SAMB for "UPt2Si2"

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- \bullet Group: No. 129 $~D_{4h}^{7}~P4/nmm~$ [tetragonal]
- Associated point group: No. 15 D_{4h} 4/mmm [tetragonal]
- Generation condition

 - time-reversal type: electric
 - irrep: [A1g]
 - spinless
- Unit cell:

$$a=4.1972,\ b=4.1972,\ c=9.6906,\ \alpha=90.0,\ \beta=90.0,\ \gamma=90.0$$

• Lattice vectors:

$$a_1 = (4.1972 \quad 0 \quad 0)$$

$$\mathbf{a}_2 = \begin{pmatrix} 0 & 4.1972 & 0 \end{pmatrix}$$

$$a_3 = \begin{pmatrix} 0 & 0 & 9.6906 \end{pmatrix}$$

Table 1: High-symmetry line: Γ -X.

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

• Kets: dimension = 46

Table 2: Hilbert space for full matrix.

N	No.	ket	No.	ket	No.	ket	No.	ket	No.	ket
	1	$f_{xyz}@{\rm U}_1$	2	$f_{ax}@\mathrm{U}_1$	3	$f_{ay}@{ m U}_1$	4	$f_{az}@{ m U}_1$	5	$f_{bx}@U_1$
	6	$f_{by}@{ m U}_1$	7	$f_{bz}@{ m U}_1$	8	$f_{xyz}@{\rm U}_2$	9	$f_{ax}@{ m U}_2$	10	$f_{ay}@{\rm U}_2$
	11	$f_{az}@{\rm U}_2$	12	$f_{bx}@{ m U}_2$	13	$f_{by}@{ m U}_2$	14	$f_{bz}@{ m U}_2$	15	d_u @Pt11
	16	d_v @Pt 1_1	17	$d_{yz}@{\rm Pt}1_1$	18	$d_{zx}@{\rm Pt}1_1$	19	d_{xy} @Pt1 ₁	20	d_u @Pt 1_2
:	21	$d_v@\mathrm{Pt}1_2$	22	$d_{yz}@{\rm Pt}1_2$	23	$d_{zx}@{\rm Pt}1_2$	24	d_{xy} @Pt 1_2	25	d_u @Pt21
:	26	d_v @Pt21	27	$d_{yz}@{\rm Pt}2_1$	28	$d_{zx}@{\rm Pt}2_1$	29	d_{xy} @Pt21	30	d_u @Pt 2_2
;	31	$d_v@{\rm Pt}2_2$	32	d_{yz} @Pt 2_2	33	d_{zx} @Pt22	34	d_{xy} @Pt22	35	$p_x@\mathrm{Si}1_1$
;	36	p_y @Si 1_1	37	$p_z@\mathrm{Si}1_1$	38	$p_x@\mathrm{Si1}_2$	39	p_y @Si 1_2	40	$p_z@\mathrm{Si}1_2$
	41	$p_x@\mathrm{Si}2_1$	42	p_y @Si 2_1	43	$p_z@\mathrm{Si}2_1$	44	p_x @Si 2_2	45	$p_y@\mathrm{Si}2_2$
4	46	$p_z@\mathrm{Si}2_2$								

• Sites in (primitive) unit cell:

Table 3: Site-clusters.

	site	position	mapping
S ₁ [2c: 4mm]	U_1	$\left(\frac{1}{4} \frac{1}{4} 0.7484\right)$	[1,2,7,8,11,12,13,14]
	U_2	$\left(\begin{array}{ccc} \frac{3}{4} & \frac{3}{4} & 0.2516 \end{array}\right)$	[3,4,5,6,9,10,15,16]
S_2 [2a: -4m2]	$Pt1_1$	$\begin{pmatrix} \frac{3}{4} & \frac{1}{4} & 0 \end{pmatrix}$	[1,2,5,6,11,12,15,16]
	$Pt1_2$	$\begin{pmatrix} \frac{1}{4} & \frac{3}{4} & 0 \end{pmatrix}$	[3,4,7,8,9,10,13,14]
S ₃ [2c: 4mm]	$Pt2_1$	$\left(\begin{array}{ccc} \frac{1}{4} & \frac{1}{4} & 0.3785 \end{array}\right)$	[1,2,7,8,11,12,13,14]
	$Pt2_2$	$\left \begin{array}{ccc} \left(\frac{3}{4} & \frac{3}{4} & 0.6215 \right) \right $	[3,4,5,6,9,10,15,16]
S_4 [2b: -4m2]	$Si1_1$	$\begin{pmatrix} \frac{3}{4} & \frac{1}{4} & \frac{1}{2} \end{pmatrix}$	[1,2,5,6,11,12,15,16]
	$Si1_2$	$\begin{pmatrix} \frac{1}{4} & \frac{3}{4} & \frac{1}{2} \end{pmatrix}$	[3,4,7,8,9,10,13,14]
S ₅ [2c: 4mm]	$Si2_1$	$\begin{pmatrix} \frac{1}{4} & \frac{1}{4} & 0.133 \end{pmatrix}$	[1,2,7,8,11,12,13,14]
	$Si2_2$	$\begin{array}{ c c c c c }\hline \left(\frac{3}{4} & \frac{3}{4} & 0.867\right) \\ \hline \end{array}$	[3,4,5,6,9,10,15,16]

• Bonds in (primitive) unit cell:

Table 4: Bond-clusters.

	bond	tail	head	n	#	$m{b}@m{c}$	mapping
B ₁ [8i: .m.]	b_1	$Si2_1$	$Pt1_1$	1	1	$\left(\begin{array}{cccc} \frac{1}{2} & 0 & 0.133 \end{array}\right) @ \left(0 & \frac{1}{4} & 0.0665 \right)$	[1,12]
	b_2	$Si2_1$	$Pt1_1$	1	1	$\left(-\frac{1}{2} 0 0.133\right) @ \left(\frac{1}{2} \frac{1}{4} 0.0665\right)$	[2,11]
	b_3	$\mathrm{Si}2_2$	$Pt1_2$	1	1	$\left(\begin{array}{cccc} \frac{1}{2} & 0 & -0.133 \end{array}\right) @ \left(\begin{array}{cccc} \frac{1}{2} & \frac{3}{4} & 0.9335 \end{array}\right)$	[3,10]
	b_4	$\mathrm{Si}2_2$	$Pt1_2$	1	1	$\left(\begin{array}{cccc} -\frac{1}{2} & 0 & -0.133 \end{array}\right) @ \left(0 & \frac{3}{4} & 0.9335 \right)$	[4,9]
	b_5	$\mathrm{Si}2_2$	$Pt1_1$	1	1	$\left(0 \frac{1}{2} -0.133\right) \circ \left(\frac{3}{4} \frac{1}{2} 0.9335\right)$	[5,16]
	b_6	$\mathrm{Si}2_2$	$Pt1_1$	1	1	$\begin{pmatrix} 0 & -\frac{1}{2} & -0.133 \end{pmatrix} @ \begin{pmatrix} \frac{3}{4} & 0 & 0.9335 \end{pmatrix}$	[6,15]
	b_7	$Si2_1$	$Pt1_2$	1	1	$\left(0 \frac{1}{2} 0.133\right) \circ \left(\frac{1}{4} 0 0.0665\right)$	[7,14]
	b_8	$Si2_1$	$Pt1_2$	1	1	$\begin{pmatrix} 0 & -\frac{1}{2} & 0.133 \end{pmatrix} @ \begin{pmatrix} \frac{1}{4} & \frac{1}{2} & 0.0665 \end{pmatrix}$	[8,13]
B ₂ [8i: .m.]	b ₉	$Si1_1$	$Pt2_1$	1	1	$\left(-\frac{1}{2} 0 0.1215\right) @ \left(0 \frac{1}{4} 0.43925\right)$	[1,12]
	b_{10}	$Si1_1$	$\mathrm{Pt}2_{1}$	1	1	$\left(\begin{array}{cccc} \frac{1}{2} & 0 & 0.1215 \end{array}\right) @ \left(\begin{array}{cccc} \frac{1}{2} & \frac{1}{4} & 0.43925 \end{array}\right)$	[2,11]
	b_{11}	$Si1_2$	$Pt2_2$	1	1	$\left(-\frac{1}{2} 0 -0.1215 \right) $ $\left(\frac{1}{2} \frac{3}{4} 0.56075 \right)$	[3,10]
	b_{12}	$Si1_2$	$Pt2_2$	1	1	$\left(\begin{array}{cccc} \left(\frac{1}{2} & 0 & -0.1215\right) @ \left(0 & \frac{3}{4} & 0.56075\right) \end{array}\right)$	[4,9]
	b_{13}	$Si1_1$	$Pt2_2$	1	1	$\begin{pmatrix} 0 & -\frac{1}{2} & -0.1215 \end{pmatrix} @ \begin{pmatrix} \frac{3}{4} & \frac{1}{2} & 0.56075 \end{pmatrix}$	[5,16]
	b_{14}	$Si1_1$	$Pt2_2$	1	1	$\left(0 \frac{1}{2} -0.1215\right) \otimes \left(\frac{3}{4} 0 0.56075\right)$	[6,15]
	b_{15}	$Si1_2$	$\mathrm{Pt}2_{1}$	1	1	$\left(0 - \frac{1}{2} 0.1215\right) @ \left(\frac{1}{4} 0 0.43925\right)$	[7,14]
	b ₁₆	$Si1_2$	$Pt2_1$	1	1	$\left(0 \frac{1}{2} 0.1215\right) @ \left(\frac{1}{4} \frac{1}{2} 0.43925\right)$	[8,13]

• SAMB:

$$\begin{split} & \boxed{ \text{No. 1} } \quad \hat{\mathbb{Q}}_0^{(A_{1g})} \ [M_1, S_1] \\ \\ & \hat{\mathbb{Z}}_1 = \mathbb{X}_1[\mathbb{Q}_0^{(a, A_{1g})}] \otimes \mathbb{Y}_1[\mathbb{Q}_0^{(s, A_{1g})}] \\ \\ & \hat{\mathbb{Z}}_1(\boldsymbol{k}) = \mathbb{X}_1[\mathbb{Q}_0^{(a, A_{1g})}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s, A_{1g})}] \end{split}$$

No. 2
$$\hat{\mathbb{Q}}_2^{(A_{1g})}$$
 [M₁, S₁]

$$\hat{\mathbb{Z}}_2 = \mathbb{X}_2[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{Y}_1[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_2(\boldsymbol{k}) = \mathbb{X}_2[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 3
$$\hat{\mathbb{Q}}_{4}^{(A_{1g},1)}$$
 [M₁, S₁]

$$\hat{\mathbb{Z}}_{3} = \mathbb{X}_{3}[\mathbb{Q}_{4}^{(a,A_{1g},1)}] \otimes \mathbb{Y}_{1}[\mathbb{Q}_{0}^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_3(\boldsymbol{k}) = \mathbb{X}_3[\mathbb{Q}_4^{(a,A_{1g},1)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\begin{tabular}{|c|c|c|c|c|}\hline No. \ 4 & \hat{\mathbb{Q}}_4^{(A_{1g},2)} \ [M_1,S_1] \\ \hline \end{tabular}$$

$$\hat{\mathbb{Z}}_4 = \mathbb{X}_4[\mathbb{Q}_4^{(a,A_{1g},2)}] \otimes \mathbb{Y}_1[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_4(\boldsymbol{k}) = \mathbb{X}_4[\mathbb{Q}_4^{(a,A_{1g},2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\begin{tabular}{|c|c|c|c|c|}\hline No. \ 5 & \hat{\mathbb{Q}}_6^{(A_{1g},1)} \ [M_1,S_1] \\ \hline \end{tabular}$$

$$\hat{\mathbb{Z}}_{5} = \mathbb{X}_{5}[\mathbb{Q}_{6}^{(a,A_{1g},1)}] \otimes \mathbb{Y}_{1}[\mathbb{Q}_{0}^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_5(\mathbf{k}) = \mathbb{X}_5[\mathbb{Q}_6^{(a,A_{1g},1)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 6
$$\hat{\mathbb{Q}}_{6}^{(A_{1g},2)}$$
 [M₁, S₁]

$$\hat{\mathbb{Z}}_{6} = \mathbb{X}_{6}[\mathbb{Q}_{6}^{(a,A_{1g},2)}] \otimes \mathbb{Y}_{1}[\mathbb{Q}_{0}^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_6(\boldsymbol{k}) = \mathbb{X}_6[\mathbb{Q}_6^{(a,A_{1g},2)}] \otimes \mathbb{U}_1[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 7
$$\hat{\mathbb{Q}}_0^{(A_{1g})}$$
 [M₂, S₂]

$$\hat{\mathbb{Z}}_7 = \mathbb{X}_7[\mathbb{Q}_0^{(a,A_{1g})}] \otimes \mathbb{Y}_2[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_7(\boldsymbol{k}) = \mathbb{X}_7[\mathbb{Q}_0^{(a,A_{1g})}] \otimes \mathbb{U}_2[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 8
$$\hat{\mathbb{Q}}_2^{(A_{1g})}$$
 [M₂, S₂]

$$\hat{\mathbb{Z}}_8 = \mathbb{X}_8[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{Y}_2[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_8(\boldsymbol{k}) = \mathbb{X}_8[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{U}_2[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 9
$$\hat{\mathbb{Q}}_{4}^{(A_{1g},1)}$$
 [M₂, S₂]

$$\hat{\mathbb{Z}}_9 = \mathbb{X}_9[\mathbb{Q}_4^{(a, A_{1g}, 1)}] \otimes \mathbb{Y}_2[\mathbb{Q}_0^{(s, A_{1g})}]$$

$$\hat{\mathbb{Z}}_9(\boldsymbol{k}) = \mathbb{X}_9[\mathbb{Q}_4^{(a,A_{1g},1)}] \otimes \mathbb{U}_2[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 10
$$\hat{\mathbb{Q}}_{4}^{(A_{1g},2)}$$
 [M₂,S₂]

$$\hat{\mathbb{Z}}_{10} = \mathbb{X}_{10}[\mathbb{Q}_4^{(a,A_{1g},2)}] \otimes \mathbb{Y}_2[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_{10}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{Q}_4^{(a,A_{1g},2)}] \otimes \mathbb{U}_2[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 11
$$\hat{\mathbb{Q}}_0^{(A_{1g})}$$
 [M₂, S₃]

$$\hat{\mathbb{Z}}_{11} = \mathbb{X}_7[\mathbb{Q}_0^{(a, A_{1g})}] \otimes \mathbb{Y}_3[\mathbb{Q}_0^{(s, A_{1g})}]$$

$$\hat{\mathbb{Z}}_{11}(\boldsymbol{k}) = \mathbb{X}_7[\mathbb{Q}_0^{(a,A_{1g})}] \otimes \mathbb{U}_3[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 12
$$\hat{\mathbb{Q}}_2^{(A_{1g})}$$
 [M₂, S₃]

$$\hat{\mathbb{Z}}_{12} = \mathbb{X}_{8}[\mathbb{Q}_{2}^{(a,A_{1g})}] \otimes \mathbb{Y}_{3}[\mathbb{Q}_{0}^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_{12}(\boldsymbol{k}) = \mathbb{X}_{8}[\mathbb{Q}_{2}^{(a,A_{1g})}] \otimes \mathbb{U}_{3}[\mathbb{Q}_{0}^{(s,A_{1g})}]$$

No. 13
$$\hat{\mathbb{Q}}_4^{(A_{1g},1)}$$
 [M₂,S₃]

$$\hat{\mathbb{Z}}_{13} = \mathbb{X}_9[\mathbb{Q}_4^{(a, A_{1g}, 1)}] \otimes \mathbb{Y}_3[\mathbb{Q}_0^{(s, A_{1g})}]$$

$$\hat{\mathbb{Z}}_{13}(\mathbf{k}) = \mathbb{X}_9[\mathbb{Q}_4^{(a,A_{1g},1)}] \otimes \mathbb{U}_3[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 14
$$\hat{\mathbb{Q}}_{4}^{(A_{1g},2)}$$
 [M₂, S₃]

$$\hat{\mathbb{Z}}_{14} = \mathbb{X}_{10}[\mathbb{Q}_4^{(a,A_{1g},2)}] \otimes \mathbb{Y}_3[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_{14}(\mathbf{k}) = \mathbb{X}_{10}[\mathbb{Q}_4^{(a,A_{1g},2)}] \otimes \mathbb{U}_3[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 15
$$\hat{\mathbb{Q}}_0^{(A_{1g})}$$
 [M₃, S₄]

$$\hat{\mathbb{Z}}_{15} = \mathbb{X}_{11}[\mathbb{Q}_0^{(a, A_{1g})}] \otimes \mathbb{Y}_4[\mathbb{Q}_0^{(s, A_{1g})}]$$

$$\hat{\mathbb{Z}}_{15}(\boldsymbol{k}) = \mathbb{X}_{11}[\mathbb{Q}_0^{(a,A_{1g})}] \otimes \mathbb{U}_4[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 16
$$\hat{\mathbb{Q}}_{2}^{(A_{1g})}$$
 [M₃, S₄]

$$\hat{\mathbb{Z}}_{16} = \mathbb{X}_{12}[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{Y}_4[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_{16}(\boldsymbol{k}) = \mathbb{X}_{12}[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{U}_4[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 17
$$\hat{\mathbb{Q}}_0^{(A_{1g})}$$
 [M₃, S₅]

$$\hat{\mathbb{Z}}_{17} = \mathbb{X}_{11}[\mathbb{Q}_0^{(a,A_{1g})}] \otimes \mathbb{Y}_5[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_{17}(\boldsymbol{k}) = \mathbb{X}_{11}[\mathbb{Q}_0^{(a,A_{1g})}] \otimes \mathbb{U}_5[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 18
$$\hat{\mathbb{Q}}_{2}^{(A_{1g})}$$
 [M₃, S₅]

$$\hat{\mathbb{Z}}_{18} = \mathbb{X}_{12}[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{Y}_5[\mathbb{Q}_0^{(s,A_{1g})}]$$

$$\hat{\mathbb{Z}}_{18}(\mathbf{k}) = \mathbb{X}_{12}[\mathbb{Q}_2^{(a,A_{1g})}] \otimes \mathbb{U}_5[\mathbb{Q}_0^{(s,A_{1g})}]$$

No. 19
$$\hat{\mathbb{Q}}_0^{(A_{1g})}$$
 [M₄, B₁]

$$\hat{\mathbb{Z}}_{19} = \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{Y}_{6}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{Y}_{7}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(b,E_{u})}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(b,E_{u})}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3} +$$

$$\hat{\mathbb{Z}}_{19}(\boldsymbol{k}) = \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{1}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{8}[\mathbb{T}_{3}^{(k,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,A_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,1}^{(k,E_{u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{6} \\ + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}]}{6} \\ + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}]}{6} \\ + \frac{\sqrt{3}\mathbb{Z}_{1,1}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{Q}_{9}[\mathbb{Q}_{1,1}^$$

No. 20 $\hat{\mathbb{Q}}_{2}^{(A_{1g})}$ [M₄, B₁]

$$\hat{\mathbb{Z}}_{20} = \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{Y}_{6}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{3} - \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{Y}_{7}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{6} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{6}$$

$$\begin{split} \hat{\mathbb{Z}}_{20}(\boldsymbol{k}) &= \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{1}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{6} + \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{6} - \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{8}[\mathbb{T}_{1}^{(k,A_{2u})}]}{6} \\ &- \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,A_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{8}[\mathbb{T}_{3}^{(k,B_{2u})}]}{6} - \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{12} \\ &+ \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{12} + \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{12} \\ &+ \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{12} + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,1}^{(k,E_{2u})}]}{12} \\ &+ \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{12} \\ &+ \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{F}_{7}[\mathbb{Q}_{1,1}^{(k,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{E}_{9}[\mathbb{Q}_{1}^{(u,A_{1g})}]} \otimes \mathbb{F}_{7}[\mathbb{Q}_{1,1}^{(k,E_{2u})}]}{12} \\ &+ \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{Q}_{1,1}^{(u,A_{1g})}]}}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{E}_{9}[\mathbb{Q}_{1,1}^{(u,A_{1g})}]} \otimes \mathbb{E}_{9}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{E}_{9}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{E}_{9}[\mathbb{Q}_{1,1}^{(u,A_{1g})}]}{12} \\ &+ \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}$$

No. 21 $\hat{\mathbb{Q}}_2^{(A_{1g})}$ [M₄, B₁]

$$\hat{\mathbb{Z}}_{21} = \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{Y}_{6}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{7} - \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{7}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,$$

$$\hat{\mathbb{Z}}_{21}(k) = \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{1}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{14} + \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(u,B_{2g})}]}{14} \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(k,B_{1g})}]} - \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}]}{14} \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(u,B_{1g})}]} - \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}]}{14} \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2}^{(k,E_{1g})}]}{14} + \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2,1}^{(k,E_{2u})}]}{28} + \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{1g})}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{3,0}^{(u,$$

No. 22 $\hat{\mathbb{Q}}_{4}^{(A_{1g},1)}$ [M₄, B₁]

$$\hat{\mathbb{Z}}_{22} = \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{Y}_{6}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{7}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3}$$

$$\hat{\mathbb{Z}}_{22}(\textbf{\textit{k}}) = \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{1}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}]}{6} \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(u,B_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(u,B_{1g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{2}^{(u,B_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,0}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{2}^{(u,B_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{2}^{(u,B_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,0}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{2}^{(u,B_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,0}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{2,1}^{(u,B_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,0}^{(k,E_{g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{Z}_{1,0}^{(u,B_{2u})} \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{Z}_{1,0}^{(u,B_{2u})} \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{Q}_{1,0}^{(u,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{Z}_{1,0}^{(u,B_{2u})}$$

No. 23 $\hat{\mathbb{Q}}_{4}^{(A_{1g},2)}$ [M₄, B₁]

$$\begin{split} \hat{\mathbb{Z}}_{23} &= \frac{\sqrt{105}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{Y}_{6}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{21} - \frac{\sqrt{105}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{7}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{42} \\ &- \frac{\sqrt{105}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{42} + \frac{3\sqrt{7}\mathbb{X}_{19}[\mathbb{Q}_{3,0}^{(a,E_{u},2)}] \otimes \mathbb{Y}_{7}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{14} + \frac{3\sqrt{7}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{Y}_{8}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{14} \end{split}$$

$$\hat{\mathbb{Z}}_{23}(k) = \frac{\sqrt{105}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{1}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{42} + \frac{\sqrt{105}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{42} - \frac{\sqrt{105}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{8}[\mathbb{T}_{1}^{(k,A_{2u})}]}{42} \\ + \frac{\sqrt{105}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{8}[\mathbb{T}_{3}^{(k,B_{2u})}]}{42} - \frac{\sqrt{105}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{42} \\ + \frac{\sqrt{105}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{42} + \frac{\sqrt{105}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_{g})}]}{84} \\ + \frac{\sqrt{105}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{84} \\ + \frac{\sqrt{105}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3,0}^{(u,B_{2u})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{84} \\ + \frac{\sqrt{105}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{84} \\ - \frac{\sqrt{105}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{84} \\ - \frac{3\sqrt{7}\mathbb{X}_{19}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{8}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{F}_{8}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{84} \\ - \frac{3\sqrt{7}\mathbb{X}_{19}[\mathbb{Q}_{3,0}^{(a,E_{u},2)}] \otimes \mathbb{F}_{8}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{28} \\ - \frac{3\sqrt{7}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{F}_{8}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{28} \\ - \frac{3\sqrt{7}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{28} \\ - \frac{3\sqrt{7}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(u,E_{u},2)}] \otimes \mathbb{F}_{9}[\mathbb{$$

No. 24
$$\hat{\mathbb{Q}}_0^{(A_{1g})}$$
 [M₄, B₁]

$$\hat{\mathbb{Z}}_{24} = \mathbb{X}_{23}[\mathbb{Q}_3^{(a,B_{2u})}] \otimes \mathbb{Y}_9[\mathbb{Q}_3^{(b,B_{2u})}]$$

$$\begin{split} \hat{\mathbb{Z}}_{24}(\boldsymbol{k}) &= \frac{\mathbb{X}_{23}[\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{2} + \frac{\mathbb{X}_{23}[\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{1}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{2} \\ &- \frac{\mathbb{X}_{23}[\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{8}[\mathbb{T}_{3}^{(k,B_{2u})}]}{2} - \frac{\mathbb{X}_{23}[\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}]}{2} \end{split}$$

No. 25
$$\hat{\mathbb{Q}}_2^{(A_{1g})}$$
 [M₄, B₁]

$$\hat{\mathbb{Z}}_{25} = -\frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_u)}] \otimes \mathbb{Y}_7[\mathbb{Q}_{1,0}^{(b,E_u)}]}{2} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{Y}_8[\mathbb{Q}_{1,1}^{(b,E_u)}]}{2}$$

$$\begin{split} \hat{\mathbb{Z}}_{25}(\pmb{k}) &= -\frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_u)}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2,1}^{(k,E_g)}]}{4} - \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_u)}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{4}[\mathbb{Q}_{2,1}^{(k,E_g)}]}{4} \\ &+ \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_u)}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_u)}]}{4} + \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_u)}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{6}[\mathbb{T}_{1,0}^{(k,E_u)}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_g)}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{3}[\mathbb{Q}_{2,0}^{(k,E_g)}]}{4} - \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_u)}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_u)}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_u)}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_u)}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_u)}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{7}[\mathbb{T}_{1,1}^{(k,E_u)}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_u)}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{T}_{1,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{9}[\mathbb{$$

No. 26
$$\hat{\mathbb{Q}}_{2}^{(A_{1g})}$$
 [M₄, B₁]

$$\hat{\mathbb{Z}}_{26} = -\mathbb{X}_{24}[\mathbb{G}_2^{(a,B_{2u})}] \otimes \mathbb{Y}_9[\mathbb{Q}_3^{(b,B_{2u})}]$$

$$\begin{split} \hat{\mathbb{Z}}_{26}(\textbf{\textit{k}}) &= -\frac{\mathbb{X}_{24}[\mathbb{G}_{2}^{(a,B_{2u})}] \otimes \mathbb{U}_{6}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{2}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{2} - \frac{\mathbb{X}_{24}[\mathbb{G}_{2}^{(a,B_{2u})}] \otimes \mathbb{U}_{7}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{1}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{2} \\ &+ \frac{\mathbb{X}_{24}[\mathbb{G}_{2}^{(a,B_{2u})}] \otimes \mathbb{U}_{8}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{8}[\mathbb{T}_{3}^{(k,B_{2u})}]}{2} + \frac{\mathbb{X}_{24}[\mathbb{G}_{2}^{(a,B_{2u})}] \otimes \mathbb{U}_{9}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{5}[\mathbb{T}_{1}^{(k,A_{2u})}]}{2} \end{split}$$

No. 27 $\hat{\mathbb{Q}}_0^{(A_{1g})}$ [M₄, B₂]

$$\hat{\mathbb{Z}}_{27} = \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{Y}_{10}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{Y}_{11}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1$$

$$\hat{\mathbb{Z}}_{27}(\textbf{\textit{k}}) = \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{10}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1}^{(k,A_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{16}[\mathbb{T}_{3}^{(k,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{14}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{E}_{13}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{1g})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{E}_{14}[\mathbb{E}_{1,0}^{(u,B_{2u})}] \otimes \mathbb{E}_{14}[\mathbb{E}_{1,0}^{(u,B_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{E}_{10}[\mathbb{Q}_{1,1}^{(u,A_{1g})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3,1}^{(u,B_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{E}_{10}[\mathbb{Q}_{1,1}^{(u,B_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3,1}^{(u,B_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{E}_{10}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3,1}^{(u,B_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{E}_{10}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3,1}^{(u,B_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{E}_{10}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3,1}^{(u,B_{2u})}]}{6} \\ - \frac{\mathbb{E}_{10}[\mathbb{Q}_{3,1}^{(u,B_{2u})}] \otimes \mathbb{E}_{11}[\mathbb{Q}_{3,1$$

No. 28 $\hat{\mathbb{Q}}_{2}^{(A_{1g})}$ [M₄, B₂]

$$\hat{\mathbb{Z}}_{28} = \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{Y}_{10}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{3} - \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{Y}_{11}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{6} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{6}$$

$$\hat{\mathbb{Z}}_{28}(\boldsymbol{k}) = \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{6} + \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{10}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{6} - \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1}^{(k,A_{2u})}]}{6} \\ - \frac{\sqrt{6}\mathbb{X}_{13}[\mathbb{Q}_{1}^{(a,A_{2u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{16}[\mathbb{T}_{3}^{(k,B_{2u})}]}{6} - \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1}^{(k,A_{2u})}]}{12} \\ + \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{g})}]}{12} + \frac{\sqrt{6}\mathbb{X}_{15}[\mathbb{Q}_{1,0}^{(a,E_{u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{g})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1}^{(k,A_{2u})}]}{12} \\ + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{g})}]}{12} + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,B_{2u})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{1g})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1}^{(k,A_{2u})}]}{12} \\ + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,A_{2u})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{g})}]}{12} + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1,1}^{(k,E_{2u})}]}{12} \\ + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,B_{2u})}] \otimes \mathbb{F}_{14}[\mathbb{Q}_{1,1}^{(k,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{E}_{13}[\mathbb{Q}_{1,1}^{(k,E_{u})}]}{12} \\ + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(a,E_{u})}] \otimes \mathbb{E}_{14}[\mathbb{Q}_{1,1}^{(u,E_{u})}]}{12} - \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(u,E_{u})}] \otimes \mathbb{E}_{14}[\mathbb{Q}_{1,1}^{(u,E_{u})}]}{12} \\ + \frac{\sqrt{6}\mathbb{X}_{16}[\mathbb{Q}_{1,1}^{(u,E_{u})}] \otimes \mathbb{E}_{14}[\mathbb{Q}_$$

No. 29
$$\hat{\mathbb{Q}}_{2}^{(A_{1g})}$$
 [M₄, B₂]

$$\hat{\mathbb{Z}}_{29} = \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{Y}_{10}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{7} - \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{11}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{11}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{14} - \frac{\sqrt{35}\mathbb{X}_{20}[\mathbb{Q}_{3,1}^{(a,E_{u},2)}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{3,0}^{(b,E_{u})}]}{14} - \frac{\mathbb{Q}_{3,0}^{(a,E_{u},1)} \otimes \mathbb{Q}_{3,0}^{(a,E_{u},1)}}{14} - \frac{\mathbb{Q}_{3,0}^{(a,E_{u},1)} \otimes \mathbb{Q}_{3,0}^{(a,E_{u},1)}}{14}$$

$$\hat{\mathbb{Z}}_{29}(k) = \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{0}^{(u,A_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{0}^{(k,A_{19})}]}{14} + \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}]}{14} \otimes \mathbb{F}_{10}[\mathbb{Q}_{2}^{(k,B_{2u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{F}_{10}[\mathbb{Q}_{3}^{(k,A_{2u})}]}{14} \otimes \mathbb{F}_{10}[\mathbb{Q}_{3}^{(k,B_{2u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,0}^{(k,E_{2u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{2u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,0}^{(k,E_{2u})}]}{14} - \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{13}[\mathbb{Q}_{2,1}^{(u,A_{19})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{2u})}]}{28} + \frac{\sqrt{21}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,A_{19})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{2u})}]}{28} - \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{2u})}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{19})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{2u})}]}{28} - \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,0}^{(u,A_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{19})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{28} - \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{2,0}^{(u,E_{u},1)}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,1}^{(u,E_{u},1)}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,0}^{(a,E_{u},2)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,0}^{(u,E_{u},2)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,1}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,1}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,1}^{(u,E_{u},1)}]}{28} + \frac{\sqrt{21}\mathbb{X}_{18}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,0}^{(u,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3,1}^{$$

No. 30
$$\hat{\mathbb{Q}}_{4}^{(A_{1g},1)}$$
 [M₄, B₂]

$$\hat{\mathbb{Z}}_{30} = \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{Y}_{10}[\mathbb{Q}_{1}^{(b,A_{2u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{11}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{1,1}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{1,1}^{(a,E_{u},1)}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{Z}_{18}[\mathbb{Q}_{1,1}^{(b,E_{u},1)}]}{3} + \frac{\sqrt{3}\mathbb{Z}_{1$$

$$\hat{\mathbb{Z}}_{30}(\boldsymbol{k}) = \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_{0}^{(k,A_{1g})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{10}[\mathbb{Q}_{2}^{(k,B_{1g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{13}[\mathbb{T}_{1}^{(k,A_{2u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{14}[\mathbb{Q}_{3}^{(a,A_{2u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{16}[\mathbb{T}_{3}^{(k,B_{2u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{17}[\mathbb{Q}_{3,0}^{(a,E_{u},1)}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{6} + \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(a,E_{u},1)}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{6} - \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{3,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{3,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{3,1}^{(u,B_{1g})}]}{6} \\ - \frac{\sqrt{3}\mathbb{X}_{18}[\mathbb{Q}_{$$

$$\begin{split} & \boxed{ \begin{bmatrix} \boxed{No. 31} \end{bmatrix} } \begin{array}{c} \hat{\mathbb{Q}}_{4}^{(A_{1g},2)} \left[\mathbf{M}_{4}, \mathbf{B}_{2} \right] } \\ \hat{\mathbb{Z}}_{31} & = \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3}^{(a,A_{2u})} \right] \otimes \mathbb{Y}_{10} \left[\mathbb{Q}_{1}^{(b,A_{2u})} \right]}{21} - \frac{\sqrt{105}\mathbb{X}_{17} \left[\mathbb{Q}_{3,0}^{(a,E_{u},1)} \right] \otimes \mathbb{Y}_{11} \left[\mathbb{Q}_{1,0}^{(b,E_{u})} \right]}{14} + \frac{3\sqrt{7}\mathbb{X}_{20} \left[\mathbb{Q}_{3,1}^{(a,E_{u},2)} \right] \otimes \mathbb{Y}_{12} \left[\mathbb{Q}_{1,1}^{(b,E_{u})} \right]}{14} \\ \hat{\mathbb{Z}}_{31}(k) & = \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3}^{(a,A_{2u})} \right] \otimes \mathbb{U}_{10} \left[\mathbb{Q}_{1}^{(u,A_{2u})} \right] \otimes \mathbb{F}_{9} \left[\mathbb{Q}_{0}^{(b,A_{1g})} \right]}{14} + \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3}^{(a,A_{2u})} \right] \otimes \mathbb{U}_{11} \left[\mathbb{Q}_{1,1}^{(b,E_{u})} \right]}{14} \\ & - \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3}^{(a,A_{2u})} \right] \otimes \mathbb{U}_{10} \left[\mathbb{Q}_{1}^{(u,A_{1g})} \right] \otimes \mathbb{F}_{13} \left[\mathbb{Q}_{1,1}^{(b,A_{2u})} \right]}{42} \\ & - \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3}^{(a,A_{2u})} \right] \otimes \mathbb{U}_{10} \left[\mathbb{Q}_{1}^{(u,A_{2u})} \right] \otimes \mathbb{F}_{13} \left[\mathbb{Q}_{2,1}^{(b,E_{u})} \right]}{42} \\ & - \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3}^{(a,E_{u},1)} \right] \otimes \mathbb{U}_{10} \left[\mathbb{Q}_{1}^{(u,A_{2u})} \right] \otimes \mathbb{F}_{13} \left[\mathbb{Q}_{2,1}^{(b,E_{u})} \right]}{42} \\ & - \frac{\sqrt{105}\mathbb{X}_{17} \left[\mathbb{Q}_{3,0}^{(a,E_{u},1)} \right] \otimes \mathbb{U}_{12} \left[\mathbb{Q}_{2,1}^{(b,E_{u})} \right]}{42} \\ & - \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3}^{(a,E_{u},1)} \right] \otimes \mathbb{U}_{12} \left[\mathbb{Q}_{3,1}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{14} \left[\mathbb{Q}_{3,0}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{18} \left[\mathbb{Q}_{3,1}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{18} \left[\mathbb{Q}_{3,1}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{18} \left[\mathbb{Q}_{3,1}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{18} \left[\mathbb{Q}_{3,1}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{18} \left[\mathbb{Q}_{3,1}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{18} \left[\mathbb{Q}_{3,1}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})} \right]}{42} \\ & + \frac{\sqrt{105}\mathbb{X}_{18} \left[\mathbb{Q}_{3,1}^{(a,E_{u},1)} \right] \otimes \mathbb{E}_{14} \left[\mathbb{Q}_{3,0}^{(b,E_{u})$$

$$\begin{split} & \widehat{\mathbb{N}}_{0}. \ 32 \quad \widehat{\mathbb{Q}}_{0}^{(A_{1g})} \ [M_{4}, B_{2}] \\ & \widehat{\mathbb{Z}}_{32} = \mathbb{X}_{23} [\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{Y}_{13} [\mathbb{Q}_{3}^{(b,B_{2u})}] \\ & \widehat{\mathbb{Z}}_{32}(\boldsymbol{k}) = \frac{\mathbb{X}_{23} [\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{10} [\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{10} [\mathbb{Q}_{2}^{(k,B_{1g})}]}{2} + \frac{\mathbb{X}_{23} [\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{11} [\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{9} [\mathbb{Q}_{0}^{(k,A_{1g})}]}{2} \\ & - \frac{\mathbb{X}_{23} [\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{12} [\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{16} [\mathbb{T}_{3}^{(k,B_{2u})}]}{2} - \frac{\mathbb{X}_{23} [\mathbb{Q}_{3}^{(a,B_{2u})}] \otimes \mathbb{U}_{13} [\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{13} [\mathbb{T}_{1}^{(k,A_{2u})}]}{2} \\ \end{split}$$

$$\begin{array}{c} \boxed{\text{No. } 33} \quad \hat{\mathbb{Q}}_{2}^{(A_{1g})} \ [\text{M}_{4}, \text{B}_{2}] \\ \\ \hat{\mathbb{Z}}_{33} = -\frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_{u})}] \otimes \mathbb{Y}_{11}[\mathbb{Q}_{1,0}^{(b,E_{u})}]}{2} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{Y}_{12}[\mathbb{Q}_{1,1}^{(b,E_{u})}]}{2} \end{array}$$

$$\begin{split} \hat{\mathbb{Z}}_{33}(\boldsymbol{k}) &= -\frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_{u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{4} - \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_{u})}] \otimes \mathbb{U}_{11}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{12}[\mathbb{Q}_{2,1}^{(k,E_{g})}]}{4} + \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_{u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{4} \\ &+ \frac{\sqrt{2}\mathbb{X}_{21}[\mathbb{G}_{2,0}^{(a,E_{u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{14}[\mathbb{T}_{1,0}^{(k,E_{u})}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_{1}^{(u,A_{2u})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{4} - \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{U}_{12}[\mathbb{Q}_{3}^{(u,B_{2u})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{3}^{(u,A_{1g})}] \otimes \mathbb{F}_{11}[\mathbb{Q}_{2,0}^{(k,E_{g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_{0}^{(u,A_{1g})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_{2}^{(u,B_{1g})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(k,E_{u})}]}{4} + \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{T}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{F}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(a,E_{u})}] \otimes \mathbb{F}_{15}[\mathbb{F}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_{22}[\mathbb{G}_{2,1}^{(u,B_{1g})}] \otimes \mathbb{F}_{15}[\mathbb{F}_{1,1}^{(u,B_{1g})}]}{4} \\ &- \frac{\sqrt{2}\mathbb{X}_$$

No. 34
$$\hat{\mathbb{Q}}_{2}^{(A_{1g})}$$
 [M₄, B₂]

$$\hat{\mathbb{Z}}_{34} = -\mathbb{X}_{24}[\mathbb{Q}_2^{(a,B_{2u})}] \otimes \mathbb{Y}_{13}[\mathbb{Q}_3^{(b,B_{2u})}]$$

$$\begin{split} \hat{\mathbb{Z}}_{34}(\pmb{k}) &= -\frac{\mathbb{X}_{24}[\mathbb{G}_2^{(a,B_{2u})}] \otimes \mathbb{U}_{10}[\mathbb{Q}_1^{(u,A_{2u})}] \otimes \mathbb{F}_{10}[\mathbb{Q}_2^{(k,B_{1g})}]}{2} - \frac{\mathbb{X}_{24}[\mathbb{G}_2^{(a,B_{2u})}] \otimes \mathbb{U}_{11}[\mathbb{Q}_3^{(u,B_{2u})}] \otimes \mathbb{F}_{9}[\mathbb{Q}_0^{(k,A_{1g})}]}{2} \\ &+ \frac{\mathbb{X}_{24}[\mathbb{G}_2^{(a,B_{2u})}] \otimes \mathbb{U}_{12}[\mathbb{T}_0^{(u,A_{1g})}] \otimes \mathbb{F}_{16}[\mathbb{T}_3^{(k,B_{2u})}]}{2} + \frac{\mathbb{X}_{24}[\mathbb{G}_2^{(a,B_{2u})}] \otimes \mathbb{U}_{13}[\mathbb{T}_2^{(u,B_{1g})}] \otimes \mathbb{F}_{13}[\mathbb{T}_1^{(k,A_{2u})}]}{2} \end{split}$$

Table 5: Atomic SAMB group.

group	bra	ket
M_1	$f_{xyz}, f_{ax}, f_{ay}, f_{az}, f_{bx}, f_{by}, f_{bz}$	$f_{xyz}, f_{ax}, f_{ay}, f_{az}, f_{bx}, f_{by}, f_{bz}$
M_2	$d_u, d_v, d_{yz}, d_{zx}, d_{xy}$	$d_u, d_v, d_{yz}, d_{zx}, d_{xy}$
M_3	p_x,p_y,p_z	p_x,p_y,p_z
M_4	p_x,p_y,p_z	$d_u, d_v, d_{yz}, d_{zx}, d_{xy}$

Table 6: Atomic SAMB.

symbol	type	group	form
\mathbb{X}_1	$\mathbb{Q}_0^{(a,A_{1g})}$	$ m M_1$	$\begin{pmatrix} \frac{\sqrt{7}}{7} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{7}}{7} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{7}}{7} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{7}}{7} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{7}}{7} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{7}}{7} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{7}}{7} \end{pmatrix}$
\mathbb{X}_2	$\mathbb{Q}_2^{(a,A_{1g})}$	$ m M_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{21}}{21} & 0 & 0 & \frac{\sqrt{35}}{14} & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{21}}{21} & 0 & 0 & -\frac{\sqrt{35}}{14} & 0 \\ 0 & 0 & 0 & \frac{2\sqrt{21}}{21} & 0 & 0 & 0 \\ 0 & \frac{\sqrt{35}}{14} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{35}}{14} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0$
\mathbb{X}_3	$\mathbb{Q}_4^{(a,A_{1g},1)}$	$ m M_1$	$\begin{pmatrix} -\frac{\sqrt{66}}{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{\sqrt{66}}{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{66}}{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{\sqrt{66}}{22} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -\frac{\sqrt{66}}{66} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{66}}{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{66}}{66} \end{pmatrix}$
\mathbb{X}_4	$\mathbb{Q}_4^{(a,A_{1g},2)}$	$ m M_1$	$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -\frac{\sqrt{2310}}{308} & 0 & 0 & -\frac{3\sqrt{154}}{308} & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{2310}}{308} & 0 & 0 & \frac{3\sqrt{154}}{308} & 0 \\ 0 & 0 & 0 & \frac{\sqrt{2310}}{154} & 0 & 0 & 0 \\ 0 & -\frac{3\sqrt{154}}{308} & 0 & 0 & \frac{\sqrt{2310}}{132} & 0 & 0 \\ 0 & 0 & \frac{3\sqrt{154}}{308} & 0 & 0 & \frac{\sqrt{2310}}{132} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2310}}{66} \end{pmatrix}$

Table 6

	4		C
symbol	type	group	form
			$\left(\frac{2\sqrt{462}}{77} 0 0 0 0 0 0$
			$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
	(a.4. 1)		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
\mathbb{X}_5	$\mathbb{Q}_6^{(a,A_{1g},1)}$	M_1	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
			$\begin{array}{cccccccccccccccccccccccccccccccccccc$
			$\begin{bmatrix} 0 & 0 & 0 & 0 & -\frac{3\sqrt{462}}{154} & 0 \end{bmatrix}$
			$\left \begin{array}{cccccccccccccccccccccccccccccccccccc$
			$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$
			$\begin{bmatrix} 0 & -\frac{5\sqrt{66}}{132} & 0 & 0 & -\frac{\sqrt{110}}{44} & 0 & 0 \end{bmatrix}$
			$\begin{bmatrix} 0 & 0 & -\frac{5\sqrt{66}}{132} & 0 & 0 & \frac{\sqrt{110}}{44} & 0 \end{bmatrix}$
\mathbb{X}_6	$\mathbb{Q}_6^{(a,A_{1g},2)}$	M_1	$\begin{bmatrix} 0 & 0 & 0 & \frac{5\sqrt{66}}{66} & 0 & 0 & 0 \end{bmatrix}$
			$\begin{bmatrix} 0 & -\frac{\sqrt{110}}{44} & 0 & 0 & -\frac{\sqrt{66}}{44} & 0 & 0 \end{bmatrix}$
			$\begin{bmatrix} 0 & 0 & \frac{\sqrt{110}}{44} & 0 & 0 & -\frac{\sqrt{66}}{44} & 0 \end{bmatrix}$
			$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{66}}{22} \end{pmatrix}$
\mathbb{X}_7	$\mathbb{Q}_0^{(a,A_{1g})}$	M_2	$\begin{pmatrix} \frac{\sqrt{5}}{5} & 0 & 0 & 0 & 0\\ 0 & \frac{\sqrt{5}}{5} & 0 & 0 & 0\\ 0 & 0 & \frac{\sqrt{5}}{5} & 0 & 0\\ 0 & 0 & 0 & \frac{\sqrt{5}}{5} & 0\\ 0 & 0 & 0 & 0 & \frac{\sqrt{5}}{5} \end{pmatrix}$
\mathbb{X}_8	$\mathbb{Q}_2^{(a,A_{1g})}$	$ m M_2$	$\begin{pmatrix} \frac{\sqrt{14}}{7} & 0 & 0 & 0 & 0\\ 0 & -\frac{\sqrt{14}}{7} & 0 & 0 & 0\\ 0 & 0 & \frac{\sqrt{14}}{14} & 0 & 0\\ 0 & 0 & 0 & \frac{\sqrt{14}}{14} & 0\\ 0 & 0 & 0 & 0 & -\frac{\sqrt{14}}{7} \end{pmatrix}$
X 9	$\mathbb{Q}_4^{(a,A_{1g},1)}$	$ m M_2$	$\begin{pmatrix} \frac{\sqrt{30}}{10} & 0 & 0 & 0 & 0\\ 0 & \frac{\sqrt{30}}{10} & 0 & 0 & 0\\ 0 & 0 & -\frac{\sqrt{30}}{15} & 0 & 0\\ 0 & 0 & 0 & -\frac{\sqrt{30}}{15} & 0\\ 0 & 0 & 0 & 0 & -\frac{\sqrt{30}}{15} \end{pmatrix}$

Table 6

Table 6		1	
symbol	type	group	form
\mathbb{X}_{10}	$\mathbb{Q}_4^{(a,A_{1g},2)}$	$ m M_2$	$\begin{pmatrix} \frac{\sqrt{42}}{14} & 0 & 0 & 0 & 0\\ 0 & -\frac{\sqrt{42}}{14} & 0 & 0 & 0\\ 0 & 0 & -\frac{\sqrt{42}}{21} & 0 & 0\\ 0 & 0 & 0 & -\frac{\sqrt{42}}{21} & 0\\ 0 & 0 & 0 & 0 & \frac{2\sqrt{42}}{21} \end{pmatrix}$
\mathbb{X}_{11}	$\mathbb{Q}_0^{(a,A_{1g})}$	M_3	$\begin{pmatrix} \frac{\sqrt{3}}{3} & 0 & 0\\ 0 & \frac{\sqrt{3}}{3} & 0\\ 0 & 0 & \frac{\sqrt{3}}{3} \end{pmatrix}$
\mathbb{X}_{12}	$\mathbb{Q}_2^{(a,A_{1g})}$	M_3	$ \begin{pmatrix} -\frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & -\frac{\sqrt{6}}{6} & 0 \\ 0 & 0 & \frac{\sqrt{6}}{3} \end{pmatrix} $ $ \begin{pmatrix} 0 & 0 & 0 & \frac{\sqrt{30}}{10} & 0 \\ 0 & 0 & \sqrt{30} & 0 & 0 \end{pmatrix} $
\mathbb{X}_{13}	$\mathbb{Q}_1^{(a,A_{2u})}$	$ m M_4$	$\begin{pmatrix} 0 & 0 & \frac{1}{10} & 0 & 0 \\ \frac{\sqrt{10}}{5} & 0 & 0 & 0 & 0 \end{pmatrix}$
\mathbb{X}_{14}	$\mathbb{Q}_3^{(a,A_{2u})}$	$ m M_4$	$\begin{pmatrix} 0 & 0 & 0 & -\frac{\sqrt{5}}{5} & 0 \\ 0 & 0 & -\frac{\sqrt{5}}{5} & 0 & 0 \\ \sqrt{15} & 0 & 0 & 0 & 0 \end{pmatrix}$
\mathbb{X}_{15}	$\mathbb{Q}_{1,0}^{(a,E_u)}$	$ m M_4$	$\begin{pmatrix} \frac{1}{5} & 0 & 0 & 0 & 0 \\ -\frac{\sqrt{10}}{10} & \frac{\sqrt{30}}{10} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sqrt{30}}{10} \\ 0 & 0 & 0 & \frac{\sqrt{30}}{10} & 0 \end{pmatrix}$
\mathbb{X}_{16}	$\mathbb{Q}_{1,1}^{(a,E_u)}$	$ m M_4$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{30}}{10} \\ -\frac{\sqrt{10}}{10} & -\frac{\sqrt{30}}{10} & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{30}}{10} & 0 & 0 \end{pmatrix}$
\mathbb{X}_{17}	$\mathbb{Q}_{3,0}^{(a,E_u,1)}$	$ m M_4$	$\begin{pmatrix} -\frac{\sqrt{15}}{10} & \frac{3\sqrt{5}}{10} & 0 & 0 & 0\\ 0 & 0 & 0 & 0 & -\frac{\sqrt{5}}{5}\\ 0 & 0 & 0 & -\frac{\sqrt{5}}{5} & 0 \end{pmatrix}$
\mathbb{X}_{18}	$\mathbb{Q}_{3,1}^{(a,E_u,1)}$	$ m M_4$	$\begin{pmatrix} 0 & 0 & 0 & 0 & -\frac{\sqrt{5}}{5} \\ -\frac{\sqrt{15}}{10} & -\frac{3\sqrt{5}}{10} & 0 & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{5}}{5} & 0 & 0 \end{pmatrix}$
\mathbb{X}_{19}	$\mathbb{Q}_{3,0}^{(a,E_u,2)}$	$ m M_4$	$\begin{pmatrix} -\frac{1}{2} & -\frac{\sqrt{3}}{6} & 0 & 0 & 0\\ 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{3}\\ 0 & 0 & 0 & -\frac{\sqrt{3}}{3} & 0 \end{pmatrix}$

Table 6

Table 0			
symbol	type	group	form
\mathbb{X}_{20}	$\mathbb{Q}_{3,1}^{(a,E_u,2)}$	$ m M_4$	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{3} \\ -\frac{1}{2} & \frac{\sqrt{3}}{6} & 0 & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{3}}{3} & 0 & 0 \end{pmatrix}$
\mathbb{X}_{21}	$\mathbb{G}_{2,0}^{(a,E_u)}$	$ m M_4$	$\begin{pmatrix} -\frac{\sqrt{2}}{2} & -\frac{\sqrt{6}}{6} & 0 & 0 & 0\\ 0 & 0 & 0 & 0 & -\frac{\sqrt{6}}{6}\\ 0 & 0 & 0 & \frac{\sqrt{6}}{6} & 0 \end{pmatrix}$
\mathbb{X}_{22}	$\mathbb{G}_{2,1}^{(a,E_u)}$	$ m M_4$	$ \begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\sqrt{6}}{6} \\ \frac{\sqrt{2}}{2} & -\frac{\sqrt{6}}{6} & 0 & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{6}}{6} & 0 & 0 \end{pmatrix} $
\mathbb{X}_{23}	$\mathbb{Q}_3^{(a,B_{2u})}$	$ m M_4$	$\begin{pmatrix} 0 & 0 & 0 & \frac{\sqrt{3}}{3} & 0 \\ 0 & 0 & -\frac{\sqrt{3}}{3} & 0 & 0 \\ 0 & \frac{\sqrt{3}}{3} & 0 & 0 & 0 \end{pmatrix}$
\mathbb{X}_{24}	$\mathbb{G}_2^{(a,B_{2u})}$	$ m M_4$	$\begin{pmatrix} 0 & \frac{\sqrt{3}}{3} & 0 & 0 & 0 \\ 0 & 0 & 0 & -\frac{\sqrt{6}}{6} & 0 \\ 0 & 0 & \frac{\sqrt{6}}{6} & 0 & 0 \\ 0 & \frac{\sqrt{6}}{3} & 0 & 0 & 0 \end{pmatrix}$

Table 7: Cluster SAMB.

symbol	type	cluster	form
\mathbb{Y}_1	$\mathbb{Q}_0^{(s,A_{1g})}$	S_1	$\left(egin{array}{cc} \sqrt{2} & \sqrt{2} \\ 2 & 2 \end{array} ight)$
\mathbb{Y}_2	$\mathbb{Q}_0^{(s,A_{1g})}$	S_2	$\left(egin{array}{cc} \sqrt{2} & \sqrt{2} \\ 2 & 2 \end{array} ight)$
\mathbb{Y}_3	$\mathbb{Q}_0^{(s,A_{1g})}$	S_3	$\left(egin{array}{cc} rac{\sqrt{2}}{2} & rac{\sqrt{2}}{2} \end{array} ight)$
\mathbb{Y}_4	$\mathbb{Q}_0^{(s,A_{1g})}$	S_4	$\begin{pmatrix} \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{pmatrix}$
\mathbb{Y}_5	$\mathbb{Q}_0^{(s,A_{1g})}$	S_5	$\begin{pmatrix} \sqrt{2} & \sqrt{2} \\ 2 & 2 \end{pmatrix}$
\mathbb{Y}_6	$\mathbb{Q}_1^{(b,A_{2u})}$	B_1	$\left[\begin{array}{cccccccccccccccccccccccccccccccccccc$
\mathbb{Y}_7	$\mathbb{Q}_{1,0}^{(b,E_u)}$ $\mathbb{Q}_{1,1}^{(b,E_u)}$	B_1	$\left(\begin{array}{cccccccccccccccccccccccccccccccccccc$
\mathbb{Y}_8	$\mathbb{Q}_{1,1}^{(b,E_u)}$	B_1	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} & -\frac{1}{2} \end{pmatrix}$

Table 7

symbol	type	cluster	form							
\mathbb{Y}_9	$\mathbb{Q}_3^{(b,B_{2u})}$	B_1								
	$\mathbb{Q}_1^{(b,A_{2u})}$	B_2	$\left(\begin{array}{cccccccccccccccccccccccccccccccccccc$							
	$\mathbb{Q}_{1,0}^{(b,E_u)}$	B_2	$\left(\begin{array}{cccccccccccccccccccccccccccccccccccc$							
\mathbb{Y}_{12}	$\mathbb{Q}_{1,1}^{(b,E_u)}$	B_2	$\begin{pmatrix} 0 & 0 & 0 & 0 & \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} & -\frac{1}{2} \end{pmatrix}$							
\mathbb{Y}_{13}	$\mathbb{Q}_3^{(b,B_{2u})}$	B_2								

Table 8: Uniform SAMB.

symbol	type	cluster	form														
			$\begin{pmatrix} \frac{\sqrt{2}}{2} \\ 0 \end{pmatrix}$	$0 \\ \frac{\sqrt{2}}{2}$	0	0	0	0	0	0	0	0					
			0	0	0	0	0	0	0	0	0	0					
			0	0	0	0	0	0	0	0	0	0					
\mathbb{U}_1	$\mathbb{Q}_0^{(s,A_{1g})}$	S_1	0	0	0	0	0	0	0	0	0	0					
01	₹0		0	0	0	0	0	0	0	0	0	0					
			0	0	0	0	0	0	0	0	0	0					
			0	0	0	0	0	0	0	0	0	0					
			0	0	0	0	0	0	0	0	0	0					
			(0	0	0	0	0	0	0	0	0	0/					
			1	0 0		0	0	0	0	0	0	0					
				0 0		0	0	0	0	0	0	0					
			0	$0 \frac{\sqrt{2}}{2}$		0	0	0	0	0	0	0					
									0 0		$\frac{\sqrt{2}}{2}$	0	0	0	0	0	0
\mathbb{U}_2	$\mathbb{Q}_0^{(s,A_{1g})}$	S_2	i	0 0		0	0	0	0	0	0	0					
_	30	_		0 0		0	0	0	0	0	0	0					
				0 0		0	0	0	0	0	0	0					
			t t	0 0		0	0	0	0	0	0	0					
			l l	0 0		0	0	0	0	0	0	0					
			/0	0 0		0	0	0	0	0	0	0/					

Table 8

Table 8		ī	T										
symbol	type	cluster					fo	rm					
			(0	0	0	0	0	0	0	0	0	0/	
			0	0	0	0	0	0	0	0	0	0	
			0	0	0	0	0	0	0	0	0	0	
			0	0	0	0	0_	0	0	0	0	0	
\mathbb{U}_3	$\mathbb{Q}_0^{(s,A_{1g})}$	S_3	0	0	0	0	$\frac{\sqrt{2}}{2}$	0_	0	0	0	0	
U3	₹0	53	0	0	0	0	0	$\frac{\sqrt{2}}{2}$	0	0	0	0	
			0	0	0	0	0	0	0	0	0	0	
			0	0	0	0	0	0	0	0	0	0	
			0	0	0	0	0	0	0	0	0	0	
			/0	0	0	0	0	0	0	0	0	0/	
			/0	0	0	0	0 (0 0		0	0	0/	
		S_4	0	0	0	0	0 (0 0		0	0	0	
			0	0	0	0	0 (0 0		0	0	0	
			0	0	0	0	0 (0 0		0	0	0	
\mathbb{U}_4	$\mathbb{Q}_0^{(s,A_{1g})}$		0	0	0	0	0 (0 0		0	0	0	
04	æ()		0	0	0	0	0 (0 0		0	0	0	
			0	0	0	0	0 ($0 \frac{\sqrt{2}}{2}$	2	0_	0	0	
			0	0	0	0	0 (0 0		$\frac{\sqrt{2}}{2}$	0	0	
			0	0	0	0	0 (0 0		0	0	0	
			/0	0	0	0	0 (0 0		0	0	0/	
			\int_{0}^{0}	0	0	0	0 (0 0	0	0		0	
			0	0	0	0	0 (0 0	0	0		0	
			0	0	0	0	0 (0 0	0	0		0	
			0	0	0	0	0 (0 0	0	0		0	
\mathbb{U}_5	$\mathbb{Q}_0^{(s,A_{1g})}$	S_5	0	0	0	0	0 (0 0	0	0		0	
⊎5	√ €0	55	0	0	0	0	0 (0 0	0	0		0	
			0	0	0	0	0 (0 0	0	0		0	
			0	0	0	0	0 (0 0	0	0_		0	
			0	0	0	0	0 (0 0	0	$\frac{\sqrt{2}}{2}$		0_	
			/0	0	0	0	0 (0 0	0	0		$\left(\frac{\sqrt{2}}{2}\right)$	

Table 8

Table 8				
symbol	type	cluster	form	
			(0 0 0 0 0 0 0 0 0 0)	
			$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{4} \end{bmatrix}$	
			$ \begin{vmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} \end{vmatrix} $	
\mathbb{U}_{6}	$\mathbb{Q}_1^{(u,A_{2u})}$	B_1		
∪6	$ \Psi_1 $	ь1		
			$ \begin{bmatrix} 0 & 0 & \frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -\frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} $	
			$\begin{pmatrix} 0 & 0 & -\frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$	
			(0 0 0 0 0 0 0 0 0 0 0 0	
		В1		
			$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 $	
			$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} \end{bmatrix}$	
\mathbb{U}_7	$\mathbb{Q}_3^{(u,B_{2u})}$			
∪7	\mathcal{U}_3			
			$\begin{bmatrix} 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	
			$ \begin{pmatrix} 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{2}}{4} & -\frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} $	
			(0 0 0 0 0 0 0 0 0 0)	
			$ \begin{vmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & -\frac{\sqrt{2}i}{4} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & -\frac{\sqrt{2}i}{4} \end{vmatrix} $	
			$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\sqrt{2}i}{4} & -\frac{\sqrt{2}i}{4} \end{bmatrix}$	
πт	$\mathbb{T}_0^{(u,A_{1g})}$	D		
\mathbb{U}_8	10	B_1		
			$ \begin{bmatrix} 0 & 0 & \frac{\sqrt{2}i}{4} & \frac{\sqrt{2}i}{4} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{\sqrt{2}i}{2}i & \frac{\sqrt{2}i}{2}i & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} $	
			$ \left(\begin{array}{cccccccccccccccccccccccccccccccccccc$	

Table 8

Table 8															
symbol	type	cluster						for	rm						
			/ 0 0)	0		0	0	0	0	0	0		0	1
			0 0)	0		0	0	0	0	0	0		0	1
			0 0)	0		0	0	0	0	0	$-\frac{\sqrt{2}i}{4}$		$\frac{\sqrt{2}i}{4}$	-
			0 0)	0		0	0	0	0	0	$-\frac{\sqrt{2}i}{\frac{\sqrt{2}i}{4}}$	-	$ \begin{array}{c} 0 \\ \frac{\sqrt{2}i}{4} \\ -\frac{\sqrt{2}i}{4} \end{array} $	<u>i</u>
πт	$\mathbb{T}_2^{(u,B_{1g})}$	D	0 0)	0		0	0	0	0	0	0		0	1
\mathbb{U}_9	¹ 2 ²	B_1	0 0)	0		0	0	0	0	0	0		0	
			0 0)	0		0	0	0	0	0	0		0	
			0 0)	0		0	0	0	0	0	0		0	ı
			0 0)	$\frac{\sqrt{2}i}{4}$		$-\frac{\sqrt{2}i}{4}$	0	0	0	0	0		0	
			\int_0^0) -	$-\frac{\sqrt{2}}{4}$	\underline{i}	$\frac{-\frac{\sqrt{2}i}{4}}{\frac{\sqrt{2}i}{4}}$	0	0	0	0	0		0	
			/0	0	0	0	0	0		0		0	0	0\	
	$\mathbb{Q}_{1}^{(u,A_{2u})}$	В2	0	0	0	0	0	0		0		0	0	0	
			0	0	0	0	0	0		0		0	0	0	
			0	0	0	0	0	0		0		0	0	0	
πт			0	0	0	0	0	0		$-\frac{\sqrt{2}}{4}$	2	$-\frac{\sqrt{2}}{4} \\ -\frac{\sqrt{2}}{4}$	0	0	
\mathbb{U}_{10}			0	0	0	0	0	0		$-\frac{1}{2}$	$\frac{\sqrt{2}}{1}$	$-\frac{\sqrt{2}}{4}$	0	0	
			0	0	0	0	$\frac{\sqrt{2}}{4}$	- V	$\frac{\sqrt{2}}{1}$	0	•	0	0	0	
			0	0	0	0	$\frac{\frac{\sqrt{2}}{4}}{\frac{\sqrt{2}}{4}}$	$-\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{1}$ $\frac{\sqrt{2}}{1}$	0		0	0	0	
			0	0	0	0	0	0		0		0	0	0	
			\int_0	0	0	0	0	0		0		0	0	0/	
			\int_{0}^{0}	0	0	0	0		0	()	0	0	0	
			0	0	0	0	0		0	()	0	0	0	
			0	0	0	0	0		0	()	0	0	0	
			0	0	0	0	0		0	(0	0	0	
\mathbb{U}_{11}	$\mathbb{Q}_3^{(u,B_{2u})}$	B_2	0	0	0	0	0		0	$\frac{}{}$	$\frac{\sqrt{2}}{1}$	$-\frac{\sqrt{2}}{4}$	0	0	
€11	$ \Psi_3 $	\mathbf{D}_2	0	0	0	0	0		0	<u>v</u>	$\frac{\sqrt{2}}{4}$ $\frac{\sqrt{2}}{4}$	$-\frac{\sqrt{2}}{4}$ $-\frac{\sqrt{2}}{4}$	0	0	
			0	0	0	0	$\frac{\sqrt{2}}{4}$	2	$\frac{\sqrt{2}}{4}$ $\frac{\sqrt{2}}{4}$	()	0	0	0	
			0	0	0	0	$-\frac{\sqrt{2}}{4}$	_	$\frac{\sqrt{2}}{4}$	()	0	0	0	
			0	0	0	0	0		0	()	0	0	0	
			/0	0	0	0	0		0	()	0	0	0/	

symbol	type	cluster						form				
			\int_{0}^{0}	0	0	0	0	0	0	0	0	0
			$\begin{bmatrix} 0 \\ 0 \end{bmatrix}$	0	0	0	0	0	0	0 0	0	0
			0	0	0	0	0	0	0	0	0	0
\mathbb{U}_{12}	$\mathbb{T}_0^{(u,A_{1g})}$	B ₂	0	0	0	0	0	0	$-\frac{\sqrt{2}i}{4}$ $-\frac{\sqrt{2}i}{\sqrt{2}i}$	$-\frac{\sqrt{2}i}{4}$ $-\frac{\sqrt{2}i}{\sqrt{2}i}$	0	0
			0	0	0	0	$\frac{0}{\sqrt{2}i}$	$\frac{0}{\sqrt{2}i}$	$-\frac{\sqrt{2}i}{4}$	$-\frac{\sqrt{2}i}{4}$	0	0
			0	0	0	0	$\frac{4}{\sqrt{2}i}$	$\frac{\frac{\sqrt{2}i}{4}}{\frac{\sqrt{2}i}{4}}$	0	0	0	0
			0	0	0	0	0	0	0	0	0	0
			/0	0	0	0	0	0	0	0	0	0/
			\int_{0}^{0}	0	0	0	0	0	0	0	0	C
			0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0	0	0	0
\mathbb{U}_{13}	$\mathbb{T}_2^{(u,B_{1g})}$	$_{ m B_2}$	0	0	0	0	0	0	$-\frac{\sqrt{2}i}{4}$	$\frac{\sqrt{2}i}{4}$	0	C
€13	1 ¹¹ 2	\mathbf{D}_2	0	0	0	0	0	0	$\frac{\sqrt{2}i}{\sqrt{2}}$	$-\frac{\sqrt{2}i}{4}$	0	0
			0	0	0	0	$\frac{\sqrt{2}i}{4}$	$-\frac{\sqrt{2}i}{4}$	0	0	0	C
			0	0	0	0	$-\frac{\sqrt{2}i}{4}$	$\frac{\sqrt{2}i}{4}$	0	0	0	(
			0	0	0	0	0	0	0	0	0	C
			\0	0	0	0	0	0	0	0	0	0

Table 9: Structure SAMB.

symbol	type	cluster	form
\mathbb{F}_1	$\mathbb{Q}_0^{(k,A_{1g})}$	B_1	$\frac{\sqrt{2}c_{001}}{2} + \frac{\sqrt{2}c_{002}}{2} + \frac{\sqrt{2}c_{005}}{2} + \frac{\sqrt{2}c_{006}}{2}$
\mathbb{F}_2	$\mathbb{Q}_2^{(k,B_{1g})}$	B_1	$\frac{\sqrt{2}c_{001}}{2} + \frac{\sqrt{2}c_{002}}{2} - \frac{\sqrt{2}c_{005}}{2} - \frac{\sqrt{2}c_{006}}{2}$
\mathbb{F}_3	$\mathbb{Q}_{2,0}^{(k,E_g)}$	B_1	$-c_{005} + c_{006}$
\mathbb{F}_4	$\mathbb{Q}_{2,1}^{(k,E_g)}$	B_1	$c_{001} - c_{002}$
\mathbb{F}_5	$\mathbb{T}_1^{(k,A_{2u})}$	B_1	$\frac{\sqrt{2}s_{001}}{2} + \frac{\sqrt{2}s_{002}}{2} - \frac{\sqrt{2}s_{005}}{2} - \frac{\sqrt{2}s_{006}}{2}$

Table 9

symbol	type	cluster	form
\mathbb{F}_6	$\mathbb{T}_{1,0}^{(k,E_u)}$	B_1	$s_{001} - s_{002}$
\mathbb{F}_7	$\mathbb{T}_{1,1}^{(k,E_u)}$	B_1	$s_{005} - s_{006}$
\mathbb{F}_8	$\mathbb{T}_3^{(k,B_{2u})}$	B_1	$\frac{\sqrt{2}s_{001}}{2} + \frac{\sqrt{2}s_{002}}{2} + \frac{\sqrt{2}s_{005}}{2} + \frac{\sqrt{2}s_{006}}{2}$
\mathbb{F}_9	$\mathbb{O}_{0}^{(k,A_{1g})}$	B_2	$\frac{\sqrt{2}c_{009}}{2} + \frac{\sqrt{2}c_{010}}{2} + \frac{\sqrt{2}c_{013}}{2} + \frac{\sqrt{2}c_{014}}{2}$
\mathbb{F}_{10}	(k,B_{1g})	B_2	$\frac{\sqrt{2}c_{009}}{2} + \frac{\sqrt{2}c_{010}}{2} - \frac{\sqrt{2}c_{013}}{2} - \frac{\sqrt{2}c_{014}}{2}$
\mathbb{F}_{11}	$\mathbb{Q}_{2,0}^{(k,E_g)}$	B_2	$-c_{013} + c_{014}$
\mathbb{F}_{12}	$\mathbb{Q}_{2,1}^{(\kappa,L_g)}$	B_2	$c_{009} - c_{010}$
\mathbb{F}_{13}	$\mathbb{T}_1^{(k,A_{2u})}$	B_2	$\frac{\sqrt{2}s_{009}}{2} + \frac{\sqrt{2}s_{010}}{2} - \frac{\sqrt{2}s_{013}}{2} - \frac{\sqrt{2}s_{014}}{2}$
\mathbb{F}_{14}	$\mathbb{T}_{1,0}^{(k,E_u)}$	B_2	$s_{009} - s_{010}$
\mathbb{F}_{15}	$\mathbb{T}_{1,1}^{(k,E_u)}$	B_2	$s_{013} - s_{014}$
\mathbb{F}_{16}	$\mathbb{T}_3^{(k,B_{2u})}$	B_2	$\frac{\sqrt{2}s_{009}}{2} + \frac{\sqrt{2}s_{010}}{2} + \frac{\sqrt{2}s_{013}}{2} + \frac{\sqrt{2}s_{014}}{2}$

Table 10: Polar harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$\mathbb{Q}_0^{(A_{1g})}$	0	A_{1g}	_	_	1
2	$\mathbb{Q}_1^{(A_{2u})}$	1	A_{2u}	_	_	z
3	$\mathbb{Q}_{1,0}^{(E_u)}$	1	E_u	_	0	x
4	$\mathbb{Q}_{1,1}^{(E_u)}$	1	E_u	_	1	y
5	$\mathbb{Q}_{1,0}^{(E_u)} \\ \mathbb{Q}_{1,1}^{(E_u)} \\ \mathbb{Q}_{1,1}^{(A_{1g})}$	2	A_{1g}	_	_	$-\frac{x^2}{2} - \frac{y^2}{2} + z^2$
6	$\mathbb{Q}_2^{(B_{1g})}$	2	B_{1g}	_	_	$-rac{x^2}{2} - rac{y^2}{2} + z^2 \ rac{\sqrt{3}(x-y)(x+y)}{2}$
7	$\mathbb{Q}_{2,0}^{(E_g)}$	2	E_g	_	0	$\sqrt{3}yz$
8	$\mathbb{Q}_{2,0}^{(E_g)}$ $\mathbb{Q}_{2,1}^{(E_g)}$	2	E_g	_	1	$\sqrt{3}xz$
9	$\mathbb{Q}_3^{(A_{2u})}$	3	A_{2u}	_	_	$-\frac{z(3x^2+3y^2-2z^2)}{2}$
10	$\mathbb{Q}_3^{(B_{2u})}$	3	B_{2u}	_	_	$rac{\sqrt{15}z(x-\tilde{y})(x+y)}{2}$
11	$\mathbb{Q}_{3,0}^{(E_u,1)}$	3	E_u	1	0	$\frac{x\left(2x^2-3y^2-3z^2\right)}{-\frac{y\left(3x^2-2y^2+3z^2\right)}{}}$
12	$\mathbb{Q}_{3,1}^{(E_u,1)}$	3	E_u	1	1	$-rac{y(3x^2-2y^2+3z^2)}{2}$

Table 10

No.	symbol	rank	irrep.	mul.	comp.	form
13	$\mathbb{Q}_{3,0}^{(E_u,2)}$	3	E_u	2	0	$\frac{\sqrt{15}x(y-z)(y+z)}{2}$
14	$\mathbb{Q}_{3,1}^{(E_u,2)}$	3	E_u	2	1	$rac{\sqrt{15}y(x-z)(x+z)}{2}$
15	$\mathbb{Q}_4^{(A_{1g},1)}$	4	A_{1g}	1	_	$\frac{\sqrt{21}\left(x^4 - 3x^2y^2 - 3x^2z^2 + y^4 - 3y^2z^2 + z^4\right)}{6}$
16	$\mathbb{Q}_4^{(A_{1g},2)}$	4	A_{1g}	2	_	$-\frac{\sqrt{15} \left(x^4 - 12 x^2 y^2 + 6 \overset{\circ}{x}^2 z^2 + y^4 + 6 y^2 z^2 - 2 z^4\right)}{12}$
17	$\mathbb{Q}_6^{(A_{1g},1)}$	6	A_{1g}	1	_	$\frac{\sqrt{2} \cdot \left(2 x^6 - 15 x^4 y^2 - 15 x^4 z^2 - 15 x^2 y^4 + 180 x^2 y^2 z^2 - 15 x^2 z^4 + 2 y^6 - 15 y^4 z^2 - 15 y^2 z^4 + 2 z^6\right)}{8}$
18	$\mathbb{Q}_{6}^{(A_{1g},2)}$	6	A_{1g}	2	_	$-\frac{\sqrt{14} \left(x^6 - 15 x^4 z^2 + 15 x^2 z^4 + y^6 - 15 y^4 z^2 + 15 y^2 z^4 - 2 z^6\right)}{8}$

Table 11: Axial harmonics.

No.	symbol	rank	irrep.	mul.	comp.	form
1	$\mathbb{G}_2^{(B_{2u})}$	2	B_{2u}	_	_	$\sqrt{3}XY$
2	$\mathbb{G}_{2,0}^{(E_u)}$	2	E_u	_	0	$\sqrt{3}YZ$
3	$\mathbb{G}_{2,1}^{(E_u)}$	2	E_u	_	1	$\sqrt{3}XZ$

 $\bullet \ \ \text{Group info.: Generator} = \{2_{001}|\frac{1}{2}\frac{1}{2}0\}, \ \{4_{\ 001}^+|\frac{1}{2}00\}, \ \{2_{010}|0\frac{1}{2}0\}, \ \{-1|0\}$

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

symmetry operations					
{1 0}					
$\{2_{001} \frac{1}{2}\frac{1}{2}0\}$					
$\{2_{100} \frac{1}{2}00\}, \{2_{010} 0\frac{1}{2}0\}$					
$\{2_{110} \frac{1}{2}\frac{1}{2}0\}, \{2_{1-10} 0\}$					
$\{4^{+}_{001} \frac{1}{2}00\}, \{4^{-}_{001} 0\frac{1}{2}0\}$					

Table 12

rep. SO	symmetry operations
$\{-1 0\}$	$\{-1 0\}$
$\{m_{001} \frac{1}{2}\frac{1}{2}0\}$	$\{\mathbf{m}_{001} \frac{1}{2}\frac{1}{2}0\}$
$\frac{1}{\{m_{100} \frac{1}{2}00\}}$	$\{m_{100} \frac{1}{2}00\}, \{m_{010} 0\frac{1}{2}0\}$
$\{m_{110} \frac{1}{2}\frac{1}{2}0\}$	$\{m_{110} \frac{1}{2}\frac{1}{2}0\}, \{m_{1-10} 0\}$
$\{-4^{+}_{001} \frac{1}{2}00\}$	$\{-4^{+}_{001} \frac{1}{2}00\}, \{-4^{-}_{001} 0\frac{1}{2}0\}$

Table 13: Symmetry operations.

No.	SO	No.	SO	No.	SO	No.	SO	No.	SO
1	{1 0}	2	$\{2_{001} \frac{1}{2}\frac{1}{2}0\}$	3	$\{2_{100} \frac{1}{2}00\}$	4	$\{2_{010} 0\frac{1}{2}0\}$	5	$\{2_{110} \frac{1}{2}\frac{1}{2}0\}$
6	$\{2_{1-10} 0\}$	7	$\{4^{+}_{001} \frac{1}{2}00\}$	8	$\{4_{001}^{-} 0\frac{1}{2}0\}$	9	$\{-1 0\}$	10	$\{m_{001} \frac{1}{2}\frac{1}{2}0\}$
11	$\{m_{100} \frac{1}{2}00\}$	12	$\{m_{010} 0\frac{1}{2}0\}$	13	$\{m_{110} \frac{1}{2}\frac{1}{2}0\}$	14	$\{m_{1-10} 0\}$	15	$\{-4^{+}_{001} \frac{1}{2}00\}$
16	$\{-4^{-}_{001} 0^{\frac{1}{2}}0\}$								

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

	1	2001	2100	2_{110}	4^{+}_{001}	-1	m_{001}	m ₁₀₀	m ₁₁₀	-4^{+}_{001}
A_{1g}	1	1	1	1	1	1	1	1	1	1
A_{2g}	1	1	-1	-1	1	1	1	-1	-1	1
B_{1g}	1	1	1	-1	-1	1	1	1	-1	-1
B_{2g}	1	1	-1	1	-1	1	1	-1	1	-1
E_g	2	-2	0	0	0	2	-2	0	0	0
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1
A_{2u}	1	1	-1	-1	1	-1	-1	1	1	-1
B_{1u}	1	1	1	-1	-1	-1	-1	-1	1	1
B_{2u}	1	1	-1	1	-1	-1	-1	1	-1	1
E_u	2	-2	0	0	0	-2	2	0	0	0

Table 15: Parity conversion.

\leftrightarrow	\leftrightarrow	\leftrightarrow	\leftrightarrow	\leftrightarrow
$A_{1g} (A_{1u})$	B_{1g} (B_{1u})	$E_g (E_u)$	$A_{2g} (A_{2u})$	$B_{2g} (B_{2u})$
$A_{1u} (A_{1g})$	$B_{1u} (B_{1g})$	$E_u (E_g)$	$A_{2u} (A_{2g})$	$B_{2u} (B_{2g})$

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

	A_{1g}	A_{2g}	B_{1g}	B_{2g}	E_g	A_{1u}	A_{2u}	B_{1u}	B_{2u}	E_u
A_{1g}	A_{1g}	A_{2g}	B_{1g}	B_{2g}	E_g	A_{1u}	A_{2u}	B_{1u}	B_{2u}	E_u
A_{2g}		A_{1g}	B_{2g}	B_{1g}	E_{g}	A_{2u}	A_{1u}	B_{2u}	B_{1u}	E_u
B_{1g}			A_{1g}	A_{2g}	E_g	B_{1u}	B_{2u}	A_{1u}	A_{2u}	E_{u}
B_{2g}				A_{1g}	E_g	B_{2u}	B_{1u}	A_{2u}	A_{1u}	E_u
E_g					$A_{1g} + B_{1g} + B_{2g}$	E_u	E_u	E_u	E_u	$A_{1u} + A_{2u} + B_{1u} + B_{2u}$
A_{1u}						A_{1g}	A_{2g}	B_{1g}	B_{2g}	E_g
A_{2u}							A_{1g}	B_{2g}	B_{1g}	E_g
B_{1u}								A_{1g}	A_{2g}	E_g
B_{2u}									A_{1g}	$E_{m{g}}$
E_u										$A_{1g} + B_{1g} + B_{2g}$

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

4	4	D	D	-	4	4	D	D	-
A_{1g}	A_{2g}	B_{1g}	B_{2g}	E_g	A_{1u}	A_{2u}	B_{1u}	B_{2u}	E_u
_	_	_	_	A_{2g}	_	_	_	_	A_{2g}

Table 18: Virtual-cluster sites.

No.	position	No.	position	No.	position	No.	position
1	$\begin{pmatrix} 2 & 1 & 1 \end{pmatrix}$	2	$\begin{pmatrix} -2 & -1 & 1 \end{pmatrix}$	3	$\begin{pmatrix} 2 & -1 & -1 \end{pmatrix}$	4	$\begin{pmatrix} -2 & 1 & -1 \end{pmatrix}$
5	$\begin{pmatrix} 1 & 2 & -1 \end{pmatrix}$	6	$\begin{pmatrix} -1 & -2 & -1 \end{pmatrix}$	7	$\begin{pmatrix} -1 & 2 & 1 \end{pmatrix}$	8	$\begin{pmatrix} 1 & -2 & 1 \end{pmatrix}$
9	$\begin{pmatrix} -2 & -1 & -1 \end{pmatrix}$	10	$\begin{pmatrix} 2 & 1 & -1 \end{pmatrix}$	11	$\begin{pmatrix} -2 & 1 & 1 \end{pmatrix}$	12	$\begin{pmatrix} 2 & -1 & 1 \end{pmatrix}$
13	$\begin{pmatrix} -1 & -2 & 1 \end{pmatrix}$	14	$\begin{pmatrix} 1 & 2 & 1 \end{pmatrix}$	15	$\begin{pmatrix} 1 & -2 & -1 \end{pmatrix}$	16	$\begin{pmatrix} -1 & 2 & -1 \end{pmatrix}$

Table 19: Virtual-cluster basis.

symbol	1	2	3	4	5	6	7	8	9	10
$\mathbb{Q}_0^{(A_{1g})}$	$\frac{1}{4}$									
	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$				
$\mathbb{Q}_1^{(A_{2u})}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$
	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$				
$\mathbb{Q}_{1,0}^{(E_{u})}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$
	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$				
$\mathbb{Q}_{1,1}^{(E_u)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$
	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$				
$\mathbb{Q}_2^{(B_{1g})}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$				
$\mathbb{Q}_2^{(B_{2g})}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$				
$\mathbb{Q}_{2,0}^{(E_g)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$
	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$				
$\mathbb{Q}_{2,1}^{(E_g)}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$
	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$				
$\mathbb{Q}_{3}^{(B_{1u})}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$
	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$				

Table 19

symbol	1	2	3	4	5	6	7	8	9	10
$\mathbb{Q}_{3}^{(B_{2u})}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$
	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$				
$\mathbb{Q}_{3,0}^{(E_{u},1)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$
	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$				
$\mathbb{Q}_{3,1}^{(E_u,1)}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$
	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$				
$\mathbb{Q}_4^{(A_{2g})}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$				
$\mathbb{Q}_{4,0}^{(E_g,1)}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$
	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$				
$\mathbb{Q}_{4,1}^{(E_g,1)}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{20}$	$-\frac{\sqrt{10}}{20}$
	$-\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{20}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$	$\frac{\sqrt{10}}{10}$	$-\frac{\sqrt{10}}{10}$				
$\mathbb{Q}_{5}^{(A_{1u})}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$
	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$	$-\frac{1}{4}$				