

$P4_332$

$O^6$

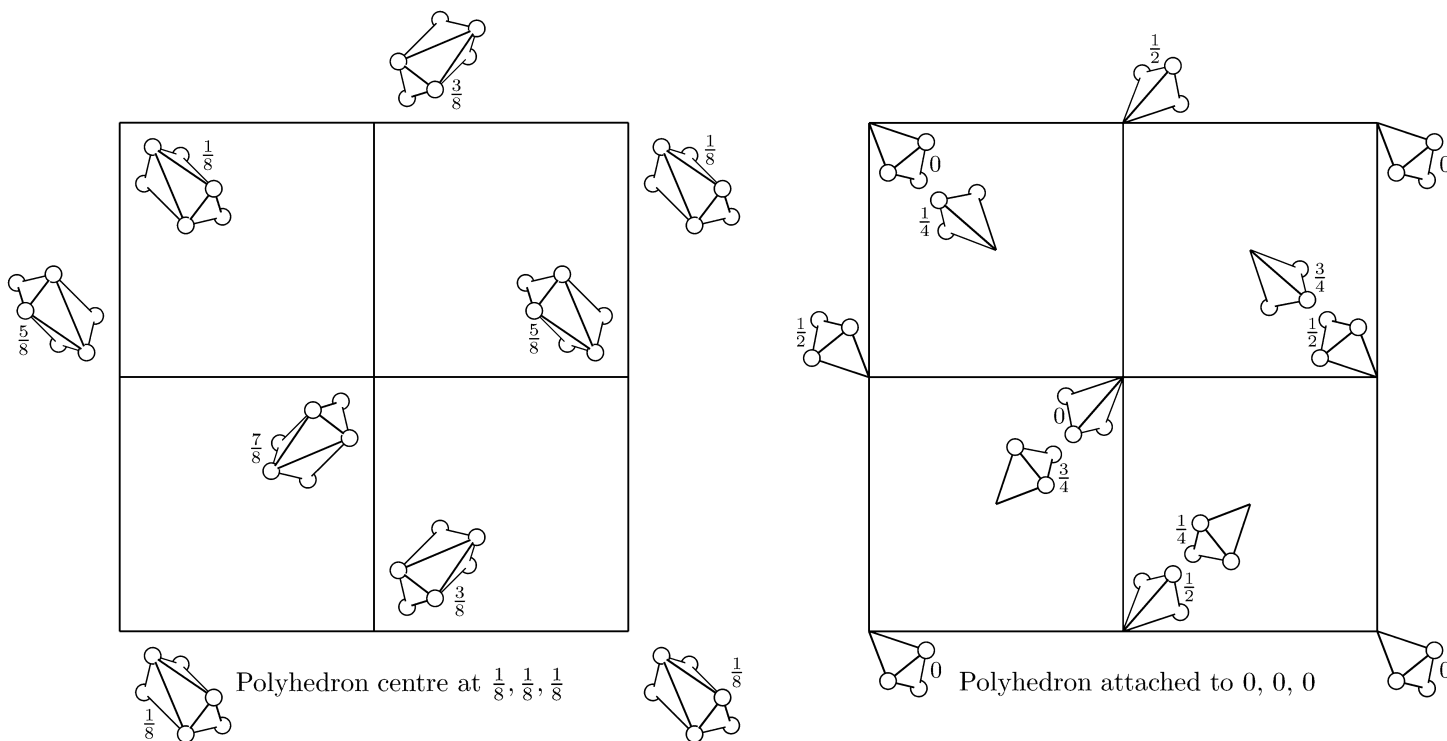
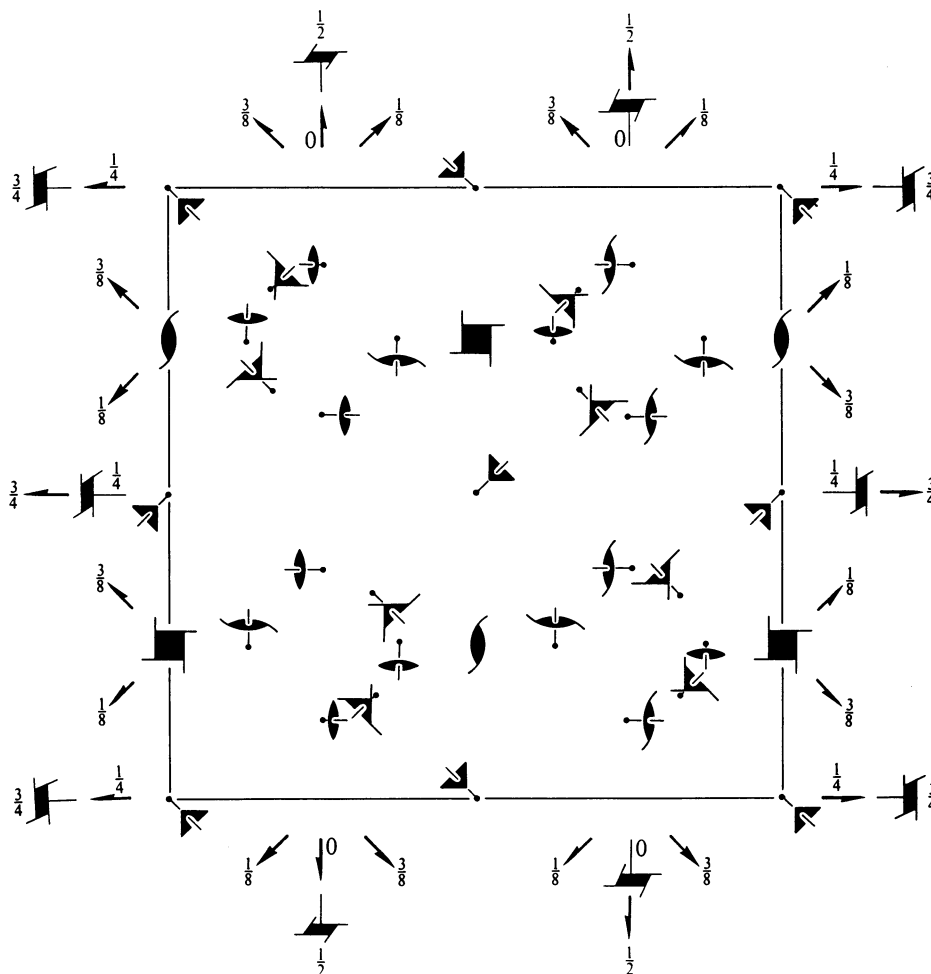
432

Cubic

No. 212

$P4_332$

Patterson symmetry  $Pm\bar{3}m$



**Origin** on  $3[111]$  at midpoint of three non-intersecting pairs of parallel screw axes  $4_3$  and  $2_1$

**Asymmetric unit**  $0 \leq x \leq \frac{1}{2}; 0 \leq y \leq \frac{3}{4}; -\frac{1}{2} \leq z \leq \frac{1}{4}; \max(-y, x - \frac{1}{2}) \leq z \leq \min(-y + \frac{1}{2}, 2x - y, 2y - x, y - 2x + \frac{1}{2})$   
**Vertices**  $0, 0, 0 \quad \frac{3}{8}, \frac{1}{8}, -\frac{1}{8} \quad \frac{1}{2}, \frac{1}{2}, 0 \quad \frac{1}{4}, \frac{3}{4}, -\frac{1}{4} \quad 0, \frac{1}{2}, -\frac{1}{2} \quad \frac{1}{4}, \frac{1}{4}, \frac{1}{4}$

## Symmetry operations

(1) 1	(2) $2(0,0,\frac{1}{2})$ $\frac{1}{4},0,z$	(3) $2(0,\frac{1}{2},0)$ $0,y,\frac{1}{4}$	(4) $2(\frac{1}{2},0,0)$ $x,\frac{1}{4},0$
(5) $3^+$ $x,x,x$	(6) $3^+$ $\bar{x}+\frac{1}{2},x,\bar{x}$	(7) $3^+$ $x+\frac{1}{2},\bar{x}-\frac{1}{2},\bar{x}$	(8) $3^+$ $\bar{x},\bar{x}+\frac{1}{2},x$
(9) $3^-$ $x,x,x$	(10) $3^-(-\frac{1}{3},\frac{1}{3},\frac{1}{3})$ $x+\frac{1}{6},\bar{x}+\frac{1}{6},\bar{x}$	(11) $3^-(-\frac{1}{3},\frac{1}{3},-\frac{1}{3})$ $\bar{x}+\frac{1}{3},\bar{x}+\frac{1}{6},x$	(12) $3^-(-\frac{1}{3},-\frac{1}{3},\frac{1}{3})$ $\bar{x}-\frac{1}{6},x+\frac{1}{3},\bar{x}$
(13) $2(\frac{1}{2},\frac{1}{2},0)$ $x,x+\frac{1}{4},\frac{3}{8}$	(14) $2$ $x,\bar{x}+\frac{1}{4},\frac{1}{8}$	(15) $4^-(0,0,\frac{1}{4})$ $\frac{3}{4},0,z$	(16) $4^+(0,0,\frac{3}{4})$ $\frac{1}{4},\frac{1}{2},z$
(17) $4^-(\frac{1}{4},0,0)$ $x,\frac{3}{4},0$	(18) $2(0,\frac{1}{2},\frac{1}{2})$ $\frac{3}{8},y-\frac{1}{4},y$	(19) $2$ $\frac{1}{8},y+\frac{1}{4},\bar{y}$	(20) $4^+(\frac{3}{4},0,0)$ $x,\frac{1}{4},\frac{1}{2}$
(21) $4^+(0,\frac{3}{4},0)$ $\frac{1}{2},y,\frac{1}{4}$	(22) $2(\frac{1}{2},0,\frac{1}{2})$ $x+\frac{1}{4},\frac{3}{8},x$	(23) $4^-(0,\frac{1}{4},0)$ $0,y,\frac{3}{4}$	(24) $2$ $\bar{x}+\frac{1}{4},\frac{1}{8},x$

Generators selected (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ; (2); (3); (5); (13)

## Positions

Multiplicity,  
Wyckoff letter,  
Site symmetry

Coordinates

Reflection conditions

 $h, k, l$  permutable

General:

24	$e$	1	(1) $x, y, z$	(2) $\bar{x} + \frac{1}{2}, \bar{y}, z + \frac{1}{2}$	(3) $\bar{x}, y + \frac{1}{2}, \bar{z} + \frac{1}{2}$	(4) $x + \frac{1}{2}, \bar{y} + \frac{1}{2}, \bar{z}$	$h00: h = 4n$
			(5) $z, x, y$	(6) $z + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{y}$	(7) $\bar{z} + \frac{1}{2}, \bar{x}, y + \frac{1}{2}$	(8) $\bar{z}, x + \frac{1}{2}, \bar{y} + \frac{1}{2}$	
			(9) $y, z, x$	(10) $\bar{y}, z + \frac{1}{2}, \bar{x} + \frac{1}{2}$	(11) $y + \frac{1}{2}, \bar{z} + \frac{1}{2}, \bar{x}$	(12) $\bar{y} + \frac{1}{2}, \bar{z}, x + \frac{1}{2}$	
			(13) $y + \frac{1}{4}, x + \frac{3}{4}, \bar{z} + \frac{3}{4}$	(14) $\bar{y} + \frac{1}{4}, \bar{x} + \frac{1}{4}, \bar{z} + \frac{1}{4}$	(15) $y + \frac{3}{4}, \bar{x} + \frac{3}{4}, z + \frac{1}{4}$	(16) $\bar{y} + \frac{3}{4}, x + \frac{1}{4}, z + \frac{3}{4}$	
			(17) $x + \frac{1}{4}, z + \frac{3}{4}, \bar{y} + \frac{3}{4}$	(18) $\bar{x} + \frac{3}{4}, z + \frac{1}{4}, y + \frac{3}{4}$	(19) $\bar{x} + \frac{1}{4}, \bar{z} + \frac{1}{4}, \bar{y} + \frac{1}{4}$	(20) $x + \frac{3}{4}, \bar{z} + \frac{3}{4}, y + \frac{1}{4}$	
			(21) $z + \frac{1}{4}, y + \frac{3}{4}, \bar{x} + \frac{3}{4}$	(22) $z + \frac{3}{4}, \bar{y} + \frac{3}{4}, x + \frac{1}{4}$	(23) $\bar{z} + \frac{3}{4}, y + \frac{1}{4}, x + \frac{3}{4}$	(24) $\bar{z} + \frac{1}{4}, \bar{y} + \frac{1}{4}, \bar{x} + \frac{1}{4}$	

Special: as above, plus

12	$d$	..2	$\frac{1}{8}, y, \bar{y} + \frac{1}{4}$	$\frac{3}{8}, \bar{y}, \bar{y} + \frac{3}{4}$	$\frac{7}{8}, y + \frac{1}{2}, y + \frac{1}{4}$	$\frac{5}{8}, \bar{y} + \frac{1}{2}, y + \frac{3}{4}$	no extra conditions
			$\bar{y} + \frac{1}{4}, \frac{1}{8}, y$	$\bar{y} + \frac{3}{4}, \frac{3}{8}, \bar{y}$	$y + \frac{1}{4}, \frac{7}{8}, y + \frac{1}{2}$	$y + \frac{3}{4}, \frac{5}{8}, \bar{y} + \frac{1}{2}$	
			$y, \bar{y} + \frac{1}{4}, \frac{1}{8}$	$\bar{y}, \bar{y} + \frac{3}{4}, \frac{3}{8}$	$y + \frac{1}{2}, y + \frac{1}{4}, \frac{7}{8}$	$\bar{y} + \frac{1}{2}, y + \frac{3}{4}, \frac{5}{8}$	

8	$c$	.3.	$x, x, x$	$\bar{x} + \frac{1}{2}, \bar{x}, x + \frac{1}{2}$	$\bar{x}, x + \frac{1}{2}, \bar{x} + \frac{1}{2}$	$x + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{x}$	$0kl: k = 2n + 1$
			$x + \frac{1}{4}, x + \frac{3}{4}, \bar{x} + \frac{3}{4}$	$\bar{x} + \frac{1}{4}, \bar{x} + \frac{1}{4}, \bar{x} + \frac{1}{4}$	$x + \frac{3}{4}, \bar{x} + \frac{3}{4}, x + \frac{1}{4}$	$\bar{x} + \frac{3}{4}, x + \frac{1}{4}, x + \frac{3}{4}$	or $l = 2n + 1$
							or $k + l = 4n$

4	$b$	.32	$\frac{5}{8}, \frac{5}{8}, \frac{5}{8}$	$\frac{7}{8}, \frac{3}{8}, \frac{1}{8}$	$\frac{3}{8}, \frac{1}{8}, \frac{7}{8}$	$\frac{1}{8}, \frac{7}{8}, \frac{3}{8}$	} $hkl: h, k = 2n + 1$ or $h = 2n + 1, k = 4n$ and $l = 4n + 2$ or $h, k, l = 4n + 2$ or $h, k, l = 4n$
4	$a$	.32	$\frac{1}{8}, \frac{1}{8}, \frac{1}{8}$	$\frac{3}{8}, \frac{7}{8}, \frac{5}{8}$	$\frac{7}{8}, \frac{5}{8}, \frac{3}{8}$	$\frac{5}{8}, \frac{3}{8}, \frac{7}{8}$	

## Symmetry of special projections

Along [001]  $p4gm$  $\mathbf{a}' = \mathbf{a}$   $\mathbf{b}' = \mathbf{b}$ Origin at  $\frac{1}{4}, \frac{1}{2}, z$ Along [111]  $p3m1$  $\mathbf{a}' = \frac{1}{3}(2\mathbf{a} - \mathbf{b} - \mathbf{c})$   $\mathbf{b}' = \frac{1}{3}(-\mathbf{a} + 2\mathbf{b} - \mathbf{c})$ Origin at  $x, x, x$ Along [110]  $p2gm$  $\mathbf{a}' = \frac{1}{2}(-\mathbf{a} + \mathbf{b})$   $\mathbf{b}' = \mathbf{c}$ Origin at  $x, x + \frac{1}{4}, \frac{3}{8}$