

$Pn\bar{3}m$

$O_h^4$

$m\bar{3}m$

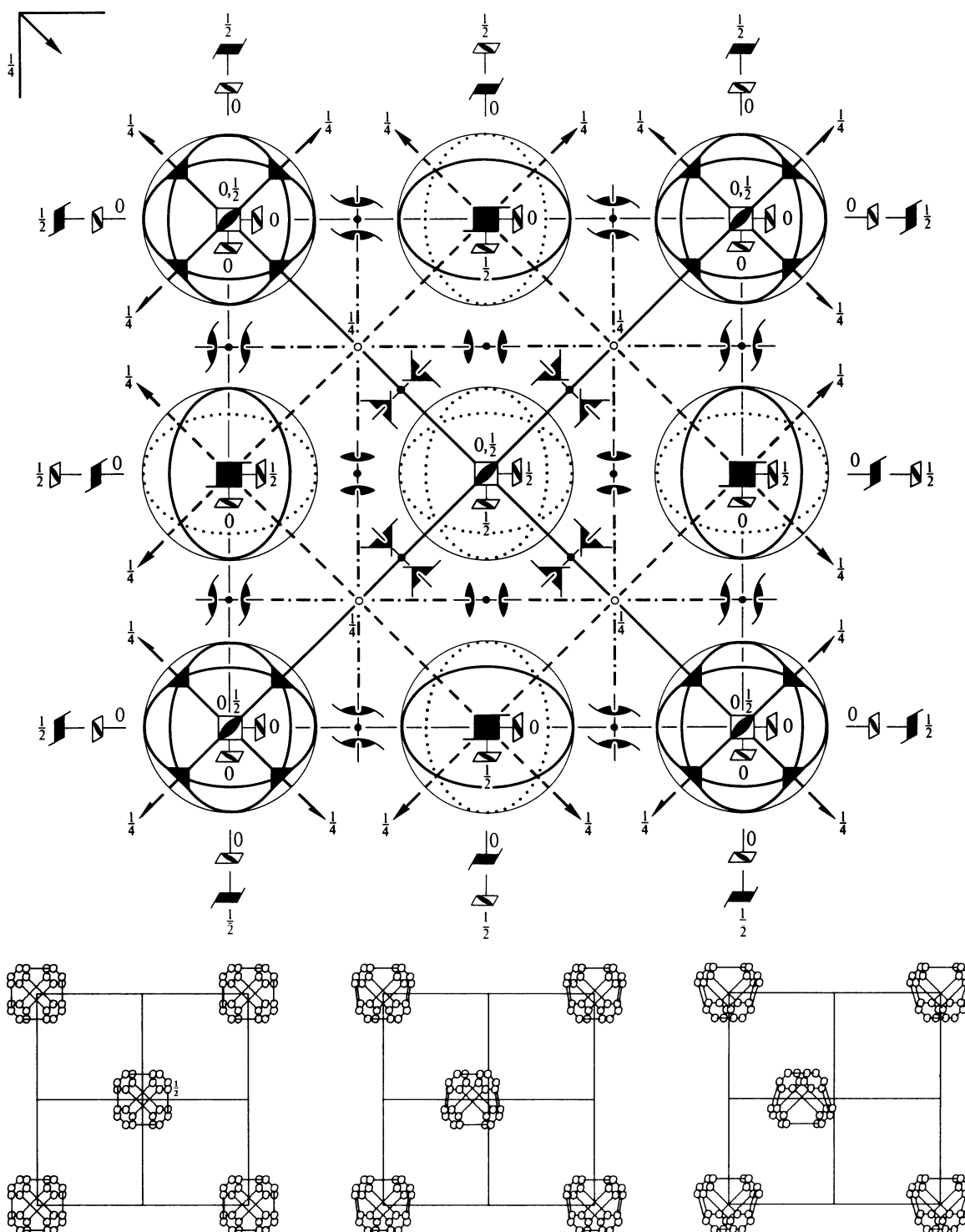
Cubic

No. 224

$P 4_2/n \bar{3} 2/m$

Patterson symmetry  $Pm\bar{3}m$

ORIGIN CHOICE 1



Origin at  $\bar{4}3m$ , at  $-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4}$  from centre ( $\bar{3}m$ )

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

Vertices  $0, 0, 0 \quad \frac{1}{2}, 0, 0 \quad \frac{1}{2}, \frac{1}{2}, 0 \quad \frac{1}{4}, \frac{1}{4}, \frac{1}{4} \quad \frac{1}{4}, \frac{1}{4}, -\frac{1}{4}$

Symmetry operations

(given on page 683)

Generators selected (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ; (2); (3); (5); (13); (25)

## Positions

Multiplicity, Wyckoff letter, Site symmetry	Coordinates	Reflection conditions					
48 $l$ 1	(1) $x, y, z$ (2) $\bar{x}, \bar{y}, \bar{z}$ (3) $\bar{x}, y, \bar{z}$ (4) $x, \bar{y}, \bar{z}$ (5) $z, x, y$ (6) $z, \bar{x}, \bar{y}$ (7) $\bar{z}, \bar{x}, y$ (8) $\bar{z}, x, \bar{y}$ (9) $y, z, x$ (10) $\bar{y}, \bar{z}, \bar{x}$ (11) $y, \bar{z}, \bar{x}$ (12) $\bar{y}, \bar{z}, x$ (13) $y + \frac{1}{2}, x + \frac{1}{2}, \bar{z} + \frac{1}{2}$ (14) $\bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}$ (15) $y + \frac{1}{2}, \bar{x} + \frac{1}{2}, z + \frac{1}{2}$ (16) $\bar{y} + \frac{1}{2}, x + \frac{1}{2}, z + \frac{1}{2}$ (17) $x + \frac{1}{2}, z + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (18) $\bar{x} + \frac{1}{2}, z + \frac{1}{2}, y + \frac{1}{2}$ (19) $\bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (20) $x + \frac{1}{2}, \bar{z} + \frac{1}{2}, y + \frac{1}{2}$ (21) $z + \frac{1}{2}, y + \frac{1}{2}, \bar{x} + \frac{1}{2}$ (22) $z + \frac{1}{2}, \bar{y} + \frac{1}{2}, x + \frac{1}{2}$ (23) $\bar{z} + \frac{1}{2}, y + \frac{1}{2}, x + \frac{1}{2}$ (24) $\bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ (25) $\bar{x} + \frac{1}{2}, \bar{y} + \frac{1}{2}, \bar{z} + \frac{1}{2}$ (26) $x + \frac{1}{2}, y + \frac{1}{2}, \bar{z} + \frac{1}{2}$ (27) $x + \frac{1}{2}, \bar{y} + \frac{1}{2}, z + \frac{1}{2}$ (28) $\bar{x} + \frac{1}{2}, y + \frac{1}{2}, z + \frac{1}{2}$ (29) $\bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (30) $\bar{z} + \frac{1}{2}, x + \frac{1}{2}, y + \frac{1}{2}$ (31) $z + \frac{1}{2}, x + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (32) $z + \frac{1}{2}, \bar{x} + \frac{1}{2}, y + \frac{1}{2}$ (33) $\bar{y} + \frac{1}{2}, \bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ (34) $y + \frac{1}{2}, \bar{z} + \frac{1}{2}, x + \frac{1}{2}$ (35) $\bar{y} + \frac{1}{2}, z + \frac{1}{2}, x + \frac{1}{2}$ (36) $y + \frac{1}{2}, z + \frac{1}{2}, \bar{x} + \frac{1}{2}$ (37) $\bar{y}, \bar{x}, z$ (38) $y, x, z$ (39) $\bar{y}, x, \bar{z}$ (40) $y, \bar{x}, \bar{z}$ (41) $\bar{x}, \bar{z}, y$ (42) $x, \bar{z}, \bar{y}$ (43) $x, z, y$ (44) $\bar{x}, z, \bar{y}$ (45) $\bar{z}, \bar{y}, x$ (46) $\bar{z}, y, \bar{x}$ (47) $z, \bar{y}, \bar{x}$ (48) $z, y, x$	$Ok_l : k + l = 2n$ $h00 : h = 2n$					
		Special: as above, plus					
24 $k$ $\dots m$	$x, x, z$ $z, x, x$ $x, z, x$ $x + \frac{1}{2}, x + \frac{1}{2}, \bar{z} + \frac{1}{2}$ $x + \frac{1}{2}, z + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $z + \frac{1}{2}, x + \frac{1}{2}, \bar{x} + \frac{1}{2}$	$\bar{x}, \bar{x}, z$ $z, \bar{x}, \bar{x}$ $\bar{x}, z, \bar{x}$ $\bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}$ $\bar{x} + \frac{1}{2}, z + \frac{1}{2}, x + \frac{1}{2}$ $z + \frac{1}{2}, \bar{x} + \frac{1}{2}, x + \frac{1}{2}$	$\bar{x}, x, \bar{z}$ $\bar{z}, \bar{x}, x$ $x, \bar{z}, \bar{x}$ $x + \frac{1}{2}, \bar{x} + \frac{1}{2}, z + \frac{1}{2}$ $\bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $\bar{z} + \frac{1}{2}, x + \frac{1}{2}, x + \frac{1}{2}$	$x, \bar{x}, \bar{z}$ $\bar{z}, x, \bar{x}$ $\bar{x}, \bar{z}, x$ $\bar{x} + \frac{1}{2}, x + \frac{1}{2}, z + \frac{1}{2}$ $x + \frac{1}{2}, \bar{z} + \frac{1}{2}, x + \frac{1}{2}$ $\bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}$	no extra conditions		
24 $j$ $\dots 2$	$\frac{1}{4}, y, y + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, \frac{3}{4}, y$ $\frac{1}{4}, \bar{y} + \frac{1}{2}, \bar{y}$ $y, \frac{3}{4}, \bar{y} + \frac{1}{2}$	$\frac{3}{4}, \bar{y}, y + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, \frac{1}{4}, \bar{y}$ $\frac{3}{4}, y + \frac{1}{2}, \bar{y}$ $y, \frac{1}{4}, y + \frac{1}{2}$	$\frac{3}{4}, y, \bar{y} + \frac{1}{2}$ $y, y + \frac{1}{2}, \frac{1}{4}$ $\frac{3}{4}, \bar{y} + \frac{1}{2}, y$ $\bar{y} + \frac{1}{2}, \bar{y}, \frac{1}{4}$	$\frac{1}{4}, \bar{y}, \bar{y} + \frac{1}{2}$ $\bar{y}, y + \frac{1}{2}, \frac{3}{4}$ $\frac{1}{4}, y + \frac{1}{2}, y$ $y + \frac{1}{2}, \bar{y}, \frac{3}{4}$	$y + \frac{1}{2}, \frac{1}{4}, y$ $y, \bar{y} + \frac{1}{2}, \frac{3}{4}$ $\bar{y}, \frac{1}{4}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, y, \frac{3}{4}$	$y + \frac{1}{2}, \frac{3}{4}, \bar{y}$ $\bar{y}, \bar{y} + \frac{1}{2}, \frac{1}{4}$ $\bar{y}, \frac{3}{4}, y + \frac{1}{2}$ $y + \frac{1}{2}, y, \frac{1}{4}$	no extra conditions
24 $i$ $\dots 2$	$\frac{1}{4}, y, \bar{y} + \frac{1}{2}$ $y + \frac{1}{2}, \frac{3}{4}, y$ $\frac{1}{4}, \bar{y} + \frac{1}{2}, y$ $\bar{y}, \frac{3}{4}, \bar{y} + \frac{1}{2}$	$\frac{3}{4}, \bar{y}, \bar{y} + \frac{1}{2}$ $y + \frac{1}{2}, \frac{1}{4}, \bar{y}$ $\frac{3}{4}, y + \frac{1}{2}, y$ $\bar{y}, \frac{1}{4}, y + \frac{1}{2}$	$\frac{3}{4}, y, y + \frac{1}{2}$ $y, \bar{y} + \frac{1}{2}, \frac{1}{4}$ $\frac{3}{4}, \bar{y} + \frac{1}{2}, \bar{y}$ $\bar{y} + \frac{1}{2}, y, \frac{1}{4}$	$\frac{1}{4}, \bar{y}, y + \frac{1}{2}$ $\bar{y}, \bar{y} + \frac{1}{2}, \frac{3}{4}$ $\frac{1}{4}, y + \frac{1}{2}, \bar{y}$ $y + \frac{1}{2}, \bar{y}, \frac{3}{4}$	$\bar{y} + \frac{1}{2}, \frac{1}{4}, y$ $y, y + \frac{1}{2}, \frac{3}{4}$ $y, \frac{1}{4}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, \bar{y}, \frac{3}{4}$	$\bar{y} + \frac{1}{2}, \frac{3}{4}, \bar{y}$ $\bar{y}, y + \frac{1}{2}, \frac{1}{4}$ $y, \frac{3}{4}, y + \frac{1}{2}$ $y + \frac{1}{2}, \bar{y}, \frac{1}{4}$	no extra conditions
24 $h$ $2 \dots$	$x, 0, \frac{1}{2}$ $\frac{1}{2}, x + \frac{1}{2}, 0$ $\bar{x} + \frac{1}{2}, \frac{1}{2}, 0$ $0, \bar{x}, \frac{1}{2}$	$\bar{x}, 0, \frac{1}{2}$ $\frac{1}{2}, \bar{x} + \frac{1}{2}, 0$ $x + \frac{1}{2}, \frac{1}{2}, 0$ $0, x, \frac{1}{2}$	$\frac{1}{2}, x, 0$ $x + \frac{1}{2}, 0, \frac{1}{2}$ $0, \bar{x} + \frac{1}{2}, \frac{1}{2}$ $\bar{x}, \frac{1}{2}, 0$	$\frac{1}{2}, \bar{x}, 0$ $\bar{x} + \frac{1}{2}, 0, \frac{1}{2}$ $0, x + \frac{1}{2}, \frac{1}{2}$ $x, \frac{1}{2}, 0$	$0, \frac{1}{2}, x$ $0, \frac{1}{2}, \bar{x} + \frac{1}{2}$ $\frac{1}{2}, 0, \bar{x} + \frac{1}{2}$ $\frac{1}{2}, 0, x$	$0, \frac{1}{2}, \bar{x}$ $0, \frac{1}{2}, x + \frac{1}{2}$ $\frac{1}{2}, 0, x + \frac{1}{2}$ $\frac{1}{2}, 0, \bar{x}$	$hkl : h + k + l = 2n$
12 $g$ $2 \dots mm$	$x, 0, 0$ $\frac{1}{2}, x + \frac{1}{2}, \frac{1}{2}$	$\bar{x}, 0, 0$ $\frac{1}{2}, \bar{x} + \frac{1}{2}, \frac{1}{2}$	$0, x, 0$ $x + \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$0, \bar{x}, 0$ $\bar{x} + \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$0, 0, x$ $\frac{1}{2}, \frac{1}{2}, \bar{x} + \frac{1}{2}$	$0, 0, \bar{x}$ $\frac{1}{2}, \frac{1}{2}, x + \frac{1}{2}$	$hkl : h + k + l = 2n$
12 $f$ $2 \dots 22$	$\frac{1}{4}, 0, \frac{1}{2}$ $\frac{1}{4}, \frac{1}{2}, 0$	$\frac{3}{4}, 0, \frac{1}{2}$ $\frac{3}{4}, \frac{1}{2}, 0$	$\frac{1}{2}, \frac{1}{4}, 0$ $0, \frac{3}{4}, \frac{1}{2}$	$\frac{1}{2}, \frac{3}{4}, 0$ $0, \frac{3}{4}, \frac{1}{2}$	$0, \frac{1}{2}, \frac{1}{4}$ $\frac{1}{2}, 0, \frac{3}{4}$	$0, \frac{1}{2}, \frac{3}{4}$ $\frac{1}{2}, 0, \frac{3}{4}$	$hkl : h + k + l = 2n$
8 $e$ $\dots 3m$	$x, x, x$ $x + \frac{1}{2}, x + \frac{1}{2}, \bar{x} + \frac{1}{2}$	$\bar{x}, \bar{x}, x$ $\bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}$	$\bar{x}, x, \bar{x}$ $x + \frac{1}{2}, \bar{x} + \frac{1}{2}, x + \frac{1}{2}$	$x, \bar{x}, \bar{x}$ $\bar{x} + \frac{1}{2}, x + \frac{1}{2}, x + \frac{1}{2}$			no extra conditions
6 $d$ $\bar{4}2 \dots m$	$0, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, 0, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, 0$	$0, \frac{1}{2}, 0$	$\frac{1}{2}, 0, 0$	$0, 0, \frac{1}{2}$	$hkl : h + k + l = 2n$
4 $c$ $\dots \bar{3}m$	$\frac{3}{4}, \frac{3}{4}, \frac{3}{4}$	$\frac{1}{4}, \frac{1}{4}, \frac{3}{4}$	$\frac{1}{4}, \frac{3}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{1}{4}, \frac{1}{4}$			$hkl : h + k, h + l, k + l = 2n$
4 $b$ $\dots \bar{3}m$	$\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{3}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{1}{4}, \frac{3}{4}$	$\frac{1}{4}, \frac{3}{4}, \frac{3}{4}$			$hkl : h + k, h + l, k + l = 2n$
2 $a$ $\bar{4}3m$	$0, 0, 0$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$					$hkl : h + k + l = 2n$

## Symmetry of special projections

Along [001]  $p4mm$ 

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

Origin at  $0, 0, z$ Along [111]  $p6mm$ 

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

Origin at  $x, x, x$ Along [110]  $p2mm$ 

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

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

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ORIGIN CHOICES 1 AND 2

Maximal non-isomorphic subgroups

<b>I</b>	[2] $P\bar{4}3m$ (215)	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 37; 38; 39; 40; 41; 42; 43; 44; 45; 46; 47; 48
	[2] $P4_232$ (208)	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24
	[2] $Pn\bar{3}1$ ( $Pn\bar{3}$ , 201)	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 25; 26; 27; 28; 29; 30; 31; 32; 33; 34; 35; 36
	{ [3] $P4_2/n12/m(P4_2/nnm, 134)$	1; 2; 3; 4; 13; 14; 15; 16; 25; 26; 27; 28; 37; 38; 39; 40
	{ [3] $P4_2/n12/m(P4_2/nnm, 134)$	1; 2; 3; 4; 17; 18; 19; 20; 25; 26; 27; 28; 41; 42; 43; 44
	{ [3] $P4_2/n12/m(P4_2/nnm, 134)$	1; 2; 3; 4; 21; 22; 23; 24; 25; 26; 27; 28; 45; 46; 47; 48
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 5; 9; 14; 19; 24; 25; 29; 33; 38; 43; 48
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 6; 12; 13; 18; 24; 25; 30; 36; 37; 42; 48
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 7; 10; 13; 19; 22; 25; 31; 34; 37; 43; 46
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 8; 11; 14; 18; 22; 25; 32; 35; 38; 42; 46

**IIa** none

**IIb** [2]  $Fd\bar{3}c$  ( $a' = 2a, b' = 2b, c' = 2c$ ) (228); [2]  $Fd\bar{3}m$  ( $a' = 2a, b' = 2b, c' = 2c$ ) (227)

Maximal isomorphic subgroups of lowest index

**IIc** [27]  $Pn\bar{3}m$  ( $a' = 3a, b' = 3b, c' = 3c$ ) (224)

Minimal non-isomorphic supergroups

**I** none

**II** [2]  $Im\bar{3}m$  (229); [4]  $Fm\bar{3}m$  (225)

ORIGIN CHOICE 1

Symmetry operations

(1) 1	(2) 2 0,0,z	(3) 2 0,y,0	(4) 2 x,0,0
(5) $3^+ x,x,x$	(6) $3^+ \bar{x},x,\bar{x}$	(7) $3^+ x,\bar{x},\bar{x}$	(8) $3^+ \bar{x},\bar{x},x$
(9) $3^- x,x,x$	(10) $3^- x,\bar{x},\bar{x}$	(11) $3^- \bar{x},\bar{x},x$	(12) $3^- \bar{x},x,\bar{x}$
(13) $2(\frac{1}{2},\frac{1}{2},0) x,x,\frac{1}{4}$	(14) $2 x,\bar{x}+\frac{1}{2},\frac{1}{4}$	(15) $4^-(0,0,\frac{1}{2}) \frac{1}{2},0,z$	(16) $4^+(0,0,\frac{1}{2}) 0,\frac{1}{2},z$
(17) $4^-(\frac{1}{2},0,0) x,\frac{1}{2},0$	(18) $2(0,\frac{1}{2},\frac{1}{2}) \frac{1}{4},y,y$	(19) $2 \frac{1}{4},y+\frac{1}{2},\bar{y}$	(20) $4^+(\frac{1}{2},0,0) x,0,\frac{1}{2}$
(21) $4^+(0,\frac{1}{2},0) \frac{1}{2},y,0$	(22) $2(\frac{1}{2},0,\frac{1}{2}) x,\frac{1}{4},x$	(23) $4^-(0,\frac{1}{2},0) 0,y,\frac{1}{2}$	(24) $2 \bar{x}+\frac{1}{2},\frac{1}{4},x$
(25) $\bar{1} \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(26) $n(\frac{1}{2},\frac{1}{2},0) x,y,\frac{1}{4}$	(27) $n(\frac{1}{2},0,\frac{1}{2}) x,\frac{1}{4},z$	(28) $n(0,\frac{1}{2},\frac{1}{2}) \frac{1}{4},y,z$
(29) $3^+ x,x,x; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(30) $3^+ \bar{x}-1,x+1,\bar{x}; -\frac{1}{4},\frac{1}{4},\frac{3}{4}$	(31) $3^+ x,\bar{x}+1,\bar{x}; \frac{1}{4},\frac{3}{4},-\frac{1}{4}$	(32) $3^+ \bar{x}+1,\bar{x},x; \frac{3}{4},-\frac{1}{4},\frac{1}{4}$
(33) $3^- x,x,x; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(34) $3^- x+1,\bar{x}-1,\bar{x}; \frac{1}{4},-\frac{1}{4},\frac{3}{4}$	(35) $3^- \bar{x},\bar{x}+1,x; -\frac{1}{4},\frac{3}{4},\frac{1}{4}$	(36) $3^- \bar{x}+1,x,\bar{x}; \frac{3}{4},\frac{1}{4},-\frac{1}{4}$
(37) $m x,\bar{x},z$	(38) $m x,x,z$	(39) $\bar{4}^- 0,0,z; 0,0,0$	(40) $\bar{4}^+ 0,0,z; 0,0,0$
(41) $\bar{4}^- x,0,0; 0,0,0$	(42) $m x,y,\bar{y}$	(43) $m x,y,y$	(44) $\bar{4}^+ x,0,0; 0,0,0$
(45) $\bar{4}^+ 0,y,0; 0,0,0$	(46) $m \bar{x},y,x$	(47) $\bar{4}^- 0,y,0; 0,0,0$	(48) $m x,y,x$

ORIGIN CHOICE 2

Symmetry operations

(1) 1	(2) 2 $\frac{1}{4},\frac{1}{4},z$	(3) 2 $\frac{1}{4},y,\frac{1}{4}$	(4) 2 $x,\frac{1}{4},\frac{1}{4}$
(5) $3^+ x,x,x$	(6) $3^+ \bar{x},x+\frac{1}{2},\bar{x}$	(7) $3^+ x+\frac{1}{2},\bar{x},\bar{x}$	(8) $3^+ \bar{x}+\frac{1}{2},\bar{x}+\frac{1}{2},x$
(9) $3^- x,x,x$	(10) $3^- x+\frac{1}{2},\bar{x},\bar{x}$	(11) $3^- \bar{x}+\frac{1}{2},\bar{x}+\frac{1}{2},x$	(12) $3^- \bar{x},x+\frac{1}{2},\bar{x}$
(13) $2(\frac{1}{2},\frac{1}{2},0) x,x,0$	(14) 2 $x,\bar{x},0$	(15) $4^-(0,0,\frac{1}{2}) \frac{1}{4},-\frac{1}{4},z$	(16) $4^+(0,0,\frac{1}{2}) -\frac{1}{4},\frac{1}{4},z$
(17) $4^-(\frac{1}{2},0,0) x,\frac{1}{4},-\frac{1}{4}$	(18) $2(0,\frac{1}{2},\frac{1}{2}) 0,y,y$	(19) 2 $0,y,\bar{y}$	(20) $4^+(\frac{1}{2},0,0) x,-\frac{1}{4},\frac{1}{4}$
(21) $4^+(0,\frac{1}{2},0) \frac{1}{4},y,-\frac{1}{4}$	(22) $2(\frac{1}{2},0,\frac{1}{2}) x,0,x$	(23) $4^-(0,\frac{1}{2},0) -\frac{1}{4},y,\frac{1}{4}$	(24) 2 $\bar{x},0,x$
(25) $\bar{1} 0,0,0$	(26) $n(\frac{1}{2},\frac{1}{2},0) x,y,0$	(27) $n(\frac{1}{2},0,\frac{1}{2}) x,0,z$	(28) $n(0,\frac{1}{2},\frac{1}{2}) 0,y,z$
(29) $3^+ x,x,x; 0,0,0$	(30) $3^+ \bar{x}-1,x+\frac{1}{2},\bar{x}; -\frac{1}{2},0,\frac{1}{2}$	(31) $3^+ x-\frac{1}{2},\bar{x}+1,\bar{x}; 0,\frac{1}{2},-\frac{1}{2}$	(32) $3^+ \bar{x}+\frac{1}{2},\bar{x}-\frac{1}{2},x; \frac{1}{2},-\frac{1}{2},0$
(33) $3^- x,x,x; 0,0,0$	(34) $3^- x+\frac{1}{2},\bar{x}-1,\bar{x}; 0,-\frac{1}{2},\frac{1}{2}$	(35) $3^- \bar{x}-\frac{1}{2},\bar{x}+\frac{1}{2},x; -\frac{1}{2},\frac{1}{2},0$	(36) $3^- \bar{x}+1,x-\frac{1}{2},\bar{x}; \frac{1}{2},0,-\frac{1}{2}$
(37) $m x+\frac{1}{2},\bar{x},z$	(38) $m x,x,z$	(39) $\bar{4}^- \frac{1}{4},\frac{1}{4},z; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(40) $\bar{4}^+ \frac{1}{4},\frac{1}{4},z; \frac{1}{4},\frac{1}{4},\frac{1}{4}$
(41) $\bar{4}^- x,\frac{1}{4},\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(42) $m x,y+\frac{1}{2},\bar{y}$	(43) $m x,y,y$	(44) $\bar{4}^+ x,\frac{1}{4},\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$
(45) $\bar{4}^+ \frac{1}{4},y,\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(46) $m \bar{x}+\frac{1}{2},y,x$	(47) $\bar{4}^- \frac{1}{4},y,\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(48) $m x,y,x$

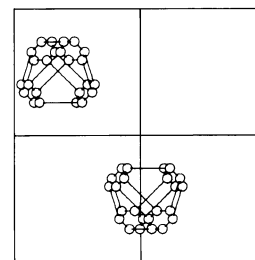
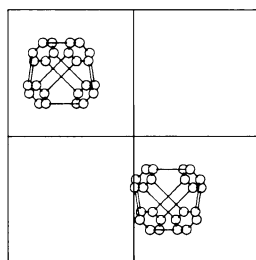
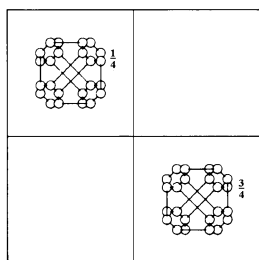
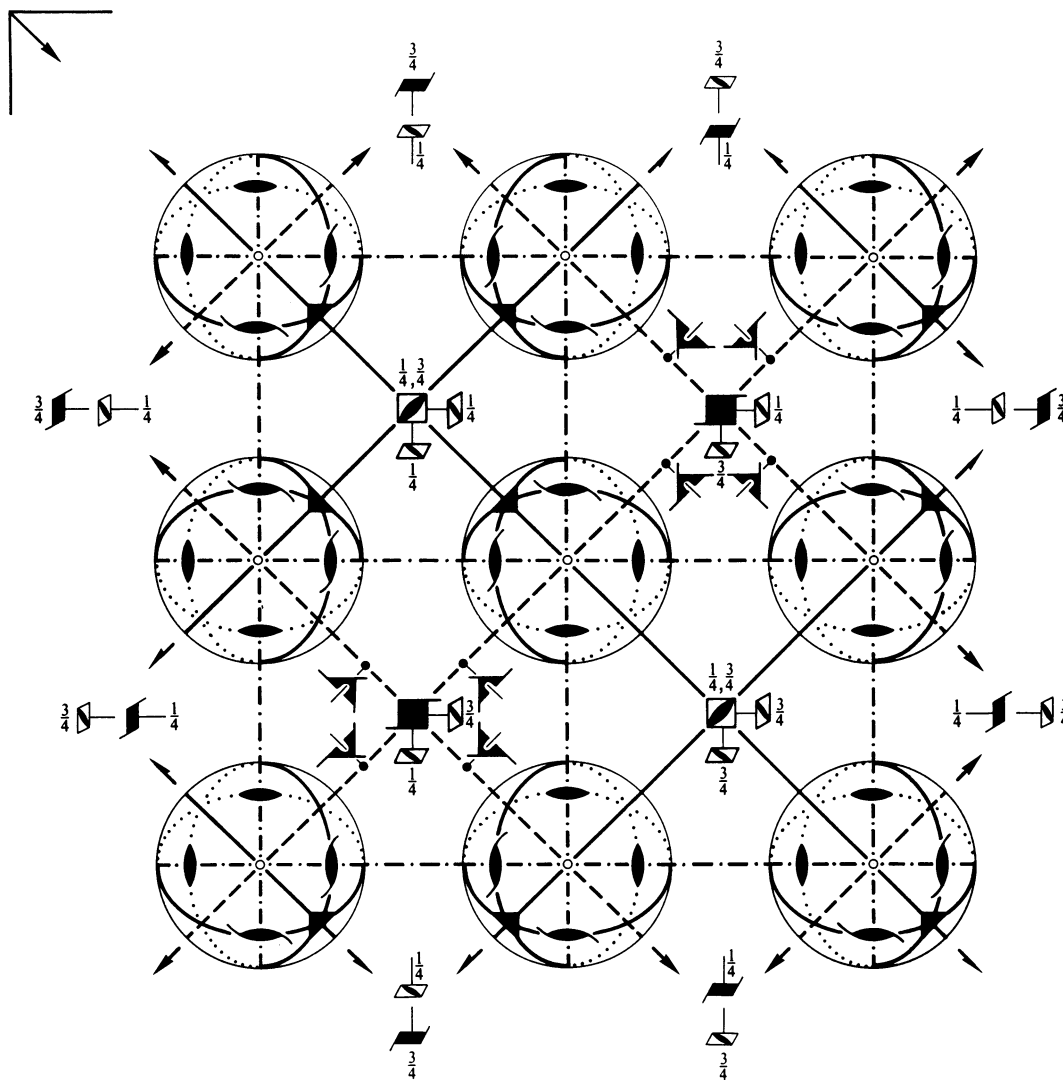
$Pn\bar{3}m$  $O_h^4$  $m\bar{3}m$ 

Cubic

No. 224

 $P 4_2/n \bar{3} 2/m$ Patterson symmetry  $Pm\bar{3}m$ 

ORIGIN CHOICE 2



**Origin** at centre ( $\bar{3}m$ ), at  $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$  from  $\bar{4}3m$

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

Vertices  $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$   $\frac{3}{4}, \frac{1}{4}, \frac{1}{4}$   $\frac{3}{4}, \frac{3}{4}, \frac{1}{4}$   $\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$   $\frac{1}{2}, \frac{1}{2}, 0$

**Symmetry operations**

(given on page 683)

**Generators selected** (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ; (2); (3); (5); (13); (25)

**Positions**

Multiplicity, Wyckoff letter, Site symmetry	Coordinates				Reflection conditions		
					$h, k, l$ permutable General:		
48 $l$ 1	(1) $x, y, z$ (5) $z, x, y$ (9) $y, z, x$ (13) $y + \frac{1}{2}, x + \frac{1}{2}, \bar{z}$ (17) $x + \frac{1}{2}, z + \frac{1}{2}, \bar{y}$ (21) $z + \frac{1}{2}, y + \frac{1}{2}, \bar{x}$ (25) $\bar{x}, \bar{y}, \bar{z}$ (29) $\bar{z}, \bar{x}, \bar{y}$ (33) $\bar{y}, \bar{z}, \bar{x}$ (37) $\bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}, z$ (41) $\bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}, y$ (45) $\bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}, x$	(2) $\bar{x} + \frac{1}{2}, \bar{y} + \frac{1}{2}, z$ (6) $z, \bar{x} + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (10) $\bar{y} + \frac{1}{2}, z, \bar{x} + \frac{1}{2}$ (14) $\bar{y}, \bar{x}, \bar{z}$ (18) $\bar{x}, z + \frac{1}{2}, y + \frac{1}{2}$ (22) $z + \frac{1}{2}, \bar{y}, x + \frac{1}{2}$ (26) $x + \frac{1}{2}, y + \frac{1}{2}, \bar{z}$ (30) $\bar{z}, x + \frac{1}{2}, y + \frac{1}{2}$ (34) $y + \frac{1}{2}, \bar{z}, x + \frac{1}{2}$ (38) $y, x, z$ (42) $x, \bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (46) $\bar{z} + \frac{1}{2}, y, \bar{x} + \frac{1}{2}$	(3) $\bar{x} + \frac{1}{2}, y, \bar{z} + \frac{1}{2}$ (7) $\bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}, y$ (11) $y, \bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ (15) $y + \frac{1}{2}, \bar{x}, z + \frac{1}{2}$ (19) $\bar{x}, \bar{z}, \bar{y}$ (23) $\bar{z}, y + \frac{1}{2}, x + \frac{1}{2}$ (27) $x + \frac{1}{2}, \bar{y}, z + \frac{1}{2}$ (31) $z + \frac{1}{2}, x + \frac{1}{2}, \bar{y}$ (35) $\bar{y}, z + \frac{1}{2}, x + \frac{1}{2}$ (39) $\bar{y} + \frac{1}{2}, x, \bar{z} + \frac{1}{2}$ (43) $x, z, y$ (47) $z, \bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}$	(4) $x, \bar{y} + \frac{1}{2}, \bar{z} + \frac{1}{2}$ (8) $\bar{z} + \frac{1}{2}, x, \bar{y} + \frac{1}{2}$ (12) $\bar{y} + \frac{1}{2}, \bar{z} + \frac{1}{2}, x$ (16) $\bar{y}, x + \frac{1}{2}, z + \frac{1}{2}$ (20) $x + \frac{1}{2}, \bar{z}, y + \frac{1}{2}$ (24) $\bar{z}, \bar{y}, \bar{x}$ (28) $\bar{x}, y + \frac{1}{2}, z + \frac{1}{2}$ (32) $z + \frac{1}{2}, \bar{x}, y + \frac{1}{2}$ (36) $y + \frac{1}{2}, z + \frac{1}{2}, \bar{x}$ (40) $y, \bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}$ (44) $\bar{x} + \frac{1}{2}, z, \bar{y} + \frac{1}{2}$ (48) $z, y, x$	$Ok l : k + l = 2n$ $h00 : h = 2n$		
24 $k$ $\dots m$	$x, x, z$ $z, x, x$ $x, z, x$ $x + \frac{1}{2}, x + \frac{1}{2}, \bar{z}$ $x + \frac{1}{2}, z + \frac{1}{2}, \bar{x}$ $z + \frac{1}{2}, x + \frac{1}{2}, \bar{x}$	$\bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}, z$ $z, \bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $\bar{x} + \frac{1}{2}, z, \bar{x} + \frac{1}{2}$ $\bar{x}, \bar{x}, \bar{z}$ $\bar{x}, z + \frac{1}{2}, x + \frac{1}{2}$ $z + \frac{1}{2}, \bar{x}, x + \frac{1}{2}$	$\bar{x} + \frac{1}{2}, x, \bar{z} + \frac{1}{2}$ $\bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}, x$ $x, \bar{z} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $x + \frac{1}{2}, \bar{x}, z + \frac{1}{2}$ $\bar{x}, \bar{z}, \bar{x}$ $\bar{z}, x + \frac{1}{2}, x + \frac{1}{2}$	$x, \bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}$ $\bar{z} + \frac{1}{2}, x, \bar{x} + \frac{1}{2}$ $\bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}, x$ $\bar{x}, x + \frac{1}{2}, z + \frac{1}{2}$ $x + \frac{1}{2}, \bar{z}, x + \frac{1}{2}$ $\bar{z}, \bar{x}, \bar{x}$	Special: as above, plus no extra conditions		
24 $j$ $\dots 2$	$\frac{1}{2}, y, \bar{y}$ $\bar{y}, \frac{1}{2}, y$ $y, \bar{y}, \frac{1}{2}$ $\frac{1}{2}, \bar{y}, y$ $y, \frac{1}{2}, \bar{y}$ $\bar{y}, y, \frac{1}{2}$	$0, \bar{y} + \frac{1}{2}, \bar{y}$ $\bar{y}, 0, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, \bar{y}, 0$ $0, y + \frac{1}{2}, y$ $y, 0, y + \frac{1}{2}$ $y + \frac{1}{2}, y, 0$	$0, y, y + \frac{1}{2}$ $y + \frac{1}{2}, 0, y$ $y, y + \frac{1}{2}, 0$ $0, \bar{y}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, 0, \bar{y}$ $\bar{y}, \bar{y} + \frac{1}{2}, 0$	$\frac{1}{2}, \bar{y} + \frac{1}{2}, y + \frac{1}{2}$ $y + \frac{1}{2}, \frac{1}{2}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, y + \frac{1}{2}, \frac{1}{2}$ $\frac{1}{2}, y + \frac{1}{2}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, \frac{1}{2}, y + \frac{1}{2}$ $y + \frac{1}{2}, \bar{y} + \frac{1}{2}, \frac{1}{2}$	no extra conditions		
24 $i$ $\dots 2$	$\frac{1}{2}, y, y + \frac{1}{2}$ $y + \frac{1}{2}, \frac{1}{2}, y$ $y, y + \frac{1}{2}, \frac{1}{2}$ $\frac{1}{2}, \bar{y}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, \frac{1}{2}, \bar{y}$ $\bar{y}, \bar{y} + \frac{1}{2}, \frac{1}{2}$	$0, \bar{y} + \frac{1}{2}, y + \frac{1}{2}$ $y + \frac{1}{2}, 0, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, y + \frac{1}{2}, 0$ $0, y + \frac{1}{2}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, 0, y + \frac{1}{2}$ $y + \frac{1}{2}, \bar{y} + \frac{1}{2}, 0$	$0, y, \bar{y}$ $\bar{y}, 0, y$ $y, \bar{y}, 0$ $0, \bar{y}, y$ $y, 0, \bar{y}$ $\bar{y}, y, 0$	$\frac{1}{2}, \bar{y} + \frac{1}{2}, \bar{y}$ $\bar{y}, \frac{1}{2}, \bar{y} + \frac{1}{2}$ $\bar{y} + \frac{1}{2}, \bar{y}, \frac{1}{2}$ $\frac{1}{2}, y + \frac{1}{2}, y$ $y, \frac{1}{2}, y + \frac{1}{2}$ $y + \frac{1}{2}, y, \frac{1}{2}$	no extra conditions		
24 $h$ 2..	$x, \frac{1}{4}, \frac{3}{4}$ $\frac{3}{4}, x + \frac{1}{2}, \frac{1}{4}$ $\bar{x}, \frac{3}{4}, \frac{1}{4}$ $\frac{1}{4}, \bar{x} + \frac{1}{2}, \frac{3}{4}$	$\bar{x} + \frac{1}{2}, \frac{1}{4}, \frac{3}{4}$ $\frac{3}{4}, \bar{x}, \frac{1}{4}$ $x + \frac{1}{2}, \frac{3}{4}, \frac{1}{4}$ $\frac{1}{4}, x, \frac{3}{4}$	$\frac{3}{4}, x, \frac{1}{4}$ $x + \frac{1}{2}, \frac{1}{4}, \frac{3}{4}$ $\frac{1}{4}, \bar{x}, \frac{3}{4}$ $\bar{x} + \frac{1}{2}, \frac{3}{4}, \frac{1}{4}$	$\frac{3}{4}, \bar{x} + \frac{1}{2}, \frac{1}{4}$ $\bar{x}, \frac{1}{4}, \frac{3}{4}$ $\frac{1}{4}, x + \frac{1}{2}, \frac{3}{4}$ $x, \frac{3}{4}, \frac{1}{4}$	$\frac{1}{4}, \frac{3}{4}, x$ $\frac{1}{4}, \frac{3}{4}, \bar{x}$ $\frac{3}{4}, \frac{1}{4}, x + \frac{1}{2}$ $\frac{3}{4}, \frac{1}{4}, \bar{x} + \frac{1}{2}$	$hkl : h + k + l = 2n$	
12 $g$ 2..mm	$x, \frac{1}{4}, \frac{1}{4}$ $\frac{3}{4}, x + \frac{1}{2}, \frac{3}{4}$	$\bar{x} + \frac{1}{2}, \frac{1}{4}, \frac{1}{4}$ $\frac{3}{4}, \bar{x}, \frac{3}{4}$	$\frac{1}{4}, x, \frac{1}{4}$ $x + \frac{1}{2}, \frac{3}{4}, \frac{3}{4}$	$\frac{1}{4}, \bar{x} + \frac{1}{2}, \frac{1}{4}$ $\bar{x}, \frac{3}{4}, \frac{3}{4}$	$\frac{1}{4}, \frac{1}{4}, x$ $\frac{3}{4}, \frac{3}{4}, \bar{x}$	$\frac{1}{4}, \frac{1}{4}, \bar{x} + \frac{1}{2}$ $\frac{3}{4}, \frac{3}{4}, x + \frac{1}{2}$	$hkl : h + k + l = 2n$
12 $f$ 2..22	$\frac{1}{2}, \frac{1}{4}, \frac{3}{4}$ $\frac{1}{2}, \frac{3}{4}, \frac{1}{4}$	$0, \frac{1}{4}, \frac{3}{4}$ $0, \frac{3}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{1}{2}, \frac{1}{4}$ $\frac{1}{4}, \frac{1}{2}, \frac{3}{4}$	$\frac{3}{4}, 0, \frac{1}{4}$ $\frac{1}{4}, 0, \frac{3}{4}$	$\frac{1}{4}, \frac{3}{4}, \frac{1}{2}$ $\frac{3}{4}, \frac{1}{4}, \frac{1}{2}$	$\frac{1}{4}, \frac{3}{4}, 0$ $\frac{3}{4}, \frac{1}{4}, 0$	$hkl : h + k + l = 2n$
8 $e$ .3m	$x, x, x$ $x + \frac{1}{2}, x + \frac{1}{2}, \bar{x}$	$\bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}, x$ $\bar{x}, \bar{x}, \bar{x}$	$\bar{x} + \frac{1}{2}, x, \bar{x} + \frac{1}{2}$ $x + \frac{1}{2}, \bar{x}, x + \frac{1}{2}$	$x, \bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $\bar{x}, x + \frac{1}{2}, x + \frac{1}{2}$	no extra conditions		
6 $d$ $\bar{4}2..m$	$\frac{1}{4}, \frac{3}{4}, \frac{3}{4}$	$\frac{3}{4}, \frac{1}{4}, \frac{3}{4}$	$\frac{3}{4}, \frac{3}{4}, \frac{1}{4}$	$\frac{1}{4}, \frac{3}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{1}{4}, \frac{1}{4}$	$\frac{1}{4}, \frac{1}{4}, \frac{3}{4}$	$hkl : h + k + l = 2n$
4 $c$ . $\bar{3}m$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$0, 0, \frac{1}{2}$	$0, \frac{1}{2}, 0$	$\frac{1}{2}, 0, 0$			$hkl : h + k, h + l, k + l = 2n$
4 $b$ . $\bar{3}m$	$0, 0, 0$	$\frac{1}{2}, \frac{1}{2}, 0$	$\frac{1}{2}, 0, \frac{1}{2}$	$0, \frac{1}{2}, \frac{1}{2}$			$hkl : h + k, h + l, k + l = 2n$
2 $a$ $\bar{4}3m$	$\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{3}{4}, \frac{3}{4}$					$hkl : h + k + l = 2n$

**Symmetry of special projections**Along [001]  $p4mm$ 

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

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

(Continued on page 683)

Along [111]  $p6mm$ 

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

Origin at  $x, x, x$ Along [110]  $p2mm$ 

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

Origin at  $x, x, 0$

ORIGIN CHOICES 1 AND 2

Maximal non-isomorphic subgroups

<b>I</b>	[2] $P\bar{4}3m$ (215)	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 37; 38; 39; 40; 41; 42; 43; 44; 45; 46; 47; 48
	[2] $P4_232$ (208)	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24
	[2] $Pn\bar{3}1$ ( $Pn\bar{3}$ , 201)	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 25; 26; 27; 28; 29; 30; 31; 32; 33; 34; 35; 36
	{ [3] $P4_2/n12/m(P4_2/nnm, 134)$	1; 2; 3; 4; 13; 14; 15; 16; 25; 26; 27; 28; 37; 38; 39; 40
	{ [3] $P4_2/n12/m(P4_2/nnm, 134)$	1; 2; 3; 4; 17; 18; 19; 20; 25; 26; 27; 28; 41; 42; 43; 44
	{ [3] $P4_2/n12/m(P4_2/nnm, 134)$	1; 2; 3; 4; 21; 22; 23; 24; 25; 26; 27; 28; 45; 46; 47; 48
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 5; 9; 14; 19; 24; 25; 29; 33; 38; 43; 48
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 6; 12; 13; 18; 24; 25; 30; 36; 37; 42; 48
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 7; 10; 13; 19; 22; 25; 31; 34; 37; 43; 46
	{ [4] $P1\bar{3}2/m(R\bar{3}m, 166)$	1; 8; 11; 14; 18; 22; 25; 32; 35; 38; 42; 46

**IIa** none

**IIb** [2]  $Fd\bar{3}c$  ( $a' = 2a, b' = 2b, c' = 2c$ ) (228); [2]  $Fd\bar{3}m$  ( $a' = 2a, b' = 2b, c' = 2c$ ) (227)

Maximal isomorphic subgroups of lowest index

**IIc** [27]  $Pn\bar{3}m$  ( $a' = 3a, b' = 3b, c' = 3c$ ) (224)

Minimal non-isomorphic supergroups

**I** none

**II** [2]  $Im\bar{3}m$  (229); [4]  $Fm\bar{3}m$  (225)

ORIGIN CHOICE 1

Symmetry operations

(1) 1	(2) 2 0,0,z	(3) 2 0,y,0	(4) 2 x,0,0
(5) $3^+ x,x,x$	(6) $3^+ \bar{x},x,\bar{x}$	(7) $3^+ x,\bar{x},\bar{x}$	(8) $3^+ \bar{x},\bar{x},x$
(9) $3^- x,x,x$	(10) $3^- x,\bar{x},\bar{x}$	(11) $3^- \bar{x},\bar{x},x$	(12) $3^- \bar{x},x,\bar{x}$
(13) $2(\frac{1}{2},\frac{1}{2},0) x,x,\frac{1}{4}$	(14) $2 x,\bar{x}+\frac{1}{2},\frac{1}{4}$	(15) $4^-(0,0,\frac{1}{2}) \frac{1}{2},0,z$	(16) $4^+(0,0,\frac{1}{2}) 0,\frac{1}{2},z$
(17) $4^-(\frac{1}{2},0,0) x,\frac{1}{2},0$	(18) $2(0,\frac{1}{2},\frac{1}{2}) \frac{1}{4},y,y$	(19) $2 \frac{1}{4},y+\frac{1}{2},\bar{y}$	(20) $4^+(\frac{1}{2},0,0) x,0,\frac{1}{2}$
(21) $4^+(0,\frac{1}{2},0) \frac{1}{2},y,0$	(22) $2(\frac{1}{2},0,\frac{1}{2}) x,\frac{1}{4},x$	(23) $4^-(0,\frac{1}{2},0) 0,y,\frac{1}{2}$	(24) $2 \bar{x}+\frac{1}{2},\frac{1}{4},x$
(25) $\bar{1} \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(26) $n(\frac{1}{2},\frac{1}{2},0) x,y,\frac{1}{4}$	(27) $n(\frac{1}{2},0,\frac{1}{2}) x,\frac{1}{4},z$	(28) $n(0,\frac{1}{2},\frac{1}{2}) \frac{1}{4},y,z$
(29) $3^+ x,x,x; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(30) $3^+ \bar{x}-1,x+1,\bar{x}; -\frac{1}{4},\frac{1}{4},\frac{3}{4}$	(31) $3^+ x,\bar{x}+1,\bar{x}; \frac{1}{4},\frac{3}{4},-\frac{1}{4}$	(32) $3^+ \bar{x}+1,\bar{x},x; \frac{3}{4},-\frac{1}{4},\frac{1}{4}$
(33) $3^- x,x,x; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(34) $3^- x+1,\bar{x}-1,\bar{x}; \frac{1}{4},-\frac{1}{4},\frac{3}{4}$	(35) $3^- \bar{x},\bar{x}+1,x; -\frac{1}{4},\frac{3}{4},\frac{1}{4}$	(36) $3^- \bar{x}+1,x,\bar{x}; \frac{3}{4},\frac{1}{4},-\frac{1}{4}$
(37) $m x,\bar{x},z$	(38) $m x,x,z$	(39) $\bar{4}^- 0,0,z; 0,0,0$	(40) $\bar{4}^+ 0,0,z; 0,0,0$
(41) $\bar{4}^- x,0,0; 0,0,0$	(42) $m x,y,\bar{y}$	(43) $m x,y,y$	(44) $\bar{4}^+ x,0,0; 0,0,0$
(45) $\bar{4}^+ 0,y,0; 0,0,0$	(46) $m \bar{x},y,x$	(47) $\bar{4}^- 0,y,0; 0,0,0$	(48) $m x,y,x$

ORIGIN CHOICE 2

Symmetry operations

(1) 1	(2) 2 $\frac{1}{4},\frac{1}{4},z$	(3) 2 $\frac{1}{4},y,\frac{1}{4}$	(4) 2 $x,\frac{1}{4},\frac{1}{4}$
(5) $3^+ x,x,x$	(6) $3^+ \bar{x},x+\frac{1}{2},\bar{x}$	(7) $3^+ x+\frac{1}{2},\bar{x},\bar{x}$	(8) $3^+ \bar{x}+\frac{1}{2},\bar{x}+\frac{1}{2},x$
(9) $3^- x,x,x$	(10) $3^- x+\frac{1}{2},\bar{x},\bar{x}$	(11) $3^- \bar{x}+\frac{1}{2},\bar{x}+\frac{1}{2},x$	(12) $3^- \bar{x},x+\frac{1}{2},\bar{x}$
(13) $2(\frac{1}{2},\frac{1}{2},0) x,x,0$	(14) 2 $x,\bar{x},0$	(15) $4^-(0,0,\frac{1}{2}) \frac{1}{4},-\frac{1}{4},z$	(16) $4^+(0,0,\frac{1}{2}) -\frac{1}{4},\frac{1}{4},z$
(17) $4^-(\frac{1}{2},0,0) x,\frac{1}{4},-\frac{1}{4}$	(18) $2(0,\frac{1}{2},\frac{1}{2}) 0,y,y$	(19) 2 $0,y,\bar{y}$	(20) $4^+(\frac{1}{2},0,0) x,-\frac{1}{4},\frac{1}{4}$
(21) $4^+(0,\frac{1}{2},0) \frac{1}{4},y,-\frac{1}{4}$	(22) $2(\frac{1}{2},0,\frac{1}{2}) x,0,x$	(23) $4^-(0,\frac{1}{2},0) -\frac{1}{4},y,\frac{1}{4}$	(24) 2 $\bar{x},0,x$
(25) $\bar{1} 0,0,0$	(26) $n(\frac{1}{2},\frac{1}{2},0) x,y,0$	(27) $n(\frac{1}{2},0,\frac{1}{2}) x,0,z$	(28) $n(0,\frac{1}{2},\frac{1}{2}) 0,y,z$
(29) $3^+ x,x,x; 0,0,0$	(30) $3^+ \bar{x}-1,x+\frac{1}{2},\bar{x}; -\frac{1}{2},0,\frac{1}{2}$	(31) $3^+ x-\frac{1}{2},\bar{x}+1,\bar{x}; 0,\frac{1}{2},-\frac{1}{2}$	(32) $3^+ \bar{x}+\frac{1}{2},\bar{x}-\frac{1}{2},x; \frac{1}{2},-\frac{1}{2},0$
(33) $3^- x,x,x; 0,0,0$	(34) $3^- x+\frac{1}{2},\bar{x}-1,\bar{x}; 0,-\frac{1}{2},\frac{1}{2}$	(35) $3^- \bar{x}-\frac{1}{2},\bar{x}+\frac{1}{2},x; -\frac{1}{2},\frac{1}{2},0$	(36) $3^- \bar{x}+1,x-\frac{1}{2},\bar{x}; \frac{1}{2},0,-\frac{1}{2}$
(37) $m x+\frac{1}{2},\bar{x},z$	(38) $m x,x,z$	(39) $\bar{4}^- \frac{1}{4},\frac{1}{4},z; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(40) $\bar{4}^+ \frac{1}{4},\frac{1}{4},z; \frac{1}{4},\frac{1}{4},\frac{1}{4}$
(41) $\bar{4}^- x,\frac{1}{4},\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(42) $m x,y+\frac{1}{2},\bar{y}$	(43) $m x,y,y$	(44) $\bar{4}^+ x,\frac{1}{4},\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$
(45) $\bar{4}^+ \frac{1}{4},y,\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(46) $m \bar{x}+\frac{1}{2},y,x$	(47) $\bar{4}^- \frac{1}{4},y,\frac{1}{4}; \frac{1}{4},\frac{1}{4},\frac{1}{4}$	(48) $m x,y,x$