{(a,A_1)}(1, -1)] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 40}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{40} = \frac{\sqrt{2}\mathbb{X}_{11}[\mathbb{G}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{12}[\mathbb{G}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 41}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{41} = -\frac{\sqrt{2}\mathbb{X}_{13}[\mathbb{G}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{14}[\mathbb{G}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 42}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, -1) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{42} = -\frac{\sqrt{2}\mathbb{X}_{11}[\mathbb{G}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{12}[\mathbb{G}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 43}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, -1) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{43} = -\frac{\sqrt{2}\mathbb{X}_{13}[\mathbb{G}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{14}[\mathbb{G}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 44}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 1) [\text{M}_2, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{44} = \mathbb{X}_{15}[\mathbb{G}_0^{(a,A_1)}(1, 1)] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 45}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\text{M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{45} = \frac{\sqrt{3}\mathbb{X}_{53}[\mathbb{Q}_1^{(a,A_2)}] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{54}[\mathbb{Q}_{1,0}^{(a,E)}] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{55}[\mathbb{Q}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 46}} \quad \hat{\mathbb{Q}}_2^{(A_1)} [\text{M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{46} = \frac{\sqrt{6}\mathbb{X}_{53}[\mathbb{Q}_1^{(a,A_2)}] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} - \frac{\sqrt{6}\mathbb{X}_{54}[\mathbb{Q}_{1,0}^{(a,E)}] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{55}[\mathbb{Q}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 47}} \quad \hat{\mathbb{G}}_2^{(A_1)} [\text{M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{47} = \frac{\sqrt{2}\mathbb{X}_{54}[\mathbb{Q}_{1,0}^{(a,E)}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{55}[\mathbb{Q}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 48}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 0) [\text{M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{48} = \frac{\sqrt{3}\mathbb{X}_{56}[\mathbb{Q}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{57}[\mathbb{Q}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{58}[\mathbb{Q}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 49}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, 0) [\text{M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{49} = \frac{\sqrt{6}\mathbb{X}_{56}[\mathbb{Q}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3} - \frac{\sqrt{6}\mathbb{X}_{57}[\mathbb{Q}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{58}[\mathbb{Q}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{6}$$



$$\boxed{\text{No. 50}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, 0) \text{ [M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{50} = \frac{\sqrt{2}\mathbb{X}_{57}[\mathbb{Q}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{58}[\mathbb{Q}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 51}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{51} = \mathbb{X}_{64}[\mathbb{G}_2^{(a,A_1)}(1, -1)] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 52}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{52} = \frac{\sqrt{2}\mathbb{X}_{59}[\mathbb{G}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{60}[\mathbb{G}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 53}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{53} = -\frac{\sqrt{2}\mathbb{X}_{61}[\mathbb{G}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{62}[\mathbb{G}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 54}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{54} = -\frac{\sqrt{2}\mathbb{X}_{59}[\mathbb{G}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{60}[\mathbb{G}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 55}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{55} = -\frac{\sqrt{2}\mathbb{X}_{61}[\mathbb{G}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{62}[\mathbb{G}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 56}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 1) \text{ [M}_4, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{56} = \mathbb{X}_{63}[\mathbb{G}_0^{(a,A_1)}(1, 1)] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 57}} \quad \hat{\mathbb{Q}}_0^{(A_1)} \text{ [M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{57} = \mathbb{X}_{17}[\mathbb{Q}_0^{(a,A_1)}] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 58}} \quad \hat{\mathbb{Q}}_2^{(A_1)} [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{58} = \mathbb{X}_{18}[\mathbb{Q}_2^{(a,A_1)}] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 59}} \quad \hat{\mathbb{G}}_2^{(A_1)} [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{59} = -\frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{Q}_{2,0}^{(a,E,1)}] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{Q}_{2,1}^{(a,E,1)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 60}} \quad \hat{\mathbb{Q}}_3^{(A_1)} [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{60} = \frac{\sqrt{2}\mathbb{X}_{23}[\mathbb{Q}_{2,0}^{(a,E,2)}] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{24}[\mathbb{Q}_{2,1}^{(a,E,2)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 61}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{61} = \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{Q}_{2,0}^{(a,E,1)}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{Q}_{2,1}^{(a,E,1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 62}} \quad \hat{\mathbb{G}}_3^{(A_1)} [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{62} = \frac{\sqrt{2}\mathbb{X}_{23}[\mathbb{Q}_{2,0}^{(a,E,2)}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{24}[\mathbb{Q}_{2,1}^{(a,E,2)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 63}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 1) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{63} = \mathbb{X}_{19}[\mathbb{Q}_0^{(a,A_1)}(1, 1)] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 64}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{64} = \mathbb{X}_{20}[\mathbb{Q}_2^{(a,A_1)}(1, -1)] \otimes \mathbb{U}_7[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 65}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{65} = -\frac{\sqrt{2}\mathbb{X}_{25}[\mathbb{Q}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{26}[\mathbb{Q}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 66}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, -1) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{66} = \frac{\sqrt{2}\mathbb{X}_{27}[\mathbb{Q}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{28}[\mathbb{Q}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 67}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, -1) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{67} = \frac{\sqrt{2}\mathbb{X}_{25}[\mathbb{Q}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{26}[\mathbb{Q}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 68}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{68} = \frac{\sqrt{2}\mathbb{X}_{27}[\mathbb{Q}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{28}[\mathbb{Q}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 69}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 0) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{69} = -\frac{\sqrt{3}\mathbb{X}_{29}[\mathbb{G}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{30}[\mathbb{G}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{52}[\mathbb{G}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3}$$

$$\boxed{\text{No. 70}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, 0) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{70} = \frac{\sqrt{6}\mathbb{X}_{29}[\mathbb{G}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{30}[\mathbb{G}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_9[\mathbb{Q}_{1,0}^{(u,E)}]}{6} + \frac{\sqrt{6}\mathbb{X}_{52}[\mathbb{G}_1^{(a,A_2)}(1, 0)] \otimes \mathbb{U}_8[\mathbb{Q}_1^{(u,A_2)}]}{3}$$

$$\boxed{\text{No. 71}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, 0) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{71} = -\frac{\sqrt{2}\mathbb{X}_{29}[\mathbb{G}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{30}[\mathbb{G}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{11}[\mathbb{Q}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 72}} \quad \hat{\mathbb{G}}_0^{(A_1)} [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{72} = \frac{\sqrt{3}\mathbb{X}_{31}[\mathbb{M}_1^{(a,A_2)}] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_{32}[\mathbb{M}_{1,0}^{(a,E)}] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{33}[\mathbb{M}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 73}} \quad \hat{\mathbb{G}}_2^{(A_1)} [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{73} = \frac{\sqrt{6}\mathbb{X}_{31}[\mathbb{M}_1^{(a,A_2)}] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_{32}[\mathbb{M}_{1,0}^{(a,E)}] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{33}[\mathbb{M}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 74}} \quad \hat{\mathbb{Q}}_2^{(A_1)} [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{74} = -\frac{\sqrt{2}\mathbb{X}_{32}[\mathbb{M}_{1,0}^{(a,E)}] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{33}[\mathbb{M}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 75}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{75} = \frac{\sqrt{3}\mathbb{X}_{34}[\mathbb{M}_1^{(a,A_2)}(1, 1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_{38}[\mathbb{M}_{1,0}^{(a,E)}(1, 1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{39}[\mathbb{M}_{1,1}^{(a,E)}(1, 1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 76}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, 1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{76} = \frac{\sqrt{6}\mathbb{X}_{34}[\mathbb{M}_1^{(a,A_2)}(1, 1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_{38}[\mathbb{M}_{1,0}^{(a,E)}(1, 1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{39}[\mathbb{M}_{1,1}^{(a,E)}(1, 1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 77}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, 1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{77} = -\frac{\sqrt{2}\mathbb{X}_{38}[\mathbb{M}_{1,0}^{(a,E)}(1, 1)] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{39}[\mathbb{M}_{1,1}^{(a,E)}(1, 1)] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 78}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{78} = \frac{\sqrt{3}\mathbb{X}_{35}[\mathbb{M}_1^{(a,A_2)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_{40}[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{41}[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 79}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{79} = \frac{\sqrt{6}\mathbb{X}_{35}[\mathbb{M}_1^{(a,A_2)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_{40}[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{41}[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 80}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{80} = -\frac{\sqrt{2}\mathbb{X}_{40}[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{41}[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 81}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{81} = \mathbb{X}_{50}[\mathbb{M}_3^{(a,A_1)}(1, -1)] \otimes \mathbb{U}_{13}[\mathbb{T}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 82}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{82} = \frac{\sqrt{21}\mathbb{X}_{36}[\mathbb{M}_3^{(a, A_2, 1)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u, A_2)}]}{7} - \frac{\sqrt{14}\mathbb{X}_{42}[\mathbb{M}_{3,0}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u, E)}]}{7} + \frac{\sqrt{14}\mathbb{X}_{43}[\mathbb{M}_{3,1}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u, E)}]}{7}$$

$$\boxed{\text{No. 83}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{83} = \frac{\sqrt{3}\mathbb{X}_{37}[\mathbb{M}_3^{(a, A_2, 2)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u, A_2)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{44}[\mathbb{M}_{3,0}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u, E)}]}{4} + \frac{\sqrt{2}\mathbb{X}_{45}[\mathbb{M}_{3,1}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u, E)}]}{4}$$

$$\boxed{\text{No. 84}} \quad \hat{\mathbb{G}}_4^{(A_1, 1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{84} = \frac{2\sqrt{7}\mathbb{X}_{36}[\mathbb{M}_3^{(a, A_2, 1)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u, A_2)}]}{7} + \frac{\sqrt{42}\mathbb{X}_{42}[\mathbb{M}_{3,0}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u, E)}]}{14} - \frac{\sqrt{42}\mathbb{X}_{43}[\mathbb{M}_{3,1}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u, E)}]}{14}$$

$$\boxed{\text{No. 85}} \quad \hat{\mathbb{G}}_4^{(A_1, 2)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{85} = \frac{\mathbb{X}_{37}[\mathbb{M}_3^{(a, A_2, 2)}(1, -1)] \otimes \mathbb{U}_{14}[\mathbb{T}_1^{(u, A_2)}]}{2} + \frac{\sqrt{6}\mathbb{X}_{44}[\mathbb{M}_{3,0}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u, E)}]}{4} - \frac{\sqrt{6}\mathbb{X}_{45}[\mathbb{M}_{3,1}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u, E)}]}{4}$$

$$\boxed{\text{No. 86}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{86} = -\frac{\sqrt{2}\mathbb{X}_{42}[\mathbb{M}_{3,0}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u, E, 1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{43}[\mathbb{M}_{3,1}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u, E, 1)}]}{2}$$

$$\boxed{\text{No. 87}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{87} = -\frac{\sqrt{2}\mathbb{X}_{44}[\mathbb{M}_{3,0}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u, E, 1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{45}[\mathbb{M}_{3,1}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u, E, 1)}]}{2}$$

$$\boxed{\text{No. 88}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, 0) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{88} = \mathbb{X}_{51}[\mathbb{T}_2^{(a, A_1)}(1, 0)] \otimes \mathbb{U}_{13}[\mathbb{T}_0^{(u, A_1)}]$$

$$\boxed{\text{No. 89}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, 0) [\mathbb{M}_3, \mathbb{B}_1]$$

$$\hat{\mathbb{Z}}_{89} = -\frac{\sqrt{2}\mathbb{X}_{46}[\mathbb{T}_{2,0}^{(a, E, 1)}(1, 0)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u, E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{47}[\mathbb{T}_{2,1}^{(a, E, 1)}(1, 0)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u, E)}]}{2}$$

$$\boxed{\text{No. 90}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, 0) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{90} = \frac{\sqrt{2}\mathbb{X}_{48}[\mathbb{T}_{2,0}^{(a,E,2)}(1, 0)] \otimes \mathbb{U}_{15}[\mathbb{T}_{1,0}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{49}[\mathbb{T}_{2,1}^{(a,E,2)}(1, 0)] \otimes \mathbb{U}_{16}[\mathbb{T}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 91}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 0) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{91} = \frac{\sqrt{2}\mathbb{X}_{46}[\mathbb{T}_{2,0}^{(a,E,1)}(1, 0)] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{47}[\mathbb{T}_{2,1}^{(a,E,1)}(1, 0)] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 92}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, 0) [\text{M}_3, \text{B}_1]$$

$$\hat{\mathbb{Z}}_{92} = \frac{\sqrt{2}\mathbb{X}_{48}[\mathbb{T}_{2,0}^{(a,E,2)}(1, 0)] \otimes \mathbb{U}_{17}[\mathbb{T}_{2,0}^{(u,E,1)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{49}[\mathbb{T}_{2,1}^{(a,E,2)}(1, 0)] \otimes \mathbb{U}_{18}[\mathbb{T}_{2,1}^{(u,E,1)}]}{2}$$

$$\boxed{\text{No. 93}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\text{M}_1, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{93} = \mathbb{X}_1[\mathbb{Q}_0^{(a,A_1)}] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 94}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, -1) [\text{M}_1, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{94} = \frac{\sqrt{3}\mathbb{X}_2[\mathbb{M}_1^{(a,A_2)}(1, -1)] \otimes \mathbb{U}_{22}[\mathbb{T}_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_3[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_4[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 95}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) [\text{M}_1, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{95} = \frac{\sqrt{6}\mathbb{X}_2[\mathbb{M}_1^{(a,A_2)}(1, -1)] \otimes \mathbb{U}_{22}[\mathbb{T}_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_3[\mathbb{M}_{1,0}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_4[\mathbb{M}_{1,1}^{(a,E)}(1, -1)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 96}} \quad \hat{\mathbb{Q}}_0^{(A_1)} [\text{M}_2, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{96} = \frac{\sqrt{2}\mathbb{X}_6[\mathbb{Q}_{1,0}^{(a,E)}] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_7[\mathbb{Q}_{1,1}^{(a,E)}] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 97}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 0) [\text{M}_2, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{97} = \frac{\sqrt{2}\mathbb{X}_{10}[\mathbb{Q}_{1,1}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_9[\mathbb{Q}_{1,0}^{(a,E)}(1, 0)] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 98}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) \text{ [M}_2, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{98} = \mathbb{X}_{16}[\mathbb{G}_2^{(a, A_1)}(1, -1)] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u, A_1)}]$$

$$\boxed{\text{No. 99}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) \text{ [M}_2, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{99} = \frac{\sqrt{2}\mathbb{X}_{11}[\mathbb{G}_{2,0}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u, E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{12}[\mathbb{G}_{2,1}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u, E)}]}{2}$$

$$\boxed{\text{No. 100}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) \text{ [M}_2, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{100} = -\frac{\sqrt{2}\mathbb{X}_{13}[\mathbb{G}_{2,0}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u, E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{14}[\mathbb{G}_{2,1}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u, E)}]}{2}$$

$$\boxed{\text{No. 101}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 1) \text{ [M}_2, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{101} = \mathbb{X}_{15}[\mathbb{G}_0^{(a, A_1)}(1, 1)] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u, A_1)}]$$

$$\boxed{\text{No. 102}} \quad \hat{\mathbb{Q}}_0^{(A_1)} \text{ [M}_4, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{102} = \frac{\sqrt{2}\mathbb{X}_{54}[\mathbb{Q}_{1,0}^{(a, E)}] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u, E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{55}[\mathbb{Q}_{1,1}^{(a, E)}] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u, E)}]}{2}$$

$$\boxed{\text{No. 103}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 0) \text{ [M}_4, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{103} = \frac{\sqrt{2}\mathbb{X}_{57}[\mathbb{Q}_{1,0}^{(a, E)}(1, 0)] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u, E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{58}[\mathbb{Q}_{1,1}^{(a, E)}(1, 0)] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u, E)}]}{2}$$

$$\boxed{\text{No. 104}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{104} = \mathbb{X}_{64}[\mathbb{G}_2^{(a, A_1)}(1, -1)] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u, A_1)}]$$

$$\boxed{\text{No. 105}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{105} = \frac{\sqrt{2}\mathbb{X}_{59}[\mathbb{G}_{2,0}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u, E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{60}[\mathbb{G}_{2,1}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u, E)}]}{2}$$

$$\boxed{\text{No. 106}} \quad \hat{\mathbb{G}}_3^{(A_1)}(1, -1) \text{ [M}_4, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{106} = -\frac{\sqrt{2}\mathbb{X}_{61}[\mathbb{G}_{2,0}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{62}[\mathbb{G}_{2,1}^{(a,E,2)}(1, -1)] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 107}} \quad \hat{\mathbb{G}}_0^{(A_1)}(1, 1) \text{ [M}_4, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{107} = \mathbb{X}_{63}[\mathbb{G}_0^{(a,A_1)}(1, 1)] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 108}} \quad \hat{\mathbb{Q}}_0^{(A_1)} \text{ [M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{108} = \mathbb{X}_{17}[\mathbb{Q}_0^{(a,A_1)}] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 109}} \quad \hat{\mathbb{Q}}_2^{(A_1)} \text{ [M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{109} = \mathbb{X}_{18}[\mathbb{Q}_2^{(a,A_1)}] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 110}} \quad \hat{\mathbb{G}}_2^{(A_1)} \text{ [M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{110} = -\frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{Q}_{2,0}^{(a,E,1)}] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{Q}_{2,1}^{(a,E,1)}] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 111}} \quad \hat{\mathbb{Q}}_3^{(A_1)} \text{ [M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{111} = \frac{\sqrt{2}\mathbb{X}_{23}[\mathbb{Q}_{2,0}^{(a,E,2)}] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{24}[\mathbb{Q}_{2,1}^{(a,E,2)}] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 112}} \quad \hat{\mathbb{Q}}_0^{(A_1)}(1, 1) \text{ [M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{112} = \mathbb{X}_{19}[\mathbb{Q}_0^{(a,A_1)}(1, 1)] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 113}} \quad \hat{\mathbb{Q}}_2^{(A_1)}(1, -1) \text{ [M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{113} = \mathbb{X}_{20}[\mathbb{Q}_2^{(a,A_1)}(1, -1)] \otimes \mathbb{U}_{19}[\mathbb{Q}_0^{(u,A_1)}]$$

$$\boxed{\text{No. 114}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) \text{ [M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{114} = -\frac{\sqrt{2}\mathbb{X}_{25}[\mathbb{Q}_{2,0}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{20}[\mathbb{Q}_{1,0}^{(u,E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{26}[\mathbb{Q}_{2,1}^{(a,E,1)}(1, -1)] \otimes \mathbb{U}_{21}[\mathbb{Q}_{1,1}^{(u,E)}]}{2}$$



$$\boxed{\text{No. 115}} \quad \hat{Q}_3^{(A_1)}(1, -1) [M_3, B_2]$$

$$\hat{Z}_{115} = \frac{\sqrt{2}\mathbb{X}_{27}[Q_{2,0}^{(a,E,2)}(1, -1)] \otimes U_{20}[Q_{1,0}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{28}[Q_{2,1}^{(a,E,2)}(1, -1)] \otimes U_{21}[Q_{1,1}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 116}} \quad \hat{G}_0^{(A_1)}(1, 0) [M_3, B_2]$$

$$\hat{Z}_{116} = -\frac{\sqrt{2}\mathbb{X}_{29}[G_{1,0}^{(a,E)}(1, 0)] \otimes U_{21}[Q_{1,1}^{(u,E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{30}[G_{1,1}^{(a,E)}(1, 0)] \otimes U_{20}[Q_{1,0}^{(u,E)}]}{2}$$

$$\boxed{\text{No. 117}} \quad \hat{G}_0^{(A_1)} [M_3, B_2]$$

$$\hat{Z}_{117} = \frac{\sqrt{3}\mathbb{X}_{31}[M_1^{(a,A_2)}] \otimes U_{22}[T_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_{32}[M_{1,0}^{(a,E)}] \otimes U_{24}[T_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{33}[M_{1,1}^{(a,E)}] \otimes U_{23}[T_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 118}} \quad \hat{G}_2^{(A_1)} [M_3, B_2]$$

$$\hat{Z}_{118} = \frac{\sqrt{6}\mathbb{X}_{31}[M_1^{(a,A_2)}] \otimes U_{22}[T_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_{32}[M_{1,0}^{(a,E)}] \otimes U_{24}[T_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{33}[M_{1,1}^{(a,E)}] \otimes U_{23}[T_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 119}} \quad \hat{G}_0^{(A_1)}(1, 1) [M_3, B_2]$$

$$\hat{Z}_{119} = \frac{\sqrt{3}\mathbb{X}_{34}[M_1^{(a,A_2)}(1, 1)] \otimes U_{22}[T_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_{38}[M_{1,0}^{(a,E)}(1, 1)] \otimes U_{24}[T_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{39}[M_{1,1}^{(a,E)}(1, 1)] \otimes U_{23}[T_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 120}} \quad \hat{G}_2^{(A_1)}(1, 1) [M_3, B_2]$$

$$\hat{Z}_{120} = \frac{\sqrt{6}\mathbb{X}_{34}[M_1^{(a,A_2)}(1, 1)] \otimes U_{22}[T_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_{38}[M_{1,0}^{(a,E)}(1, 1)] \otimes U_{24}[T_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{39}[M_{1,1}^{(a,E)}(1, 1)] \otimes U_{23}[T_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 121}} \quad \hat{G}_0^{(A_1)}(1, -1) [M_3, B_2]$$

$$\hat{Z}_{121} = \frac{\sqrt{3}\mathbb{X}_{35}[M_1^{(a,A_2)}(1, -1)] \otimes U_{22}[T_1^{(u,A_2)}]}{3} - \frac{\sqrt{3}\mathbb{X}_{40}[M_{1,0}^{(a,E)}(1, -1)] \otimes U_{24}[T_{1,1}^{(u,E)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{41}[M_{1,1}^{(a,E)}(1, -1)] \otimes U_{23}[T_{1,0}^{(u,E)}]}{3}$$

$$\boxed{\text{No. 122}} \quad \hat{G}_2^{(A_1)}(1, -1) [M_3, B_2]$$

$$\hat{Z}_{122} = \frac{\sqrt{6}\mathbb{X}_{35}[M_1^{(a,A_2)}(1, -1)] \otimes U_{22}[T_1^{(u,A_2)}]}{3} + \frac{\sqrt{6}\mathbb{X}_{40}[M_{1,0}^{(a,E)}(1, -1)] \otimes U_{24}[T_{1,1}^{(u,E)}]}{6} - \frac{\sqrt{6}\mathbb{X}_{41}[M_{1,1}^{(a,E)}(1, -1)] \otimes U_{23}[T_{1,0}^{(u,E)}]}{6}$$

$$\boxed{\text{No. 123}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, -1) [\text{M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{123} = \frac{\sqrt{21}\mathbb{X}_{36}[\mathbb{M}_3^{(a, A_2, 1)}(1, -1)] \otimes \mathbb{U}_{22}[\mathbb{T}_1^{(u, A_2)}]}{7} - \frac{\sqrt{14}\mathbb{X}_{42}[\mathbb{M}_{3,0}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u, E)}]}{7} + \frac{\sqrt{14}\mathbb{X}_{43}[\mathbb{M}_{3,1}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u, E)}]}{7}$$

$$\boxed{\text{No. 124}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, -1) [\text{M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{124} = \frac{\sqrt{3}\mathbb{X}_{37}[\mathbb{M}_3^{(a, A_2, 2)}(1, -1)] \otimes \mathbb{U}_{22}[\mathbb{T}_1^{(u, A_2)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{44}[\mathbb{M}_{3,0}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u, E)}]}{4} + \frac{\sqrt{2}\mathbb{X}_{45}[\mathbb{M}_{3,1}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u, E)}]}{4}$$

$$\boxed{\text{No. 125}} \quad \hat{\mathbb{G}}_4^{(A_1, 1)}(1, -1) [\text{M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{125} = \frac{2\sqrt{7}\mathbb{X}_{36}[\mathbb{M}_3^{(a, A_2, 1)}(1, -1)] \otimes \mathbb{U}_{22}[\mathbb{T}_1^{(u, A_2)}]}{7} + \frac{\sqrt{42}\mathbb{X}_{42}[\mathbb{M}_{3,0}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u, E)}]}{14} - \frac{\sqrt{42}\mathbb{X}_{43}[\mathbb{M}_{3,1}^{(a, E, 1)}(1, -1)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u, E)}]}{14}$$

$$\boxed{\text{No. 126}} \quad \hat{\mathbb{G}}_4^{(A_1, 2)}(1, -1) [\text{M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{126} = \frac{\mathbb{X}_{37}[\mathbb{M}_3^{(a, A_2, 2)}(1, -1)] \otimes \mathbb{U}_{22}[\mathbb{T}_1^{(u, A_2)}]}{2} + \frac{\sqrt{6}\mathbb{X}_{44}[\mathbb{M}_{3,0}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u, E)}]}{4} - \frac{\sqrt{6}\mathbb{X}_{45}[\mathbb{M}_{3,1}^{(a, E, 2)}(1, -1)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u, E)}]}{4}$$

$$\boxed{\text{No. 127}} \quad \hat{\mathbb{G}}_2^{(A_1)}(1, 0) [\text{M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{127} = -\frac{\sqrt{2}\mathbb{X}_{46}[\mathbb{T}_{2,0}^{(a, E, 1)}(1, 0)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u, E)}]}{2} - \frac{\sqrt{2}\mathbb{X}_{47}[\mathbb{T}_{2,1}^{(a, E, 1)}(1, 0)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u, E)}]}{2}$$

$$\boxed{\text{No. 128}} \quad \hat{\mathbb{Q}}_3^{(A_1)}(1, 0) [\text{M}_3, \text{B}_2]$$

$$\hat{\mathbb{Z}}_{128} = \frac{\sqrt{2}\mathbb{X}_{48}[\mathbb{T}_{2,0}^{(a, E, 2)}(1, 0)] \otimes \mathbb{U}_{23}[\mathbb{T}_{1,0}^{(u, E)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{49}[\mathbb{T}_{2,1}^{(a, E, 2)}(1, 0)] \otimes \mathbb{U}_{24}[\mathbb{T}_{1,1}^{(u, E)}]}{2}$$

Table 4: Atomic SAMB group.

group	bra	ket
M <sub>1</sub>	$(s, \uparrow), (s, \downarrow)$	$(s, \uparrow), (s, \downarrow)$
M <sub>2</sub>	$(s, \uparrow), (s, \downarrow)$	$(p_x, \uparrow), (p_x, \downarrow), (p_y, \uparrow), (p_y, \downarrow), (p_z, \uparrow), (p_z, \downarrow)$

*continued ...*

Table 4

group	bra	ket
M <sub>3</sub>	$(p_x, \uparrow), (p_x, \downarrow), (p_y, \uparrow), (p_y, \downarrow), (p_z, \uparrow), (p_z, \downarrow)$	$(p_x, \uparrow), (p_x, \downarrow), (p_y, \uparrow), (p_y, \downarrow), (p_z, \uparrow), (p_z, \downarrow)$
M <sub>4</sub>	$(p_x, \uparrow), (p_x, \downarrow), (p_y, \uparrow), (p_y, \downarrow), (p_z, \uparrow), (p_z, \downarrow)$	$(s, \uparrow), (s, \downarrow)$

Table 5: Atomic SAMB.

symbol	type	group	form
$\mathbb{X}_1$	$\mathbb{Q}_0^{(a, A_1)}$	M <sub>1</sub>	$\begin{pmatrix} \frac{\sqrt{2}}{2} & 0 \\ 0 & \frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{X}_2$	$\mathbb{M}_1^{(a, A_2)}(1, -1)$	M <sub>1</sub>	$\begin{pmatrix} \frac{\sqrt{2}}{2} & 0 \\ 0 & -\frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{X}_3$	$\mathbb{M}_{1,0}^{(a, E)}(1, -1)$	M <sub>1</sub>	$\begin{pmatrix} 0 & \frac{\sqrt{2}i}{2} \\ -\frac{\sqrt{2}i}{2} & 0 \end{pmatrix}$
$\mathbb{X}_4$	$\mathbb{M}_{1,1}^{(a, E)}(1, -1)$	M <sub>1</sub>	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & 0 \end{pmatrix}$
$\mathbb{X}_5$	$\mathbb{Q}_1^{(a, A_2)}$	M <sub>2</sub>	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{2} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{X}_6$	$\mathbb{Q}_{1,0}^{(a, E)}$	M <sub>2</sub>	$\begin{pmatrix} \frac{\sqrt{2}}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{2}}{2} & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_7$	$\mathbb{Q}_{1,1}^{(a, E)}$	M <sub>2</sub>	$\begin{pmatrix} 0 & 0 & \frac{\sqrt{2}}{2} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{2}}{2} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_8$	$\mathbb{Q}_1^{(a, A_2)}(1, 0)$	M <sub>2</sub>	$\begin{pmatrix} 0 & -\frac{1}{2} & 0 & \frac{i}{2} & 0 & 0 \\ \frac{1}{2} & 0 & \frac{i}{2} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_9$	$\mathbb{Q}_{1,0}^{(a, E)}(1, 0)$	M <sub>2</sub>	$\begin{pmatrix} 0 & 0 & -\frac{i}{2} & 0 & 0 & \frac{1}{2} \\ 0 & 0 & 0 & \frac{i}{2} & -\frac{1}{2} & 0 \end{pmatrix}$
$\mathbb{X}_{10}$	$\mathbb{Q}_{1,1}^{(a, E)}(1, 0)$	M <sub>2</sub>	$\begin{pmatrix} \frac{i}{2} & 0 & 0 & 0 & 0 & -\frac{i}{2} \\ 0 & -\frac{i}{2} & 0 & 0 & -\frac{i}{2} & 0 \end{pmatrix}$
$\mathbb{X}_{11}$	$\mathbb{G}_{2,0}^{(a, E, 1)}(1, -1)$	M <sub>2</sub>	$\begin{pmatrix} \frac{i}{2} & 0 & 0 & 0 & 0 & \frac{i}{2} \\ 0 & -\frac{i}{2} & 0 & 0 & \frac{i}{2} & 0 \end{pmatrix}$
$\mathbb{X}_{12}$	$\mathbb{G}_{2,1}^{(a, E, 1)}(1, -1)$	M <sub>2</sub>	$\begin{pmatrix} 0 & 0 & \frac{i}{2} & 0 & 0 & \frac{1}{2} \\ 0 & 0 & 0 & -\frac{i}{2} & -\frac{1}{2} & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{13}$	$\mathbb{G}_{2,0}^{(a,E,2)}(1,-1)$	$M_2$	$\begin{pmatrix} 0 & \frac{1}{2} & 0 & \frac{i}{2} & 0 & 0 \\ -\frac{1}{2} & 0 & \frac{i}{2} & 0 & 0 & 0 \\ 0 & \frac{i}{2} & 0 & -\frac{1}{2} & 0 & 0 \\ \frac{i}{2} & 0 & \frac{1}{2} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{14}$	$\mathbb{G}_{2,1}^{(a,E,2)}(1,-1)$	$M_2$	$\begin{pmatrix} 0 & \frac{\sqrt{6}i}{6} & 0 & \frac{\sqrt{6}}{6} & \frac{\sqrt{6}i}{6} & 0 \\ \frac{\sqrt{6}i}{6} & 0 & -\frac{\sqrt{6}}{6} & 0 & 0 & -\frac{\sqrt{6}i}{6} \\ 0 & -\frac{\sqrt{3}i}{6} & 0 & -\frac{\sqrt{3}}{6} & \frac{\sqrt{3}i}{3} & 0 \\ -\frac{\sqrt{3}i}{6} & 0 & \frac{\sqrt{3}}{6} & 0 & 0 & -\frac{\sqrt{3}i}{3} \end{pmatrix}$
$\mathbb{X}_{15}$	$\mathbb{G}_0^{(a,A_1)}(1,1)$	$M_2$	$\begin{pmatrix} 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \end{pmatrix}$
$\mathbb{X}_{16}$	$\mathbb{G}_2^{(a,A_1)}(1,-1)$	$M_2$	$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & \frac{\sqrt{3}}{6} \\ 0 & 0 & 0 & \frac{\sqrt{3}i}{6} & -\frac{\sqrt{3}}{6} & 0 \\ \frac{\sqrt{3}i}{6} & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} \\ 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 \\ 0 & -\frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 \\ \frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{17}$	$\mathbb{Q}_0^{(a,A_1)}$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & \frac{\sqrt{3}}{6} \\ 0 & 0 & 0 & \frac{\sqrt{3}i}{6} & -\frac{\sqrt{3}}{6} & 0 \\ \frac{\sqrt{3}i}{6} & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} \\ 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 \\ 0 & -\frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 \\ \frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{18}$	$\mathbb{Q}_2^{(a,A_1)}$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 & -\frac{\sqrt{6}}{12} \\ 0 & 0 & 0 & \frac{\sqrt{6}i}{6} & \frac{\sqrt{6}}{12} & 0 \\ \frac{\sqrt{6}i}{6} & 0 & 0 & 0 & 0 & \frac{\sqrt{6}i}{12} \\ 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 & \frac{\sqrt{6}i}{12} & 0 \\ 0 & \frac{\sqrt{6}}{12} & 0 & -\frac{\sqrt{6}i}{12} & 0 & 0 \\ -\frac{\sqrt{6}}{12} & 0 & -\frac{\sqrt{6}i}{12} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{19}$	$\mathbb{Q}_0^{(a,A_1)}(1,1)$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & \frac{\sqrt{3}}{6} \\ 0 & 0 & 0 & \frac{\sqrt{3}i}{6} & -\frac{\sqrt{3}}{6} & 0 \\ \frac{\sqrt{3}i}{6} & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} \\ 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 \\ 0 & -\frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 \\ \frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{20}$	$\mathbb{Q}_2^{(a,A_1)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 & -\frac{\sqrt{6}}{12} \\ 0 & 0 & 0 & \frac{\sqrt{6}i}{6} & \frac{\sqrt{6}}{12} & 0 \\ \frac{\sqrt{6}i}{6} & 0 & 0 & 0 & 0 & \frac{\sqrt{6}i}{12} \\ 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 & \frac{\sqrt{6}i}{12} & 0 \\ 0 & \frac{\sqrt{6}}{12} & 0 & -\frac{\sqrt{6}i}{12} & 0 & 0 \\ -\frac{\sqrt{6}}{12} & 0 & -\frac{\sqrt{6}i}{12} & 0 & 0 & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{21}$	$\mathbb{Q}_{2,0}^{(a,E,1)}$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{1}{2} \\ 0 & 0 & \frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{1}{2} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{22}$	$\mathbb{Q}_{2,1}^{(a,E,1)}$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{1}{2} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{23}$	$\mathbb{Q}_{2,0}^{(a,E,2)}$	$M_3$	$\begin{pmatrix} \frac{1}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 & 0 & 0 \\ 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{24}$	$\mathbb{Q}_{2,1}^{(a,E,2)}$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 \\ -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{25}$	$\mathbb{Q}_{2,0}^{(a,E,1)}(1, -1)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & -\frac{\sqrt{2}}{4} & \frac{\sqrt{2}i}{4} & 0 \\ 0 & 0 & \frac{\sqrt{2}}{4} & 0 & 0 & -\frac{\sqrt{2}i}{4} \\ 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{26}$	$\mathbb{Q}_{2,1}^{(a,E,1)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 \\ 0 & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 & \frac{\sqrt{2}i}{4} & 0 \\ -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} \\ 0 & 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{27}$	$\mathbb{Q}_{2,0}^{(a,E,2)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}}{4} \\ 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & 0 \\ 0 & \frac{\sqrt{2}}{4} & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{28}$	$\mathbb{Q}_{2,1}^{(a,E,2)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{2}}{4} & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} & 0 & 0 \\ \frac{\sqrt{2}i}{4} & 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{29}$	$\mathbb{G}_{1,0}^{(a,E)}(1,0)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & \frac{\sqrt{2}i}{4} & 0 \\ \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} \\ 0 & 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{30}$	$\mathbb{G}_{1,1}^{(a,E)}(1,0)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & -\frac{\sqrt{2}}{4} & -\frac{\sqrt{2}i}{4} & 0 \\ 0 & 0 & \frac{\sqrt{2}}{4} & 0 & 0 & \frac{\sqrt{2}i}{4} \\ 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{31}$	$\mathbb{M}_1^{(a,A_2)}$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{i}{2} & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{i}{2} & 0 & 0 \\ \frac{i}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{i}{2} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{32}$	$\mathbb{M}_{1,0}^{(a,E)}$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{i}{2} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{i}{2} \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \frac{i}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{i}{2} & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{33}$	$\mathbb{M}_{1,1}^{(a,E)}$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -\frac{i}{2} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{i}{2} \\ 0 & 0 & \frac{i}{2} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{i}{2} & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{34}$	$\mathbb{M}_1^{(a,A_2)}(1,1)$	$M_3$	$\begin{pmatrix} -\frac{\sqrt{30}}{30} & 0 & 0 & 0 & 0 & \frac{\sqrt{30}}{20} \\ 0 & \frac{\sqrt{30}}{30} & 0 & 0 & \frac{\sqrt{30}}{20} & 0 \\ 0 & 0 & -\frac{\sqrt{30}}{30} & 0 & 0 & -\frac{\sqrt{30}i}{20} \\ 0 & 0 & 0 & \frac{\sqrt{30}}{30} & \frac{\sqrt{30}i}{20} & 0 \\ 0 & \frac{\sqrt{30}}{20} & 0 & -\frac{\sqrt{30}i}{20} & \frac{\sqrt{30}}{15} & 0 \\ \frac{\sqrt{30}}{20} & 0 & \frac{\sqrt{30}i}{20} & 0 & 0 & -\frac{\sqrt{30}}{15} \end{pmatrix}$
$\mathbb{X}_{35}$	$\mathbb{M}_1^{(a,A_2)}(1,-1)$	$M_3$	$\begin{pmatrix} \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{6}}{6} \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{36}$	$\mathbb{M}_3^{(a, A_2, 1)}(1, -1)$	$M_3$	$\begin{pmatrix} -\frac{\sqrt{5}}{10} & 0 & 0 & 0 & 0 & -\frac{\sqrt{5}}{10} \\ 0 & \frac{\sqrt{5}}{10} & 0 & 0 & -\frac{\sqrt{5}}{10} & 0 \\ 0 & 0 & -\frac{\sqrt{5}}{10} & 0 & 0 & \frac{\sqrt{5}i}{10} \\ 0 & 0 & 0 & \frac{\sqrt{5}}{10} & -\frac{\sqrt{5}i}{10} & 0 \\ 0 & -\frac{\sqrt{5}}{10} & 0 & \frac{\sqrt{5}i}{10} & \frac{\sqrt{5}}{5} & 0 \\ -\frac{\sqrt{5}}{10} & 0 & -\frac{\sqrt{5}i}{10} & 0 & 0 & -\frac{\sqrt{5}}{5} \end{pmatrix}$
$\mathbb{X}_{37}$	$\mathbb{M}_3^{(a, A_2, 2)}(1, -1)$	$M_3$	$\begin{pmatrix} 0 & -\frac{\sqrt{2}i}{4} & 0 & \frac{\sqrt{2}}{4} & 0 & 0 \\ \frac{\sqrt{2}i}{4} & 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 \\ 0 & \frac{\sqrt{2}}{4} & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{38}$	$\mathbb{M}_{1,0}^{(a, E)}(1, 1)$	$M_3$	$\begin{pmatrix} 0 & -\frac{\sqrt{30}i}{30} & 0 & -\frac{\sqrt{30}}{20} & 0 & 0 \\ \frac{\sqrt{30}i}{30} & 0 & -\frac{\sqrt{30}}{20} & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{30}}{20} & 0 & \frac{\sqrt{30}i}{15} & -\frac{\sqrt{30}}{20} & 0 \\ -\frac{\sqrt{30}}{20} & 0 & -\frac{\sqrt{30}i}{15} & 0 & 0 & \frac{\sqrt{30}}{20} \\ 0 & 0 & -\frac{\sqrt{30}}{20} & 0 & 0 & -\frac{\sqrt{30}i}{30} \\ 0 & 0 & 0 & \frac{\sqrt{30}}{20} & \frac{\sqrt{30}i}{30} & 0 \end{pmatrix}$
$\mathbb{X}_{39}$	$\mathbb{M}_{1,1}^{(a, E)}(1, 1)$	$M_3$	$\begin{pmatrix} 0 & \frac{\sqrt{30}}{15} & 0 & -\frac{\sqrt{30}i}{20} & \frac{\sqrt{30}}{20} & 0 \\ \frac{\sqrt{30}}{15} & 0 & \frac{\sqrt{30}i}{20} & 0 & 0 & -\frac{\sqrt{30}}{20} \\ 0 & -\frac{\sqrt{30}i}{20} & 0 & -\frac{\sqrt{30}}{30} & 0 & 0 \\ \frac{\sqrt{30}i}{20} & 0 & -\frac{\sqrt{30}}{30} & 0 & 0 & 0 \\ \frac{\sqrt{30}}{20} & 0 & 0 & 0 & 0 & -\frac{\sqrt{30}}{30} \\ 0 & -\frac{\sqrt{30}}{20} & 0 & 0 & -\frac{\sqrt{30}i}{30} & 0 \end{pmatrix}$
$\mathbb{X}_{40}$	$\mathbb{M}_{1,0}^{(a, E)}(1, -1)$	$M_3$	$\begin{pmatrix} 0 & \frac{\sqrt{6}i}{6} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{6}i}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{6}i}{6} & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{6}i}{6} \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{6}i}{6} & 0 \end{pmatrix}$

continued ...



Table 5

symbol	type	group	form
$\mathbb{X}_{41}$	$\mathbb{M}_{1,1}^{(a,E)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \\ 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \end{pmatrix}$
$\mathbb{X}_{42}$	$\mathbb{M}_{3,0}^{(a,E,1)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & -\frac{\sqrt{30}i}{60} & 0 & \frac{\sqrt{30}}{60} & 0 & 0 \\ \frac{\sqrt{30}i}{60} & 0 & \frac{\sqrt{30}}{60} & 0 & 0 & 0 \\ 0 & \frac{\sqrt{30}}{60} & 0 & -\frac{\sqrt{30}i}{20} & -\frac{\sqrt{30}}{15} & 0 \\ \frac{\sqrt{30}}{60} & 0 & \frac{\sqrt{30}i}{20} & 0 & 0 & \frac{\sqrt{30}}{15} \\ 0 & 0 & -\frac{\sqrt{30}}{15} & 0 & 0 & \frac{\sqrt{30}i}{15} \\ 0 & 0 & 0 & \frac{\sqrt{30}}{15} & -\frac{\sqrt{30}i}{15} & 0 \end{pmatrix}$
$\mathbb{X}_{43}$	$\mathbb{M}_{3,1}^{(a,E,1)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & -\frac{\sqrt{30}}{20} & 0 & \frac{\sqrt{30}i}{60} & \frac{\sqrt{30}}{15} & 0 \\ -\frac{\sqrt{30}}{20} & 0 & -\frac{\sqrt{30}i}{60} & 0 & 0 & -\frac{\sqrt{30}}{15} \\ 0 & \frac{\sqrt{30}i}{60} & 0 & -\frac{\sqrt{30}}{60} & 0 & 0 \\ -\frac{\sqrt{30}i}{60} & 0 & -\frac{\sqrt{30}}{60} & 0 & 0 & 0 \\ \frac{\sqrt{30}}{15} & 0 & 0 & 0 & 0 & \frac{\sqrt{30}}{15} \\ 0 & -\frac{\sqrt{30}}{15} & 0 & 0 & \frac{\sqrt{30}}{15} & 0 \end{pmatrix}$
$\mathbb{X}_{44}$	$\mathbb{M}_{3,0}^{(a,E,2)}(1,-1)$	$M_3$	$\begin{pmatrix} \frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{6} \\ 0 & -\frac{\sqrt{3}}{6} & 0 & 0 & \frac{\sqrt{3}}{6} & 0 \\ 0 & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 & \frac{\sqrt{3}i}{6} \\ 0 & 0 & 0 & \frac{\sqrt{3}}{6} & -\frac{\sqrt{3}i}{6} & 0 \\ 0 & \frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 \\ \frac{\sqrt{3}}{6} & 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{45}$	$\mathbb{M}_{3,1}^{(a,E,2)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 & \frac{\sqrt{3}i}{6} \\ 0 & 0 & 0 & \frac{\sqrt{3}}{6} & -\frac{\sqrt{3}i}{6} & 0 \\ -\frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}}{6} \\ 0 & \frac{\sqrt{3}}{6} & 0 & 0 & -\frac{\sqrt{3}}{6} & 0 \\ 0 & \frac{\sqrt{3}i}{6} & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 \\ -\frac{\sqrt{3}i}{6} & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{46}$	$\mathbb{T}_{2,0}^{(a,E,1)}(1,0)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & \frac{\sqrt{6}i}{12} & \frac{\sqrt{6}}{12} & 0 \\ 0 & 0 & -\frac{\sqrt{6}i}{12} & 0 & 0 & -\frac{\sqrt{6}}{12} \\ 0 & \frac{\sqrt{6}i}{12} & 0 & \frac{\sqrt{6}}{6} & 0 & 0 \\ -\frac{\sqrt{6}i}{12} & 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ \frac{\sqrt{6}}{12} & 0 & 0 & 0 & 0 & -\frac{\sqrt{6}}{6} \\ 0 & -\frac{\sqrt{6}}{12} & 0 & 0 & -\frac{\sqrt{6}}{6} & 0 \end{pmatrix}$
$\mathbb{X}_{47}$	$\mathbb{T}_{2,1}^{(a,E,1)}(1,0)$	$M_3$	$\begin{pmatrix} 0 & -\frac{\sqrt{6}i}{6} & 0 & -\frac{\sqrt{6}}{12} & 0 & 0 \\ \frac{\sqrt{6}i}{6} & 0 & -\frac{\sqrt{6}}{12} & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{6}}{12} & 0 & 0 & \frac{\sqrt{6}}{12} & 0 \\ -\frac{\sqrt{6}}{12} & 0 & 0 & 0 & 0 & -\frac{\sqrt{6}}{12} \\ 0 & 0 & \frac{\sqrt{6}}{12} & 0 & 0 & \frac{\sqrt{6}i}{6} \\ 0 & 0 & 0 & -\frac{\sqrt{6}}{12} & -\frac{\sqrt{6}i}{6} & 0 \end{pmatrix}$
$\mathbb{X}_{48}$	$\mathbb{T}_{2,0}^{(a,E,2)}(1,0)$	$M_3$	$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{6}}{6} & 0 & 0 & -\frac{\sqrt{6}i}{12} \\ 0 & 0 & 0 & \frac{\sqrt{6}}{6} & \frac{\sqrt{6}i}{12} & 0 \\ -\frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{12} \\ 0 & \frac{\sqrt{6}}{6} & 0 & 0 & \frac{\sqrt{6}}{12} & 0 \\ 0 & -\frac{\sqrt{6}i}{12} & 0 & \frac{\sqrt{6}}{12} & 0 & 0 \\ \frac{\sqrt{6}i}{12} & 0 & \frac{\sqrt{6}}{12} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{49}$	$\mathbb{T}_{2,1}^{(a,E,2)}(1,0)$	$M_3$	$\begin{pmatrix} -\frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{12} \\ 0 & \frac{\sqrt{6}}{6} & 0 & 0 & \frac{\sqrt{6}}{12} & 0 \\ 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 & \frac{\sqrt{6}i}{12} \\ 0 & 0 & 0 & -\frac{\sqrt{6}}{6} & -\frac{\sqrt{6}i}{12} & 0 \\ 0 & \frac{\sqrt{6}}{12} & 0 & \frac{\sqrt{6}i}{12} & 0 & 0 \\ \frac{\sqrt{6}}{12} & 0 & -\frac{\sqrt{6}i}{12} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{50}$	$\mathbb{M}_3^{(a,A_1)}(1,-1)$	$M_3$	$\begin{pmatrix} 0 & \frac{\sqrt{2}}{4} & 0 & \frac{\sqrt{2}i}{4} & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} & 0 & 0 \\ -\frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{51}$	$\mathbb{T}_2^{(a,A_1)}(1,0)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}i}{4} \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} \\ 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & \frac{\sqrt{2}}{4} & 0 & 0 \\ -\frac{\sqrt{2}i}{4} & 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{52}$	$\mathbb{G}_1^{(a,A_2)}(1,0)$	$M_3$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}i}{4} \\ 0 & 0 & 0 & 0 & \frac{\sqrt{2}i}{4} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{2}}{4} & 0 \\ 0 & -\frac{\sqrt{2}i}{4} & 0 & -\frac{\sqrt{2}}{4} & 0 & 0 \\ -\frac{\sqrt{2}i}{4} & 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{X}_{53}$	$\mathbb{Q}_1^{(a,A_2)}$	$M_4$	$\begin{pmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ \frac{\sqrt{2}}{2} & 0 \\ 0 & \frac{\sqrt{2}}{2} \end{pmatrix}$
$\mathbb{X}_{54}$	$\mathbb{Q}_{1,0}^{(a,E)}$	$M_4$	$\begin{pmatrix} \frac{\sqrt{2}}{2} & 0 \\ 0 & \frac{\sqrt{2}}{2} \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$
$\mathbb{X}_{55}$	$\mathbb{Q}_{1,1}^{(a,E)}$	$M_4$	$\begin{pmatrix} 0 & 0 \\ 0 & 0 \\ \frac{\sqrt{2}}{2} & 0 \\ 0 & \frac{\sqrt{2}}{2} \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{56}$	$\mathbb{Q}_1^{(a,A_2)}(1,0)$	$M_4$	$\begin{pmatrix} 0 & \frac{1}{2} \\ -\frac{1}{2} & 0 \\ 0 & -\frac{i}{2} \\ -\frac{i}{2} & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$
$\mathbb{X}_{57}$	$\mathbb{Q}_{1,0}^{(a,E)}(1,0)$	$M_4$	$\begin{pmatrix} 0 & 0 \\ 0 & 0 \\ \frac{i}{2} & 0 \\ 0 & -\frac{i}{2} \\ 0 & -\frac{1}{2} \\ \frac{1}{2} & 0 \end{pmatrix}$
$\mathbb{X}_{58}$	$\mathbb{Q}_{1,1}^{(a,E)}(1,0)$	$M_4$	$\begin{pmatrix} -\frac{i}{2} & 0 \\ 0 & \frac{i}{2} \\ 0 & 0 \\ 0 & 0 \\ 0 & \frac{i}{2} \\ \frac{i}{2} & 0 \end{pmatrix}$
$\mathbb{X}_{59}$	$\mathbb{G}_{2,0}^{(a,E,1)}(1,-1)$	$M_4$	$\begin{pmatrix} -\frac{i}{2} & 0 \\ 0 & \frac{i}{2} \\ 0 & 0 \\ 0 & 0 \\ 0 & -\frac{i}{2} \\ -\frac{i}{2} & 0 \end{pmatrix}$
$\mathbb{X}_{60}$	$\mathbb{G}_{2,1}^{(a,E,1)}(1,-1)$	$M_4$	$\begin{pmatrix} 0 & 0 \\ 0 & 0 \\ -\frac{i}{2} & 0 \\ 0 & \frac{i}{2} \\ 0 & -\frac{1}{2} \\ \frac{1}{2} & 0 \end{pmatrix}$

continued ...

Table 5

symbol	type	group	form
$\mathbb{X}_{61}$	$\mathbb{G}_{2,0}^{(a,E,2)}(1,-1)$	$M_4$	$\begin{pmatrix} 0 & -\frac{1}{2} \\ \frac{1}{2} & 0 \\ 0 & -\frac{i}{2} \\ -\frac{i}{2} & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$
$\mathbb{X}_{62}$	$\mathbb{G}_{2,1}^{(a,E,2)}(1,-1)$	$M_4$	$\begin{pmatrix} 0 & -\frac{i}{2} \\ -\frac{i}{2} & 0 \\ 0 & \frac{1}{2} \\ -\frac{1}{2} & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$
$\mathbb{X}_{63}$	$\mathbb{G}_0^{(a,A_1)}(1,1)$	$M_4$	$\begin{pmatrix} 0 & -\frac{\sqrt{6}i}{6} \\ -\frac{\sqrt{6}i}{6} & 0 \\ 0 & -\frac{\sqrt{6}}{6} \\ \frac{\sqrt{6}}{6} & 0 \\ -\frac{\sqrt{6}i}{6} & 0 \\ 0 & \frac{\sqrt{6}i}{6} \end{pmatrix}$
$\mathbb{X}_{64}$	$\mathbb{G}_2^{(a,A_1)}(1,-1)$	$M_4$	$\begin{pmatrix} 0 & \frac{\sqrt{3}i}{6} \\ \frac{\sqrt{3}i}{6} & 0 \\ 0 & \frac{\sqrt{3}}{6} \\ -\frac{\sqrt{3}}{6} & 0 \\ -\frac{\sqrt{3}i}{3} & 0 \\ 0 & \frac{\sqrt{3}i}{3} \end{pmatrix}$

Table 6: Uniform SAMB.

symbol	type	cluster	form
$\mathbb{U}_1$	$\mathbb{Q}_0^{(s,A_1)}$	$S_1$	$\begin{pmatrix} \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \end{pmatrix}$
$\mathbb{U}_2$	$\mathbb{Q}_1^{(s,A_2)}$	$S_1$	$\begin{pmatrix} \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \end{pmatrix}$
$\mathbb{U}_3$	$\mathbb{Q}_{1,0}^{(s,E)}$	$S_1$	$\begin{pmatrix} \frac{1}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} \end{pmatrix}$
$\mathbb{U}_4$	$\mathbb{Q}_{1,1}^{(s,E)}$	$S_1$	$\begin{pmatrix} -\frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{3}}{3} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{3}}{6} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{3} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}}{6} \end{pmatrix}$
$\mathbb{U}_5$	$\mathbb{Q}_{2,0}^{(s,E,1)}$	$S_1$	$\begin{pmatrix} -\frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{3}}{3} & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{3} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}}{6} \end{pmatrix}$

continued ...

Table 6

symbol	type	cluster	form
$\mathbb{U}_6$	$\mathbb{Q}_{2,1}^{(s,E,1)}$	$S_1$	$\begin{pmatrix} -\frac{1}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{1}{2} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{1}{2} \end{pmatrix}$
$\mathbb{U}_7$	$\mathbb{Q}_0^{(u,A_1)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} \\ 0 & 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} & 0 & 0 \\ 0 & \frac{\sqrt{3}}{6} & 0 & \frac{\sqrt{3}}{6} & 0 & 0 \\ 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} & 0 & 0 & 0 \\ \frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{6} \\ \frac{\sqrt{3}}{6} & 0 & 0 & 0 & \frac{\sqrt{3}}{6} & 0 \end{pmatrix}$
$\mathbb{U}_8$	$\mathbb{Q}_1^{(u,A_2)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{6} & \frac{\sqrt{3}}{6} \\ 0 & 0 & -\frac{\sqrt{3}}{6} & -\frac{\sqrt{3}}{6} & 0 & 0 \\ 0 & -\frac{\sqrt{3}}{6} & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 \\ 0 & -\frac{\sqrt{3}}{6} & -\frac{\sqrt{3}}{6} & 0 & 0 & 0 \\ \frac{\sqrt{3}}{6} & 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{6} \\ \frac{\sqrt{3}}{6} & 0 & 0 & 0 & \frac{\sqrt{3}}{6} & 0 \end{pmatrix}$
$\mathbb{U}_9$	$\mathbb{Q}_{1,0}^{(u,E)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} \\ 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & 0 & 0 \\ 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{U}_{10}$	$\mathbb{Q}_{1,1}^{(u,E)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{\sqrt{6}}{12} & -\frac{\sqrt{6}}{12} \\ 0 & 0 & \frac{\sqrt{6}}{12} & \frac{\sqrt{6}}{12} & 0 & 0 \\ 0 & \frac{\sqrt{6}}{12} & 0 & -\frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & \frac{\sqrt{6}}{12} & -\frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ -\frac{\sqrt{6}}{12} & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \\ -\frac{\sqrt{6}}{12} & 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \end{pmatrix}$

continued ...

Table 6

symbol	type	cluster	form
$\mathbb{U}_{11}$	$\mathbb{Q}_{2,0}^{(u,E,1)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{\sqrt{6}}{12} & -\frac{\sqrt{6}}{12} \\ 0 & 0 & -\frac{\sqrt{6}}{12} & -\frac{\sqrt{6}}{12} & 0 & 0 \\ 0 & -\frac{\sqrt{6}}{12} & 0 & \frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & -\frac{\sqrt{6}}{12} & \frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ -\frac{\sqrt{6}}{12} & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \\ -\frac{\sqrt{6}}{12} & 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \end{pmatrix}$
$\mathbb{U}_{12}$	$\mathbb{Q}_{2,1}^{(u,E,1)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} \\ 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & 0 & 0 \\ 0 & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{U}_{13}$	$\mathbb{T}_0^{(u,A_1)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} & \frac{\sqrt{3}i}{6} \\ 0 & 0 & -\frac{\sqrt{3}i}{6} & \frac{\sqrt{3}i}{6} & 0 & 0 \\ 0 & \frac{\sqrt{3}i}{6} & 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 \\ 0 & -\frac{\sqrt{3}i}{6} & \frac{\sqrt{3}i}{6} & 0 & 0 & 0 \\ \frac{\sqrt{3}i}{6} & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} \\ -\frac{\sqrt{3}i}{6} & 0 & 0 & 0 & \frac{\sqrt{3}i}{6} & 0 \end{pmatrix}$
$\mathbb{U}_{14}$	$\mathbb{T}_1^{(u,A_2)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} & \frac{\sqrt{3}i}{6} \\ 0 & 0 & \frac{\sqrt{3}i}{6} & -\frac{\sqrt{3}i}{6} & 0 & 0 \\ 0 & -\frac{\sqrt{3}i}{6} & 0 & \frac{\sqrt{3}i}{6} & 0 & 0 \\ 0 & \frac{\sqrt{3}i}{6} & -\frac{\sqrt{3}i}{6} & 0 & 0 & 0 \\ \frac{\sqrt{3}i}{6} & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} \\ -\frac{\sqrt{3}i}{6} & 0 & 0 & 0 & \frac{\sqrt{3}i}{6} & 0 \end{pmatrix}$
$\mathbb{U}_{15}$	$\mathbb{T}_{1,0}^{(u,E)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & -\frac{\sqrt{2}i}{4} \\ 0 & 0 & -\frac{\sqrt{2}i}{4} & -\frac{\sqrt{2}i}{4} & 0 & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & 0 \\ \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$

continued ...



Table 6

symbol	type	cluster	form
$\mathbb{U}_{16}$	$\mathbb{T}_{1,1}^{(u,E)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{6}i}{12} & -\frac{\sqrt{6}i}{12} \\ 0 & 0 & -\frac{\sqrt{6}i}{12} & \frac{\sqrt{6}i}{12} & 0 & 0 \\ 0 & \frac{\sqrt{6}i}{12} & 0 & \frac{\sqrt{6}i}{6} & 0 & 0 \\ 0 & -\frac{\sqrt{6}i}{12} & -\frac{\sqrt{6}i}{6} & 0 & 0 & 0 \\ -\frac{\sqrt{6}i}{12} & 0 & 0 & 0 & 0 & -\frac{\sqrt{6}i}{6} \\ \frac{\sqrt{6}i}{12} & 0 & 0 & 0 & \frac{\sqrt{6}i}{6} & 0 \end{pmatrix}$
$\mathbb{U}_{17}$	$\mathbb{T}_{2,0}^{(u,E,1)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{6}i}{12} & -\frac{\sqrt{6}i}{12} \\ 0 & 0 & \frac{\sqrt{6}i}{12} & -\frac{\sqrt{6}i}{12} & 0 & 0 \\ 0 & -\frac{\sqrt{6}i}{12} & 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 \\ 0 & \frac{\sqrt{6}i}{12} & \frac{\sqrt{6}i}{6} & 0 & 0 & 0 \\ -\frac{\sqrt{6}i}{12} & 0 & 0 & 0 & 0 & -\frac{\sqrt{6}i}{6} \\ \frac{\sqrt{6}i}{12} & 0 & 0 & 0 & \frac{\sqrt{6}i}{6} & 0 \end{pmatrix}$
$\mathbb{U}_{18}$	$\mathbb{T}_{2,1}^{(u,E,1)}$	$B_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{2}i}{4} & \frac{\sqrt{2}i}{4} \\ 0 & 0 & -\frac{\sqrt{2}i}{4} & -\frac{\sqrt{2}i}{4} & 0 & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{U}_{19}$	$\mathbb{Q}_0^{(u,A_1)}$	$B_2$	$\begin{pmatrix} 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{6}}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \\ 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{U}_{20}$	$\mathbb{Q}_{1,0}^{(u,E)}$	$B_2$	$\begin{pmatrix} 0 & \frac{\sqrt{3}}{3} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{3}}{3} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{3}}{6} \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{3}}{6} & 0 \\ 0 & 0 & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{3}}{6} & 0 & 0 & 0 \end{pmatrix}$

continued ...

Table 6

symbol	type	cluster	form
$\mathbb{U}_{21}$	$\mathbb{Q}_{1,1}^{(u,E)}$	$B_2$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{1}{2} \\ 0 & 0 & 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{U}_{22}$	$\mathbb{T}_1^{(u,A_2)}$	$B_2$	$\begin{pmatrix} 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 & 0 & 0 \\ \frac{\sqrt{6}i}{6} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{6}i}{6} \\ 0 & 0 & 0 & 0 & \frac{\sqrt{6}i}{6} & 0 \\ 0 & 0 & 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{6}i}{6} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{U}_{23}$	$\mathbb{T}_{1,0}^{(u,E)}$	$B_2$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{i}{2} \\ 0 & 0 & 0 & 0 & \frac{i}{2} & 0 \\ 0 & 0 & 0 & -\frac{i}{2} & 0 & 0 \\ 0 & 0 & \frac{i}{2} & 0 & 0 & 0 \end{pmatrix}$
$\mathbb{U}_{24}$	$\mathbb{T}_{1,1}^{(u,E)}$	$B_2$	$\begin{pmatrix} 0 & \frac{\sqrt{3}i}{3} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{3}i}{3} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{3}i}{6} \\ 0 & 0 & 0 & 0 & \frac{\sqrt{3}i}{6} & 0 \\ 0 & 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{3}i}{6} & 0 & 0 & 0 \end{pmatrix}$

Table 7: Polar harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$\mathbb{Q}_0^{(A_1)}$	0	$A_1$	—	—	1
2	$\mathbb{Q}_1^{(A_2)}$	1	$A_2$	—	—	$z$
3	$\mathbb{Q}_{1,0}^{(E)}$	1	$E$	—	0	$x$
4	$\mathbb{Q}_{1,1}^{(E)}$	1	$E$	—	1	$y$
5	$\mathbb{Q}_2^{(A_1)}$	2	$A_1$	—	—	$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$
6	$\mathbb{Q}_{2,0}^{(E,1)}$	2	$E$	1	0	$\sqrt{3}yz$
7	$\mathbb{Q}_{2,1}^{(E,1)}$	2	$E$	1	1	$-\sqrt{3}xz$
8	$\mathbb{Q}_{2,0}^{(E,2)}$	2	$E$	2	0	$\frac{\sqrt{3}(x-y)(x+y)}{2}$
9	$\mathbb{Q}_{2,1}^{(E,2)}$	2	$E$	2	1	$-\sqrt{3}xy$

Table 8: Axial harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$\mathbb{G}_0^{(A_1)}$	0	$A_1$	—	—	1
2	$\mathbb{G}_1^{(A_2)}$	1	$A_2$	—	—	$Z$
3	$\mathbb{G}_{1,0}^{(E)}$	1	$E$	—	0	$-Y$
4	$\mathbb{G}_{1,1}^{(E)}$	1	$E$	—	1	$X$
5	$\mathbb{G}_2^{(A_1)}$	2	$A_1$	—	—	$-\frac{X^2}{2} - \frac{Y^2}{2} + Z^2$
6	$\mathbb{G}_{2,0}^{(E,1)}$	2	$E$	1	0	$\sqrt{3}XZ$
7	$\mathbb{G}_{2,1}^{(E,1)}$	2	$E$	1	1	$\sqrt{3}YZ$
8	$\mathbb{G}_{2,0}^{(E,2)}$	2	$E$	2	0	$\sqrt{3}XY$
9	$\mathbb{G}_{2,1}^{(E,2)}$	2	$E$	2	1	$\frac{\sqrt{3}(X-Y)(X+Y)}{2}$
10	$\mathbb{G}_3^{(A_1)}$	3	$A_1$	—	—	$\frac{\sqrt{10}X(X^2-3Y^2)}{2}$
11	$\mathbb{G}_3^{(A_2,1)}$	3	$A_2$	1	—	$\frac{Z(3X^2+3Y^2-2Z^2)}{2}$
12	$\mathbb{G}_3^{(A_2,2)}$	3	$A_2$	2	—	$\frac{\sqrt{10}Y(3X^2-Y^2)}{2}$
13	$\mathbb{G}_{3,0}^{(E,1)}$	3	$E$	1	0	$\frac{\sqrt{6}Y(X^2+Y^2-4Z^2)}{2}$
14	$\mathbb{G}_{3,1}^{(E,1)}$	3	$E$	1	1	$-\frac{\sqrt{6}X(X^2+Y^2-4Z^2)}{2}$
15	$\mathbb{G}_{3,0}^{(E,2)}$	3	$E$	2	0	$\frac{\sqrt{15}Z(X-Y)(X+Y)}{2}$

continued ...

Table 8

No.	symbol	rank	irrep.	mul.	comp.	form
16	$\mathbb{G}_{3,1}^{(E,2)}$	3	$E$	2	1	$-\sqrt{15}XYZ$

- 
- Group info.: Generator =  $3_{001}^+$ ,  $2_{110}$

Table 9: Conjugacy class.

rep. SO	symmetry operations
1	1
$2_{100}$	$2_{100}$ , $2_{010}$ , $2_{110}$
$3_{001}^+$	$3_{001}^+$ , $3_{001}^-$

Table 10: Symmetry operations.

No.	SO	No.	SO	No.	SO	No.	SO	No.	SO
1	1	2	$2_{100}$	3	$2_{010}$	4	$2_{110}$	5	$3_{001}^+$
6	$3_{001}^-$								

Table 11: Character table.

	1	$2_{100}$	$3_{001}^+$
$A_1$	1	1	1
$A_2$	1	-1	1
$E$	2	0	-1

Table 12: Parity conversion.

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

Table 13: Symmetric product,  $[\Gamma \otimes \Gamma']_+$ .

	$A_1$	$A_2$	$E$
$A_1$	$A_1$	$A_2$	$E$
$A_2$		$A_1$	$E$
$E$			$A_1 + E$

Table 14: Anti-symmetric product,  $[\Gamma \otimes \Gamma']_-$ .

$A_1$	$A_2$	$E$
$-$	$-$	$A_2$

Table 15: Virtual-cluster sites.

No.	position	No.	position	No.	position	No.	position
1	$\begin{pmatrix} 1 & -1 & 1 \end{pmatrix}$	2	$\begin{pmatrix} 2 & 1 & -1 \end{pmatrix}$	3	$\begin{pmatrix} -1 & -2 & -1 \end{pmatrix}$	4	$\begin{pmatrix} -1 & 1 & -1 \end{pmatrix}$
5	$\begin{pmatrix} 1 & 2 & 1 \end{pmatrix}$	6	$\begin{pmatrix} -2 & -1 & 1 \end{pmatrix}$				

Table 16: Virtual-cluster basis.

symbol	1	2	3	4	5	6
$Q_0^{(A_1)}$	$\frac{\sqrt{6}}{6}$	$\frac{\sqrt{6}}{6}$	$\frac{\sqrt{6}}{6}$	$\frac{\sqrt{6}}{6}$	$\frac{\sqrt{6}}{6}$	$\frac{\sqrt{6}}{6}$
$Q_1^{(A_2)}$	$\frac{\sqrt{6}}{6}$	$-\frac{\sqrt{6}}{6}$	$-\frac{\sqrt{6}}{6}$	$-\frac{\sqrt{6}}{6}$	$\frac{\sqrt{6}}{6}$	$\frac{\sqrt{6}}{6}$
$Q_{1,0}^{(E)}$	$\frac{1}{2}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	0	$-\frac{1}{2}$
$Q_{1,1}^{(E)}$	$-\frac{\sqrt{3}}{6}$	$\frac{\sqrt{3}}{6}$	$-\frac{\sqrt{3}}{3}$	$\frac{\sqrt{3}}{6}$	$\frac{\sqrt{3}}{3}$	$-\frac{\sqrt{3}}{6}$
$Q_{2,0}^{(E,1)}$	$-\frac{\sqrt{3}}{6}$	$-\frac{\sqrt{3}}{6}$	$\frac{\sqrt{3}}{3}$	$-\frac{\sqrt{3}}{6}$	$\frac{\sqrt{3}}{3}$	$-\frac{\sqrt{3}}{6}$
$Q_{2,1}^{(E,1)}$	$-\frac{1}{2}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	0	$\frac{1}{2}$