Monoclinic (Hittorf's) Phosphorus Structure: A_mP84_13_21g-001

This structure originally had the label `A_mP84_13_21g`. Calls to that address will be redirected here.

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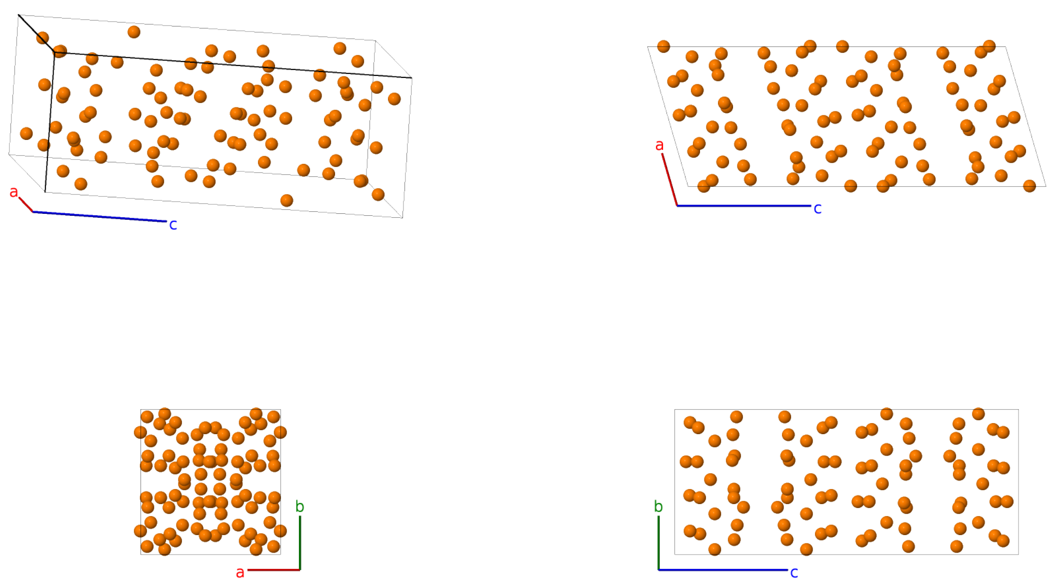
https://aflow.org/p/SEQF

https://aflow.org/p/A_mP84_13_21g-001

P



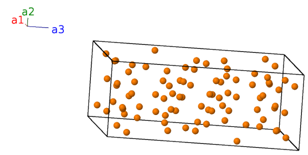
Prototype	P
AFLOW prototype label	A_mP84_13_21g-001
Mineral name	hittorf's phosphorus
ICSD	29273
Pearson symbol	mP84
Space group number	13
Space group symbol	$P2/c$
AFLOW prototype command	`aflow --proto=A_mP84_13_21g-001 --params=`$a, b/a, c/a, \beta, x_1, y_1, z_1, x_2, y_2, z_2, x_3, y_3, z_3, x_4, y_4, z_4, x_5, y_5, z_5, x_6, y_6, z_6, x_7, y_7, z_7, x_8, y_8, z_8, x_9, y_9, z_9, x_{10}, y_{10}, z_{10}, x_{11}, y_{11}, z_{11}, x_{12}, y_{12}, z_{12}, x_{13}, y_{13}, z_{13}, x_{14}, y_{14}, z_{14}, x_{15}, y_{15}, z_{15}, x_{16}, y_{16}, z_{16}, x_{17}, y_{17}, z_{17}, x_{18}, y_{18}, z_{18}, x_{19}, y_{19}, z_{19}, x_{20}, y_{20}, z_{20}, x_{21}, y_{21}, z_{21}$

- Phosphorus is found in at least three forms:

– Black phosphorus, *Strukturbericht* A17,
– Monoclinic Hittorf's phosphorus, (this structure) and
– Low temperature triclinic "white" phosphorus, stable below 197K.

Simple Monoclinic primitive vectors

$$\mathbf{a_1} = a\,\hat{\mathbf{x}}$$
$$\mathbf{a_2} = b\,\hat{\mathbf{y}}$$
$$\mathbf{a_3} = c\cos\beta\,\hat{\mathbf{x}} + c\sin\beta\,\hat{\mathbf{z}}$$



Basis vectors

		Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B_1}$	=	$x_1\,\mathbf{a}_1 + y_1\,\mathbf{a}_2 + z_1\,\mathbf{a}_3$	=	$(ax_1 + cz_1\cos\beta)\,\hat{\mathbf{x}} + by_1\,\hat{\mathbf{y}} + cz_1\sin\beta\,\hat{\mathbf{z}}$	(4g)	P I
$\mathbf{B_2}$	=	$-x_1\,\mathbf{a}_1 + y_1\,\mathbf{a}_2 - \left(z_1 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_1 + c\left(z_1 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_1\,\hat{\mathbf{y}} - c\left(z_1 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P I
$\mathbf{B_3}$	=	$-x_1\,\mathbf{a}_1 - y_1\,\mathbf{a}_2 - z_1\,\mathbf{a}_3$	=	$-(ax_1 + cz_1\cos\beta)\,\hat{\mathbf{x}} - by_1\,\hat{\mathbf{y}} - cz_1\sin\beta\,\hat{\mathbf{z}}$	(4g)	P I
$\mathbf{B_4}$	=	$x_1\,\mathbf{a}_1 - y_1\,\mathbf{a}_2 + \left(z_1 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_1 + c\left(z_1 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_1\,\hat{\mathbf{y}} + c\left(z_1 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P I
$\mathbf{B_5}$	=	$x_2\,\mathbf{a}_1 + y_2\,\mathbf{a}_2 + z_2\,\mathbf{a}_3$	=	$(ax_2 + cz_2\cos\beta)\,\hat{\mathbf{x}} + by_2\,\hat{\mathbf{y}} + cz_2\sin\beta\,\hat{\mathbf{z}}$	(4g)	P II
$\mathbf{B_6}$	=	$-x_2\,\mathbf{a}_1 + y_2\,\mathbf{a}_2 - \left(z_2 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_2 + c\left(z_2 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_2\,\hat{\mathbf{y}} - c\left(z_2 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P II
$\mathbf{B_7}$	=	$-x_2\,\mathbf{a}_1 - y_2\,\mathbf{a}_2 - z_2\,\mathbf{a}_3$	=	$-(ax_2 + cz_2\cos\beta)\,\hat{\mathbf{x}} - by_2\,\hat{\mathbf{y}} - cz_2\sin\beta\,\hat{\mathbf{z}}$	(4g)	P II
$\mathbf{B_8}$	=	$x_2\,\mathbf{a}_1 - y_2\,\mathbf{a}_2 + \left(z_2 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_2 + c\left(z_2 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_2\,\hat{\mathbf{y}} + c\left(z_2 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P II
$\mathbf{B_9}$	=	$x_3\,\mathbf{a}_1 + y_3\,\mathbf{a}_2 + z_3\,\mathbf{a}_3$	=	$(ax_3 + cz_3\cos\beta)\,\hat{\mathbf{x}} + by_3\,\hat{\mathbf{y}} + cz_3\sin\beta\,\hat{\mathbf{z}}$	(4g)	P III
$\mathbf{B_{10}}$	=	$-x_3\,\mathbf{a}_1 + y_3\,\mathbf{a}_2 - \left(z_3 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_3 + c\left(z_3 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_3\,\hat{\mathbf{y}} - c\left(z_3 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P III
$\mathbf{B_{11}}$	=	$-x_3\,\mathbf{a}_1 - y_3\,\mathbf{a}_2 - z_3\,\mathbf{a}_3$	=	$-(ax_3 + cz_3\cos\beta)\,\hat{\mathbf{x}} - by_3\,\hat{\mathbf{y}} - cz_3\sin\beta\,\hat{\mathbf{z}}$	(4g)	P III
$\mathbf{B_{12}}$	=	$x_3\,\mathbf{a}_1 - y_3\,\mathbf{a}_2 + \left(z_3 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_3 + c\left(z_3 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_3\,\hat{\mathbf{y}} + c\left(z_3 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P III
$\mathbf{B_{13}}$	=	$x_4\,\mathbf{a}_1 + y_4\,\mathbf{a}_2 + z_4\,\mathbf{a}_3$	=	$(ax_4 + cz_4\cos\beta)\,\hat{\mathbf{x}} + by_4\,\hat{\mathbf{y}} + cz_4\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IV
$\mathbf{B_{14}}$	=	$-x_4\,\mathbf{a}_1 + y_4\,\mathbf{a}_2 - \left(z_4 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_4 + c\left(z_4 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_4\,\hat{\mathbf{y}} - c\left(z_4 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IV
$\mathbf{B_{15}}$	=	$-x_4\,\mathbf{a}_1 - y_4\,\mathbf{a}_2 - z_4\,\mathbf{a}_3$	=	$-(ax_4 + cz_4\cos\beta)\,\hat{\mathbf{x}} - by_4\,\hat{\mathbf{y}} - cz_4\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IV
$\mathbf{B_{16}}$	=	$x_4\,\mathbf{a}_1 - y_4\,\mathbf{a}_2 + \left(z_4 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_4 + c\left(z_4 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_4\,\hat{\mathbf{y}} + c\left(z_4 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IV
$\mathbf{B_{17}}$	=	$x_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2 + z_5\,\mathbf{a}_3$	=	$(ax_5 + cz_5\cos\beta)\,\hat{\mathbf{x}} + by_5\,\hat{\mathbf{y}} + cz_5\sin\beta\,\hat{\mathbf{z}}$	(4g)	P V
$\mathbf{B_{18}}$	=	$-x_5\,\mathbf{a}_1 + y_5\,\mathbf{a}_2 - \left(z_5 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_5 + c\left(z_5 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_5\,\hat{\mathbf{y}} - c\left(z_5 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P V
$\mathbf{B_{19}}$	=	$-x_5\,\mathbf{a}_1 - y_5\,\mathbf{a}_2 - z_5\,\mathbf{a}_3$	=	$-(ax_5 + cz_5\cos\beta)\,\hat{\mathbf{x}} - by_5\,\hat{\mathbf{y}} - cz_5\sin\beta\,\hat{\mathbf{z}}$	(4g)	P V
$\mathbf{B_{20}}$	=	$x_5\,\mathbf{a}_1 - y_5\,\mathbf{a}_2 + \left(z_5 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_5 + c\left(z_5 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_5\,\hat{\mathbf{y}} + c\left(z_5 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P V
$\mathbf{B_{21}}$	=	$x_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2 + z_6\,\mathbf{a}_3$	=	$(ax_6 + cz_6\cos\beta)\,\hat{\mathbf{x}} + by_6\,\hat{\mathbf{y}} + cz_6\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VI

$\mathbf{B_{22}}$	=	$-x_6\,\mathbf{a}_1 + y_6\,\mathbf{a}_2 - \left(z_6 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_6 + c\left(z_6 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_6\,\hat{\mathbf{y}} - c\left(z_6 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VI
$\mathbf{B_{23}}$	=	$-x_6\,\mathbf{a}_1 - y_6\,\mathbf{a}_2 - z_6\,\mathbf{a}_3$	=	$-\left(ax_6 + cz_6\cos\beta\right)\,\hat{\mathbf{x}} - by_6\,\hat{\mathbf{y}} - cz_6\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VI
$\mathbf{B_{24}}$	=	$x_6\,\mathbf{a}_1 - y_6\,\mathbf{a}_2 + \left(z_6 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_6 + c\left(z_6 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_6\,\hat{\mathbf{y}} + c\left(z_6 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VI
$\mathbf{B_{25}}$	=	$x_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2 + z_7\,\mathbf{a}_3$	=	$\left(ax_7 + cz_7\cos\beta\right)\,\hat{\mathbf{x}} + by_7\,\hat{\mathbf{y}} + cz_7\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VII
$\mathbf{B_{26}}$	=	$-x_7\,\mathbf{a}_1 + y_7\,\mathbf{a}_2 - \left(z_7 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_7 + c\left(z_7 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_7\,\hat{\mathbf{y}} - c\left(z_7 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VII
$\mathbf{B_{27}}$	=	$-x_7\,\mathbf{a}_1 - y_7\,\mathbf{a}_2 - z_7\,\mathbf{a}_3$	=	$-\left(ax_7 + cz_7\cos\beta\right)\,\hat{\mathbf{x}} - by_7\,\hat{\mathbf{y}} - cz_7\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VII
$\mathbf{B_{28}}$	=	$x_7\,\mathbf{a}_1 - y_7\,\mathbf{a}_2 + \left(z_7 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_7 + c\left(z_7 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_7\,\hat{\mathbf{y}} + c\left(z_7 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VII
$\mathbf{B_{29}}$	=	$x_8\,\mathbf{a}_1 + y_8\,\mathbf{a}_2 + z_8\,\mathbf{a}_3$	=	$\left(ax_8 + cz_8\cos\beta\right)\,\hat{\mathbf{x}} + by_8\,\hat{\mathbf{y}} + cz_8\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VIII
$\mathbf{B_{30}}$	=	$-x_8\,\mathbf{a}_1 + y_8\,\mathbf{a}_2 - \left(z_8 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_8 + c\left(z_8 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_8\,\hat{\mathbf{y}} - c\left(z_8 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VIII
$\mathbf{B_{31}}$	=	$-x_8\,\mathbf{a}_1 - y_8\,\mathbf{a}_2 - z_8\,\mathbf{a}_3$	=	$-\left(ax_8 + cz_8\cos\beta\right)\,\hat{\mathbf{x}} - by_8\,\hat{\mathbf{y}} - cz_8\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VIII
$\mathbf{B_{32}}$	=	$x_8\,\mathbf{a}_1 - y_8\,\mathbf{a}_2 + \left(z_8 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_8 + c\left(z_8 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_8\,\hat{\mathbf{y}} + c\left(z_8 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P VIII
$\mathbf{B_{33}}$	=	$x_9\,\mathbf{a}_1 + y_9\,\mathbf{a}_2 + z_9\,\mathbf{a}_3$	=	$\left(ax_9 + cz_9\cos\beta\right)\,\hat{\mathbf{x}} + by_9\,\hat{\mathbf{y}} + cz_9\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IX
$\mathbf{B_{34}}$	=	$-x_9\,\mathbf{a}_1 + y_9\,\mathbf{a}_2 - \left(z_9 - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_9 + c\left(z_9 - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_9\,\hat{\mathbf{y}} - c\left(z_9 - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IX
$\mathbf{B_{35}}$	=	$-x_9\,\mathbf{a}_1 - y_9\,\mathbf{a}_2 - z_9\,\mathbf{a}_3$	=	$-\left(ax_9 + cz_9\cos\beta\right)\,\hat{\mathbf{x}} - by_9\,\hat{\mathbf{y}} - cz_9\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IX
$\mathbf{B_{36}}$	=	$x_9\,\mathbf{a}_1 - y_9\,\mathbf{a}_2 + \left(z_9 + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_9 + c\left(z_9 + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_9\,\hat{\mathbf{y}} + c\left(z_9 + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P IX
$\mathbf{B_{37}}$	=	$x_{10}\,\mathbf{a}_1 + y_{10}\,\mathbf{a}_2 + z_{10}\,\mathbf{a}_3$	=	$\left(ax_{10} + cz_{10}\cos\beta\right)\,\hat{\mathbf{x}} + by_{10}\,\hat{\mathbf{y}} + cz_{10}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P X
$\mathbf{B_{38}}$	=	$-x_{10}\,\mathbf{a}_1 + y_{10}\,\mathbf{a}_2 - \left(z_{10} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{10} + c\left(z_{10} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{10}\,\hat{\mathbf{y}} - c\left(z_{10} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P X
$\mathbf{B_{39}}$	=	$-x_{10}\,\mathbf{a}_1 - y_{10}\,\mathbf{a}_2 - z_{10}\,\mathbf{a}_3$	=	$-\left(ax_{10} + cz_{10}\cos\beta\right)\,\hat{\mathbf{x}} - by_{10}\,\hat{\mathbf{y}} - cz_{10}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P X
$\mathbf{B_{40}}$	=	$x_{10}\,\mathbf{a}_1 - y_{10}\,\mathbf{a}_2 + \left(z_{10} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{10} + c\left(z_{10} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{10}\,\hat{\mathbf{y}} + c\left(z_{10} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P X
$\mathbf{B_{41}}$	=	$x_{11}\,\mathbf{a}_1 + y_{11}\,\mathbf{a}_2 + z_{11}\,\mathbf{a}_3$	=	$\left(ax_{11} + cz_{11}\cos\beta\right)\,\hat{\mathbf{x}} + by_{11}\,\hat{\mathbf{y}} + cz_{11}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XI
$\mathbf{B_{42}}$	=	$-x_{11}\,\mathbf{a}_1 + y_{11}\,\mathbf{a}_2 - \left(z_{11} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{11} + c\left(z_{11} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{11}\,\hat{\mathbf{y}} - c\left(z_{11} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XI
$\mathbf{B_{43}}$	=	$-x_{11}\,\mathbf{a}_1 - y_{11}\,\mathbf{a}_2 - z_{11}\,\mathbf{a}_3$	=	$-\left(ax_{11} + cz_{11}\cos\beta\right)\,\hat{\mathbf{x}} - by_{11}\,\hat{\mathbf{y}} - cz_{11}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XI
$\mathbf{B_{44}}$	=	$x_{11}\,\mathbf{a}_1 - y_{11}\,\mathbf{a}_2 + \left(z_{11} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{11} + c\left(z_{11} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{11}\,\hat{\mathbf{y}} + c\left(z_{11} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XI
$\mathbf{B_{45}}$	=	$x_{12}\,\mathbf{a}_1 + y_{12}\,\mathbf{a}_2 + z_{12}\,\mathbf{a}_3$	=	$\left(ax_{12} + cz_{12}\cos\beta\right)\,\hat{\mathbf{x}} + by_{12}\,\hat{\mathbf{y}} + cz_{12}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XII
$\mathbf{B_{46}}$	=	$-x_{12}\,\mathbf{a}_1 + y_{12}\,\mathbf{a}_2 - \left(z_{12} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{12} + c\left(z_{12} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{12}\,\hat{\mathbf{y}} - c\left(z_{12} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XII
$\mathbf{B_{47}}$	=	$-x_{12}\,\mathbf{a}_1 - y_{12}\,\mathbf{a}_2 - z_{12}\,\mathbf{a}_3$	=	$-\left(ax_{12} + cz_{12}\cos\beta\right)\,\hat{\mathbf{x}} - by_{12}\,\hat{\mathbf{y}} - cz_{12}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XII
$\mathbf{B_{48}}$	=	$x_{12}\,\mathbf{a}_1 - y_{12}\,\mathbf{a}_2 + \left(z_{12} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{12} + c\left(z_{12} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{12}\,\hat{\mathbf{y}} + c\left(z_{12} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XII
$\mathbf{B_{49}}$	=	$x_{13}\,\mathbf{a}_1 + y_{13}\,\mathbf{a}_2 + z_{13}\,\mathbf{a}_3$	=	$\left(ax_{13} + cz_{13}\cos\beta\right)\,\hat{\mathbf{x}} + by_{13}\,\hat{\mathbf{y}} + cz_{13}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XIII

$\mathbf{B_{50}}$	=	$-x_{13}\,\mathbf{a}_1 + y_{13}\,\mathbf{a}_2 - \left(z_{13} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{13} + c\left(z_{13} - \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} + by_{13}\,\mathbf{\hat{y}} - c\left(z_{13} - \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIII
$\mathbf{B_{51}}$	=	$-x_{13}\,\mathbf{a}_1 - y_{13}\,\mathbf{a}_2 - z_{13}\,\mathbf{a}_3$	=	$-\left(ax_{13} + cz_{13}\cos\beta\right)\,\mathbf{\hat{x}} - by_{13}\,\mathbf{\hat{y}} - cz_{13}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIII
$\mathbf{B_{52}}$	=	$x_{13}\,\mathbf{a}_1 - y_{13}\,\mathbf{a}_2 + \left(z_{13} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{13} + c\left(z_{13} + \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} - by_{13}\,\mathbf{\hat{y}} + c\left(z_{13} + \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIII
$\mathbf{B_{53}}$	=	$x_{14}\,\mathbf{a}_1 + y_{14}\,\mathbf{a}_2 + z_{14}\,\mathbf{a}_3$	=	$\left(ax_{14} + cz_{14}\cos\beta\right)\,\mathbf{\hat{x}} + by_{14}\,\mathbf{\hat{y}} + cz_{14}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIV
$\mathbf{B_{54}}$	=	$-x_{14}\,\mathbf{a}_1 + y_{14}\,\mathbf{a}_2 - \left(z_{14} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{14} + c\left(z_{14} - \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} + by_{14}\,\mathbf{\hat{y}} - c\left(z_{14} - \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIV
$\mathbf{B_{55}}$	=	$-x_{14}\,\mathbf{a}_1 - y_{14}\,\mathbf{a}_2 - z_{14}\,\mathbf{a}_3$	=	$-\left(ax_{14} + cz_{14}\cos\beta\right)\,\mathbf{\hat{x}} - by_{14}\,\mathbf{\hat{y}} - cz_{14}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIV
$\mathbf{B_{56}}$	=	$x_{14}\,\mathbf{a}_1 - y_{14}\,\mathbf{a}_2 + \left(z_{14} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{14} + c\left(z_{14} + \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} - by_{14}\,\mathbf{\hat{y}} + c\left(z_{14} + \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIV
$\mathbf{B_{57}}$	=	$x_{15}\,\mathbf{a}_1 + y_{15}\,\mathbf{a}_2 + z_{15}\,\mathbf{a}_3$	=	$\left(ax_{15} + cz_{15}\cos\beta\right)\,\mathbf{\hat{x}} + by_{15}\,\mathbf{\hat{y}} + cz_{15}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XV
$\mathbf{B_{58}}$	=	$-x_{15}\,\mathbf{a}_1 + y_{15}\,\mathbf{a}_2 - \left(z_{15} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{15} + c\left(z_{15} - \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} + by_{15}\,\mathbf{\hat{y}} - c\left(z_{15} - \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XV
$\mathbf{B_{59}}$	=	$-x_{15}\,\mathbf{a}_1 - y_{15}\,\mathbf{a}_2 - z_{15}\,\mathbf{a}_3$	=	$-\left(ax_{15} + cz_{15}\cos\beta\right)\,\mathbf{\hat{x}} - by_{15}\,\mathbf{\hat{y}} - cz_{15}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XV
$\mathbf{B_{60}}$	=	$x_{15}\,\mathbf{a}_1 - y_{15}\,\mathbf{a}_2 + \left(z_{15} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{15} + c\left(z_{15} + \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} - by_{15}\,\mathbf{\hat{y}} + c\left(z_{15} + \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XV
$\mathbf{B_{61}}$	=	$x_{16}\,\mathbf{a}_1 + y_{16}\,\mathbf{a}_2 + z_{16}\,\mathbf{a}_3$	=	$\left(ax_{16} + cz_{16}\cos\beta\right)\,\mathbf{\hat{x}} + by_{16}\,\mathbf{\hat{y}} + cz_{16}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVI
$\mathbf{B_{62}}$	=	$-x_{16}\,\mathbf{a}_1 + y_{16}\,\mathbf{a}_2 - \left(z_{16} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{16} + c\left(z_{16} - \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} + by_{16}\,\mathbf{\hat{y}} - c\left(z_{16} - \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVI
$\mathbf{B_{63}}$	=	$-x_{16}\,\mathbf{a}_1 - y_{16}\,\mathbf{a}_2 - z_{16}\,\mathbf{a}_3$	=	$-\left(ax_{16} + cz_{16}\cos\beta\right)\,\mathbf{\hat{x}} - by_{16}\,\mathbf{\hat{y}} - cz_{16}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVI
$\mathbf{B_{64}}$	=	$x_{16}\,\mathbf{a}_1 - y_{16}\,\mathbf{a}_2 + \left(z_{16} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{16} + c\left(z_{16} + \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} - by_{16}\,\mathbf{\hat{y}} + c\left(z_{16} + \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVI
$\mathbf{B_{65}}$	=	$x_{17}\,\mathbf{a}_1 + y_{17}\,\mathbf{a}_2 + z_{17}\,\mathbf{a}_3$	=	$\left(ax_{17} + cz_{17}\cos\beta\right)\,\mathbf{\hat{x}} + by_{17}\,\mathbf{\hat{y}} + cz_{17}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVII
$\mathbf{B_{66}}$	=	$-x_{17}\,\mathbf{a}_1 + y_{17}\,\mathbf{a}_2 - \left(z_{17} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{17} + c\left(z_{17} - \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} + by_{17}\,\mathbf{\hat{y}} - c\left(z_{17} - \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVII
$\mathbf{B_{67}}$	=	$-x_{17}\,\mathbf{a}_1 - y_{17}\,\mathbf{a}_2 - z_{17}\,\mathbf{a}_3$	=	$-\left(ax_{17} + cz_{17}\cos\beta\right)\,\mathbf{\hat{x}} - by_{17}\,\mathbf{\hat{y}} - cz_{17}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVII
$\mathbf{B_{68}}$	=	$x_{17}\,\mathbf{a}_1 - y_{17}\,\mathbf{a}_2 + \left(z_{17} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{17} + c\left(z_{17} + \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} - by_{17}\,\mathbf{\hat{y}} + c\left(z_{17} + \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVII
$\mathbf{B_{69}}$	=	$x_{18}\,\mathbf{a}_1 + y_{18}\,\mathbf{a}_2 + z_{18}\,\mathbf{a}_3$	=	$\left(ax_{18} + cz_{18}\cos\beta\right)\,\mathbf{\hat{x}} + by_{18}\,\mathbf{\hat{y}} + cz_{18}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVIII
$\mathbf{B_{70}}$	=	$-x_{18}\,\mathbf{a}_1 + y_{18}\,\mathbf{a}_2 - \left(z_{18} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{18} + c\left(z_{18} - \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} + by_{18}\,\mathbf{\hat{y}} - c\left(z_{18} - \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVIII
$\mathbf{B_{71}}$	=	$-x_{18}\,\mathbf{a}_1 - y_{18}\,\mathbf{a}_2 - z_{18}\,\mathbf{a}_3$	=	$-\left(ax_{18} + cz_{18}\cos\beta\right)\,\mathbf{\hat{x}} - by_{18}\,\mathbf{\hat{y}} - cz_{18}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVIII
$\mathbf{B_{72}}$	=	$x_{18}\,\mathbf{a}_1 - y_{18}\,\mathbf{a}_2 + \left(z_{18} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{18} + c\left(z_{18} + \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} - by_{18}\,\mathbf{\hat{y}} + c\left(z_{18} + \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XVIII
$\mathbf{B_{73}}$	=	$x_{19}\,\mathbf{a}_1 + y_{19}\,\mathbf{a}_2 + z_{19}\,\mathbf{a}_3$	=	$\left(ax_{19} + cz_{19}\cos\beta\right)\,\mathbf{\hat{x}} + by_{19}\,\mathbf{\hat{y}} + cz_{19}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIX
$\mathbf{B_{74}}$	=	$-x_{19}\,\mathbf{a}_1 + y_{19}\,\mathbf{a}_2 - \left(z_{19} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{19} + c\left(z_{19} - \frac{1}{2}\right)\cos\beta\right)\,\mathbf{\hat{x}} + by_{19}\,\mathbf{\hat{y}} - c\left(z_{19} - \frac{1}{2}\right)\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIX
$\mathbf{B_{75}}$	=	$-x_{19}\,\mathbf{a}_1 - y_{19}\,\mathbf{a}_2 - z_{19}\,\mathbf{a}_3$	=	$-\left(ax_{19} + cz_{19}\cos\beta\right)\,\mathbf{\hat{x}} - by_{19}\,\mathbf{\hat{y}} - cz_{19}\sin\beta\,\mathbf{\hat{z}}$	(4g)	P XIX

$\mathbf{B_{76}}$	=	$x_{19}\,\mathbf{a}_1 - y_{19}\,\mathbf{a}_2 + \left(z_{19} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{19} + c\left(z_{19} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{19}\,\hat{\mathbf{y}} + c\left(z_{19} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XIX
$\mathbf{B_{77}}$	=	$x_{20}\,\mathbf{a}_1 + y_{20}\,\mathbf{a}_2 + z_{20}\,\mathbf{a}_3$	=	$(ax_{20} + cz_{20}\cos\beta)\,\hat{\mathbf{x}} + by_{20}\,\hat{\mathbf{y}} + cz_{20}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XX
$\mathbf{B_{78}}$	=	$-x_{20}\,\mathbf{a}_1 + y_{20}\,\mathbf{a}_2 - \left(z_{20} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{20} + c\left(z_{20} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{20}\,\hat{\mathbf{y}} - c\left(z_{20} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XX
$\mathbf{B_{79}}$	=	$-x_{20}\,\mathbf{a}_1 - y_{20}\,\mathbf{a}_2 - z_{20}\,\mathbf{a}_3$	=	$-(ax_{20} + cz_{20}\cos\beta)\,\hat{\mathbf{x}} - by_{20}\,\hat{\mathbf{y}} - cz_{20}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XX
$\mathbf{B_{80}}$	=	$x_{20}\,\mathbf{a}_1 - y_{20}\,\mathbf{a}_2 + \left(z_{20} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{20} + c\left(z_{20} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{20}\,\hat{\mathbf{y}} + c\left(z_{20} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XX
$\mathbf{B_{81}}$	=	$x_{21}\,\mathbf{a}_1 + y_{21}\,\mathbf{a}_2 + z_{21}\,\mathbf{a}_3$	=	$(ax_{21} + cz_{21}\cos\beta)\,\hat{\mathbf{x}} + by_{21}\,\hat{\mathbf{y}} + cz_{21}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XXI
$\mathbf{B_{82}}$	=	$-x_{21}\,\mathbf{a}_1 + y_{21}\,\mathbf{a}_2 - \left(z_{21} - \frac{1}{2}\right)\,\mathbf{a}_3$	=	$-\left(ax_{21} + c\left(z_{21} - \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} + by_{21}\,\hat{\mathbf{y}} - c\left(z_{21} - \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XXI
$\mathbf{B_{83}}$	=	$-x_{21}\,\mathbf{a}_1 - y_{21}\,\mathbf{a}_2 - z_{21}\,\mathbf{a}_3$	=	$-(ax_{21} + cz_{21}\cos\beta)\,\hat{\mathbf{x}} - by_{21}\,\hat{\mathbf{y}} - cz_{21}\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XXI
$\mathbf{B_{84}}$	=	$x_{21}\,\mathbf{a}_1 - y_{21}\,\mathbf{a}_2 + \left(z_{21} + \frac{1}{2}\right)\,\mathbf{a}_3$	=	$\left(ax_{21} + c\left(z_{21} + \frac{1}{2}\right)\cos\beta\right)\,\hat{\mathbf{x}} - by_{21}\,\hat{\mathbf{y}} + c\left(z_{21} + \frac{1}{2}\right)\sin\beta\,\hat{\mathbf{z}}$	(4g)	P XXI

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