High pressure $Bi_2Fe_4O_9$ Structure: A2B4C9_oP60_62_d_2cd_3c3d-001

https://aflow.org/p/BYQL

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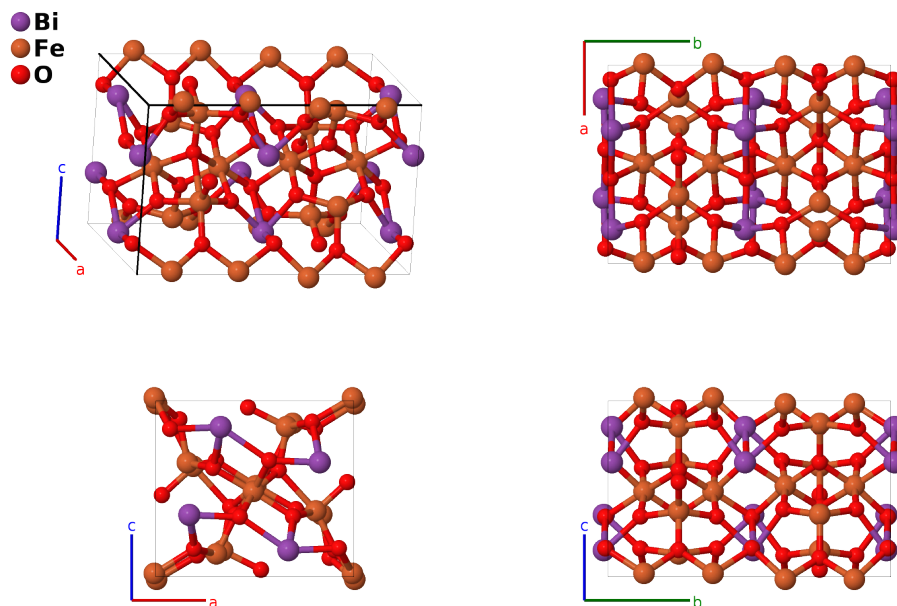
Prototype	$Bi_2Fe_4O_9$
AFLOW prototype label	A2B4C9_oP60_62_d_2cd_3c3d-001
ICSD	186444
Pearson symbol	oP60
Space group number	62
Space group symbol	$Pnma$
AFLOW prototype command	aflow --proto=A2B4C9_oP60_62_d_2cd_3c3d-001
	--params=$a, b/a, c/a, x_1, z_1, x_2, z_2, x_3, z_3, x_4, z_4, x_5, z_5, x_6, y_6, z_6, x_7, y_7, z_7, x_8, y_8, z_8, x_9, y_9, z_9, x_{10}, y_{10}, z_{10}$

- This is the high pressure phase of $Bi_2Fe_4O_9$, using data taken by (Friedrich, 2012) at 9.4GPa. Below 6.89GPa it transforms to the low pressure $Bi_2Fe_4O_9$ structure.

Simple Orthorhombic primitive vectors

$$\mathbf{a_1} = a\,\hat{\mathbf{x}}$$
$$\mathbf{a_2} = b\,\hat{\mathbf{y}}$$
$$\mathbf{a_3} = c\,\hat{\mathbf{z}}$$
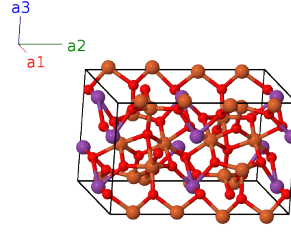
Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	$=$	$x_1\,\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} + z_1\,\mathbf{a_3}$	$=$	$ax_1\,\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} + cz_1\,\hat{\mathbf{z}}$	(4c)	Fe I
$\mathbf{B_2}$	$=$	$-\left(x_1 - \frac{1}{2}\right)\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} + \left(z_1 + \frac{1}{2}\right)\mathbf{a_3}$	$=$	$-a\left(x_1 - \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} + c\left(z_1 + \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	Fe I
$\mathbf{B_3}$	$=$	$-x_1\,\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} - z_1\,\mathbf{a_3}$	$=$	$-ax_1\,\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} - cz_1\,\hat{\mathbf{z}}$	(4c)	Fe I
$\mathbf{B_4}$	$=$	$\left(x_1 + \frac{1}{2}\right)\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} - \left(z_1 - \frac{1}{2}\right)\mathbf{a_3}$	$=$	$a\left(x_1 + \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} - c\left(z_1 - \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	Fe I
$\mathbf{B_5}$	$=$	$x_2\,\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} + z_2\,\mathbf{a_3}$	$=$	$ax_2\,\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} + cz_2\,\hat{\mathbf{z}}$	(4c)	Fe II
$\mathbf{B_6}$	$=$	$-\left(x_2 - \frac{1}{2}\right)\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} + \left(z_2 + \frac{1}{2}\right)\mathbf{a_3}$	$=$	$-a\left(x_2 - \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} + c\left(z_2 + \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	Fe II
$\mathbf{B_7}$	$=$	$-x_2\,\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} - z_2\,\mathbf{a_3}$	$=$	$-ax_2\,\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} - cz_2\,\hat{\mathbf{z}}$	(4c)	Fe II
$\mathbf{B_8}$	$=$	$\left(x_2 + \frac{1}{2}\right)\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} - \left(z_2 - \frac{1}{2}\right)\mathbf{a_3}$	$=$	$a\left(x_2 + \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} - c\left(z_2 - \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	Fe II
$\mathbf{B_9}$	$=$	$x_3\,\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} + z_3\,\mathbf{a_3}$	$=$	$ax_3\,\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} + cz_3\,\hat{\mathbf{z}}$	(4c)	O I
$\mathbf{B_{10}}$	$=$	$-\left(x_3 - \frac{1}{2}\right)\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} + \left(z_3 + \frac{1}{2}\right)\mathbf{a_3}$	$=$	$-a\left(x_3 - \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} + c\left(z_3 + \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	O I
$\mathbf{B_{11}}$	$=$	$-x_3\,\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} - z_3\,\mathbf{a_3}$	$=$	$-ax_3\,\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} - cz_3\,\hat{\mathbf{z}}$	(4c)	O I
$\mathbf{B_{12}}$	$=$	$\left(x_3 + \frac{1}{2}\right)\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} - \left(z_3 - \frac{1}{2}\right)\mathbf{a_3}$	$=$	$a\left(x_3 + \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} - c\left(z_3 - \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	O I
$\mathbf{B_{13}}$	$=$	$x_4\,\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} + z_4\,\mathbf{a_3}$	$=$	$ax_4\,\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} + cz_4\,\hat{\mathbf{z}}$	(4c)	O II
$\mathbf{B_{14}}$	$=$	$-\left(x_4 - \frac{1}{2}\right)\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} + \left(z_4 + \frac{1}{2}\right)\mathbf{a_3}$	$=$	$-a\left(x_4 - \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} + c\left(z_4 + \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	O II
$\mathbf{B_{15}}$	$=$	$-x_4\,\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} - z_4\,\mathbf{a_3}$	$=$	$-ax_4\,\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} - cz_4\,\hat{\mathbf{z}}$	(4c)	O II
$\mathbf{B_{16}}$	$=$	$\left(x_4 + \frac{1}{2}\right)\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} - \left(z_4 - \frac{1}{2}\right)\mathbf{a_3}$	$=$	$a\left(x_4 + \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} - c\left(z_4 - \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	O II
$\mathbf{B_{17}}$	$=$	$x_5\,\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} + z_5\,\mathbf{a_3}$	$=$	$ax_5\,\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} + cz_5\,\hat{\mathbf{z}}$	(4c)	O III
$\mathbf{B_{18}}$	$=$	$-\left(x_5 - \frac{1}{2}\right)\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} + \left(z_5 + \frac{1}{2}\right)\mathbf{a_3}$	$=$	$-a\left(x_5 - \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} + c\left(z_5 + \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	O III
$\mathbf{B_{19}}$	$=$	$-x_5\,\mathbf{a_1} + \frac{3}{4}\,\mathbf{a_2} - z_5\,\mathbf{a_3}$	$=$	$-ax_5\,\hat{\mathbf{x}} + \frac{3}{4}b\,\hat{\mathbf{y}} - cz_5\,\hat{\mathbf{z}}$	(4c)	O III
$\mathbf{B_{20}}$	$=$	$\left(x_5 + \frac{1}{2}\right)\mathbf{a_1} + \frac{1}{4}\,\mathbf{a_2} - \left(z_5 - \frac{1}{2}\right)\mathbf{a_3}$	$=$	$a\left(x_5 + \frac{1}{2}\right)\hat{\mathbf{x}} + \frac{1}{4}b\,\hat{\mathbf{y}} - c\left(z_5 - \frac{1}{2}\right)\hat{\mathbf{z}}$	(4c)	O III
$\mathbf{B_{21}}$	$=$	$x_6\,\mathbf{a_1} + y_6\,\mathbf{a_2} + z_6\,\mathbf{a_3}$	$=$	$ax_6\,\hat{\mathbf{x}} + by_6\,\hat{\mathbf{y}} + cz_6\,\hat{\mathbf{z}}$	(8d)	Bi I
$\mathbf{B_{22}}$	$=$	$-\left(x_6 - \frac{1}{2}\right)\mathbf{a_1} - y_6\,\mathbf{a_2} + \left(z_6 + \frac{1}{2}\right)\mathbf{a_3}$	$=$	$-a\left(x_6 - \frac{1}{2}\right)\hat{\mathbf{x}} - by_6\,\hat{\mathbf{y}} + c\left(z_6 + \frac{1}{2}\right)\hat{\mathbf{z}}$	(8d)	Bi I
$\mathbf{B_{23}}$	$=$	$-x_6\,\mathbf{a_1} + \left(y_6 + \frac{1}{2}\right)\mathbf{a_2} - z_6\,\mathbf{a_3}$	$=$	$-ax_6\,\hat{\mathbf{x}} + b\left(y_6 + \frac{1}{2}\right)\hat{\mathbf{y}} - cz_6\,\hat{\mathbf{z}}$	(8d)	Bi I
$\mathbf{B_{24}}$	$=$	$\left(x_6 + \frac{1}{2}\right)\mathbf{a_1} - \left(y_6 - \frac{1}{2}\right)\mathbf{a_2} - \left(z_6 - \frac{1}{2}\right)\mathbf{a_3}$	$=$	$a\left(x_6 + \frac{1}{2}\right)\hat{\mathbf{x}} - b\left(y_6 - \frac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_6 - \frac{1}{2}\right)\hat{\mathbf{z}}$	(8d)	Bi I
$\mathbf{B_{25}}$	$=$	$-x_6\,\mathbf{a_1} - y_6\,\mathbf{a_2} - z_6\,\mathbf{a_3}$	$=$	$-ax_6\,\hat{\mathbf{x}} - by_6\,\hat{\mathbf{y}} - cz_6\,\hat{\mathbf{z}}$	(8d)	Bi I
$\mathbf{B_{26}}$	$=$	$\left(x_6 + \frac{1}{2}\right)\mathbf{a_1} + y_6\,\mathbf{a_2} - \left(z_6 - \frac{1}{2}\right)\mathbf{a_3}$	$=$	$a\left(x_6 + \frac{1}{2}\right)\hat{\mathbf{x}} + by_6\,\hat{\mathbf{y}} - c\left(z_6 - \frac{1}{2}\right)\hat{\mathbf{z}}$	(8d)	Bi I

$$\mathbf{B_{27}} = x_6\,\mathbf{a_1} - \left(y_6 - \tfrac{1}{2}\right)\mathbf{a_2} + z_6\,\mathbf{a_3} = ax_6\,\hat{\mathbf{x}} - b\left(y_6 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + cz_6\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Bi I}$$

$$\mathbf{B_{28}} = -\left(x_6 - \tfrac{1}{2}\right)\mathbf{a_1} + \left(y_6 + \tfrac{1}{2}\right)\mathbf{a_2} + \left(z_6 + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_6 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + b\left(y_6 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_6 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Bi I}$$

$$\mathbf{B_{29}} = x_7\,\mathbf{a_1} + y_7\,\mathbf{a_2} + z_7\,\mathbf{a_3} = ax_7\,\hat{\mathbf{x}} + by_7\,\hat{\mathbf{y}} + cz_7\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{30}} = -\left(x_7 - \tfrac{1}{2}\right)\mathbf{a_1} - y_7\,\mathbf{a_2} + \left(z_7 + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_7 - \tfrac{1}{2}\right)\hat{\mathbf{x}} - by_7\,\hat{\mathbf{y}} + c\left(z_7 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{31}} = -x_7\,\mathbf{a_1} + \left(y_7 + \tfrac{1}{2}\right)\mathbf{a_2} - z_7\,\mathbf{a_3} = -ax_7\,\hat{\mathbf{x}} + b\left(y_7 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - cz_7\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{32}} = \left(x_7 + \tfrac{1}{2}\right)\mathbf{a_1} - \left(y_7 - \tfrac{1}{2}\right)\mathbf{a_2} - \left(z_7 - \tfrac{1}{2}\right)\mathbf{a_3} = a\left(x_7 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - b\left(y_7 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_7 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{33}} = -x_7\,\mathbf{a_1} - y_7\,\mathbf{a_2} - z_7\,\mathbf{a_3} = -ax_7\,\hat{\mathbf{x}} - by_7\,\hat{\mathbf{y}} - cz_7\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{34}} = \left(x_7 + \tfrac{1}{2}\right)\mathbf{a_1} + y_7\,\mathbf{a_2} - \left(z_7 - \tfrac{1}{2}\right)\mathbf{a_3} = a\left(x_7 + \tfrac{1}{2}\right)\hat{\mathbf{x}} + by_7\,\hat{\mathbf{y}} - c\left(z_7 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{35}} = x_7\,\mathbf{a_1} - \left(y_7 - \tfrac{1}{2}\right)\mathbf{a_2} + z_7\,\mathbf{a_3} = ax_7\,\hat{\mathbf{x}} - b\left(y_7 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + cz_7\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{36}} = -\left(x_7 - \tfrac{1}{2}\right)\mathbf{a_1} + \left(y_7 + \tfrac{1}{2}\right)\mathbf{a_2} + \left(z_7 + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_7 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + b\left(y_7 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_7 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{Fe III}$$

$$\mathbf{B_{37}} = x_8\,\mathbf{a_1} + y_8\,\mathbf{a_2} + z_8\,\mathbf{a_3} = ax_8\,\hat{\mathbf{x}} + by_8\,\hat{\mathbf{y}} + cz_8\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{38}} = -\left(x_8 - \tfrac{1}{2}\right)\mathbf{a_1} - y_8\,\mathbf{a_2} + \left(z_8 + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_8 - \tfrac{1}{2}\right)\hat{\mathbf{x}} - by_8\,\hat{\mathbf{y}} + c\left(z_8 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{39}} = -x_8\,\mathbf{a_1} + \left(y_8 + \tfrac{1}{2}\right)\mathbf{a_2} - z_8\,\mathbf{a_3} = -ax_8\,\hat{\mathbf{x}} + b\left(y_8 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - cz_8\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{40}} = \left(x_8 + \tfrac{1}{2}\right)\mathbf{a_1} - \left(y_8 - \tfrac{1}{2}\right)\mathbf{a_2} - \left(z_8 - \tfrac{1}{2}\right)\mathbf{a_3} = a\left(x_8 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - b\left(y_8 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_8 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{41}} = -x_8\,\mathbf{a_1} - y_8\,\mathbf{a_2} - z_8\,\mathbf{a_3} = -ax_8\,\hat{\mathbf{x}} - by_8\,\hat{\mathbf{y}} - cz_8\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{42}} = \left(x_8 + \tfrac{1}{2}\right)\mathbf{a_1} + y_8\,\mathbf{a_2} - \left(z_8 - \tfrac{1}{2}\right)\mathbf{a_3} = a\left(x_8 + \tfrac{1}{2}\right)\hat{\mathbf{x}} + by_8\,\hat{\mathbf{y}} - c\left(z_8 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{43}} = x_8\,\mathbf{a_1} - \left(y_8 - \tfrac{1}{2}\right)\mathbf{a_2} + z_8\,\mathbf{a_3} = ax_8\,\hat{\mathbf{x}} - b\left(y_8 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + cz_8\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{44}} = -\left(x_8 - \tfrac{1}{2}\right)\mathbf{a_1} + \left(y_8 + \tfrac{1}{2}\right)\mathbf{a_2} + \left(z_8 + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_8 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + b\left(y_8 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_8 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O IV}$$

$$\mathbf{B_{45}} = x_9\,\mathbf{a_1} + y_9\,\mathbf{a_2} + z_9\,\mathbf{a_3} = ax_9\,\hat{\mathbf{x}} + by_9\,\hat{\mathbf{y}} + cz_9\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{46}} = -\left(x_9 - \tfrac{1}{2}\right)\mathbf{a_1} - y_9\,\mathbf{a_2} + \left(z_9 + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_9 - \tfrac{1}{2}\right)\hat{\mathbf{x}} - by_9\,\hat{\mathbf{y}} + c\left(z_9 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{47}} = -x_9\,\mathbf{a_1} + \left(y_9 + \tfrac{1}{2}\right)\mathbf{a_2} - z_9\,\mathbf{a_3} = -ax_9\,\hat{\mathbf{x}} + b\left(y_9 + \tfrac{1}{2}\right)\hat{\mathbf{y}} - cz_9\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{48}} = \left(x_9 + \tfrac{1}{2}\right)\mathbf{a_1} - \left(y_9 - \tfrac{1}{2}\right)\mathbf{a_2} - \left(z_9 - \tfrac{1}{2}\right)\mathbf{a_3} = a\left(x_9 + \tfrac{1}{2}\right)\hat{\mathbf{x}} - b\left(y_9 - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_9 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{49}} = -x_9\,\mathbf{a_1} - y_9\,\mathbf{a_2} - z_9\,\mathbf{a_3} = -ax_9\,\hat{\mathbf{x}} - by_9\,\hat{\mathbf{y}} - cz_9\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{50}} = \left(x_9 + \tfrac{1}{2}\right)\mathbf{a_1} + y_9\,\mathbf{a_2} - \left(z_9 - \tfrac{1}{2}\right)\mathbf{a_3} = a\left(x_9 + \tfrac{1}{2}\right)\hat{\mathbf{x}} + by_9\,\hat{\mathbf{y}} - c\left(z_9 - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{51}} = x_9\,\mathbf{a_1} - \left(y_9 - \tfrac{1}{2}\right)\mathbf{a_2} + z_9\,\mathbf{a_3} = ax_9\,\hat{\mathbf{x}} - b\left(y_9 - \tfrac{1}{2}\right)\hat{\mathbf{y}} + cz_9\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{52}} = -\left(x_9 - \tfrac{1}{2}\right)\mathbf{a_1} + \left(y_9 + \tfrac{1}{2}\right)\mathbf{a_2} + \left(z_9 + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_9 - \tfrac{1}{2}\right)\hat{\mathbf{x}} + b\left(y_9 + \tfrac{1}{2}\right)\hat{\mathbf{y}} + c\left(z_9 + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O V}$$

$$\mathbf{B_{53}} = x_{10}\,\mathbf{a_1} + y_{10}\,\mathbf{a_2} + z_{10}\,\mathbf{a_3} = ax_{10}\,\hat{\mathbf{x}} + by_{10}\,\hat{\mathbf{y}} + cz_{10}\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O VI}$$

$$\mathbf{B_{54}} = -\left(x_{10} - \tfrac{1}{2}\right)\mathbf{a_1} - y_{10}\,\mathbf{a_2} + \left(z_{10} + \tfrac{1}{2}\right)\mathbf{a_3} = -a\left(x_{10} - \tfrac{1}{2}\right)\hat{\mathbf{x}} - by_{10}\,\hat{\mathbf{y}} + c\left(z_{10} + \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O VI}$$

$$\mathbf{B_{55}} = -x_{10}\,\mathbf{a_1} + \left(y_{10} + \tfrac{1}{2}\right)\mathbf{a_2} - z_{10}\,\mathbf{a_3} = -ax_{10}\,\hat{\mathbf{x}} + b\left(y_{10} + \tfrac{1}{2}\right)\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O VI}$$

$$\mathbf{B_{56}} = \left(x_{10} + \tfrac{1}{2}\right)\mathbf{a_1} - \left(y_{10} - \tfrac{1}{2}\right)\mathbf{a_2} - \left(z_{10} - \tfrac{1}{2}\right)\mathbf{a_3} = a\left(x_{10} + \tfrac{1}{2}\right)\hat{\mathbf{x}} - b\left(y_{10} - \tfrac{1}{2}\right)\hat{\mathbf{y}} - c\left(z_{10} - \tfrac{1}{2}\right)\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O VI}$$

$$\mathbf{B_{57}} = -x_{10}\,\mathbf{a_1} - y_{10}\,\mathbf{a_2} - z_{10}\,\mathbf{a_3} = -ax_{10}\,\hat{\mathbf{x}} - by_{10}\,\hat{\mathbf{y}} - cz_{10}\,\hat{\mathbf{z}} \qquad \text{(8d)} \qquad \text{O VI}$$

$$
\begin{array}{llll}
\mathbf{B_{58}} = & \left(x_{10}+\tfrac{1}{2}\right)\mathbf{a}_1 + y_{10}\,\mathbf{a}_2 - & = & a\left(x_{10}+\tfrac{1}{2}\right)\hat{\mathbf{x}} + b y_{10}\,\hat{\mathbf{y}} - c\left(z_{10}-\tfrac{1}{2}\right)\hat{\mathbf{z}} \quad\quad (8\text{d}) \quad\quad \text{O VI}\\
& \left(z_{10}-\tfrac{1}{2}\right)\mathbf{a}_3 & & \\
\mathbf{B_{59}} = & x_{10}\,\mathbf{a}_1 - \left(y_{10}-\tfrac{1}{2}\right)\mathbf{a}_2 + z_{10}\,\mathbf{a}_3 & = & a x_{10}\,\hat{\mathbf{x}} - b\left(y_{10}-\tfrac{1}{2}\right)\hat{\mathbf{y}} + c z_{10}\,\hat{\mathbf{z}} \quad\quad (8\text{d}) \quad\quad \text{O VI}\\
\mathbf{B_{60}} = & -\left(x_{10}-\tfrac{1}{2}\right)\mathbf{a}_1 + \left(y_{10}+\tfrac{1}{2}\right)\mathbf{a}_2 + & = & -a\left(x_{10}-\tfrac{1}{2}\right)\hat{\mathbf{x}} + b\left(y_{10}+\tfrac{1}{2}\right)\hat{\mathbf{y}} + \quad\quad (8\text{d}) \quad\quad \text{O VI}\\
& \left(z_{10}+\tfrac{1}{2}\right)\mathbf{a}_3 & & c\left(z_{10}+\tfrac{1}{2}\right)\hat{\mathbf{z}}
\end{array}
$$

References

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