

$Fm\bar{3}c$

O_h^6

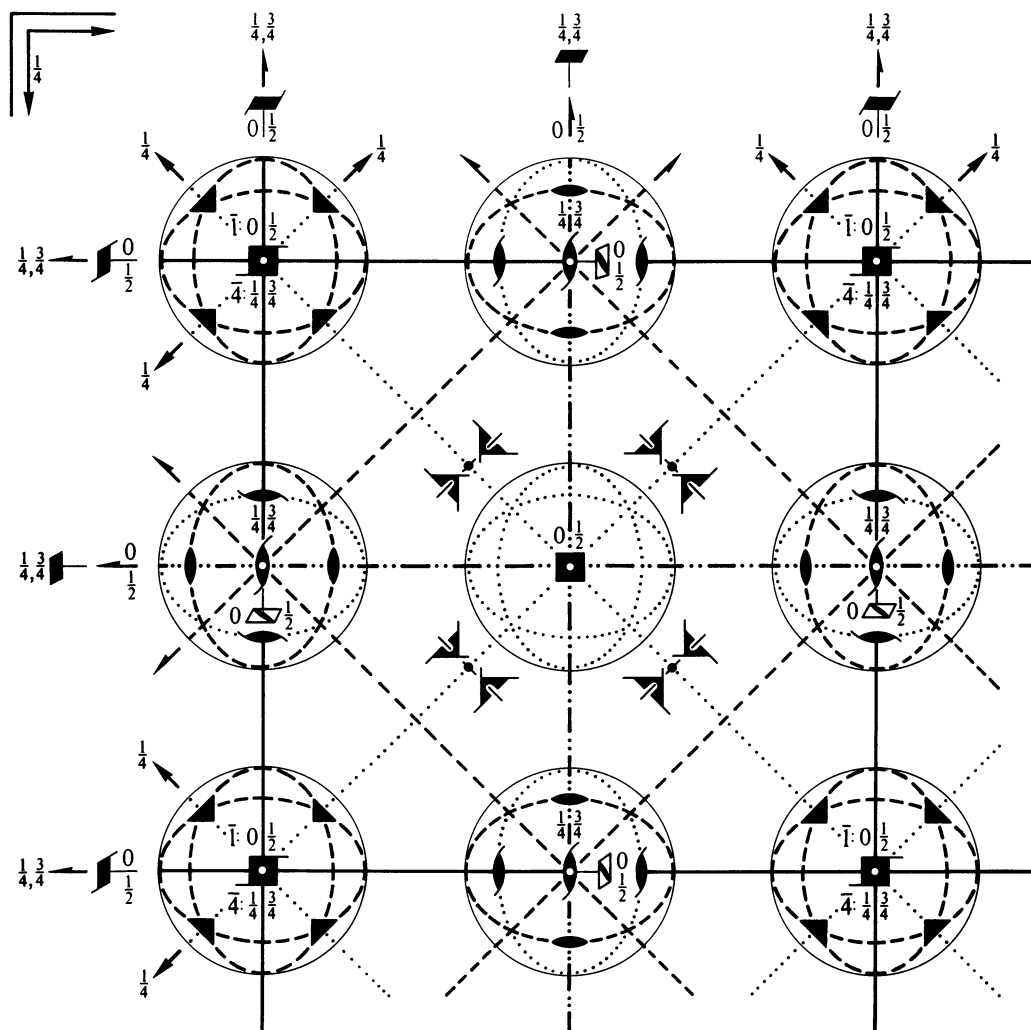
$m\bar{3}m$

Cubic

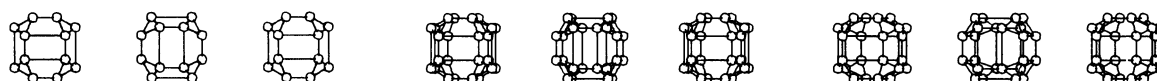
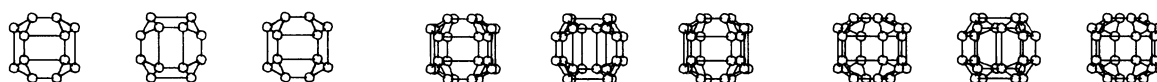
No. 226

$F 4/m \bar{3} 2/c$

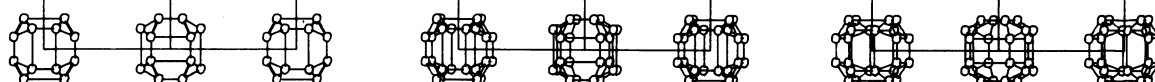
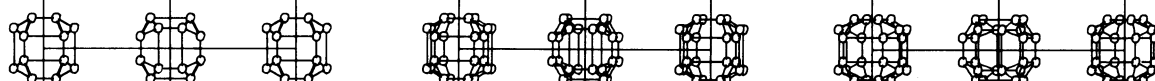
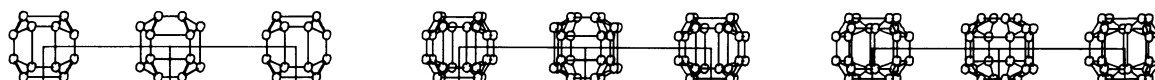
Patterson symmetry $Fm\bar{3}m$



Upper left quadrant only



Upper half of unit cell



Lower half of unit cell

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

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

Symmetry operations

(given on page 695)

Generators selected (1); $t(1, 0, 0)$; $t(0, 1, 0)$; $t(0, 0, 1)$; $t(0, \frac{1}{2}, \frac{1}{2})$; $t(\frac{1}{2}, 0, \frac{1}{2})$; (2); (3); (5); (13); (25)

Positions

Multiplicity, Wyckoff letter, Site symmetry	Coordinates				Reflection conditions
	$(0, 0, 0)+$	$(0, \frac{1}{2}, \frac{1}{2})+$	$(\frac{1}{2}, 0, \frac{1}{2})+$	$(\frac{1}{2}, \frac{1}{2}, 0)+$	h, k, l permutable General:

192	j	1	(1) x, y, z (5) z, x, y (9) y, z, x (13) $y + \frac{1}{2}, x + \frac{1}{2}, z + \frac{1}{2}$ (17) $x + \frac{1}{2}, z + \frac{1}{2}, y + \frac{1}{2}$ (21) $z + \frac{1}{2}, y + \frac{1}{2}, x + \frac{1}{2}$ (25) $\bar{x}, \bar{y}, \bar{z}$ (29) $\bar{z}, \bar{x}, \bar{y}$ (33) $\bar{y}, \bar{z}, \bar{x}$ (37) $\bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}, z + \frac{1}{2}$ (41) $\bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}, y + \frac{1}{2}$ (45) $\bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}, x + \frac{1}{2}$	(2) \bar{x}, \bar{y}, z (6) z, \bar{x}, \bar{y} (10) \bar{y}, z, \bar{x} (14) $\bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}, z + \frac{1}{2}$ (18) $\bar{x} + \frac{1}{2}, z + \frac{1}{2}, y + \frac{1}{2}$ (22) $z + \frac{1}{2}, \bar{y} + \frac{1}{2}, x + \frac{1}{2}$ (26) x, y, \bar{z} (30) \bar{z}, x, y (34) y, \bar{z}, x (38) $y + \frac{1}{2}, x + \frac{1}{2}, z + \frac{1}{2}$ (42) $x + \frac{1}{2}, \bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (46) $\bar{z} + \frac{1}{2}, y + \frac{1}{2}, \bar{x} + \frac{1}{2}$	(3) \bar{x}, y, \bar{z} (7) \bar{z}, \bar{x}, y (11) y, z, \bar{x} (15) $y + \frac{1}{2}, \bar{x} + \frac{1}{2}, z + \frac{1}{2}$ (19) $\bar{x} + \frac{1}{2}, \bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (23) $\bar{z} + \frac{1}{2}, y + \frac{1}{2}, x + \frac{1}{2}$ (27) x, \bar{y}, z (31) z, x, \bar{y} (35) \bar{y}, z, x (39) $\bar{y} + \frac{1}{2}, x + \frac{1}{2}, z + \frac{1}{2}$ (43) $x + \frac{1}{2}, z + \frac{1}{2}, y + \frac{1}{2}$ (47) $z + \frac{1}{2}, \bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}$	(4) x, \bar{y}, \bar{z} (8) \bar{z}, x, \bar{y} (12) \bar{y}, \bar{z}, x (16) $\bar{y} + \frac{1}{2}, x + \frac{1}{2}, z + \frac{1}{2}$ (20) $x + \frac{1}{2}, \bar{z} + \frac{1}{2}, y + \frac{1}{2}$ (24) $\bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ (28) \bar{x}, \bar{y}, z (32) z, \bar{x}, y (36) y, z, \bar{x} (40) $y + \frac{1}{2}, \bar{x} + \frac{1}{2}, z + \frac{1}{2}$ (44) $\bar{x} + \frac{1}{2}, z + \frac{1}{2}, \bar{y} + \frac{1}{2}$ (48) $z + \frac{1}{2}, y + \frac{1}{2}, x + \frac{1}{2}$	hkl : $h + k = 2n$ and $h + l, k + l = 2n$ $0kl$: $k, l = 2n$ hhl : $h, l = 2n$ $h00$: $h = 2n$
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Special: as above, plus

96	i	$m..$	$0, y, z$ $z, 0, y$ $y, z, 0$ $y + \frac{1}{2}, \frac{1}{2}, z + \frac{1}{2}$ $\frac{1}{2}, z + \frac{1}{2}, \bar{y} + \frac{1}{2}$ $z + \frac{1}{2}, y + \frac{1}{2}, \frac{1}{2}$	$0, \bar{y}, z$ $z, 0, \bar{y}$ $\bar{y}, z, 0$ $\bar{y} + \frac{1}{2}, \frac{1}{2}, z + \frac{1}{2}$ $\frac{1}{2}, z + \frac{1}{2}, y + \frac{1}{2}$ $z + \frac{1}{2}, \bar{y} + \frac{1}{2}, \frac{1}{2}$	$0, y, \bar{z}$ $\bar{z}, 0, y$ $y, \bar{z}, 0$ $y + \frac{1}{2}, \frac{1}{2}, z + \frac{1}{2}$ $\frac{1}{2}, \bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}$ $\bar{z} + \frac{1}{2}, y + \frac{1}{2}, \frac{1}{2}$	$0, \bar{y}, \bar{z}$ $\bar{z}, 0, \bar{y}$ $\bar{y}, \bar{z}, 0$ $\bar{y} + \frac{1}{2}, \frac{1}{2}, z + \frac{1}{2}$ $\frac{1}{2}, \bar{z} + \frac{1}{2}, y + \frac{1}{2}$ $\bar{z} + \frac{1}{2}, \bar{y} + \frac{1}{2}, \frac{1}{2}$	no extra conditions
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96	h	$..2$	$\frac{1}{4}, y, y$ $\bar{y}, \frac{3}{4}, y$ $\frac{3}{4}, \bar{y}, \bar{y}$ $y, \frac{1}{4}, \bar{y}$	$\frac{3}{4}, \bar{y}, y$ $\bar{y}, \frac{1}{4}, \bar{y}$ $\frac{1}{4}, y, \bar{y}$ $y, \frac{3}{4}, y$	$\frac{3}{4}, y, \bar{y}$ $y, y, \frac{1}{4}$ $\frac{1}{4}, \bar{y}, y$ $\bar{y}, \bar{y}, \frac{3}{4}$	$\frac{1}{4}, \bar{y}, \bar{y}$ $\bar{y}, y, \frac{3}{4}$ $\frac{3}{4}, y, y$ $y, \bar{y}, \frac{1}{4}$	$y, \frac{1}{4}, y$ $y, \bar{y}, \frac{3}{4}$ $\bar{y}, \frac{3}{4}, \bar{y}$ $\bar{y}, y, \frac{1}{4}$	$y, \frac{3}{4}, \bar{y}$ $\bar{y}, \bar{y}, \frac{1}{4}$ $\bar{y}, \frac{1}{4}, y$ $y, y, \frac{3}{4}$	hkl : $h = 2n$
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64	g	$.3.$	x, x, x \bar{x}, x, \bar{x} $x + \frac{1}{2}, x + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $x + \frac{1}{2}, \bar{x} + \frac{1}{2}, x + \frac{1}{2}$ $\bar{x}, \bar{x}, \bar{x}$ x, \bar{x}, x $\bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}, x + \frac{1}{2}$ $\bar{x} + \frac{1}{2}, x + \frac{1}{2}, \bar{x} + \frac{1}{2}$	\bar{x}, \bar{x}, x x, \bar{x}, \bar{x} $\bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}$ $\bar{x} + \frac{1}{2}, x + \frac{1}{2}, x + \frac{1}{2}$ x, x, \bar{x} \bar{x}, x, x $x + \frac{1}{2}, x + \frac{1}{2}, x + \frac{1}{2}$ $x + \frac{1}{2}, \bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}$				hkl : $h = 2n$
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48	f	$4..$	$x, \frac{1}{4}, \frac{1}{4}$ $\bar{x}, \frac{3}{4}, \frac{3}{4}$	$\bar{x}, \frac{3}{4}, \frac{1}{4}$ $x, \frac{1}{4}, \frac{3}{4}$	$\frac{1}{4}, x, \frac{1}{4}$ $\frac{3}{4}, \bar{x}, \frac{3}{4}$	$\frac{1}{4}, \bar{x}, \frac{3}{4}$ $\frac{3}{4}, x, \frac{1}{4}$	$\frac{1}{4}, \frac{1}{4}, x$ $\frac{3}{4}, \frac{3}{4}, \bar{x}$	$\frac{3}{4}, \frac{1}{4}, \bar{x}$ $\frac{1}{4}, \frac{3}{4}, x$	hkl : $h = 2n$
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48	e	$mm2..$	$x, 0, 0$ $0, 0, x$ $x + \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\bar{x}, 0, 0$ $0, 0, \bar{x}$ $\bar{x} + \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$0, x, 0$ $\frac{1}{2}, x + \frac{1}{2}, \frac{1}{2}$ $\frac{1}{2}, \frac{1}{2}, \bar{x} + \frac{1}{2}$	$0, \bar{x}, 0$ $\frac{1}{2}, \bar{x} + \frac{1}{2}, \frac{1}{2}$ $\frac{1}{2}, \frac{1}{2}, x + \frac{1}{2}$		hkl : $h = 2n$
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24	d	$4/m..$	$0, \frac{1}{4}, \frac{1}{4}$	$0, \frac{3}{4}, \frac{1}{4}$	$\frac{1}{4}, 0, \frac{1}{4}$	$\frac{1}{4}, 0, \frac{3}{4}$	$\frac{1}{4}, \frac{1}{4}, 0$	$\frac{3}{4}, \frac{1}{4}, 0$	hkl : $h = 2n$
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24	c	$\bar{4}m.2$	$\frac{1}{4}, 0, 0$	$\frac{3}{4}, 0, 0$	$0, \frac{1}{4}, 0$	$0, \frac{3}{4}, 0$	$0, 0, \frac{1}{4}$	$0, 0, \frac{3}{4}$	hkl : $h = 2n$
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8	b	$m\bar{3}.$	$0, 0, 0$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$					hkl : $h = 2n$
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8	a	432	$\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{3}{4}, \frac{3}{4}$					hkl : $h = 2n$
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Symmetry of special projections

Along [001] $p4mm$
 $\mathbf{a}' = \frac{1}{2}\mathbf{a}$ $\mathbf{b}' = \frac{1}{2}\mathbf{b}$
 Origin at 0, 0, z

Along [111] $p6mm$
 $\mathbf{a}' = \frac{1}{6}(2\mathbf{a} - \mathbf{b} - \mathbf{c})$ $\mathbf{b}' = \frac{1}{6}(-\mathbf{a} + 2\mathbf{b} - \mathbf{c})$
 Origin at x, x, x

Along [110] $p2mm$
 $\mathbf{a}' = \frac{1}{4}(-\mathbf{a} + \mathbf{b})$ $\mathbf{b}' = \frac{1}{2}\mathbf{c}$
 Origin at x, x, 0

Maximal non-isomorphic subgroups

I	<p>[2] $F\bar{4}3c$ (219) (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] $F432$ (209) (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] $Fm\bar{3}1$ ($Fm\bar{3}$, 202) (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] $F4_2/m12/n$ ($I4/mcm$, 140) (1; 2; 3; 4; 13; 14; 15; 16; 25; 26; 27; 28; 37; 38; 39; 40)+ [3] $F4_2/m12/n$ ($I4/mcm$, 140) (1; 2; 3; 4; 17; 18; 19; 20; 25; 26; 27; 28; 41; 42; 43; 44)+ [3] $F4_2/m12/n$ ($I4/mcm$, 140) (1; 2; 3; 4; 21; 22; 23; 24; 25; 26; 27; 28; 45; 46; 47; 48)+ { [4] $F1\bar{3}2/n$ ($R\bar{3}c$, 167) (1; 5; 9; 14; 19; 24; 25; 29; 33; 38; 43; 48)+ [4] $F1\bar{3}2/n$ ($R\bar{3}c$, 167) (1; 6; 12; 13; 18; 24; 25; 30; 36; 37; 42; 48)+ [4] $F1\bar{3}2/n$ ($R\bar{3}c$, 167) (1; 7; 10; 13; 19; 22; 25; 31; 34; 37; 43; 46)+ [4] $F1\bar{3}2/n$ ($R\bar{3}c$, 167) (1; 8; 11; 14; 18; 22; 25; 32; 35; 38; 42; 46)+</p>
IIa	<p>{ [4] $Pm\bar{3}n$ (223) 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33; 34; 35; 36; 37; 38; 39; 40; 41; 42; 43; 44; 45; 46; 47; 48 [4] $Pm\bar{3}n$ (223) 1; 2; 3; 4; 13; 14; 15; 16; 25; 26; 27; 28; 37; 38; 39; 40; (9; 10; 11; 12; 17; 18; 19; 20; 33; 34; 35; 36; 41; 42; 43; 44) + $(0, \frac{1}{2}, \frac{1}{2})$; (5; 6; 7; 8; 21; 22; 23; 24; 29; 30; 31; 32; 45; 46; 47; 48) + $(\frac{1}{2}, 0, \frac{1}{2})$ [4] $Pm\bar{3}n$ (223) 1; 2; 3; 4; 17; 18; 19; 20; 25; 26; 27; 28; 41; 42; 43; 44; (9; 10; 11; 12; 21; 22; 23; 24; 33; 34; 35; 36; 45; 46; 47; 48) + $(\frac{1}{2}, 0, \frac{1}{2})$; (5; 6; 7; 8; 13; 14; 15; 16; 29; 30; 31; 32; 37; 38; 39; 40) + $(\frac{1}{2}, \frac{1}{2}, 0)$ [4] $Pm\bar{3}n$ (223) 1; 2; 3; 4; 21; 22; 23; 24; 25; 26; 27; 28; 45; 46; 47; 48; (5; 6; 7; 8; 17; 18; 19; 20; 29; 30; 31; 32; 41; 42; 43; 44) + $(0, \frac{1}{2}, \frac{1}{2})$; (9; 10; 11; 12; 13; 14; 15; 16; 33; 34; 35; 36; 37; 38; 39; 40) + $(\frac{1}{2}, \frac{1}{2}, 0)$ { [4] $Pn\bar{3}n$ (222) 1; 5; 9; 14; 19; 24; 25; 29; 33; 38; 43; 48; (4; 6; 11; 16; 18; 23; 28; 30; 35; 40; 42; 47) + $(0, \frac{1}{2}, \frac{1}{2})$; (3; 8; 10; 15; 20; 22; 27; 32; 34; 39; 44; 46) + $(\frac{1}{2}, 0, \frac{1}{2})$; (2; 7; 12; 13; 17; 21; 26; 31; 36; 37; 41; 45) + $(\frac{1}{2}, \frac{1}{2}, 0)$ [4] $Pn\bar{3}n$ (222) 1; 6; 12; 13; 18; 24; 25; 30; 36; 37; 42; 48; (4; 5; 10; 15; 19; 23; 28; 29; 34; 39; 43; 47) + $(0, \frac{1}{2}, \frac{1}{2})$; (3; 7; 11; 16; 17; 22; 27; 31; 35; 40; 41; 46) + $(\frac{1}{2}, 0, \frac{1}{2})$; (2; 8; 9; 14; 20; 21; 26; 32; 33; 38; 44; 45) + $(\frac{1}{2}, \frac{1}{2}, 0)$ [4] $Pn\bar{3}n$ (222) 1; 7; 10; 13; 19; 22; 25; 31; 34; 37; 43; 46; (4; 8; 12; 15; 18; 21; 28; 32; 36; 39; 42; 45) + $(0, \frac{1}{2}, \frac{1}{2})$; (3; 6; 9; 16; 20; 24; 27; 30; 33; 40; 44; 48) + $(\frac{1}{2}, 0, \frac{1}{2})$; (2; 5; 11; 14; 17; 23; 26; 29; 35; 38; 41; 47) + $(\frac{1}{2}, \frac{1}{2}, 0)$ [4] $Pn\bar{3}n$ (222) 1; 8; 11; 14; 18; 22; 25; 32; 35; 38; 42; 46; (4; 7; 9; 16; 19; 21; 28; 31; 33; 40; 43; 45) + $(0, \frac{1}{2}, \frac{1}{2})$; (3; 5; 12; 15; 17; 24; 27; 29; 36; 39; 41; 48) + $(\frac{1}{2}, 0, \frac{1}{2})$; (2; 6; 10; 13; 20; 23; 26; 30; 34; 37; 44; 47) + $(\frac{1}{2}, \frac{1}{2}, 0)$</p>
IIb	<p>none</p>

Maximal isomorphic subgroups of lowest index

IIc [27] $Fm\bar{3}c$ ($\mathbf{a}' = 3\mathbf{a}, \mathbf{b}' = 3\mathbf{b}, \mathbf{c}' = 3\mathbf{c}$) (226)

Minimal non-isomorphic supergroups

I none

II [2] $Pm\bar{3}m$ ($\mathbf{a}' = \frac{1}{2}\mathbf{a}, \mathbf{b}' = \frac{1}{2}\mathbf{b}, \mathbf{c}' = \frac{1}{2}\mathbf{c}$) (221)

Symmetry operations

For (0,0,0)+ set

- | | | | |
|--|--|--|---|
| (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) $\bar{1}$ 0,0,0 | (26) m x,y,0 | (27) m x,0,z | (28) m 0,y,z |
| (29) $\bar{3}^+$ x,x,x; 0,0,0 | (30) $\bar{3}^+$ \bar{x},x,\bar{x} ; 0,0,0 | (31) $\bar{3}^+$ x, \bar{x},\bar{x} ; 0,0,0 | (32) $\bar{3}^+$ \bar{x},\bar{x},x ; 0,0,0 |
| (33) $\bar{3}^-$ x,x,x; 0,0,0 | (34) $\bar{3}^-$ x, \bar{x},\bar{x} ; 0,0,0 | (35) $\bar{3}^-$ \bar{x},\bar{x},x ; 0,0,0 | (36) $\bar{3}^-$ \bar{x},x,\bar{x} ; 0,0,0 |
| (37) c x+ $\frac{1}{2},\bar{x},z$ | (38) n($\frac{1}{2},\frac{1}{2},\frac{1}{2}$) x,x,z | (39) $\bar{4}^-$ 0, $\frac{1}{2},z$; 0, $\frac{1}{2},\frac{1}{4}$ | (40) $\bar{4}^+$ $\frac{1}{2},0,z$; $\frac{1}{2},0,\frac{1}{4}$ |
| (41) $\bar{4}^-$ x,0, $\frac{1}{2}$; $\frac{1}{4},0,\frac{1}{2}$ | (42) a x,y+ $\frac{1}{2},\bar{y}$ | (43) n($\frac{1}{2},\frac{1}{2},\frac{1}{2}$) x,y,y | (44) $\bar{4}^+$ x, $\frac{1}{2},0$; $\frac{1}{4},\frac{1}{2},0$ |
| (45) $\bar{4}^+$ 0,y, $\frac{1}{2}$; 0, $\frac{1}{4},\frac{1}{2}$ | (46) b $\bar{x}+\frac{1}{2},y,x$ | (47) $\bar{4}^-$ $\frac{1}{2},y,0$; $\frac{1}{2},\frac{1}{4},0$ | (48) n($\frac{1}{2},\frac{1}{2},\frac{1}{2}$) x,y,x |

For (0, $\frac{1}{2},\frac{1}{2}$)+ set

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

For ($\frac{1}{2},0,\frac{1}{2}$)+ set

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

For ($\frac{1}{2},\frac{1}{2},0$)+ set

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