# Pu$_{31}$Rh$_{20}$ Structure: A31B20_tI204_140_b2gh3m_ac2fh3l-001
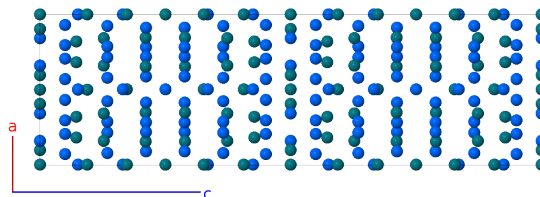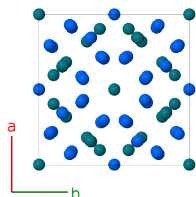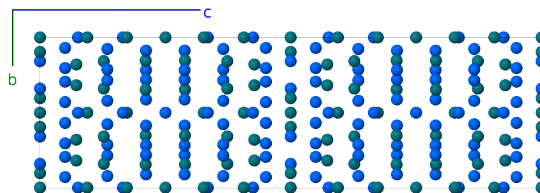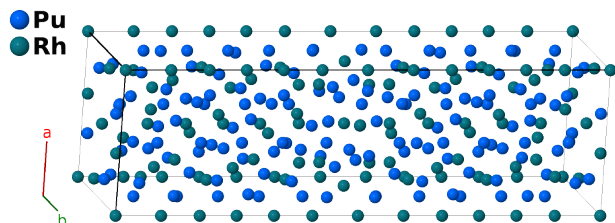
This structure originally had the label A31B20_tI204_140_b2gh3m_ac2fh3l. Calls to that address will be redirected here.

https://aflow.org/p/TBHL

https://aflow.org/p/A31B20_tI204_140_b2gh3m_ac2fh3l-001



| | |
|---|---|
| **Prototype** | Pu$_{31}$Rh$_{20}$ |
| **AFLOW prototype label** | A31B20_tI204_140_b2gh3m_ac2fh3l-001 |
| **ICSD** | 1111 |
| **Pearson symbol** | tI204 |
| **Space group number** | 140 |
| **Space group symbol** | $I4/mcm$ |
| **AFLOW prototype command** | aflow --proto=A31B20_tI204_140_b2gh3m_ac2fh3l-001 --params=$a, c/a, z_4, z_5, z_6, z_7, x_8, x_9, x_{10}, z_{10}, x_{11}, z_{11}, x_{12}, z_{12}, x_{13}, y_{13}, z_{13}, x_{14}, y_{14}, z_{14}, x_{15}, y_{15}, z_{15}$ |

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**Other compounds with this structure**

Pu$_{31}$Pt$_{20}$, Ca$_{31}$Sn$_{20}$

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**Body-centered Tetragonal primitive vectors**

$$\mathbf{a_1} = -\tfrac{1}{2}a\,\hat{\mathbf{x}} + \tfrac{1}{2}a\,\hat{\mathbf{y}} + \tfrac{1}{2}c\,\hat{\mathbf{z}}$$
$$\mathbf{a_2} = \tfrac{1}{2}a\,\hat{\mathbf{x}} - \tfrac{1}{2}a\,\hat{\mathbf{y}} + \tfrac{1}{2}c\,\hat{\mathbf{z}}$$
$$\mathbf{a_3} = \tfrac{1}{2}a\,\hat{\mathbf{x}} + \tfrac{1}{2}a\,\hat{\mathbf{y}} - \tfrac{1}{2}c\,\hat{\mathbf{z}}$$



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**Basis vectors**

| | | Lattice coordinates | | Cartesian coordinates | Wyckoff position | Atom type |
|---|---|---|---|---|---|---|
| $\mathbf{B_1}$ | = | $\frac{1}{4}\,\mathbf{a}_1 + \frac{1}{4}\,\mathbf{a}_2$ | = | $\frac{1}{4}c\,\hat{\mathbf{z}}$ | (4a) | Rh I |
| $\mathbf{B_2}$ | = | $\frac{3}{4}\,\mathbf{a}_1 + \frac{3}{4}\,\mathbf{a}_2$ | = | $\frac{3}{4}c\,\hat{\mathbf{z}}$ | (4a) | Rh I |
| $\mathbf{B_3}$ | = | $\frac{3}{4}\,\mathbf{a}_1 + \frac{1}{4}\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{y}} + \frac{1}{4}c\,\hat{\mathbf{z}}$ | (4b) | Pu I |
| $\mathbf{B_4}$ | = | $\frac{1}{4}\,\mathbf{a}_1 + \frac{3}{4}\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{x}} + \frac{1}{4}c\,\hat{\mathbf{z}}$ | (4b) | Pu I |
| $\mathbf{B_5}$ | = | $0$ | = | $0$ | (4c) | Rh II |
| $\mathbf{B_6}$ | = | $\frac{1}{2}\,\mathbf{a}_1 + \frac{1}{2}\,\mathbf{a}_2$ | = | $\frac{1}{2}c\,\hat{\mathbf{z}}$ | (4c) | Rh II |
| $\mathbf{B_7}$ | = | $z_4\,\mathbf{a}_1 + z_4\,\mathbf{a}_2$ | = | $cz_4\,\hat{\mathbf{z}}$ | (8f) | Rh III |
| $\mathbf{B_8}$ | = | $-\left(z_4 - \frac{1}{2}\right)\mathbf{a}_1 - \left(z_4 - \frac{1}{2}\right)\mathbf{a}_2$ | = | $-c\left(z_4 - \frac{1}{2}\right)\hat{\mathbf{z}}$ | (8f) | Rh III |
| $\mathbf{B_9}$ | = | $-z_4\,\mathbf{a}_1 - z_4\,\mathbf{a}_2$ | = | $-cz_4\,\hat{\mathbf{z}}$ | (8f) | Rh III |
| $\mathbf{B_{10}}$ | = | $\left(z_4 + \frac{1}{2}\right)\mathbf{a}_1 + \left(z_4 + \frac{1}{2}\right)\mathbf{a}_2$ | = | $c\left(z_4 + \frac{1}{2}\right)\hat{\mathbf{z}}$ | (8f) | Rh III |
| $\mathbf{B_{11}}$ | = | $z_5\,\mathbf{a}_1 + z_5\,\mathbf{a}_2$ | = | $cz_5\,\hat{\mathbf{z}}$ | (8f) | Rh IV |
| $\mathbf{B_{12}}$ | = | $-\left(z_5 - \frac{1}{2}\right)\mathbf{a}_1 - \left(z_5 - \frac{1}{2}\right)\mathbf{a}_2$ | = | $-c\left(z_5 - \frac{1}{2}\right)\hat{\mathbf{z}}$ | (8f) | Rh IV |
| $\mathbf{B_{13}}$ | = | $-z_5\,\mathbf{a}_1 - z_5\,\mathbf{a}_2$ | = | $-cz_5\,\hat{\mathbf{z}}$ | (8f) | Rh IV |
| $\mathbf{B_{14}}$ | = | $\left(z_5 + \frac{1}{2}\right)\mathbf{a}_1 + \left(z_5 + \frac{1}{2}\right)\mathbf{a}_2$ | = | $c\left(z_5 + \frac{1}{2}\right)\hat{\mathbf{z}}$ | (8f) | Rh IV |
| $\mathbf{B_{15}}$ | = | $\left(z_6 + \frac{1}{2}\right)\mathbf{a}_1 + z_6\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{y}} + cz_6\,\hat{\mathbf{z}}$ | (8g) | Pu II |
| $\mathbf{B_{16}}$ | = | $z_6\,\mathbf{a}_1 + \left(z_6 + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{x}} + cz_6\,\hat{\mathbf{z}}$ | (8g) | Pu II |
| $\mathbf{B_{17}}$ | = | $-z_6\,\mathbf{a}_1 - \left(z_6 - \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{x}} - cz_6\,\hat{\mathbf{z}}$ | (8g) | Pu II |
| $\mathbf{B_{18}}$ | = | $-\left(z_6 - \frac{1}{2}\right)\mathbf{a}_1 - z_6\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{y}} - cz_6\,\hat{\mathbf{z}}$ | (8g) | Pu II |
| $\mathbf{B_{19}}$ | = | $\left(z_7 + \frac{1}{2}\right)\mathbf{a}_1 + z_7\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{y}} + cz_7\,\hat{\mathbf{z}}$ | (8g) | Pu III |
| $\mathbf{B_{20}}$ | = | $z_7\,\mathbf{a}_1 + \left(z_7 + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{x}} + cz_7\,\hat{\mathbf{z}}$ | (8g) | Pu III |
| $\mathbf{B_{21}}$ | = | $-z_7\,\mathbf{a}_1 - \left(z_7 - \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{x}} - cz_7\,\hat{\mathbf{z}}$ | (8g) | Pu III |
| $\mathbf{B_{22}}$ | = | $-\left(z_7 - \frac{1}{2}\right)\mathbf{a}_1 - z_7\,\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $\frac{1}{2}a\,\hat{\mathbf{y}} - cz_7\,\hat{\mathbf{z}}$ | (8g) | Pu III |
| $\mathbf{B_{23}}$ | = | $\left(x_8 + \frac{1}{2}\right)\mathbf{a}_1 + x_8\,\mathbf{a}_2 + \left(2x_8 + \frac{1}{2}\right)\mathbf{a}_3$ | = | $ax_8\,\hat{\mathbf{x}} + a\left(x_8 + \frac{1}{2}\right)\hat{\mathbf{y}}$ | (8h) | Pu IV |
| $\mathbf{B_{24}}$ | = | $-\left(x_8 - \frac{1}{2}\right)\mathbf{a}_1 - x_8\,\mathbf{a}_2 - \left(2x_8 - \frac{1}{2}\right)\mathbf{a}_3$ | = | $-ax_8\,\hat{\mathbf{x}} - a\left(x_8 - \frac{1}{2}\right)\hat{\mathbf{y}}$ | (8h) | Pu IV |
| $\mathbf{B_{25}}$ | = | $x_8\,\mathbf{a}_1 - \left(x_8 - \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $-a\left(x_8 - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_8\,\hat{\mathbf{y}}$ | (8h) | Pu IV |
| $\mathbf{B_{26}}$ | = | $-x_8\,\mathbf{a}_1 + \left(x_8 + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $a\left(x_8 + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_8\,\hat{\mathbf{y}}$ | (8h) | Pu IV |
| $\mathbf{B_{27}}$ | = | $\left(x_9 + \frac{1}{2}\right)\mathbf{a}_1 + x_9\,\mathbf{a}_2 + \left(2x_9 + \frac{1}{2}\right)\mathbf{a}_3$ | = | $ax_9\,\hat{\mathbf{x}} + a\left(x_9 + \frac{1}{2}\right)\hat{\mathbf{y}}$ | (8h) | Rh V |
| $\mathbf{B_{28}}$ | = | $-\left(x_9 - \frac{1}{2}\right)\mathbf{a}_1 - x_9\,\mathbf{a}_2 - \left(2x_9 - \frac{1}{2}\right)\mathbf{a}_3$ | = | $-ax_9\,\hat{\mathbf{x}} - a\left(x_9 - \frac{1}{2}\right)\hat{\mathbf{y}}$ | (8h) | Rh V |
| $\mathbf{B_{29}}$ | = | $x_9\,\mathbf{a}_1 - \left(x_9 - \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $-a\left(x_9 - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_9\,\hat{\mathbf{y}}$ | (8h) | Rh V |
| $\mathbf{B_{30}}$ | = | $-x_9\,\mathbf{a}_1 + \left(x_9 + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $a\left(x_9 + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_9\,\hat{\mathbf{y}}$ | (8h) | Rh V |
| $\mathbf{B_{31}}$ | = | $\left(x_{10} + z_{10} + \frac{1}{2}\right)\mathbf{a}_1 + \left(x_{10} + z_{10}\right)\mathbf{a}_2 + \left(2x_{10} + \frac{1}{2}\right)\mathbf{a}_3$ | = | $ax_{10}\,\hat{\mathbf{x}} + a\left(x_{10} + \frac{1}{2}\right)\hat{\mathbf{y}} + cz_{10}\,\hat{\mathbf{z}}$ | (16l) | Rh VI |
| $\mathbf{B_{32}}$ | = | $\left(-x_{10} + z_{10} + \frac{1}{2}\right)\mathbf{a}_1 - \left(x_{10} - z_{10}\right)\mathbf{a}_2 - \left(2x_{10} - \frac{1}{2}\right)\mathbf{a}_3$ | = | $-ax_{10}\,\hat{\mathbf{x}} - a\left(x_{10} - \frac{1}{2}\right)\hat{\mathbf{y}} + cz_{10}\,\hat{\mathbf{z}}$ | (16l) | Rh VI |
| $\mathbf{B_{33}}$ | = | $\left(x_{10} + z_{10}\right)\mathbf{a}_1 + \left(-x_{10} + z_{10} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\,\mathbf{a}_3$ | = | $-a\left(x_{10} - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_{10}\,\hat{\mathbf{y}} + cz_{10}\,\hat{\mathbf{z}}$ | (16l) | Rh VI |

$$\mathbf{B_{34}} = \begin{array}{c} -\left(x_{10} - z_{10}\right)\mathbf{a}_1 + \\ \left(x_{10} + z_{10} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = a\left(x_{10} + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_{10}\,\hat{\mathbf{y}} + cz_{10}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VI}$$

$$\mathbf{B_{35}} = \begin{array}{c} \left(x_{10} - z_{10}\right)\mathbf{a}_1 - \\ \left(x_{10} + z_{10} - \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = -a\left(x_{10} - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_{10}\,\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VI}$$

$$\mathbf{B_{36}} = \begin{array}{c} -\left(x_{10} + z_{10}\right)\mathbf{a}_1 + \\ \left(x_{10} - z_{10} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = a\left(x_{10} + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_{10}\,\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VI}$$

$$\mathbf{B_{37}} = \begin{array}{c} \left(x_{10} - z_{10} + \frac{1}{2}\right)\mathbf{a}_1 + \\ \left(x_{10} - z_{10}\right)\mathbf{a}_2 + \left(2x_{10} + \frac{1}{2}\right)\mathbf{a}_3 \end{array} = ax_{10}\,\hat{\mathbf{x}} + a\left(x_{10} + \frac{1}{2}\right)\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VI}$$

$$\mathbf{B_{38}} = \begin{array}{c} -\left(x_{10} + z_{10} - \frac{1}{2}\right)\mathbf{a}_1 - \\ \left(x_{10} + z_{10}\right)\mathbf{a}_2 - \left(2x_{10} - \frac{1}{2}\right)\mathbf{a}_3 \end{array} = -ax_{10}\,\hat{\mathbf{x}} - a\left(x_{10} - \frac{1}{2}\right)\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VI}$$

$$\mathbf{B_{39}} = \begin{array}{c} \left(x_{11} + z_{11} + \frac{1}{2}\right)\mathbf{a}_1 + \\ \left(x_{11} + z_{11}\right)\mathbf{a}_2 + \left(2x_{11} + \frac{1}{2}\right)\mathbf{a}_3 \end{array} = ax_{11}\,\hat{\mathbf{x}} + a\left(x_{11} + \frac{1}{2}\right)\hat{\mathbf{y}} + cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{40}} = \begin{array}{c} \left(-x_{11} + z_{11} + \frac{1}{2}\right)\mathbf{a}_1 - \\ \left(x_{11} - z_{11}\right)\mathbf{a}_2 - \left(2x_{11} - \frac{1}{2}\right)\mathbf{a}_3 \end{array} = -ax_{11}\,\hat{\mathbf{x}} - a\left(x_{11} - \frac{1}{2}\right)\hat{\mathbf{y}} + cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{41}} = \begin{array}{c} \left(x_{11} + z_{11}\right)\mathbf{a}_1 + \\ \left(-x_{11} + z_{11} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = -a\left(x_{11} - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_{11}\,\hat{\mathbf{y}} + cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{42}} = \begin{array}{c} -\left(x_{11} - z_{11}\right)\mathbf{a}_1 + \\ \left(x_{11} + z_{11} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = a\left(x_{11} + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_{11}\,\hat{\mathbf{y}} + cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{43}} = \begin{array}{c} \left(x_{11} - z_{11}\right)\mathbf{a}_1 - \\ \left(x_{11} + z_{11} - \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = -a\left(x_{11} - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_{11}\,\hat{\mathbf{y}} - cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{44}} = \begin{array}{c} -\left(x_{11} + z_{11}\right)\mathbf{a}_1 + \\ \left(x_{11} - z_{11} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = a\left(x_{11} + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_{11}\,\hat{\mathbf{y}} - cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{45}} = \begin{array}{c} \left(x_{11} - z_{11} + \frac{1}{2}\right)\mathbf{a}_1 + \\ \left(x_{11} - z_{11}\right)\mathbf{a}_2 + \left(2x_{11} + \frac{1}{2}\right)\mathbf{a}_3 \end{array} = ax_{11}\,\hat{\mathbf{x}} + a\left(x_{11} + \frac{1}{2}\right)\hat{\mathbf{y}} - cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{46}} = \begin{array}{c} -\left(x_{11} + z_{11} - \frac{1}{2}\right)\mathbf{a}_1 - \\ \left(x_{11} + z_{11}\right)\mathbf{a}_2 - \left(2x_{11} - \frac{1}{2}\right)\mathbf{a}_3 \end{array} = -ax_{11}\,\hat{\mathbf{x}} - a\left(x_{11} - \frac{1}{2}\right)\hat{\mathbf{y}} - cz_{11}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VII}$$

$$\mathbf{B_{47}} = \begin{array}{c} \left(x_{12} + z_{12} + \frac{1}{2}\right)\mathbf{a}_1 + \\ \left(x_{12} + z_{12}\right)\mathbf{a}_2 + \left(2x_{12} + \frac{1}{2}\right)\mathbf{a}_3 \end{array} = ax_{12}\,\hat{\mathbf{x}} + a\left(x_{12} + \frac{1}{2}\right)\hat{\mathbf{y}} + cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{48}} = \begin{array}{c} \left(-x_{12} + z_{12} + \frac{1}{2}\right)\mathbf{a}_1 - \\ \left(x_{12} - z_{12}\right)\mathbf{a}_2 - \left(2x_{12} - \frac{1}{2}\right)\mathbf{a}_3 \end{array} = -ax_{12}\,\hat{\mathbf{x}} - a\left(x_{12} - \frac{1}{2}\right)\hat{\mathbf{y}} + cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{49}} = \begin{array}{c} \left(x_{12} + z_{12}\right)\mathbf{a}_1 + \\ \left(-x_{12} + z_{12} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = -a\left(x_{12} - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_{12}\,\hat{\mathbf{y}} + cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{50}} = \begin{array}{c} -\left(x_{12} - z_{12}\right)\mathbf{a}_1 + \\ \left(x_{12} + z_{12} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = a\left(x_{12} + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_{12}\,\hat{\mathbf{y}} + cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{51}} = \begin{array}{c} \left(x_{12} - z_{12}\right)\mathbf{a}_1 - \\ \left(x_{12} + z_{12} - \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = -a\left(x_{12} - \frac{1}{2}\right)\hat{\mathbf{x}} + ax_{12}\,\hat{\mathbf{y}} - cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{52}} = \begin{array}{c} -\left(x_{12} + z_{12}\right)\mathbf{a}_1 + \\ \left(x_{12} - z_{12} + \frac{1}{2}\right)\mathbf{a}_2 + \frac{1}{2}\mathbf{a}_3 \end{array} = a\left(x_{12} + \frac{1}{2}\right)\hat{\mathbf{x}} - ax_{12}\,\hat{\mathbf{y}} - cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{53}} = \begin{array}{c} \left(x_{12} - z_{12} + \frac{1}{2}\right)\mathbf{a}_1 + \\ \left(x_{12} - z_{12}\right)\mathbf{a}_2 + \left(2x_{12} + \frac{1}{2}\right)\mathbf{a}_3 \end{array} = ax_{12}\,\hat{\mathbf{x}} + a\left(x_{12} + \frac{1}{2}\right)\hat{\mathbf{y}} - cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{54}} = \begin{array}{c} -\left(x_{12} + z_{12} - \frac{1}{2}\right)\mathbf{a}_1 - \\ \left(x_{12} + z_{12}\right)\mathbf{a}_2 - \left(2x_{12} - \frac{1}{2}\right)\mathbf{a}_3 \end{array} = -ax_{12}\,\hat{\mathbf{x}} - a\left(x_{12} - \frac{1}{2}\right)\hat{\mathbf{y}} - cz_{12}\,\hat{\mathbf{z}} \qquad (16l) \qquad \text{Rh VIII}$$

$$\mathbf{B_{55}} = \begin{array}{c} \left(y_{13} + z_{13}\right)\mathbf{a}_1 + \left(x_{13} + z_{13}\right)\mathbf{a}_2 + \\ \left(x_{13} + y_{13}\right)\mathbf{a}_3 \end{array} = ax_{13}\,\hat{\mathbf{x}} + ay_{13}\,\hat{\mathbf{y}} + cz_{13}\,\hat{\mathbf{z}} \qquad (32m) \qquad \text{Pu V}$$

$$\mathbf{B_{56}} = \begin{array}{c} -\left(y_{13} - z_{13}\right)\mathbf{a}_1 - \\ \left(x_{13} - z_{13}\right)\mathbf{a}_2 - \left(x_{13} + y_{13}\right)\mathbf{a}_3 \end{array} = -ax_{13}\,\hat{\mathbf{x}} - ay_{13}\,\hat{\mathbf{y}} + cz_{13}\,\hat{\mathbf{z}} \qquad (32m) \qquad \text{Pu V}$$

$$
\begin{array}{llllll}
\mathbf{B_{57}} & = & (x_{13}+z_{13})\,\mathbf{a}_1-(y_{13}-z_{13})\,\mathbf{a}_2+ & = & -ay_{13}\,\hat{\mathbf{x}}+ax_{13}\,\hat{\mathbf{y}}+cz_{13}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & (x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{58}} & = & -(x_{13}-z_{13})\,\mathbf{a}_1+ & = & ay_{13}\,\hat{\mathbf{x}}-ax_{13}\,\hat{\mathbf{y}}+cz_{13}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & (y_{13}+z_{13})\,\mathbf{a}_2-(x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{59}} & = & \left(y_{13}-z_{13}+\tfrac{1}{2}\right)\mathbf{a}_1- & = & -ax_{13}\,\hat{\mathbf{x}}+ay_{13}\,\hat{\mathbf{y}}-c\left(z_{13}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(x_{13}+z_{13}-\tfrac{1}{2}\right)\mathbf{a}_2- & & & \\
& & (x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{60}} & = & -\left(y_{13}+z_{13}-\tfrac{1}{2}\right)\mathbf{a}_1+ & = & ax_{13}\,\hat{\mathbf{x}}-ay_{13}\,\hat{\mathbf{y}}-c\left(z_{13}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(x_{13}-z_{13}+\tfrac{1}{2}\right)\mathbf{a}_2+ & & & \\
& & (x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{61}} & = & \left(x_{13}-z_{13}+\tfrac{1}{2}\right)\mathbf{a}_1+ & = & ay_{13}\,\hat{\mathbf{x}}+ax_{13}\,\hat{\mathbf{y}}-c\left(z_{13}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(y_{13}-z_{13}+\tfrac{1}{2}\right)\mathbf{a}_2+ & & & \\
& & (x_{13}+y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{62}} & = & -\left(x_{13}+z_{13}-\tfrac{1}{2}\right)\mathbf{a}_1- & = & -ay_{13}\,\hat{\mathbf{x}}-ax_{13}\,\hat{\mathbf{y}}-c\left(z_{13}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(y_{13}+z_{13}-\tfrac{1}{2}\right)\mathbf{a}_2- & & & \\
& & (x_{13}+y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{63}} & = & -(y_{13}+z_{13})\,\mathbf{a}_1- & = & -ax_{13}\,\hat{\mathbf{x}}-ay_{13}\,\hat{\mathbf{y}}-cz_{13}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & (x_{13}+z_{13})\,\mathbf{a}_2-(x_{13}+y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{64}} & = & (y_{13}-z_{13})\,\mathbf{a}_1+(x_{13}-z_{13})\,\mathbf{a}_2+ & = & ax_{13}\,\hat{\mathbf{x}}+ay_{13}\,\hat{\mathbf{y}}-cz_{13}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & (x_{13}+y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{65}} & = & -(x_{13}+z_{13})\,\mathbf{a}_1+ & = & ay_{13}\,\hat{\mathbf{x}}-ax_{13}\,\hat{\mathbf{y}}-cz_{13}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & (y_{13}-z_{13})\,\mathbf{a}_2-(x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{66}} & = & (x_{13}-z_{13})\,\mathbf{a}_1-(y_{13}+z_{13})\,\mathbf{a}_2+ & = & -ay_{13}\,\hat{\mathbf{x}}+ax_{13}\,\hat{\mathbf{y}}-cz_{13}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & (x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{67}} & = & \left(-y_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_1+ & = & ax_{13}\,\hat{\mathbf{x}}-ay_{13}\,\hat{\mathbf{y}}+c\left(z_{13}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(x_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_2+ & & & \\
& & (x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{68}} & = & \left(y_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_1+ & = & -ax_{13}\,\hat{\mathbf{x}}+ay_{13}\,\hat{\mathbf{y}}+c\left(z_{13}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(-x_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_2- & & & \\
& & (x_{13}-y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{69}} & = & \left(-x_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_1+ & = & -ay_{13}\,\hat{\mathbf{x}}-ax_{13}\,\hat{\mathbf{y}}+c\left(z_{13}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(-y_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_2- & & & \\
& & (x_{13}+y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{70}} & = & \left(x_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_1+ & = & ay_{13}\,\hat{\mathbf{x}}+ax_{13}\,\hat{\mathbf{y}}+c\left(z_{13}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu V} \\
& & \left(y_{13}+z_{13}+\tfrac{1}{2}\right)\mathbf{a}_2+ & & & \\
& & (x_{13}+y_{13})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{71}} & = & (y_{14}+z_{14})\,\mathbf{a}_1+(x_{14}+z_{14})\,\mathbf{a}_2+ & = & ax_{14}\,\hat{\mathbf{x}}+ay_{14}\,\hat{\mathbf{y}}+cz_{14}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu VI} \\
& & (x_{14}+y_{14})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{72}} & = & -(y_{14}-z_{14})\,\mathbf{a}_1- & = & -ax_{14}\,\hat{\mathbf{x}}-ay_{14}\,\hat{\mathbf{y}}+cz_{14}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu VI} \\
& & (x_{14}-z_{14})\,\mathbf{a}_2-(x_{14}+y_{14})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{73}} & = & (x_{14}+z_{14})\,\mathbf{a}_1-(y_{14}-z_{14})\,\mathbf{a}_2+ & = & -ay_{14}\,\hat{\mathbf{x}}+ax_{14}\,\hat{\mathbf{y}}+cz_{14}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu VI} \\
& & (x_{14}-y_{14})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{74}} & = & -(x_{14}-z_{14})\,\mathbf{a}_1+ & = & ay_{14}\,\hat{\mathbf{x}}-ax_{14}\,\hat{\mathbf{y}}+cz_{14}\,\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu VI} \\
& & (y_{14}+z_{14})\,\mathbf{a}_2-(x_{14}-y_{14})\,\mathbf{a}_3 & & & \\[4pt]
\mathbf{B_{75}} & = & \left(y_{14}-z_{14}+\tfrac{1}{2}\right)\mathbf{a}_1- & = & -ax_{14}\,\hat{\mathbf{x}}+ay_{14}\,\hat{\mathbf{y}}-c\left(z_{14}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & \text{(32m)} \qquad \text{Pu VI} \\
& & \left(x_{14}+z_{14}-\tfrac{1}{2}\right)\mathbf{a}_2- & & & \\
& & (x_{14}-y_{14})\,\mathbf{a}_3 & & & \\
\end{array}
$$

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$$
\begin{array}{llll}
\mathbf{B_{76}} = & -\left(y_{14}+z_{14}-\tfrac{1}{2}\right)\mathbf{a}_1 + & = & ax_{14}\,\hat{\mathbf{x}} - ay_{14}\,\hat{\mathbf{y}} - c\left(z_{14}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(x_{14}-z_{14}+\tfrac{1}{2}\right)\mathbf{a}_2 + & & & & \\
& \left(x_{14}-y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{77}} = & \left(x_{14}-z_{14}+\tfrac{1}{2}\right)\mathbf{a}_1 + & = & ay_{14}\,\hat{\mathbf{x}} + ax_{14}\,\hat{\mathbf{y}} - c\left(z_{14}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(y_{14}-z_{14}+\tfrac{1}{2}\right)\mathbf{a}_2 + & & & & \\
& \left(x_{14}+y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{78}} = & -\left(x_{14}+z_{14}-\tfrac{1}{2}\right)\mathbf{a}_1 - & = & -ay_{14}\,\hat{\mathbf{x}} - ax_{14}\,\hat{\mathbf{y}} - c\left(z_{14}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(y_{14}+z_{14}-\tfrac{1}{2}\right)\mathbf{a}_2 - & & & & \\
& \left(x_{14}+y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{79}} = & -\left(y_{14}+z_{14}\right)\mathbf{a}_1 - & = & -ax_{14}\,\hat{\mathbf{x}} - ay_{14}\,\hat{\mathbf{y}} - cz_{14}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(x_{14}+z_{14}\right)\mathbf{a}_2 - \left(x_{14}+y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{80}} = & \left(y_{14}-z_{14}\right)\mathbf{a}_1 + \left(x_{14}-z_{14}\right)\mathbf{a}_2 + & = & ax_{14}\,\hat{\mathbf{x}} + ay_{14}\,\hat{\mathbf{y}} - cz_{14}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(x_{14}+y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{81}} = & -\left(x_{14}+z_{14}\right)\mathbf{a}_1 + & = & ay_{14}\,\hat{\mathbf{x}} - ax_{14}\,\hat{\mathbf{y}} - cz_{14}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(y_{14}-z_{14}\right)\mathbf{a}_2 - \left(x_{14}-y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{82}} = & \left(x_{14}-z_{14}\right)\mathbf{a}_1 - \left(y_{14}+z_{14}\right)\mathbf{a}_2 + & = & -ay_{14}\,\hat{\mathbf{x}} + ax_{14}\,\hat{\mathbf{y}} - cz_{14}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(x_{14}-y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{83}} = & \left(-y_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_1 + & = & ax_{14}\,\hat{\mathbf{x}} - ay_{14}\,\hat{\mathbf{y}} + c\left(z_{14}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(x_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_2 + & & & & \\
& \left(x_{14}-y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{84}} = & \left(y_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_1 + & = & -ax_{14}\,\hat{\mathbf{x}} + ay_{14}\,\hat{\mathbf{y}} + c\left(z_{14}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(-x_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_2 - & & & & \\
& \left(x_{14}-y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{85}} = & \left(-x_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_1 + & = & -ay_{14}\,\hat{\mathbf{x}} - ax_{14}\,\hat{\mathbf{y}} + c\left(z_{14}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(-y_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_2 - & & & & \\
& \left(x_{14}+y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{86}} = & \left(x_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_1 + & = & ay_{14}\,\hat{\mathbf{x}} + ax_{14}\,\hat{\mathbf{y}} + c\left(z_{14}+\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VI} \\
& \left(y_{14}+z_{14}+\tfrac{1}{2}\right)\mathbf{a}_2 + & & & & \\
& \left(x_{14}+y_{14}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{87}} = & \left(y_{15}+z_{15}\right)\mathbf{a}_1 + \left(x_{15}+z_{15}\right)\mathbf{a}_2 + & = & ax_{15}\,\hat{\mathbf{x}} + ay_{15}\,\hat{\mathbf{y}} + cz_{15}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(x_{15}+y_{15}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{88}} = & -\left(y_{15}-z_{15}\right)\mathbf{a}_1 - & = & -ax_{15}\,\hat{\mathbf{x}} - ay_{15}\,\hat{\mathbf{y}} + cz_{15}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(x_{15}-z_{15}\right)\mathbf{a}_2 - \left(x_{15}+y_{15}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{89}} = & \left(x_{15}+z_{15}\right)\mathbf{a}_1 - \left(y_{15}-z_{15}\right)\mathbf{a}_2 + & = & -ay_{15}\,\hat{\mathbf{x}} + ax_{15}\,\hat{\mathbf{y}} + cz_{15}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(x_{15}-y_{15}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{90}} = & -\left(x_{15}-z_{15}\right)\mathbf{a}_1 + & = & ay_{15}\,\hat{\mathbf{x}} - ax_{15}\,\hat{\mathbf{y}} + cz_{15}\,\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(y_{15}+z_{15}\right)\mathbf{a}_2 - \left(x_{15}-y_{15}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{91}} = & \left(y_{15}-z_{15}+\tfrac{1}{2}\right)\mathbf{a}_1 - & = & -ax_{15}\,\hat{\mathbf{x}} + ay_{15}\,\hat{\mathbf{y}} - c\left(z_{15}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(x_{15}+z_{15}-\tfrac{1}{2}\right)\mathbf{a}_2 - & & & & \\
& \left(x_{15}-y_{15}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{92}} = & -\left(y_{15}+z_{15}-\tfrac{1}{2}\right)\mathbf{a}_1 + & = & ax_{15}\,\hat{\mathbf{x}} - ay_{15}\,\hat{\mathbf{y}} - c\left(z_{15}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(x_{15}-z_{15}+\tfrac{1}{2}\right)\mathbf{a}_2 + & & & & \\
& \left(x_{15}-y_{15}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{93}} = & \left(x_{15}-z_{15}+\tfrac{1}{2}\right)\mathbf{a}_1 + & = & ay_{15}\,\hat{\mathbf{x}} + ax_{15}\,\hat{\mathbf{y}} - c\left(z_{15}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(y_{15}-z_{15}+\tfrac{1}{2}\right)\mathbf{a}_2 + & & & & \\
& \left(x_{15}+y_{15}\right)\mathbf{a}_3 & & & & \\[4pt]
\mathbf{B_{94}} = & -\left(x_{15}+z_{15}-\tfrac{1}{2}\right)\mathbf{a}_1 - & = & -ay_{15}\,\hat{\mathbf{x}} - ax_{15}\,\hat{\mathbf{y}} - c\left(z_{15}-\tfrac{1}{2}\right)\hat{\mathbf{z}} & (32\mathrm{m}) & \mathrm{Pu\ VII} \\
& \left(y_{15}+z_{15}-\tfrac{1}{2}\right)\mathbf{a}_2 - & & & & \\
& \left(x_{15}+y_{15}\right)\mathbf{a}_3 & & & & \\
\end{array}
$$

$$\mathbf{B_{95}} \;=\; -(y_{15}+z_{15})\,\mathbf{a}_1 - (x_{15}+z_{15})\,\mathbf{a}_2 - (x_{15}+y_{15})\,\mathbf{a}_3 \;=\; -ax_{15}\,\hat{\mathbf{x}} - ay_{15}\,\hat{\mathbf{y}} - cz_{15}\,\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

$$\mathbf{B_{96}} \;=\; (y_{15}-z_{15})\,\mathbf{a}_1 + (x_{15}-z_{15})\,\mathbf{a}_2 + (x_{15}+y_{15})\,\mathbf{a}_3 \;=\; ax_{15}\,\hat{\mathbf{x}} + ay_{15}\,\hat{\mathbf{y}} - cz_{15}\,\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

$$\mathbf{B_{97}} \;=\; -(x_{15}+z_{15})\,\mathbf{a}_1 + (y_{15}-z_{15})\,\mathbf{a}_2 - (x_{15}-y_{15})\,\mathbf{a}_3 \;=\; ay_{15}\,\hat{\mathbf{x}} - ax_{15}\,\hat{\mathbf{y}} - cz_{15}\,\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

$$\mathbf{B_{98}} \;=\; (x_{15}-z_{15})\,\mathbf{a}_1 - (y_{15}+z_{15})\,\mathbf{a}_2 + (x_{15}-y_{15})\,\mathbf{a}_3 \;=\; -ay_{15}\,\hat{\mathbf{x}} + ax_{15}\,\hat{\mathbf{y}} - cz_{15}\,\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

$$\mathbf{B_{99}} \;=\; \left(-y_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_1 + \left(x_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_2 + (x_{15}-y_{15})\,\mathbf{a}_3 \;=\; ax_{15}\,\hat{\mathbf{x}} - ay_{15}\,\hat{\mathbf{y}} + c\left(z_{15}+\tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

$$\mathbf{B_{100}} \;=\; \left(y_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_1 + \left(-x_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_2 - (x_{15}-y_{15})\,\mathbf{a}_3 \;=\; -ax_{15}\,\hat{\mathbf{x}} + ay_{15}\,\hat{\mathbf{y}} + c\left(z_{15}+\tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

$$\mathbf{B_{101}} \;=\; \left(-x_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_1 + \left(-y_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_2 - (x_{15}+y_{15})\,\mathbf{a}_3 \;=\; -ay_{15}\,\hat{\mathbf{x}} - ax_{15}\,\hat{\mathbf{y}} + c\left(z_{15}+\tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

$$\mathbf{B_{102}} \;=\; \left(x_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_{15}+z_{15}+\tfrac{1}{2}\right)\mathbf{a}_2 + (x_{15}+y_{15})\,\mathbf{a}_3 \;=\; ay_{15}\,\hat{\mathbf{x}} + ax_{15}\,\hat{\mathbf{y}} + c\left(z_{15}+\tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(32m)} \qquad \text{Pu VII}$$

## References

[1] D. T. Cromer and A. C. Larson, *The Crystal Structure of $Pu_{31}Pt_{20}$ and $Pu_{31}Rh_{20}$*, Acta Crystallogr. Sect. B **33**, 2620–2627 (1977), doi:10.1107/S0567740877009030.