

$I\bar{4}3d$

T_d^6

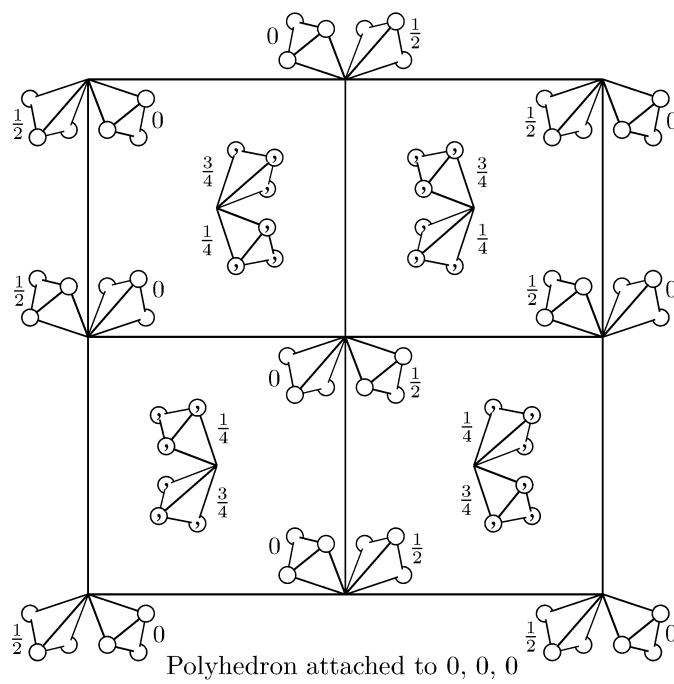
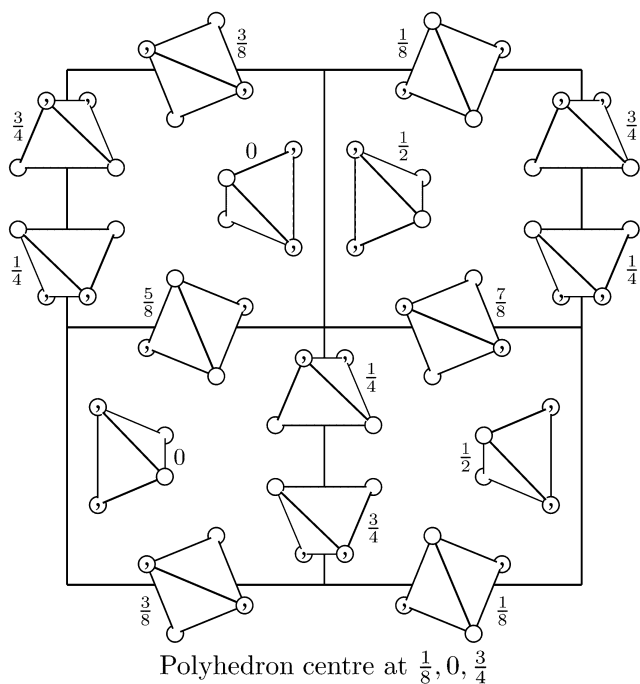
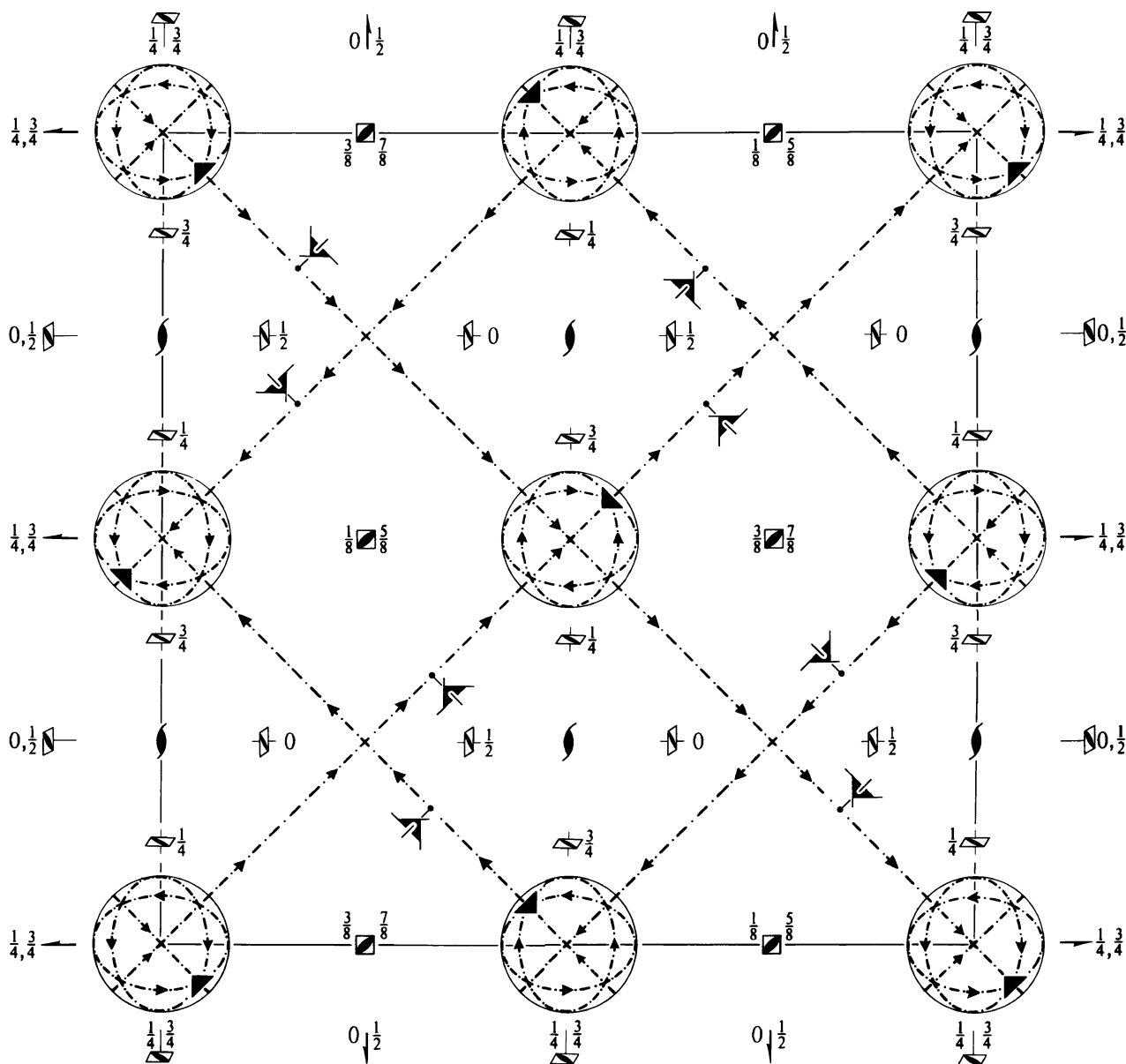
$\bar{4}3m$

Cubic

No. 220

$I\bar{4}3d$

Patterson symmetry $Im\bar{3}m$



Origin on $3[111]$ at midpoint of three non-intersecting pairs of parallel $\bar{4}$ axes and of three non-intersecting pairs of parallel 2_1 axes

Asymmetric unit $\frac{1}{4} \leq x \leq \frac{1}{2}; \frac{1}{4} \leq y \leq \frac{1}{2}; 0 \leq z \leq \frac{1}{2}; z \leq \min(x, y)$
 Vertices $\frac{1}{4}, \frac{1}{4}, 0; \frac{1}{2}, \frac{1}{4}, 0; \frac{1}{2}, \frac{1}{2}, 0; \frac{1}{4}, \frac{1}{2}, 0$
 $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}; \frac{1}{2}, \frac{1}{4}, \frac{1}{4}; \frac{1}{2}, \frac{1}{2}, \frac{1}{2}; \frac{1}{4}, \frac{1}{2}, \frac{1}{4}$

Symmetry operations

For (0,0,0)+ set

- | | | | |
|---|---|---|---|
| (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) $d(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}) x, x, z$ | (14) $d(-\frac{1}{4}, \frac{1}{4}, \frac{3}{4}) x + \frac{1}{2}, \bar{x}, z$ | (15) $\bar{4}^+ \frac{1}{2}, -\frac{1}{4}, z; \frac{1}{2}, -\frac{1}{4}, \frac{3}{8}$ | (16) $\bar{4}^- 0, \frac{3}{4}, z; 0, \frac{3}{4}, \frac{3}{8}$ |
| (17) $d(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}) x, y, y$ | (18) $\bar{4}^+ x, \frac{1}{2}, -\frac{1}{4}; \frac{3}{8}, \frac{1}{2}, -\frac{1}{4}$ | (19) $\bar{4}^- x, 0, \frac{3}{4}; \frac{3}{8}, 0, \frac{3}{4}$ | (20) $d(\frac{3}{4}, -\frac{1}{4}, \frac{1}{4}) x, y + \frac{1}{2}, \bar{y}$ |
| (21) $d(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}) x, y, x$ | (22) $\bar{4}^- \frac{3}{4}, y, 0; \frac{3}{4}, \frac{3}{8}, 0$ | (23) $d(\frac{1}{4}, \frac{3}{4}, -\frac{1}{4}) \bar{x} + \frac{1}{2}, y, x$ | (24) $\bar{4}^+ -\frac{1}{4}, y, \frac{1}{2}; -\frac{1}{4}, \frac{3}{8}, \frac{1}{2}$ |

For $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ + set

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

Generators selected (1); $t(1,0,0)$; $t(0,1,0)$; $t(0,0,1)$; $t(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$; (2); (3); (5); (13)

Positions

Multiplicity, Wyckoff letter, Site symmetry	Coordinates $(0,0,0) + (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) +$	Reflection conditions h, k, l permutable General:
48 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) $x + \frac{1}{2}, \bar{y} + \frac{1}{2}, \bar{z}$ (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) $y + \frac{1}{4}, x + \frac{1}{4}, z + \frac{1}{4}$ (14) $\bar{y} + \frac{1}{4}, \bar{x} + \frac{3}{4}, z + \frac{3}{4}$ (15) $y + \frac{3}{4}, \bar{x} + \frac{1}{4}, \bar{z} + \frac{3}{4}$ (16) $\bar{y} + \frac{3}{4}, x + \frac{3}{4}, \bar{z} + \frac{1}{4}$ (17) $x + \frac{1}{4}, z + \frac{1}{4}, y + \frac{1}{4}$ (18) $\bar{x} + \frac{3}{4}, z + \frac{3}{4}, \bar{y} + \frac{1}{4}$ (19) $\bar{x} + \frac{1}{4}, \bar{z} + \frac{3}{4}, y + \frac{3}{4}$ (20) $x + \frac{3}{4}, \bar{z} + \frac{1}{4}, \bar{y} + \frac{3}{4}$ (21) $z + \frac{1}{4}, y + \frac{1}{4}, x + \frac{1}{4}$ (22) $z + \frac{3}{4}, \bar{y} + \frac{1}{4}, \bar{x} + \frac{3}{4}$ (23) $\bar{z} + \frac{3}{4}, y + \frac{3}{4}, \bar{x} + \frac{1}{4}$ (24) $\bar{z} + \frac{1}{4}, \bar{y} + \frac{3}{4}, x + \frac{3}{4}$	$hkl: h + k + l = 2n$ $OkI: k + l = 2n$ $hhl: 2h + l = 4n$ $h00: h = 4n$
24 d 2..	$x, 0, \frac{1}{4}$ $\frac{1}{4}, x + \frac{1}{4}, \frac{1}{2}$ $\bar{x} + \frac{1}{2}, 0, \frac{3}{4}$ $\frac{1}{4}, \bar{x} + \frac{3}{4}, 0$ $\frac{1}{4}, x, 0$ $x + \frac{1}{4}, \frac{1}{2}, \frac{1}{4}$ $\frac{3}{4}, \bar{x} + \frac{1}{2}, 0$ $\bar{x} + \frac{3}{4}, 0, \frac{1}{4}$ $0, \frac{1}{4}, x$ $\frac{1}{2}, \frac{1}{4}, x + \frac{1}{4}$ $0, \frac{3}{4}, \bar{x} + \frac{1}{2}$ $0, \frac{1}{4}, \bar{x} + \frac{3}{4}$	$hkl: h = 2n + 1$ or $h = 4n$
16 c .3.	x, x, x $x + \frac{1}{4}, x + \frac{1}{4}, x + \frac{1}{4}$ $\bar{x} + \frac{1}{2}, \bar{x}, x + \frac{1}{2}$ $\bar{x} + \frac{1}{4}, \bar{x} + \frac{3}{4}, x + \frac{3}{4}$ $\bar{x}, x + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $x + \frac{3}{4}, \bar{x} + \frac{1}{4}, \bar{x} + \frac{3}{4}$ $x + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{x}$ $\bar{x} + \frac{3}{4}, x + \frac{3}{4}, \bar{x} + \frac{1}{4}$	$hkl: h = 2n + 1$ or $h + k + l = 4n$
12 b $\bar{4}$..	$\frac{7}{8}, 0, \frac{1}{4}$ $\frac{5}{8}, 0, \frac{3}{4}$ $\frac{1}{4}, \frac{7}{8}, 0$ $\frac{3}{4}, \frac{5}{8}, 0$ $0, \frac{1}{4}, \frac{7}{8}$ $0, \frac{3}{4}, \frac{5}{8}$	$hkl: h, k = 2n, h + k + l = 4n$ or $h, k = 2n + 1, l = 4n + 2$ or $h = 8n, k = 8n + 4$ and $h + k + l = 4n + 2$ or $h = 8n + 1$ and $k = 8n + 3, l = 4n$ or $h = 8n + 1$ and $k = 8n + 5, l = 4n$ or $h = 8n + 7$ and $k = 8n + 3, l = 4n$ or $h = 8n + 7$ and $k = 8n + 5, l = 4n$
12 a $\bar{4}$..	$\frac{3}{8}, 0, \frac{1}{4}$ $\frac{1}{8}, 0, \frac{3}{4}$ $\frac{1}{4}, \frac{3}{8}, 0$ $\frac{3}{4}, \frac{1}{8}, 0$ $0, \frac{1}{4}, \frac{3}{8}$ $0, \frac{3}{4}, \frac{1}{8}$	

Special: as above, plus

Symmetry of special projections

Along $[001] p4gm$

$a' = \frac{1}{2}(a - b)$ $b' = \frac{1}{2}(a + b)$

Origin at $0, \frac{1}{4}, z$

Along $[111] p31m$

$a' = \frac{1}{3}(2a - b - c)$ $b' = \frac{1}{3}(-a + 2b - c)$

Origin at x, x, x

Along $[110] c1m1$

$a' = \frac{1}{2}(-a + b)$ $b' = \frac{1}{2}c$

Origin at $x, x + \frac{1}{4}, 0$